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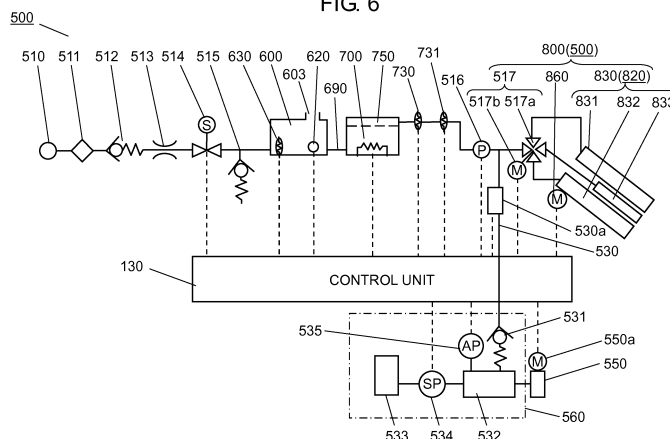
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(54) **HYGIENIC CLEANING DEVICE**

(57) A hygienic cleaning device includes a body, foam generation unit (560) for generating cleaning foam, spray nozzle (550) for forming a water film or a foam film onto an inner surface of a toilet bowl, and a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to spray nozzle (550). The hygienic cleaning device further includes spray nozzle drive unit (550a) for rotating a direction of a discharge opening of spray nozzle (560),

opening and closing valve (530a) for opening and closing a water passage to the spray nozzle, control unit (130), and an operation unit for setting an instruction for the control unit. Control unit (130) changes, in accordance with a rotational angle of the discharge opening of spray nozzle (550), an output of the discharge water amount variable unit. As a result, the hygienic cleaning device capable of using spray nozzle (550) in a diversified manner can be provided.

FIG. 6



Description

TECHNICAL FIELD

[0001] The present invention relates to a hygienic cleaning device that sprays cleaning water or cleaning foam toward a toilet bowl.

BACKGROUND ART

[0002] With this kind of a conventional hygienic cleaning 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] Widely known problems in the conventional hygienic cleaning device include sticky dirt adhered on a dried inner surface of a toilet bowl, which is difficult to remove.

[0004] Therefore, a proposed hygienic cleaning device includes, in addition to a cleaning water nozzle described above for cleaning a private part of a human body, a spray nozzle for injecting foam toward an inner surface of a toilet bowl before a user defecates to form a foam film onto the inner surface of the toilet bowl (for example, see PTL 1).

[0005] The hygienic cleaning device described in PTL 1 detects a seated user with a detection unit, and automatically injects foam from the spray nozzle toward the toilet bowl. Accordingly, before the user defecates, a foam film is formed onto the inner surface of the toilet bowl to prevent as much as possible dirt from adhering onto the inner surface of the toilet bowl.

[0006] However, the conventional hygienic cleaning device has not been configured to fully satisfy other diversified use and requests of users, than defecation. Accordingly, further improvements have been required in a view point of a value of use of a foam discharging spray nozzle.

[0007] Similarly, another proposed hygienic cleaning device is configured to spray water toward an inner surface of a toilet bowl beforehand to wet the inner surface of the toilet bowl so as to prevent as much as possible, with a water film, dirt from adhering, as well as to allow a user to easily clean and remove adhered dirt (for example, see PTL 2).

[0008] Hereinafter, the hygienic cleaning device described in PTL 2 will now be described with reference to FIGS. 39 to 41.

[0009] FIG. 39 is a cross-sectional view of the conventional hygienic cleaning device. FIG. 40 is a side view of a water spray nozzle of the conventional hygienic cleaning device. FIG. 41 is a transverse cross-sectional view of the water spray nozzle.

[0010] As shown in FIG. 39, the conventional hygienic cleaning device includes Western-style toilet bowl 101,

toilet seat 102, toilet seat body 103, and the like. Toilet seat 102 is disposed and provided on toilet bowl 101. Toilet seat body 103 openably pivot-supports toilet seat 102. Further, toilet seat body 103 includes extendable cleaning water nozzle 104 for cleaning a private part of a human body, and water spray nozzle 105 disposed on a rear side of toilet bowl 101 for spraying water toward the inner surface of toilet bowl 101.

[0011] Upon detecting that, with a human body detection sensor, a user has entered a toilet room, water spray nozzle 105 starts spraying of water toward the inner surface of toilet bowl 101. Accordingly, before the user seats on toilet seat 102, a water film is formed onto the inner surface of toilet bowl 101 to prevent as much as possible dirt from adhering.

[0012] Water spray nozzle 105 includes, as shown in FIG. 40, water supply body 107 having water supply passage 106, and water diffusing body 108 for radially diffusing water supplying from water supply passage 106. Water supply passage 106 and water diffusing body 108 are connected each other with a plurality of ribs 109 positioned at even intervals in a circumferential direction.

[0013] Water supplied from water supply passage 106 of water supply body 107 and radially diffused by water diffusing body 108 is sprayed from gaps between ribs 109 toward the inner surface of toilet bowl 101 at a predetermined height. Accordingly, a water film is formed onto the inner surface of toilet bowl 101 to prevent as much as possible dirt from adhering.

[0014] However, the hygienic cleaning device disclosed in PTL 2 radially diffuses water with water diffusing body 108 toward the inner surface of toilet bowl 101. In this case, a flow rate and a flow speed of water to be diffused solely depend on annular gaps t set between water supply body 107 and water diffusing body 108. Accordingly, water spray nozzle 105 disposed on the rear side would not sometimes fully spray water toward a whole circumference of the inner surface on a front side of toilet bowl 101.

[0015] Further, the plurality of ribs 109 provided between annular gaps t is likely to cause unevenness in water spray distribution. Further, since, due to ribs 109, water does not reach some portions, a water film could not securely be formed onto the inner surface of toilet bowl 101.

[0016] That is, with the conventional hygienic cleaning device, diversified purposes have not fully been satisfied, as well as dirt has not been fully and securely prevented from adhering onto the whole inner surface of the toilet bowl.

Citation List

Patent Literature

[0017]

PTL 1: Unexamined Japanese Patent Publication

No. 2000-104319

PTL 2: Japanese Patent No. 3447352

SUMMARY OF THE INVENTION

[0018] The present invention provides a hygienic cleaning device capable of using, in a diversified manner in accordance with a situation of use, a spray nozzle for discharging cleaning foam.

[0019] That is, the hygienic cleaning device according to the present invention includes a body provided on a toilet bowl, a foam generation unit for generating cleaning foam, a spray nozzle for forming a water film or a foam film onto an inner surface of the toilet bowl, and a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to the spray nozzle. The hygienic cleaning device further includes a spray nozzle drive unit for rotating a direction of a discharge opening of the spray nozzle, an opening and closing valve for opening and closing a water passage to the spray nozzle, a control unit, and an operation unit for setting an instruction for the control unit. The control unit changes, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the discharge water amount variable unit to cause the spray nozzle to discharge cleaning water or cleaning foam.

[0020] According to this configuration, as will be described below, in accordance with a situation of use, the spray nozzle for discharging cleaning water or cleaning foam can be used in a diversified manner.

[0021] For example, to spray cleaning water or foam (hereinafter referred to as "cleaning foam") from the spray nozzle while no user has seated, the control unit changes a rotational angle of the discharge opening of the spray nozzle so that cleaning foam will be sprayed toward a whole circumference of the inner surface of the toilet bowl. At this time, the control unit controls an output of the discharge water amount variable unit so that the cleaning foam evenly reaches around a rim (circumference) of the toilet bowl.

[0022] Further, to spray cleaning foam from the spray nozzle while a user has seated, the control unit performs a control so that the cleaning foam is sprayed toward the inner surface on only a rear side of the toilet bowl. Specifically, the control unit drives and rotates the spray nozzle to a position at which a direction of the discharge opening of the spray nozzle faces the rear side of the toilet bowl, and then the control unit stops the spray nozzle. The control unit then performs a control so that the discharge water amount variable unit is set to a lower output to cause the spray nozzle to discharge cleaning foam. Accordingly, the cleaning foam is gently discharged toward the inner surface on the rear side of the toilet bowl. As a result, the cleaning foam can be prevented from splashing toward the user, but can be sprayed toward the inner surface on the rear side of the toilet bowl.

[0023] Further, to spray cleaning foam from the spray nozzle when a male user is about to urinate without seating on a toilet seat, and a signal sent from a toilet seat open and close detection unit shows that a toilet seat is open, the control unit performs a control as described below. That is, the control unit first drives and rotates the spray nozzle to a position at which a direction of the discharge opening of the spray nozzle faces a drainage opening of the toilet bowl in order to spray cleaning foam toward the drainage opening of the toilet bowl, and then the control unit stops the spray nozzle. The control unit then performs a control so that the discharge water amount variable unit is set to a medium output to cause the spray nozzle to discharge cleaning foam. Accordingly, when urinating, water can be prevented from splashing in the discharge opening. As a result, a toilet room can be kept clean.

[0024] That is, in accordance with detected states of whether a user has seated on the toilet seat and whether the toilet seat is open or closed, the control unit drives and rotates, via the spray nozzle drive unit, the spray nozzle. The control unit then changes, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the discharge water amount variable unit. Therefore, in accordance with a situation of use of the hygienic cleaning device, the spray nozzle for discharging cleaning foam can be used in a diversified manner. As a result, in accordance with a situation of use, a foam amount can appropriately be controlled so as to save detergent and the like.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

FIG. 1 is a perspective view showing a state where a hygienic cleaning 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 hygienic cleaning device is removed.

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

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

FIG. 7 is a perspective view showing a disassembled state of the water circuit of the hygienic cleaning device.

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

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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 hygienic cleaning 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 hygienic cleaning device.

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

FIG. 31 is a perspective view showing an external appearance of a spray nozzle of the hygienic cleaning 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 hygienic cleaning device, and a rotational angle of a discharge opening of the spray nozzle.

FIG. 34 is a chart showing an output of a discharge water amount variable unit 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. 35A is an explanatory drawing showing a discharge operation of the spray nozzle toward an inner surface of a toilet bowl.

FIG. 35B is an explanatory drawing showing a discharge direction of the spray nozzle toward the inner surface of the toilet bowl.

FIG. 36A is an explanatory drawing showing another discharge operation of the spray nozzle toward the inner surface of the toilet bowl.

FIG. 36B is an explanatory drawing showing another discharge direction of the spray nozzle toward the inner surface of the toilet bowl.

FIG. 37 is a perspective view showing an external appearance of a state where another exemplary hygienic cleaning device according to the exemplary embodiment is installed on a toilet bowl.

FIG. 38 is a perspective view of a body of another exemplary hygienic cleaning device according to the exemplary embodiment.

FIG. 39 is a cross-sectional view of a conventional hygienic cleaning device.

FIG. 40 is a side view of a water spray nozzle of the conventional hygienic cleaning device.

FIG. 41 is a transverse cross-sectional view of the water spray nozzle.

DESCRIPTION OF EMBODIMENT

[0026] Hereinafter, an exemplary embodiment of the present invention is described with reference to drawings. However, the present invention is not limited by the exemplary embodiment.

EXEMPLARY EMBODIMENT

<1> Overall configuration of hygienic cleaning device

[0027] Hereinafter, the overall configuration of the hygienic cleaning device according to an exemplary embodiment is described with reference to FIGS. 1 to 5.

[0028] FIG. 1 is a perspective view showing a state where the hygienic cleaning device according to this exemplary embodiment 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 hygienic cleaning 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 hygienic cleaning device are removed. FIG. 4 is a perspective view showing an upper surface of an operation unit of the hygienic cleaning device. FIG. 5 is a perspective view showing an external appearance of a remote controller.

[0029] As shown in FIG. 1, hygienic cleaning device 100 of this exemplary embodiment includes, as main constitutional elements of hygienic cleaning 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.

[0030] Hereinafter, the arrangement of the respective constitutional elements is described by assuming a side of hygienic cleaning device 100 where body 200 is disposed as a rear side, a side of the hygienic cleaning 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.

[0031] 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.

[0032] 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 hygienic cleaning device 100. On the other hand, when toilet lid 320 is closed, toilet lid 320 conceals an upper surface of toilet seat 300.

[0033] 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.

[0034] 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.

[0035] Further, seating sensor 330 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.

[0036] Further, as shown in FIGS. 2 and 3, body 200 internally includes, sub tank 600, heat exchanger 700, cleaning unit 500 that includes 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 hygienic cleaning device 100.

[0037] 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.

[0038] 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.

[0039] As shown in FIG. 4, a plurality of switches and display lamps 240 for operating and setting the respective functions of hygienic cleaning 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.

[0040] 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.

[0041] The switches of operation unit 210 are constituted 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.

[0042] 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.

[0043] 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.

[0044] The following operations are performed by a user when the respective switches are operated by pushing.

[0045] 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 hygienic cleaning device

100 is not used, and lowers a warming temperature of toilet seat 300 during the period of time where hygienic cleaning 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.

[0046] Many operations of hygienic cleaning 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.

[0047] 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 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.

[0048] 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.

[0049] 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.

[0050] The following operations are performed by a user when the respective switches are operated by pushing.

[0051] 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 in 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.

[0052] 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.

[0053] 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.

[0054] 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. An open state of toilet seat 300 refers to a state when toilet seat 300 is raised approximately upright when a male person urinates, for example. On the other hand, a closed state of toilet seat 300 refers to a state when toilet seat 300 lies approximately parallel to an upper edge surface of toilet bowl 110. An open state and a closed state of the toilet seat is detected based on a signal detected by toilet seat open and close sensor 331 that is the toilet seat open and close detection unit.

[0055] 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.

[0056] Hygienic cleaning device 100 according to this exemplary embodiment is configured as described above.

<2> Configuration of water circuit of hygienic cleaning device

[0057] Hereinafter, the overall configuration of a water circuit of the hygienic cleaning device according to this exemplary embodiment is described with reference to FIG. 6.

[0058] FIG. 6 is a schematic view showing a configuration of the water circuit of the hygienic cleaning device.

[0059] Cleaning unit 500 shown in FIG. 6 is incorporated in body 200, and cleans a private part of a user.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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 formed into an integral body as shown in FIG. 7.

[0064] 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.

[0065] 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.

[0066] 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.

[0067] Foam generation unit 560 includes check valve 531, foam tank 532, detergent tank 533, detergent pump 534, air pump 535, and the like.

[0068] Branch passage 530 supplies cleaning water, via check valve 531, to foam tank 532 of foam generation unit 560.

[0069] 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.

[0070] 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.

[0071] Broken lines shown in FIG. 6 show that respective components are electrically connected with control unit 130 and controlled by control unit 130.

[0072] 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.

[0073] 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.

[0074] 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.

[0075] 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.

[0076] 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.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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.

[0081] 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.

[0082] 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, vibrations of water pump 516 can effectively be absorbed.

[0083] 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.

[0084] 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 hygienic cleaning device 100 during use can be enhanced.

[0085] 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.

[0086] The water circuit of hygienic cleaning device 100 according to this exemplary embodiment is configured as described above.

<3> Configuration of sub tank

[0087] Hereinafter, the configuration of the sub tank of the hygienic cleaning device of this exemplary embodiment is described with reference to FIGS. 9 to 11.

[0088] 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.

[0089] 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 thermometer, for example, and detects a temperature of cleaning water supplied into the inside of tank body 610.

[0090] 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.

[0091] Water inflow port 601 is formed at a lower por-

tion 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.

[0092] 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.

[0093] 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.

[0094] 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).

[0095] 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.

[0096] 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.

[0097] 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).

[0098] Next, the flow of cleaning water in sub tank 600 is described.

[0099] 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.

[0100] 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.

[0101] 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.

[0102] When air is contained in cleaning water supplied to heat exchanger 700 from sub tank 600, bubbles are generated in heat exchanger 700. Accordingly, there may be a case where a temperature in heat exchanger 700 is abnormally increased so that heat exchanger 700 is damaged. 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.

[0103] 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.

[0104] 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.

[0105] 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.

[0106] A method for detecting a water level of cleaning water using water level electrodes 622 will now be described herein.

[0107] 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 cleaning water in storage tank 616 rises, lower limit electrode 624 and upper limit electrode 623 are immersed in water. In this case, a voltage between common electrode 621 and lower limit electrode 624 and a voltage between common electrode 621 and upper limit electrode 623 are lowered. Consequently, control unit 130 detects a water level of cleaning water based on the lowering of voltages.

[0108] 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.

[0109] Sub tank 600 of this exemplary embodiment is constituted as described above.

<4> Configuration of heat exchanger

[0110] Hereinafter, the configuration of the heat exchanger of the hygienic cleaning device of this exemplary embodiment is described with reference to FIGS. 12 and 13.

[0111] 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.

[0112] 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.

[0113] 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.

[0114] 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.

[0115] 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.

[0116] 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.

[0117] 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.

[0118] 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.

[0119] 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 whereby cleaning water having uniform temperature is flown out from hot water outflow port 712.

[0120] 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.

[0121] Heat exchanger 700 according to this exemplary embodiment is configured as described above.

<6> Configuration of nozzle device

[0122] Hereinafter, the configuration of the nozzle device of the hygienic cleaning device of this exemplary embodiment is described with reference to FIGS. 16 to 28.

[0123] 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.

[0124] 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.

[0125] 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.

[0126] Support portion 810 is formed into a frame shape, and is formed of: 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.

[0127] 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.

[0128] 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 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. Accordingly, with reduced sliding resistance, flexible rack 861 is further securely guided. 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.

[0129] 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.

[0130] 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.

[0131] 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.

[0132] 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 by human waste or the like.

[0133] 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.

[0134] As shown in FIG. 21, nozzle portion 820 includes 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 is joined to nozzle cover 840.

[0135] 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.

[0136] 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.

[0137] 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.

[0138] 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.

[0139] 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.

[0140] 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 por-

tions of connecting member 842.

[0141] 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.

[0142] 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.

[0143] 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.

[0144] 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.

[0145] 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.

[0146] 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 water supply joint 817 of support portion 810 via connecting tube 802.

[0147] Next, hereinafter, connecting portion 850 of this exemplary embodiment which is formed of connecting member 842 of nozzle cover 840 and connection receiving portion 851 of nozzle body 830 is described with reference to FIGS. 22 and 28.

[0148] 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.

[0149] 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.

[0150] 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.

[0151] 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.

[0152] Nozzle device 800 according to this exemplary embodiment is configured as described above.

<6> Control and manner of operation of cleaning unit

[0153] Hereinafter, control and the manner of operation of the cleaning unit of the hygienic cleaning device according to this exemplary embodiment are described.

[0154] Firstly, the basic manner of operation of cleaning unit 500 is described with reference to FIG. 6 hereinafter.

[0155] Firstly, tap water which flows through the city water pipe is supplied to hygienic cleaning device 100 from water supply connecting port 510 as cleaning water. 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 514 is controlled by control unit 130 based on an operation of remote controller 400 and an operation of opera-

tion unit 210.

[0156] 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. 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.

[0157] 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 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.

[0158] 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 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.

[0159] 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.

[0160] Firstly, the description is made with respect to a control of cleaning unit 500 at an initial stage of use of hygienic cleaning device 100 of this exemplary embodiment with reference to FIG. 29.

[0161] FIG. 29 is a timing chart of the cleaning unit at the initial stage of use of the hygienic cleaning device. A term "at an initial stage of use" refers to a state where no cleaning water is stored in cleaning unit 500, such as when hygienic cleaning device 100 is used for a first time after installed, or when hygienic cleaning device 100 is used again after cleaning water has been discharged for preventing cleaning water from freezing.

[0162] 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. 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.

[0163] 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.

[0164] 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. Similarly, 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.

[0165] 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.

[0166] 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, such a 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.

[0167] 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.

[0168] Next, 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.

[0169] 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.

[0170] If water pump 516 is kept driving from the point of time P3, a water level of cleaning water in sub tank 600 lowers. Therefore, at a point of time P7 where water level detection sensor 620 detects a lower limit water level, control unit 130 starts the supply of electricity to water stop electromagnetic valve 514 to supply cleaning water. After that, to a point of time P8 at which water level detection sensor 620 detects the upper limit water level, control unit 130 keeps the supply of electricity to water stop electromagnetic valve 514.

[0171] 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.

[0172] 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 arithmetic processing is finished, control unit 130 adjusts an output of water pump 516 so as to correct the flow rate of cleaning water.

[0173] 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.

[0174] 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.

[0175] 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.

[0176] 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.

[0177] As has been described heretofore, a control of the cleaning unit at the initial stage of use of hygienic cleaning device 100 of this exemplary embodiment is performed.

[0178] Hereinafter, the description is made with respect to a control of the cleaning unit at a usual stage of use of hygienic cleaning device 100 of this exemplary embodiment with reference to FIG. 30.

[0179] FIG. 30 is a timing chart of the cleaning unit at the usual stage of use of the hygienic cleaning device. A term "at a usual stage of use" refers to a state where a hygienic cleaning device that has undergone an initial stage of use and thus is now in a standby state performs a cleaning operation.

[0180] 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 hygienic cleaning device has

undergone an initial stage of use.

[0181] 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.

[0182] 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.

[0183] 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.

[0184] As described above, in the hygienic cleaning 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.

[0185] Further, in the hygienic cleaning 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 hygienic cleaning device having high safety and reliability at a low cost.

[0186] As described above, control and the manner of operation of the cleaning unit of the hygienic cleaning 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

[0187] Hereinafter, control and the manner of operation of the spray nozzle of the hygienic cleaning 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.

[0188] FIG. 31 is a perspective view showing an external appearance of the spray nozzle of the hygienic cleaning 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 hygienic cleaning 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.

[0189] 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 driven and rotated by spray nozzle drive unit 550a fitted via shaft 550n.

[0190] Spray nozzle 550 according to this exemplary embodiment is configured as described above, and operates as described below.

[0191] 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.

[0192] 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.

[0193] Next, how spray nozzle 550 is controlled to discharge cleaning foam or the like will now be described herein with reference to FIG. 6.

[0194] 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.

[0195] Firstly, control unit 130 of hygienic cleaning device 100 detects that, with human body detection sensor 450, a user has entered 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.

[0196] 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.

[0197] 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 to form a water film or a foam film onto the inner surface of the toilet bowl.

[0198] 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.

[0199] 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).

[0200] 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.

[0201] 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.

[0202] Firstly, control unit 130 detects that, with human body detection sensor 450, a user has entered the toilet room. Accordingly, control unit 130 starts the above described control.

[0203] 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 con-

figuring 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.

[0204] 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).

[0205] 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.

[0206] 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.

[0207] 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 from discharge opening 550u.

[0208] More specifically, to discharge cleaning foam 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. Accordingly, the cleaning foam can fully reach to the inner surface on the front side of the toilet bowl.

[0209] On the other hand, to discharge cleaning foam 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. Accordingly, unfavorable events such as splashing of cleaning foam can be prevented.

[0210] 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.

[0211] 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, in a wider area on the inner surface of the toilet bowl, a water film or a foam film can be formed to prevent as much as possible dirt from adhering.

[0212] The above exemplary embodiment has described, without limitation, a configuration of setting, based on an average level of "medium," 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. 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 hygienic cleaning 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.

[0213] 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.

[0214] 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 can securely be sprayed toward a distant area on an inner surface of a toilet bowl, while splashing of the cleaning foam at a nearer area on the inner surface of the toilet bowl can securely be suppressed.

[0215] 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.

[0216] 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 becomes thinner. On the other hand, in an area on the inner surface of the toilet

bowl, which is nearer from discharge opening 550u of spray nozzle 550, spray density of cleaning foam becomes thicker.

[0217] When spraying cleaning foam by changing an output of above described water pump 516, the cleaning foam can be sprayed at uniform spray density to a certain extent.

[0218] However, when cleaning foam 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.

[0219] 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 the upper graph of FIG. 34, when cleaning foam or the like 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 slowly passes around the front side of the toilet bowl so that spray density becomes thicker.

[0220] On the other hand, when cleaning foam or the like 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 the like 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.

[0221] As a result, cleaning water or cleaning foam can be sprayed at uniform (less unevenness) spray density onto the inner surface of the toilet bowl, regardless of a rotational angle. Accordingly, dirt can be prevented as much as possible from adhering over the whole circumference of the inner surface of the toilet bowl.

[0222] 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).

[0223] 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.

[0224] 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 toilet, 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.

[0225] 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 the like. For example, the above described exemplary embodiment may be configured to spray cleaning foam 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.

[0226] 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.

[0227] 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.

[0228] However, when spraying cleaning foam or the like in a reciprocating rotation manner, cleaning foam or the like 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 reduced. Accordingly, cleaning foam or the like 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.

[0229] 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.

[0230] 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.

[0231] 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.

[0232] 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. Cleaning foam or the like 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 the like 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.

[0233] Further, spray nozzle 550 in the above described configuration can always recognize 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-operations, 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 the like 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.

[0234] A configuration of physically restricting a rota-

tional 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.

[0235] Hereinafter, a configuration of foam generation unit 560 of the hygienic cleaning device according to this exemplary embodiment will now be described.

[0236] 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.

[0237] 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.

[0238] 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.

[0239] 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. Further, air pump 535 supplies cleaning water or cleaning foam to be generated to spray nozzle 550.

[0240] Foam generation unit 560 is configured as described above, and operates as described below.

[0241] 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.

[0242] 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.

[0243] 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.

[0244] 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 the like 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.

[0245] 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.

[0246] 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.

[0247] 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.

[0248] Further, the cleaning foam containing detergent effectively suppresses an unpleasant 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.

[0249] 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 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.

[0250] 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 strong an odor smells. As a result, detergent can be saved to provide improved cost performance.

[0251] 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 can effectively and fully be discharged. As a result, a foam 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.

[0252] 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 can be vigorously sprayed farther from discharge opening 550u of spray nozzle 550.

[0253] 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 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.

[0254] 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 CCD, how the toilet bowl is dirty. At this time, control unit 130 follows a result of detection by the dirt detection unit to cause the spray nozzle to intensively spray cleaning foam or the like in a partially reciprocating manner toward 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 through which cleaning foam or the like is intensively sprayed in a partially reciprocating manner toward a still 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 increase respective outputs when discharge opening 550u of spray nozzle 550 passes a still dirty portion. Accordingly, a similar or identical effect can be achieved.

[0255] The control and the manner of operation of the spray nozzle when discharging cleaning foam toward the inner surface of the toilet bowl while no user has seated and the toilet seat is closed have been exemplified.

[0256] That is, control unit 130 rotates a direction of discharge opening 550u of spray nozzle 550 in a wider rotational angle range. At this time, control unit 130 controls an output of water pump 516 configuring the discharge water amount variable unit in a range from "low (small)" to "high (large)" to discharge cleaning foam toward the whole circumference of the inner surface of the toilet bowl. Accordingly, cleaning foam can fully be discharged toward a wider area on the inner surface of the toilet bowl. As a result, a foam film can be formed onto the wider area on the inner surface of the toilet bowl to effectively prevent dirt from adhering.

[0257] Controlling water pump 516 at an output of "high" as described above means that the output is relatively higher than an output of water pump 516 operated under either operation conditions described in items <8> and <9> described later.

<8> Control and manner of operation of spray nozzle when discharging cleaning water, cleaning foam, or the like toward inner surface of toilet bowl while user has seated

[0258] Hereinafter, a discharge control of spray nozzle 550 when a user seats on toilet seat 300 and operates spray switch 417 will now be described with reference to FIGS. 35A and 35B.

[0259] FIG. 35A is an explanatory drawing showing a discharge operation of the spray nozzle toward the inner surface of the toilet bowl. FIG. 35B is an explanatory drawing showing a discharge direction of the spray nozzle toward the inner surface of the toilet bowl.

[0260] In this case, toilet seat open and close detection unit 331 detects that the toilet seat is closed, while seating detection unit 330 detects that a user has seated.

[0261] In a state described above, the user presses spray switch 417 on operation unit 210 or remote controller 400.

[0262] Accordingly, as shown in FIG. 35B, firstly, control unit 130 drives and rotates spray nozzle drive unit 550a to a position at which a direction of discharge opening 550u of spray nozzle 550 faces the rear side of the toilet bowl. Control unit 130 then stops driving of spray nozzle 550. The rear side of the toilet bowl corresponds to, in this exemplary embodiment, a position at which a rotational angle of discharge opening 550u shown in FIG. 35A is, for example, around 100° (see FIG. 33). A rota-

tional angle is not limited to the above described rotational angle, but may be any rotational angle, as long as the rotational angle falls within, for example, a range from approximately 100° to 240° inclusive in a counterclockwise direction.

[0263] Next, control unit 130 controls a discharge output of water pump 516 or air pump 535 configuring the discharge water amount variable unit to an output of "low." Cleaning foam is then discharged from spray nozzle 550, in a direction indicated by an arrow shown in FIG. 35B, toward the rear side of the toilet bowl for a predetermined time. In this exemplary embodiment, a predetermined time is set to, for example, eight seconds.

[0264] That is, under the above described condition, cleaning foam is gently discharged (at an output of "low") toward a position on the rear side of the toilet bowl. Accordingly, the discharged cleaning foam would be less likely to splash toward the user seating on toilet seat 300. Further, the cleaning foam sprayed toward the rear side of the toilet bowl covers over a water level surface in the toilet bowl. Accordingly, an odor along excretion can be suppressed, as well as dirt can be prevented as much as possible from adhering onto the inner surface of the toilet bowl.

[0265] Further, the cleaning foam covering over the water level surface on the toilet bowl serves as cushions when solid and water waste matters excreted by the user seating on the toilet seat dropped onto the water level surface. As a result, through cushioning of the cleaning foam, splashing of such solid and water waste matters around the toilet bowl and the user can be suppressed.

[0266] According to the above described operation of spray nozzle 550, control unit 130 drives and rotates, while the user has seated on the closed toilet seat, when a foam spray signal is input through spray switch 417, spray nozzle drive unit 550a to a position at which a direction of discharge opening 550u of spray nozzle 550 faces the rear side of the toilet bowl, and then control unit 130 stops spray nozzle drive unit 550a. After that, control unit 130 controls water pump 516 and air pump 535 to discharge, at an output of "low," cleaning foam toward the rear side of the toilet bowl.

[0267] That is, while the user has seated on toilet seat 300, cleaning foam is gently discharged toward the inner surface on the rear side of the toilet bowl. Accordingly, without allowing the cleaning foam to splash toward the user, the water level surface on drainage opening 115 can be covered with the cleaning foam. As a result, an odor along excretion can be suppressed, as well as dirt can be prevented as much as possible from adhering onto the inner surface of the toilet bowl.

<9> Control and manner of operation of spray nozzle when discharging cleaning water, cleaning foam, or the like while toilet seat is open and no user has seated

[0268] Hereinafter, a discharge control of the spray nozzle, when a male user is about to urinate without seat-

ing on toilet seat 300, where toilet seat 300 is open approximately upright, and when the user has operated spray switch 417, will now be described with reference to FIGS. 36A and 36B.

[0269] FIG. 36A is an explanatory drawing showing a discharge operation of the spray nozzle toward the inner surface of the toilet bowl. FIG. 36B is an explanatory drawing showing a discharge direction of the spray nozzle toward the inner surface of the toilet bowl.

[0270] In this case, the user is standing, and toilet seat 300 is thus open. That is, toilet seat open and close detection unit 331 detects that the toilet seat is open, while seating detection unit 330 detects that no user has seated.

[0271] In a state as described above, the user presses spray switch 417 on operation unit 210 or remote controller 400.

[0272] Accordingly, as shown in FIG. 36B, firstly, control unit 130 drives and rotates spray nozzle drive unit 550a to a position at which a direction of discharge opening 550u of spray nozzle 550 faces drainage opening 115 of the toilet bowl. Control unit 130 then stops driving of spray nozzle 550. In this exemplary embodiment, spray nozzle drive unit 550a stops at a position (see FIG. 33) at which a rotational angle of discharge opening 550u shown in FIG. 36A is, for example, around 150°. Accordingly, a direction of discharge opening 550u faces drainage opening 115 of the toilet bowl.

[0273] Next, control unit 130 controls a discharge output of water pump 516 or air pump 535 configuring the discharge water amount variable unit to, as shown in FIG. 36A, an output of approximately "medium." Cleaning foam is then discharged from spray nozzle 550, in a direction indicated by an arrow shown in FIG. 36B, toward drainage opening 115 of the toilet bowl for a predetermined time. In this exemplary embodiment, a predetermined time is set to, for example, eight seconds. Accordingly, the discharged cleaning foam covers over a water surface, in other words, a water level surface, on drainage opening 115. An output of approximately "medium" described above means, in this exemplary embodiment, an output to an extent that cleaning foam or the like directly reaches drainage opening 115 of the toilet bowl.

[0274] That is, under the above described condition, control unit 130 controls the discharge water amount variable unit to discharge cleaning foam or the like at an output of approximately "medium." Cleaning foam is then discharged beforehand around the water level surface on drainage opening 115 so that the cleaning foam promptly covers the water level surface. Accordingly, an odor along excretion including urination can be suppressed, as well as dirt can be prevented as much as possible from adhering onto an area around the water level surface in the toilet bowl.

[0275] Further, the cleaning foam covering over the water level surface serves as cushions when a water waste matter excreted dropped onto around the water level surface. As a result, through cushioning of the clean-

ing foam, splashing of such a water waste matter around the toilet bowl can be suppressed.

[0276] FIGS. 36A and 36B have exemplified that, without limitation, cleaning foam is discharged toward a point around a center of drainage opening 115 of the toilet bowl. For example, cleaning foam may be discharged from discharge opening 550u of spray nozzle 550 in any direction, as long as the cleaning foam fully covers the water level surface on drainage opening 115. In this case, the cleaning foam may be sprayed toward front, center, rear, left, or right around the water level surface on drainage opening 115 of the toilet bowl. That is, the cleaning foam will be sprayed toward around an area (including within the area) of the water level surface on drainage opening 115. Accordingly, within a few seconds after discharged, cleaning foam can be sprayed toward the water level surface. As a result, dirt can further securely be prevented from adhering onto an area around the water level surface on the toilet bowl.

[0277] At this time, it is not necessary that cleaning foam be discharged from discharge opening 550u that is stationary at a fixed rotational angle. For example, cleaning foam may be sprayed while causing spray nozzle 550 to move in a reciprocating manner in a narrower area around the water level surface on drainage opening 115. Further, cleaning foam may be discharged at varied discharge outputs of water pump 516 and air pump 535. Accordingly, the water level surface on drainage opening 115 can effectively be covered with cleaning foam.

[0278] According to the above described operation of spray nozzle 550, control unit 130 drives and rotates, while the user has not seated on the toilet seat, and the toilet seat is open, when a foam spray signal is input through spray switch 417, spray nozzle drive unit 550a to a position at which a direction of discharge opening 550u of spray nozzle 550 faces the drainage opening of toilet bowl, and then control unit 130 stops spray nozzle drive unit 550a. After that, water pump 516 and air pump 535 are controlled to discharge, at an output of approximately "medium," cleaning foam toward an area around the water level surface on drainage opening 115 of toilet bowl.

[0279] That is, while the user has not seated on toilet seat 300, and the toilet seat is open, and when the user has operated spray switch 417, cleaning foam is discharged at a magnitude of approximately "medium" toward the water level surface on drainage opening 115 of toilet bowl 110. Accordingly, the water level surface on drainage opening 115 of toilet bowl 110 can be covered with cleaning foam. As a result, an odor along urination can be suppressed, as well as dirt can be prevented as much as possible from adhering onto around the water level surface of toilet bowl 110.

[0280] As described above, in the hygienic cleaning device according to this exemplary embodiment, control unit 130 changes, in accordance with whether a user has seated on toilet seat 300, and whether the toilet seat is open or closed, a direction of discharge opening 550u of

spray nozzle 550 and an output of the discharge water amount variable unit. Accordingly, spray nozzle 550 for discharging cleaning foam can be used in a diversified manner in accordance with a situation of use of hygienic cleaning device 100. As a result, a foam amount can appropriately be controlled, and detergent can be saved, in accordance with the situation of use.

[0281] Hereinafter, another exemplary hygienic cleaning device according to this exemplary embodiment will be described with reference to FIGS. 37 and 38.

[0282] FIG. 37 is a perspective view showing an external appearance of a state where another exemplary hygienic cleaning device according to this exemplary embodiment of the present invention is installed on a toilet bowl. FIG. 38 is a perspective view of a body of another exemplary hygienic cleaning device according to the exemplary embodiment.

[0283] As shown in FIGS. 37 and 38, in another exemplary hygienic cleaning device 100Y according to this exemplary embodiment, in toilet bowl 110Y with a toilet seat, body 200Y is fixed interposed between toilet bowl 110Y and toilet seat 300Y. Therefore, hygienic cleaning device 100Y differs from hygienic cleaning device 100 according to the above described exemplary embodiment. Other configurations and the manner of operation are identical to the configurations and the manner of operation of the above described exemplary embodiment, and are thus omitted.

[0284] In this case, hygienic cleaning device 100Y is installed as described below.

[0285] Firstly, loosen bolts and nuts (not shown in the drawing) on toilet bowl 110Y.

[0286] Next, insert a bolt so that the bolt fits to bolt groove 200M of body 200Y shown in FIG. 38.

[0287] Next, with bolt groove 200M of body 200Y fitted, tighten the bolts and nuts. With the above described operation, install and fix body 200Y of hygienic cleaning device 100Y onto toilet bowl 110Y.

[0288] Further, body 200Y of hygienic cleaning device 100Y includes, similar to hygienic cleaning device 100 according to the above described exemplary embodiment, toilet seat 300Y, toilet lid 320Y, spray nozzle 550, cleaning water nozzle 831Y, a water pump (not shown in the drawing) configuring a discharge water amount variable unit, a spray nozzle drive unit, an opening and closing valve for opening and closing a branch passage to spray nozzle 550, a control unit, operation unit 210, and the like.

[0289] Above described hygienic cleaning device 100Y includes, but not limited to, in addition to spray nozzle 550, cleaning water nozzle 831Y for cleaning a private part of a human body. For example, a hygienic cleaning device may not include cleaning water nozzle 831Y.

[0290] The control unit of above described hygienic cleaning device 100Y changes, similar to hygienic cleaning device 100 according to the exemplary embodiment, in accordance with a rotational angle of the discharge opening of spray nozzle 550, an output of the discharge

water amount variable unit to discharge cleaning water or cleaning foam toward an inner surface of the toilet bowl.

[0291] At this time, as described above, depending on a rotational angle direction of discharge opening 550u of spray nozzle 550, a distance from spray nozzle 550 to the inner surface of the toilet bowl differs.

[0292] Therefore, the control unit drives, when a distance from the discharge opening to the inner surface of the toilet bowl is at maximum, the water pump configuring the discharge water amount variable unit at an output of "large (high)." On the other hand, when a distance from the discharge opening to the inner surface of the toilet bowl is at minimum, the control unit drives the water pump at an output of "small (low)." That is, in accordance with a rotational angle of the discharge opening, a jetting amount (and a jetting speed) of cleaning water, cleaning foam, or the like is (are) controlled. Accordingly, cleaning water or cleaning foam can fully and evenly be discharged over an inner peripheral surface of the toilet bowl. As a result, a water film or a foam film can be formed beforehand on the inner surface on the front side of the toilet bowl in order to prevent as much as possible dirt from adhering.

[0293] At this time, similar to the above described exemplary embodiment, in accordance with a rotational angle of the discharge opening of spray nozzle 550, the spray nozzle drive unit may be configured to change a rotational speed of the rotation nozzle. Accordingly, cleaning water, cleaning foam, or the like can be discharged at further uniform spray density onto the inner surface of the toilet bowl. As a result, dirt can further effectively be prevented from adhering.

[0294] As described above, the hygienic cleaning device according to the present invention includes a body provided on a toilet bowl, a foam generation unit for generating cleaning foam, a spray nozzle for forming a water film or a foam film onto an inner surface of the toilet bowl, and a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to the spray nozzle. The hygienic cleaning device further includes a spray nozzle drive unit for rotating a direction of a discharge opening of the spray nozzle, an opening and closing valve for opening and closing a water passage to the spray nozzle, a control unit, and an operation unit for setting an instruction for the control unit. The control unit may change, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the discharge water amount variable unit to cause the spray nozzle to discharge cleaning water or cleaning foam.

[0295] Accordingly, the spray nozzle for discharging cleaning water or cleaning foam can be used in a diversified manner in accordance with a situation of use of the hygienic cleaning device.

[0296] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, when a direction of the discharge open-

ing of the spray nozzle faces a front side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is longer, an output of the discharge water amount variable unit is increased, and, when a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is shorter, an output of the discharge water amount variable unit is reduced.

[0297] Accordingly, cleaning water or cleaning foam can be sprayed to form a water film or a foam film onto a whole circumference of the inner surface of the toilet bowl. As a result, dirt can be prevented as much as possible from adhering.

[0298] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that the spray nozzle sprays cleaning water or cleaning foam toward a plurality of areas at different heights on the inner surface of the toilet bowl.

[0299] Accordingly, cleaning water or cleaning foam can be discharged over or a desired area on the inner surface of the toilet bowl.

[0300] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, within a predetermined rotational angle range of the spray nozzle, through at least one reciprocating cycle of positive and reverse rotation operations, the spray nozzle sprays cleaning water or cleaning foam toward the inner surface of the toilet bowl.

[0301] Accordingly, a non-sprayed area can be reduced. Accordingly, cleaning foam or the like can further evenly be sprayed toward the inner surface of the toilet bowl.

[0302] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that the discharge water amount variable unit is set to a lower output, when the spray nozzle is positive-rotated, than an output of the discharge water amount variable unit when the spray nozzle is reverse-rotated to cause the spray nozzle to discharge cleaning water or cleaning foam.

[0303] Accordingly, in reciprocating driving and rotating of the spray nozzle, when the spray nozzle is positive-rotated, cleaning foam can be sprayed toward an area near a water level surface inside a rim of the toilet bowl, while, when the spray nozzle is reverse-rotated, cleaning foam can be sprayed toward an area near the rim of the toilet bowl. Accordingly, in an initial stage of spraying of cleaning foam, the cleaning foam can promptly cover the water level surface on the drainage opening of the toilet bowl, and then cleaning foam can be sprayed toward an approximately whole circumference of the inner surface near the rim of the toilet bowl. As a result, a foam film can fully be formed onto the inner surface from the front side to the rear side of the toilet bowl to effectively prevent dirt from adhering.

[0304] Further, the control unit of the hygienic cleaning device according to the present invention may perform

a control so that, in accordance with a rotational angle of the discharge opening of the spray nozzle, a rotational speed of the discharge opening of the spray nozzle is changed.

[0305] Accordingly, spray density of cleaning water or cleaning foam to be sprayed toward the whole inner surface of the toilet bowl can be adjusted as desired.

[0306] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, when a direction of the discharge opening of the spray nozzle faces a front side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is longer, a rotational speed of the discharge opening of the spray nozzle is reduced, and, when a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is shorter, a rotational speed of the discharge opening of the spray nozzle is increased.

[0307] Accordingly, cleaning water or cleaning foam can be sprayed at further uniform spray density toward the whole inner surface of the toilet bowl.

[0308] Further, the hygienic cleaning device according to the present invention may include, on a rear side of the toilet bowl, a rotation restriction unit for restricting a rotational range of the spray nozzle, where the control unit may perform a control so that the spray nozzle is reciprocating-rotated within a rotational range that is not restricted by the rotation restriction unit.

[0309] According to this configuration, even when the rotation nozzle of the spray nozzle is reciprocating-operated, a position difference in origin can be reduced. Accordingly, improved positional accuracy in rotational angle of the spray nozzle relative to the inner surface of the toilet bowl, and improved accuracy in rotational speed can be achieved. As a result, cleaning foam or the like can always be sprayed toward an identical position on the inner surface of the toilet bowl at an identical discharge output and identical spray density.

[0310] Further, the foam generation unit of the hygienic cleaning device according to the present invention includes a foam tank for which cleaning water is supplied by the discharge water amount variable unit, a detergent pump for supplying detergent in a detergent tank to the foam tank, and an air pump for supplying air to the foam tank. Cleaning water or cleaning foam generated in the foam tank may then be discharged from the spray nozzle.

[0311] According to this configuration, cleaning water or cleaning foam containing detergent is discharged toward the inner surface of the toilet bowl. Accordingly, an improved cleaning effect and an improved dirt-adhesion suppression effect can be achieved. Further, with cleaning foam, an unpleasant odor can be suppressed, and, simultaneously, a visually clean impression can be provided. As a result, the user can feel much more comfortable.

[0312] Further, the control unit of the hygienic cleaning device according to the present invention may perform

a control so that, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the air pump is changed to discharge cleaning water or cleaning foam from the discharge opening of the spray nozzle toward the inner surface of the toilet bowl.

[0313] Accordingly, the spray nozzle for discharging cleaning water or cleaning foam can be used in a diversified manner in accordance with a situation of use of the hygienic cleaning device.

[0314] Further, the hygienic cleaning device according to the present invention further includes a human body detection sensor for detecting whether a user has entered or exited a toilet room. The control unit may then perform a control so that, upon the human body detection sensor detects that a user has entered the toilet room, the cleaning water or the cleaning foam is sprayed from the discharge opening of the spray nozzle toward the inner surface of the toilet bowl at a predetermined rotation speed or for a predetermined time.

[0315] According to this configuration, cleaning water or cleaning foam is 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.

[0316] The hygienic cleaning device according to the present invention further includes a toilet seat tiltably provided on the toilet bowl, a seating detection unit for detecting whether a user has seated on the toilet seat, and a toilet seat open and close detection unit for detecting whether the toilet seat is open or closed. The control unit may then perform a control so that, in accordance with signals sent from the seating detection unit and the toilet seat open and close detection unit, a direction of the discharge opening of the spray nozzle for discharging cleaning water or cleaning foam and an output of the discharge water amount variable unit are changed.

[0317] According to this configuration, based on signals detected by the seating detection unit and the toilet seat open and close detection unit, a discharge output of cleaning water or cleaning foam from the spray nozzle and a rotational speed of the spray nozzle are controlled. Accordingly, the spray nozzle for discharging cleaning water or cleaning foam can be used in a diversified manner in accordance with a situation of use of the hygienic cleaning device.

[0318] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, when a signal sent from the seating detection unit shows that the user has not seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is closed, and a foam spray signal is input, while a direction of the discharge opening of the spray nozzle is rotated, an output of the discharge water amount variable unit is adjusted to cause the spray nozzle to discharge cleaning water or cleaning foam toward the whole circumference of the inner surface of the toilet bowl.

[0319] According to this configuration, an output of the discharge water amount variable unit is adjusted, in accordance with a direction of the discharge opening of the spray nozzle, in a range from "high (large)" to "low (small)" to discharge cleaning foam or the like. Accordingly, cleaning water or cleaning foam can fully and securely be discharged in a wider area on the inner surface of the toilet bowl. As a result, in a wider area on the inner surface of the toilet bowl, a water film or a foam film can be formed to prevent as much as possible dirt from adhering.

[0320] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, when a signal sent from the seating detection unit shows that the user has seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is closed, and a foam spray signal is input, after a direction of the discharge opening of the spray nozzle is rotated to a position at which a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, and then the spray nozzle is stopped, the discharge water amount variable unit is set to a lower output to cause the spray nozzle to discharge cleaning foam toward the rear side of the toilet bowl.

[0321] According to this configuration, when a user has seated on the toilet seat, cleaning water or cleaning foam is gently discharged toward the inner surface on the rear side of the toilet bowl. Accordingly, cleaning foam or the like can be sprayed without being splashed toward the user. As a result, an unpleasant odor along excretion can be suppressed, as well as dirt can be prevented as much as possible from adhering onto the inner surface of the toilet bowl.

[0322] Further, the control unit of the hygienic cleaning device according to the present invention may perform a control so that, when a signal sent from the seating detection unit shows that the user has not seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is open, and a foam spray signal is input, after a direction of the discharge opening of the spray nozzle is rotated to a position at which a direction of the discharge opening of the spray nozzle faces the drainage opening of the toilet bowl, and then the spray nozzle is stopped, the discharge water amount variable unit is set to a medium output to cause the spray nozzle to discharge cleaning foam toward the drainage opening of the toilet bowl.

[0323] According to this configuration, for example, when a male user is about to urinate without seating on the toilet seat, and a signal sent from the toilet seat open and close detection unit shows that the toilet seat is open, cleaning foam is discharged at a medium magnitude toward the drainage opening of the toilet bowl. Accordingly, the water level surface on the drainage opening of the toilet bowl can be covered with cleaning foam. As a result, an unpleasant odor along urination can be suppressed, as well as dirt can be prevented as much as possible from adhering onto around the water level surface of the

toilet bowl.

INDUSTRIAL APPLICABILITY

[0324] The present invention is applicable to hygienic cleaning devices in which a spray nozzle for discharging cleaning foam or the like is required to be used in a diversified manner in accordance with a situation of use, and water application devices equipped with such a spray nozzle.

REFERENCE MARKS IN THE DRAWINGS

[0325]

100, 100Y: hygienic cleaning device
 101, 110, 110Y: toilet bowl
 102, 300, 300Y: toilet seat
 103: toilet seat body
 104, 831Y: cleaning water nozzle
 105: water spray nozzle
 106: water supply passage
 107: water supply body
 108: water diffusing body
 109: rib
 115: drainage opening
 120: deodorizing device
 130: control unit
 200, 200Y: body
 200M: bolt groove
 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
 320, 320Y: toilet lid
 330: seating sensor (seating detection unit)
 331: toilet seat open and close sensor (toilet seat open and close detection unit)
 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		615a: upper surface opening portion
418: toilet lid switch		616: storage tank
419: toilet seat switch		617: barrier wall
421: display lamp		618: flow straightening rib
422: position display lamp	5	620: water level detection sensor
450: human body detection sensor		621: common electrode
500: cleaning unit		622: water level electrode
501: chassis		623: upper limit electrode
501a: water pump mounting portion		624: lower limit electrode
501b: leg portion	10	630: inflow water temperature sensor
502: connecting tube		690: cleaning water supply passage
510: water supply connecting port		700: heat exchanger
511: strainer		701: casing
512: check valve		702: flat-plate-like heater
513: constant flow regulating valve	15	703: hot water outflow member
514: water stop electromagnetic valve		710: front surface member
515: relief valve		711: water inflow port
516: water pump (discharge water amount variable unit)		712: hot water outflow port
516a: motor unit	20	713: water inflow passage
516b: link mechanism part		714: slit
516c: piston unit		715: heating passage
516d: water suction port		716: partition rib
516e: discharge opening		717: water through hole
517: flow regulating valve	25	718: projection
517a: valve body		720: back surface member
517b: stepping motor		730: outflow hot water temperature sensor
517c: water supply port		731: excessively elevated temperature sensor
530: branch passage		750: buffer tank
530a: opening and closing valve	30	800: nozzle device
531: check valve		801: nozzle lid
532: foam tank		802: connecting tube
533: detergent tank		810: support portion
534: detergent pump		811: bottom side portion
535: air pump (discharge water amount variable unit)	35	812: inclined portion
550: spray nozzle		813: vertical side portion
550a: spray nozzle drive unit		814: guide rail
550b: inlet passage		815: rack guide
550c: body		816: holding portion
550d: rotation nozzle	40	817: water supply joint
550e: O-ring		820: nozzle portion
550f: O-ring		830: nozzle body
550h: inlet hole		831: buttock cleaning water nozzle
550n: shaft		832: bidet cleaning water nozzle
550u: discharge opening	45	833: nozzle cleaning unit
560: foam generation unit		834: buttock cleaning water jetting port
600: sub tank		835: buttock cleaning water passage
601: water inflow port		835a: straightening plate
602: water outflow port		836: bidet cleaning water jetting port
603: atmosphere open port	50	837: bidet cleaning water passage
610: tank body		838: nozzle cleaning water jetting port
611: front tank		839: nozzle cleaning water passage
612: rear tank		840: nozzle cover
613: atmosphere open portion		841: nozzle cover body
613a: buffer portion	55	842: connecting member
613b: flow passage		843: connecting piece
614: partition wall		843a: connecting projection
615: water inflow tank		844: jetting opening
		845: discharge opening

850: connecting portion
 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 hygienic cleaning device comprising:

a body provided on a toilet bowl;
 a foam generation unit for generating cleaning foam;
 a spray nozzle for forming a water film or a foam film onto an inner surface of the toilet bowl;
 a discharge water amount variable unit for variably changing a flow rate of cleaning water or cleaning foam to be delivered to the spray nozzle;
 a spray nozzle drive unit for rotating a direction of a discharge opening of the spray nozzle;
 an opening and closing valve for opening and closing a water passage to the spray nozzle;
 a control unit; and
 an operation unit for setting an instruction for the control unit,
 wherein the control unit changes, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the discharge water amount variable unit to cause the spray nozzle to discharge the cleaning water or the cleaning foam.

2. The hygienic cleaning device according to claim 1, wherein the control unit performs a control so that, when a direction of the discharge opening of the spray nozzle faces a front side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is longer, an output of the discharge water amount variable unit is increased, and, when a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is shorter, an output of the discharge water amount variable unit is reduced.

3. The hygienic cleaning device according to claim 1, wherein the control unit performs a control so that the spray nozzle sprays the cleaning water or the cleaning foam toward a plurality of areas at different heights on the inner surface of the toilet bowl.

4. The hygienic cleaning device according to claim 1, wherein the control unit performs a control so that,

within a predetermined rotational angle range of the spray nozzle, through at least one reciprocating cycle of positive and reverse rotation operations, the spray nozzle sprays the cleaning water or the cleaning foam toward the inner surface of the toilet bowl.

5. The hygienic cleaning device according to claim 4, wherein the control unit performs a control so that the discharge water amount variable unit is set to a lower output, when the spray nozzle is positive-rotated, than an output of the discharge water amount variable unit when the spray nozzle is reverse-rotated to cause the spray nozzle to discharge the cleaning water or the cleaning foam.

6. The hygienic cleaning device according to claim 1, wherein the control unit performs a control so that, in accordance with a rotational angle of the discharge opening of the spray nozzle, a rotational speed of the discharge opening of the spray nozzle is changed.

7. The hygienic cleaning device according to claim 6, wherein the control unit performs a control so that, when a direction of the discharge opening of the spray nozzle faces a front side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is longer, the rotational speed of the discharge opening of the spray nozzle is reduced, and, when a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, at a rotational angle of which a distance to the inner surface of the toilet bowl is shorter, the rotational speed of the discharge opening of the spray nozzle is increased.

8. The hygienic cleaning device according to claim 1, further comprising, on a rear side of the toilet bowl, a rotation restriction unit for restricting a rotational range of the spray nozzle, wherein the control unit performs a control so that the spray nozzle is reciprocating-rotated within a rotational range that is not restricted by the rotation restriction unit.

9. The hygienic cleaning device according to claim 1, wherein the foam generation unit includes a foam tank for which cleaning water is supplied by the discharge water amount variable unit, a detergent pump for supplying detergent in a detergent tank to the foam tank, and an air pump for supplying air to the foam tank, wherein the cleaning water or the cleaning foam generated in the foam tank is discharged from the spray nozzle.

10. The hygienic cleaning device according to claim 9, wherein the control unit performs a control so that, in accordance with a rotational angle of the discharge opening of the spray nozzle, an output of the air pump

is changed to discharge the cleaning water or the cleaning foam from the discharge opening of the spray nozzle toward the inner surface of the toilet bowl.

11. The hygienic cleaning device according to claim 1, further comprising a human body detection sensor for detecting whether a user has entered or exited a toilet room, wherein the control unit performs a control so that, upon the human body detection sensor detects that a user has entered the toilet room, the cleaning water or the cleaning foam is sprayed from the discharge opening of the spray nozzle toward the inner surface of the toilet bowl at a predetermined rotation speed or for a predetermined time.
12. The hygienic cleaning device according to claim 1, further comprising a toilet seat tiltably provided on the toilet bowl, a seating detection unit for detecting whether a user has seated on the toilet seat, and a toilet seat open and close detection unit for detecting whether the toilet seat is open or closed, wherein the control unit performs a control so that, in accordance with signals sent from the seating detection unit and the toilet seat open and close detection unit, a direction of the discharge opening of the spray nozzle for discharging the cleaning water or the cleaning foam and an output of the discharge water amount variable unit are changed.
13. The hygienic cleaning device according to claim 12, wherein the control unit performs a control so that, when a signal sent from the seating detection unit shows that a user has not seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is closed, and a foam spray signal is input, while a direction of the discharge opening of the spray nozzle is rotated, an output of the discharge water amount variable unit is adjusted to cause the spray nozzle to discharge the cleaning water or the cleaning foam toward a whole circumference of an inner surface of the toilet bowl.
14. The hygienic cleaning device according to claim 12, wherein the control unit performs a control so that, when a signal sent from the seating detection unit shows that a user has seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is closed, and a foam spray signal is input, after a direction of the discharge opening of the spray nozzle is rotated to a position at which a direction of the discharge opening of the spray nozzle faces a rear side of the toilet bowl, and then the spray nozzle is stopped, the discharge water amount variable unit is set to a lower output to cause the spray nozzle to discharge the cleaning foam toward the rear side of the toilet bowl.

15. The hygienic cleaning device according to claim 12, wherein the control unit performs a control so that, when a signal sent from the seating detection unit shows that a user has not seated, a signal sent from the toilet seat open and close detection unit shows that the toilet seat is open, and a foam spray signal is input, after a direction of the discharge opening of the spray nozzle is rotated to a position at which a direction of the discharge opening of the spray nozzle faces a drainage opening of the toilet bowl, and then the spray nozzle is stopped, the discharge water amount variable unit is set to a medium output to cause the spray nozzle to discharge the cleaning foam toward the drainage opening of the toilet bowl.

FIG. 1

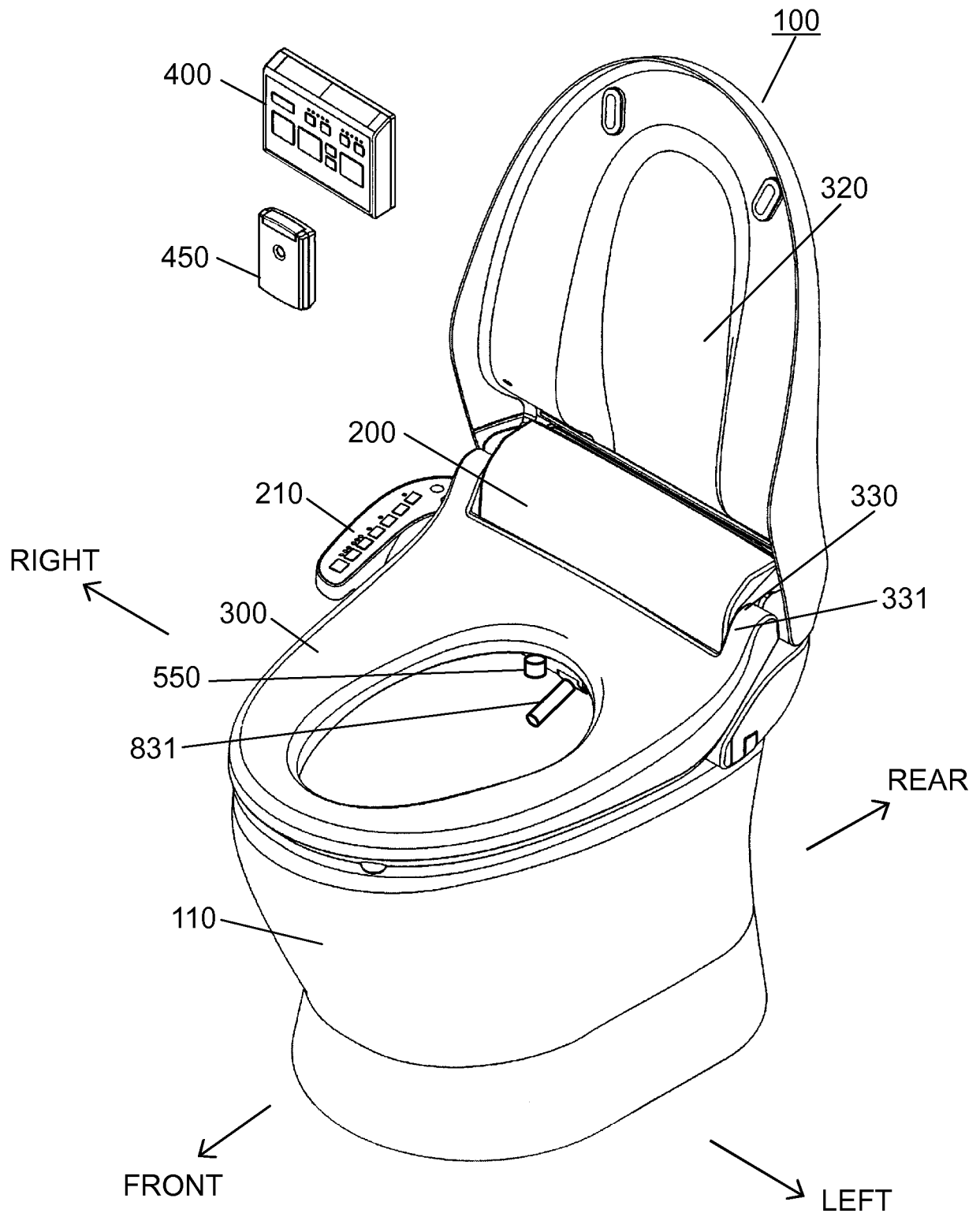


FIG. 2

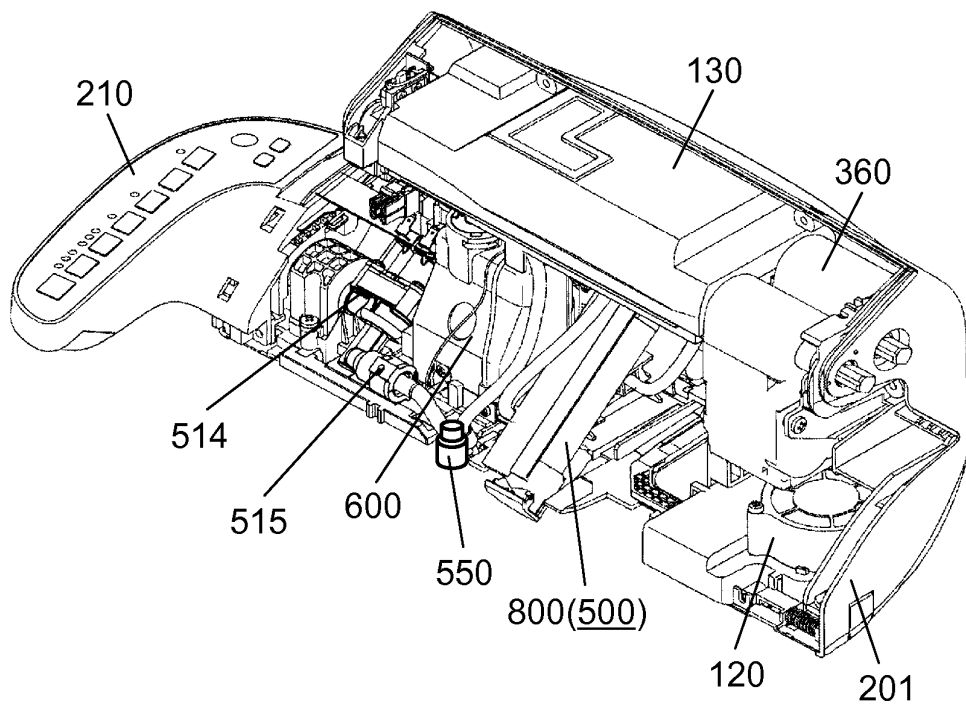


FIG. 3

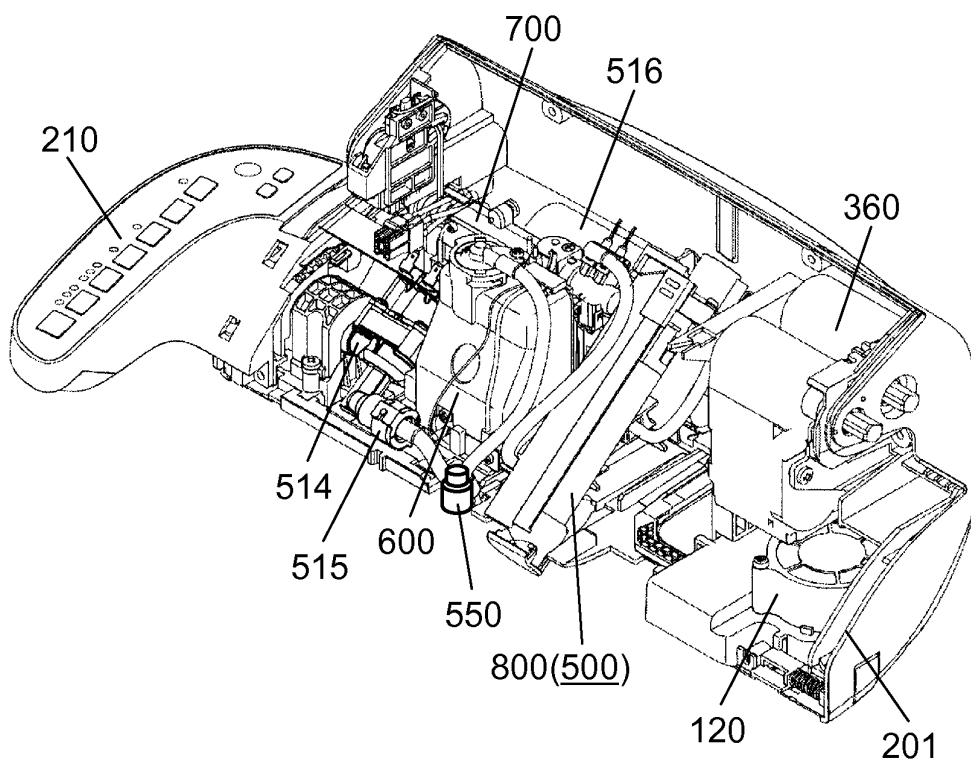


FIG. 4

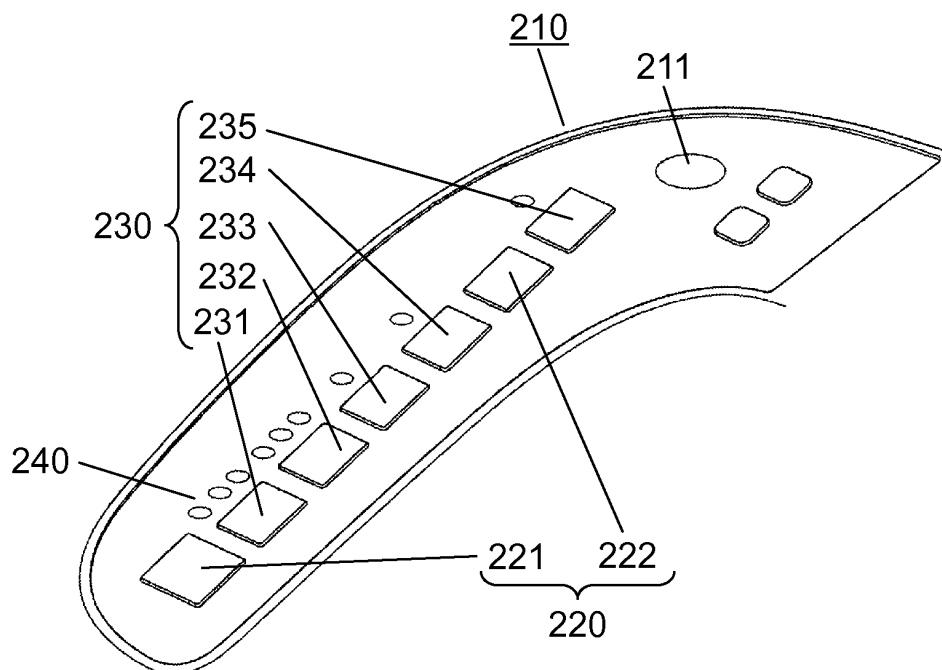


FIG. 5

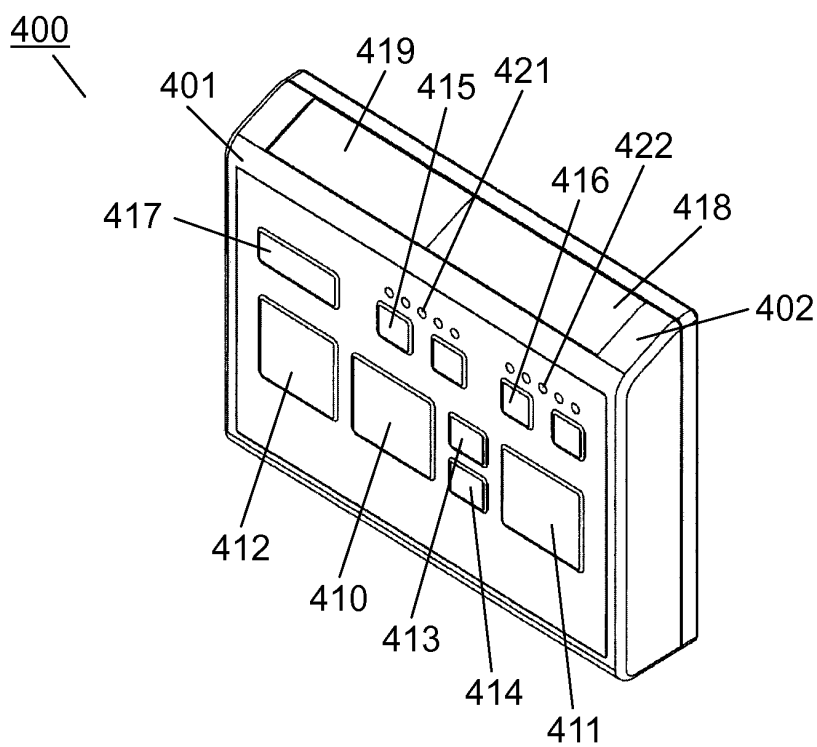


FIG. 6

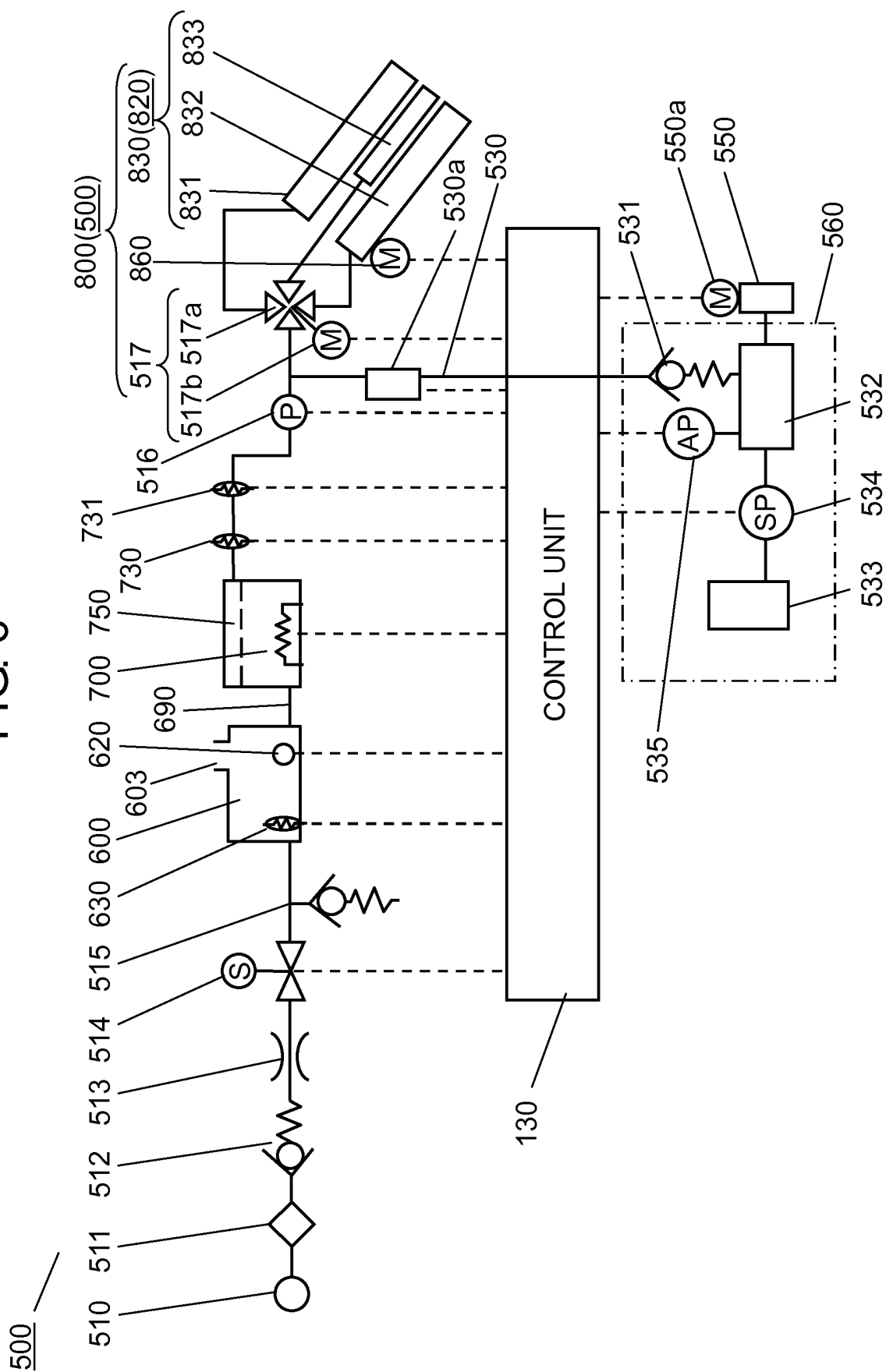


FIG. 7

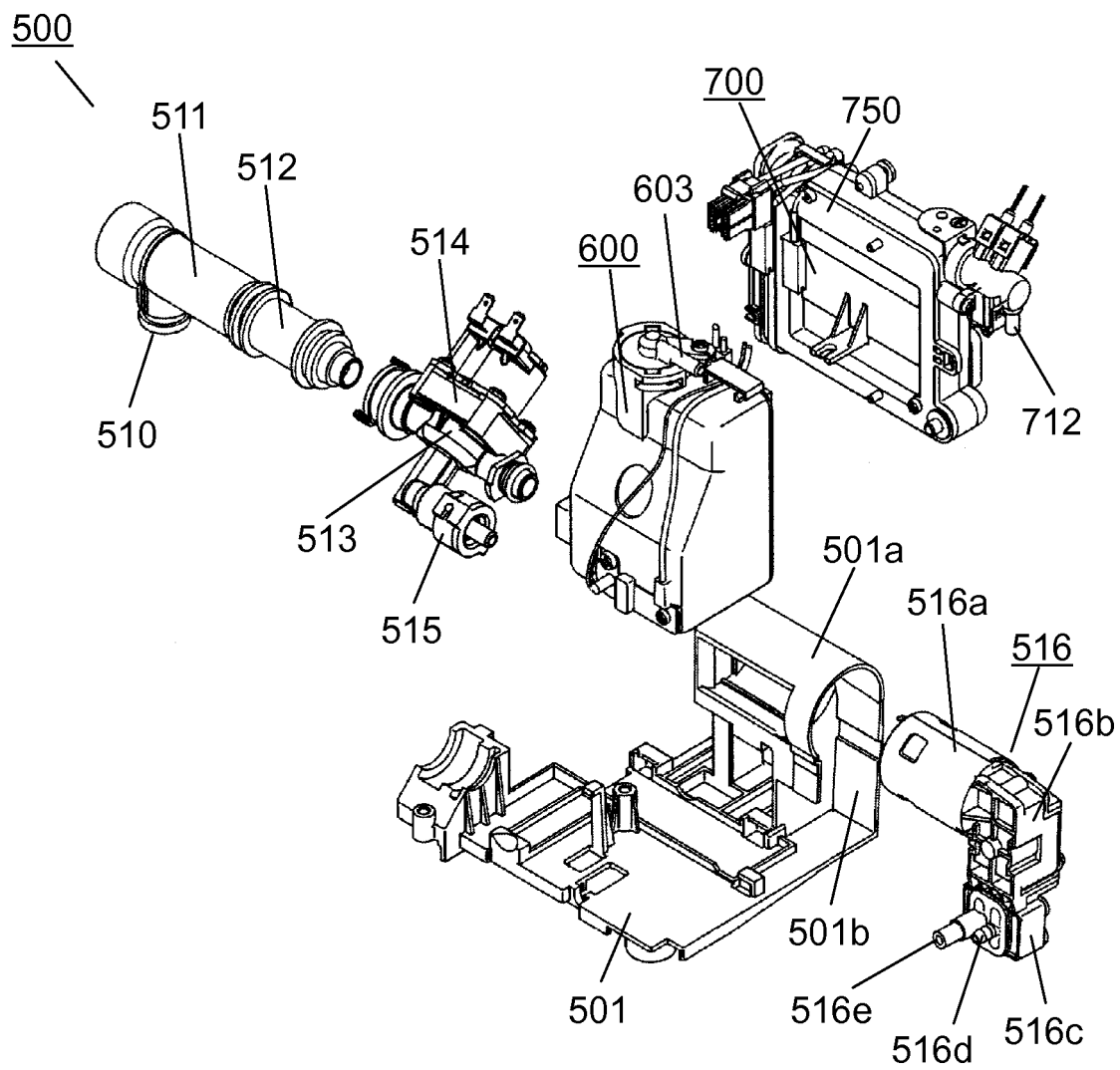


FIG. 8

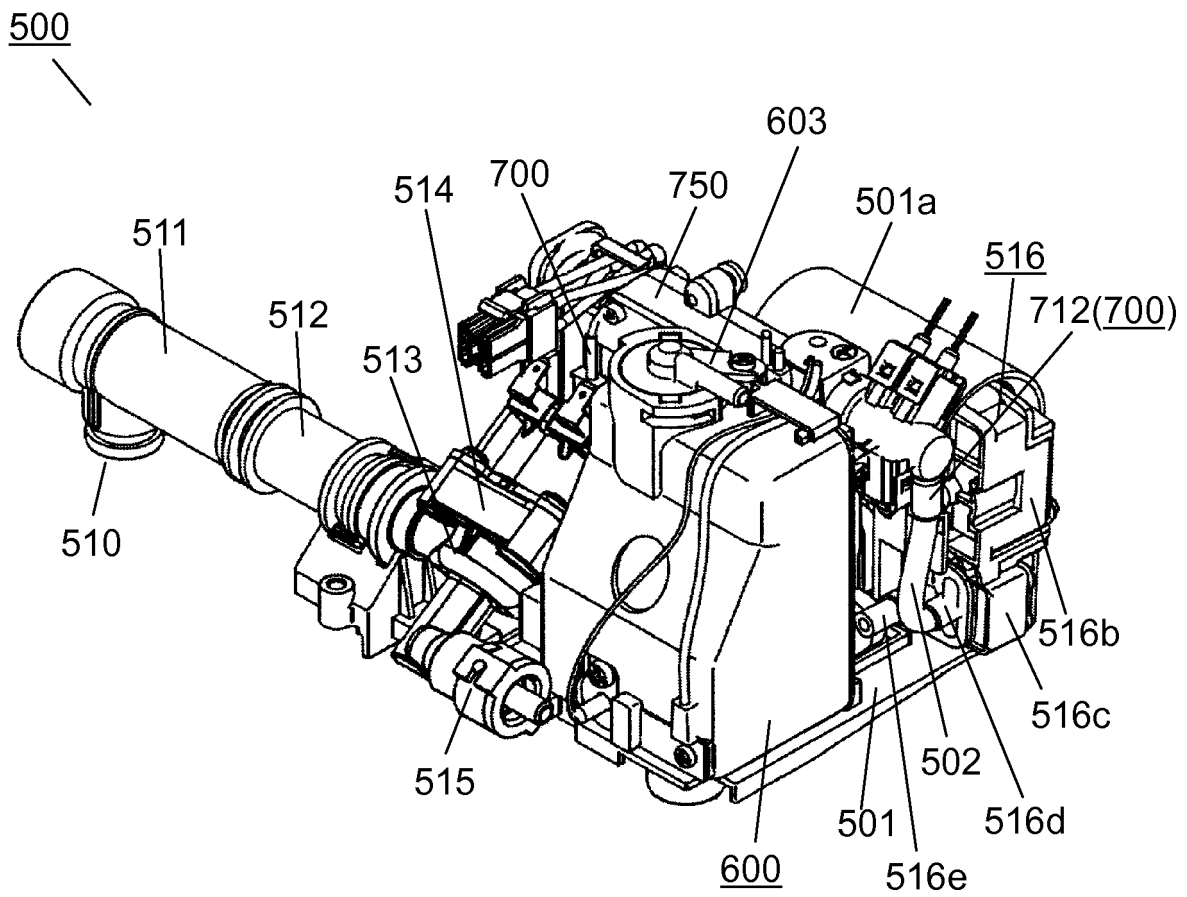


FIG. 9

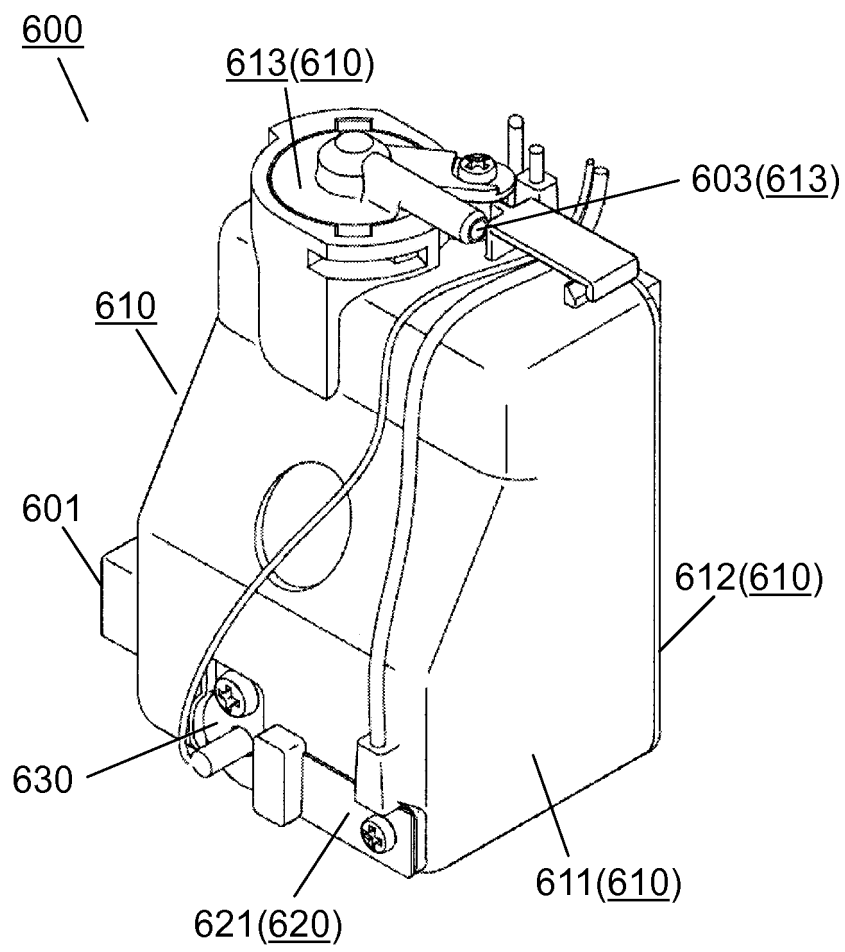


FIG. 10

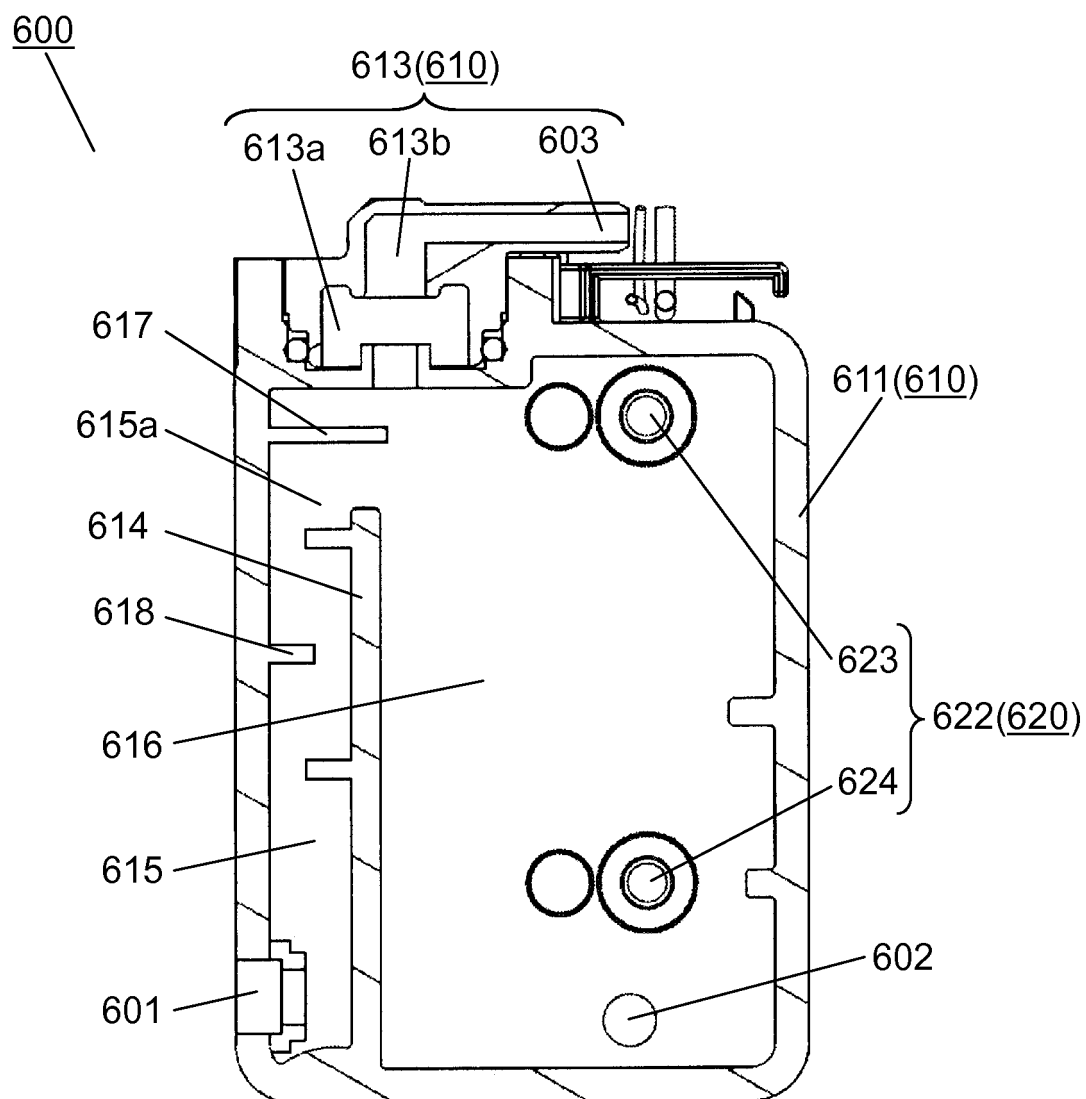


FIG. 11

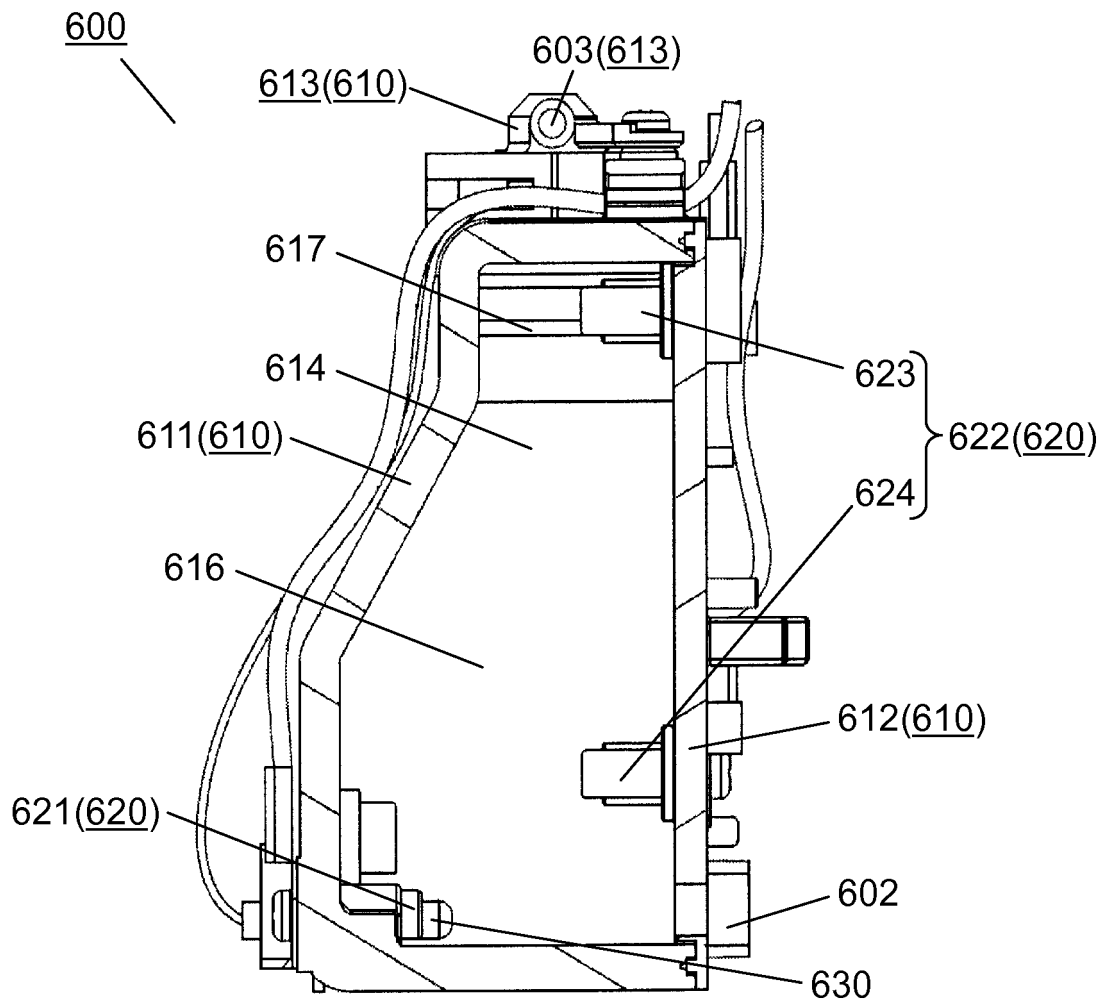


FIG. 12

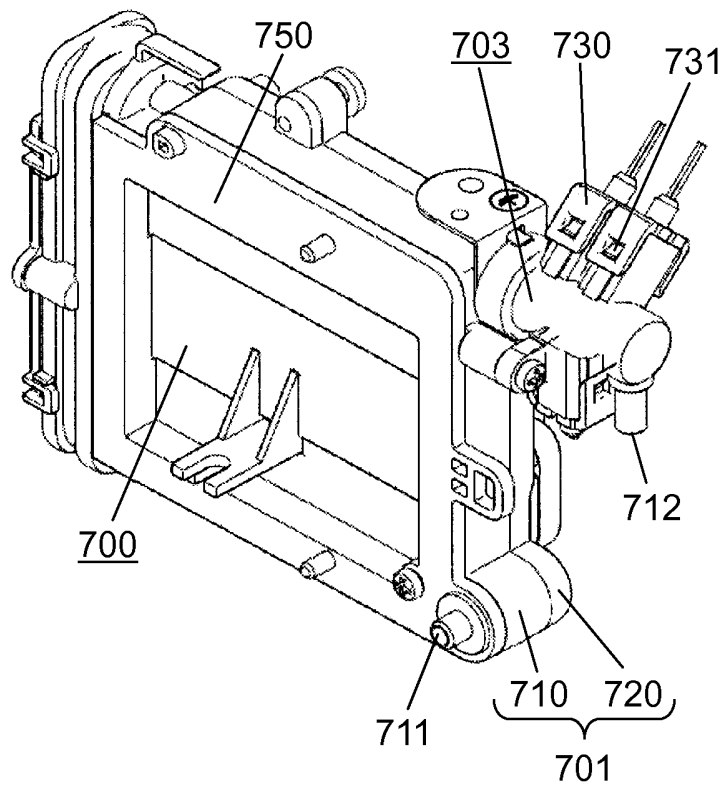


FIG. 13

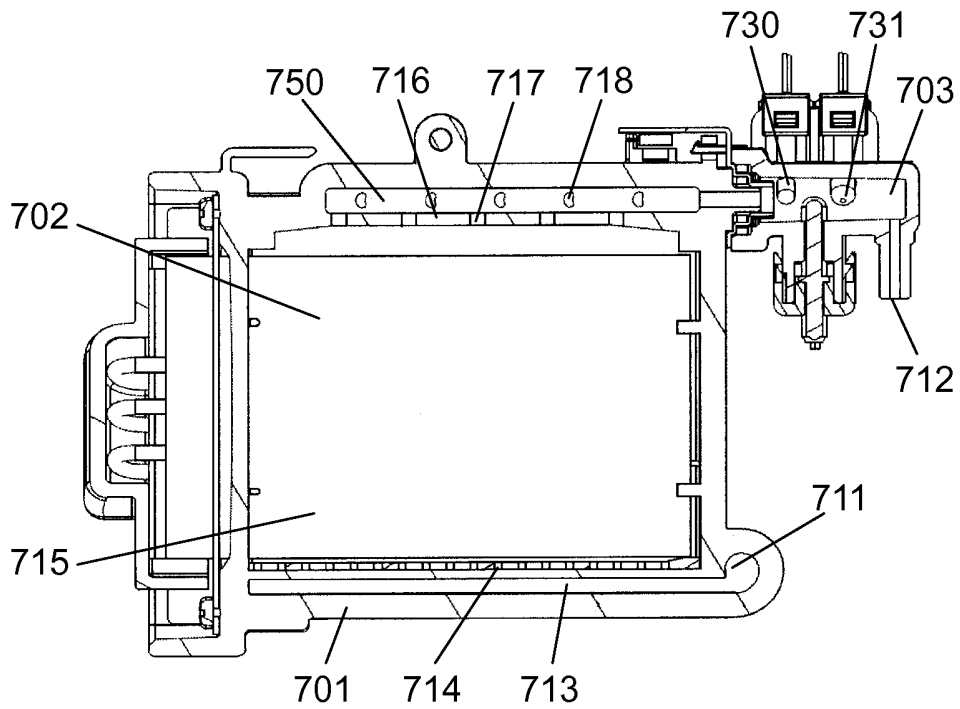


FIG. 14

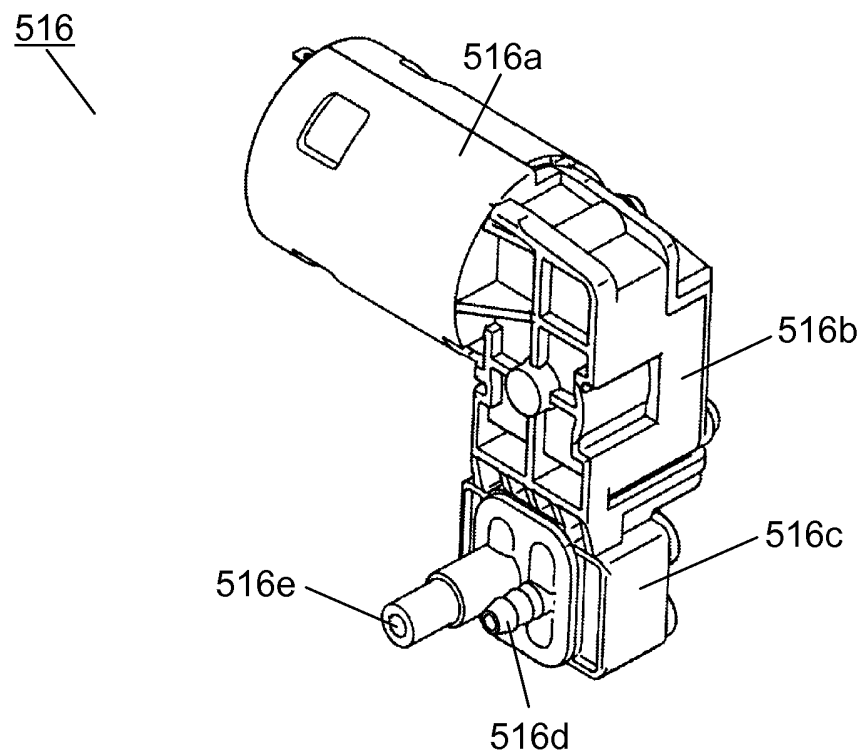


FIG. 15

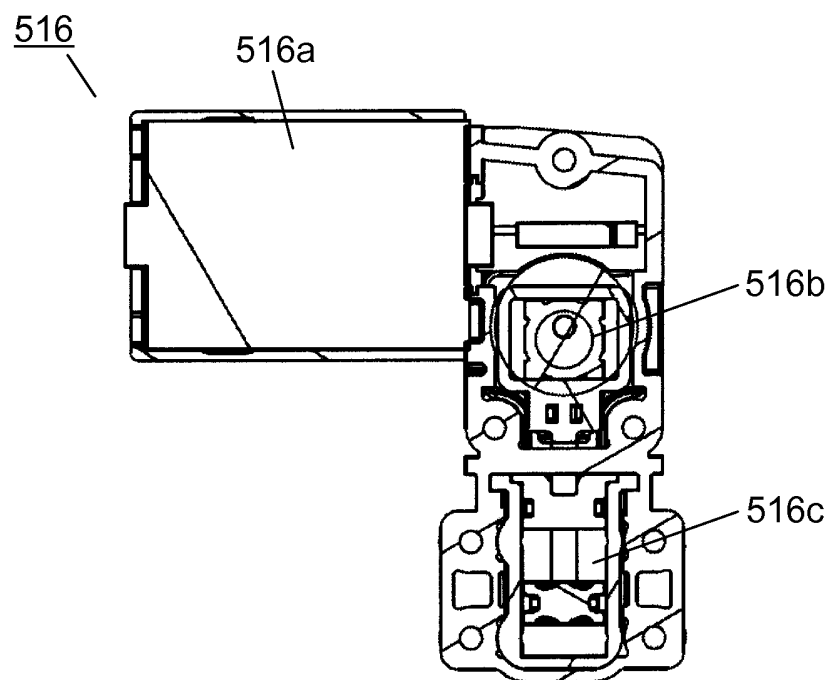


FIG. 16

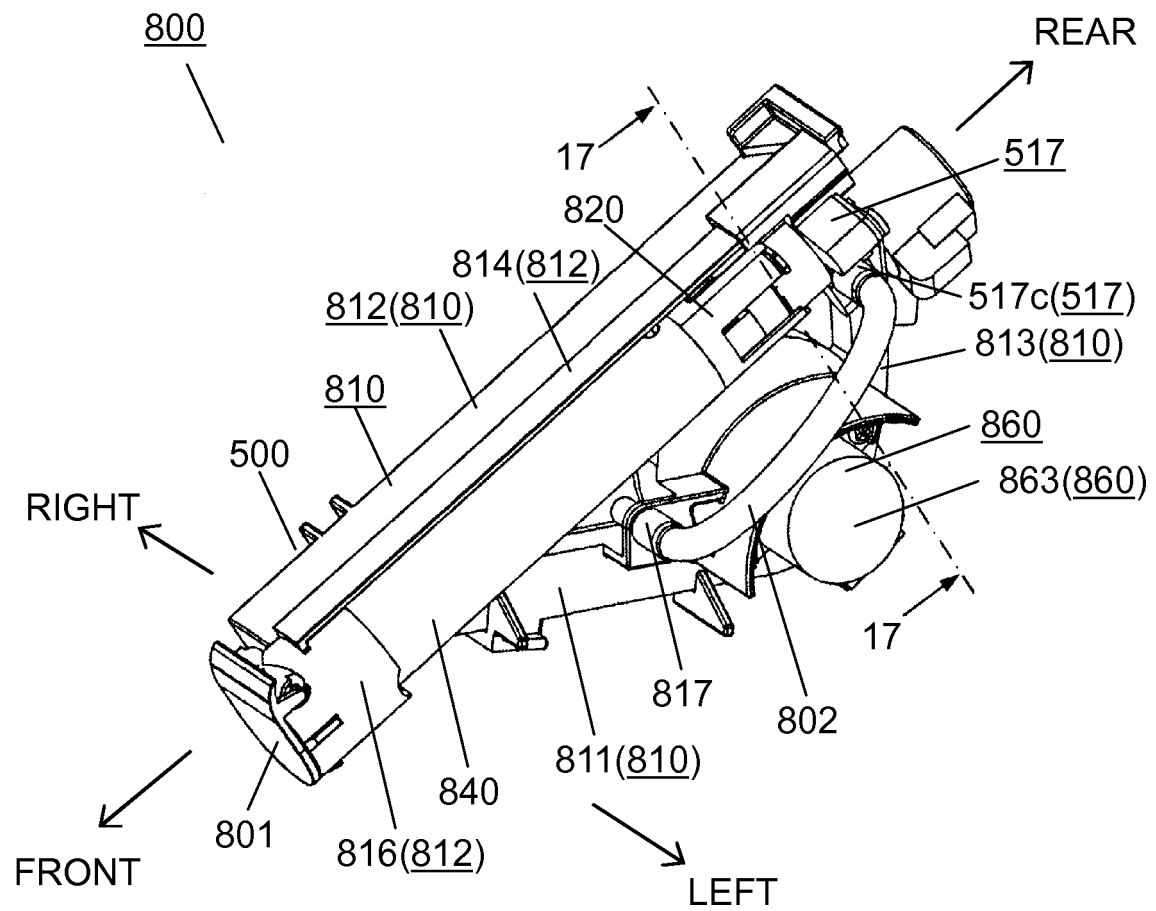


FIG. 17

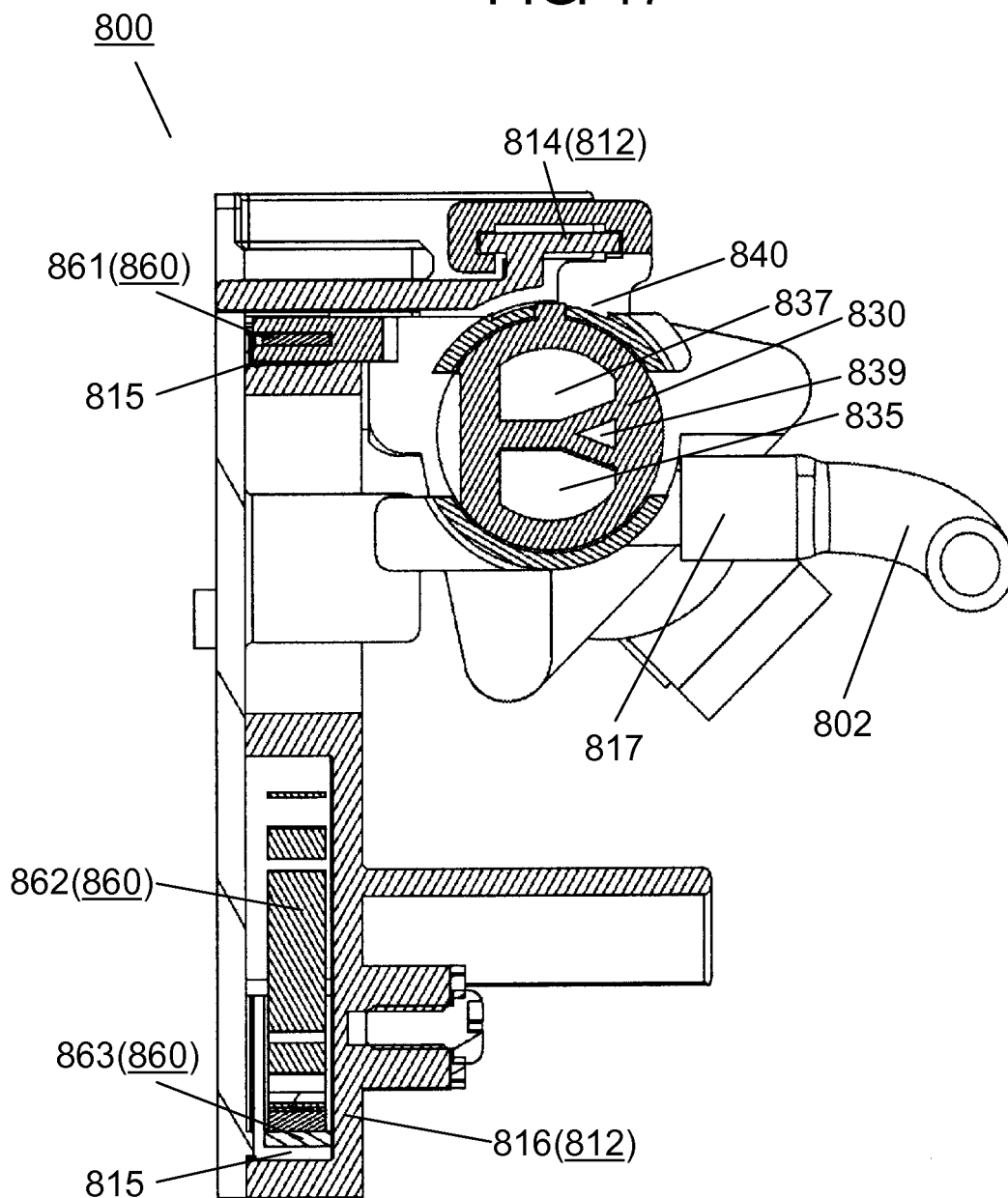


FIG. 18

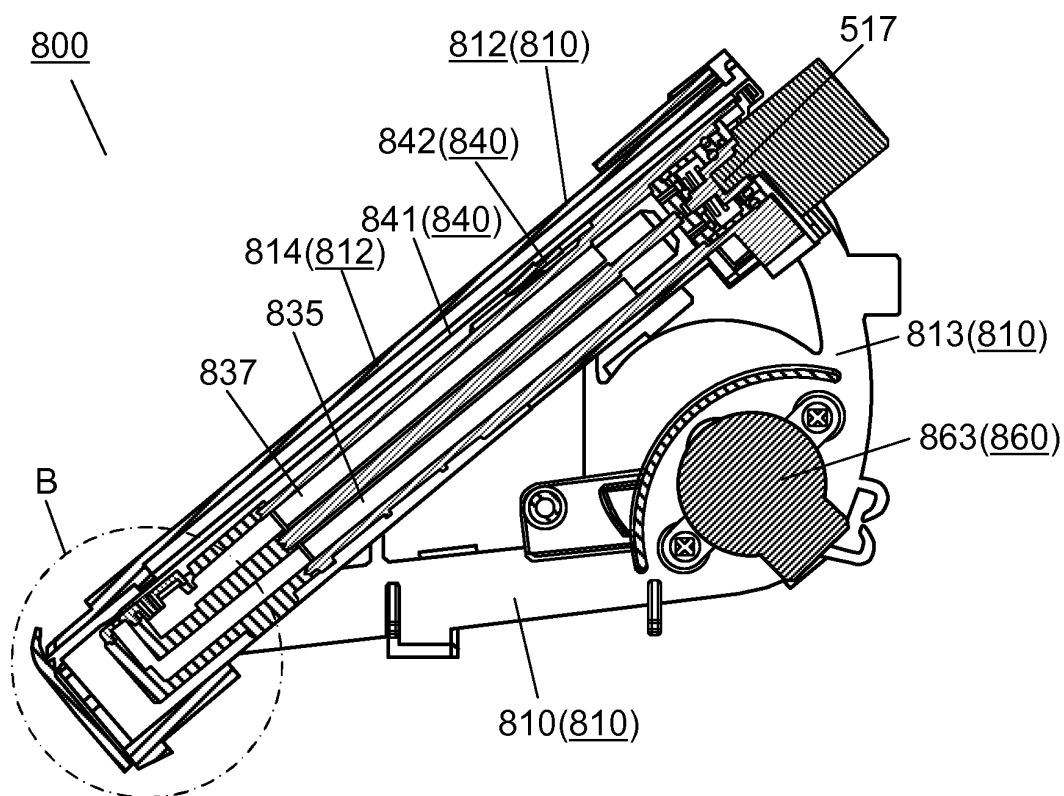


FIG. 19

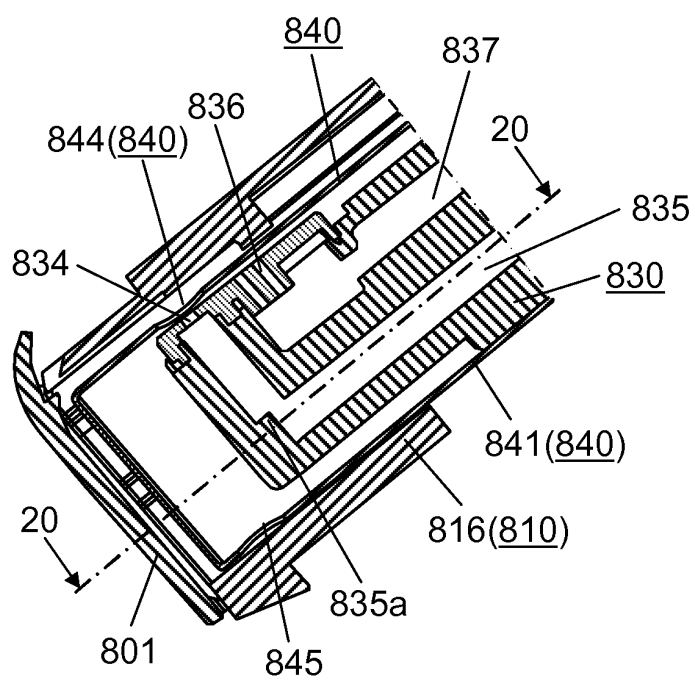


FIG. 20

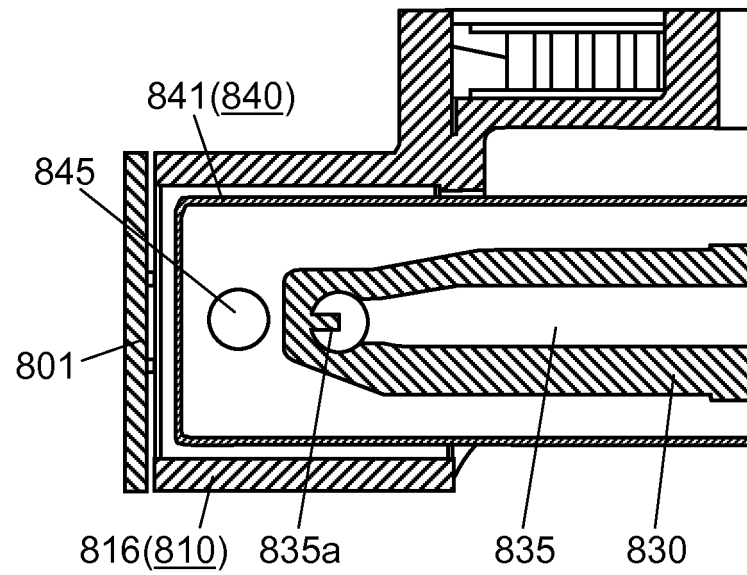


FIG. 21

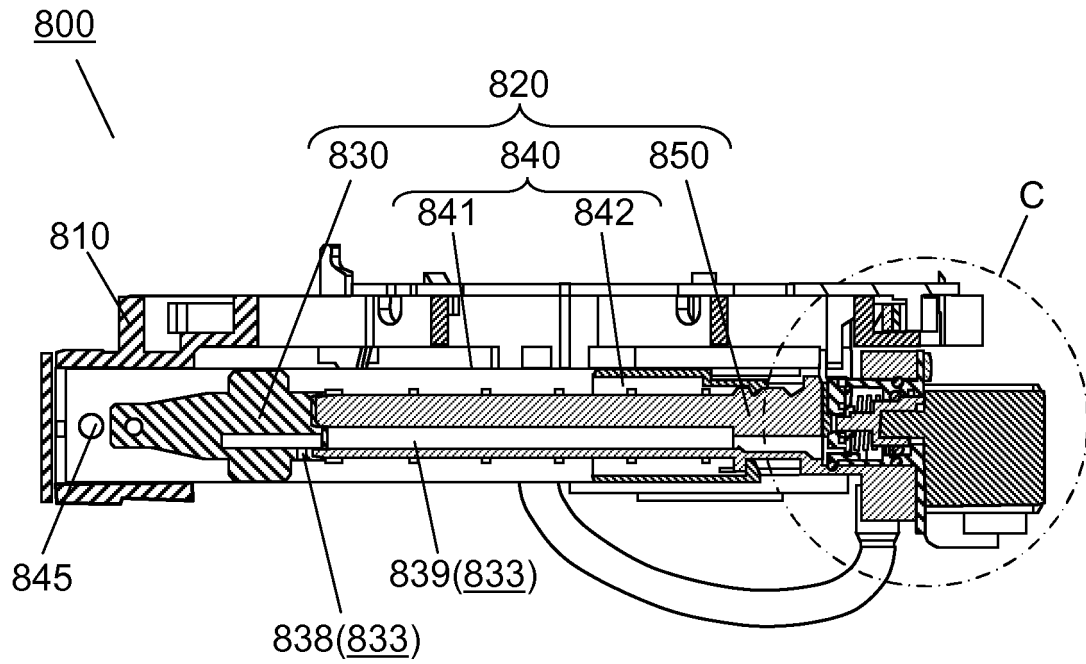


FIG. 22

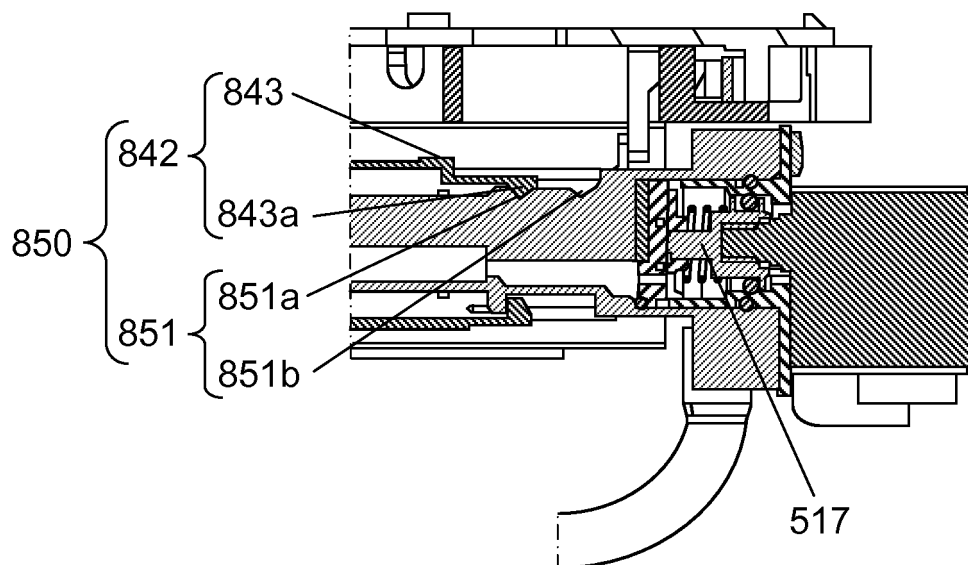


FIG. 23

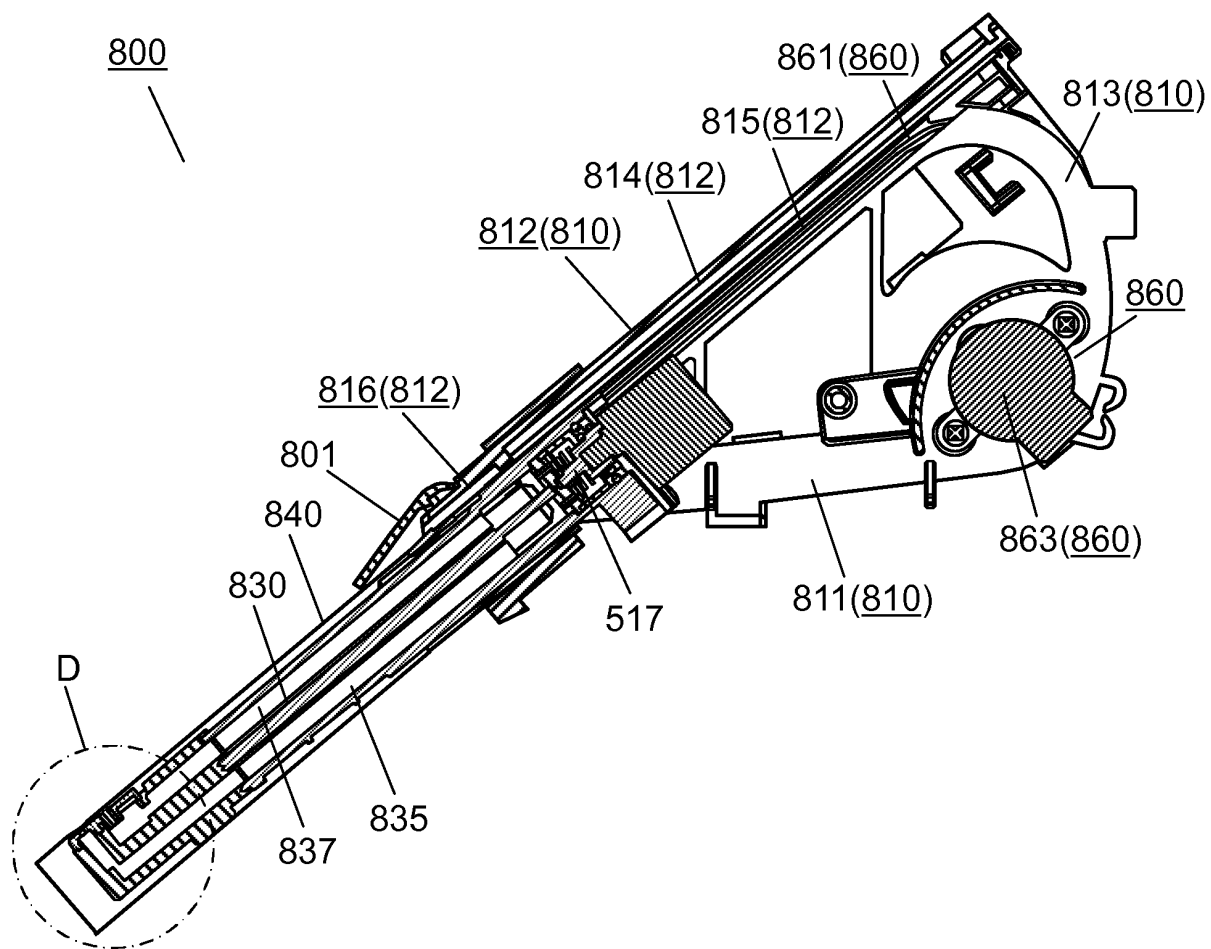


FIG. 24

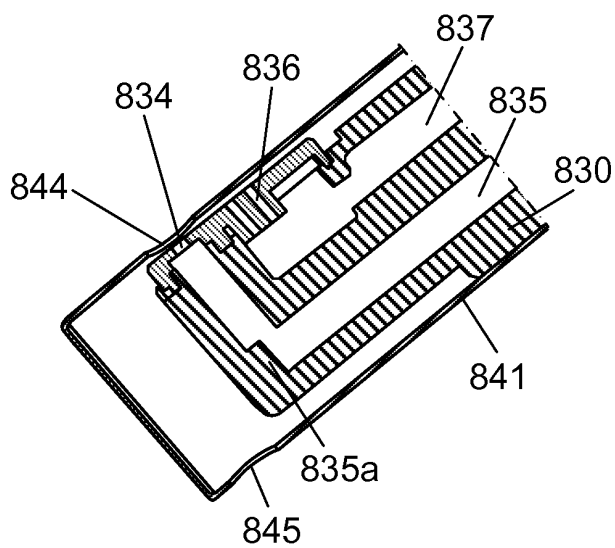


FIG. 25

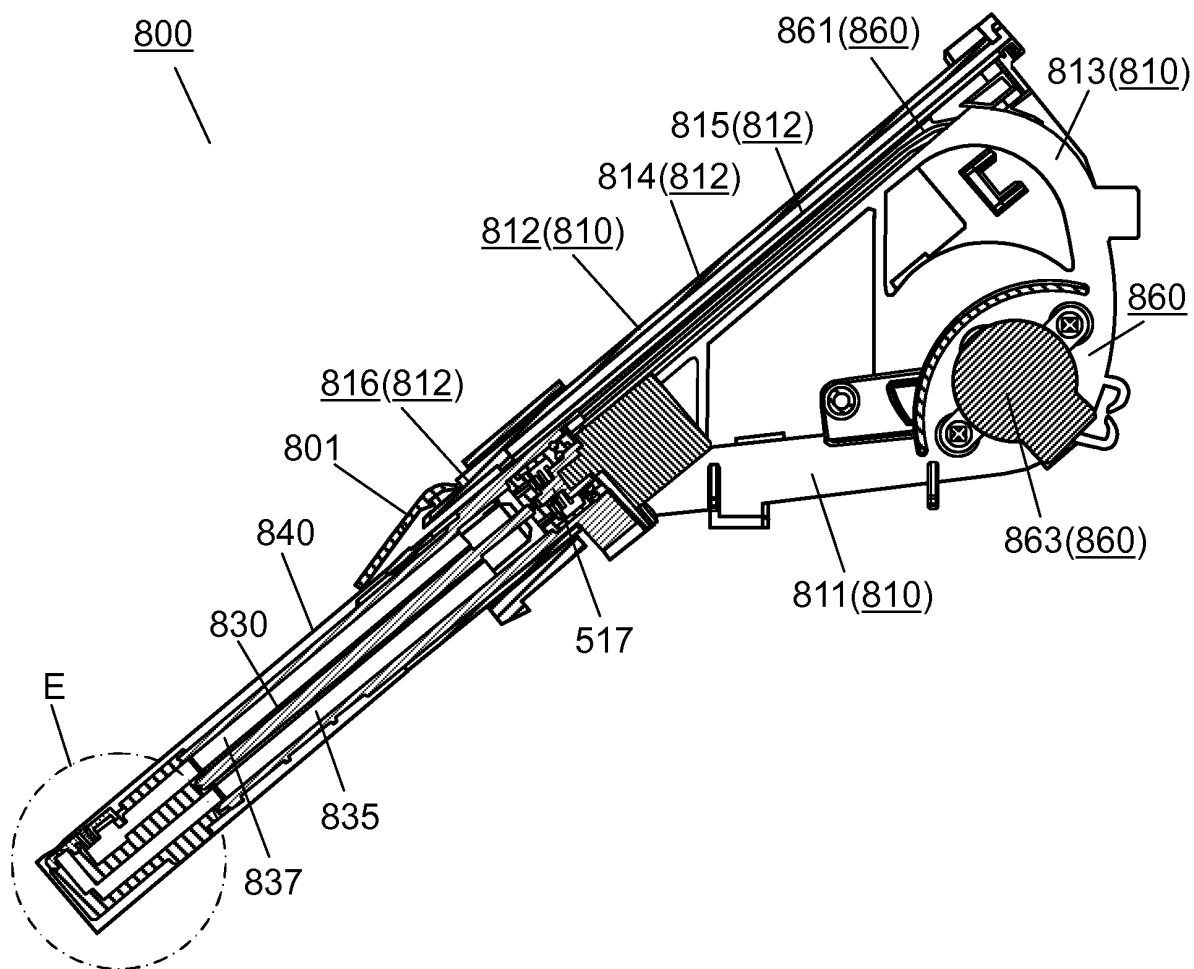


FIG. 26

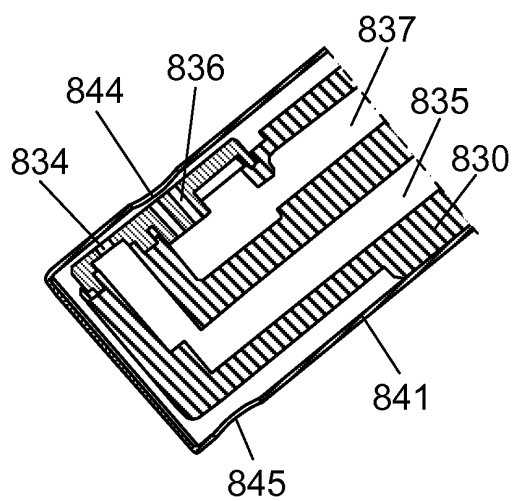


FIG. 27

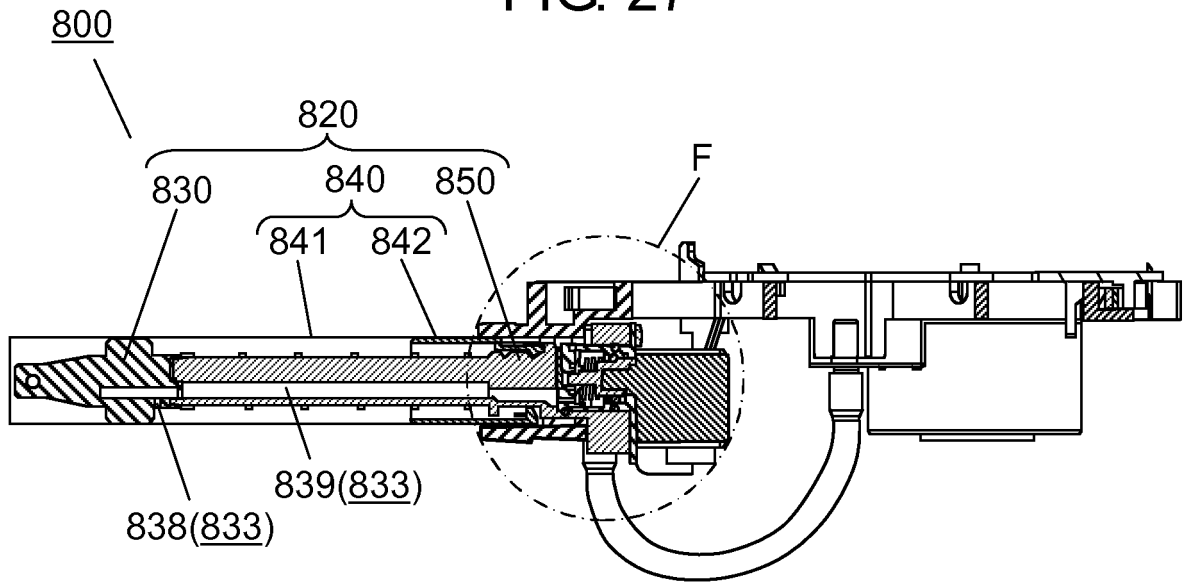


FIG. 28

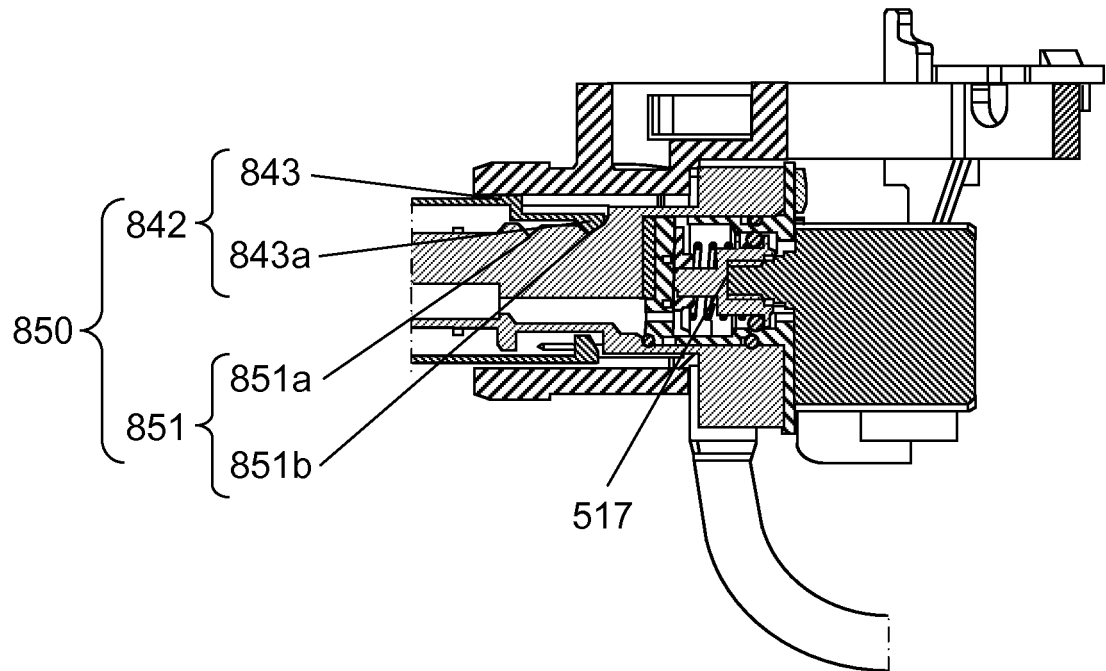


FIG. 29

TIME CHART AT INITIAL STAGE OF USE OF CLEANING UNIT

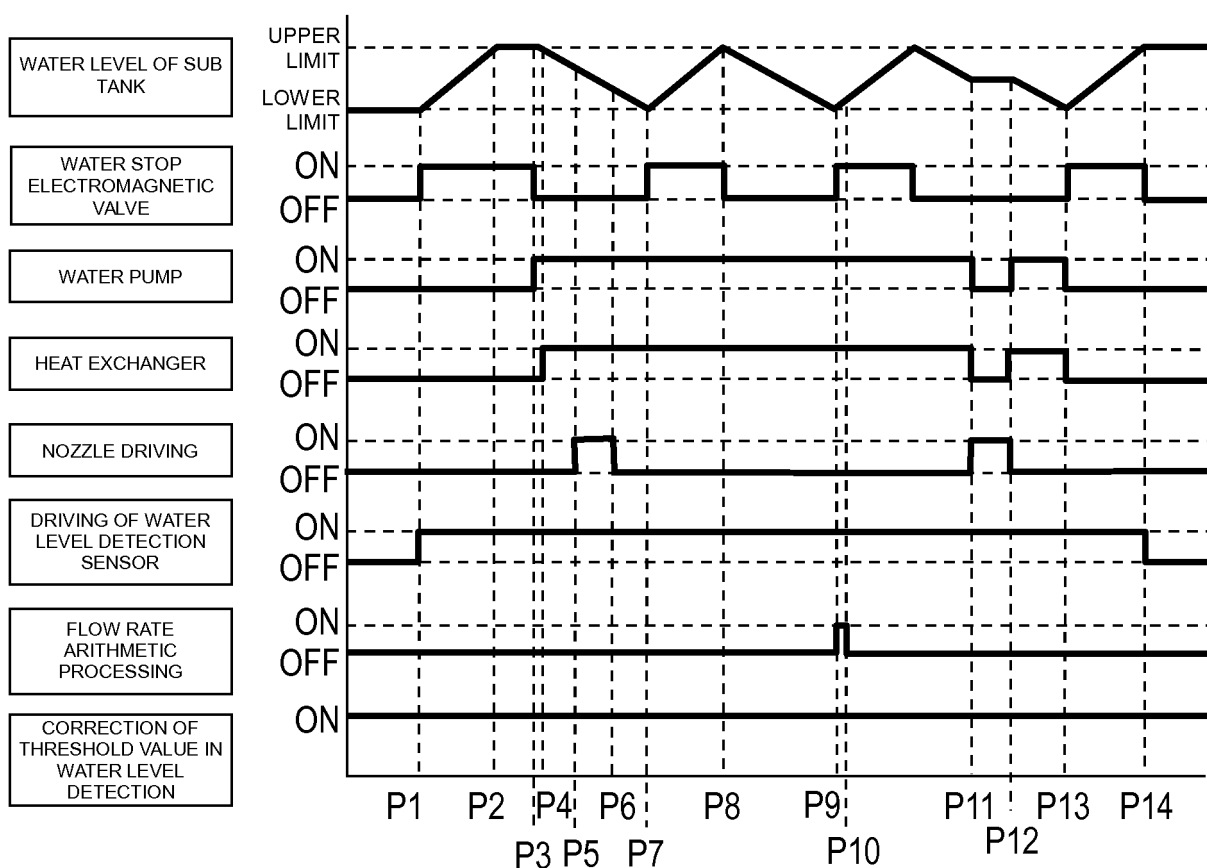


FIG. 30

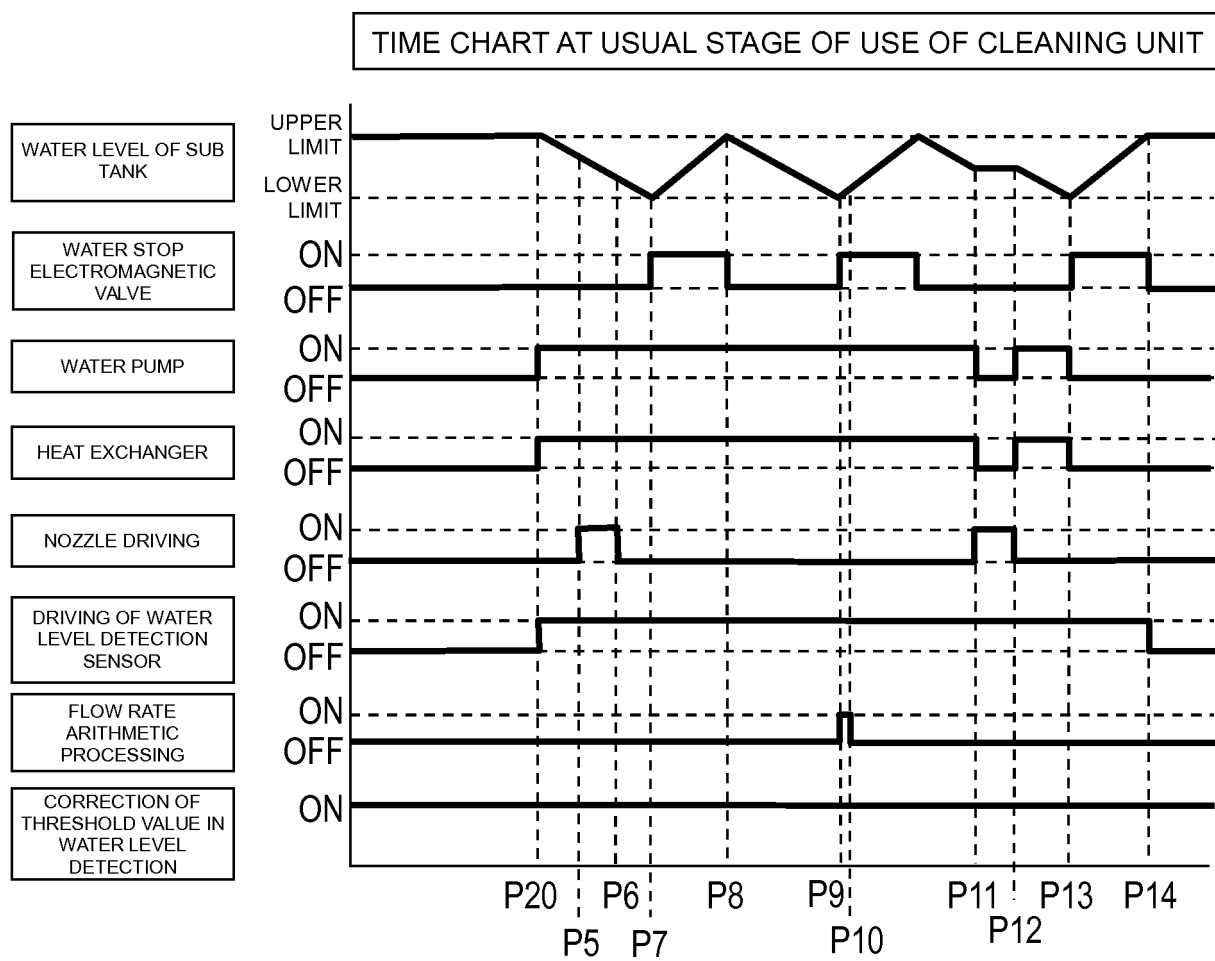


FIG. 31

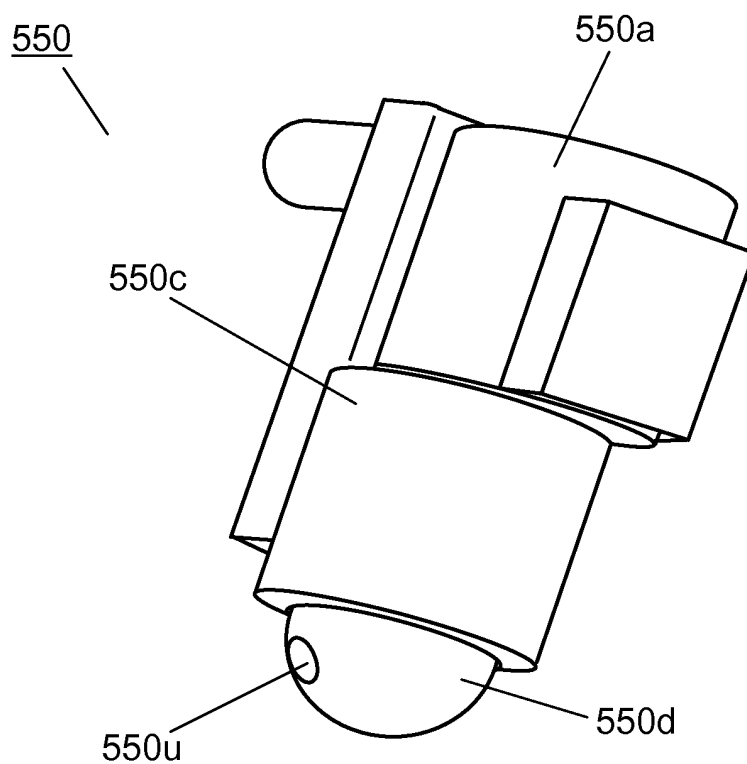


FIG. 32

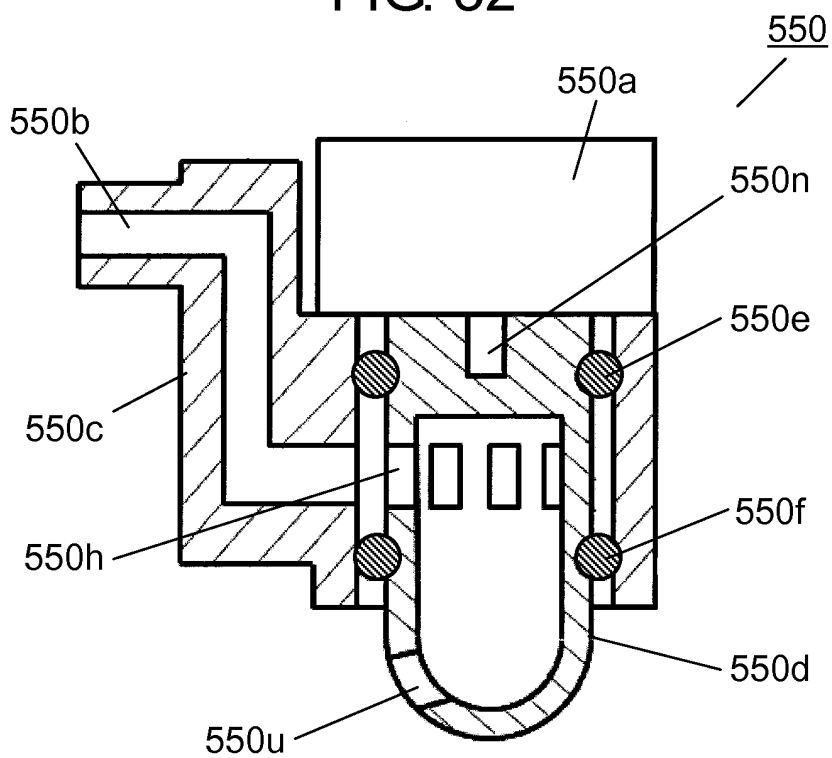


FIG. 33

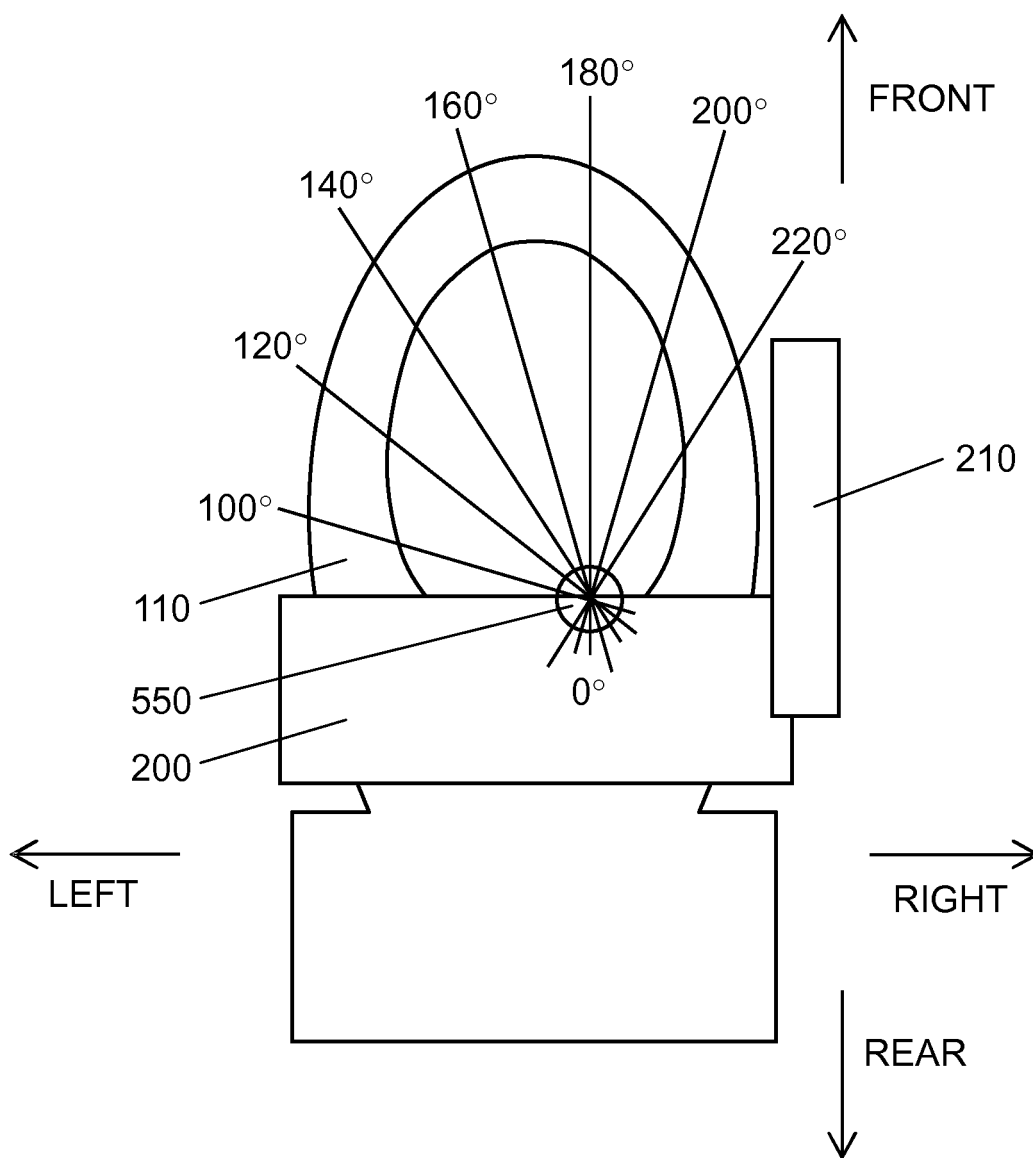


FIG. 34

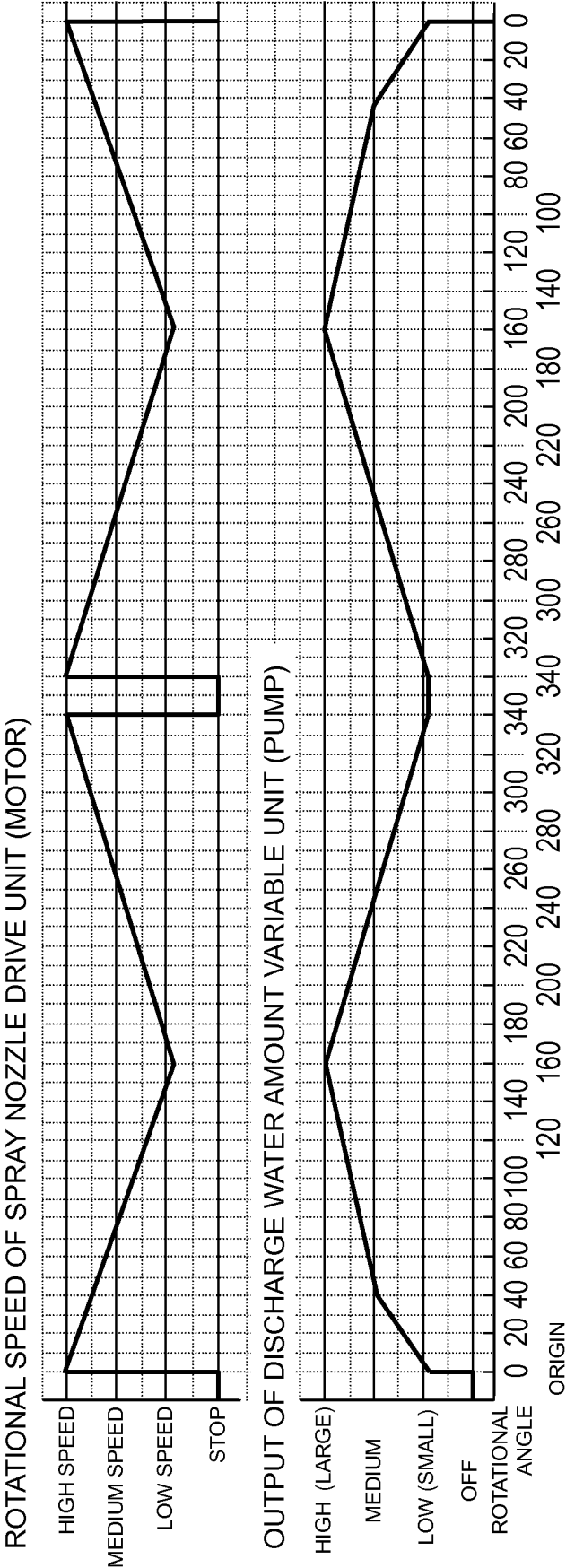


FIG. 35A

OUTPUT OF DISCHARGE WATER AMOUNT VARIABLE UNIT (PUMP)

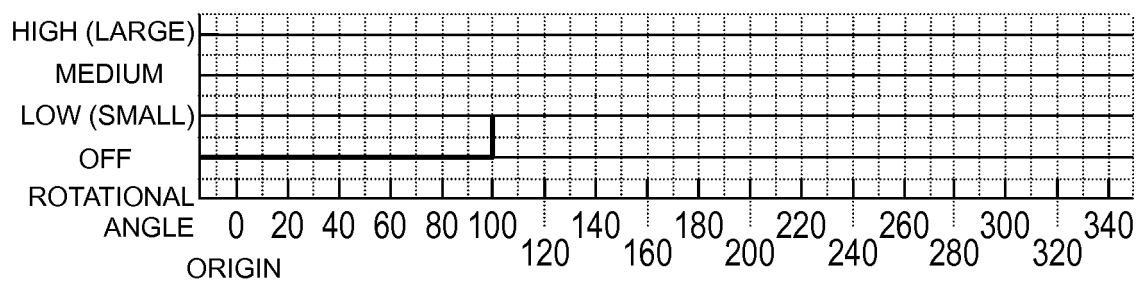


FIG. 35B

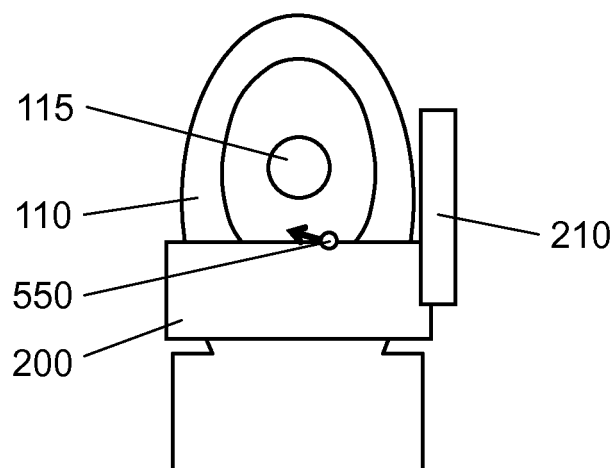


FIG. 36A

OUTPUT OF DISCHARGE WATER AMOUNT VARIABLE UNIT (PUMP)

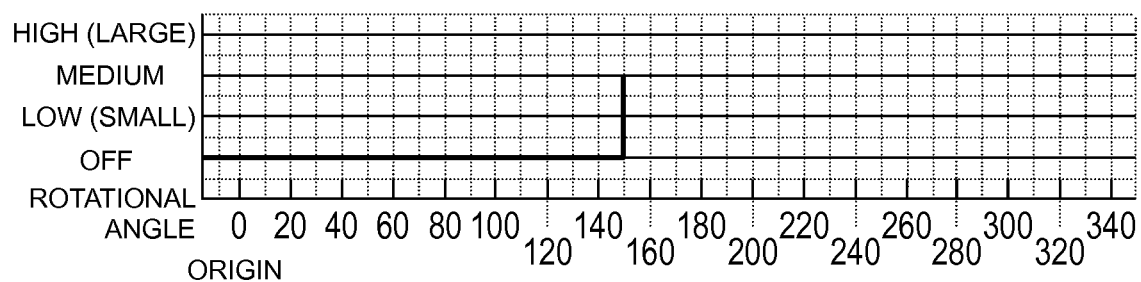


FIG. 36B

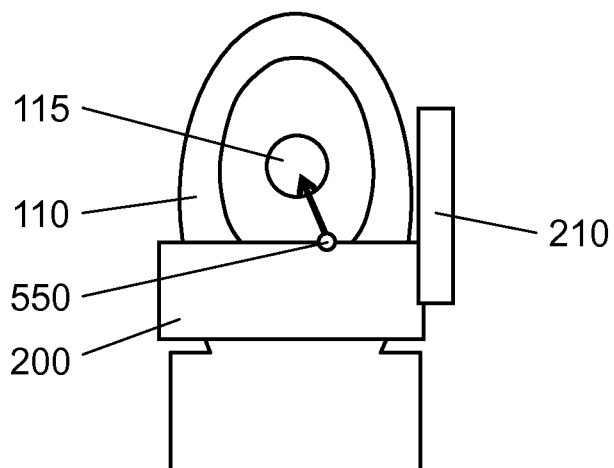


FIG. 37

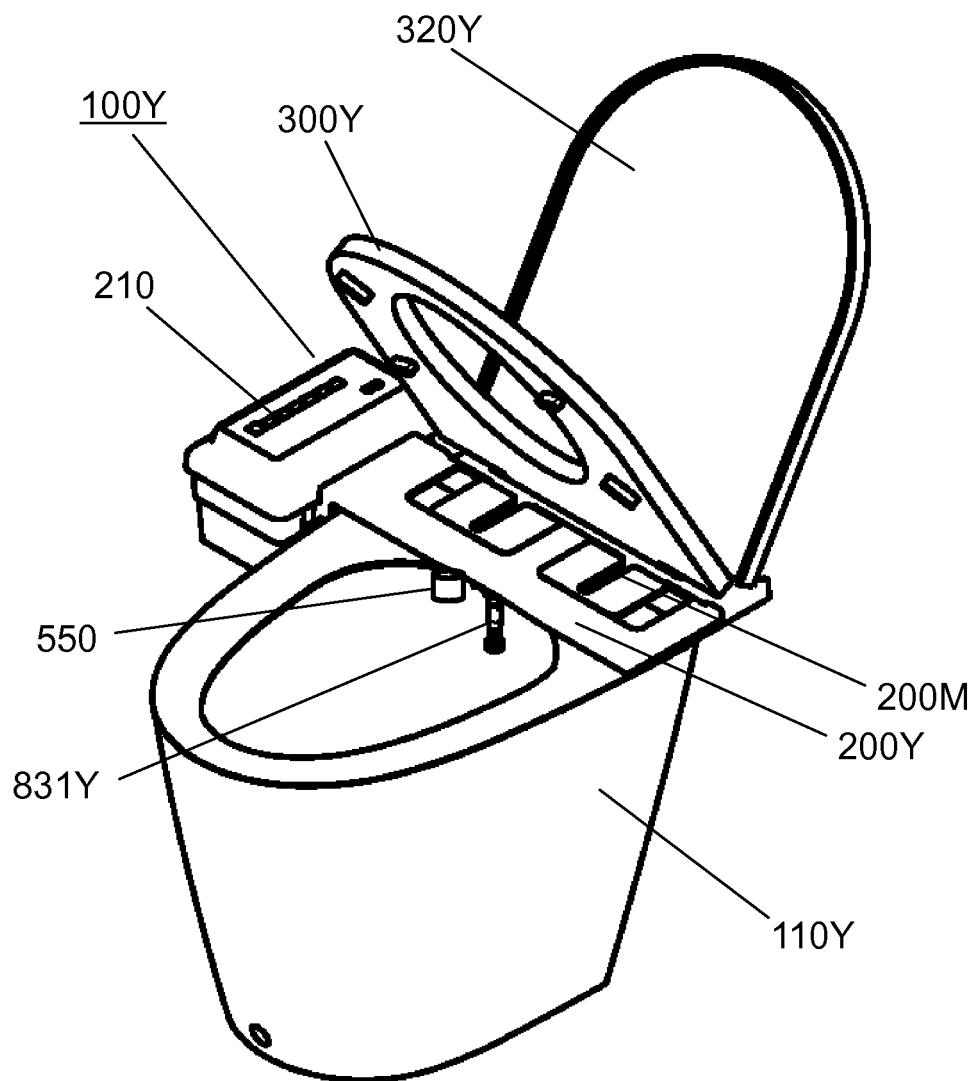


FIG. 38

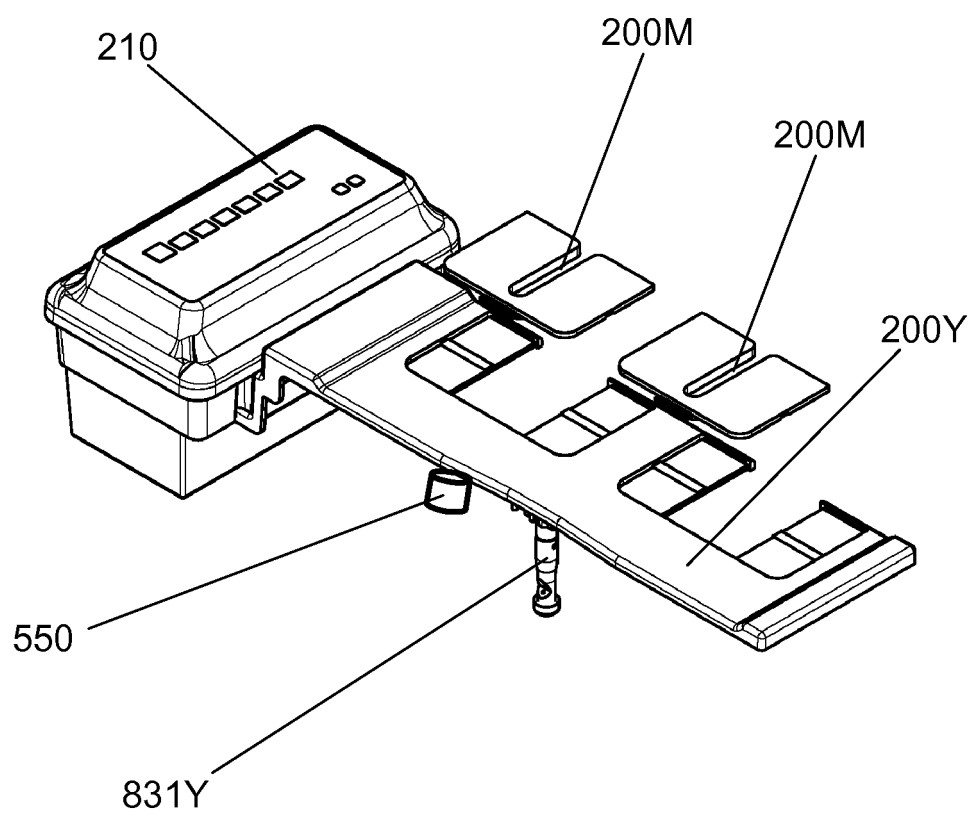


FIG. 39

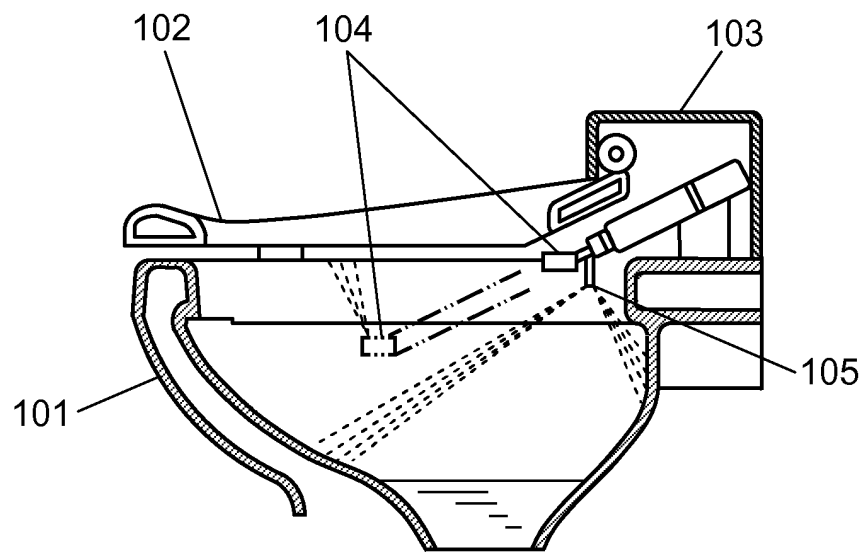


FIG. 40

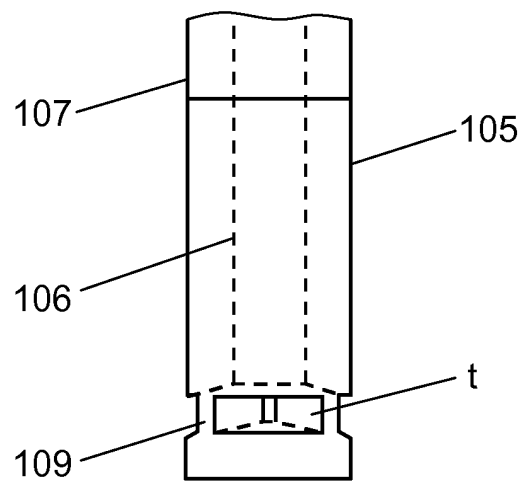
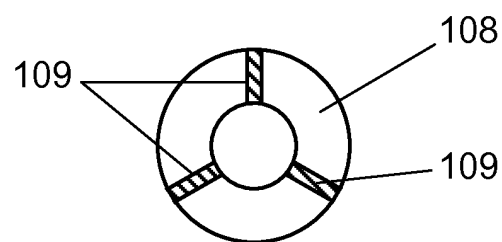


FIG. 41



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/004660

A. CLASSIFICATION OF SUBJECT MATTER

E03D9/00(2006.01)i, E03D9/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E03D9/00, E03D9/08

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2001-146783 A (Seiko Precision Inc.), 29 May 2001 (29.05.2001), paragraphs [0016] to [0028]; fig. 1 to 8 (Family: none)	1-4, 8-11 5-7, 12-15
Y A	JP 2000-104319 A (Matsushita Electric Works, Ltd.), 11 April 2000 (11.04.2000), paragraphs [0001], [0004] to [0023]; fig. 2, 5 (Family: none)	1-4, 8-11 5-7, 12-15
Y A	JP 2007-314973 A (Matsushita Electric Works, Ltd.), 06 December 2007 (06.12.2007), paragraphs [0026], [0027] (Family: none)	9, 10 5-7, 12-15

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

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

08 December 2015 (08.12.15)

Date of mailing of the international search report

15 December 2015 (15.12.15)

Name and mailing address of the ISA/

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku,

Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/004660

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2008-038334 A (Matsushita Electric Industrial Co., Ltd.), 21 February 2008 (21.02.2008), paragraphs [0005], [0007], [0022], [0024], [0034]; fig. 7 (Family: none)	11 5-7, 12-15

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000104319 A [0017]
- JP 3447352 B [0017]