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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**  
**Osaka-shi, Osaka 540-6207 (JP)**

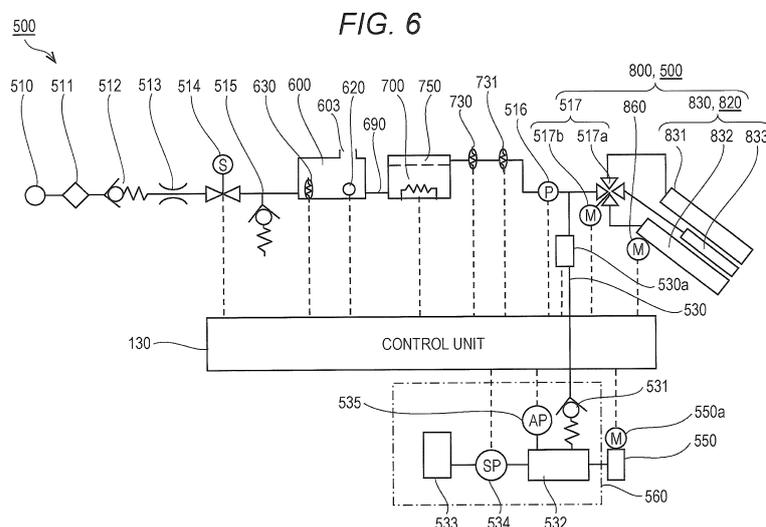
(72) Inventors:  
 • **MATSUI, Kenji**  
**Osaka 540-6207 (JP)**  
 • **SATOI, Takayuki**  
**Osaka 540-6207 (JP)**

(74) Representative: **Schwabe - Sandmair - Marx**  
**Patentanwälte Rechtsanwalt**  
**Partnerschaft mbB**  
**Joseph-Wild-Straße 20**  
**81829 München (DE)**

(54) **SANITARY WASHING DEVICE**

(57) A sanitary washing device includes heat exchanger (700), cleaning water nozzle (831), cleaning water nozzle drive unit (860), foam generation unit (560) for generating a cleaning foam, spray nozzle (550) for discharging a cleaning water or cleaning foam into a toilet bowl. The sanitary washing device further includes discharge water amount variable unit (516) for variably changing a flow rate of the cleaning water or the cleaning foam, spray nozzle drive unit (550) for driving a discharge

opening of spray nozzle (550) in a predetermined direction, opening and closing valve (530a) for opening and closing branch passage (530) to spray nozzle (550), a control unit, and an operation unit. The control unit performs control to discharge the cleaning foam from spray nozzle (550) to a surface of cleaning water nozzle (831). As a result, the sanitary washing device capable of preventing adhesion of dirt to cleaning water nozzle (831) with cleaning foam can be provided.



## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a sanitary washing device that cleans a private part of a human body.

### BACKGROUND ART

**[0002]** With this kind of a conventional sanitary washing device, a cleaning water nozzle extends from a storage position to a buttock cleaning position or a bidet cleaning position. The cleaning water nozzle then discharges cleaning water from a discharge opening. As a result, a configuration for cleaning a private part of a human body can be achieved.

**[0003]** In this case, there has been proposed a sanitary washing device having a configuration for washing away dirt from a cleaning water nozzle (see, for example, PTL 1).

**[0004]** The sanitary washing device disclosed in PTL 1 cleans the cleaning water nozzle by washing away dirt using water or hot water from a heat exchanger as cleaning water for washing dirt from the cleaning water nozzle.

**[0005]** With the above configuration, however, in order to prevent residual dirt from adhering and depositing on the cleaning water nozzle, the user needs to periodically brush the cleaning water nozzle. That is, the configuration does not provide satisfaction in terms of preventing the cleaning water nozzle from being contaminated. That is, there has still been room for improvement in terms of preventing the cleaning water nozzle from being contaminated. Citation List

### Patent Literature

**[0006]** PTL 1: Japanese Patent No. 3555254

### SUMMARY OF THE INVENTION

**[0007]** The present invention provides a sanitary washing device capable of generating cleaning foam on a surface of a cleaning water nozzle and preventing adhesion of dirt.

**[0008]** That is, the sanitary washing device according to the present invention includes a heat exchanger for heating cleaning water, a cleaning water nozzle for cleaning a human body, a cleaning water nozzle drive unit for driving the cleaning water nozzle, a foam generation unit for generating cleaning foam, and a spray nozzle for discharging cleaning water or cleaning foam into a toilet bowl. The device further includes a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to the cleaning water nozzle and the spray nozzle, a spray nozzle drive unit for driving and rotating a discharge opening of the spray nozzle in a predetermined direction, an open-

ing and closing valve for opening and closing a branch passage to the spray nozzle, a control unit, and an operation unit for setting an instruction for the control unit. The device then performs control to discharge cleaning foam generated by the foam generation unit from the spray nozzle onto the surface of the cleaning water nozzle.

**[0009]** According to this configuration, the discharge opening of the spray nozzle, which is rotated by the spray nozzle drive unit, is directed to face the cleaning water nozzle. Cleaning foam generated by the foam generation unit is then discharged from the spray nozzle to the cleaning water nozzle. Discharging the cleaning foam in this manner prevents dirt from adhering to the cleaning water nozzle.

### BRIEF DESCRIPTION OF DRAWINGS

#### [0010]

FIG. 1 is a perspective view showing a state where a sanitary washing device according to an exemplary embodiment of the present invention is installed on a toilet bowl.

FIG. 2 is a perspective view showing a state where a front body case of the sanitary washing device is removed.

FIG. 3 is a perspective view showing a state where the front body case and a control unit of the sanitary washing device are removed.

FIG. 4 is a perspective view showing an upper surface of an operation unit of the sanitary washing device.

FIG. 5 is a perspective view showing an external appearance of a remote controller.

FIG. 6 is a schematic view showing a configuration of a water circuit of a cleaning unit of the sanitary washing device.

FIG. 7 is a perspective view showing a disassembled state of the water circuit of the sanitary washing device.

FIG. 8 is a perspective view showing an assembled state of the water circuit of the sanitary washing device.

FIG. 9 is a perspective view showing an external appearance of a sub tank of the water circuit.

FIG. 10 is a cross-sectional view of the sub tank as viewed in a front view.

FIG. 11 is a cross-sectional view of the sub tank as viewed in a side view.

FIG. 12 is a perspective view showing an external appearance of a heat exchanger of the water circuit. FIG. 13 is a cross-sectional view of the heat exchanger.

FIG. 14 is a perspective view showing an external appearance of a water pump of the water circuit.

FIG. 15 is a cross-sectional view of the water pump. FIG. 16 is a perspective view showing an external

appearance of a storage state of a nozzle device of the sanitary washing device.

FIG. 17 is a cross-sectional view taken along line 17-17 shown in FIG. 16.

FIG. 18 is a longitudinal cross-sectional view of a storage state of the nozzle device.

FIG. 19 is a cross-sectional view showing a detailed configuration of portion B shown in FIG. 18.

FIG. 20 is a cross-sectional view taken along line 20-20 shown in FIG. 19.

FIG. 21 is a transverse cross-sectional view showing a storage state of the nozzle device.

FIG. 22 is a cross-sectional view showing a detailed configuration of portion C shown in FIG. 21.

FIG. 23 is a longitudinal cross-sectional view showing a buttock cleaning state of the nozzle device.

FIG. 24 is a cross-sectional view showing a detailed configuration of portion D shown in FIG. 23.

FIG. 25 is a longitudinal cross-sectional view showing a bidet cleaning state of the nozzle device.

FIG. 26 is a cross-sectional view of a detailed configuration of portion E shown in FIG. 25.

FIG. 27 is a transverse cross-sectional view showing a bidet cleaning state of the nozzle device.

FIG. 28 is a cross-sectional view of a detailed configuration of portion F shown in FIG. 27.

FIG. 29 is a timing chart of the cleaning unit at an initial stage of use of the sanitary washing device.

FIG. 30 is a timing chart of the cleaning unit at a usual stage of use of the sanitary washing device.

FIG. 31 is a perspective view showing an external appearance of a spray nozzle of the sanitary washing device.

FIG. 32 is a longitudinal cross-sectional view of the spray nozzle.

FIG. 33 is a plan view showing an installation position of the spray nozzle in the sanitary washing device, and a rotational angle of a discharge opening of the spray nozzle.

FIG. 34 is a chart showing a pump output and a rotational speed of a spray nozzle drive unit, each corresponding to a rotational angle of the discharge opening of the spray nozzle.

FIG. 35 is a perspective view showing how a cleaning water nozzle is cleaned by the spray nozzle.

FIG. 36 is a perspective view showing how the cleaning water nozzle is cleaned by the spray nozzle.

FIG. 37 is a perspective view showing how the cleaning water nozzle is cleaned by the spray nozzle.

## DESCRIPTION OF EMBODIMENT

**[0011]** Exemplary embodiments according to the present invention are hereinafter described with reference to the drawings. Note that the present invention is not limited to this exemplary embodiment.

(Exemplary embodiment)

<1> Overall configuration of sanitary washing device

**[0012]** Hereinafter, the overall configuration of the sanitary washing device according to an exemplary embodiment is described with reference to FIGS. 1 to 5.

**[0013]** FIG. 1 is a perspective view showing a state where the sanitary washing device according to this exemplary embodiment of the present invention is installed on a toilet bowl. FIG. 2 is a perspective view showing a state where a front body case of a body of the sanitary washing device is removed. FIG. 3 is a perspective view showing a state where the front body case of the body and a control unit of the sanitary washing device are removed. FIG. 4 is a perspective view showing an upper surface of an operation unit of the sanitary washing device. FIG. 5 is a perspective view showing an external appearance of a remote controller.

**[0014]** As shown in FIG. 1, sanitary washing device 100 of this exemplary embodiment includes, as main constitutional elements of sanitary washing device 100, at least body 200, toilet seat 300, toilet lid 320, remote controller 400, human body detection sensor 450 and the like. Body 200, toilet seat 300, and toilet lid 320 are formed as an integral body, and are mounted on an upper surface of toilet bowl 110.

**[0015]** Hereinafter, the arrangement of the respective constitutional elements is described by assuming a side of sanitary washing device 100 where body 200 is disposed as a rear side, a side of the sanitary washing device 100 where toilet seat 300 is disposed as a front side, a right side when a user faces frontward as a right side, and a left side when the user faces frontward as a left side.

**[0016]** Operation unit 210 is integrally mounted on body 200 in a state where operation unit 210 projects right-sideward from body 200. Toilet seat and toilet lid rotating mechanism 360 is disposed on a front portion side of body 200, and drives toilet seat 300 and toilet lid 320 in an openable and closeable manner. Toilet seat and toilet lid rotating mechanism 360 includes a DC motor and a plurality of gears, for example, and can open or close toilet seat 300 and toilet lid 320 independently from each other or simultaneously.

**[0017]** As shown in FIG. 1, when toilet lid 320 is open, toilet lid 320 is raised so as to be positioned at a rearmost portion of sanitary washing device 100. On the other hand, when toilet lid 320 is closed, toilet lid 320 conceals an upper surface of toilet seat 300.

**[0018]** Toilet lid 320 is molded by using a resin material such as polypropylene (PP) and ABS, for example. Toilet lid 320 has the heat insulation structure formed of the double structure and a heat insulation material.

**[0019]** A toilet seat heater (not shown in the drawing) which heats a seating surface is provided in toilet seat 300. The toilet seat heater heats the seating surface of toilet seat 300 such that the seating surface becomes a comfortable temperature for a user.

**[0020]** Further, seating sensor 330 is a component of a seating detection unit that is mounted on a bearing portion disposed inside body 200 which supports a rotary shaft of toilet seat 300, and detects a human body seated on toilet seat 300. Seating sensor 330 is formed of a weight-type sensor, for example, and opens and closes a switch in response to a change in weight brought about by sitting of a user on toilet seat 300. Due to such an operation, seating sensor 330 detects that a user has seated on the seating surface of toilet seat 300.

**[0021]** Further, as shown in FIGS. 2 and 3, body 200 internally includes, cleaning unit 500 that includes sub tank 600, heat exchanger 700, and nozzle device 800, spray nozzle 550, deodorizing device 120, control unit 130, and the like. Nozzle device 800 includes, for example, buttock cleaning water nozzle 831 that is a cleaning water nozzle for cleaning a private part of a human body. Spray nozzle 550 sprays cleaning water or cleaning foam toward an inner surface of the toilet bowl. Deodorizing device 120 deodorizes an odor generated at a time of defecation. Control unit 130 controls respective functions of sanitary washing device 100. Note that buttock cleaning water nozzle 831 will be described as an example of a cleaning water nozzle in some cases.

**[0022]** Nozzle device 800 that is a main constitutional element of cleaning unit 500 is provided in a center portion inside body 200. On right of nozzle device 800, spray nozzle 550 is provided, while, on left of nozzle device 800, deodorizing device 120 is provided. Toilet seat and toilet lid rotating mechanism 360 which drives toilet seat 300 and toilet lid 320 in an openable and closeable manner is disposed on left of nozzle device 800.

**[0023]** Water stop electromagnetic valve 514 of cleaning unit 500, relief valve 515, sub tank 600 and the like are further disposed on front right of nozzle device 800. Heat exchanger 700 is disposed on rear of nozzle device 800. On rear of heat exchanger 700, water pump 516 configuring a discharge water amount variable unit is provided. Control unit 130 is disposed above cleaning unit 500.

**[0024]** As shown in FIG. 4, a plurality of switches and display lamps 240 for operating and setting the respective functions of sanitary washing device 100 are disposed, in addition to other components, on operation unit 210. An operation board (not shown in the drawing) is disposed inside operation unit 210. A plurality of tact switches and a plurality of LEDs (not shown in the drawing) are disposed on the operation board. A user can then operate the tact switches by pushing and can visually recognize the LEDs by means of a switch name plate adhered to an upper surface of operation unit 210.

**[0025]** Operation unit 210 includes infrared-ray receiver 211. Infrared-ray receiver 211 is disposed on a rear side of the upper surface of operation unit 210. Infrared-ray receiver 211 receives infrared ray signals transmitted from remote controller 400 and human body detection sensor 450 shown in FIG. 1.

**[0026]** The switches of operation unit 210 are consti-

tuted of a plurality of operation switches 220 for operating a cleaning operation, a plurality of setting switches 230 for setting various kinds of functions and the like. Further, display lamps 240 are constituted of a plurality of LEDs for displaying set states of body 200.

**[0027]** Operation switches 220 of operation unit 210 include, for example, buttock cleaning switch 221 and nozzle cleaning switch 222. Buttock cleaning switch 221 can be used for an auxiliary purpose if a battery of remote controller 400 expires or if a fault arises in remote controller 400. Nozzle cleaning switch 222 can be used to clean the nozzle.

**[0028]** Setting switches 230 of operation unit 210 are constituted of, for example: hot water temperature switch 231; toilet seat temperature switch 232; 8-hour warming stop switch 233; power saving switch 234; toilet lid automatically opening/closing switch 235 and the like.

**[0029]** The following operations are performed by a user when the respective switches are operated by pushing.

**[0030]** Hot water temperature switch 231 is provided for setting a temperature of cleaning water. Toilet seat temperature switch 232 is provided for setting a temperature of toilet seat 300. When 8-hour warming stop switch 233 is turned on, warming of toilet seat 300 is stopped, and warming of toilet seat 300 is started again after 8 hours elapse. Power saving switch 234 automatically learns a period of time where sanitary washing device 100 is not used, and lowers a warming temperature of toilet seat 300 during the period of time where sanitary washing device 100 is not used, thus achieving power saving. Toilet lid automatically opening/closing switch 235 is provided for setting automatic opening/closing operation of toilet seat 300 and toilet lid 320.

**[0031]** Many operations of sanitary washing device 100 are performed by remote controller 400 which is constituted as a constitutional element separated from body 200. Accordingly, remote controller 400 is mounted on a wall surface or the like of a toilet room which a user seated on toilet seat 300 can easily operate.

**[0032]** As shown in FIG. 5, the overall shape of remote controller 400 is formed into a thin rectangular parallelepiped shape. Remote controller 400 is configured such that the plurality of switches and display lamps are mounted on an upper surface and a front surface of box-shaped remote controller body 401 which is molded by using a resin material such as polypropylene (PP) and ABS, for example. Transmitting part 402 which transmits an operation signal from remote controller 400 to body 200 in the form of infrared rays is disposed in a vicinity of an upper corner portion of remote controller body 401.

**[0033]** A control board (not shown in the drawing) which forms a control function of remote controller 400, a battery (not shown in the drawing) which is a power source for remote controller 400 and the like are incorporated in the inside of remote controller body 401.

**[0034]** Buttock cleaning switch 410, bidet cleaning switch 411, stop switch 412, move cleaning switch 413, rhythm cleaning switch 414 and the like are disposed on

a front center portion of remote controller body 401, for example.

**[0035]** The following operations are performed by a user when the respective switches are operated by pushing.

**[0036]** When buttock cleaning switch 410 is operated, buttock cleaning starts. When bidet cleaning switch 411 is operated, cleaning of a woman's private part starts. When stop switch 412 is operated, buttock cleaning or bidet cleaning stops. When move cleaning switch 413 is operated, cleaning over a wide range becomes possible by advancing and retracting a cleaning position of a nozzle periodically at the time of performing buttock cleaning or bidet cleaning. When rhythm cleaning switch 414 is operated, cleaning becomes possible where a cleaning strength is changed periodically at the time of performing buttock cleaning.

**[0037]** Cleaning strength switch 415, cleaning position switch 416, spray switch 417 and the like are disposed on an upper front portion of remote controller body 401, for example. When cleaning strength switch 415 is operated, a cleaning strength at the time of performing buttock cleaning and a cleaning strength at the time of performing bidet cleaning can be adjusted using two switches. When cleaning position switch 416 is operated, a cleaning position at the time of performing buttock cleaning and a cleaning position at the time of bidet cleaning can be adjusted using two switches. When spray switch 417 is operated, spray nozzle 550 discharges and sprays cleaning water or cleaning foam toward the inner surface of the toilet bowl or a surface of the cleaning water nozzle.

**[0038]** Strength display lamp 421 formed of LEDs which displays a cleaning strength in five stages, for example, is disposed above cleaning strength switch 415. Further, position display lamp 422 which displays a cleaning position in five stages, for example, is disposed above cleaning position switch 416.

**[0039]** Toilet lid switch 418 for electrically opening and closing toilet lid 320, and toilet seat switch 419 for electrically opening and closing toilet seat 300 are disposed on the upper surface of remote controller body 401. By operating respective switches, a user can arbitrarily open and close toilet seat 300 and toilet lid 320.

**[0040]** Human body detection sensor 450 shown in FIG. 1 is constituted as a constitutional element separated from body 200, and is mounted on the wall surface of the toilet room or the like, for example. Human body detection sensor 450 includes: a pyroelectric sensor; a sensor control unit; an infrared-ray transmitting part; a battery which is a power source for human body detection sensor 450 and the like (not shown in the drawings). The pyroelectric sensor receives infrared rays emitted from a human body. The sensor control unit detects the presence of a human body in response to a signal from the pyroelectric sensor. The infrared-ray transmitting part transmits a human body detection signal sent from the sensor control unit to the control unit of body 200 in the form of infrared rays.

**[0041]** Sanitary washing device 100 according to this

exemplary embodiment is configured as described above.

<2> Water circuit configuration of sanitary washing device

**[0042]** Hereinafter, the configuration of a water circuit of the sanitary washing device according to this exemplary embodiment is described with reference to FIG. 6.

**[0043]** FIG. 6 is a schematic view showing the configuration of the water circuit of the sanitary washing device.

**[0044]** Cleaning unit 500 shown in FIG. 6 is incorporated in body 200, and cleans a private part of a user.

**[0045]** As shown in FIG. 6, cleaning unit 500 configuring the water circuit includes at least: nozzle device 800 for jetting cleaning water; a series of cleaning water supply passage 690 through which cleaning water is supplied to nozzle device 800 from water supply connecting port 510 and the like.

**[0046]** Water supply connecting port 510, strainer 511, check valve 512, constant flow regulating valve 513, water stop electromagnetic valve 514, relief valve 515, sub tank 600, heat exchanger 700, buffer tank 750, water pump 516 configuring the discharge water amount variable unit, flow regulating valve 517 and the like are sequentially mounted in cleaning water supply passage 690. A most downstream end of cleaning water supply passage 690 is connected to nozzle device 800.

**[0047]** Water supply connecting port 510 is disposed below a right side of body 200, and is connected with an external city water pipe, for example. Strainer 511 is disposed inside water supply connecting port 510, and prevents the inflow of dusts and dirt contained in tap water. Check valve 512 prevents the backflow of water stored in sub tank 600 to the city water pipe.

**[0048]** Constant flow regulating valve 513 is disposed downstream of check valve 512, and maintains an amount of cleaning water which flows in cleaning water supply passage 690 at a fixed value. Based on a signal sent from control unit 130, water stop electromagnetic valve 514 electrically opens and closes cleaning water supply passage 690. Constant flow regulating valve 513, water stop electromagnetic valve 514, and relief valve 515 are integrally formed as shown in FIG. 7.

**[0049]** Sub tank 600 is disposed downstream of water stop electromagnetic valve 514, and has an atmosphere open port 603. Heat exchanger 700 heats cleaning water instantaneously. Buffer tank 750 makes a temperature of hot water which is heated by heat exchanger 700 uniform.

**[0050]** Water pump 516 configuring the discharge water amount variable unit is connected downstream of buffer tank 750. Nozzle device 800 is disposed downstream of water pump 516, and connected, via flow regulating valve 517, to water pump 516. Buttock cleaning water nozzle 831, bidet cleaning water nozzle 832, nozzle cleaning unit 833 and the like of nozzle device 800 are connected to respective ports of flow regulating valve

517.

**[0051]** Further, as shown in FIG. 6, branch passage 530 includes opening and closing valve 530a, and is disposed and branched, at a point between water pump 516 and flow regulating valve 517, from cleaning water supply passage 690. Branch passage 530 connects cleaning water supply passage 690 with foam generation unit 560.

**[0052]** Foam generation unit 560 includes check valve 531, foam tank 532, detergent tank 533, detergent pump 534, air pump 535, and the like.

**[0053]** Branch passage 530 supplies cleaning water, via check valve 531, to foam tank 532 of foam generation unit 560.

**[0054]** Spray nozzle 550 is connected downstream of foam tank 532, and is driven and rotated by spray nozzle drive unit 550a. Detergent tank 533 and detergent pump 534 are connected to foam tank 532 to supply detergent to foam tank 532.

**[0055]** Air pump 535 supplies air to foam tank 532 into which cleaning water or detergent is supplied to generate cleaning foam when detergent is supplied. The generated cleaning foam, cleaning water, or the like is then supplied from foam tank 532 to spray nozzle 550.

**[0056]** Broken lines shown in FIG. 6 show that respective components are electrically connected with control unit 130 and controlled by control unit 130.

**[0057]** As shown in FIGS. 7 and 8, out of members which constitute cleaning unit 500, water supply connecting port 510, strainer 511, check valve 512, constant flow regulating valve 513, water stop electromagnetic valve 514, relief valve 515, sub tank 600, heat exchanger 700, buffer tank 750, water pump 516 are assembled into chassis 501. Chassis 501 is molded by using a resin material such as ABS, and, as shown in FIG. 2, assembled to rear body case 201 of body 200.

**[0058]** Specifically, strainer 511 and check valve 512 are integrally assembled to water supply connecting port 510. Constant flow regulating valve 513 and relief valve 515 are integrally assembled to water stop electromagnetic valve 514. Buffer tank 750 is integrally formed with heat exchanger 700.

**[0059]** Connecting ports of water supply connecting port 510 and water stop electromagnetic valve 514, connecting ports of water stop electromagnetic valve 514 and sub tank 600, and connecting ports of sub tank 600 and heat exchanger 700 are respectively directly connected to each other with a packing, for example, an O-ring (not shown in the drawing) sandwiched therebetween without interposing a connecting tube or the like therebetween. That is, members configuring the above described water circuit are provided and fixed at predetermined positions of chassis 501.

**[0060]** With the above described configuration, an improved watertight structure is achieved, where accuracy in relative arrangement of members is enhanced. Particularly, the accuracy in relative arrangement of sub tank 600 and heat exchanger 700 is enhanced. Accordingly, the accuracy in controlling a flow rate of cleaning water

is enhanced. As a result, the performance of cleaning unit 500 is enhanced and, at the same time, the accuracy in controlling a flow rate is enhanced.

**[0061]** Next, a configuration of water pump 516 configuring the discharge water amount variable unit will now be described herein with reference to FIGS. 7 and 8 and using FIGS. 14 and 15.

**[0062]** FIG. 14 is a perspective view showing an external appearance of a water pump of the water circuit. FIG. 15 is a cross-sectional view of the water pump.

**[0063]** As shown in FIGS. 14 and 15, water pump 516 is formed of a piston pump which is a positive displacement pump having an outer shape of an approximately L shape (including an L shape), for example. Water pump 516 includes motor unit 516a having an approximately circular cylindrical shape (including a circular cylindrical shape), link mechanism part 516b, piston unit 516c, and the like. Link mechanism part 516b converts a rotary motion of the motor into a reciprocating motion. Piston unit 516c is driven through a reciprocating motion of link mechanism part 516b to suck and discharge cleaning water. Accordingly, piston unit 516c includes, on an external surface, as connecting ports, water suction port 516d and discharge opening 516e.

**[0064]** In case of water pump 516 of this exemplary embodiment, vibrations generated in motor unit 516a which performs only a rotary motion are smaller than vibrations generated by link mechanism part 516b and piston unit 516c which perform a reciprocating motion.

**[0065]** To describe the operation of water pump 516 specifically, firstly when motor unit 516a is driven, piston unit 516c starts a reciprocating motion. Accordingly, cleaning water is sucked into water pump 516 from water suction port 516d of piston unit 516c, and the cleaning water is discharged from discharge opening 516e. The cleaning water discharged from discharge opening 516e is discharged while forming the flow of water having appropriate pulsation along with a reciprocating motion of piston unit 516c.

**[0066]** An outer periphery of motor unit 516a having an approximately circular columnar shape (including circular columnar shape) of water pump 516 having the above-mentioned configuration is surrounded by a buffer member (not shown in the drawing) made of a foamed resin having resiliency. Motor unit 516a is inserted into water pump mounting portion 501a having an approximately circular cylindrical shape (including a circular cylindrical shape) and provided on a rear portion of chassis 501. Accordingly, water pump mounting portion 501a supports motor unit 516a. In such a configuration, link mechanism part 516b and piston unit 516c are disposed in a downwardly suspended manner.

**[0067]** As shown in FIG. 7, water pump mounting portion 501a is formed of an ABS resin to have a thin wall thickness, and is formed on an upper portion of rib-shaped leg portion 501b which is raised from a bottom surface of chassis 501. Accordingly, with elasticity of a resin configuring water pump mounting portion 501a, vi-

brations of water pump 516 can effectively be absorbed.

**[0068]** Hot water outflow port 712 which is a connecting port of heat exchanger 700 with which buffer tank 750 is integrally formed and water suction port 516d which is a connecting port of water pump 516 are connected to each other by connecting tube 502 (see FIG. 8) made of a soft resin.

**[0069]** As described above, in water pump 516 of this exemplary embodiment, motor unit 516a which generates a small amount of vibrations is mounted in water pump mounting portion 501a having a thin wall thickness of chassis 501 by way of the buffer member. On the other hand, link mechanism part 516b and piston unit 516c which generate a large amount of vibrations are provided in a freely suspended manner. Further, piston unit 516c and the like are connected to buffer tank 750 by way of connecting tube 502 (see FIG. 8) made of a soft resin. With such a configuration, it is possible to suppress vibrations generated at the time of driving water pump 516 from being transmitted to chassis 501, other members, and body 200. As a result, comfortability and durability of sanitary washing device 100 during use can be enhanced.

**[0070]** Particularly, water pump 516 is supported by way of two members made of materials different from each other, that is, the buffer member made of a foamed resin and water pump mounting portion 501a made of a resin having resiliency. Therefore, vibrations frequencies in a wide range can be absorbed. Accordingly, it is possible to further effectively suppress the transmission of vibrations to body 200.

**[0071]** The water circuit of sanitary washing device 100 according to this exemplary embodiment is configured as described above.

### <3> Configuration of sub tank

**[0072]** Hereinafter, the configuration of the sub tank of the sanitary washing device of this exemplary embodiment is described with reference to FIGS. 9 to 11.

**[0073]** FIG. 9 is a perspective view showing an external appearance of the sub tank of the water circuit. FIG. 10 is a transverse cross-sectional view of the sub tank. FIG. 11 is a longitudinal cross-sectional view of the sub tank.

**[0074]** Firstly, as shown in FIG. 9, sub tank 600 includes at least: tank body 610 which is molded by using a resin material such as ABS, for example; water level detection sensor 620; inflow water temperature sensor 630 and the like. Water level detection sensor 620 detects a water level of cleaning water stored in tank body 610. Inflow water temperature sensor 630 is formed of a thermistor, for example, and detects a temperature of cleaning water supplied into the inside of tank body 610.

**[0075]** Tank body 610 includes three members, that is, front tank 611 which forms a front wall, side walls, a bottom surface, and a top surface of the tank, rear tank 612 which forms a rear wall of the tank, and atmosphere open portion 613 which is disposed on a top surface of tank

body 610. The overall shape of tank body 610 is formed of a plurality of planes consisting of the front wall, the rear wall, the side walls, the bottom surface, and the top surface. As shown in FIG. 10, the overall shape of tank body 610 as viewed in a plan view is formed into an approximately quadrangular shape (including a quadrangular shape). The front wall of front tank 611 has an inclined portion which is inclined rearward from an intermediate portion of the front wall. That is, when tank body 610 is viewed in a side view as shown in FIG. 11, tank body 610 is formed into an approximately trapezoidal shape (including a trapezoidal shape) where a width of an upper portion is smaller than a width of a lower portion. With such a configuration, a cross-sectional area of the upper portion of tank body 610 is smaller than a cross-sectional area of the lower portion of tank body 610.

**[0076]** Water inflow port 601 is formed at a lower portion of one of the side walls of front tank 611 of tank body 610, and water outflow port 602 is formed at a lower portion of the rear wall of rear tank 612 of tank body 610.

**[0077]** Atmosphere open port 603 which makes the inside and the outside of tank body 610 communicate with each other is formed on atmosphere open portion 613 which is disposed on the top surface of tank body 610.

Atmosphere open port 603 discharges air accumulated in tank body 610 to the outside so as to consistently maintain inner pressure of tank body 610 at atmospheric pressure. With such a configuration, the inside of sub tank 600 is maintained at atmospheric pressure, and cleaning water supply passage 690 from a downstream side of sub tank 600 to water suction port 516d of water pump 516 is also maintained at atmospheric pressure. Accordingly, without being affected by variations in pressure of tap water to be supplied, water pump 516 can supply cleaning water to nozzle device 800. As a result, water pump 516 can perform a pump function stably.

**[0078]** As shown in FIG. 10, in flow passage 613b which communicates with atmosphere open port 603 of atmosphere open portion 613 in water pump 516, buffer portion 613a at where flow passage 613b partially has a large cross-sectional area is formed. In the case where cleaning water intends to flow out with an impulse along with bubbles from atmosphere open port 603 or the like, buffer portion 613a temporarily stores cleaning water. Due to such an operation, the flowing out of cleaning water from atmosphere open port 603 is suppressed.

**[0079]** Further, inside tank body 610, partition wall 614 is provided. Partition wall 614 divides the inside of tank body 610 into two tanks, that is, water inflow tank 615 and storage tank 616. Tank body 610 includes water inflow port 601 provided, at a position near the bottom surface, on a side surface of water inflow tank 615 (front tank 611), and water outflow port 602 provided, at a position near the bottom surface, on a rear wall of storage tank 616 (rear tank 612).

**[0080]** That is, tank body 610 is formed, by partition wall 614, with water inflow tank 615 and storage tank 616. Accordingly, when air is contained in cleaning water

which flows into tank body 610 through water inflow port 601, air passes through atmosphere open port 603 from an upper portion of water inflow tank 615 and is discharged to the outside. Accordingly, only cleaning water containing no air is allowed to flow into storage tank 616.

**[0081]** Above water inflow tank 615 of tank body 610, barrier wall 617 which lies between upper surface opening portion 615a of water inflow tank 615 and atmosphere open portion 613 is disposed in a state where barrier wall 617 projects from the side wall of front tank 611 of tank body 610 in an approximately horizontal direction (including a horizontal direction). Barrier wall 617 has a size capable of covering the whole surface of upper surface opening portion 615a of water inflow tank 615.

**[0082]** Further, inside water inflow tank 615, a plurality of flow straightening ribs 618 is provided. Flow straightening ribs 618 are provided on the side walls of front tank 611 of tank body 610 and partition wall 614 so as to alternately project in an approximately horizontal direction (including a horizontal direction).

**[0083]** Next, the flow of cleaning water in sub tank 600 is described.

**[0084]** Cleaning water which flows into sub tank 600 from water inflow port 601, firstly, flows into a lower portion of water inflow tank 615. The flowed cleaning water rises in water inflow tank 615 while the flow direction of cleaning water is changed by flow straightening ribs 618. At this stage of operation, when pressure of cleaning water which flows into sub tank 600 from water inflow port 601 is high, or when cleaning water contains a large amount of air so that the flow of cleaning water is remarkably turbulent, flow straightening ribs 618 suitably straighten the flow of cleaning water. Further, flow straightening ribs 618 separate air contained in cleaning water due to a vortex generated downstream of flow straightening ribs 618.

**[0085]** Cleaning water which rises in water inflow tank 615 and from which air is separated overflows an upper end of partition wall 614, flows into storage tank 616, and is stored in storage tank 616. At this time, even when pressure of cleaning water which flows into storage tank 616 from water inflow port 601 is high, or even when cleaning water contains a large amount of air so that the flow of cleaning water is remarkably turbulent, the flow of cleaning water in the upward direction (toward atmosphere open portion 613) is suppressed by barrier wall 617. That is, barrier wall 617 prevents cleaning water from directly hitting atmosphere open portion 613, and, from atmosphere open port 603, from flowing out to the outside of sub tank 600.

**[0086]** As described above, during a period where cleaning water which flows into sub tank 600 from water inflow port 601 of sub tank 600 rises in water inflow tank 615, air contained in the cleaning water is separated from the cleaning water due to flow straightening ribs 618 and the like. The separated air is discharged to the outside of tank body 610 from atmosphere open port 603. With such a configuration, cleaning water containing no air is

stored in storage tank 616, and such cleaning water is supplied to heat exchanger 700 from water outflow port 602 of sub tank 600.

**[0087]** Note that if air is mixed in cleaning water supplied from sub tank 600 to heat exchanger 700, air bubbles are generated in heat exchanger 700. This may cause an abnormal rise in temperature inside heat exchanger 700 and damage heat exchanger 700. Therefore, sub tank 600 of this exemplary embodiment is provided with partition wall 614 in sub tank 600, thus preventing the mixing of air by separating air from cleaning water. Only the cleaning water is then supplied to heat exchanger 700. With such a configuration, it is possible to effectively prevent heat exchanger 700 from being damaged.

**[0088]** As shown in FIGS. 10 and 11, sub tank 600 includes water level detection sensor 620 which includes common electrode 621 made of a stainless material and used in common, and a plurality of water level electrodes 622 disposed corresponding to respective water levels in sub tank 600. This exemplary embodiment has described, without limitation, a configuration of water level detection sensor 620 including one common electrode 621 and two water level electrodes 622.

**[0089]** Common electrode 621 is disposed, at a lower portion, on an inner surface of the front wall of tank body 610. Water level electrodes 622 are disposed on an inner surface of the rear wall of tank body 610. Water level electrodes 622 include upper limit electrode 623 disposed on an upper portion of the inner surface of the rear wall, and lower limit electrode 624 disposed on a lower portion of the inner surface of the rear wall. Common electrode 621 is disposed at a position below lower limit electrode 624 which constitutes one of water level electrodes 622, and is always immersed in cleaning water in a normal state of use.

**[0090]** That is, common electrode 621 is provided on a surface, at a height different from heights of upper limit electrode 623 and lower limit electrode 624, both configuring water level electrodes 622. Accordingly, it can be suppressed that water remained and adhered on the inner surface of tank body 610 is erroneously detected as stored water.

**[0091]** A method for detecting a water level of cleaning water using water level electrodes 622 will now be described herein.

**[0092]** Firstly, a DC voltage is applied between common electrode 621 and water level electrodes 622. Then, whether or not water level electrodes 622 are immersed in cleaning water is detected based on a change in voltage. Accordingly, a water level of cleaning water in tank body 610 is detected. That is, when the water level of storage tank 616 increases, lower limit electrode 624 and upper limit electrode 623 are immersed in water. At this time, a voltage between common electrode 621 and lower limit electrode 624 and upper limit electrode 623 decreases. Consequently, control unit 130 detects a water level of cleaning water based on the lowering of voltages.

**[0093]** Upper limit electrode 623 which constitutes one of water level electrodes 622 is used for detecting an upper limit water level, and lower limit electrode 624 which constitutes the other of water level electrodes 622 is used for detecting a lower limit water level. Accordingly, upper limit electrode 623 is disposed at a position below atmosphere open port 603. With such a configuration, cleaning water is prevented from flowing out from atmosphere open port 603. Further, lower limit electrode 624 is disposed above water outflow port 602 through which water is supplied to heat exchanger 700. With such a configuration, air is prevented from flowing into heat exchanger 700.

**[0094]** Sub tank 600 of this exemplary embodiment is constituted as described above.

#### <4> Configuration of heat exchanger

**[0095]** Hereinafter, the configuration of the heat exchanger of the sanitary washing device of this exemplary embodiment is described with reference to FIGS. 12 and 13.

**[0096]** FIG. 12 is a perspective view showing an external appearance of the heat exchanger of the water circuit. FIG. 13 is a cross-sectional view of the heat exchanger.

**[0097]** In this exemplary embodiment, buffer tank 750 is integrally formed with heat exchanger 700, and buffer tank 750 is mounted on an upper portion of heat exchanger 700.

**[0098]** Firstly, heat exchanger 700 is formed into a flat plate shape having an approximately rectangular shape (including a rectangular shape) as viewed in a front view (see FIG. 13). Heat exchanger 700 includes at least: casing 701 which is molded by using a reinforced ABS resin made of an ABS resin compounded with glass fibers; flat-plate-like heater 702 made of ceramic, hot water outflow member 703 and the like.

**[0099]** Casing 701 includes: front surface member 710 which constitutes a front surface portion of casing 701, and back surface member 720 which constitutes a back surface portion of casing 701. Flat-plate-like heater 702 is disposed in a space formed between front surface member 710 and back surface member 720. Heating passage 715 is formed of: a gap defined between front surface member 710 and flat-plate-like heater 702; and a gap defined between back surface member 720 and flat-plate-like heater 702.

**[0100]** Heat exchanger 700 having the above-mentioned configuration instantaneously increases a temperature of cleaning water which flows through heating passage 715 by flat-plate-like heater 702.

**[0101]** In heat exchanger 700, water inflow port 711 which constitutes a connecting port is formed at a lower right end of a front surface of front surface member 710, and hot water outflow port 712 which constitutes a connecting port is formed on hot water outflow member 703 which is mounted on an upper end of a right side surface of front surface member 710.

**[0102]** As shown in FIG. 13, water inflow passage 713 which is continuously formed with water inflow port 711 is formed over the approximately whole width (including a whole width) of the lower end portion of casing 701. On an upper surface of water inflow passage 713, a plurality of slits 714 is provided over the whole width. Water inflow passage 713 is configured such that cleaning water flowed into water inflow passage 713 passes through slits 714, and flows into heating passage 715. Slits 714 have a function of allowing cleaning water to flow into heating passage 715 uniformly over the whole width of heating passage 715.

**[0103]** Partition rib 716 is provided to an upper end portion of heating passage 715, and, above partition rib 716, buffer tank 750 is provided. A plurality of water through holes 717 is formed on partition rib 716 over the approximately whole width (including the whole width) of partition rib 716. With such a configuration, cleaning water which is heated by heating passage 715 flows into buffer tank 750 through water through holes 717.

**[0104]** Projections 718 each having an approximately semicircular cross section (including a semicircular cross section), for example, are disposed in buffer tank 750 at intervals over the approximately whole width (including the whole width) of buffer tank 750. Projections 718 are provided for making the flow of cleaning water which flows toward hot water outflow port 712 in the inside of buffer tank 750 turbulent. With such a configuration, cleaning water is agitated so that irregularity in temperature of cleaning water is eliminated. As a result, cleaning water having uniform temperature is flown out from hot water outflow port 712.

**[0105]** Two thermistors, that is, outflow hot water temperature sensor 730 and excessively elevated temperature sensor 731 are mounted on hot water outflow member 703. Outflow hot water temperature sensor 730 detects an outflow hot water temperature of cleaning water. Excessively elevated temperature sensor 731 detects an excessively elevated temperature of heat exchanger 700. With such a configuration, control unit 130 controls a temperature of cleaning water flown out from heat exchanger 700.

**[0106]** Heat exchanger 700 according to this exemplary embodiment is configured as described above.

#### <5> Configuration of nozzle device

**[0107]** Hereinafter, the configuration of the nozzle device of the sanitary washing device of this exemplary embodiment is described with reference to FIGS. 16 to 28.

**[0108]** FIG. 16 is a perspective view showing a storage state of the nozzle device according to this exemplary embodiment. FIG. 17 is a cross-sectional view taken along line 17-17 shown in FIG. 16. FIG. 18 is a longitudinal cross-sectional view showing a storage state of the nozzle device. FIG. 19 is a cross-sectional view showing a detailed configuration of portion B shown in FIG. 18. FIG. 20 is a cross-sectional view taken along line 20-20

shown in FIG. 19. FIG. 21 is a transverse cross-sectional view showing a storage state of the nozzle device. FIG. 22 is a cross-sectional view showing a detailed configuration of portion C shown in FIG. 21. FIG. 23 is a longitudinal cross-sectional view showing a buttock cleaning state of the nozzle device. FIG. 24 is a cross-sectional view showing a detailed configuration of portion D shown in FIG. 23. FIG. 25 is a longitudinal cross-sectional view showing a bidet cleaning state of the nozzle device. FIG. 26 is a cross-sectional view showing a detailed configuration of portion E shown in FIG. 25. FIG. 27 is a transverse cross-sectional view of the nozzle portion showing a bidet cleaning state of the nozzle device. FIG. 28 is a cross-sectional view showing a detailed configuration of portion G shown in FIG. 27.

**[0109]** As shown in FIG. 16, nozzle device 800 includes at least support portion 810, nozzle portion 820, cleaning water nozzle drive unit 860, flow regulating valve 517 and the like. Support portion 810 is molded by using a resin material such as polyoxymethylene (POM) or ABS, for example, and is formed into an approximately triangular (including a triangular shape) frame shape as viewed in a side view. Nozzle portion 820 moves forward and backward along support portion 810. Cleaning water nozzle drive unit 860 drives and moves nozzle portion 820 forward and backward. Flow regulating valve 517 changes over the supply of cleaning water to nozzle portion 820.

**[0110]** In the description of nozzle device 800 made hereinafter, the arrangement of the respective constitutional elements is described by assuming that a direction along which nozzle portion 820 is stored is a rearward direction, a direction along which nozzle portion 820 advances is a frontward direction, a right side in a direction from a rear side to a front side is a right side, and a left side in a direction from a rear side to a front side is a left side.

**[0111]** Support portion 810 is formed on a frame formed from: inclined portion 812 which is lowered toward a front portion from a rear portion of inclined portion 812 with respect to a bottom side portion 811 disposed approximately horizontally (including horizontally); and vertical side portion 813 which connects a rear end of bottom side portion 811 and a rear end of inclined portion 812 to each other. Guide rail 814 which guides forward and backward movement of nozzle portion 820 and rack guide 815 (see FIG. 17) which guides flexible rack 861 (see FIG. 17) of cleaning water nozzle drive unit 860 are formed over the approximately whole length (including the whole length) of inclined portion 812. Holding portion 816 having an approximately circular cylindrical shape (including a circular cylindrical shape) which supports nozzle portion 820 in a surrounding manner is integrally formed on a lower side of a front end of inclined portion 812.

**[0112]** As shown in FIG. 16, guide rail 814 which guides nozzle portion 820 is formed into an approximately T shape (including a T shape) in cross section. Rack guide 815 which guides flexible rack 861 has an approximately

U shape (including a U shape) as viewed in cross section where one side surface is open. Rack guide 815 is configured to guide flexible rack 861 while restricting upper and lower surfaces and one side surface of flexible rack 861.

**[0113]** Rack guide 815 is also formed on vertical side portion 813 and bottom side portion 811 disposed at a rear portion of support portion 810 continuously with inclined portion 812. Rack guides 815 at a corner formed by inclined portion 812 and vertical side portion 813 are connected to each other in an arcuate shape, for example, and rack guides 815 at a corner formed by vertical side portion 813 and bottom side portion 811 are connected to each other in an arcuate shape, for example.

Rack guide 815 formed on vertical side portion 813 and rack guide 815 formed on bottom side portion 811 are also formed into an approximately U shape (including a U shape) in cross section. On the other hand, with respect to a side surface of rack guide 815, a left side surface of rack guide 815 is open at inclined portion 812, and a side opposite to the left side surface, that is, a right side surface of rack guide 815 is open at vertical side portion 813 and bottom side portion 811. This reduces sliding resistance and can more reliably guide flexible rack 861. Further, open surfaces of rack guides 815 at vertical side portion 813 and bottom side portion 811 are closed by a support portion lid or the like which is a member provided separately from rack guide 815, for example.

**[0114]** Cleaning water nozzle drive unit 860 includes: flexible rack 861 which is joined to nozzle portion 820; pinion gear 862 which is meshed with flexible rack 861; and drive motor 863 which rotatably drives pinion gear 862. Cleaning water nozzle drive unit 860 moves nozzle portion 820 forward and backward along guide rail 814.

**[0115]** Drive motor 863 is formed of a stepping motor, for example, and a rotational angle of drive motor 863 is controlled by a pulse signal. Further, due to the rotation of drive motor 863, flexible rack 861 is driven by way of pinion gear 862.

**[0116]** A gap is defined between an inner peripheral surface of holding portion 816 of support portion 810 and an outer peripheral surface of nozzle portion 820. Accordingly, cleaning water jetted from nozzle portion 820 flows into the gap and cleans the outer peripheral surface of nozzle portion 820.

**[0117]** Nozzle lid 801 is disposed on a front side of holding portion 816 in an openable and closeable manner, and is open or closed in response to advancing and retracting of nozzle portion 820. With nozzle portion 820 retracted, nozzle lid 801 is then closed. Accordingly, nozzle portion 820 is prevented from becoming dirty.

**[0118]** On bottom side portion 811 of support portion 810, water supply joint 817 which connects a water supply tube (not shown in the drawing) connected to cleaning water supply passage 690 and connecting tube 802 provided for supplying cleaning water to flow regulating valve 517 from support portion 810 to each other is formed.

**[0119]** As shown in FIG. 21, nozzle portion 820 in-

cludes at least: rod-like nozzle body 830 which is molded by using a resin material such as ABS, for example; nozzle cover 840; connecting portion 850 and the like. Nozzle cover 840 is formed into a cylindrical shape, and covers approximately whole nozzle body 830 (including whole nozzle body 830). In connecting portion 850, nozzle body 830 tucks nozzle cover 840.

**[0120]** As shown in FIG. 6, nozzle body 830 of nozzle portion 820 includes: buttock cleaning water nozzle 831 for cleaning a private part; bidet cleaning water nozzle 832 for cleaning a woman's private part; nozzle cleaning unit 833 for cleaning nozzle portion 820 and the like.

**[0121]** As shown in FIGS. 23 and 24, buttock cleaning water nozzle 831 includes: buttock cleaning water jetting port 834 which is formed on a distal end portion of nozzle body 830 in an upwardly opening manner; and buttock cleaning water passage 835 which communicates with buttock cleaning water jetting port 834 from a rear end of nozzle body 830. Buttock cleaning water passage 835 is disposed on a lower portion side of nozzle body 830, and has a bent portion which is bent upward and is formed below buttock cleaning water jetting port 834. Straightening plate 835a which straightens the flow of cleaning water is disposed on the bent portion. With such a configuration, cleaning water jetted from buttock cleaning water jetting port 834 is jetted upward through jetting opening 844 formed on nozzle cover 840. As shown in FIGS. 25 and 26, bidet cleaning water nozzle 832 includes: bidet cleaning water jetting port 836 which is disposed behind buttock cleaning water jetting port 834; and bidet cleaning water passage 837 which communicates with bidet cleaning water jetting port 836 from a rear end of nozzle body 830. Cleaning water jetted from bidet cleaning water jetting port 836 is jetted upward through jetting opening 844 formed on nozzle cover 840.

**[0122]** As shown in FIG. 27, nozzle cleaning unit 833 includes: nozzle cleaning water jetting port 838 disposed on a side surface of nozzle body 830; and nozzle cleaning water passage 839 which communicates with nozzle cleaning water jetting port 838 from the rear end of nozzle body 830. Cleaning water jetted from nozzle cleaning water jetting port 838 is jetted to the inside of nozzle cover 840, and is discharged to the outside of nozzle cover 840 from discharge opening 845 of nozzle cover 840. Cleaning water jetted from nozzle cleaning water jetting port 838 is used for cleaning nozzle portion 820 and the surrounding of nozzle portion 820.

**[0123]** Further, a front side of nozzle portion 820 is inserted into and supported by holding portion 816 of support portion 810. A rear portion of nozzle portion 820 is suspended by and slidably provided to guide rail 814. Nozzle portion 820 is configured to move frontward and backward among a storage position shown in FIG. 16 where nozzle portion 820 is stored in an area behind holding portion 816, a buttock cleaning position shown in FIG. 23 where nozzle portion 820 projects from holding portion 816, and a bidet cleaning position shown in FIG. 25.

**[0124]** Nozzle cover 840 includes, as shown in FIG. 21, nozzle cover body 841 and connecting member 842. Nozzle cover body 841 is formed by machining a stainless thin plate into a circular cylindrical shape, for example. A distal end surface of nozzle cover body 841 is formed into a closed surface, and a rear end surface of nozzle cover body 841 is formed into an open surface. Connecting member 842 is molded by using a resin material such as ABS, for example, and is formed into an approximately circular cylindrical shape (including a circular cylindrical shape). Connecting piece 843 which engages with nozzle body 830 is formed on both side portions of connecting member 842.

**[0125]** A nozzle cover stopper (not shown in the drawing) for restricting a slide range of nozzle cover 840 is integrally formed on a right rear end of connecting member 842. The nozzle cover stopper is configured such that the slide range of nozzle cover 840 is restricted by bringing the nozzle cover stopper into contact with a front stopper receiving portion (not shown in the drawing) and a rear stopper receiving portion (not shown in the drawing) formed on support portion 810.

**[0126]** A portion of connecting member 842 is fixed to and integrally formed with nozzle cover body 841 in a state where the portion of connecting member 842 is inserted into the inside of nozzle cover body 841 from an opening formed on a rear end of nozzle cover body 841.

**[0127]** Single jetting opening 844 which can face buttock cleaning water jetting port 834 and bidet cleaning water jetting port 836 of nozzle body 830 is formed, for example, on a front upper surface of nozzle cover body 841. Discharge opening 845 through which cleaning water flowing out to the inside of nozzle cover body 841 is discharged to the outside is formed on a front lower surface of nozzle cover body 841.

**[0128]** An inner diameter of nozzle cover 840 has a size slightly larger than an outer diameter of nozzle body 830. With such a configuration, nozzle body 830 and nozzle cover 840 are configured to be smoothly slidable relative to each other in a state where nozzle body 830 is inserted into nozzle cover 840.

**[0129]** Flow regulating valve 517 is mounted on a rear end surface of nozzle body 830. Flow regulating valve 517 includes, for example, disc-type valve body 517a, and stepping motor 517b for driving a switching operation. Through a switching operation, flow regulating valve 517 selectively supplies cleaning water to either buttock cleaning water passage 835, bidet cleaning water passage 837, or nozzle cleaning water passage 839.

**[0130]** On an external surface of valve body 517a of flow regulating valve 517, water supply port 517c for supplying cleaning water to flow regulating valve 517 is provided. Water supply port 517c is connected to and in communication with support portion 810 via water supply joint 817 and connecting tube 802.

**[0131]** Next, hereinafter, connecting portion 850 of this exemplary embodiment which is formed of connecting member 842 of nozzle cover 840 and connection receiv-

ing portion 851 of nozzle body 830 is described with reference to FIGS. 22 and 28.

**[0132]** As shown in FIGS. 22 and 28, connection receiving portion 851 is formed on a right side of an outer periphery of a rear end portion of nozzle body 830. Two grooves having an approximately V-shape (including a V-shape) which constitute front recessed portion 851a and rear recessed portion 851b respectively are formed on a front side and a rear side of connection receiving portion 851. Front recessed portion 851a and rear recessed portion 851b are disposed in a spaced-apart manner from each other in a longitudinal direction of nozzle body 830. A distance between front recessed portion 851a and rear recessed portion 851b is set equal to a distance between buttock cleaning water jetting port 834 and bidet cleaning water jetting port 836.

**[0133]** On the other hand, connecting member 842 of nozzle cover 840 is molded by using a resin material such as ABS and POM, for example, and is formed into an approximately circular cylindrical shape (including a circular cylindrical shape). Connecting piece 843 which projects rearward is formed on both side portions of a rear portion of connecting member 842. Approximately V-shaped (including V-shaped) connecting projection 843a which projects inward is provided on a rear end portion of connecting piece 843.

**[0134]** When nozzle body 830 is inserted into nozzle cover 840, connecting projection 843a of connecting member 842 of nozzle cover 840 is always brought into pressure contact with connection receiving portion 851 of nozzle body 830 due to resiliency of connecting member 842. In such a state, when connecting projection 843a is made to engage with either front recessed portion 851a or rear recessed portion 851b, nozzle body 830 and nozzle cover 840 are brought into a mutually connected state. With such a configuration, nozzle cover 840 is movable by being towed by nozzle body 830.

**[0135]** In a state where connecting projection 843a enters front recessed portion 851a as shown in FIG. 22, bidet cleaning water jetting port 836 of nozzle body 830 and jetting opening 844 of nozzle cover 840 face each other as shown in FIG. 26. On the other hand, as shown in FIG. 28, in a state where connecting projection 843a enters rear recessed portion 851b, buttock cleaning water jetting port 834 and jetting opening 844 face each other as shown in FIGS. 19 and 24. With such a configuration, cleaning water can be jetted from a predetermined jetting port.

**[0136]** Nozzle device 800 according to this exemplary embodiment is configured as described above.

<6> Control and manner of operation of cleaning unit

**[0137]** Hereinafter, control and the manner of operation of the cleaning unit of the sanitary washing device according to this exemplary embodiment are described.

**[0138]** Firstly, the basic manner of operation of cleaning unit 500 is described with reference to FIGS. 6 and

26 hereinafter.

**[0139]** Firstly, tap water which flows through the city water pipe is supplied to sanitary washing device 100 from water supply connecting port 510 as cleaning water.

5 Then, water stop electromagnetic valve 514 is open so that cleaning water is supplied to sub tank 600. At this stage of operation, a flow rate of cleaning water which flows through cleaning water supply passage 690 is maintained at a fixed value by constant flow regulating valve 513. Driving of water stop electromagnetic valve 10 514 is controlled by control unit 130 based on an operation of remote controller 400 and an operation of operation unit 210.

**[0140]** Next, cleaning water supplied into sub tank 600 is stored in sub tank 600 and, at the same time, is supplied to heat exchanger 700 and water pump 516 configuring the discharge water amount variable unit. Further, by driving water pump 516, cleaning water is supplied to nozzle device 800 through flow regulating valve 517. 20 Driving of water pump 516 is controlled by control unit 130 based on an operation of remote controller 400 and an operation of operation unit 210.

**[0141]** Next, control unit 130 drives water pump 516. Further, control unit 130 starts heating of cleaning water by supplying electricity to flat-plate-like heater 702 of heat exchanger 700. At this stage of operation, control unit 25 130 controls the supply of electricity to flat-plate-like heater 702 based on information detected by inflow water temperature sensor 630 and outflow hot water temperature sensor 730. Further, control unit 130 performs a control of maintaining a temperature of the cleaning water at a temperature set by hot water temperature switch 231 of operation unit 210.

**[0142]** Next, control unit 130 controls switching of flow regulating valve 517 based on operation information of operation unit 210 and operation information of remote controller 400. That is, control unit 130 causes flow regulating valve 517 to select a cleaning water flow passage by switching and to supply cleaning water to any one of 35 buttock cleaning water nozzle 831, bidet cleaning water nozzle 832, and nozzle cleaning unit 833 of nozzle device 800. With such an operation, cleaning water is jetted from one of buttock cleaning water jetting port 834, bidet cleaning water jetting port 836, and nozzle cleaning water jetting port 838.

**[0143]** Hereinafter, a control with respect to sub tank 600 according to this exemplary embodiment, in particular, detection of a water level and a flow rate, will now be described in detail.

50 **[0144]** Firstly, the description is made with respect to a control of cleaning unit 500 at an initial stage of use of sanitary washing device 100 of this exemplary embodiment with reference to FIG. 29.

**[0145]** FIG. 29 is a timing chart concerning the cleaning unit at the initial stage of use of the sanitary washing device. Note that a term "at an initial stage of use" refers to a state where no cleaning water is stored in the cleaning unit, such as when sanitary washing device 100 is

used for a first time after installed, or when sanitary washing device 100 is used again after cleaning water has been discharged for preventing cleaning water from freezing.

**[0146]** As shown in FIG. 29, at a point of time P1, a cleaning switch (for example, buttock cleaning switch 221 or buttock cleaning switch 410) on operation unit 210 or remote controller 400 is operated by a user. Accordingly, control unit 130 supplies electricity to water stop electromagnetic valve 514 to simultaneously start both supplying of cleaning water to sub tank 600 and driving of water level detection sensor 620. Further, control unit 130 starts driving of water level detection sensor 620. Driving of water level detection sensor 620 continues until, at a point of time P14, after buttock cleaning ends, and post-cleaning ends, cleaning water is supplied to sub tank 600, and water level detection sensor 620 detects an upper limit water level.

**[0147]** Next, when water level detection sensor 620 detects an upper limit water level at a point of time P2, control unit 130 starts the measurement of time. Further, after a predetermined time elapses, that is, at a point of time P3, the supply of electricity to water stop electromagnetic valve 514 is stopped so that the supply of cleaning water is stopped.

**[0148]** In this exemplary embodiment, the supply of electricity is stopped, for example, after two seconds elapse from the detection of an upper limit water level. The reason is as follows. At the point of time P2 where the upper limit water level is detected, basically, sub tank 600 and heat exchanger 700 reach a fully filled state. At this time, the supply of cleaning water is further continued for two seconds. Accordingly, heat exchanger 700 and water pump 516 are securely filled with cleaning water to remove air in heat exchanger 700. As a result, no-water heating of heat exchanger 700 due to an existence of residual air can be prevented with certainty and hence, safety and durability of heat exchanger 700 can be ensured. At the same time, water pump 516 configuring the discharge water amount variable unit can securely be supplied and fully filled with cleaning water. Accordingly, by starting water pump 516 fully stored with cleaning water, cleaning water can further securely be supplied to nozzle portion 820.

**[0149]** Next, control unit 130 starts driving of water pump 516 at the point of time P3 where the supply of electricity to water stop electromagnetic valve 514 is stopped. Simultaneously, control unit 130 drives flow regulating valve 517 so as to start the supply of cleaning water to buttock cleaning water passage 835 of nozzle portion 820. At this stage of operation, due to driving of water pump 516, a water level of cleaning water in sub tank 600 is lowered and, at a point of time P4, the detection of an upper limit water level by water level detection sensor 620 is canceled. Therefore, at the point of time P4, control unit 130 starts driving of heat exchanger 700. That is, through a detected, lowered water level, a normal operation of water pump 516 can be confirmed. With such

an operation, it is possible to prevent the abnormal temperature increase in heat exchanger 700, such as no-water heating.

**[0150]** Then, cleaning water supplied to buttock cleaning water passage 835 is jetted from buttock cleaning water jetting port 834. The jetted cleaning water passes through jetting opening 844 and hits and is reflected on an inner surface of holding portion 816 formed on a distal end of support portion 810. With such an operation, an outer peripheral surface of nozzle cover 840 is cleaned. Hereinafter, the above cleaning operation is referred to as "pre-cleaning." The pre-cleaning is continued to, for example, a point of time P5 which comes after two seconds elapses from a point of time where hot water temperature of cleaning water in heat exchanger 700 reaches 25°C.

**[0151]** Next, upon the pre-cleaning ends at the point of time P5, control unit 130 starts driving of cleaning water nozzle drive unit 860 of nozzle device 800. Control unit 130 then causes nozzle portion 820 to advance from the storage position to the buttock cleaning position. At this time, while nozzle portion 820 is advancing from the storage position to the buttock cleaning position, control unit 130 switches flow regulating valve 517 to supply cleaning water to nozzle cleaning water passage 839. The cleaning water supplied to nozzle cleaning water passage 839 is jetted to the inside of nozzle cover 840 from nozzle cleaning water jetting port 838. The jetted cleaning water flows out to the outside of nozzle cover 840 from discharge opening 845 after cleaning the inner surface of nozzle cover 840. Meanwhile, nozzle portion 820 is heated by the cleaning water heated by heat exchanger 700. Accordingly, cold water is prevented from jetting toward a buttock to be cleaned so that a user does not feel uncomfortable.

**[0152]** At a point of time P6 at which nozzle portion 820 has reached the buttock cleaning position, control unit 130 switches flow regulating valve 517 to start supplying of cleaning water to buttock cleaning water passage 835. Then, cleaning water supplied to buttock cleaning water passage 835 is jetted from buttock cleaning water jetting port 834. The cleaning water then passes through jetting opening 844 to clean a private part of the user. Cleaning of the buttock continues to a point of time P11 at which, for example, the user stops the cleaning.

**[0153]** At this time, control unit 130 controls a temperature of cleaning water to a set temperature based on detection data of inflow water temperature sensor 630 and detection data of outflow hot water temperature sensor 730 during driving of heat exchanger 700.

**[0154]** If water pump 516 is kept driving from the point of time P3, a water level of cleaning water in sub tank 600 lowers. At a point of time P7 at which water level detection sensor 620 detects the lower limit water level, control unit 130 starts energizing water stop electromagnetic valve 514 to supply cleaning water, and keeps energizing water stop electromagnetic valve 514 until a point of time P8 at which water level detection sensor

620 detects the upper limit water level.

**[0155]** At the point of time P8 where the upper limit water level is detected, control unit 130 stops the supply of electricity to water stop electromagnetic valve 514 and, at the same time, starts the measurement of time. Then, control unit 130 measures a time elapsed from the point of time P8 to a point of time P9 where water level detection sensor 620 detects a lower limit water level next time.

**[0156]** Next, at the point of time P9 where the lower limit water level is detected, control unit 130 calculates a flow rate of cleaning water by arithmetic processing based on a measured elapsed time and an amount of water from an upper limit water level to a lower limit water level (for example, 65 cc). When there is a difference between a flow rate which is set for every cleaning strength and a flow rate of jetted cleaning water at a point of time P10 where the calculation of the flow rate of cleaning water by a flow rate arithmetic processing unit is finished, control unit 130 adjusts an output of water pump 516 so as to correct the flow rate of cleaning water.

**[0157]** Next, at the point of time P11 where a cleaning stop operation is performed by a user using operation unit 210 or remote controller 400, control unit 130 stops the supply of electricity to water pump 516 and heat exchanger 700. Simultaneously, control unit 130 drives cleaning water nozzle drive unit 860 of nozzle device 800 so as to retract nozzle portion 820 to the storage position from the buttock cleaning position.

**[0158]** At a point of time P12 where nozzle portion 820 is retracted to the storage position, control unit 130 stops driving of cleaning water nozzle drive unit 860. Simultaneously, control unit 130 drives water pump 516 and heat exchanger 700 again so as to start "post-cleaning" where nozzle portion 820 is cleaned.

**[0159]** Next, at a point of time P13 where a predetermined time elapses from starting of "post-cleaning," control unit 130 stops driving of water pump 516 and heat exchanger 700. With such an operation, the "post-cleaning" is finished.

**[0160]** Next, at the point of time P13 where the post-cleaning of nozzle portion 820 is finished, control unit 130 supplies electricity to water stop electromagnetic valve 514 again so that cleaning water is supplied to sub tank 600. Then, at the point of time P14 where water level detection sensor 620 detects the upper limit water level, control unit 130 stops the supply of electricity to water stop electromagnetic valve 514 so that a series of control for buttock cleaning is finished. With such an operation, where sub tank 600 fully filled with cleaning water to the upper limit water level, cleaning unit 500 is brought into a standby state.

**[0161]** As has been described heretofore, a control of the cleaning unit at the initial stage of use of sanitary washing device 100 of this exemplary embodiment is performed.

**[0162]** Hereinafter, the description is made with respect to a control of the cleaning unit at a usual stage of use of sanitary washing device 100 of this exemplary

embodiment with reference to FIG. 30.

**[0163]** FIG. 30 is a timing chart of the cleaning unit at the usual stage of use of the sanitary washing device. A term "at a usual stage of use" refers to a state where a sanitary washing device that has undergone an initial stage of use and thus is now in a standby state performs a cleaning operation.

**[0164]** A control of the cleaning unit at a usual stage of use shown in FIG. 30 differs from the control of the cleaning unit at an initial stage of use shown in FIG. 29 with respect to a point where sub tank 600 is already in a fully filled state at a point of time P20 where the cleaning operation is performed and a point where control unit 130 stores in a memory that the sanitary washing device has undergone an initial stage of use.

**[0165]** Firstly, as shown in FIG. 30, at the point of time P20, a cleaning switch (for example, buttock cleaning switch 221 or 410) on operation unit 210 or remote controller 400 is operated, by a user, in a standby state where sub tank 600 is in a fully filled state. Accordingly, control unit 130 supplies electricity to water pump 516 to start supplying of cleaning water to a predetermined nozzle portion. Simultaneously, control unit 130 starts the supply of electricity to heat exchanger 700 based on stored data that a control of an initial operation has been already performed.

**[0166]** Then, control unit 130 starts the "pre-cleaning" operation of nozzle device 800 simultaneously with the supply of electricity to heat exchanger 700. Further, control unit 130 starts driving of water level detection sensor 620.

**[0167]** That is, the case of the initial stage of use described with reference to FIG. 29 and the case of the usual stage of use differ from each other with respect to a control from a point of time that the cleaning operation is performed to a point of time that the supply of electricity to heat exchanger 700 is started. Both cases are substantially equal to FIG. 29 with respect to the control and the manner of operation after a point of time P5 where driving of nozzle device 800 is started and hence, the repeated description of the control and the manner of operation after the point of time P5 is omitted.

**[0168]** As described above, in the sanitary washing device of this exemplary embodiment, a change in water level of cleaning water is detected by the water level detection sensor mounted on the sub tank and a flow rate of cleaning water is calculated by an arithmetic operation. Accordingly, it is not necessary that a special flow rate sensor for detecting a flow rate be separately provided to the cleaning unit. As a result, a configuration of the cleaning unit can be simplified in a cost-effective manner.

**[0169]** The sanitary washing device according to this exemplary embodiment corrects a threshold for determining a change in output voltage between the electrodes in water level detection in accordance with a temperature. This improves the accuracy in water level detection and flow rate detection and enables the use of water having different conductivities in a wide range as

cleaning water for the sanitary washing device. As a consequence, it is possible to further increase the range of use of the sanitary washing device and improve its user-friendliness.

**[0170]** Further, in the sanitary washing device of this exemplary embodiment, at an initial stage of use, a fully filled state of the sub tank is detected and, thereafter, the supply of water is continued for a predetermined time. Simultaneously, after the water pump is driven, and the water level detection sensor has detected a cancellation of the upper limit water level, the supply of electricity to the heat exchanger is started. Accordingly, it can be determined that the heat exchanger is securely supplied with cleaning water. As a result, it is possible to prevent no-water heating of the heat exchanger. Accordingly, the configuration of this exemplary embodiment can be simplified compared to the conventional configuration which prevents no-water heating using a flow rate sensor. As a result, it is possible to realize the sanitary washing device having high safety and reliability at a low cost.

**[0171]** As described above, control and the manner of operation of the cleaning unit of the sanitary washing device according to this exemplary embodiment is executed.

<7> Control and manner of operation of spray nozzle for discharging cleaning water toward inner surface of toilet bowl

**[0172]** Hereinafter, control and the manner of operation of the spray nozzle of the sanitary washing device according to this exemplary embodiment for discharging cleaning water toward an inner surface of a toilet bowl will now be described with reference to FIGS. 31 to 34.

**[0173]** FIG. 31 is a perspective view showing an external appearance of the spray nozzle of the sanitary washing device. FIG. 32 is a longitudinal cross-sectional view of the spray nozzle. FIG. 33 is a plan view showing an installation position of the spray nozzle in the sanitary washing device, and a rotational angle of the discharge opening of the spray nozzle. FIG. 34 is a chart showing an output of the discharge water amount variable unit and a rotational speed of the spray nozzle drive unit, each corresponding to a rotational angle of the discharge opening of the spray nozzle.

**[0174]** Spray nozzle 550 includes, as shown in FIGS. 31 and 32, spray nozzle drive unit 550a, body 550c, rotation nozzle 550d, and the like. Spray nozzle drive unit 550a includes, for example, a motor for driving and rotating rotation nozzle 550d. Body 550c includes inlet passage 550b and inlet holes 550h to supply cleaning foam, cleaning water, or the like generated by foam generation unit 560 shown in FIG. 6 to rotation nozzle 550d. Further, body 550c rotatably holds rotation nozzle 550d internally shaft-sealed with O-ring 550e and O-ring 550f. Rotation nozzle 550d is fitted to spray nozzle drive unit 550a via shaft 550n of a rotary drive body and driven and rotated.

**[0175]** Spray nozzle 550 according to this exemplary

embodiment is configured as described above, and operates as described below.

**[0176]** Firstly, cleaning water or cleaning foam generated by foam generation unit 560 shown in FIG. 6 is supplied from inlet passage 550b of body 550c of spray nozzle 550. The supplied cleaning water or cleaning foam is then supplied from a plurality of inlet holes 550h of body 550c, which is open around rotation nozzle 550d, to rotation nozzle 550d. After that, the supplied cleaning water or cleaning foam is discharged from discharge opening 550u of rotation nozzle 550d toward the inner surface of the toilet bowl, buttock cleaning water nozzle 831, and the like.

**[0177]** Spray nozzle 550 is disposed, as shown in FIG. 33, on right of a center of body 200. A reason of this arrangement is to dispose at the center in a prioritized manner buttock cleaning water nozzle 831 and the like for cleaning a private part of a human body. Accordingly, spray nozzle 550 is not disposed at the center, but on either left or right of the center. The above described arrangement may obviously be reversed.

**[0178]** Next, how spray nozzle 550 is controlled to discharge cleaning foam or the like will now be described herein with reference to FIG. 6.

**[0179]** How spray nozzle 550 is controlled to discharge cleaning foam or the like when a user has not seated and a toilet seat is closed will now be described herein.

**[0180]** Firstly, control unit 130 of sanitary washing device 100 detects that, with human body detection sensor 450, a user has entered into a toilet room. Simultaneously, control unit 130 starts water pump 516 configuring the discharge water amount variable unit to operate. Further, control unit 130 opens opening and closing valve 530a of branch passage 530.

**[0181]** In this case, flow regulating valve 517 for switching a passage to buttock cleaning water nozzle 831, bidet cleaning water nozzle 832, nozzle cleaning unit 833, or the like is closed. Accordingly, cleaning water is supplied from heat exchanger 700, via branch passage 530, and check valve 531 and foam tank 532, both configuring foam generation unit 560, to spray nozzle 550. The supplied cleaning water is discharge from discharge opening 550u of spray nozzle 550 toward the inner surface of the toilet bowl, buttock cleaning water nozzle 831, and the like.

**[0182]** At this time, control unit 130 drives spray nozzle drive unit 550a of spray nozzle 550 to drive and rotate discharge opening 550u of rotation nozzle 550d. Accordingly, cleaning water or cleaning foam discharged from discharge opening 550u is sprayed toward a whole circumference of the inner surface of the toilet bowl, buttock cleaning water nozzle 831, and the like to form a water film or a foam film. This prevents adhesion of dirt and the like.

**[0183]** As shown in FIG. 33, a distance from discharge opening 550u of spray nozzle 550 to the inner surface of the toilet bowl differs depending on a rotational angle direction of spray nozzle 550.

**[0184]** That is, when a rotational angle of spray nozzle 550 disposed at the above described position is changed to, as shown in FIG. 33, a rotational angle of discharge opening 550u of spray nozzle 550 of 160°, a distance from discharge opening 550u to the inner surface of the toilet bowl becomes maximum (farthest). On the other hand, at a position where a rotational angle of discharge opening 550u is 340° (turned 180° from the above described angle of 160°), a distance from discharge opening 550u to the inner surface of the toilet bowl becomes minimum (nearest).

**[0185]** Therefore, control unit 130 performs a control so that, as shown in FIG. 34, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, an output of water pump 516 configuring the discharge water amount variable unit and a rotational speed of spray nozzle drive unit 550a are changed.

**[0186]** Hereinafter, a control to change, in accordance with a rotational angle of spray nozzle 550, an output of water pump 516 and a rotational speed of spray nozzle drive unit 550a will now be described.

**[0187]** Firstly, control unit 130 detects that, with human body detection sensor 450, a user has entered into the toilet room. Accordingly, control unit 130 starts the above described control.

**[0188]** Next, while control unit 130 changes, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, an output of water pump 516 configuring the discharge water amount variable unit in a range from "high" to "low," as shown in a lower graph of FIG. 34, cleaning foam is discharged.

**[0189]** Specifically, around a rotational angle of 160° at which a distance to the inner surface of the toilet bowl, as shown in FIG. 33, becomes maximum (farthest), control unit 130 increases an output of water pump 516 to large (high). On the other hand, around a rotational angle of 340° at which a distance to the inner surface of the toilet bowl becomes minimum (nearest), control unit 130 lowers an output of water pump 516 to small (low).

**[0190]** Further, in a rotational angle range from above 0° to below 160°, control unit 130 gradually or continuously changes an output of water pump 516 from "low" to "high." Similarly, in a rotational angle range from above 160° to below 340°, control unit 130 gradually or continuously changes an output of water pump 516 from "high" to "low." Therefore, in accordance with a distance from discharge opening 550u to the inner surface of the toilet bowl, cleaning water or cleaning foam is evenly sprayed in a predetermined height range over the whole circumference of the inner surface of the toilet bowl.

**[0191]** FIG. 34 has exemplified an operation of spray nozzle 550 including a rotation restriction unit described later. Accordingly, changes in an output of water pump 516 in a rotational angle range from 0° to 340° inclusive are illustrated in a graph. However, in a configuration where no rotation restriction unit is provided, an output of water pump 516 may obviously be changed in a rotational angle range from 0° to 360° inclusive, in short, in

a rotational angle range of one rotation.

**[0192]** That is, control unit 130 controls, in accordance with a rotational angle of spray nozzle 550, in other words, a distance between discharge opening 550u and the inner surface of the toilet bowl, a jetting amount (and a jetting speed) of cleaning foam or cleaning water from discharge opening 550u.

**[0193]** More specifically, to discharge cleaning foam or cleaning water toward a front side of the toilet bowl, which lies at a position most distant from discharge opening 550u of spray nozzle 550, water pump 516 is set to an output of "high" to most vigorously discharge the cleaning foam or cleaning water. Accordingly, the cleaning foam or cleaning water can fully reach to the inner surface on the front side of the toilet bowl.

**[0194]** On the other hand, to discharge cleaning foam or cleaning water toward a rear side of the toilet bowl, which lies at a position nearest from discharge opening 550u of spray nozzle 550, water pump 516 is set to an output of "low" to most gently discharge the cleaning foam or cleaning water. Accordingly, unfavorable events such as splashing of cleaning foam or cleaning water can be prevented.

**[0195]** Cleaning water or cleaning foam is then discharged toward the whole inner surface of the toilet bowl beforehand to form a water film or a foam film. Accordingly, dirt can be prevented as much as possible from adhering onto the inner surface of the toilet bowl when used.

**[0196]** As described above, control unit 130 changes, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, an output of water pump 516. Accordingly, toward the inner surface on the front side, sides, and the rear side of the toilet bowl, where distances vary, cleaning water or cleaning foam can fully and securely be discharged. As a result, a water film or a foam film can be formed on the entire inner surface of a front part of the toilet bowl to prevent as much as possible dirt from adhering.

**[0197]** The above exemplary embodiment has described, without limitation, a configuration of setting, based on an average level "medium" of outputs of water pump 516 of "high" and "low." For example, water pump 516 may be configured to raise or lower the average output level of "medium" itself to change a standard level. For example, water pump 516 may be configured to raise or lower the average output level of "medium" itself to change a standard level. In this case, a level changeover switch for adjusting an average level should advantageously be provided to operation unit 210 or remote controller 400. Accordingly, in even larger or smaller toilet bowl 110 for which sanitary washing device 100 is provided, cleaning water or cleaning foam can be discharged toward a whole circumference of an inner surface of the toilet bowl. Further, a height position (from a horizontal surface) on the inner surface of the toilet bowl, at which cleaning foam is to be sprayed, can be changed in a desired manner. As a result, a water film or a foam film

can further securely be formed onto the whole inner surface of the toilet bowl to prevent as much as possible dirt from adhering.

**[0198]** The above exemplary embodiment has described, without limitation, the discharge control performed by control unit 130 to change, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, an output of water pump 516. For example, in addition to a change in output of water pump 516, as shown in an upper graph of FIG. 34, a control may be performed so that a rotational speed of spray nozzle drive unit 550a is changed in accordance with a rotational angle of discharge opening 550u of spray nozzle 550.

**[0199]** As described above, by changing an output of water pump 516, magnitude of how strongly or gently cleaning water or cleaning foam will be discharged is changed. Accordingly, cleaning foam or cleaning water can securely be sprayed toward a distant area on an inner surface of a toilet bowl, while splashing of the cleaning foam or cleaning water at a nearer area on the inner surface of the toilet bowl can securely be suppressed.

**[0200]** At this time, further, in accordance with a rotational angle of discharge opening 550u, a rotational speed of spray nozzle drive unit 550a is changed. Accordingly, cleaning water or cleaning foam can be sprayed at further uniform spray density toward the whole circumference of the inner surface of the toilet bowl.

**[0201]** That is, when discharge opening 550u of spray nozzle 550 is rotated at a constant rotational speed, in an area on the inner surface of the toilet bowl, which is distant from discharge opening 550u of spray nozzle 550, spray density of cleaning foam or cleaning water becomes thinner. On the other hand, in an area on the inner surface of the toilet bowl, which is distant from discharge opening 550u of spray nozzle 550, spray density of cleaning foam or cleaning water becomes thicker.

**[0202]** When spraying cleaning foam or cleaning water by changing an output of water pump 516, the cleaning foam or cleaning water can be sprayed at uniform spray density to a certain extent.

**[0203]** However, when cleaning foam or cleaning water is sprayed by changing a rotational speed of spray nozzle drive unit 550a in accordance with a rotational angle of spray nozzle 550, further uniform spray density can be achieved. In other words, when cleaning water or cleaning foam is discharged from discharge opening 550u of spray nozzle 550 toward the whole circumference of the inner surface of the toilet bowl, further uniform spray density can be achieved.

**[0204]** Normally, when a rotational speed is constant, as shown in FIG. 33, and cleaning water or cleaning foam is sprayed toward an area most distant from discharge opening 550u of spray nozzle 550, at which a rotational angle is around 160°, in other words, the front side of the toilet bowl, the cleaning water or cleaning foam disperses, and spray density becomes thinner. Therefore, as shown in FIG. 34, when cleaning foam or cleaning water is discharged toward the front side of the toilet bowl, a

rotational speed of spray nozzle 550 should be lowered to minimum (lowest speed). Accordingly, discharge opening 550u of spray nozzle 550 quickly passes around the rear side of the toilet bowl so that spray density becomes thinner.

**[0205]** On the other hand, when cleaning foam or cleaning water is discharged toward an area nearest from discharge opening 550u of spray nozzle 550, at which a rotational angle is around 340°, in other words, the rear side of the toilet bowl, the cleaning foam or cleaning water concentrates, and spray density becomes thicker. Therefore, as shown in the upper graph of FIG. 34, a rotational speed of spray nozzle 550 is increased to maximum (highest speed). Accordingly, discharge opening 550u of spray nozzle 550 quickly passes around the rear side of the toilet bowl so that spray density becomes thinner.

**[0206]** As a result, a spray distribution of cleaning water or cleaning foam sprayed onto the inner surface of the toilet bowl can be made uniform (made to have no density unevenness) spray density, regardless of a rotational speed. Accordingly, dirt can be prevented as much as possible from adhering over the whole circumference of the inner surface of the toilet bowl.

**[0207]** As described above, control unit 130 changes, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, a rotational speed of spray nozzle drive unit 550a. For example, at a rotational angle at which discharge opening 550u of spray nozzle 550 faces the front side of the toilet bowl, where a distance to the inner surface of the toilet bowl is longer, a rotational speed of spray nozzle drive unit 550a is lowered to small (lower speed). On the other hand, at a rotational angle at which discharge opening 550u faces the rear side of toilet bowl, where a distance to the inner surface of the toilet bowl is shorter, a rotational speed of spray nozzle drive unit 550a is increased to large (higher speed).

**[0208]** Accordingly, toward the inner surface on the front side, the sides, and the rear side of the toilet bowl, where distances vary, cleaning water or cleaning foam can evenly be discharged with less unevenness in spray density. As a result, with a water film or a foam film evenly formed onto the inner surface of the toilet bowl, dirt can be prevented as much as possible from adhering.

**[0209]** In this exemplary embodiment, upon control unit 130 detects that, with human body detection sensor 450, a user has entered, control unit 130 performs a control so that cleaning water or cleaning foam is sprayed beforehand from spray nozzle 550 toward the inner surface of the toilet bowl. Specifically, control unit 130 controls spray nozzle drive unit 550a so that rotation nozzle 550d rotates twice, and then automatically stops, for example. Accordingly, before the user uses the sanitary washing device, a water film or a foam film is formed onto the inner surface of the toilet bowl. As a result, dirt can be prevented as much as possible from adhering during use onto the inner surface of the toilet bowl.

**[0210]** The above exemplary embodiment has described, without limitation, an operation of rotating, before

a user uses the toilet, spray nozzle 550 twice to spray cleaning foam or cleaning water. For example, the above described exemplary embodiment may be configured to spray cleaning foam or cleaning water at a predetermined rotation speed or only for a predetermined time so that the cleaning foam is fully sprayed toward the inner surface of the toilet bowl, and then to stop spraying of the cleaning foam.

**[0211]** Further, the above exemplary embodiment has described, without limitation, a configuration of rotating, even though a particular rotation direction of spray nozzle 550 has not specified, rotation nozzle 550d twice in a certain direction. For example, as shown in FIG. 34, rotation nozzle 550d of spray nozzle 550 may be configured to reciprocating rotate in a predetermined rotational range.

**[0212]** Normally, in a configuration where rotation nozzle 550d of spray nozzle 550 is rotated either clockwise or counterclockwise for a whole circumference, cleaning water or cleaning foam will always be sprayed in an identical direction.

**[0213]** However, when spraying cleaning foam or cleaning water in a reciprocating rotation manner, cleaning foam or cleaning water can be sprayed toward the inner surface of the toilet bowl in two directions through positive and reverse rotations of a reciprocating operation. Accordingly, a non-sprayed area can be further reduced. Accordingly, cleaning foam or cleaning water can further evenly be sprayed toward the inner surface of the toilet bowl. As a result, with even a less number (time) of spray operations, dirt can be prevented as much as possible from adhering. The above described reciprocating rotation may obviously be performed not only once, but also twice, thrice, or any plurality of times.

**[0214]** Specifically, as shown in the upper graph of FIG. 34, firstly, rotation nozzle 550d of spray nozzle 550 positive-rotates (for example, clockwise) in a rotational angle range from 0°, which corresponds to a direction toward the front side of the toilet bowl, to 340° inclusive, and then rotation nozzle 550d of spray nozzle 550 once stops. After that, rotation nozzle 550d reverse-rotates (for example, counterclockwise) in a rotational angle range from 340° to 0° for a reciprocating rotation, and then rotation nozzle 550d stops.

**[0215]** In this case, a rotation restriction unit that is, for example, a mechanical stopper (not shown in the drawing) is provided for restricting a rotatable range of rotation nozzle 550d of spray nozzle 550 in a rotational angle range from 0° to 340° inclusive.

**[0216]** Specifically, for example, a projection formed at a part of an outer periphery of rotation nozzle 550d, and a rotation restriction wall of body 550c are used to configure the rotation restriction unit (not shown in the drawing). With this configuration, when the projection rotates and physically abuts the rotation restriction wall, a rotating operation of rotation nozzle 550d is restricted. That is, through this abutting, the motor configuring the spray nozzle drive unit 550a slips. Accordingly, rotation

nozzle 550d is configured to rotate within the rotatable range.

**[0217]** As described above, spray nozzle 550 configured as described above is provided with the rotation restriction unit for restricting a rotational range to allow spray nozzle 550 to reciprocating-rotate within a rotatable range that is not restricted by the rotation restriction unit. With this operation, cleaning foam or cleaning water is then sprayed toward the inner surface of the toilet bowl in positive and reverse directions through reciprocating, in other words, two directions through positive and reverse rotations. Accordingly, a non-sprayed area can be reduced. Accordingly, cleaning foam or cleaning water can further evenly be sprayed toward the inner surface of the toilet bowl. As a result, with even a less number (time) of spray operations, dirt can be prevented as much as possible from adhering.

**[0218]** Further, spray nozzle 550 in the above described configuration always allows recognition of a position at which the projection of rotation nozzle 550d driven by the motor configuring spray nozzle drive unit 550a abuts the rotation restriction unit, as an origin of rotation of spray nozzle drive unit 550a. That is, even when rotation nozzle 550d of spray nozzle 550 reciprocating-operates, any position difference in origin does not arise. Accordingly, improved positional accuracy in rotational angle, relative to the inner surface of the toilet bowl, can be achieved. Accordingly, a position difference and the like relative to a predetermined position of the inner surface of the toilet bowl can be highly reduced. As a result, cleaning foam or cleaning water can precisely be sprayed from discharge opening 550u of spray nozzle 550 toward a rotational angle position on the inner surface of the toilet bowl at an appropriate discharge output and an appropriate rotational speed.

**[0219]** A configuration of physically restricting a rotational range of spray nozzle 550 has been described above without limitation. If a position difference in the origin of spray nozzle 550 is not problematic, a positive and reverse rotation operation may simply be performed with spray nozzle drive unit 550a. Accordingly, while no rotation restriction unit is required, operations with, for example, a positive and reverse rotation and a single direction rotation can be used in a diversified manner. As a result, in accordance with how degree the inner surface of the toilet bowl is dirty, a further appropriate operation can be achieved. In this case, it is advantageous that, by setting a rotational angle, at which a rotation direction is switched, to around 160°, a rotational speed is gradually reduced around the angle. Accordingly, a load applied to spray nozzle drive unit 550a at a time of switching a direction can be reduced.

**[0220]** Hereinafter, a configuration of foam generation unit 560 of the sanitary washing device according to this exemplary embodiment will now be described.

**[0221]** Foam generation unit 560 is connected to, as described above with reference to FIG. 6, branch passage 530 branched from cleaning water supply passage

690 at a point between water pump 516 configuring the discharge water amount variable unit and flow regulating valve 517, via opening and closing valve 530a. Through opening and closing of opening and closing valve 530a, cleaning water is then supplied, via branch passage 530, to foam generation unit 560.

**[0222]** Foam generation unit 560 includes check valve 531, foam tank 532, detergent tank 533, detergent pump 534, air pump 535, and the like. Foam tank 532 is connected, via check valve 531, to branch passage 530.

**[0223]** At downstream of foam tank 532, above described spray nozzle 550 is connected. Foam tank 532 is connected, via detergent pump 534, to detergent tank 533 for supplying detergent.

**[0224]** Foam tank 532 is further connected to air pump 535. Air pump 535 supplies air to foam tank 532 to generate cleaning foam or the like. Air pump 535 supplies cleaning water or generated cleaning foam to spray nozzle 550.

**[0225]** Foam generation unit 560 is configured as described above, and operates as described below.

**[0226]** Firstly, control unit 130 opens opening and closing valve 530a. Control unit 130 then drives water pump 516 to supply cleaning water from heat exchanger 700 to foam tank 532 of foam generation unit 560.

**[0227]** At this time, in foam tank 532, detergent supplied by detergent pump 534 from detergent tank 533, and cleaning water supplied from heat exchanger 700 are mixed.

**[0228]** Next, control unit 130 drives air pump 535 to supply air into foam tank 532. Accordingly, in foam tank 532, cleaning foam is generated. The generated cleaning foam is supplied to spray nozzle 550, and discharged from discharge opening 550u of rotation nozzle 550d toward the inner surface of the toilet bowl.

**[0229]** At this time, in accordance with increased or decreased outputs of water pump 516 and air pump 535, a discharge amount and magnitude of discharge (discharge speed and discharge pressure) of cleaning water or cleaning foam to be discharged from spray nozzle 550 are increased or decreased. Accordingly, as described with reference to FIG. 34, cleaning foam or cleaning water can evenly be sprayed toward the inner surface of the toilet bowl. That is, air pump 535 of foam generation unit 560 also functions, similar to water pump 516, as a discharge water amount variable unit.

**[0230]** A configuration of branch passage 530 provided with opening and closing valve 530a has been described above without limitation. For example, a branching portion provided with a passage switch-over valve may be configured between branch passage 530 and cleaning water supply passage 690.

**[0231]** That is, foam generation unit 560 according to this exemplary embodiment includes foam tank 532 lying between opening and closing valve 530a and spray nozzle 550. With detergent supplied from detergent tank 533 to foam tank 532, cleaning foam is generated. In this configuration, the generated cleaning foam is discharged

from discharge opening 550u of spray nozzle 550 toward the inner surface of the toilet bowl.

**[0232]** Accordingly, onto the inner surface of the toilet bowl, instead of a simple water film formed with sprayed water or hot water, cleaning foam containing detergent forms a foam film. As a result, the cleaning foam can further effectively prevent dirt from adhering.

**[0233]** Further, the cleaning foam containing detergent effectively suppresses an odor generated from dirt and the like. Further, the cleaning foam provides a visually clean impression to a user. As a result, the user can feel much more comfortable.

**[0234]** The above exemplary embodiment has described, without limitation, a configuration of spraying cleaning water or cleaning foam toward the inner surface of the toilet bowl when human body detection sensor 450 has detected that a person has entered. For example, the above described exemplary embodiment may be configured to include spray switch 417 on operation unit 210 or remote controller 400 to execute spraying when a person operates the switch. Accordingly, even if the toilet as a sanitary washing device is not used, if dirt on the inner surface of the toilet bowl is not negligible, cleaning foam containing detergent or the like can be sprayed toward the inner surface of the toilet bowl in order to remove the dirt. Further, an unfavorable event where dirt adheres and dries onto an area around a water level surface or the like can be prevented as much as possible from occurring. That is, whenever a user operates spray switch 417, a foam film can be formed with cleaning foam containing detergent onto the inner surface of the toilet bowl. As a result, the inner surface of the toilet bowl can be kept clean.

**[0235]** Further, the above described exemplary embodiment may be configured so that a user is able to select as desired with a spray selection switch (not shown in the drawing) on operation unit 210 or remote controller 400 whether either cleaning water or cleaning foam will be sprayed toward the inner surface of the toilet bowl. Accordingly, cleaning water or cleaning foam can be selected in accordance with how the inner surface of the toilet bowl is dirty and how an odor smells. As a result, detergent can be saved to provide improved cost performance.

**[0236]** Further, the above described exemplary embodiment may be configured so that, to spray cleaning foam toward the inner surface of the toilet bowl, control unit 130 changes, in accordance with a rotational angle of discharge opening 550u of spray nozzle 550, similar to an output of water pump 516 described with reference to FIG. 34, an output of air pump 535. That is, air pump 535 may be used as a discharge water amount variable unit. Accordingly, toward the inner surface on the front side, the sides, and the rear side of the toilet bowl, where distances vary, cleaning foam or cleaning water can effectively and fully be discharged. As a result, a foam film or a water film can fully be formed onto the inner surface on the front side of the toilet bowl in order to prevent as

much as possible dirt from adhering.

**[0237]** Specifically, as described in FIG. 34, at around a rotational angle of 160° at which a distance from discharge opening 550u of spray nozzle 550 to the inner surface of the toilet bowl becomes maximum (farthest), control unit 130 increases an output (air pressure) of air pump 535 to large (high). Accordingly, with increased pressure of air supplied from air pump 535, cleaning foam or cleaning water can be vigorously sprayed farther from discharge opening 550u of spray nozzle 550.

**[0238]** On the other hand, at around a rotational angle of 340° at which a distance from discharge opening 550u to the inner surface of the toilet bowl becomes minimum (nearest), control unit 130 lowers an output (air pressure) of air pump 535 to small (low). Accordingly, with lowered pressure of air supplied from air pump 535, cleaning foam or cleaning water can be gently sprayed. That is, in accordance with a distance from discharge opening 550u of spray nozzle 550 to the inner surface of the toilet bowl, pressure of air to be discharged from air pump 535 is adjusted. As a result, cleaning foam or cleaning water can fully and evenly be discharged toward the inner surface of the toilet bowl.

**[0239]** The above described exemplary embodiment may be configured to further include a dirt detection unit (not shown in the drawing) for detecting, with an image element such as a charge coupled device (CCD), how the toilet bowl is dirty. At this time, control unit 130 follows a result of detection by the dirt detection unit to reciprocally and intensively spray cleaning foam or cleaning water to a still dirty portion. Accordingly, dirt can effectively be prevented as much as possible from adhering, as well as adhered dirt can effectively be removed. In addition to the method in which cleaning foam or cleaning water is reciprocally sprayed to only a dirty portion, discharge opening 550u of spray nozzle 550 may be driven and rotated at a lower rotational speed when discharge opening 550u of spray nozzle 550 passes a still dirty portion. Further, the above described exemplary embodiment may be configured to cause water pump 516 and air pump 535 to further increase respective outputs when discharge opening 550u of spray nozzle 550 passes a dirty portion. Accordingly, a similar or identical effect can be achieved.

<8> Discharge control and manner of operation of spray nozzle with respect to cleaning water nozzle

**[0240]** Control and the manner of operation of the spray nozzle with respect to the cleaning water nozzle of the sanitary washing device according to this exemplary embodiment will be described with reference to FIGS. 35 to 37. Note that the cleaning water nozzle corresponds to, for example, buttock cleaning water nozzle 831 as described above. Accordingly, buttock cleaning water nozzle 831 will be exemplified as a cleaning water nozzle. It is, however, obvious that the following description also applies to a bidet cleaning nozzle.

**[0241]** FIGS. 35 to 37 show three different cleaning methods when the spray nozzle discharges cleaning foam or the like to clean the buttock cleaning water nozzle. That is, each method for cleaning the inner surface of the toilet bowl by the spray nozzle to be described in this item differs from that described in previous item <7>.

**[0242]** Note that as shown in FIGS. 35 to 37, spray nozzle 550 for discharging cleaning foam or cleaning water to the surface of buttock cleaning water nozzle 831 is identical to spray nozzle 550 for discharging cleaning foam to the inner surface of the toilet bowl described in previous item <7>. In addition, foam generation unit 560 for generating cleaning foam or the like is identical to the one described in item <7>.

**[0243]** The first cleaning method for cleaning buttock cleaning water nozzle 831 by discharging cleaning foam from spray nozzle 550 will be described first with reference to FIG. 35.

**[0244]** As shown in FIG. 35, in the first cleaning method for buttock cleaning water nozzle 831, first of all, the user manually operates operation unit 210 or spray switch 417 of remote controller 400.

**[0245]** The above operation makes control unit 130 of sanitary washing device 100 drive cleaning water nozzle drive unit 860 to move nozzle portion 820 forward and backward, as shown in FIG. 16. This causes buttock cleaning water jetting port 834 and nozzle cover 840 of buttock cleaning water nozzle 831 to move forward to, for example, the cleaning position, as shown in FIG. 23.

**[0246]** At the same time, control unit 130 drives spray nozzle drive unit 550a of spray nozzle 550. This rotates discharge opening 550u of rotation nozzle 550d of spray nozzle 550 in a predetermined direction, for example, a direction to face buttock cleaning water nozzle 831 that has moved forward.

**[0247]** Control unit 130 then starts to operate water pump 516 as the discharge water amount variable unit. In addition, control unit 130 opens opening and closing valve 530a provided in branch passage 530. At this time, flow regulating valve 517 is closed, which switches between the passages to buttock cleaning water nozzle 831, bidet cleaning water nozzle 832, nozzle cleaning unit 833, and the like. Accordingly, cleaning water from heat exchanger 700 is supplied to foam tank 532 via branch passage 530 and check valve 531. The supplied cleaning water is mixed with detergent supplied from detergent tank 533 by detergent pump 534. This generates cleaning foam in foam tank 532. Air pump 535 is driven to supply the generated cleaning foam to spray nozzle 550. The supplied cleaning foam is then discharged from discharge opening 550u formed in rotation nozzle 550d of spray nozzle 550 toward nozzle cover 840 covering buttock cleaning water nozzle 831 and the like.

**[0248]** At this time, as described above, control unit 130 drives spray nozzle drive unit 550a to rotate discharge opening 550u of rotation nozzle 550d of spray nozzle 550 to face buttock cleaning water nozzle 831. Control unit 130 then stops rotating discharge opening

550u of spray nozzle 550 at a position to face buttock cleaning water nozzle 831. In this state, control unit 130 discharges cleaning foam from spray nozzle 550 to buttock cleaning water nozzle 831 while causing cleaning water nozzle drive unit 860 to reciprocate buttock cleaning water nozzle 831.

**[0249]** As described above, in the first cleaning method, control unit 130 causes spray nozzle drive unit 550a to rotate rotation nozzle 550d of spray nozzle 550. Control unit 130 stops rotating discharge opening 550u of rotation nozzle 550d at a position to face buttock cleaning water nozzle 831. In this state, control unit 130 causes cleaning water nozzle drive unit 860 to move buttock cleaning water nozzle 831 forward and backward. With this configuration, cleaning foam is discharged from spray nozzle 550 over a wide range on the surface of buttock cleaning water nozzle 831. This makes it possible to maintain buttock cleaning water nozzle 831 in a clean state and prevent adhesion of dirt.

**[0250]** The second cleaning method for cleaning buttock cleaning water nozzle 831 by discharging cleaning foam from spray nozzle 550 will be described next with reference to FIG. 36.

**[0251]** Note that the second cleaning method is basically the same as the first cleaning method, and hence different operations of spray nozzle 550 and buttock cleaning water nozzle 831 will be described.

**[0252]** As shown in FIG. 36, in the second cleaning method for the buttock cleaning water nozzle, first of all, as in the first cleaning method, control unit 130 drives spray nozzle drive unit 550a. This drives and rotates discharge opening 550u of rotation nozzle 550d of spray nozzle 550 in a predetermined direction, for example, a direction to face buttock cleaning water nozzle 831. Control unit 130 then stops rotating discharge opening 550u of spray nozzle 550 at a position to face buttock cleaning water nozzle 831.

**[0253]** Control unit 130 then causes cleaning water nozzle drive unit 860 to advance buttock cleaning water nozzle 831 to near the human body cleaning position, and then stops buttock cleaning water nozzle 831.

**[0254]** While stopping buttock cleaning water nozzle 831, control unit 130 discharges cleaning foam from discharge opening 550u of spray nozzle 550 toward buttock cleaning water nozzle 831. At this time, control unit 130 causes spray nozzle drive unit 550a to rotate and drives spray nozzle 550 forward and backward while discharging cleaning foam.

**[0255]** As described above, in the second cleaning method, spray nozzle 550 is reciprocally rotated via spray nozzle drive unit 550a while buttock cleaning water nozzle 831 faces discharge opening 550u of spray nozzle 550. With this configuration, cleaning foam is sprayed from spray nozzle 550 over a wide range on the surface of buttock cleaning water nozzle 831. This makes it possible to maintain buttock cleaning water nozzle 831 in a clean state and prevent adhesion of dirt.

**[0256]** The third cleaning method for cleaning buttock

cleaning water nozzle 831 by discharging cleaning foam from spray nozzle 550 will be further described with reference to FIG. 37.

**[0257]** Note that the third cleaning method is basically the same as the first cleaning method and the second cleaning method, and hence different operations of spray nozzle 550 and buttock cleaning water nozzle 831 will be described.

**[0258]** As shown in FIG. 37, the third cleaning method for the buttock cleaning water nozzle corresponds to a method for performing cleaning by combining operations of spray nozzle 550 and buttock cleaning water nozzle 831 in the first cleaning method and those in the second cleaning method.

**[0259]** That is, as shown in FIG. 37, spray nozzle drive unit 550a is driven to rotate discharge opening 550u of rotation nozzle 550d of spray nozzle 550 in a predetermined direction, for example, a direction to face buttock cleaning water nozzle 831. Control unit 130 then stops rotating discharge opening 550u of spray nozzle 550 at a position to face buttock cleaning water nozzle 831.

**[0260]** Control unit 130 then causes cleaning water nozzle drive unit 860 to advance buttock cleaning water nozzle 831 to near the human body cleaning position, and then stops buttock cleaning water nozzle 831.

**[0261]** While buttock cleaning water nozzle 831 faces discharge opening 550u of spray nozzle 550, control unit 130 rotates discharge opening 550u of spray nozzle 550 forward and backward via spray nozzle drive unit 550a. At the same time, in the above state, control unit 130 drives buttock cleaning water nozzle 831 forward and backward via cleaning water nozzle drive unit 860. With this configuration, cleaning foam is discharged from spray nozzle 550 over a wide range on the surface of buttock cleaning water nozzle 831. This makes it possible to maintain buttock cleaning water nozzle 831 in a clean state and prevent adhesion of dirt.

**[0262]** Note that in the third cleaning method, buttock cleaning water nozzle 831 and spray nozzle 550 are preferably driven in the following manner.

**[0263]** That is, first of all, when causing cleaning water nozzle drive unit 860 to move buttock cleaning water nozzle 831 forward (in a forward direction), control unit 130 causes spray nozzle 550 to discharge cleaning foam while moving discharge opening 550u of spray nozzle 550 from a distal end side of buttock cleaning water nozzle 831 toward a proximal end (storage) side. In contrast, when causing cleaning water nozzle drive unit 860 to move buttock cleaning water nozzle 831 backward (in a backward direction), control unit 130 causes spray nozzle 550 to discharge cleaning foam while moving discharge opening 550u of spray nozzle 550 from the proximal end side of buttock cleaning water nozzle 831 toward the distal end side. That is, control unit 130 reciprocates buttock cleaning water nozzle 831 and spray nozzle 550 in opposite moving directions. This sprays cleaning foam over a wider range on the surface of buttock cleaning water nozzle 831. This makes it possible to maintain buttock

cleaning water nozzle 831 in a clean state and prevent adhesion of dirt.

**[0264]** In addition, after buttock cleaning water nozzle 831 is cleaned by the first to third cleaning methods, buttock cleaning water nozzle 831 and spray nozzle 550 operate in the following manner.

**[0265]** As described above, the user manually operates operation unit 210 or spray switch 417 of remote controller 400 to start to clean buttock cleaning water nozzle 831 with cleaning foam. With this operation, control unit 130 sprays cleaning foam to the surface of buttock cleaning water nozzle 831 for a predetermined time (for example, 10 sec). After the predetermined time elapses, control unit 130 automatically stops discharging cleaning foam from discharge opening 550u of spray nozzle 550.

**[0266]** Subsequently, control unit 130 causes cleaning water nozzle drive unit 860 to retract buttock cleaning water nozzle 831 to the storage position shown in FIG. 16.

**[0267]** Control unit 130 then sprays cleaning water from nozzle cleaning unit 833 to the entire surface of buttock cleaning water nozzle 831. With this operation, control unit 130 executes so-called "rinsing", that is, rinsing away residual cleaning foam and the like left on buttock cleaning water nozzle 831. Control unit 130 then terminates the cleaning operation for buttock cleaning water nozzle 831 via spray nozzle 550.

**[0268]** Although the above description has exemplified the case in which "rinsing" is executed via nozzle cleaning unit 833, this is not exhaustive. For example, "rinsing" by spray nozzle 550 may be performed by replacing cleaning foam discharged from spray nozzle 550 with cleaning water in the process of cleaning buttock cleaning water nozzle 831. More specifically, first of all, control unit 130 stops driving detergent pump 534 of foam generation unit 560 in the process of cleaning buttock cleaning water nozzle 831 to stop supplying detergent to foam tank 532. Control unit 130 then causes air pump 535 to supply cleaning water, supplied from branch passage 530 to foam tank 532, from foam tank 532 to spray nozzle 550. With this operation, control unit 130 performs "rinsing" for buttock cleaning water nozzle 831 with cleaning water.

**[0269]** That is, the first to third cleaning methods are configured to spray cleaning foam from discharge opening 550u of spray nozzle 550 to the surface of buttock cleaning water nozzle 831 used to clean a human body. After spraying cleaning foam, control unit 130 stores buttock cleaning water nozzle 831 in body 200. Control unit 130 then executes "rinsing", that is, rinsing away cleaning foam from stored buttock cleaning water nozzle 831 with cleaning water. This configuration makes it possible to clean buttock cleaning water nozzle 831 without worrying about splashing cleaning water, used to clean buttock cleaning water nozzle 831, outside the toilet bowl. This is because, cleaning foam is a kind of foam, and hence there is no need to worry about splashing of cleaning foam upon bouncing back when it is sprayed to the sur-

face of buttock cleaning water nozzle 831. On the other hand, "rinsing" is executed at a position where buttock cleaning water nozzle 831 is stored in body 200. This can more reliably prevent cleaning water, which may be splashed upon being bounced back, from being splashed outside the toilet bowl.

**[0270]** In addition, the above embodiment has exemplified the configuration in which the user manually operates operation unit 210 or the manual switch of remote controller 400 to execute cleaning of buttock cleaning water nozzle 831 with cleaning foam. However, this is not exhaustive. For example, cleaning of buttock cleaning water nozzle 831 with cleaning foam may be executed by operating an automatic cleaning setting switch (not shown) of buttock cleaning water nozzle 831. More specifically, first of all, the user seats on toilet seat 300, and then defecates. Thereafter, buttock cleaning is executed via buttock cleaning water nozzle 831. When the user moves away from the toilet seat, seating sensor 330 detects an unseated state. When the seating sensor detects that the user has moved away from the toilet seat, control unit 130 automatically cleans buttock cleaning water nozzle 831 with cleaning foam in accordance with the set automatic cleaning setting switch.

**[0271]** With this operation, when the user moves away from the toilet seat after he/she defecates and his/her buttock is cleaned, by which buttock cleaning water nozzle 831 is most easily contaminated, buttock cleaning water nozzle 831 is automatically cleaned with cleaning foam. This can provide a clean, user-friendly sanitary washing device.

**[0272]** The above embodiment has not specifically referred to a flow rate of cleaning water or cleaning foam to be discharged from spray nozzle 550 to buttock cleaning water nozzle 831. In this case, the flow rate of cleaning water or cleaning foam to be discharged from spray nozzle 550 to buttock cleaning water nozzle 831 is preferably lower than that to be discharged to the inner surface of the toilet bowl. The following are the reasons for this.

**[0273]** That is, a distance from spray nozzle 550, from which cleaning water or cleaning foam is sprayed, to buttock cleaning water nozzle 831 is smaller (shorter) than a distance from spray nozzle 550 to the inner surface of the toilet bowl. In addition, a surface area of buttock cleaning water nozzle 831 to which cleaning foam or cleaning water needs to be sprayed is smaller than that of the inner surface of the toilet bowl to which cleaning foam or cleaning water needs to be sprayed. For these reasons, adhesion of dirt can be sufficiently prevented even if the flow rate of cleaning water or cleaning foam from spray nozzle 550 to buttock cleaning water nozzle 831 is set to be lower than the flow rate of cleaning water or cleaning foam discharged to the inner surface of the toilet bowl. This makes it possible to reduce unnecessary consumption of cleaning water or cleaning foam and sufficiently prevent adhesion of dirt to buttock cleaning water nozzle 831.

**[0274]** As has been described above, the sanitary

washing device according to the present invention includes the heat exchanger for heating cleaning water, the cleaning water nozzle for cleaning a human body, the cleaning water nozzle drive unit for driving the cleaning water nozzle, the foam generation unit for generating cleaning foam, and the spray nozzle for discharging cleaning water or cleaning foam into the toilet bowl. The device further includes a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to the cleaning water nozzle and the spray nozzle, a spray nozzle drive unit for driving and rotating a discharge opening of the spray nozzle in a predetermined direction, an opening and closing valve for opening and closing a branch passage to the spray nozzle, a control unit, and an operation unit for setting an instruction for the control unit. The control unit may be configured to perform control to discharge cleaning foam from the spray nozzle to the surface of the cleaning water nozzle.

**[0275]** According to this configuration, the discharge opening of the spray nozzle, which is rotated by the spray nozzle drive unit, is directed to face the cleaning water nozzle. Cleaning foam generated by the foam generation unit is then discharged from the spray nozzle to the surface of the cleaning water nozzle. With this operation, discharged cleaning foam prevents adhesion of dirt to the cleaning water nozzle.

**[0276]** Further, the foam generation unit of the sanitary washing device according to the present invention includes the foam tank to which cleaning water is supplied from the heat exchanger by the discharge water amount variable unit, the detergent pump for supplying detergent in a detergent tank to the foam tank, and the air pump for supplying air to the foam tank. The foam generation unit may be configured to discharge cleaning water or cleaning foam in the foam tank from the spray nozzle.

**[0277]** According to this configuration, cleaning water or cleaning foam containing detergent generated by the foam generation unit is discharged from the spray nozzle toward the surface of the cleaning water nozzle and the inner surface of the toilet bowl. Accordingly, a further improved cleaning effect and a further improved dirt-adhesion suppression effect can be achieved. Further, with cleaning foam containing detergent, diffusion of an unpleasant odor can be prevented. In addition, a visually clean impression can be improved and provided to the user.

**[0278]** Moreover, the control unit of the sanitary washing device according to the present invention may be configured to cause the cleaning water nozzle drive unit to reciprocate the cleaning water nozzle, when performing nozzle cleaning by discharging cleaning water or cleaning foam from the spray nozzle to the surface of the cleaning water nozzle, while stopping the spray nozzle drive unit at a position where the discharge opening of the spray nozzle is directed to face the cleaning water nozzle.

**[0279]** According to this configuration, the control unit

stops the spray nozzle drive unit at a position where the discharge opening of the spray nozzle is directed to face the cleaning water nozzle. The control unit then discharges cleaning foam from the discharge opening of the spray nozzle to the cleaning water nozzle while causing the cleaning water nozzle drive unit to reciprocate the cleaning water nozzle. This can discharge cleaning foam over a wide range on the cleaning water nozzle. As a result, it is possible to prevent adhesion of dirt while maintaining the cleaning water nozzle in a clean state.

**[0280]** In addition, the control unit of the sanitary washing device according to the present invention may be configured to cause the spray nozzle drive unit to reciprocate the spray nozzle near a position where the discharge opening of the spray nozzle is directed to face the cleaning water nozzle and also cause the cleaning water nozzle drive unit to reciprocate the cleaning water nozzle when performing nozzle cleaning by discharging cleaning water or cleaning foam from the spray nozzle to the surface of the cleaning water nozzle.

**[0281]** According to this configuration, the control unit causes the spray nozzle drive unit to reciprocate the spray nozzle near a position where the discharge opening of the spray nozzle is directed to face the cleaning water nozzle. At this time, the control unit causes the cleaning water nozzle drive unit to reciprocate the cleaning water nozzle. The control unit then discharges cleaning foam from the discharge opening of the spray nozzle to the cleaning water nozzle while reciprocating the spray nozzle and the cleaning water nozzle relative to each other. This can discharge cleaning foam over a wider range on the cleaning water nozzle. As a result, it is possible to prevent adhesion of dirt while maintaining the cleaning water nozzle clean over a wide range.

**[0282]** The control unit of the sanitary washing device according to the present invention may be configured to cause the spray nozzle drive unit to reciprocally rotate the spray nozzle, when performing nozzle cleaning by discharging cleaning water or cleaning foam from the spray nozzle to the surface of the cleaning water nozzle, while stopping the cleaning water nozzle at a position where the cleaning water nozzle has advanced to near the human body cleaning position.

**[0283]** According to this arrangement, the control unit stops the cleaning water nozzle at a position where the cleaning water nozzle has advanced to near the human body cleaning position. While stopping the cleaning water nozzle, the control unit causes the spray nozzle drive unit to reciprocally rotate the spray nozzle. The control unit then discharges cleaning foam from the discharge opening of the spray nozzle to the cleaning water nozzle. This can discharge cleaning foam over a wider range on the cleaning water nozzle. As a result, it is possible to prevent adhesion of dirt while maintaining the cleaning water nozzle clean.

**[0284]** Further, the control unit of the sanitary washing device according to the present invention may be configured to set a flow rate of cleaning water or cleaning

foam discharged from the spray nozzle toward the surface of the cleaning water nozzle lower than a flow rate of cleaning water or cleaning foam discharged from the spray nozzle to the inner surface of the toilet bowl.

**[0285]** According to this arrangement, the flow rate of cleaning water or cleaning foam discharged from the spray nozzle to the surface of the cleaning water nozzle is smaller than that discharged from the spray nozzle to the inner surface of the toilet bowl. This can reduce unnecessary consumption of cleaning water or cleaning foam. As a result, it is possible to provide a sanitary washing device that effectively prevents adhesion of dirt to a cleaning water nozzle.

#### INDUSTRIAL APPLICABILITY

**[0286]** The present invention can prevent adhesion of dirt to the cleaning water nozzle by discharging cleaning foam generated by the foam generation unit from the spray nozzle to the cleaning water nozzle, and hence can be applied to not only a sanitary washing device but also, for example, other types of water application devices equipped with such a spray nozzle.

#### REFERENCE MARKS IN THE DRAWINGS

##### **[0287]**

100: sanitary washing device  
 110: toilet bowl  
 120: deodorizing device  
 130: control unit  
 200: body  
 201: rear body case  
 210: operation unit  
 211: infrared-ray receiver  
 220: operation switch  
 221: buttock cleaning switch  
 222: nozzle cleaning switch  
 230: setting switch  
 231: hot water temperature switch  
 232: toilet seat temperature switch  
 233: 8-hour warming stop switch  
 234: power saving switch  
 235: toilet lid automatically opening/closing switch  
 240: display lamp  
 300: toilet seat  
 320: toilet lid  
 330: seating sensor  
 360: toilet seat and toilet lid rotating mechanism  
 400: remote controller  
 401: remote controller body  
 402: transmitting part  
 410: buttock cleaning switch  
 411: bidet cleaning switch  
 412: stop switch  
 413: move cleaning switch  
 414: rhythm cleaning switch

415: cleaning strength switch  
 416: cleaning position switch  
 417: spray switch  
 418: toilet lid switch  
 419: toilet seat switch  
 421: display lamp  
 422: position display lamp  
 450: human body detection sensor  
 500: cleaning unit  
 501: chassis  
 501a: water pump mounting portion  
 501b: leg portion  
 502: connecting tube  
 510: water supply connecting port  
 511: strainer  
 531: check valve  
 513: constant flow regulating valve  
 514: water stop electromagnetic valve  
 515: relief valve  
 516: water pump (discharge water amount variable unit)  
 516a: motor  
 516b: link mechanism part  
 516c: piston  
 516d: water suction port  
 516e: discharge port  
 517: flow regulating valve  
 517a: valve body  
 517b: stepping motor  
 517c: water supply port  
 530: branch passage  
 530a: opening/closing valve  
 531: check valve  
 532: foam tank  
 533: detergent tank  
 534: detergent pump  
 535: air pump (discharge water amount variable unit)  
 550: spray nozzle  
 550a: spray nozzle drive unit  
 550b: inlet passage  
 550c: body  
 550d: rotation nozzle  
 550f: O-ring  
 550f: O-ring  
 550h: inlet hole  
 550n: shaft  
 550u: discharge port  
 560: foam generation unit  
 600: sub tank  
 601: water inflow port  
 602: water outflow port  
 603: atmosphere open port  
 610: tank body  
 611: front tank  
 612: rear tank  
 613: atmosphere open portion  
 613a: buffer portion  
 613b: passage

614: partition wall  
 615: water inflow tank  
 615a: upper surface opening portion  
 616: storage tank  
 617: barrier wall  
 618: flow straightening rib  
 620: water level detection sensor  
 621: common electrode  
 622: water level electrode  
 623: upper limit electrode  
 624: lower limit electrode  
 630: inflow water temperature sensor  
 690: cleaning water supply passage  
 700: heat exchanger  
 701: casing  
 702: flat-plate-like heater  
 703: hot water outflow member  
 710: front surface member  
 711: water inflow port  
 712: hot water outflow port  
 713: water inflow passage  
 714: slit  
 715: heating passage  
 716: partition rib  
 717: water through hole  
 718: protrusion  
 720: back surface member  
 730: outflow hot water temperature sensor  
 731: excessively elevated temperature sensor  
 750: buffer tank  
 800: nozzle device  
 801: nozzle lid  
 802: connecting tube  
 810: support part  
 811: bottom side portion  
 812: inclined portion  
 813: vertical side portion  
 814: guide rail  
 815: rack guide  
 816: holding portion  
 817: water supply joint  
 820: nozzle portion  
 830: nozzle body  
 831: buttock cleaning water nozzle (cleaning water nozzle)  
 832: bidet cleaning water nozzle  
 833: nozzle cleaning unit  
 834: buttock cleaning water jetting port  
 835: buttock cleaning water passage  
 835a: straightening plate  
 836: bidet cleaning water jetting port  
 837: bidet cleaning water passage  
 838: nozzle cleaning water jetting port  
 839: nozzle cleaning water passage  
 840: nozzle cover  
 841: nozzle cover body  
 842: connecting member  
 843: connecting piece

843a: connecting piece  
 844: jetting opening  
 845: drain port  
 850: coupler  
 851: connection receiving portion  
 851a: front recessed portion  
 851b: rear recessed portion  
 860: cleaning water nozzle drive unit  
 861: flexible rack  
 862: pinion gear  
 863: drive motor

## Claims

1. A sanitary washing device comprising:

a heat exchanger configured to heat cleaning water;  
 a cleaning water nozzle configured to clean a human body;  
 a cleaning water nozzle drive unit configured to drive the cleaning water nozzle;  
 a foam generation unit configured to generate cleaning foam;  
 a spray nozzle configured to discharge the cleaning water or the cleaning foam into a toilet bowl;  
 a discharge water amount variable unit configured to variably change a flow rate of the cleaning water or the cleaning foam to be delivered to the cleaning water nozzle and the spray nozzle;  
 a spray nozzle drive unit configured to rotate a discharge opening of the spray nozzle in a predetermined direction;  
 an opening and closing valve configured to open and close a branch passage to the spray nozzle;  
 a control unit; and  
 an operation unit configured to issue an instruction to the control unit,  
 wherein the control unit performs control to discharge the cleaning foam from the spray nozzle to a surface of the cleaning water nozzle.

2. The sanitary washing device according to claim 1, wherein the foam generation unit comprises a foam tank to which the cleaning water is delivered from the heat exchanger by the discharge water amount variable unit, a detergent pump configured to supply detergent in a detergent tank to the foam tank, and an air pump configured to supply air to the foam tank, and discharges the cleaning water or the cleaning foam in the foam tank from the spray nozzle.

3. The sanitary washing device according to any one of claims 1 and 2, wherein the control unit causes the cleaning water nozzle drive unit to reciprocate

the cleaning water nozzle, during performing nozzle  
 cleaning by discharging the cleaning water or the  
 cleaning foam from the spray nozzle to the surface  
 of the cleaning water nozzle, in a state where the  
 spray nozzle drive unit is stopped at a position where  
 the discharge opening of the spray nozzle is directed  
 to face the cleaning water nozzle. 5

4. The sanitary washing device according to any one  
 of claims 1 and 2, wherein the control unit causes  
 the cleaning water nozzle drive unit to reciprocate  
 the cleaning water nozzle, during performing nozzle  
 cleaning by discharging the cleaning water or the  
 cleaning foam from the spray nozzle to the surface  
 of the cleaning water nozzle, in a state where the  
 spray nozzle drive unit is reciprocally rotated near a  
 position where the discharge opening of the spray  
 nozzle is directed to face the cleaning water nozzle. 10  
 15

5. The sanitary washing device according to any one  
 of claims 1 and 2, wherein the control unit causes  
 the spray nozzle drive unit to reciprocally rotate the  
 cleaning water nozzle, during performing nozzle  
 cleaning by discharging the cleaning water or the  
 cleaning foam from the spray nozzle to the surface  
 of the cleaning water nozzle, in a state where the  
 cleaning water nozzle is stopped at a position where  
 the cleaning water nozzle has advanced to near a  
 human body cleaning position. 20  
 25

6. The sanitary washing device according to claim 1,  
 wherein the control unit performs control such that  
 a discharge amount of the cleaning water or the  
 cleaning foam discharged from the spray nozzle to  
 the surface of the cleaning water nozzle becomes  
 smaller than the flow rate of the cleaning water or  
 the cleaning foam discharged from the spray nozzle  
 to an inner surface of the toilet bowl. 30  
 35

40

45

50

55

FIG. 1

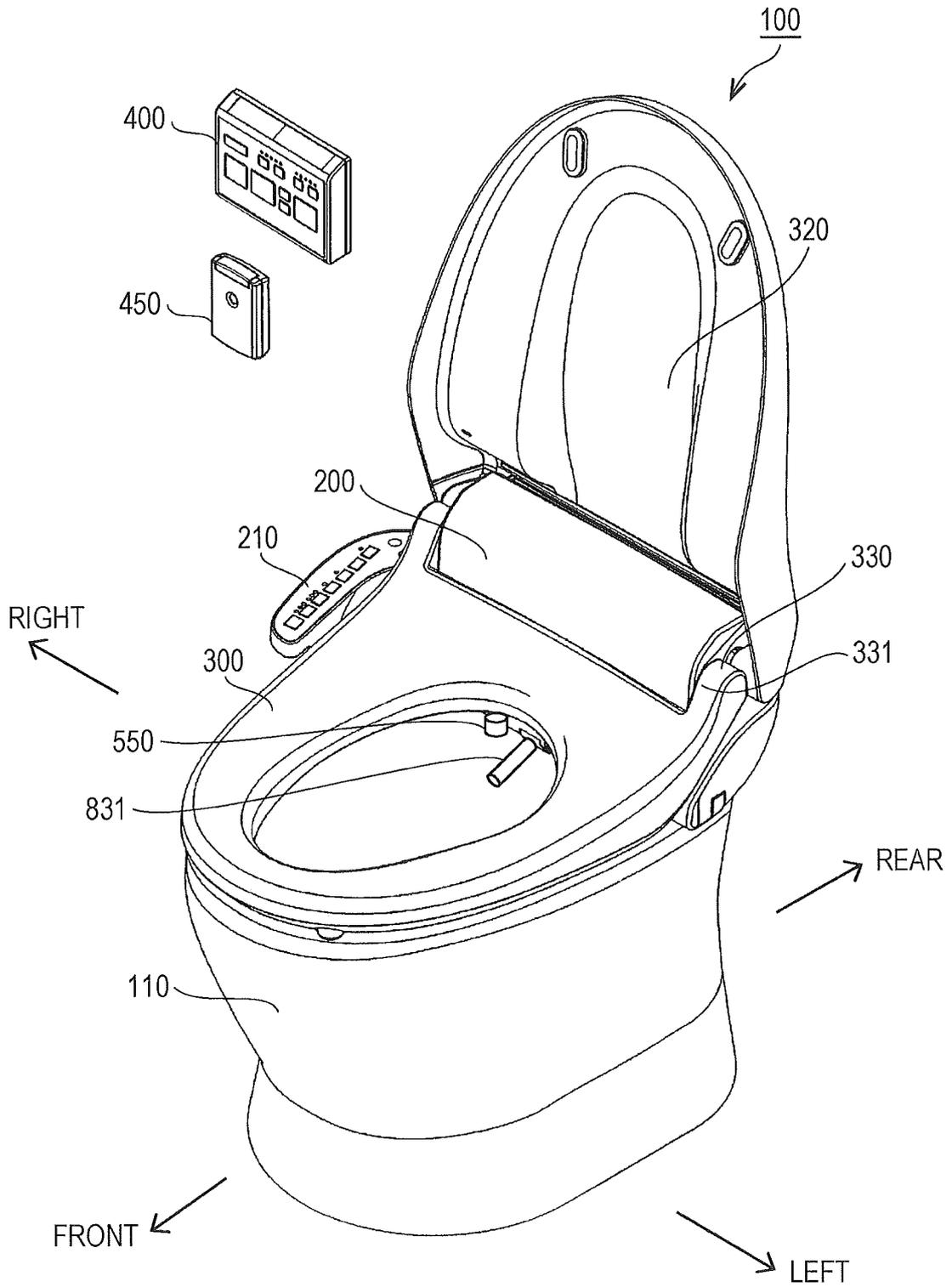


FIG. 2

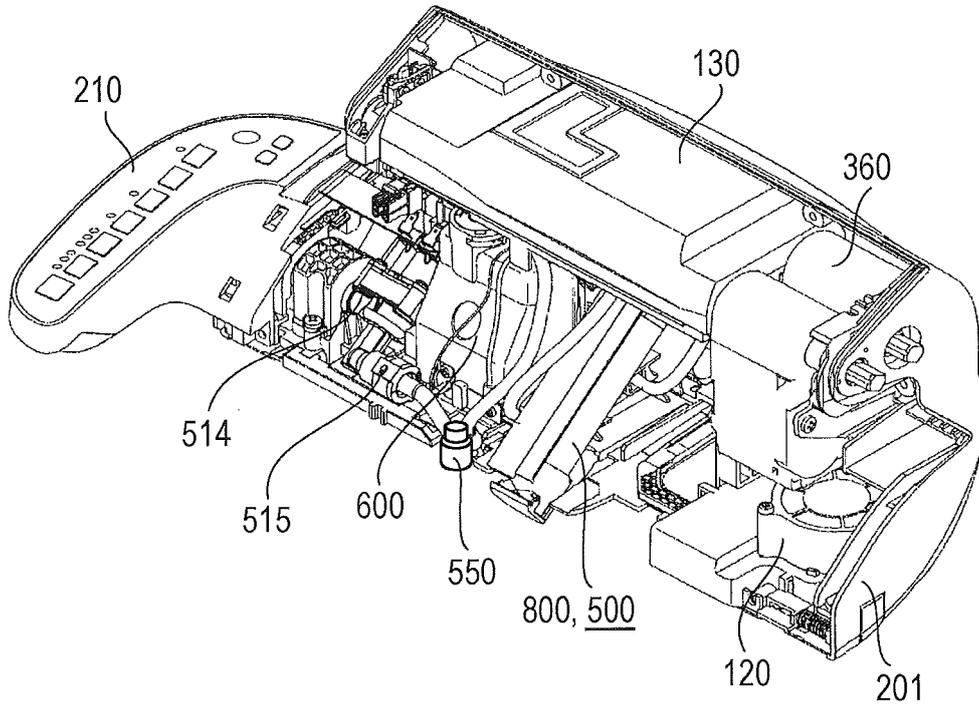


FIG. 3

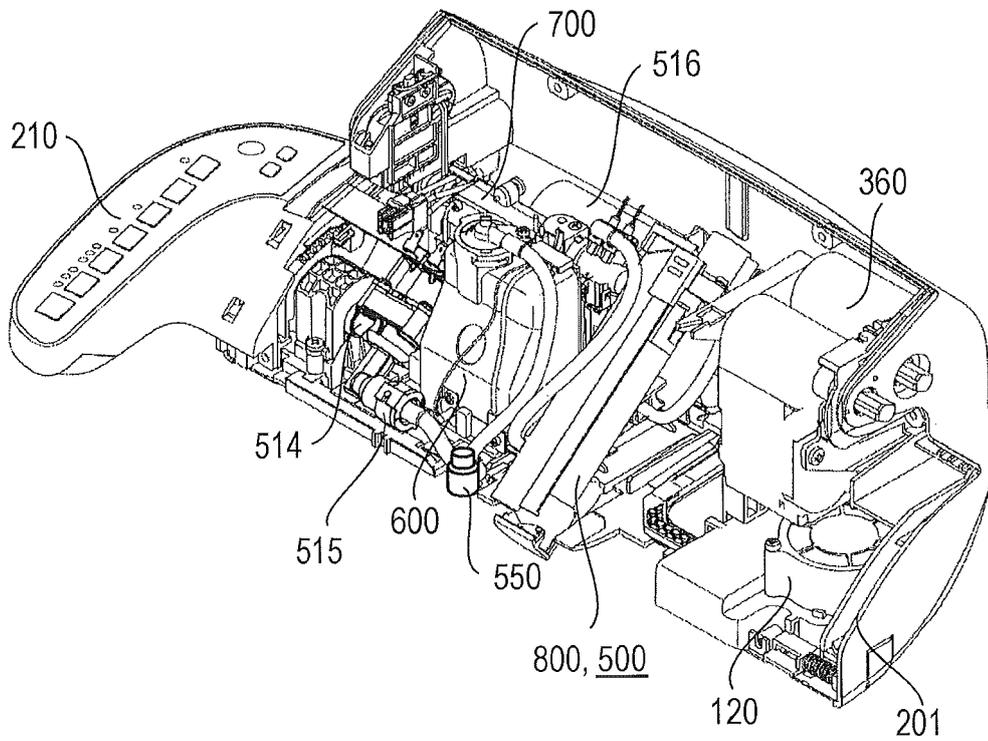


FIG. 4

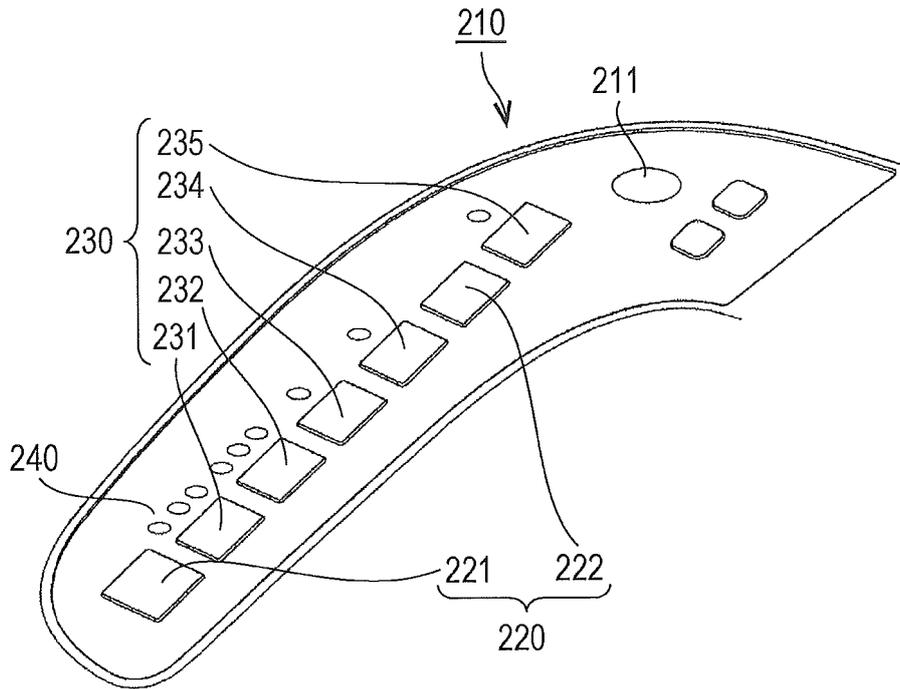


FIG. 5

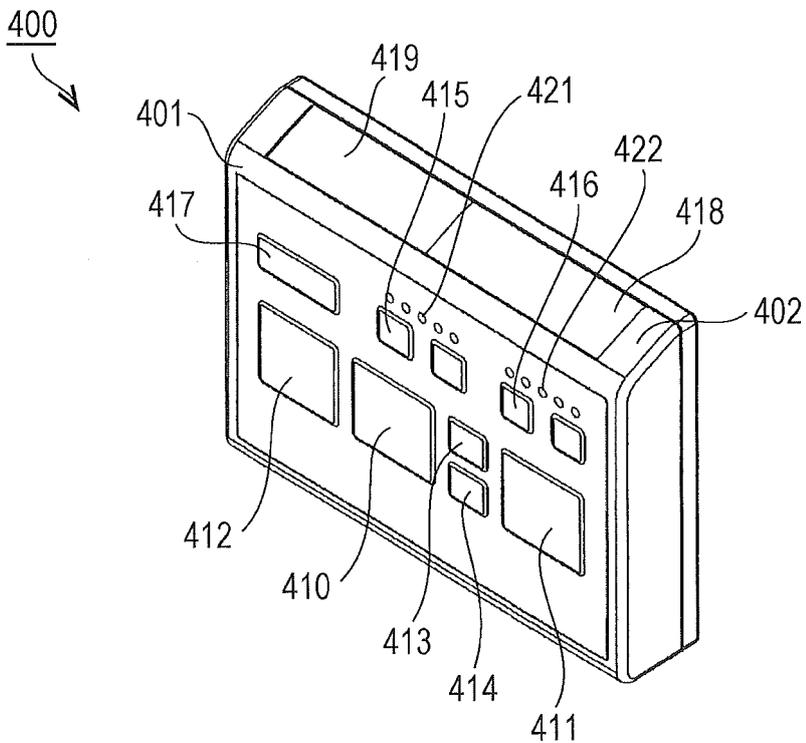




FIG. 7

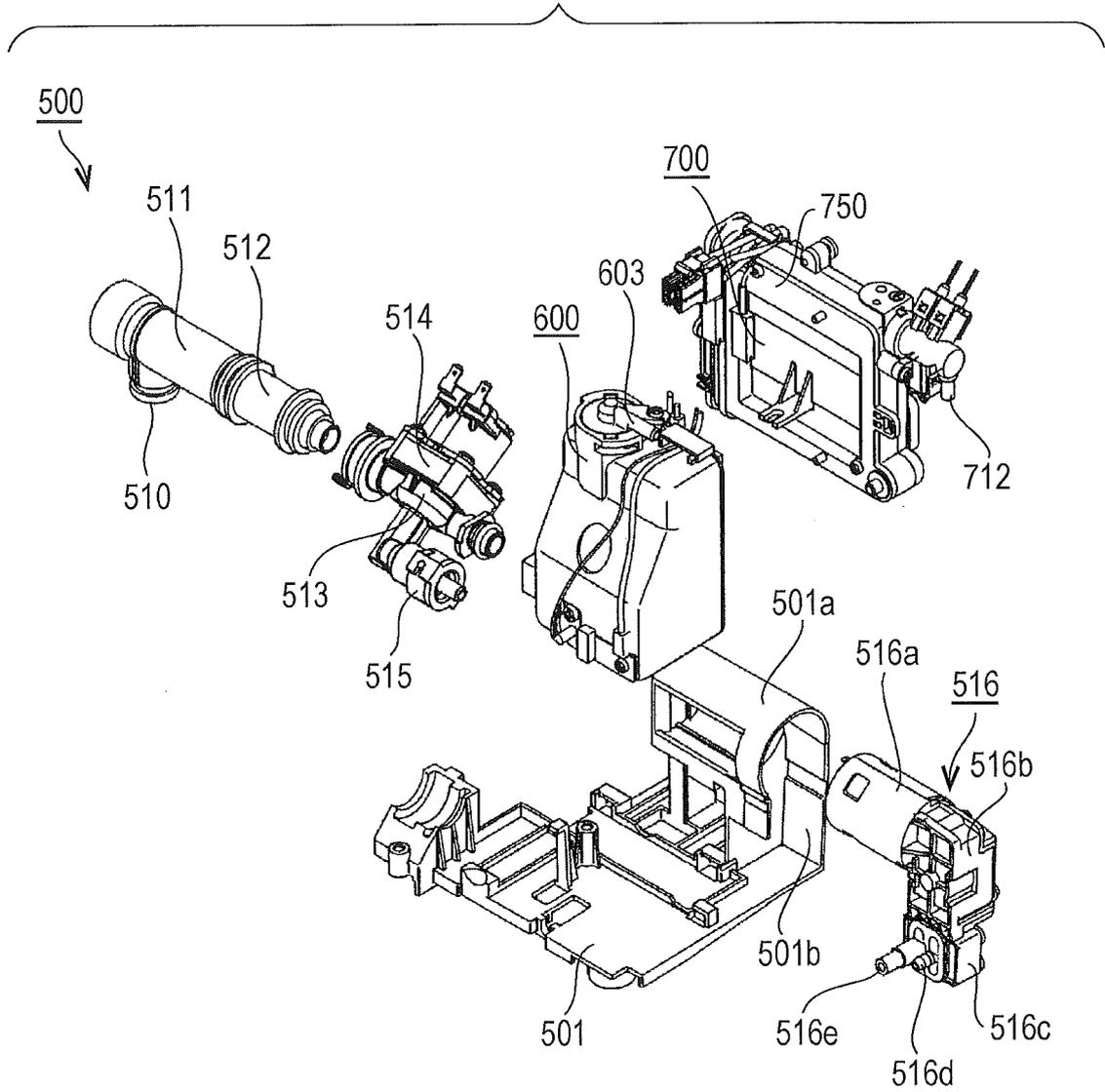


FIG. 8

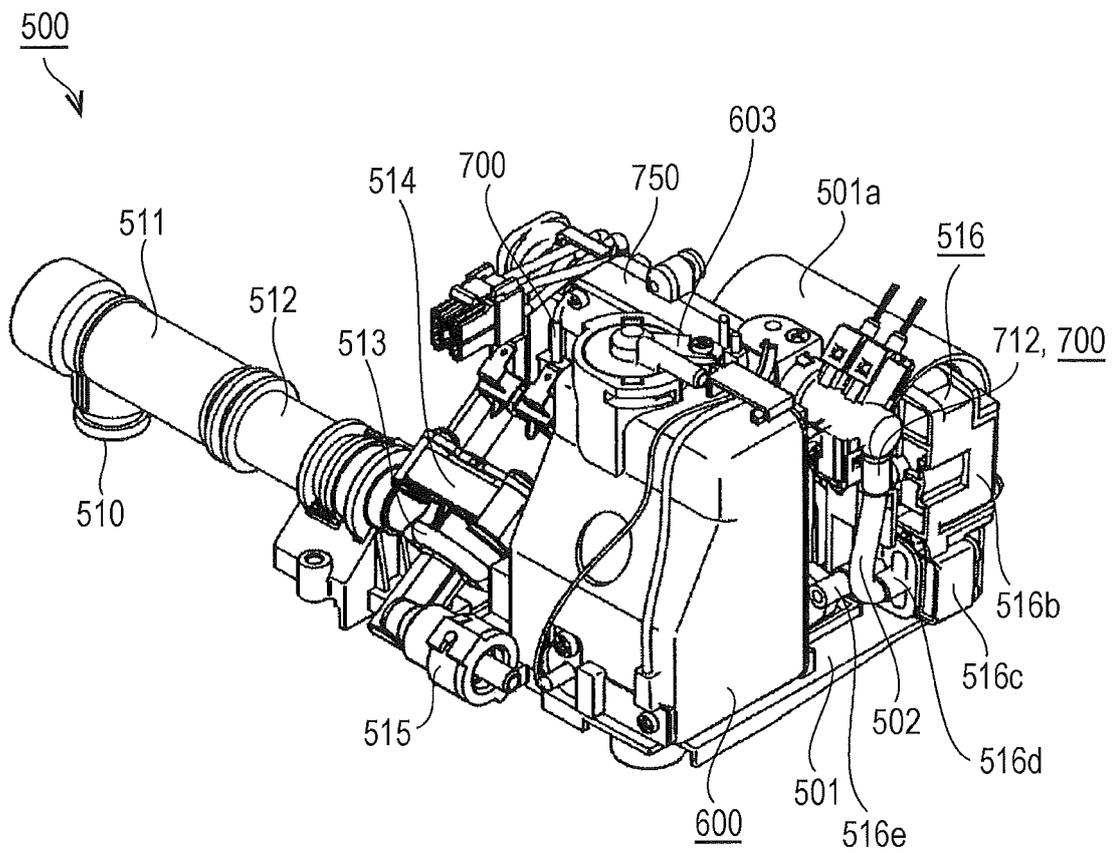


FIG. 9

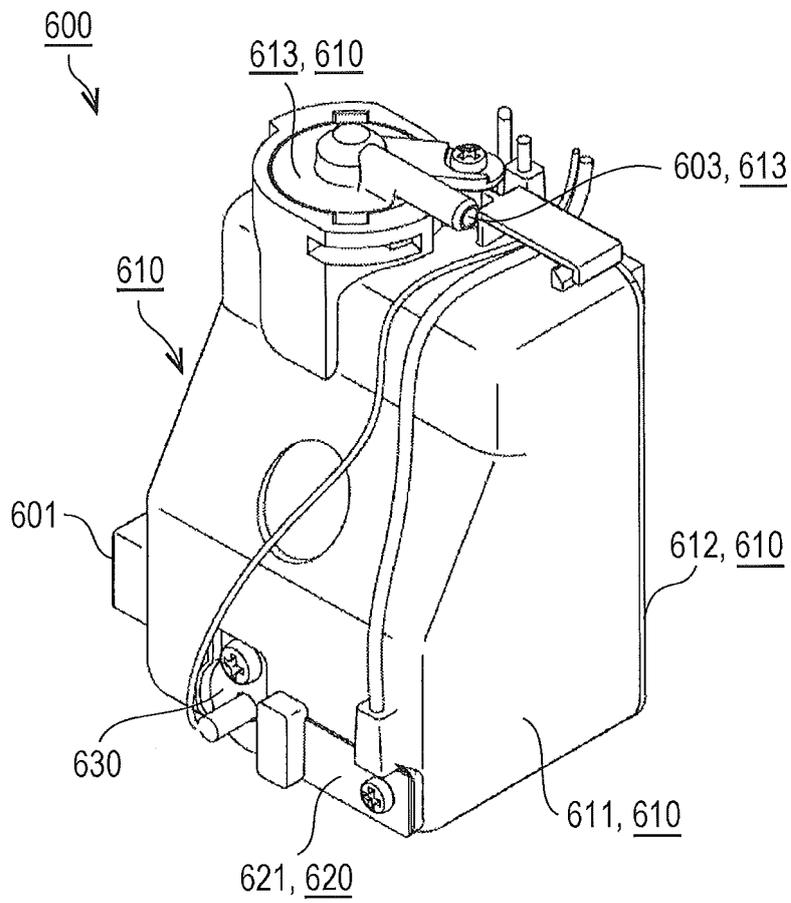


FIG. 10

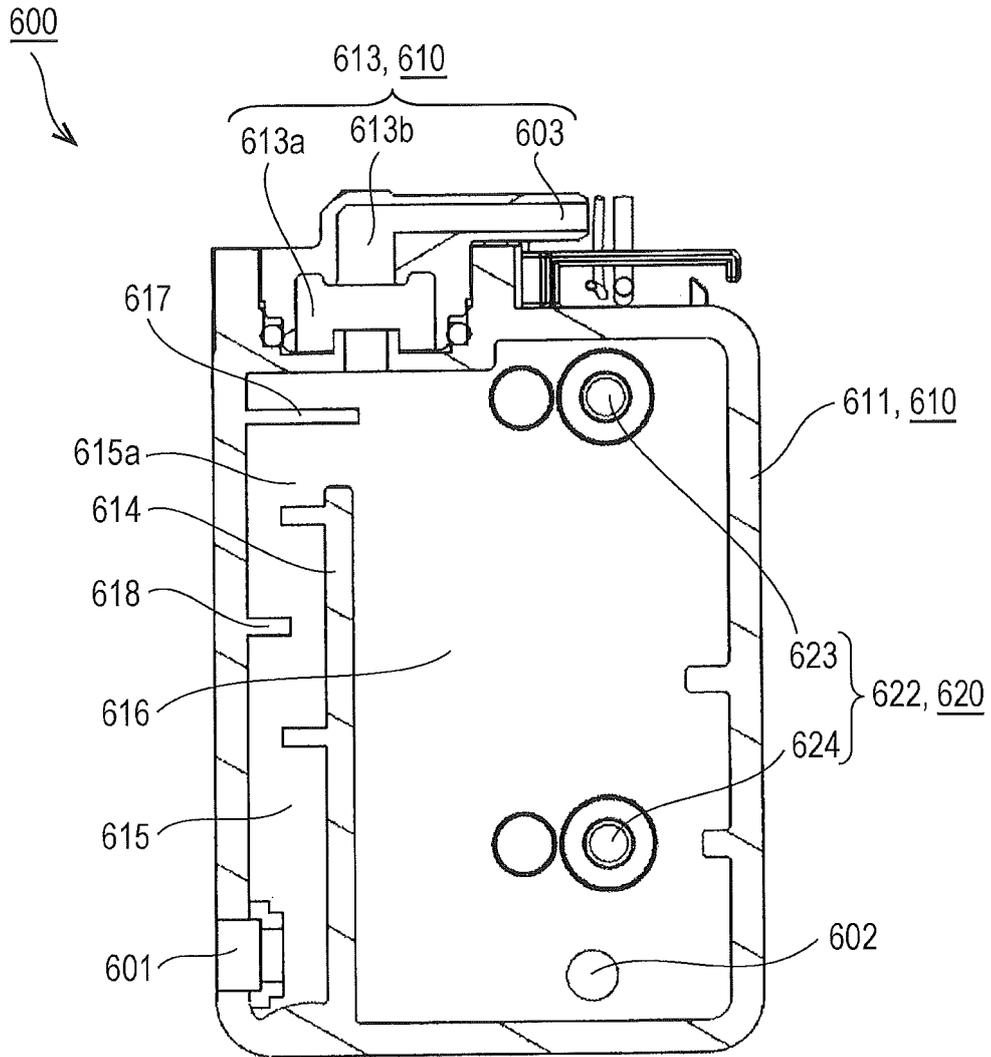


FIG. 11

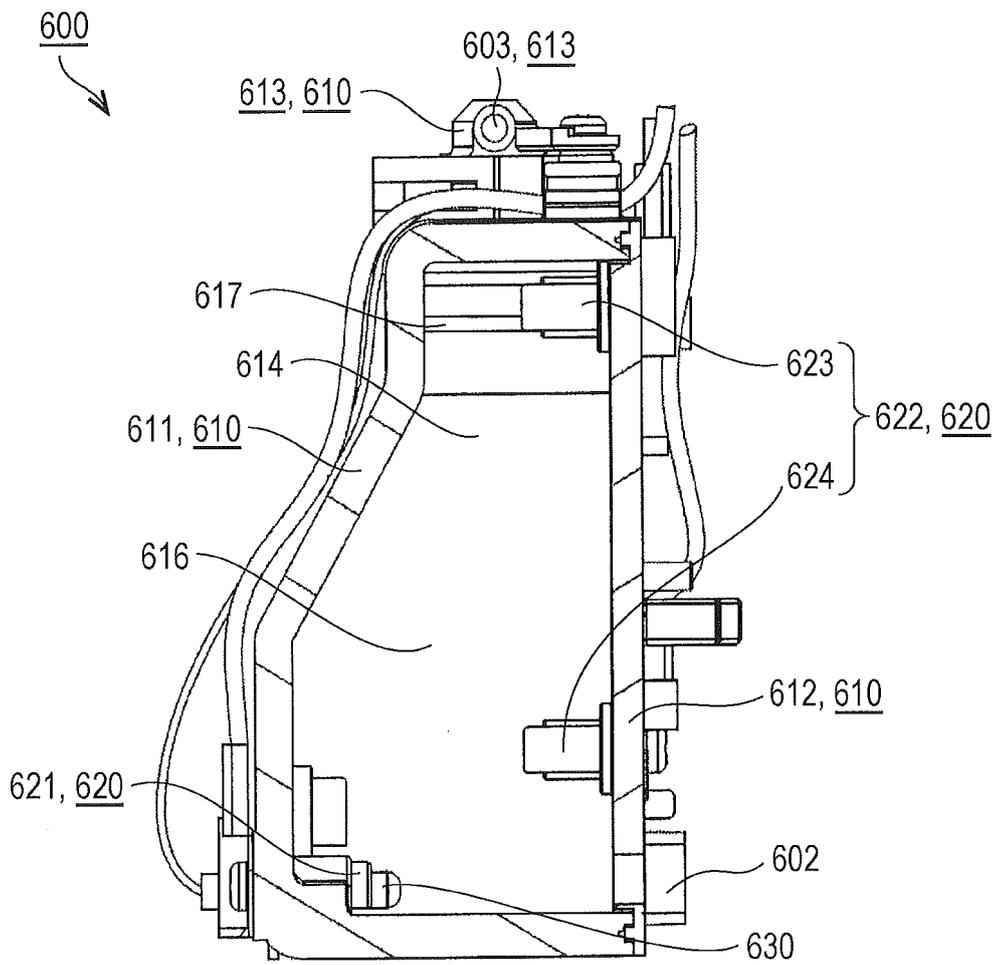


FIG. 12

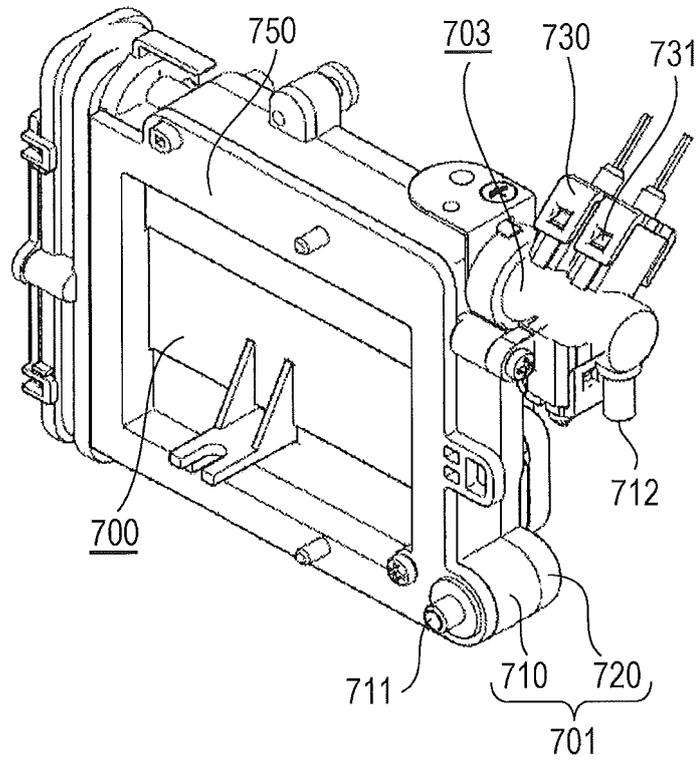


FIG. 13

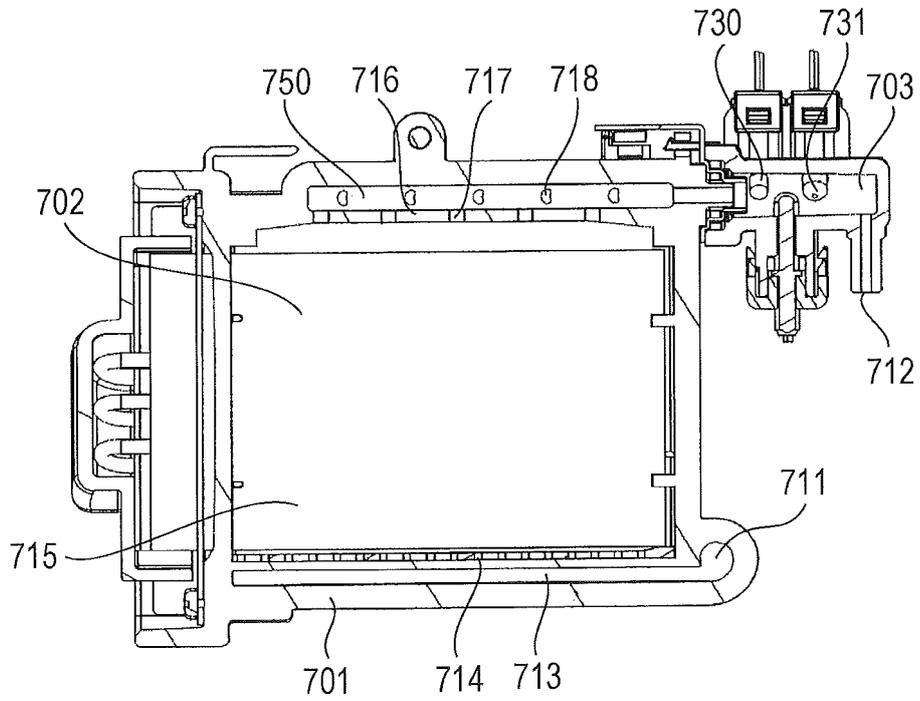


FIG. 14

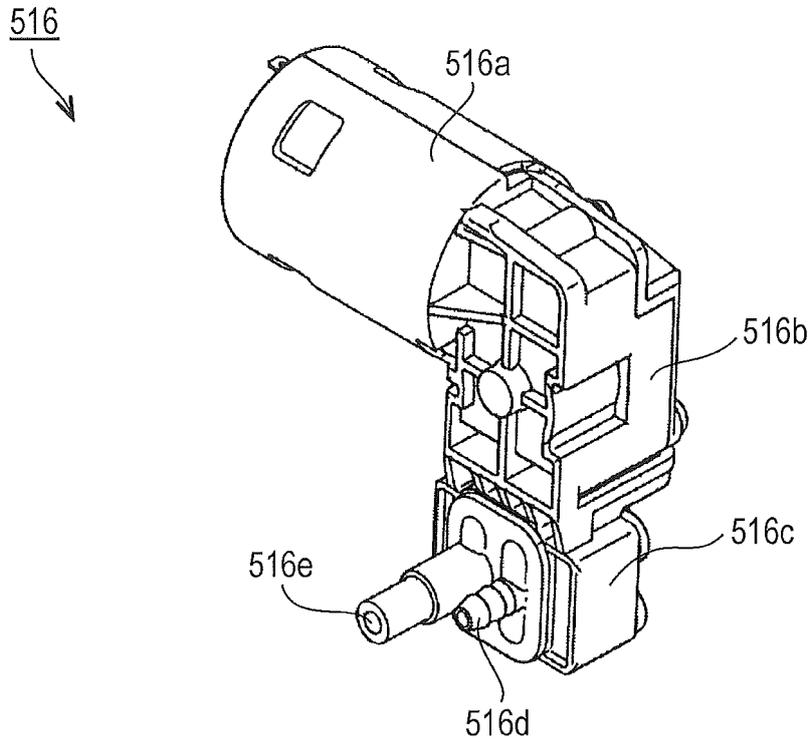


FIG. 15

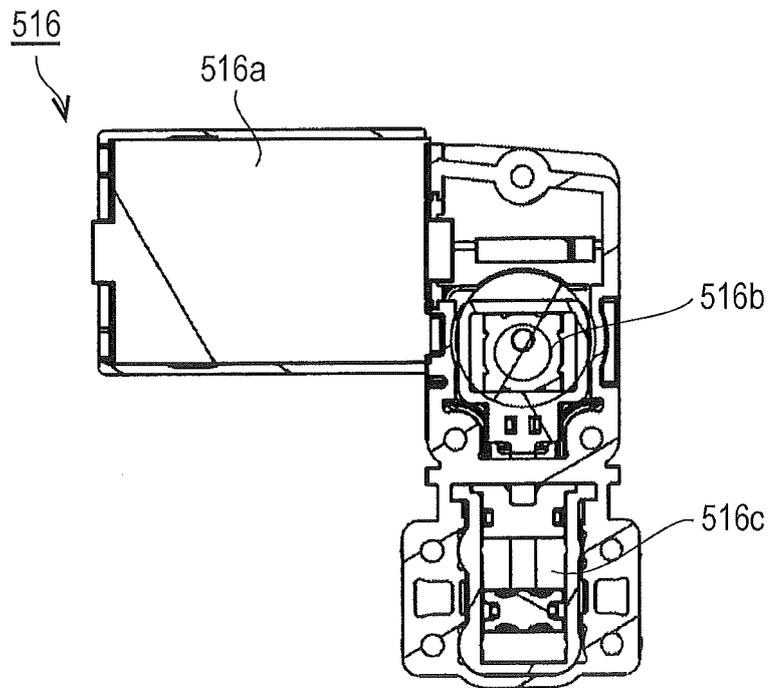


FIG. 16

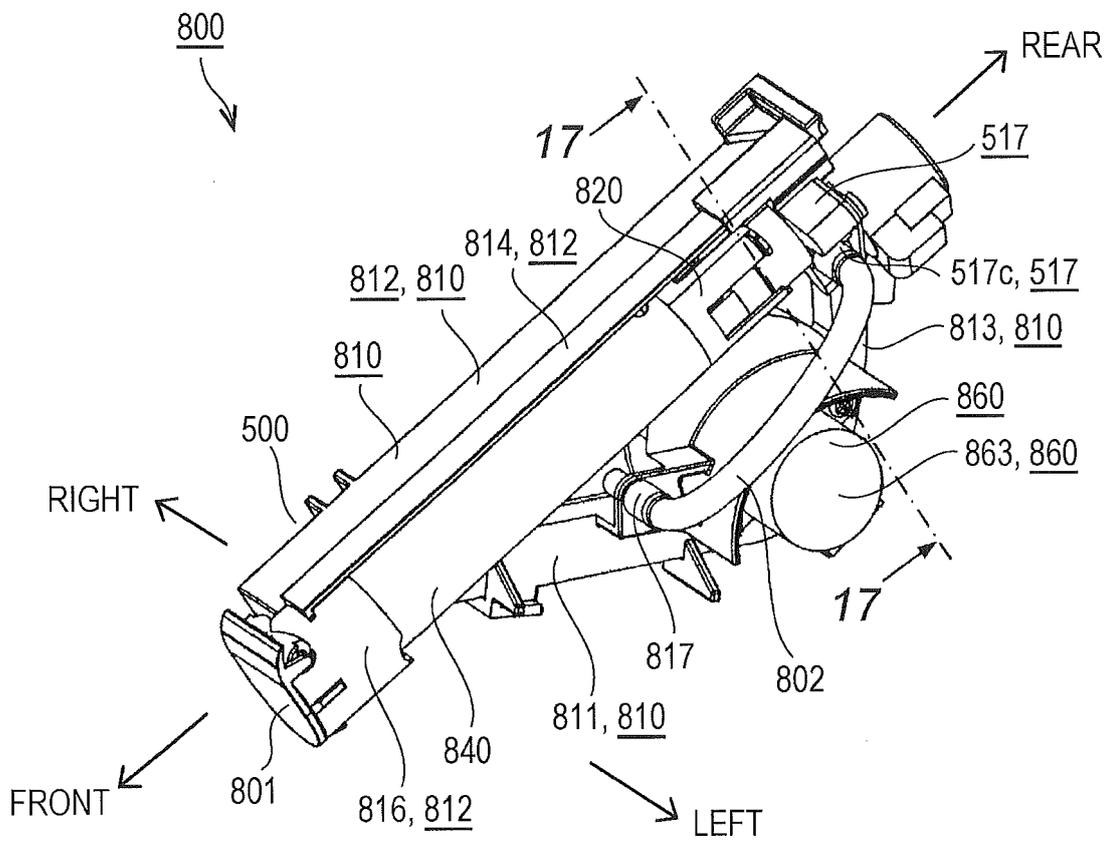




FIG. 18

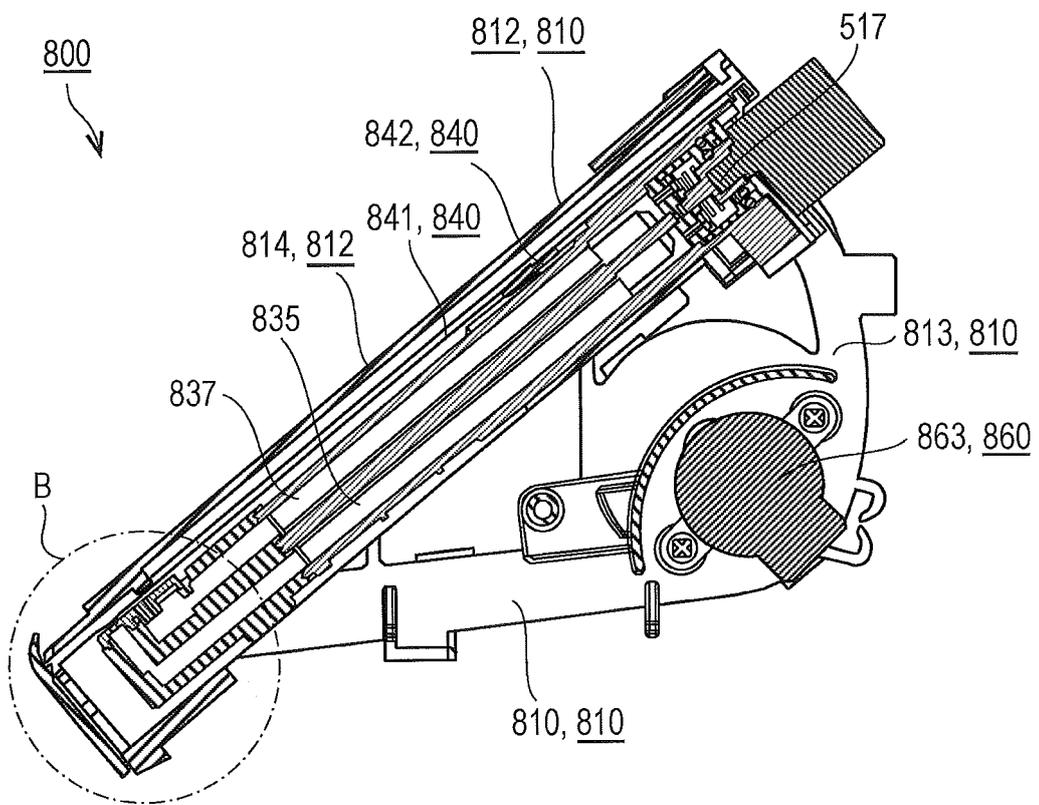


FIG. 19

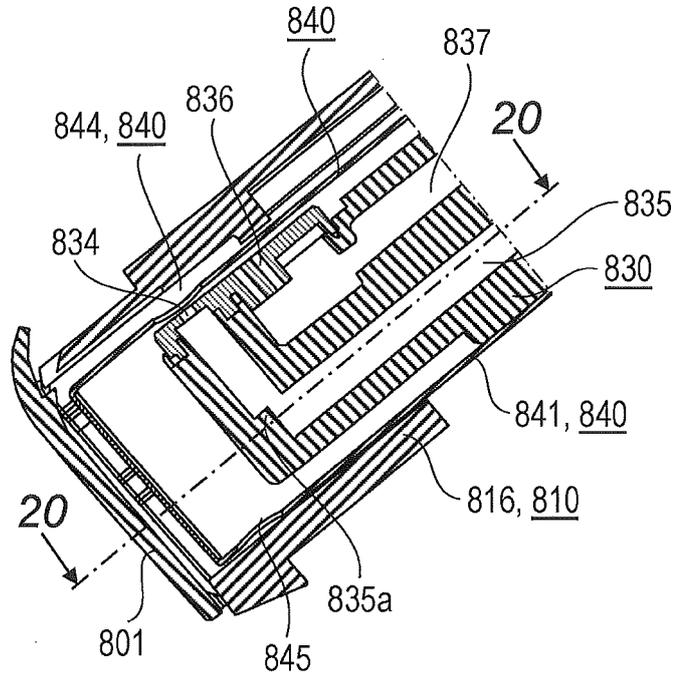


FIG. 20

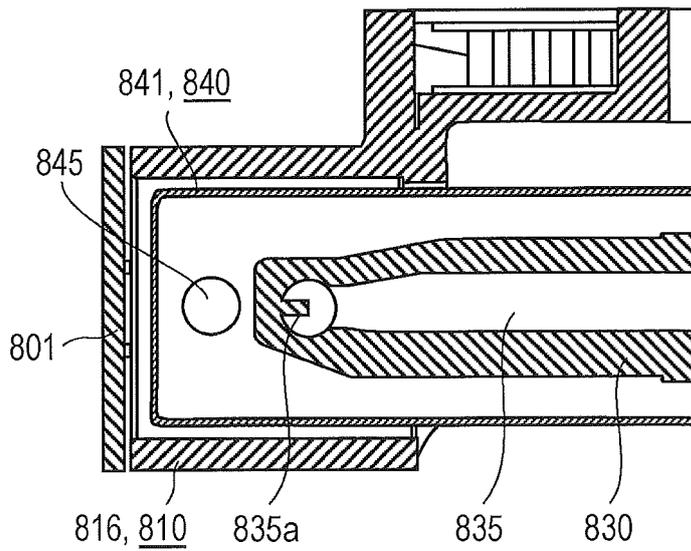


FIG. 21

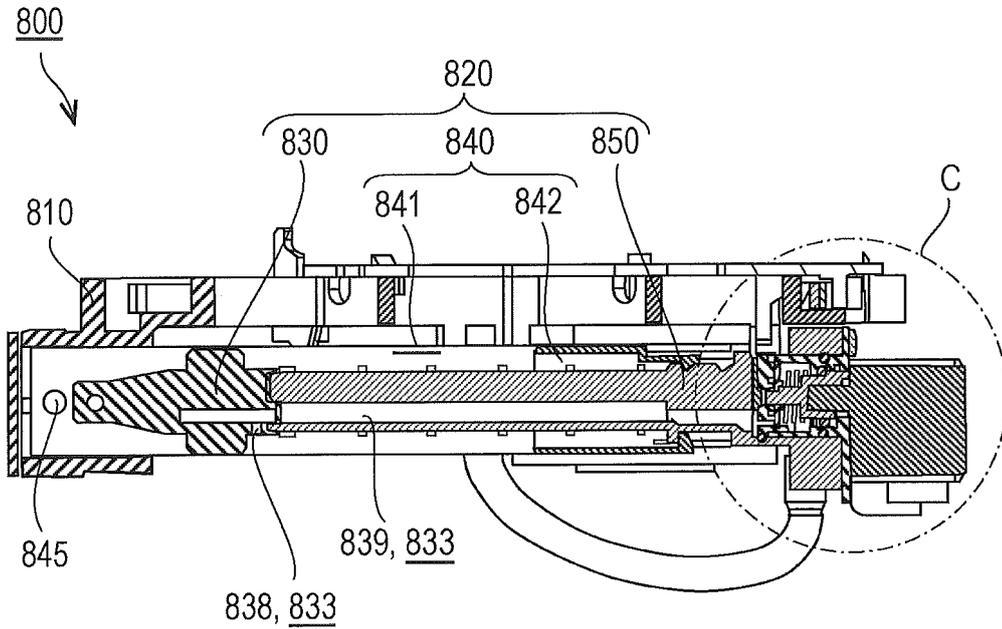


FIG. 22

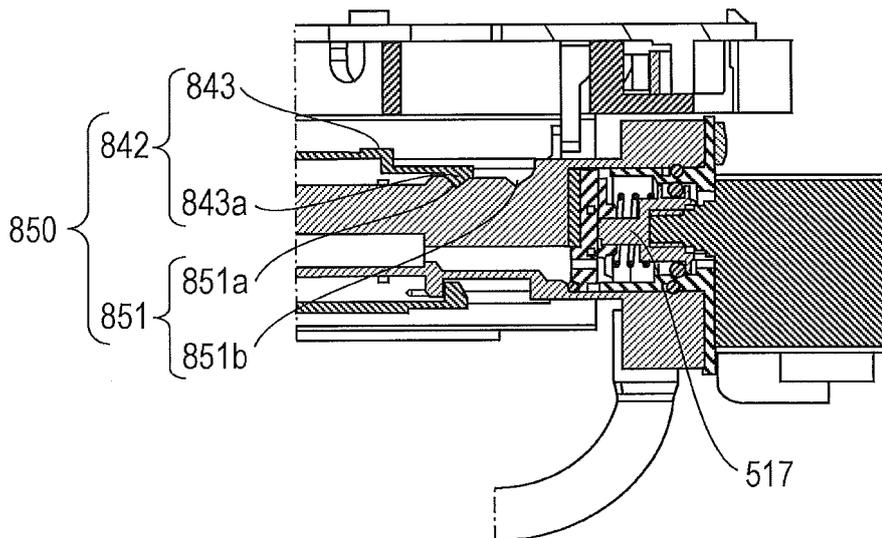


FIG. 23

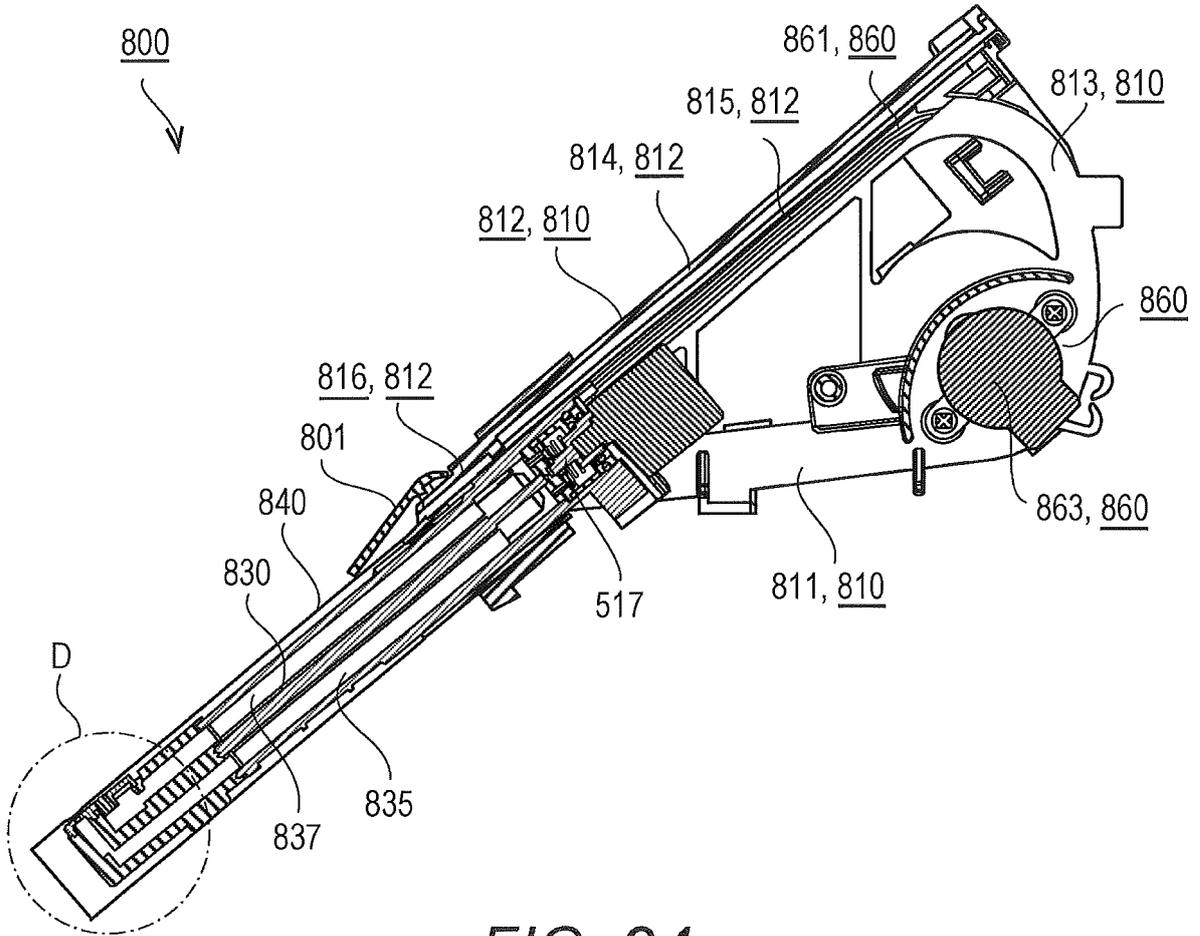


FIG. 24

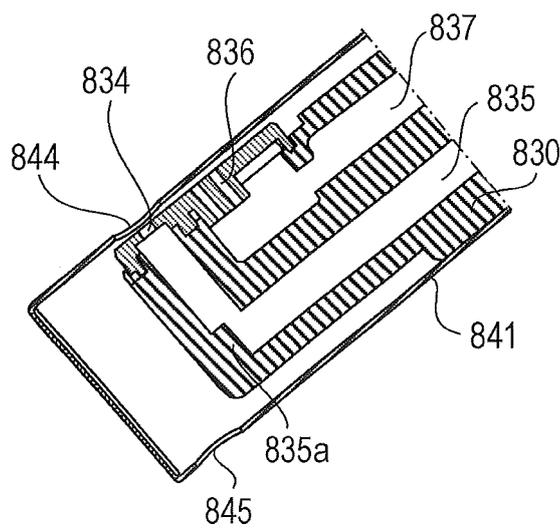


FIG. 25

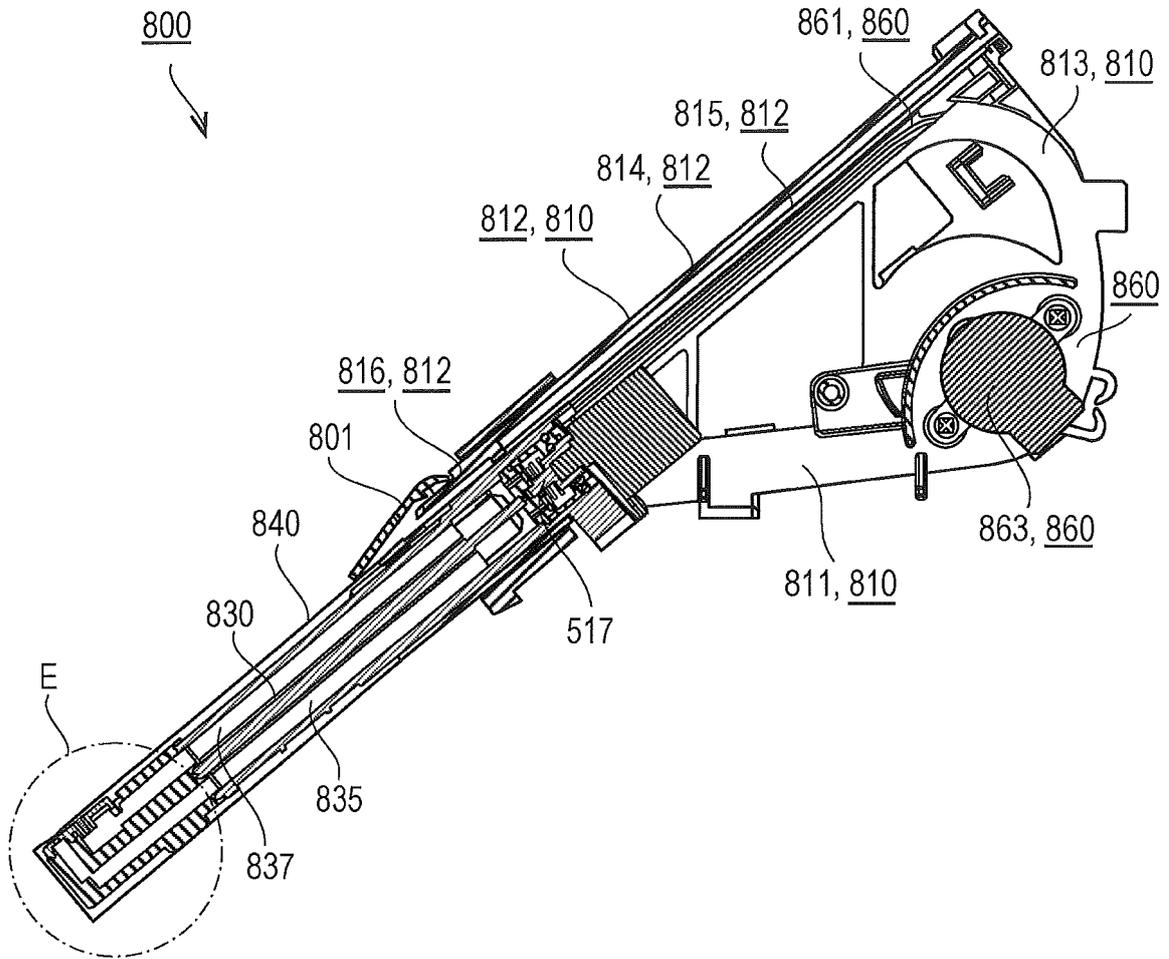


FIG. 26

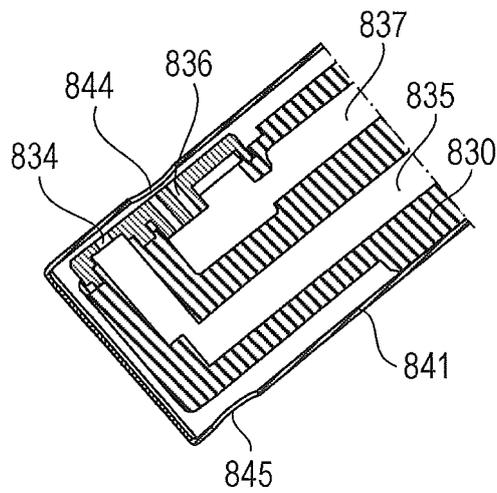


FIG. 27

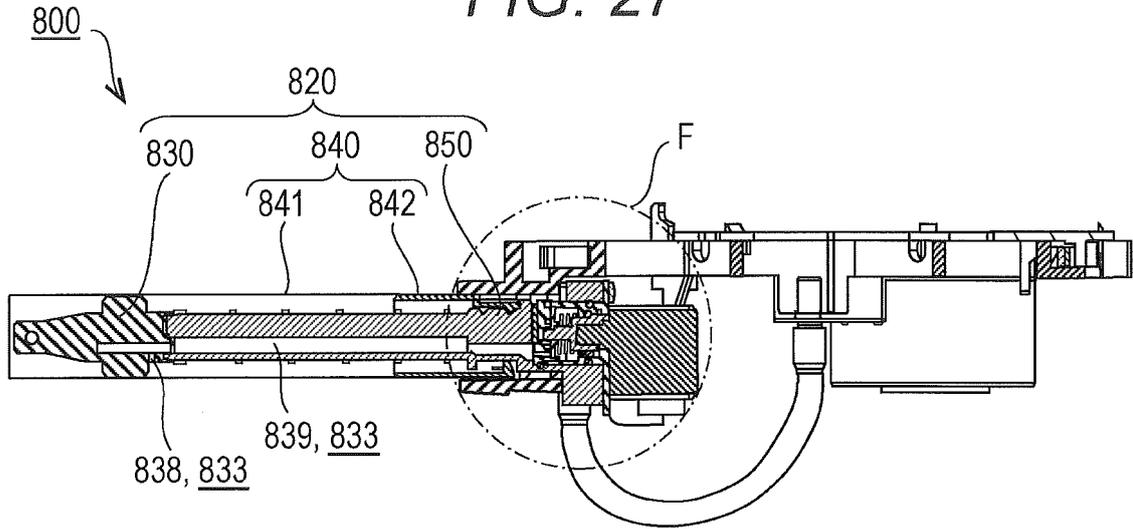


FIG. 28

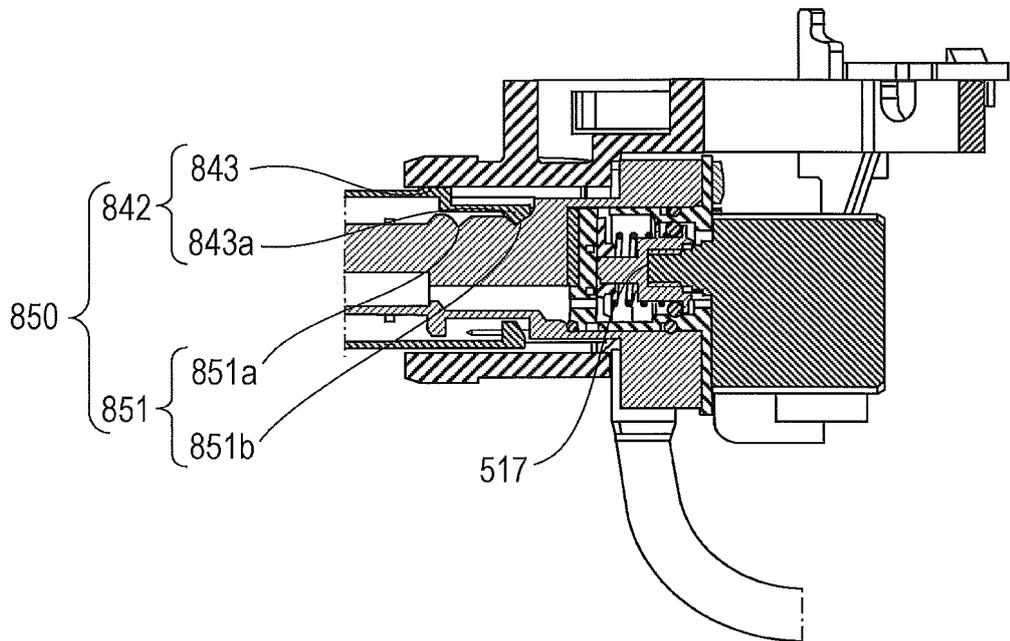


FIG. 29

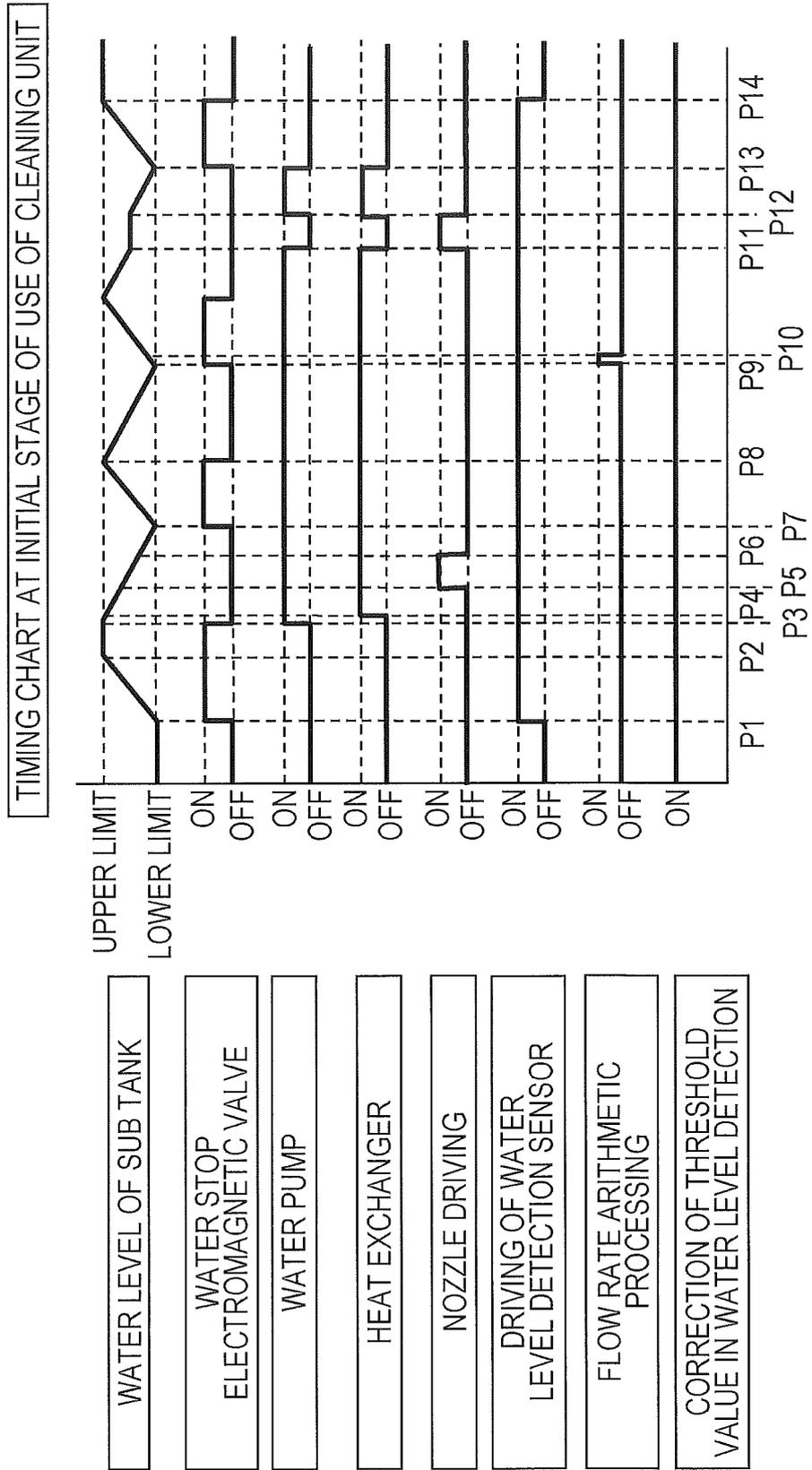


FIG. 30

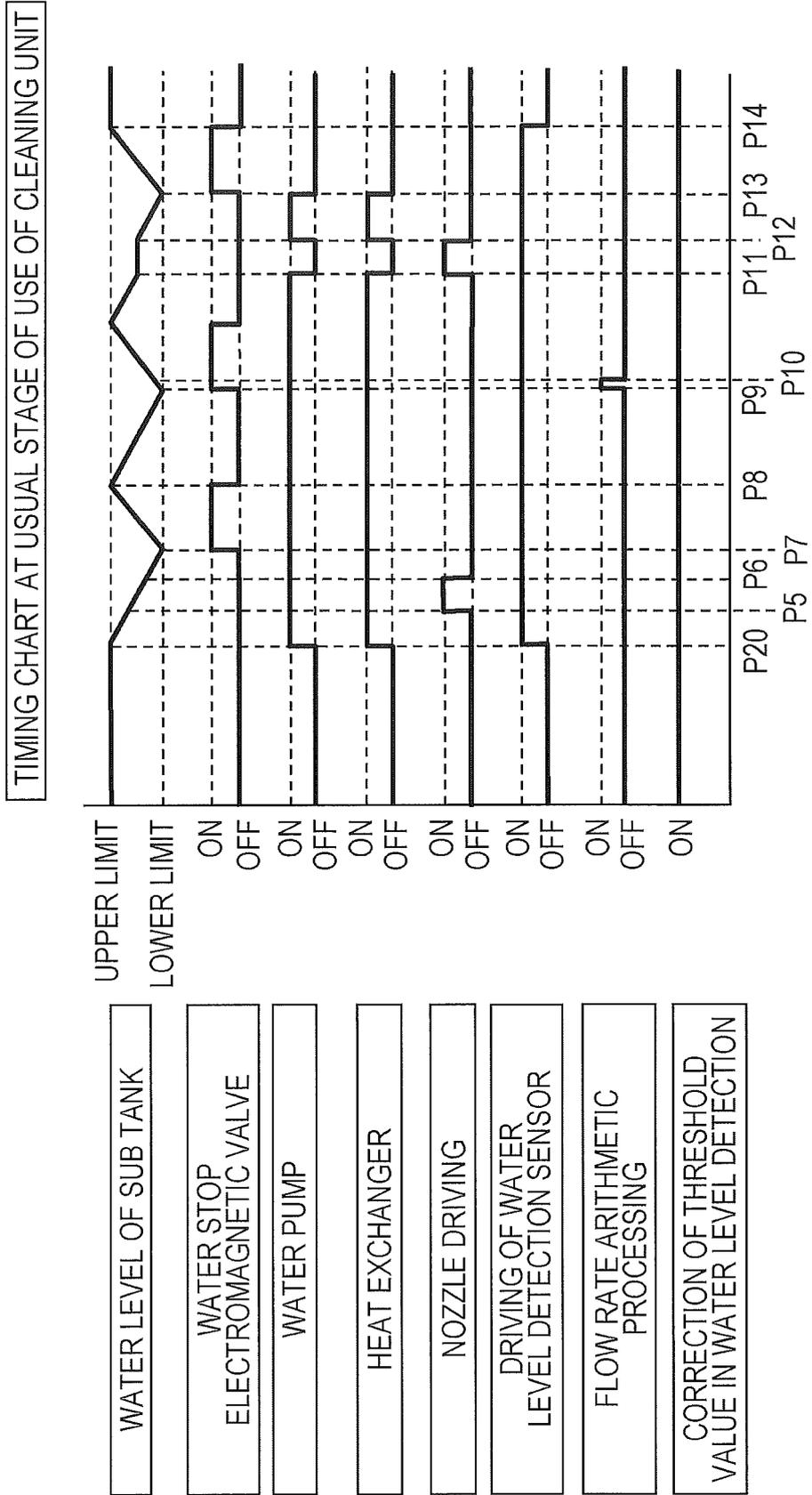


FIG. 31

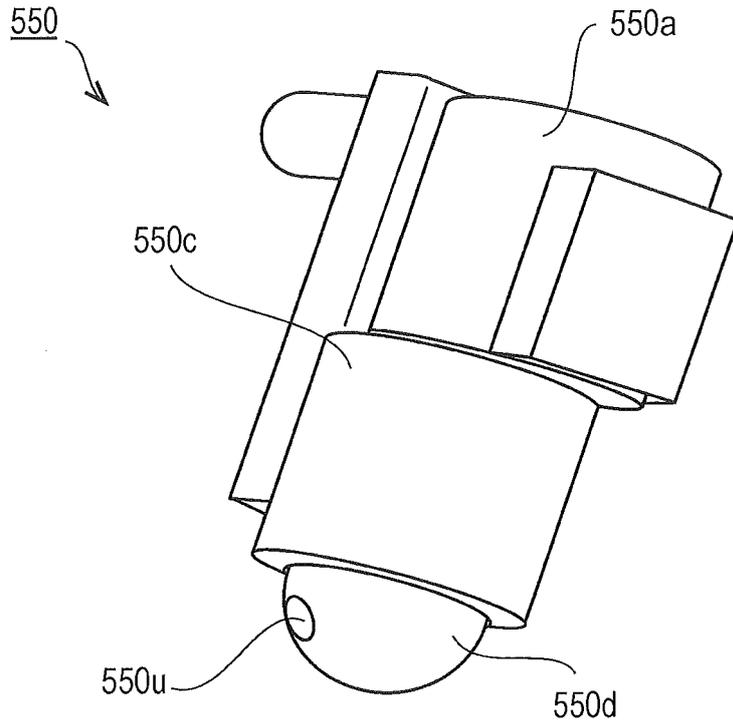


FIG. 32

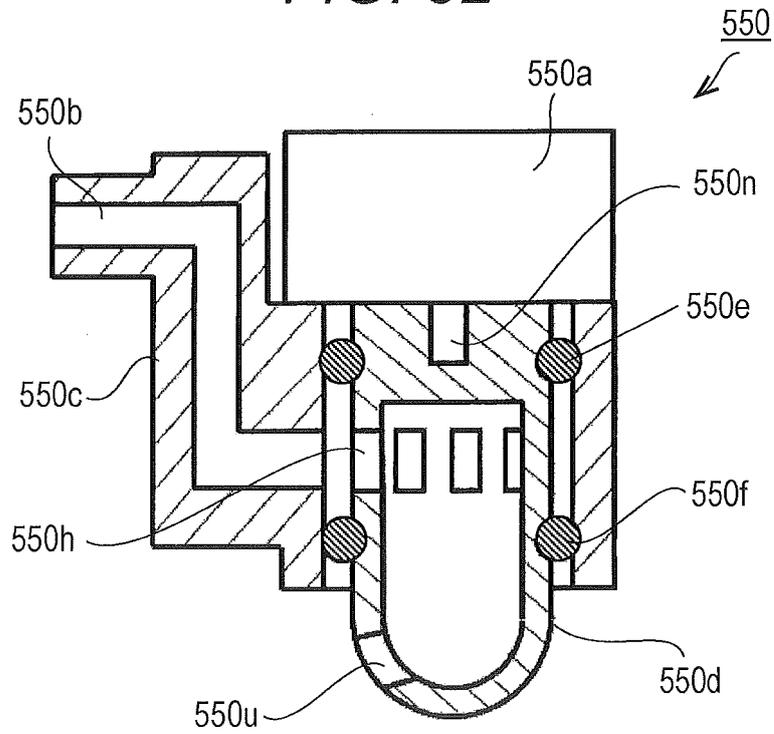


FIG. 33

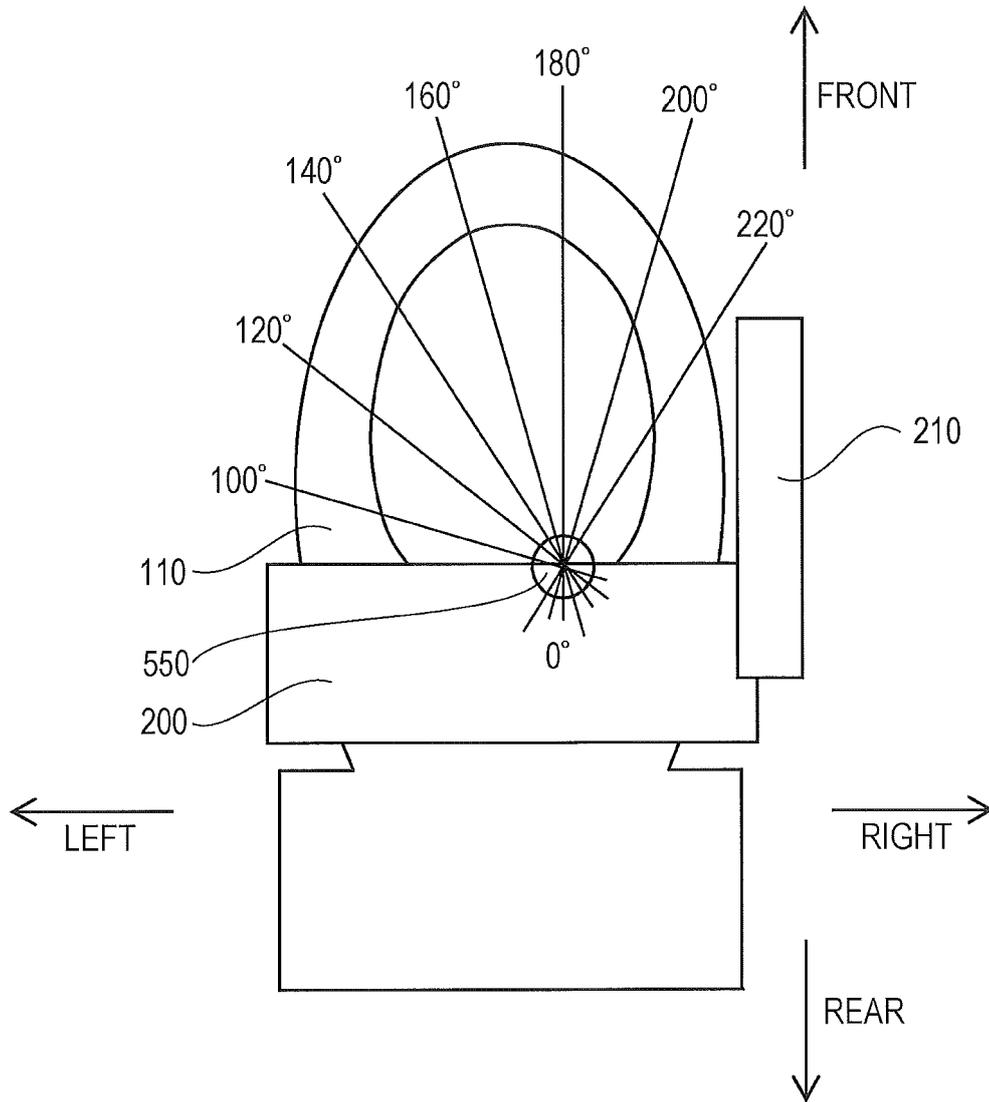


FIG. 34

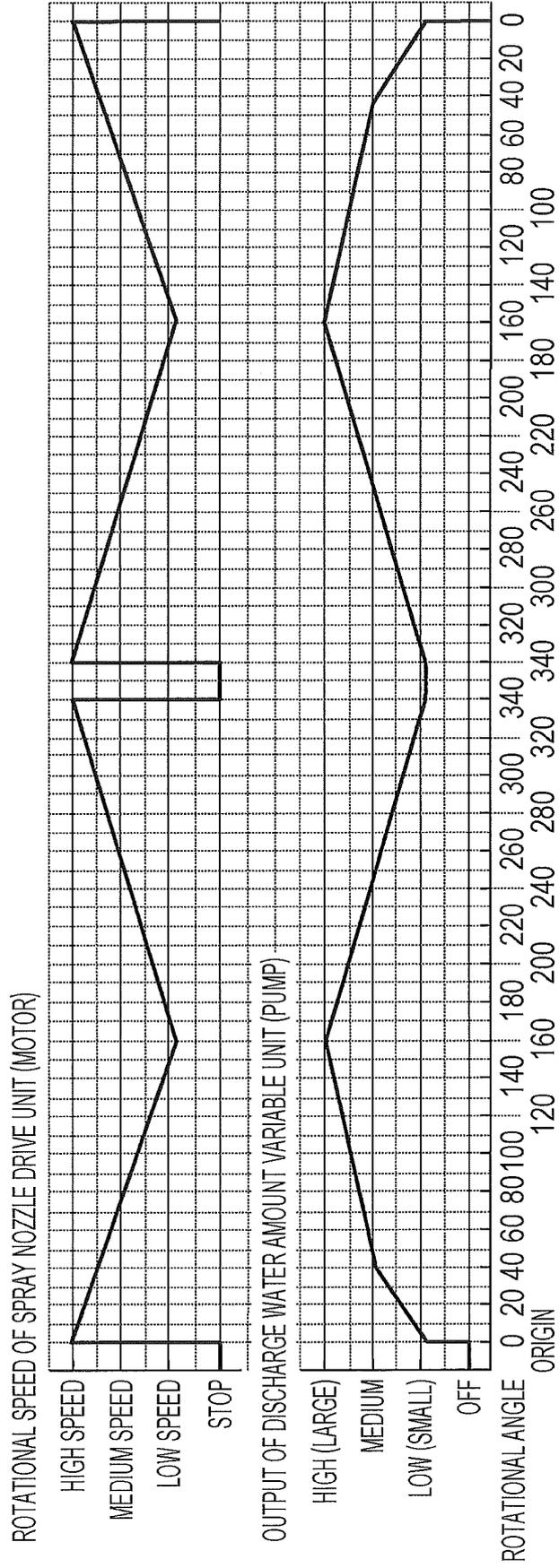


FIG. 35

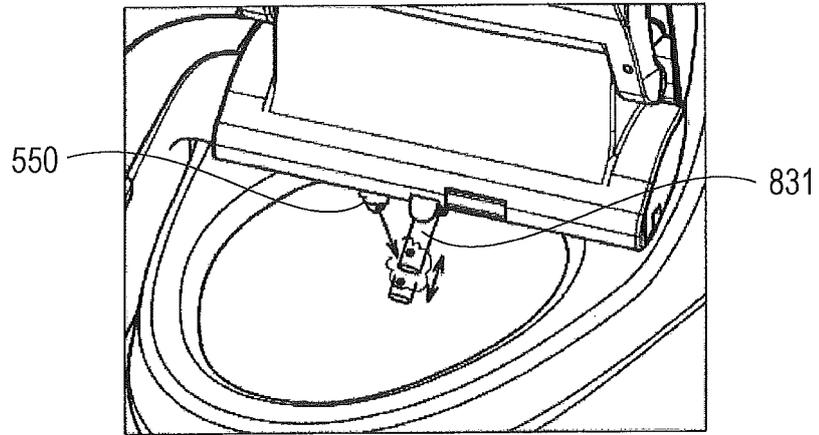


FIG. 36

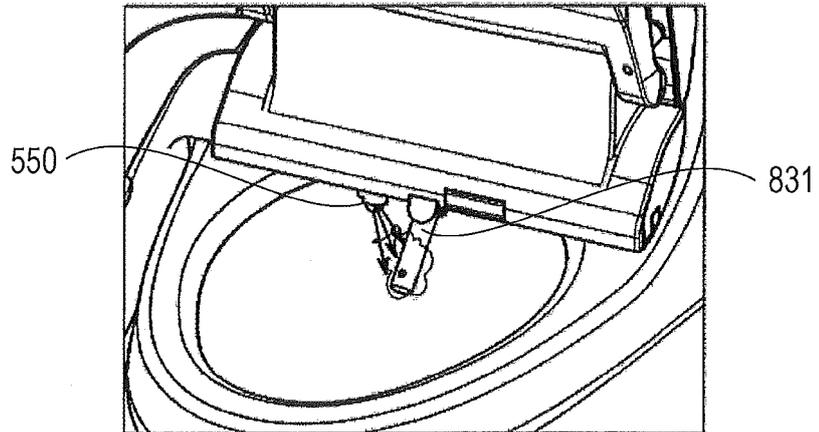
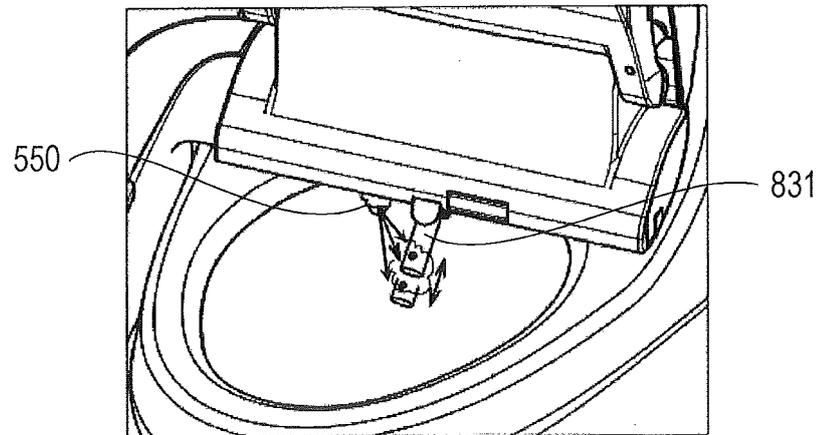


FIG. 37



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/001732

5	A. CLASSIFICATION OF SUBJECT MATTER E03D9/08(2006.01) i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) E03D9/08	
15	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 1996-2016 Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	Y	JP 2014-196628 A (Toto Ltd.), 16 October 2014 (16.10.2014), paragraphs [0024] to [0029]; fig. 2 (Family: none)
30	Y	JP 2003-247259 A (Matsushita Electric Works, Ltd.), 05 September 2003 (05.09.2003), paragraphs [0013] to [0021]; fig. 1 (Family: none)
35	Y	JP 5598637 B1 (Panasonic Corp.), 01 October 2014 (01.10.2014), paragraphs [0017], [0043]; fig. 6 & EP 2966230 A1 paragraphs [0017], [0043]; fig. 6 & WO 2014/136371 A1 & CN 105008628 A
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* 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
50	Date of the actual completion of the international search 26 May 2016 (26.05.16)	Date of mailing of the international search report 07 June 2016 (07.06.16)
55	Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer  Telephone No.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/001732

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2012-211487 A (Aisin Seiki Co., Ltd.), 01 November 2012 (01.11.2012), paragraphs [0019] to [0022]; fig. 1 (Family: none)	1-6
Y	JP 2000-8446 A (Toto Ltd.), 11 January 2000 (11.01.2000), paragraphs [0021] to [0022] (Family: none)	1-6
Y	JP 2008-61928 A (Matsushita Electric Works, Ltd.), 21 March 2008 (21.03.2008), paragraph [0023] (Family: none)	1-6
Y	JP 2010-525947 A (S.C. Johnson & Son Inc.), 29 July 2010 (29.07.2010), paragraphs [0020], [0037] & US 2008/0272200 A1 paragraphs [0023], [0058]	1-6
Y	JP 2001-254425 A (Aisin Seiki Co., Ltd.), 21 September 2001 (21.09.2001), paragraphs [0025] to [0030], [0034]; fig. 1 & US 2001/0022006 A1 paragraphs [0030] to [0035], [0040]; fig. 1	3-5

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 3555254 B [0006]