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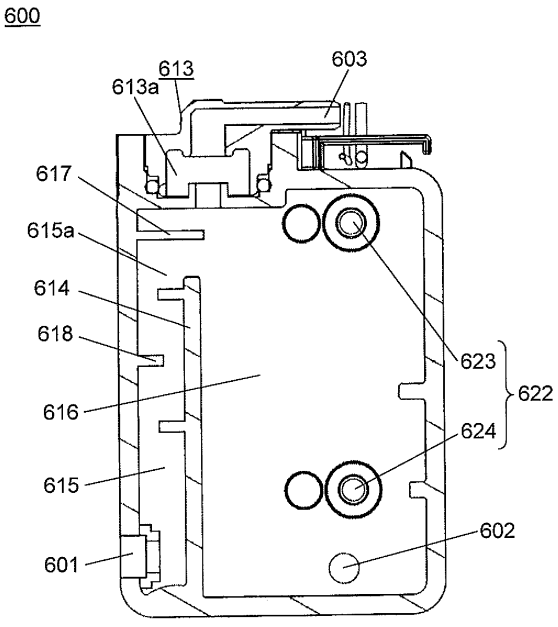
(54) **SANITARY WASHING DEVICE**

(57) A sanitary washing device includes a nozzle device, a water pump, a heat exchanger, and sub tank (600). Sub tank (600) includes: atmosphere open port (603), water inflow tank (615) and storage tank (616) formed separately from each other by partition wall (614). Washing water flows into the sanitary washing device through water inflow port (601) of water inflow tank (615), overflows the partition wall (614), flows into the storage tank (616), and is supplied to heat exchanger from water outflow port (602) of storage tank (616). Accordingly, a portion of air contained in washing water is separated and is discharged to the outside of the sub tank (600) through the atmosphere open port (603), and washing water containing a reduced amount of air is supplied to the heat exchanger. As a result, bubbles generated in the heat exchanger can be reduced so that thermal efficiency and durability of the heat exchanger can be enhanced.

FIG. 10



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Description

TECHNICAL FIELD

[0001] The present invention relates to a water supply structure for supplying washing water in a sanitary washing device which washes a human private part.

BACKGROUND ART

[0002] Conventionally, in the sanitary washing device of this type provided with a heat exchanger which instantaneously heats washing water, on an upstream side of the heat exchanger, a strainer, a check valve, a constant flow regulating valve, a water stop electromagnetic valve and a flow rate sensor are sequentially connected from a branch faucet connected to a city water pipe. Downstream of the heat exchanger, a temperature sensor, a pump, a changeover valve, and a nozzle portion are sequentially connected. Further, there is disclosed a sanitary washing device where a flow passage having a sealed structure from a branch faucet to a nozzle device is formed, and an upstream side of a heat exchanger particularly has a completely sealed structure (see PTL 1, for example).

[0003] The conventional sanitary washing device is described with reference to FIG. 37 hereinafter.

[0004] FIG. 37 is a schematic view showing the constitution of a water circuit of the conventional sanitary washing device described in PTL 1.

[0005] As shown in FIG. 37, in the conventional sanitary washing device, a branch faucet 2 connected to a city water pipe 1 is disposed on an uppermost stream side of a water circuit. Strainer 3, check valve 4, constant flow regulating valve 5, water stop electromagnetic valve 6, flow rate sensor 7, temperature sensor 8 and heat exchanger 9 are disposed sequentially downstream of the branch faucet. Temperature sensor 10, pump 11, changeover valve 12 and nozzle portion 13 are disposed sequentially downstream of the heat exchanger 9.

[0006] However, with respect to the configuration of the conventional sanitary washing device, a high-capacity and high-temperature-use heater is used in the heat exchanger for heating washing water instantaneously. Accordingly, air contained in washing water is separated, and bubbles are easily generated on a surface of the heater. As a result, heat of the heater is minimally transferred to washing water, thus lowering thermal efficiency of the heat exchanger.

[0007] Further, when a large amount of bubbles is generated, a boiling phenomenon occurs locally and hence, the heater of the heat exchanger becomes partially high temperature. Accordingly, the heater is damaged or durability of heater is lowered. That is, there is still room for improvement from a viewpoint of enhancing thermal efficiency of the heat exchanger and ensuring durability of the heat exchanger.

Citation List

Patent Literature

[0008] PTL 1: Unexamined Japanese Patent Publication No. 2005-076417

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a sanitary washing device provided with a heat exchanger which exhibits high efficiency and high durability by reducing air contained in washing water supplied to the heat exchanger.

[0010] That is, the sanitary washing device of the present invention includes: a nozzle device for jetting washing water; a washing water supply passage for supplying washing water to the nozzle device; and a control part. The washing water supply passage includes: a water pump for supplying washing water to the nozzle device; a heat exchanger disposed upstream of the water pump and provided for heating washing water; and a sub tank disposed upstream of the heat exchanger and provided for opening a portion of washing water supply passage to atmosphere. The sub tank includes: an atmosphere open port disposed on an upper surface thereof; a water inflow tank and a storage tank formed separately from each other by a partition wall; a water inflow port disposed in a vicinity of a bottom portion of the water inflow tank, and a water outflow port disposed in a vicinity of a bottom portion of the storage tank. Washing water flowing into the water inflow tank through the water inflow port of the sub tank overflows an upper end of the partition wall and flows into the storage tank.

[0011] With such a configuration, from washing water containing air which flows into the water inflow tank of the sub tank through the water inflow port disposed in a vicinity of the bottom portion of the water inflow tank, at least a portion of air is separated in the course of rising inside the water inflow tank. Separated air is discharged to the outside of the sub tank through the atmosphere open port so that an amount of air contained in washing water is reduced. Washing water containing a reduced amount of air overflows the partition wall and flows into the storage tank. Then, washing water containing a reduced amount of air flows out through the water outflow port disposed in a vicinity of the bottom portion of the storage tank and is supplied to the heat exchanger. That is, washing water containing a reduced amount of air is supplied to the heat exchanger. Accordingly, the generation of bubbles in the heat exchanger can be reduced and hence, thermal efficiency of the heat exchanger can be enhanced. As a result, it is possible to realize the sanitary washing device which can achieve the reduction of damage of the heat exchanger and the enhancement of durability of the heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a perspective view showing a state where a sanitary washing device according to a first exemplary embodiment of the present invention is installed on a toilet bowl.
FIG. 2 is a perspective view showing a state where a front body case of a body of the sanitary washing device is removed.
FIG. 3 is a perspective view showing a state where the front body case of the body and a control part of the sanitary washing device are removed.
FIG. 4 is a perspective view showing an upper surface of an operation part of the sanitary washing device.
FIG. 5 is a perspective view showing an external appearance of a remote controller.
FIG. 6 is a schematic view showing a configuration of a water circuit of the sanitary washing device.
FIG. 7 is a perspective view showing a disassembled state of the water circuit of the sanitary washing device.
FIG. 8 is a perspective view showing an assembled state of the water circuit of the sanitary washing device.
FIG. 9 is a perspective view showing an external appearance of a sub tank.
FIG. 10 is a cross-sectional view of the sub tank in a transverse direction.
FIG. 11 is a cross-sectional view of the sub tank in a longitudinal direction.
FIG. 12 is a perspective view showing an external appearance of a heat exchanger.
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.
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.
FIG. 17 is a cross-sectional view taken along a line 17-17 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 a B portion shown in FIG. 18.
FIG. 20 is a cross-sectional view taken along a line 20-20 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 a C portion shown in FIG. 21.
FIG. 23 is a longitudinal cross-sectional view showing a buttock washing state of the nozzle device.
FIG. 24 is a cross-sectional view showing a detailed configuration of a D portion shown in FIG. 23.
FIG. 25 is a longitudinal cross-sectional view showing a bidet washing state of the nozzle device.
FIG. 26 is a cross-sectional view showing a detailed configuration of an E portion shown in FIG. 25.
FIG. 27 is a transverse cross-sectional view showing a bidet washing state of the nozzle device.
FIG. 28 is a cross-sectional view showing a detailed configuration of a G portion shown in FIG. 27.
FIG. 29 is a perspective view showing a disassembled state of a toilet lid in an upside down state.
FIG. 30 is a perspective view showing an assembled state of the toilet lid in an upside down state.
FIG. 31 is a cross-sectional view taken along a line 31-31 in FIG. 30.
FIG. 32 is a cross-sectional view taken along a line 32-32 in FIG. 30.
FIG. 33 is a perspective view showing an external appearance of a sub tank according to a second exemplary embodiment of the present invention.
FIG. 34 is a cross-sectional view of the sub tank according to the second exemplary embodiment in a transverse direction.
FIG. 35 is a cross-sectional view of the sub tank according to the second exemplary embodiment in a longitudinal direction.
FIG. 36 is a schematic view of a top surface portion of the sub tank according to the second exemplary embodiment in a state where the sub tank is filled with water.
FIG. 37 is a schematic view showing a configuration of a water circuit of a conventional sanitary washing device.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinafter, exemplary embodiments of the present invention are described with reference to drawings. However, the present invention is not limited by these exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

<1> Overall configuration of sanitary washing device

[0014] Hereinafter, the overall configuration of the sanitary washing device according to the first exemplary embodiment is described with reference to FIG. 1 to FIG. 5.

[0015] FIG. 1 is a perspective view showing a state where the sanitary washing device according to the first 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 sanitary washing device is removed. FIG. 3 is a perspective view showing a state where the front body case of the body and a control part of the sanitary washing device are removed. FIG. 4 is a perspective view showing an upper surface of an operation part of the sanitary washing device. FIG. 5 is a perspective view showing an external appearance of a re-

mote controller.

[0016] As shown in FIG. 1, sanitary washing device 100 of this exemplary embodiment includes, as main constitutional elements thereof, 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.

[0017] Hereinafter, the arrangement of the respective constitutional elements is described by assuming a side of sanitary washing device 100 where body 200 is disposed as a rear side, a side of the sanitary washing device 100 where toilet seat 300 is disposed as a front side, a right side when a user faces frontward as a right side, and a left side when the user faces frontward as a left side.

[0018] Operation part 210 is integrally mounted on body 200 in a state where operation part 210 projects 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.

[0019] As shown in FIG. 1, when toilet lid 320 is opened, toilet lid 320 is raised so as to be positioned at a rearmost portion of sanitary washing device 100. On the other hand, when toilet lid 320 is closed, toilet lid 320 conceals a top surface of toilet seat 300.

[0020] Toilet lid 320 is molded by using a resin material such as PP (polypropylene) and ABS, for example. Toilet lid 320 has the heat insulation structure formed of the double structure and a heat insulation material. The detailed configuration of toilet lid 320 is described later.

[0021] A toilet seat heater (not shown in the drawing) which heats a seating surface is incorporated 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.

[0022] Further, a seating sensor (not shown in the drawing) 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. The seating sensor 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, the seating sensor detects that a user is seated on the seating surface of toilet seat 300.

[0023] As shown in FIG. 2 and FIG. 3, in the inside of body 200, sub tank 600, heat exchanger 700, washing part 500 which includes nozzle device 800 for washing a private part of a human body, deodorizing device 120 for deodorizing odor generated at the time of defecation, control part 130 for controlling various functions of sanitary washing device 100 and the like are incorporated. The detailed configuration of washing part 500 is described later.

[0024] Nozzle device 800 which is a main constitutional element of washing part 500 is disposed on a center portion in the inside of body 200, and deodorizing device 120 is disposed on a left side of nozzle device 800. Further, 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 a left side portion of nozzle device 800.

[0025] Water stop electromagnetic valve 514 of washing part 500, sub tank 600 and the like are disposed on a right and a front side of nozzle device 800. Heat exchanger 700 is disposed on a rear side of nozzle device 800. Water pump 516 is disposed behind heat exchanger 700. Control part 130 is disposed above washing part 500.

[0026] As shown in FIG. 4, a plurality of switches and display lamps 240 for operating and setting the respective functions of sanitary washing device 100 are disposed on operation part 210. An operation board (not shown in the drawing) is disposed inside operation part 210. A plurality of tact switches and a plurality of LEDs are disposed on the operation board. With such a configuration, a user can 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 part 210.

[0027] Operation part 210 includes infrared-ray receiver 211. Infrared-ray receiver 211 is disposed on a rear side of an upper surface of operation part 210. Infrared-ray receiver 211 receives infrared ray signals transmitted from remote controller 400 and human body detection sensor 450 shown in FIG. 1.

[0028] The switches of operation part 210 are constituted of a plurality of operation switches 220 for operating a washing 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.

[0029] Operation switches 220 of operation part 210 are constituted of: buttock washing switch 221 which is auxiliarily used when battery exhaustion or a failure occurs in remote controller 400; and nozzle cleaning switch 222 which is operated at the time of cleaning a nozzle.

[0030] Setting switches 230 of operation part 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. The respective switches perform the following operation in response to pushing operations. That is, hot water temperature switch 231 is provided for setting a temperature of washing water. Toilet seat temperature switch 232 is provided for setting a temperature of toilet seat 300. When 8-hour warming stop switch 233 is turned on, warming of toilet seat 300 is stopped, and warming of toilet seat 300 is started again after 8 hours elapse. Power saving switch 234 automatically learns a period of time

where sanitary washing device 100 is not used, and lowers a warming temperature of toilet seat 300 during the period of time where sanitary washing device 100 is not used, thus achieving power saving. Toilet lid automatically opening/closing switch 235 is provided for setting automatic opening/closing operation of toilet seat 300 and toilet lid 320.

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

[0032] As shown in FIG. 5, the overall shape of remote controller 400 is formed into a thin rectangular parallelepiped shape. Remote controller 400 is configured such that the plurality of switches and display lamps are mounted on an upper surface and a front surface of box-shaped remote controller body 401 which 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.

[0033] A control board (not shown in the drawing) which provides a function of controlling remote controller 400, a battery (not shown in the drawing) which constitutes power source of remote controller 400 and the like are incorporated in remote controller body 401.

[0034] Buttock washing switch 410, bidet washing switch 411, stop switch 412, move washing switch 413, rhythm washing switch 414 and the like are disposed on a front center portion of remote controller body 401, for example. The following operations are performed when the respective switches are operated by pushing. When buttock washing switch 410 is operated, buttock washing starts. When bidet washing switch 411 is operated, washing of a private part of a woman starts. When stop switch 412 is operated, buttock washing or bidet washing stops. When move washing switch 413 is operated, washing in a wide range becomes possible by advancing and retracting a washing position of a nozzle periodically at the time of performing buttock washing or bidet washing. When rhythm washing switch 414 is operated, washing becomes possible where a washing strength of washing water is changed periodically at the time of performing buttock washing.

[0035] Washing strength switch 415, washing position switch 416, nozzle sterilizing switch 417 and the like are disposed on an upper front portion of remote controller body 401, for example. When washing strength switch 415 is operated, a washing strength at the time of performing buttock washing and a washing strength at the time of performing bidet washing can be adjusted using two switches. When washing position switch 416 is operated, a washing position at the time of performing buttock washing and a washing position at the time of bidet washing can be adjusted using two switches. When nozzle sterilizing switch 417 is operated, the nozzle is sterilized by being washed with hot water of 40°C for approximately 1 minute, for example.

[0036] Strength display lamp 421 formed of LEDs which displays a washing strength in five stages is disposed above washing strength switch 415. Further, position display lamp 422 which displays a washing position in five stages is disposed above washing position switch 416.

[0037] 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 an 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.

[0038] 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 part; 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 part determines the detection of a human body in response to a signal from the pyroelectric sensor. The infrared-ray transmitting part transmits a human body detection signal from the sensor control part to the control part of body 200 in the form of infrared rays.

[0039] The sanitary washing device according to this exemplary embodiment is configured as described above.

<2> Configuration of washing part

[0040] Hereinafter, the configuration of the washing part of the sanitary washing device according to this exemplary embodiment is described with reference to FIG. 6 to FIG. 8.

[0041] FIG. 6 is a schematic view showing the configuration of a water circuit of the sanitary washing device. FIG. 7 is a perspective view showing a disassembled state of the water circuit of the sanitary washing device. FIG. 8 is a perspective view showing an assembled state of the water circuit of the sanitary washing device.

[0042] Washing part 500 shown in FIG. 6 is incorporated in body 200, and washes a private part of a user.

[0043] As shown in FIG. 6, washing part 500 includes at least: nozzle device 800 for jetting washing water; a series of washing water supply passage 900 through which washing water is supplied to nozzle device 800 from water supply connecting port 510 and the like.

[0044] 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, flow regulating valve 517 are sequentially

mounted in washing water supply passage 900. A most downstream end of washing water supply passage 900 is connected to nozzle device 800.

[0045] Water supply connecting port 510 is disposed below a right side of body 200, and is connected with a city water pipe. Strainer 511 is disposed inside water supply connecting port 510, and prevents the inflow of dusts contained in tap water. Check valve 512 prevents the backflow of water stored in sub tank 600 to the city water pipe.

[0046] Constant flow regulating valve 513 maintains an amount of washing water which flows in washing water supply passage 900 at a fixed value. Water stop electromagnetic valve 514 electrically opens and closes washing water supply passage 900. 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.

[0047] Sub tank 600 is disposed downstream of water stop electromagnetic valve 514, and has an atmosphere open port 603. Heat exchanger 700 heats washing water instantaneously. Buffer tank 750 makes a temperature of hot water which is heated by heat exchanger 700 uniform.

[0048] Water pump 516 is connected to a downstream side of buffer tank 750. Nozzle device 800 is connected to water pump 516 by way of flow regulating valve 517. Further, buttock washing portion 831, bidet washing portion 832, nozzle cleaning portion 833 and the like of nozzle device 800 are connected to respective ports of flow regulating valve 517.

[0049] As shown in FIG. 7 and FIG. 8, out of members which constitute washing part 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 which is molded by using a resin material such as ABS, for example, and are constituted as an integral body. Further, those members are assembled to rear body case 201 of body 200 in a state where the members are assembled into chassis 501.

[0050] Strainer 511 and check valve 512 are integrally assembled into water supply connecting port 510, and constant flow regulating valve 513 and relief valve 515 are integrally assembled into water stop electromagnetic valve 514. Buffer tank 750 is integrally formed with heat exchanger 700.

[0051] 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 sandwiched therebetween without interposing a connecting tube or the like therebetween. These members which constitute the water circuit are disposed and fixed to chassis 501 at predetermined positions respectively.

[0052] By adopting the above-mentioned configuration in the water circuit, the watertight structure is enhanced and, at the same time, the arrangement accuracy among the respective members is also enhanced. Particularly, the arrangement accuracy between sub tank 600 and heat exchanger 700 is enhanced and hence, the control accuracy in flow rate of washing water is enhanced. As a result, the performance of washing part 500 and the control accuracy in flow rate are enhanced.

[0053] Next, the configuration of above-mentioned water pump 516 is described with reference to FIG. 14 and FIG. 15 while also referencing Fig. 7.

[0054] FIG. 14 is a perspective view showing an external appearance of the water pump. FIG. 15 is a cross-sectional view of the water pump.

[0055] As shown in FIG. 14 and FIG. 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. Specifically, water pump 516 includes: motor part 516a which has an approximately circular cylindrical shape (including a circular cylindrical shape); link mechanism part 516b which converts a rotary motion of the motor into a reciprocating motion; and piston part 516c which is driven by the reciprocating motion of link mechanism part 516b. Water suction port 516d and water discharge port 516e are formed in an outer surface of piston part 516c as connecting ports.

[0056] In case of water pump 516 of this exemplary embodiment, at the time of driving water pump 516, vibrations generated in motor part 516a which performs only a rotary motion are smaller than vibrations generated by link mechanism part 516b and piston part 516c which perform a reciprocating motion.

[0057] To describe the operation of water pump 516 specifically, firstly when motor part 516a is driven, piston part 516c starts a reciprocating motion. Washing water is sucked into water pump 516 from water suction port 516d of piston part 516c, and washing water is discharged from water discharge port 516e. Washing water discharged from water discharge port 516e is discharged while forming the flow of water having appropriate pulsation along with a reciprocating motion of piston part 516c.

[0058] The outer periphery of motor part 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. By inserting motor part 516a into water pump mounting portion 501a having an approximately circular cylindrical shape (including circular cylindrical shape) formed on a rear portion of chassis 501, motor part 516a is supported on water pump mounting portion 501a. In such a configuration, link mechanism part 516b and piston part 516c are disposed in a downwardly suspended manner.

[0059] As shown in FIG. 7, water pump mounting por-

tion 501a is formed 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. That is, by forming water pump mounting portion 501a with thin wall thickness, it is possible to effectively absorb vibrations of water pump 516 due to resiliency of a resin from which water pump mounting portion 501a is formed.

[0060] 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 a connecting tube made of a soft resin.

[0061] As described above, in water pump 516 of this exemplary embodiment, motor part 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 part 516c which generate a large amount of vibrations are freely suspended. Further, piston part 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 the sanitary washing device can be enhanced.

[0062] 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.

[0063] Hereinafter, a basic control of washing part 500 of the sanitary washing device of this exemplary embodiment is described with reference to FIG. 6.

[0064] Firstly, as shown in FIG. 6, tap water which flows through the city water pipe is supplied from water supply connecting port 510 as washing water, and the washing water is supplied to sub tank 600 by opening water stop electromagnetic valve 514. At this stage of operation, a flow rate of washing water which flows through washing water supply passage 900 is maintained at a fixed value by constant flow regulating valve 513. Driving of water stop electromagnetic valve 514 is controlled by control part 130 based on an operation of remote controller 400 and an operation of operation part 210.

[0065] Next, washing water stored in sub tank 600 is supplied to heat exchanger 700 due to the driving of water pump 516. The driving of water pump 516 is controlled by control part 130 based on an operation of remote controller 400 and an operation of operation part 210.

[0066] Control part 130 drives water pump 516 and, at the same time, starts supplying of electricity to flat-plate-like heater 702 (see FIG. 13) of heat exchanger 700, thus starting heating of washing water. At this stage of operation, control part 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. With such an operation, a temperature of washing water can be maintained at a temperature which is set by hot water temperature switch 231 of operation part 210.

[0067] Next, washing water heated by heat exchanger 700 is supplied to flow regulating valve 517. Control part 130 controls flow regulating valve 517 based on operation information of operation part 210 and operation information of remote controller 400. With such an operation, washing water is supplied to any one of buttock washing portion 831, bidet washing portion 832, nozzle cleaning portion 833 of nozzle device 800. As a result, washing water is jetted from a jetting port of any one of buttock washing water jetting port 834, bidet washing jetting port 836, and nozzle cleaning jetting port 838 so that predetermined washing is performed.

[0068] The washing part of the sanitary washing device of this exemplary embodiment is controlled as described above, and the desired operation is executed.

<3> Configuration of sub tank

[0069] Hereinafter, the configuration of the sub tank of the sanitary washing device of this exemplary embodiment is described with reference to FIG. 9 to FIG. 11.

[0070] FIG. 9 is a perspective view showing an external appearance of the sub tank. FIG. 10 is a transverse cross-sectional view of the sub tank. FIG. 11 is a longitudinal cross-sectional view of the sub tank.

[0071] 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 washing water stored in tank body 610. Inflow water temperature sensor 630 is formed of a thermistor, for example, and detects a temperature of washing water supplied into the inside of tank body 610.

[0072] 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, 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.

[0073] Water inflow port 601 is formed in a lower portion of one side wall of tank body 610, and water outflow port 602 is formed in a lower portion of the rear wall of tank body 610.

[0074] Further, atmosphere open port 603 which makes the inside and the outside of tank body 610 communicate with each other is formed in 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 an inner pressure of tank body 610 at an atmospheric pressure. With such a configuration, the inside of sub tank 600 is consistently maintained at an atmospheric pressure, and washing water supply passage 900 from a downstream side of sub tank 600 to water suction port 516d of water pump 516 is also maintained at an atmospheric pressure. Accordingly, water pump 516 can suck water without being influenced by fluctuation of water pressure. As a result, water pump 516 can perform a pump function stably.

[0075] As shown in FIG. 10, in a flow passage which communicates with atmosphere open port 603 of atmosphere open portion 613 in sub tank 600, a buffer portion 613a at where the passage has a large cross-sectional area is formed. In the case where washing water intends to flow out with an impulse along with bubbles from atmosphere open port 603 or the like, buffer portion 613a temporarily stores washing water. Due to such an operation, the flowing out of washing water from atmosphere open port 603 is suppressed.

[0076] A partition wall 614 is disposed inside tank body 610. Partition wall 614 divides the inside of tank body 610 into two tanks, that is, water inflow tank 615 and storage tank 616. Water inflow port 601 is formed in a side surface of water inflow tank 615 in a vicinity of a bottom surface of water inflow tank 615, and water outflow port 602 is formed in a rear wall of storage tank 616 in a vicinity of a bottom surface of storage tank 616.

[0077] That is, by forming water inflow tank 615 and storage tank 616 by partition wall 614, when air is contained in washing 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 washing water containing no air is allowed to flow into storage tank 616.

[0078] Above water inflow tank 615 of tank body 610, barrier wall 617 which is interposed 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 tank body 610 in a substantially 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.

[0079] In the inside of water inflow tank 615, a plurality of flow straightening ribs 618 are formed on the side wall of tank body 610 and partition wall 614 alternately in an projecting manner in the substantially horizontal direction (including a horizontal direction).

[0080] Hereinafter, the flow of washing water in sub tank 600 is described.

[0081] Washing water which flows into sub tank 600 from water inflow port 601, firstly, flows into a lower portion of water inflow tank 615. Then, washing water rises in water inflow tank 615 while the flow direction of washing water is changed by flow straightening ribs 618. At this stage of operation, when a pressure of washing water which flows into sub tank 600 from water inflow port 601 is high, or when washing water contains a large amount of air so that the flow of washing water is remarkably turbulent, flow straightening ribs 618 suitably straighten the flow of washing water. Further, flow straightening ribs 618 separate air contained in washing water due to a vortex generated downstream of flow straightening rib 618.

[0082] Washing 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 stage of operation, even when a pressure of washing water which flows into storage tank 616 from water inflow port 601 is high, or even when washing water contains a large amount of air so that the flow of washing water is remarkably turbulent, the flow of washing water in the upward direction is suppressed by barrier wall 617. Accordingly, washing water hits atmosphere open portion 613 and hence, it is possible to prevent washing water from directly flowing out to the outside of sub tank 600 from atmosphere open port 603.

[0083] As described above, during a period where washing 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 washing water is separated from the washing water due to flow straightening ribs 618 and the like. Separated air is discharged to the outside of tank body 610 from atmosphere open port 603. With such a configuration, washing water containing no air is stored in storage tank 616, and such washing water is supplied to heat exchanger 700 from water outflow port 602 of sub tank 600.

[0084] When air is contained in washing 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 therein, thus preventing the mixing of air. With such a configuration, it is possible to effectively prevent heat exchanger 700 from being damaged.

[0085] As shown in FIG. 10 and FIG. 11, sub tank 600

includes therein 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 this exemplary embodiment, an example where water level detection sensor 620 includes one common electrode 621 and two water level electrodes 622 is described.

[0086] Common electrode 621 is disposed on an inner surface of a lower portion of the front wall of tank body 610, and water level electrodes 622 are disposed on an inner surface of the rear wall of tank body 610. Further, water level electrodes 622 are constituted of upper electrode 623 disposed on an upper portion of the inner surface of the rear wall, and lower electrode 624 disposed on a lower portion of the inner surface of the rear wall. In such a configuration, common electrode 621 is disposed at a position below lower electrode 624 which constitutes one of water level electrodes 622 and is always immersed in washing water in a usual use state.

[0087] That is, by disposing common electrode 621 and upper electrode 623 and lower electrode 624 which constitute water level electrodes 622 on different surfaces respectively, it is possible to suppress an erroneous detection where remaining water which adheres to the inner surface of tank body 610 is erroneously detected as stored water.

[0088] Detection of water level of washing water by water level electrodes 622 is performed as follows. Firstly, a DC current is applied between common electrode 621 and water level electrodes 622. Then, whether or not water level electrodes 622 are immersed in washing water is detected based on a change in voltage. Due to such detection, a water level of washing water is detected. That is, when a water level of washing water in storage tank 616 rises, lower electrode 624 and upper electrode 623 are immersed in washing water. In this case, a voltage between common electrode 621 and lower electrode 624 and a voltage between common electrode 621 and upper electrode 623 are lowered. Consequently, control part 130 detects a water level of washing water based on the lowering of voltages.

[0089] Upper electrode 623 which constitutes one of water level electrodes 622 is used for detecting an upper limit water level, and lower electrode 624 which constitutes the other of water level electrodes 622 is used for detecting a lower limit water level. Upper electrode 623 is disposed at a position below atmosphere open port 603. With such a configuration, it is possible to prevent washing water from being flown out from atmosphere open port 603. Further, lower electrode 624 is disposed above water outflow port 602 through which washing water is supplied to heat exchanger 700. With such a configuration, it is possible to prevent air from flowing into heat exchanger 700.

[0090] Control part 130 is configured to apply a DC current between common electrode 621 and water level electrodes 622 while periodically inverting a polarity of the DC current. Metals which form the electrode are eluded by oxidation and ionization of the metal due to an action of electrolysis generated when a DC current is applied between common electrode 621 and water level electrodes 622 via washing water. This inversion of polarity of the DC current is performed for preventing such elusion of metals. That is, when a DC current is applied, there may be a case where water level electrodes 622 are deteriorated within a short period of time. In view of the above, the deterioration of water level electrodes 622 caused by electrolysis is suppressed by periodically inverting polarity of the DC current.

[0091] In this exemplary embodiment, a polarity inversion interval is set to a time corresponding to an AC power source which is supplied as power source for the sanitary washing device. That is, the polarity inversion interval is set to 1/50 seconds when the AC power source to be supplied is 50Hz, and the polarity inversion interval is set to 1/60 seconds when the AC power source to be supplied is 60Hz. With such a configuration, it is unnecessary to add a new control circuit for inverting a polarity, thus realizing the miniaturization and the reduction of cost of the sanitary washing device.

[0092] As described previously, in sanitary washing device 100 of this exemplary embodiment, water stop electromagnetic valve 514 is opened so that washing water is supplied to sub tank 600. Then, when an upper limit water level is detected by water level electrode 622, water stop electromagnetic valve 514 is closed so that the supply of water is stopped. Then, the inside of sub tank 600 is filled with water.

[0093] When normal washing operation is executed in a state where sub tank 600 is filled with washing water, a water level is lowered. When a lower limit water level is detected by water level electrode 622, water stop electromagnetic valve 514 is opened again so that washing water is supplied to sub tank 600. Due to such an operation, the supply of washing water is continued until an upper limit water level is detected by water level electrode 622.

[0094] Usually, a maximum amount of washing water stored in sub tank 600 is 100cc. In view of the above, in this exemplary embodiment, an amount of water from the upper limit water level to the lower limit water level of sub tank 600 is set to 65cc. However, this amount of water is merely one example, and it is needless to say that the amount of water is not limited to the example.

[0095] Usually, a flow rate of washing water used for washing is set to 450cc/min when washing is performed with highest washing strength, and the flow rate is set to 260cc/min when washing is performed with lowest washing strength. Accordingly, a time required until washing water reaches the lower limit water level from the upper limit water level is 8.7 seconds when washing is performed with highest washing strength, and the time is 15 seconds when washing is performed with lowest washing strength.

[0096] Generally, a time necessary for a user to wash

his private part is 30 seconds or more. Accordingly, even when washing is performed with a lowest washing strength, washing water of 130cc is used. That is, during a washing operation performed one time, it is possible to detect, at least one time, a change in amount of washing water from the upper limit water level to the lower limit water level by water level electrode 622.

[0097] Therefore, control part 130 measures an elapsed time from the upper limit water level to the lower limit water level, and performs an arithmetic operation based on the measured time and an amount of water (65cc) from the upper limit water level to the lower limit water level, thus calculating a flow rate of washing water. Then, when there exists a difference between the flow rate set for every washing strength and the calculated flow rate, control part 130 adjusts an output of water pump 516, thus correcting the flow rate of washing water.

[0098] In this exemplary embodiment, the description is made by taking the case where the bottom surface of sub tank 600 has an approximately quadrangular shape as an example. However, the present invention is not limited to such a configuration. For example, the bottom surface of sub tank 600 may be formed into other polygonal shapes, and may be changed by taking into account a balance between sub tank 600 and parts surrounding sub tank 600 and a situation of a place where sub tank 600 is installed.

[0099] In this exemplary embodiment, the description is made by taking the case where common electrode 621 and water level electrodes 622 are mounted on facing wall surfaces, that is, on the front wall and the rear wall respectively as an example. However, the present invention is not limited to such a configuration. For example, common electrode 621 and water level electrodes 622 may be mounted on surfaces different from the above-mentioned wall surfaces such as wall surfaces disposed adjacent to each other, that is, the front wall and the side wall. Further, common electrode 621 may be mounted on the front wall, and water level electrodes 622 may be mounted on a top surface. In this case, it is necessary to make a length of lower electrode 624 and a length of upper electrode 623 different from each other such that a distal end of lower electrode 624 is positioned at the lower limit water level and a distal end of upper electrode 623 is positioned at the upper limit water level.

[0100] In this exemplary embodiment, the description is made by taking the case where water level electrodes 622 include two electrodes, that is, upper electrode 623 and lower electrode 624 as an example. However, the present invention is not limited to such a configuration. For example, an interval of the water level detection may be subdivided by arranging three or more water level electrodes 622 or the like. Due to such a configuration, the accuracy of the water level detection and the accuracy of the flow rate detection can be further enhanced.

[0101] The sub tank of this exemplary embodiment is constituted as described above.

<4> Configuration of heat exchanger

[0102] Hereinafter, the configuration of the heat exchanger of the sanitary washing device of this exemplary embodiment is described with reference to FIG. 12 and FIG. 13.

[0103] FIG. 12 is a perspective view of an external appearance of the heat exchanger. FIG. 13 is a cross-sectional view of the heat exchanger.

[0104] 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.

[0105] 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-shaped heater 702 made of ceramic, hot water outflow member 703 and the like.

[0106] 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-shaped heater 702 is disposed in a space formed between front surface member 710 and back surface member 720. Heating flow passage 715 is formed of: a gap defined between front surface member 710 and flat-plate-shaped heater 702; and a gap defined between back surface member 720 and flat-plate-shaped heater 702. Heat exchanger 700 having the above-mentioned configuration instantaneously increases a temperature of washing water which flows through heating flow passage 715 by flat-plate-shaped heater 702.

[0107] In heat exchanger 700, water inflow port 711 which constitutes a connecting port is formed in 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 in hot water outflow member 703 which is mounted on an upper end of a right side surface of front surface member 710.

[0108] As shown in FIG. 13, water inflow passage 713 which is continuously formed with water inflow port 711 shown in FIG. 12 is formed over the substantially whole width of the lower end portion of casing 701. A plurality of slits 714 are formed over the whole width of the upper surface of water inflow passage 713, and washing water which flows into water inflow passage 713 passes through slits 714 and flows into heating flow passage 715. Slits 714 have a function of allowing washing water to flow into heating flow passage 715 uniformly over the whole width of heating flow passage 715.

[0109] Partition rib 716 is provided to an upper end portion of heating flow passage 715, and an area above partition rib 716 forms buffer tank 750. A plurality of water through holes 717 are formed in partition rib 716 over the substantially whole width (including the whole width) of

partition rib 716. With such a configuration, washing water which is heated by heating flow passage 715 flows into buffer tank 750 through water through holes 717.

[0110] Projections 718 having an approximately semicircular cross section (including a semicircular cross section), for example, are disposed in buffer tank 750 at intervals in the substantially whole width (including the whole width) of buffer tank 750. Projections 718 are provided for making the flow of washing water which flows toward hot water outflow port 712 in the inside of buffer tank 750 turbulent. With such a configuration, washing water is agitated so that irregularity in temperature of washing water is eliminated whereby washing water having uniform temperature is flown out from hot water outflow port 712.

[0111] Two thermistors, that is, outflow hot water temperature sensor 730 and excessive temperature rise sensor 731 are mounted on hot water outflow member 703. Outflow hot water temperature sensor 730 detects an outflow hot water temperature of washing water. Excessive temperature rise sensor 731 detects an excessive temperature rise of heat exchanger 700. With such a configuration, control part 130 controls a temperature of washing water flown out from heat exchanger 700.

<5> Configuration of nozzle device

[0112] Hereinafter, the configuration of the nozzle device of the sanitary washing device of this exemplary embodiment is described with reference to FIG. 16 to FIG. 28.

[0113] 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 a 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 a B portion shown in FIG. 18. FIG. 20 is a cross-sectional view taken along a 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 a C portion shown in FIG. 21. FIG. 23 is a longitudinal cross-sectional view showing a buttock washing state of the nozzle device. FIG. 24 is a cross-sectional view showing a detailed configuration of a D portion shown in FIG. 23. FIG. 25 is a longitudinal cross-sectional view showing a bidet washing state of the nozzle device. FIG. 26 is a cross-sectional view showing a detailed configuration of an E portion shown in FIG. 25. FIG. 27 is a transverse cross-sectional view of the nozzle portion showing a bidet washing state of the nozzle device. FIG. 28 is a cross-sectional view showing a detailed configuration of a G portion shown in FIG. 27.

[0114] As shown in FIG. 16, nozzle device 800 includes at least support portion 810, nozzle portion 820, drive part 860, flow regulating valve 517 and the like. Support portion 810 is molded by using a resin material such as POM (polyoxymethylene) 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. Drive part 860 drives and moves nozzle portion 820 forward and backward. Flow regulating valve 517 changes over the supply of washing water to nozzle portion 820.

[0115] In the description of the nozzle device made hereinafter, the arrangement of the respective constitutional elements is described by assuming that a direction along which the nozzle portion is stored is a rearward direction, a direction along which the nozzle portion 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.

[0116] Support portion 810 is formed into a frame shape, and is formed of: an inclined portion 812 which is lowered toward a front portion from a rear portion thereof 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 drive part 860 are formed over the substantially 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.

[0117] As shown in FIG. 17, 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 opened. Rack guide 815 is configured to guide flexible rack 861 while restricting upper and lower surfaces and one side surface of flexible rack 861.

[0118] 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 an opened side surface of rack guide 815, a left side surface of rack guide 815 is opened at inclined portion

812, and a side opposite to the left side surface, that is, a right side surface of rack guide 815 is opened at vertical side portion 813 and bottom side portion 811. Further, opened 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.

[0119] Drive part 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. Drive part 860 moves nozzle portion 820 forward and backward along guide rail 814.

[0120] Drive motor 863 is formed of a stepping motor, for example, and a rotation 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.

[0121] 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. Washing water jetted from nozzle portion 820 flows into the gap and washes an outer peripheral surface of nozzle portion 820.

[0122] Nozzle lid 801 is disposed on a front side of holding portion 816 in an openable and closeable manner, and is opened or closed in response to advancing and retracting of nozzle portion 820. By closing nozzle lid 801 in a state where nozzle portion 820 is stored, it is possible to prevent nozzle portion 820 from being contaminated by feces or the like.

[0123] 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 a washing water supply portion and connecting tube 802 provided for supplying washing water to flow regulating valve 517 from support portion 810 to each other is formed.

[0124] 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 substantially whole nozzle body 830 (including the whole nozzle body 830). In connecting portion 850, nozzle body 830 tows nozzle cover 840.

[0125] As shown in FIG. 6, nozzle body 830 of nozzle portion 820 includes: buttock washing portion 831 for washing a private part; bidet washing portion 832 for washing a women's private part; nozzle cleaning portion 833 for cleaning nozzle portion 820 and the like.

[0126] As shown in FIG. 23 and FIG. 24, buttock washing portion 831 includes: buttock washing water jetting port 834 which is formed on a distal end portion of nozzle body 830 in an upwardly opening manner; and buttock washing water flow passage 835 which communicates with buttock washing water jetting port 834 from a rear end of nozzle body 830. Buttock washing water flow 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 washing water jetting port 834. Flow straightening plate 835a which straightens the flow of washing water is disposed on the bent portion. With such a configuration, washing water jetted from buttock washing water jetting port 834 is jetted upward through jetting opening 844 formed in nozzle cover 840.

[0127] As shown in FIG. 25 and FIG. 26, bidet washing portion 832 includes: bidet washing water jetting port 836 which is disposed behind buttock washing water jetting port 834; and bidet washing water flow passage 837 which communicates with bidet washing water jetting port 836 from a rear end of nozzle body 830. Washing water jetted from bidet washing water jetting port 836 is jetted upward through jetting opening 844 formed in nozzle cover 840.

[0128] As shown in FIG. 27, nozzle cleaning portion 833 includes: nozzle cleaning jetting port 838 disposed on a side surface of nozzle body 830; and nozzle cleaning flow passage 839 which communicates with nozzle cleaning jetting port 838 from the rear end of nozzle body 830. Washing water jetted from nozzle cleaning jetting port 838 is jetted to the inside of nozzle cover 840, and is discharged to the outside of nozzle cover 840 from water discharge port 845 of nozzle cover 840. Washing water jetted from nozzle cleaning jetting port 838 is used for cleaning nozzle portion 820 and the surrounding of nozzle portion 820.

[0129] A front side of nozzle portion 820 is supported in a state where the front side of nozzle portion 820 is inserted into holding portion 816 of support portion 810, and a rear portion of nozzle portion 820 is disposed in a slidable manner in a state where the rear portion of nozzle portion 820 is suspended from 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 washing position shown in FIG. 23 where nozzle portion 820 projects from holding portion 816, and a bidet washing position shown in FIG. 25.

[0130] Nozzle cover 840 includes nozzle cover body 841 and connecting member 842. Nozzle cover body 841 is formed by forming 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 opened surface. Connecting member 842 is molded by using a resin material such as ABS, for example, and is formed into an approximately circular cylindrical shape (including a circular cylindrical shape). Connecting piece 843 which engages with nozzle body 830 is formed on both side portions of connecting member 842.

[0131] 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. Further, 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.

[0132] 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 in a rear end of nozzle cover body 841.

[0133] Single jetting opening 844 which can face buttock washing water jetting port 834 and bidet washing water jetting port 836 of nozzle body 830 is formed on a front upper surface of nozzle cover body 841. Water discharge port 845 through which washing water flowing out to the inside of nozzle cover body 841 is discharged to the outside is formed in a front lower surface of nozzle cover body 841.

[0134] 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.

[0135] Flow regulating valve 517 is mounted on a rear end surface of nozzle body 830. Flow regulating valve 517 includes disc-type valve body 517a and stepping motor 517b for driving a switching operation of the valve body 517a. Flow regulating valve 517 supplies washing water by selectively switching a flow passage among buttock washing water flow passage 835, bidet washing water flow passage 837, and nozzle cleaning flow passage 839.

[0136] Water supply port 517c for supplying washing water to flow regulating valve 517 is formed in an outer surface of valve body 517a of flow regulating valve 517. Water supply port 517c is joined to and is made to communicate with water supply joint 817 mounted on support portion 810 by means of connecting tube 802.

[0137] 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 FIG. 22 and FIG. 28.

[0138] As shown in FIG. 22 and FIG. 28, connection receiving portion 851 is formed on a right side of an outer periphery of a rear end portion of nozzle body 830. Front recessed portion 851a and rear recessed portion 851b having an approximately V-shaped (including V-shaped) trench 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. A distance between front recessed portion 851a and rear recessed portion 851b is set equal to a distance between buttock washing water jetting port 834 and bidet washing water jetting port 836.

[0139] 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 a V-shaped) connecting projection 843a which projects inward is formed on a rear end portion of connecting piece 843.

[0140] 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 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.

[0141] In a state where connecting projection 843a enters front recessed portion 851a as shown in FIG. 22, bidet washing 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 washing water jetting port 834 and jetting opening 844 face each other as shown in FIG. 19 and FIG. 24. With such a configuration, washing water can be jetted from a predetermined jetting port.

<6> Configuration of toilet lid

[0142] Hereinafter, the configuration of the toilet lid of the sanitary washing device according to this exemplary embodiment is described with reference to FIG. 29 to FIG. 32.

[0143] FIG. 29 is a perspective view showing a disassembled state of the toilet lid in an upside down state. FIG. 30 is a perspective view showing an assembled state of the toilet lid in an upside down state. FIG. 31 is a cross-sectional view taken along a line 31-31 in FIG. 30. FIG. 32 is a cross-sectional view taken along a line 32-32 in FIG. 30.

[0144] As shown in FIG. 29, in this exemplary embodiment, toilet lid 320 includes at least: toilet lid body 330; toilet lid inner surface member 340; heat insulating member 350; buffer member 351 and the like. Toilet lid body 330 and toilet lid inner surface member 340 are formed into an integral body by molding using a polypropylene resin (PP), for example. Heat insulating member 350 is formed of foamed polystyrene, for example. Buffer member 351 is made of a soft resin material having resiliency. Buffer member 351 is molded by using a thermoplastic elastomer resin (TPE) or the like, for example.

[0145] Toilet lid body 330 includes: upper surface portion 331 having an approximately semielliptical shape (including a semielliptical shape); and side surface portion 332 which is integrally formed with a front portion

and both side portions of the outer periphery of upper surface portion 331. A planar shape of upper surface portion 331 of toilet lid body 330 is substantially similar (including "similar") to an outer shape of toilet seat 300 shown in FIG. 1. In a state where toilet lid 320 is closed, upper surface portion 331 covers the whole upper surface of toilet seat 300. Further, side surface portion 332 of toilet lid body 330 is formed into a shape so as to cover a portion of the side surface of toilet seat 300.

[0146] Holding portions 333 for holding toilet lid inner surface member 340 and buffer member 351 are formed at two portions of a front inner surface of upper surface portion 331 of toilet lid body 330.

[0147] Cylindrical bearing portions 334 into which a rotary shaft mounted on body 200 is fitted are integrally formed on both rear end portions of side surface portion 332. By pushing and expanding side surface portions 332 by making use of resiliency of a resin material, bearing portions 334 of side surface portions 332 can be mounted on or dismounted from the rotary shaft of body 200.

[0148] Engaging portion 334a which engages with a rear end of toilet lid inner surface member 340 is integrally formed on a joint portion between each bearing portion 334 and upper surface portion 331.

[0149] Toilet lid inner surface member 340 is an integral body formed of at least planar surface portion 341, side surface rib 342, reinforcing ribs 343 and the like. Planar surface portion 341 is formed into a shape approximately similar to a shape of upper surface portion 331 of toilet lid body 330 (including a similar shape). Side surface ribs 342 are formed on both side portions of planar surface portion 341 by being cut and raised in a direction perpendicular to planar surface portion 341. Reinforcing ribs 343 are formed on an outer surface of side surface rib 342 so as to reinforce strength of side surface rib 342.

[0150] In a state shown in FIG. 29, on the outer periphery of the front portion and both side portions of planar surface portion 341, joint side 347 which is formed in an upwardly curved shape and has a wall thickness gradually decreased toward a distal end of planar surface portion 341 is formed. Due to the formation of joint side 347, when toilet lid body 330 and toilet lid inner surface member 340 are assembled to each other, it is possible to enhance the close contact of the outer periphery.

[0151] Joint portions 344 which are joined to holding portions 333 formed on toilet lid body 330 are integrally formed on planar surface portion 341 of toilet lid inner surface member 340 at two front portions of planar surface portion 341. A screw hole is formed in the center of joint portion 344. Toilet lid body 330 and toilet lid inner surface member 340 are configured to be fixed to each other by screws 322. Further, engaging pieces 345 which engage with engaging portion 334a formed on toilet lid body 330 are formed on both side portions of a rear end portion of toilet lid inner surface member 340.

[0152] As shown in FIG. 29, in a state where a surface of toilet lid inner surface member 340 which faces toilet lid body 330 shown in FIG. 30 is directed downward, recessed portions 346 which are recessed upward are formed on both side portions of planar surface portion 341 of toilet lid inner surface member 340. Recessed portions 346 are formed such that recessed portions 346 extend from a rear end of planar surface portion 341 of toilet lid inner surface member 340 to the vicinity of a front end of the planar surface portion 341.

[0153] As shown in FIG. 31, usually, toilet lid body 330 and toilet lid inner surface member 340 are configured such that a small gap 321 of 1mm or less, for example, is formed between toilet lid body 330 and toilet lid inner surface member 340 at planar surface portion 341. However, there may be portions where toilet lid body 330 and toilet lid inner surface member 340 are partially brought into contact with each other due to irregularities in shape of a molding member. Further, gap 321 of approximately 3cm at maximum is formed between toilet lid body 330 and toilet lid inner surface member 340 at recessed portion 346.

[0154] Heat insulating member 350 is formed into a flat plate having an approximately rectangular shape (including a rectangular shape) as viewed in a plan view. Specifically, heat insulating member 350 is molded into a shape such that heat insulating member 350 can be stored in recessed portion 346 of toilet lid inner surface member 340. With such a configuration, heat insulating member 350 is stored in gap 321 formed by toilet lid body 330 and toilet lid inner surface member 340.

[0155] As shown in FIG. 32, buffer member 351 is formed by integrally molding leg portion 351a which is fitted in holding portion 333 of toilet lid body 330 and contact portion 351b which is brought into contact with the upper surface of toilet seat 300. Buffer member 351 buffers an impact generated when toilet lid 320 and toilet seat 300 are brought into contact with each other. Leg portion 351a of buffer member 351 is configured such that leg portion 351a is press-fitted in holding portion 333 of toilet lid body 330 so that leg portion 351a is not easily removed from holding portion 333. Accordingly, contact portion 351b is formed with a size larger than a size of leg portion 351a.

[0156] Hereinafter, assembling of toilet lid 320 having the above-mentioned configuration is described in detail.

[0157] Firstly, two heat insulating members 350 are disposed on an inner surface of toilet lid body 330 at predetermined positions. In such a state, engaging piece 345 of toilet lid inner surface member 340 is engaged with engaging portion 334a of toilet lid body 330. With such a configuration, a rear portion of toilet lid inner surface member 340 is engaged with toilet lid body 330 in a state where heat insulating members 350 are incorporated.

[0158] Next, as shown in FIG. 32, joint portions 344 of toilet lid inner surface member 340 are engaged with holding portions 333 of toilet lid body 330 and joint portions 344 and holding portions 333 are fixed to each other

using screws 322. With such a configuration, toilet lid inner surface member 340 and toilet lid body 330 are fixed to each other by way of screws 322.

[0159] Next, buffer member 351 is press-fitted to holding portion 333 from a state where toilet lid inner surface member 340 and toilet lid body 330 are fixed to each other by screws 322. With such press fitting, buffer member 351 is fixed to holding portion 333.

[0160] That is, as shown in FIG. 31 and FIG. 32, in a state where toilet lid body 330, toilet lid inner surface member 340, and buffer members 351 are assembled to one another, joint side 347 of toilet lid inner surface member 340 and the inner surface of toilet lid body 330 are brought into an approximately close contact state. With such a configuration, the flow of air inside gap 321 formed between toilet lid body 330 and toilet lid inner surface member 340 is suppressed. As a result, heat insulating effect of toilet lid 320 is enhanced.

[0161] As described above, according to the sanitary washing device of this exemplary embodiment, the partition wall is formed inside the sub tank, the water inflow tank and storage tank are formed, and the atmosphere open port is formed in the top surface of the sub tank. With such a configuration, at least a portion of air is separated, in the course of rising in the water inflow tank, from air-containing washing water which flows into the water inflow tank through the water inflow port disposed in the vicinity of the bottom portion of the water inflow tank. Separated air is discharged to the outside of the sub tank through the atmosphere open port. On the other hand, washing water containing a reduced amount of air overflows the partition wall and flows into the storage tank. Further, washing water containing a reduced amount of air flows out through the water outflow port disposed in the vicinity of the bottom portion of the storage tank. Therefore, washing water containing a reduced amount of air is supplied to the heat exchanger. Accordingly, an amount of bubbles generated in the heat exchanger can be reduced and hence, thermal efficiency of the heat exchanger can be enhanced. As a result, it is possible to realize the sanitary washing device which can achieve the reduction of damage on the heat exchanger and the enhancement of durability of the heat exchanger.

[0162] According to the sanitary washing device of this exemplary embodiment, a flow rate is calculated by detecting a change in water level using the water level detection sensor disposed in the sub tank without providing a dedicated flow rate sensor for detecting a flow rate separately to the water circuit. Accordingly, the configuration of the water circuit can be simplified and, at the same time, it is possible to realize the reduction of cost.

[0163] According to the sanitary washing device of this exemplary embodiment, the common electrode and the water level electrodes of the water level detection sensor disposed in the sub tank are mounted on different surfaces respectively. With such a configuration, it is possible to suppress an erroneous detection where remaining water which adheres to the inner surface of tank body is erroneously detected as stored water. As a result, the detection accuracy and the reliability of the water level detection sensor can be enhanced.

[0164] According to the sanitary washing device of this exemplary embodiment, the motor part which generates a small amount of vibrations of the water pump is mounted on the water pump mounting portion of the chassis by way of the buffer member made of a foamed resin having resiliency. Further, the buffer tank is connected to the water pump by way of the connecting tube. With such a configuration, it is possible to suppress vibrations generated when the water pump is driven from being transmitted to the chassis, other members, and the body.

SECOND EXEMPLARY EMBODIMENT

[0165] Hereinafter, the configuration of a sanitary washing device according to a second exemplary embodiment is described with reference to FIG. 33 to FIG. 36.

[0166] FIG. 33 is a perspective view showing an external appearance of a sub tank according to the second exemplary embodiment of the present invention. FIG. 34 is a cross-sectional view of the sub tank according to the second exemplary embodiment in a transverse direction. FIG. 35 is a cross-sectional view of the sub tank according to the second exemplary embodiment in a longitudinal direction. FIG. 36 is a schematic view of a top surface portion of the sub tank according to the second exemplary embodiment in a state where the sub tank is filled with water.

[0167] That is, the sanitary washing device according to this exemplary embodiment differs from the sanitary washing device according to the first exemplary embodiment with respect to the configuration of the sub tank. Other configurations of the sanitary washing device are substantially equal to corresponding configurations of the sanitary washing device according to the first exemplary embodiment and hence, the detailed description of other configurations is omitted. Further, constitutional elements identical with the constitutional elements of the first exemplary embodiment are described by giving the same symbols.

[0168] As shown in FIG. 33, sub tank 650 of the sanitary washing device of this exemplary embodiment includes at least: tank body 660, water level detection sensor 620; inflow water temperature sensor 630 and the like. Tank body 660 is molded by using a resin material such as ABS, for example. Water level detection sensor 620 detects a water level of washing water stored in tank body 660. Inflow water temperature sensor 630 is formed of a thermistor, for example, and detects a temperature of washing water supplied to the inside of tank body 660.

[0169] Tank body 660 includes two members, that is, front tank 661 which forms a front wall, side walls, a bottom surface, and a top surface of the tank, and rear tank 662 which forms a rear wall of the tank. The overall shape

of tank body 660 is formed of, in the same manner as the first exemplary embodiment, a plurality of planes consisting of the front wall, the rear wall, the side walls, the bottom surface, and the top surface. The overall shape of tank body 660 as viewed in a plan view is formed into an approximately quadrangular shape (including a quadrangular shape) as shown in FIG. 34. The front wall of front tank 611 has an inclined portion which is inclined rearward from an intermediate portion thereof. That is, when tank body 660 is viewed in a side view as shown in FIG. 35, a shape of tank body 660 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 660 is smaller than a cross-sectional area of the lower portion of tank body 660.

[0170] Water inflow port 601 is formed in a lower portion of one side wall of tank body 660, and water outflow port 602 is formed in a lower portion of the rear wall of tank body 660.

[0171] Further, atmosphere open port 603 which makes the inside and the outside of tank body 660 communicate with each other is formed in an upper portion of the side wall of tank body 660. Atmosphere open port 603 discharges air accumulated in the inside of tank body 660 to the outside so as to consistently maintain an inner pressure of tank body 660 at an atmospheric pressure. With such a configuration, an inner pressure of sub tank 650 is consistently maintained at an atmospheric pressure, and an inner pressure of washing water supply passage 900 (see FIG. 6) from a downstream side of sub tank 650 to water suction port 516d of water pump 516 is also maintained at an atmospheric pressure. Accordingly, water pump 516 can suck water without being influenced by fluctuations in water pressure. As a result, water pump 516 can perform a pump function stably.

[0172] As shown in FIG. 34, in the inside of water inflow port 601 of tank body 660, at least partition wall 663 and flow straightening portion 665 are formed. Partition wall 663 is formed on a bottom surface in a raised manner at a position where partition wall 663 faces water inflow port 601. Flow straightening portion 665 is formed of flow straightening rib 664 which extends in an approximately L shape (including an L shape) from a side wall so as to cover partition wall 663.

[0173] Flow straightening portion 665 is formed of inflow tank 665a and outflow passage 665b, and is formed over the whole width of the side wall of tank body 660. Inflow tank 665a is formed of the side wall and partition wall 663. Outflow passage 665b is formed of partition wall 663 and flow straightening rib 664.

[0174] Hereinafter, the flow of washing water in sub tank 650 is described.

[0175] Washing water which flows in sub tank 600 from water inflow port 601, firstly, flows into a lower portion of inflow tank 665a of flow straightening portion 665. In the course where washing water flowing into inflow tank 665a is diffused and rises in the inside of inflow tank 665a, a flow rate of washing water flowing into the lower portion of inflow tank 665a is decreased. Washing water whose flow rate is decreased overflows an upper end of partition wall 663 and flows into outflow passage 665b. Then, washing water flows downwardly into tank body 660 from a lower end of outflow passage 665b which forms a lower end of flow straightening rib 664.

[0176] At this stage of operation, when a pressure of washing water which flows through water inflow port 601 is high, or when washing water contains a large amount of air so that the flow of washing water is remarkably turbulent, the flow of washing water is straightened in flow straightening portion 665. Then, straightened washing water flows into tank body 660 and is stored in tank body 660. With such a configuration, air contained in washing water is separated from washing water during the storing of washing water in tank body 660, and separated air is discharged to the outside of tank body 660 from atmosphere open port 603.

[0177] Washing water flows into sub tank 650 as described above.

[0178] As shown in FIG. 33 to FIG. 36, sub tank 650 includes therein water level detection sensor 620 which includes common electrode 671 made of a stainless material and used in common, and a plurality of water level electrodes 672 disposed corresponding to respective water levels. Also in this exemplary embodiment, in the same manner as the first exemplary embodiment, an example where water level detection sensor 620 includes one common electrode 671 and two water level electrodes 672 is described.

[0179] Common electrode 671 is disposed on an inner surface of a lower portion of the front wall of tank body 660, water level electrodes 672 are disposed on an inner surface of the top surface of tank body 660. Water level electrodes 672 are constituted of upper electrode 673 and lower electrode 674 which are disposed in a downwardly suspended manner from the top surface. Upper electrode 673 has a short electrode length and a distal end of upper electrode 673 is disposed at a high position. On the other hand, lower electrode 674 has a long electrode length, and a distal end of lower electrode 674 is disposed at a low position. Further, common electrode 671 is disposed at a position lower than the distal end of lower electrode 674 which constitutes one of water level electrode 672 and is always immersed in washing water in a usual use state.

[0180] As shown in FIG. 34 and FIG. 36, two recessed portions 667 which are recessed upward are formed on the top surface of tank body 660 using two ribs 666 which extend downward. When a water level in the inside of tank body 660 rises above a lower end of rib 666, recessed portions 667 are closed by water surface 651 so that spaces where air is stored are formed. With such a configuration, even when sub tank 650 is in a state where the sub tank 650 is filled with water, hermetically sealed spaces 668 into which washing water does not enter are

formed on at least a portion of recessed portion 667.

[0181] Upper electrode 673 and lower electrode 674 are disposed on the top surface disposed at a highest position of recessed portion 667. A proximal portion of upper electrode 673 and a proximal portion of lower electrode 674 are disposed inside hermetically sealed spaces 668 which are formed when a water level rises.

[0182] That is, by disposing upper electrode 673 and lower electrode 674 inside hermetically sealed spaces 668, the proximal portions of upper electrode 673 and lower electrode 674 are not always brought into direct contact with washing water. Accordingly, in a state where the distal ends of upper electrode 673 and lower electrode 674 are separated from water surface 651, the proximal portions of upper electrode 673 and lower electrode 674 and remaining water adhering to the inner surface of tank body 660 are surely separated from each other. As a result, it is possible to prevent an erroneous detection where remaining water which adheres to the inner surface of tank body 660 is erroneously detected as stored water.

[0183] In this exemplary embodiment, flow straightening portion 665 is disposed inside water inflow port 601 of tank body 660. Accordingly, it is possible to prevent an erroneous detection of a water level brought about by splashing and adhering of washing water flowing through water inflow port 601 to water level electrodes 672. Further, it is possible to suppress the generation of waves on a water surface when a water level in tank body 660 rises. As a result, the accuracy of the water level detection can be further enhanced.

[0184] In this exemplary embodiment, the description is made by taking the configuration where two recessed portions are formed on the top surface of the tank body thus forming two hermetically sealed spaces, and the upper electrode and the lower electrode are disposed in the hermetically sealed spaces individually as an example. However, the present invention is not limited to such a configuration. For example, one hermetically sealed space may be formed on the top surface of the tank body, and the upper electrode and the lower electrode may be disposed in the same hermetically sealed space.

[0185] In this exemplary embodiment, the description is made by taking the configuration where the common electrode is disposed on the front wall of the tank body, and only two water level electrodes are disposed in the hermetically sealed spaces on the top surface as an example. However, the present invention is not limited to such a configuration. For example, all electrodes may be disposed in the hermetically sealed spaces on the top surface. With such a configuration, it is possible to further surely prevent an erroneous detection caused by remaining water.

[0186] As has been described heretofore, the sanitary washing device of the present invention includes the nozzle device for jetting washing water, the washing water supply passage for supplying washing water to the nozzle device, and the control part. The washing water supply passage includes the water pump for supplying washing water to the nozzle device, the heat exchanger disposed upstream of the water pump and provided for heating washing water, and the sub tank disposed upstream of the heat exchanger and provided for opening a portion of the washing water supply passage to atmosphere. The sub tank includes the atmosphere open port disposed on the upper surface of the sub tank, the water inflow tank and the storage tank formed separately from each other by the partition wall, the water inflow port disposed in the vicinity of a bottom portion of the water inflow tank, and the water outflow port disposed in the vicinity of a bottom portion of the storage tank. The sanitary washing device of the present invention may be configured such that washing water flowing into the water inflow tank through the water inflow port of the sub tank overflows the upper end of the partition wall and flows into the storage tank.

[0187] With such a configuration, from washing water containing air which flows into the water inflow tank of the sub tank through the water inflow port disposed in the vicinity of the bottom portion of the water inflow tank, at least a portion of air is separated in the course of rising in the inside of the water inflow tank. Separated air is discharged to the outside of the sub tank through the atmosphere open port so that an amount of air contained in washing water is reduced. Washing water containing a reduced amount of air overflows the partition wall and flows into the storage tank. Then, washing water containing a reduced amount of air flows out through the water outflow port disposed in the vicinity of the bottom portion of the storage tank and is supplied to the heat exchanger. That is, washing water containing a reduced amount of air is supplied to the heat exchanger. Accordingly, the generation of bubbles in the heat exchanger can be reduced and hence, thermal efficiency of the heat exchanger can be enhanced. As a result, it is possible to realize the sanitary washing device which can achieve the reduction of damage on the heat exchanger and the enhancement of durability of the heat exchanger.

[0188] The sub tank of the sanitary washing device of the present invention may include the barrier wall which is disposed between the upper-surface opening portion of the water inflow tank and the atmosphere open port and projects from the inner wall of the sub tank.

[0189] With such a configuration, even when a pressure of washing water which flows into the storage tank from the water inflow port is high, or even when washing water contains a large amount of air so that the flow of washing water is remarkably turbulent, the flow of washing water in the upward direction can be suppressed by the barrier wall. As a result, it is possible to prevent washing water from flowing out to the outside of the sub tank from the atmosphere open port beforehand.

[0190] The sanitary washing device of the present invention may include, in the water inflow tank, a plurality of flow straightening ribs which alternately project from the partition wall and the inner wall, facing the partition wall, of the sub tank.

[0191] With such a configuration, even when a pressure of washing water which flows into the storage tank from the water inflow port is high, or even when washing water contains a large amount of air so that the flow of washing water is remarkably turbulent, the flow of washing water is moderately straightened by the flow straightening ribs. As a result, air contained in washing water is separated from washing water due to a vortex generated downstream of the flow straightening ribs and hence, an amount of air contained in washing water can be reduced.

[0192] The sub tank of the sanitary washing device of the present invention further includes the water level detection sensor for detecting a water level of washing water stored in the sub tank. The water level detection sensor includes the common electrode and the plurality of water level electrodes on the inner surface of the sub tank. The control part is configured to apply a DC current between the common electrode and the water level electrodes and to detect a water level based on a change in voltage. Further, the common electrode and the water level electrodes of the water level detection sensor may be disposed on the different surfaces respectively.

[0193] With such a configuration, it is possible to suppress an erroneous detection where remaining water which adheres to the inner surface of tank body is erroneously detected as stored water. That is, the detection accuracy and the reliability of the water level detection sensor are enhanced. With such a configuration, it is possible to surely prevent the overflow of washing water from the sub tank. As a result, it is possible to realize the sanitary washing device having high safety and high reliability.

[0194] Further, the sanitary washing device of the present invention may be configured such that the common electrode and the water level electrodes are disposed on facing surfaces respectively.

[0195] With such a configuration, the common electrode and the water level electrodes can be respectively disposed at positions maximally away from each other. Accordingly, it is possible to more surely suppress an erroneous detection caused by remaining water which adheres to the inner surface of the sub tank. As a result, it is possible to enhance the reliability and the detection accuracy of the water level detection sensor.

[0196] The sub tank of the sanitary washing device of the present invention may further include the hermetically sealed space which is formed of a portion of the top surface and a water surface of stored washing water and into which washing water does not enter, and the water level electrode may be disposed on the top surface which forms the hermetically sealed space.

[0197] With such a configuration, the water level electrode and remaining water which adheres to the inner surface of the sub tank can be surely separated from each other. Accordingly, it is possible to prevent an erroneous detection where remaining water which adheres to the inner surface of tank body is erroneously detected as stored water. As a result, it is possible to further enhance the detection accuracy and the reliability of the water level detection sensor.

[0198] The sanitary washing device of the present invention may be configured such that the control part applies a DC current between the common electrode and the water level electrodes with a polarity of the DC current being cyclically inverted.

[0199] With such a configuration, oxidation and elusion of metal for forming the electrode brought about by an action of electrolysis can be suppressed whereby it is possible to suppress the deterioration of the electrode. As a result, it is possible to realize the sanitary washing device which exhibits the excellent reliability for a long period of time.

INDUSTRIAL APPLICABILITY

[0200] According to the present invention, it is possible to effectively reduce an amount of air contained in washing water in a sub tank of a sanitary washing device. Accordingly, the present invention is also applicable to other water supply equipment which is used in a state where the water supply equipment is directly connected to a city water pipe.

REFERENCE MARKS IN THE DRAWINGS

[0201]

1	city water pipe
2	branch faucet
3, 511	strainer
4, 512	check valve
5, 513	constant flow regulating valve
6, 514	water stop electromagnetic valve
7	flow rate sensor
8, 10	temperature sensor
9, 700	heat exchanger
11	pump
12	changeover valve
13	nozzle portion
100	sanitary washing device
110	toilet bowl
120	deodorizing device
130	control part
200	body
201	rear body case
210	operation part
211	infrared-ray receiver
220	operation switch
221	buttock washing switch
222	nozzle cleaning switch
230	setting switch
231	hot water temperature switch
232	toilet seat temperature switch
233	8-hour warming stop switch
234	power saving switch
235	toilet lid automatically opening/closing

	switch
240	display lamp
300	toilet seat
320	toilet lid
321	gap
330	toilet lid body
331	upper surface portion
332	side surface portion
333	holding portion
334	bearing portion
334a	engaging portion
340	toilet lid inner surface member
341	planar surface portion
342	side surface rib
343	reinforcing rib
344	joint portion
345	engaging piece
346, 667	recessed portion
347	joint side
350	heat insulating member
351	buffer member
351a	leg portion
351b	contact portion
360	toilet seat and toilet lid rotating mechanism
400	remote controller
401	remote controller body
402	transmitting part
410	buttock washing switch
411	bidet washing switch
412	stop switch
413	move washing switch
414	rhythm washing switch
415	washing strength switch
416	washing position switch
417	nozzle sterilizing switch
418	toilet lid switch
419	toilet seat switch
421	strength display lamp
422	position display lamp
450	human body detection sensor
500	washing part
501	chassis
501a	water pump mounting portion
501b	leg portion
502	connecting tube
510	water supply connecting port
515	relief valve
516	water pump
516a	motor part
516b	link mechanism part
516c	piston part
516d	water suction port
516e	water discharge port
517	flow regulating valve
517a	valve body
517b	stepping motor
517c	water supply port
600, 650	sub tank
601	water inflow port
602	water outflow port
603	atmosphere open port
610, 660	tank body
611, 661	front tank
612, 662	rear tank
613	atmosphere open portion
613a	buffer portion
614, 663	partition wall
615	water inflow tank
615a	upper surface opening portion
616	storage tank
617	barrier wall
618, 664	flow straightening rib
620	water level detection sensor
621, 671	common electrode
622, 672	water level electrode
623, 673	upper electrode
624, 674	lower electrode
630	inflow water temperature sensor
651	water surface
665	flow straightening portion
665a	inflow tank
665b	outflow passage
666	rib
668	hermetically sealed space
701	casing
702	flat-plate-like heater
703	hot water outflow member
710	front surface member
711	water inflow port
712	hot water outflow port
713	water inflow passage
714	slit
715	heating flow passage
716	partition rib
717	water through hole
718	projection
720	back surface member
730	outflow hot water temperature sensor
731	excessive temperature rise sensor
750	buffer tank
800	nozzle device
801	nozzle lid
802	connecting tube
810	support portion
811	bottom side portion
812	inclined portion
813	vertical side portion
814	guide rail
815	rack guide
816	holding portion
817	water supply joint
820	nozzle portion
830	nozzle body
831	buttock washing portion
832	bidet washing portion
833	nozzle cleaning portion

834	buttock washing water jetting port
835	buttock washing water flow passage
835a	flow straightening plate
836	bidet washing water jetting port
837	bidet washing water flow passage
838	nozzle cleaning jetting port
839	nozzle cleaning flow passage
840	nozzle cover
841	nozzle cover body
842	connecting member
843	connecting piece
843a	connecting projection
844	jetting opening
845	water discharge port
850	connecting portion
851	connection receiving portion
851a	front recessed portion
851b	rear recessed portion
860	drive part
861	flexible rack
862	pinion gear
863	drive motor
900	washing water supply passage

Claims

1. A sanitary washing device comprising:

a nozzle device for jetting washing water;
a washing water supply passage for supplying the washing water to the nozzle device; and
a control part,
wherein
the washing water supply passage includes:

a water pump for supplying the washing water to the nozzle device;
a heat exchanger, disposed upstream of the water pump, for heating the washing water; and
a sub tank, disposed upstream of the heat exchanger, for opening a portion of the washing water supply passage to atmosphere,

the sub tank includes:

an atmosphere open port disposed on an upper surface of the sub thank;
a water inflow tank and a storage tank which are formed separately from each other by a partition wall;
a water inflow port disposed in a vicinity of a bottom portion of the water inflow tank; and
a water outflow port disposed in a vicinity of a bottom portion of the storage tank, and

the washing water flowing into the water inflow tank through the water inflow port overflows an upper end of the partition wall and flows into the storage tank.

2. The sanitary washing device according to claim 1, wherein the sub tank includes a barrier wall which is disposed between an upper-surface opening portion of the water inflow tank and the atmosphere open port and projects from an inner wall of the sub tank.

3. The sanitary washing device according to claim 1, wherein the water inflow tank includes a plurality of flow straightening ribs which alternately project from the partition wall and an inner wall, facing the partition wall, of the sub tank.

4. The sanitary washing device according to claim 1, wherein
the sub tank further includes a water level detection sensor for detecting a water level of the washing water stored in the sub tank,
the water level detection sensor includes a common electrode and a water level electrode on an inner surface of the sub tank,
the control part is configured to apply a DC current between the common electrode and the water level electrode and to detect a water level based on a change in voltage, and
the common electrode and the water level electrode are disposed on different surfaces.

5. The sanitary washing device according to claim 4, wherein the common electrode and the water level electrode are disposed on surfaces which face each other.

6. The sanitary washing device according to claim 4, wherein
the sub tank further includes a hermetically sealed space which prevents intrusion of the washing water thereinto and which is formed of a portion of a top surface of the sub tank and a water surface of the washing water stored in the sub tank in a state where the sub tank is filled with the washing water, and
the water level electrode is disposed on the top surface which forms the hermetically sealed space.

7. The sanitary washing device according to claim 4, wherein the control part is configured to apply a DC current between the common electrode and the water level electrode with a polarity of the DC current being cyclically inverted.

FIG. 1

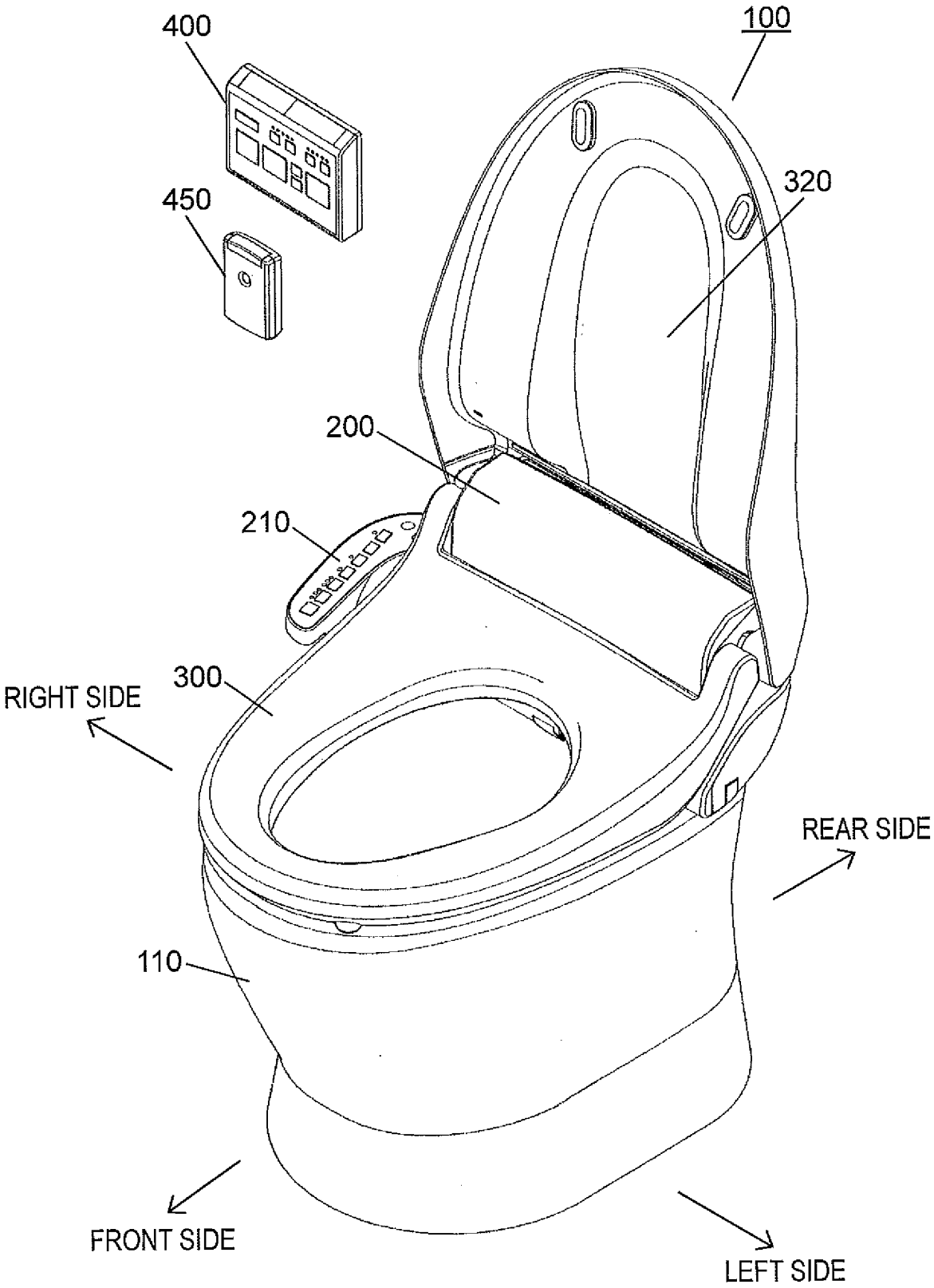

400
100
450
320
200
210
300
RIGHT SIDE
REAR SIDE
110
FRONT SIDE
LEFT SIDE

FIG. 2

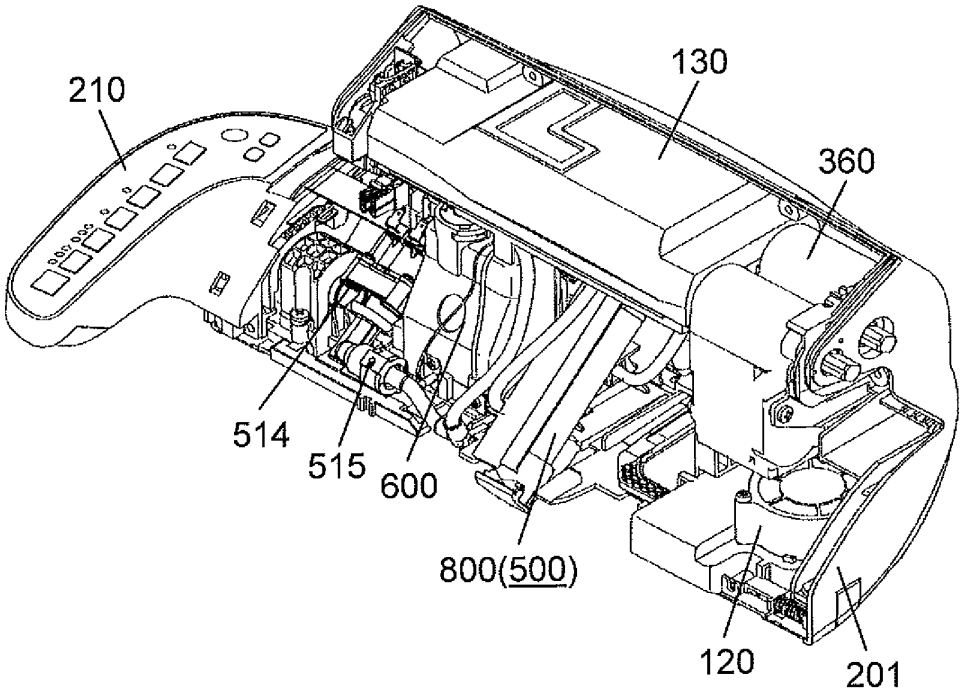

210
130
360
514
515
600
800(500)
120
201

FIG. 3

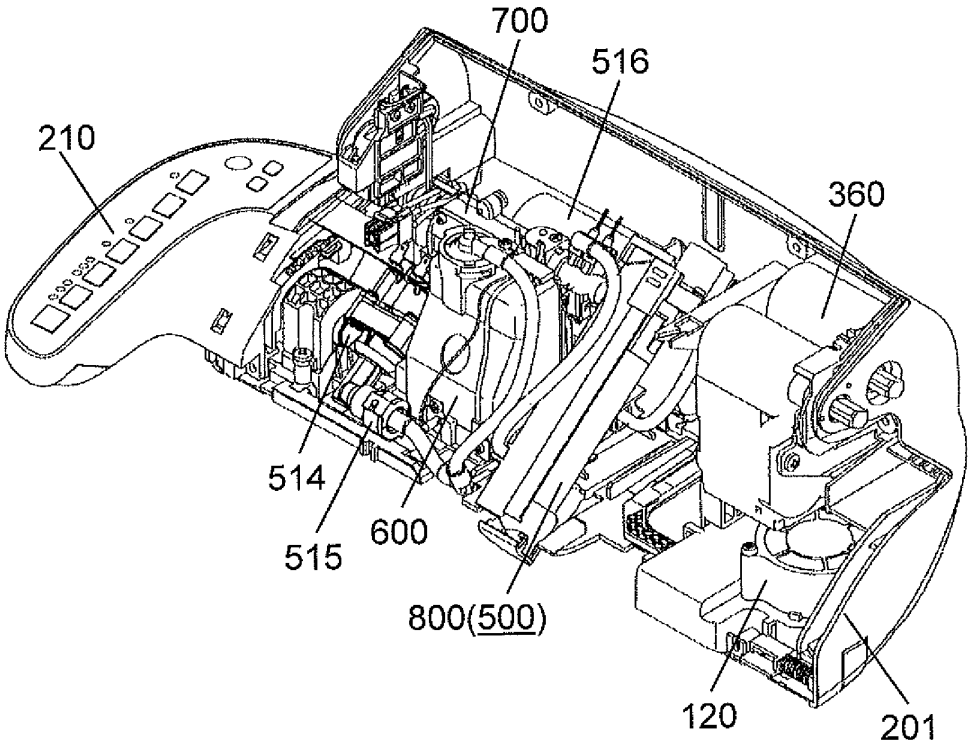
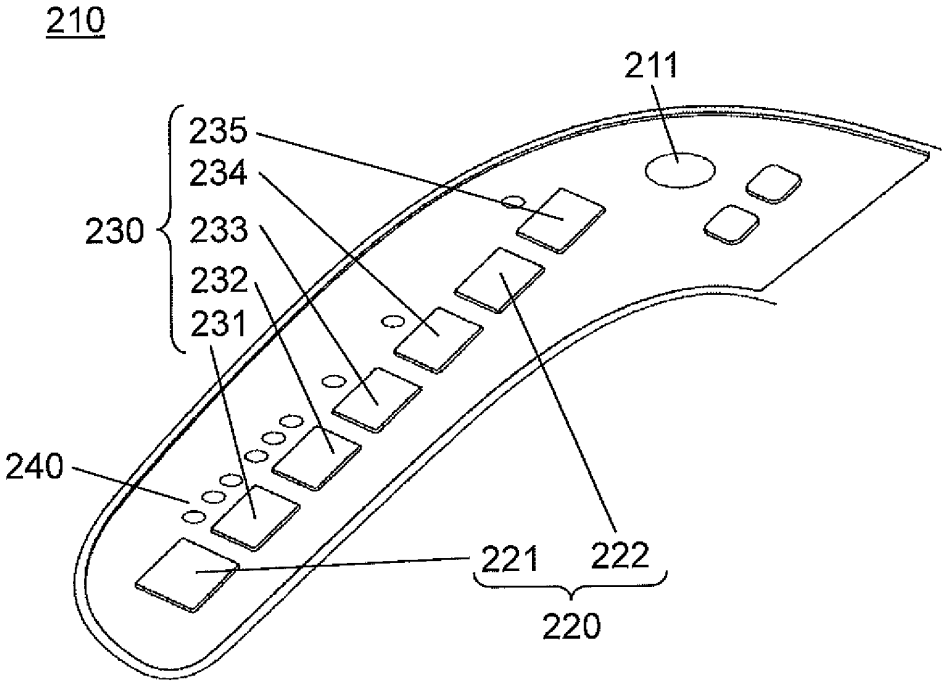

700
516
210
360
514
515
600
800(500)
120
201

FIG. 4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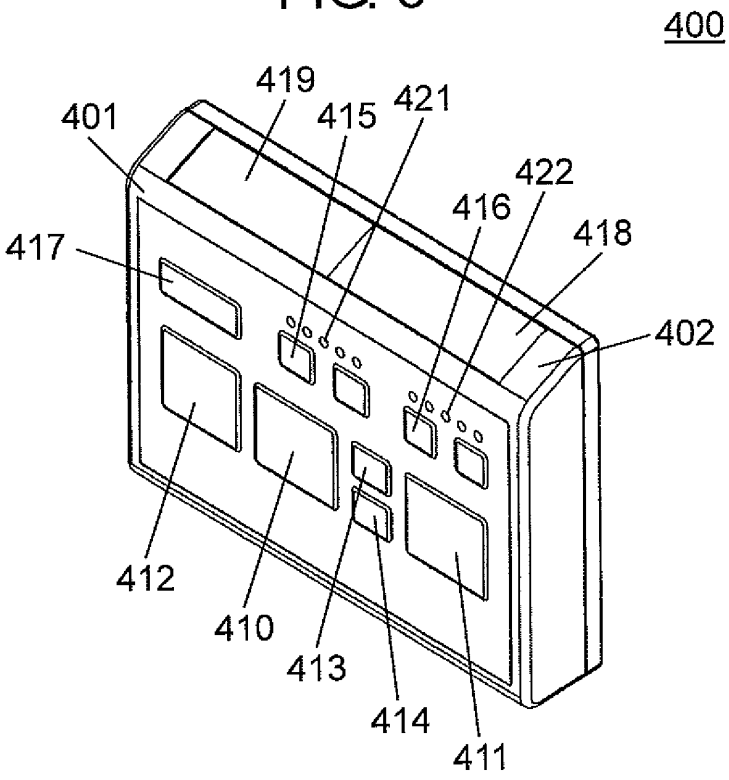
222
220

FIG. 5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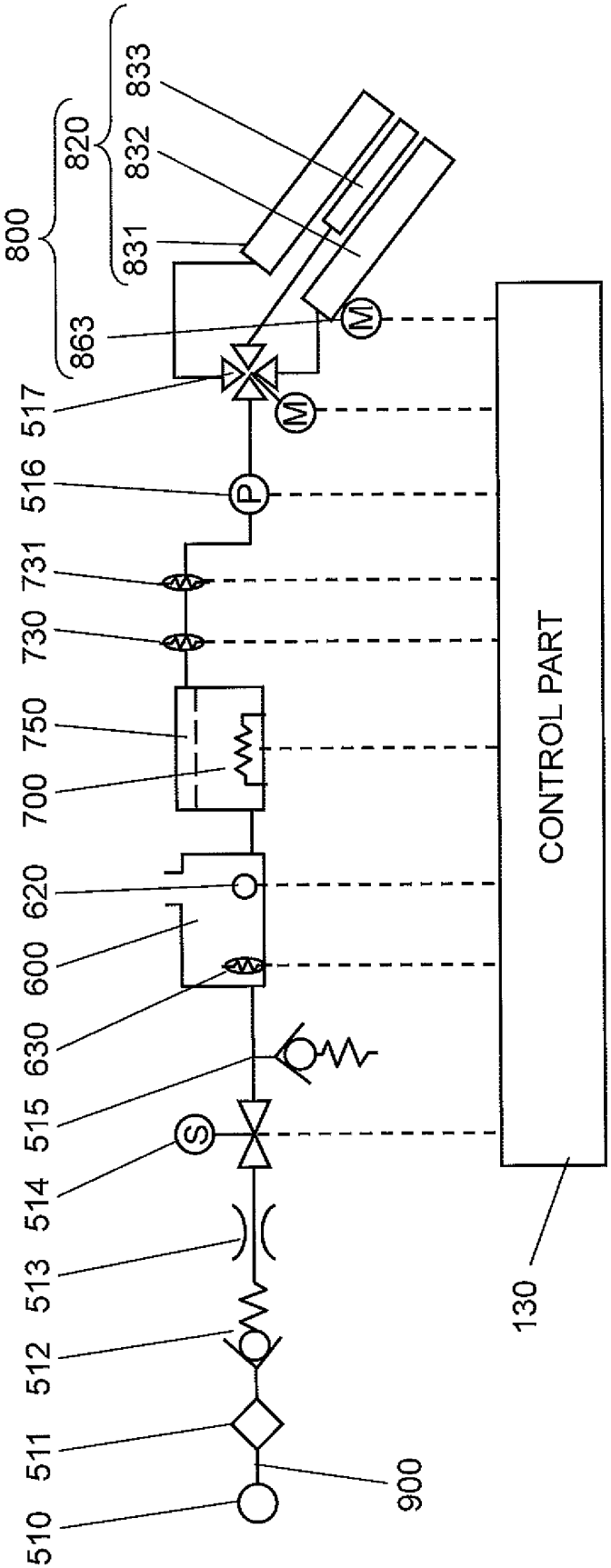
413
414
411

FIG. 6


800
820
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832
831
863
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516
731
730
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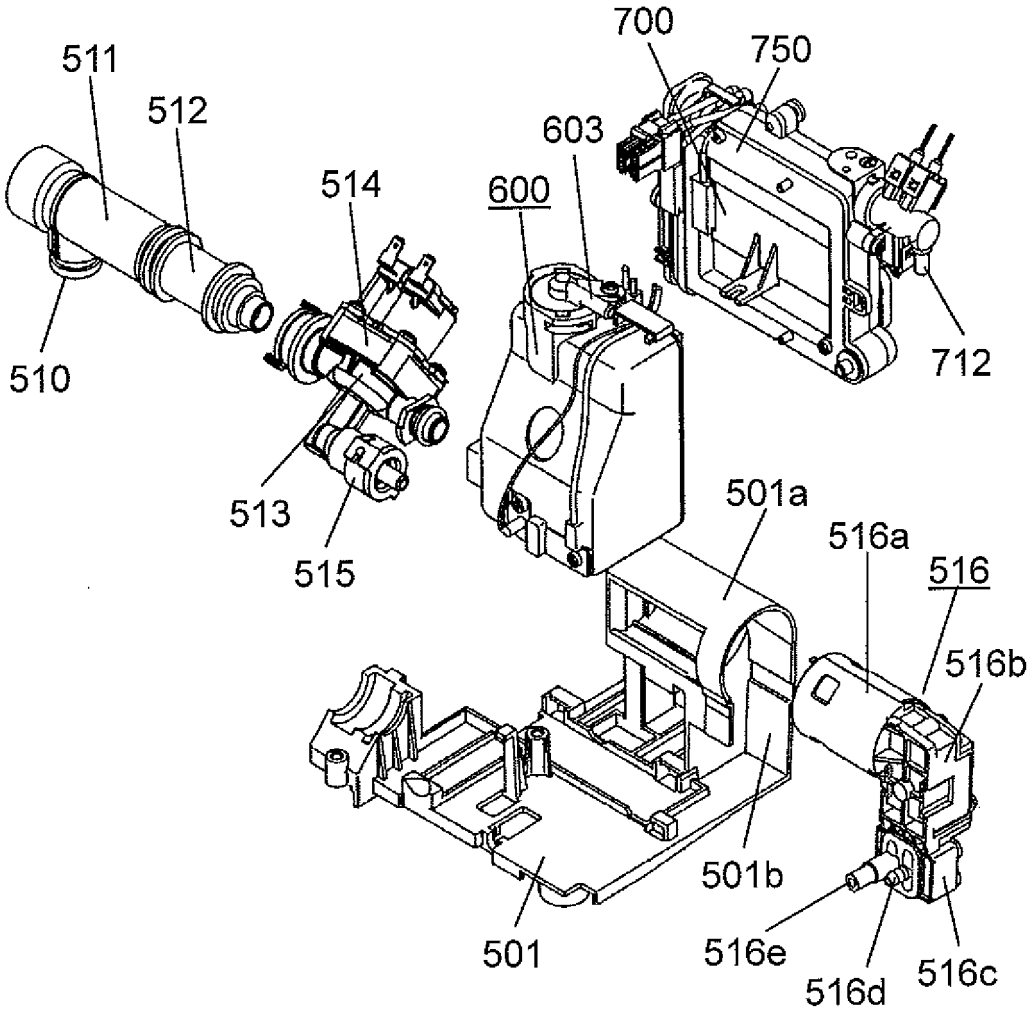
700
620
600
630
515
514
513
512
511
510
900
M
M
P
S
CONTROL PART
130

FIG. 7


700
750
511
512
603
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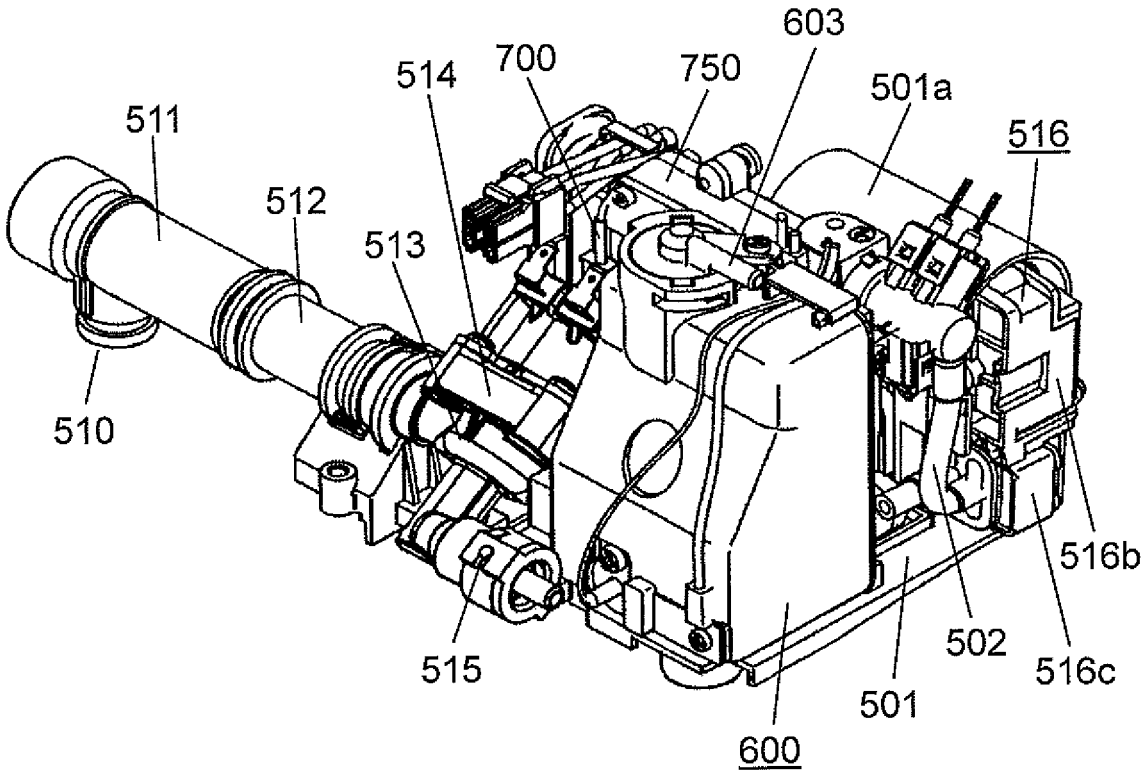
600
510
712
513
515
501a
516a
516
516b
501b
501
516e
516d
516c

FIG. 8


603
700
750
514
501a
511
516
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516b
502
515
516c
501
600

FIG. 9

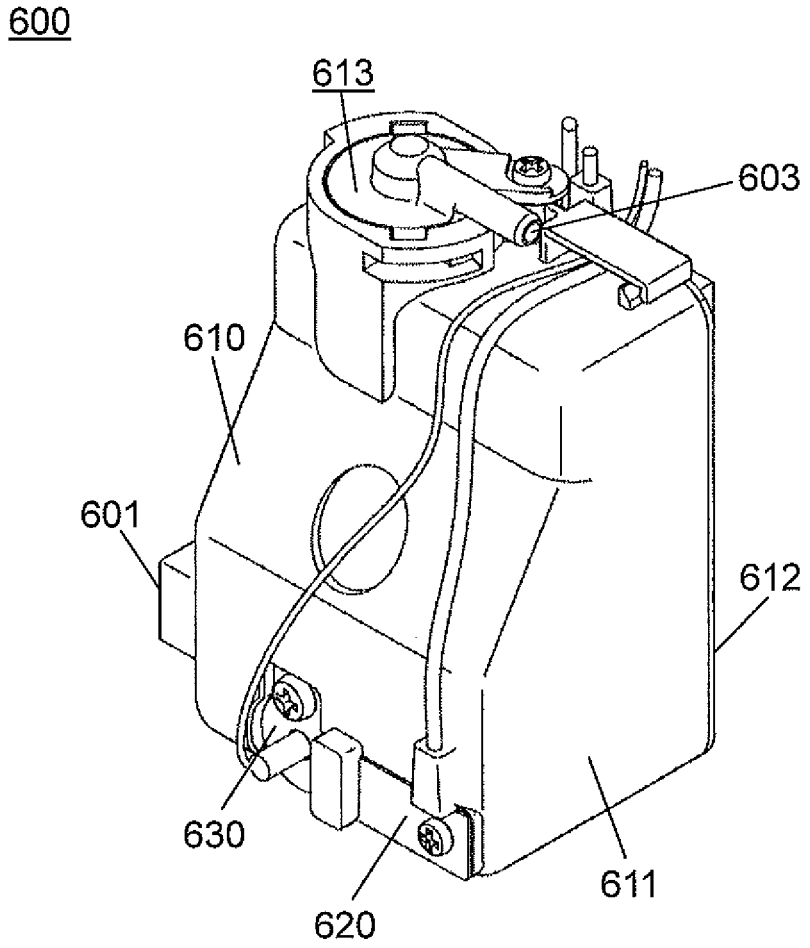


FIG. 10

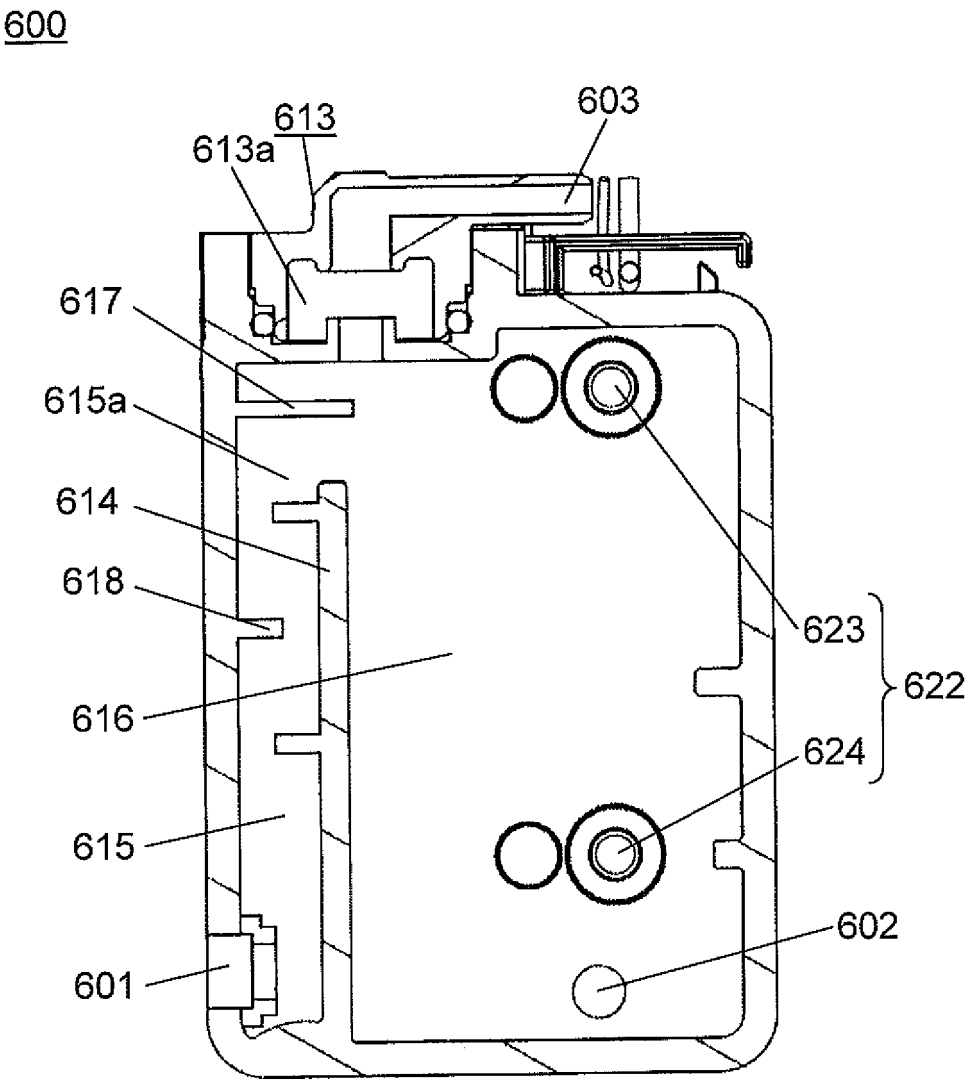


FIG. 11

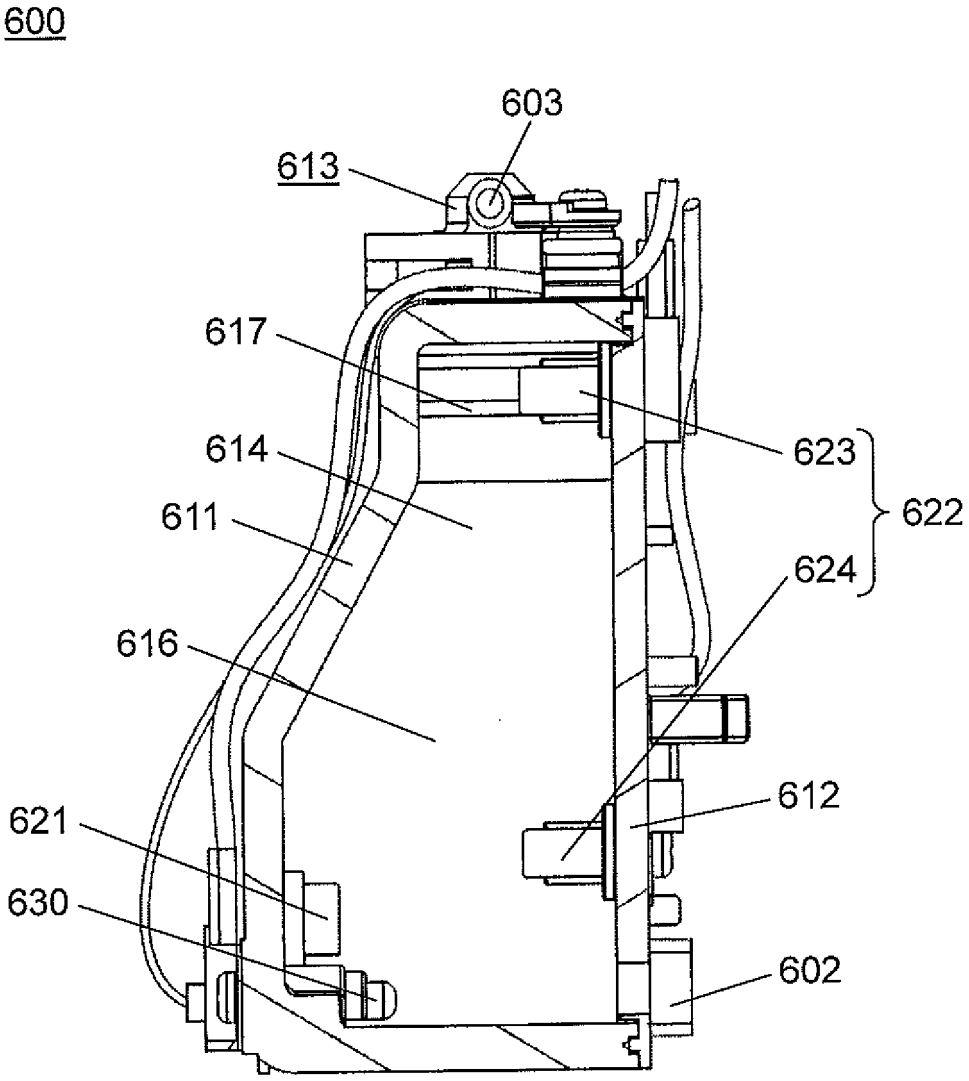


FIG. 12

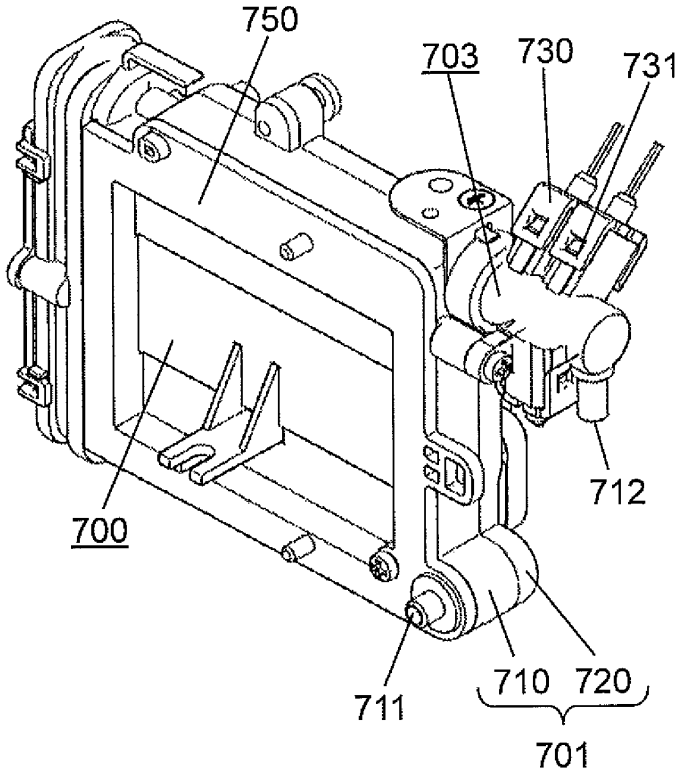
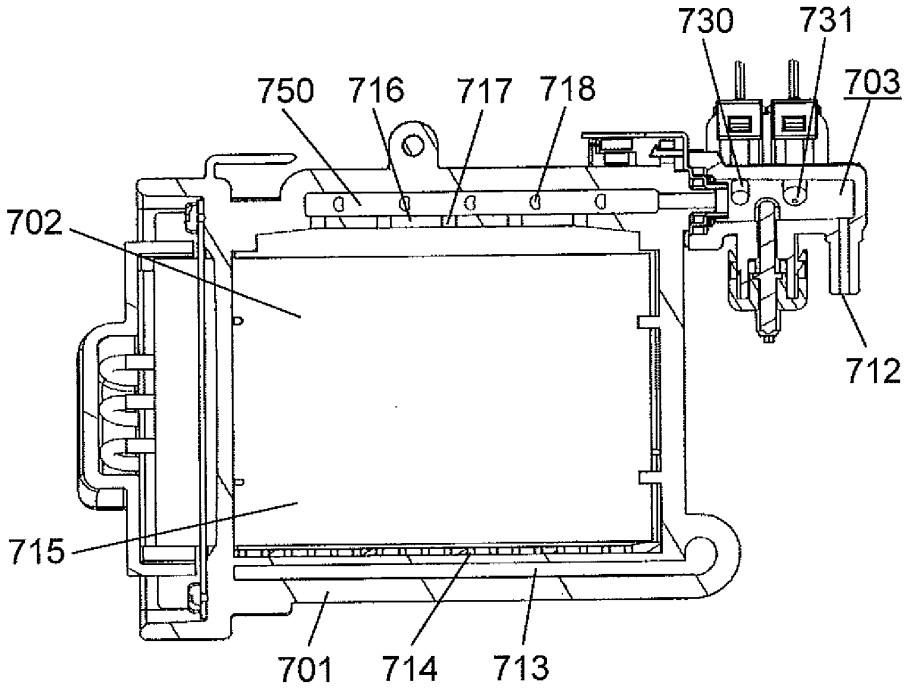

750
703
730
731
712
700
711
710
720
701

FIG. 13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717
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701
714
713

FIG. 14

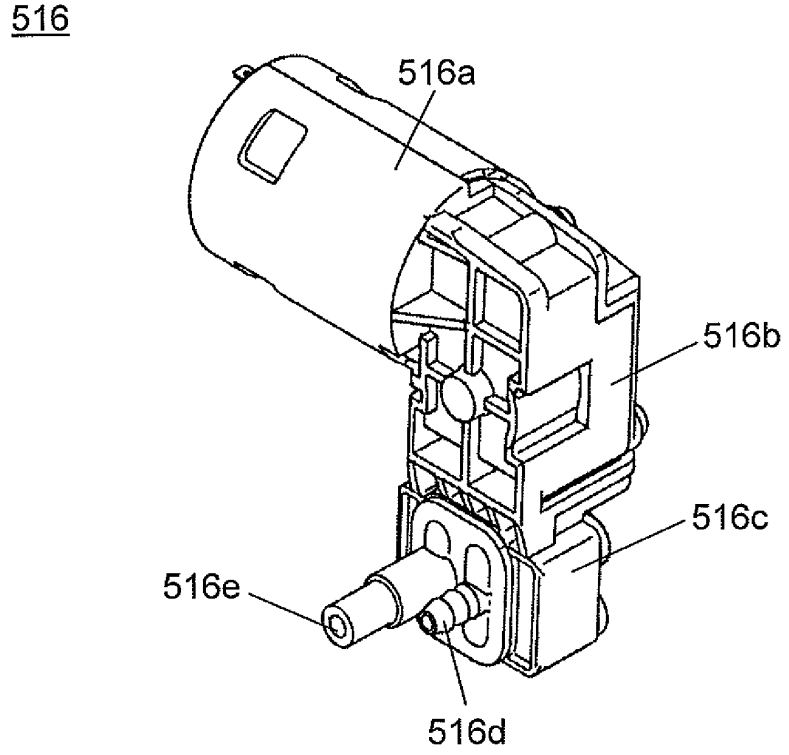


FIG. 15

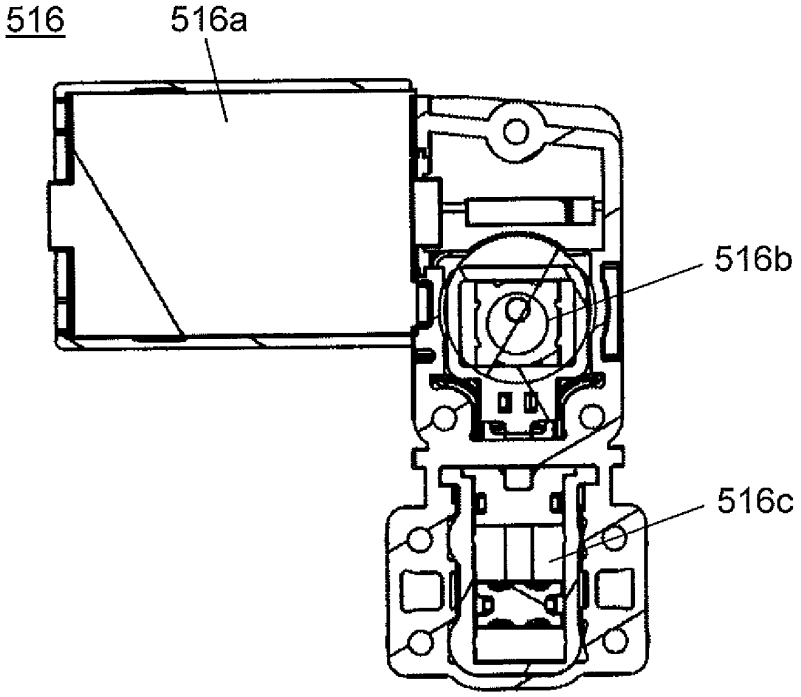


FIG. 16

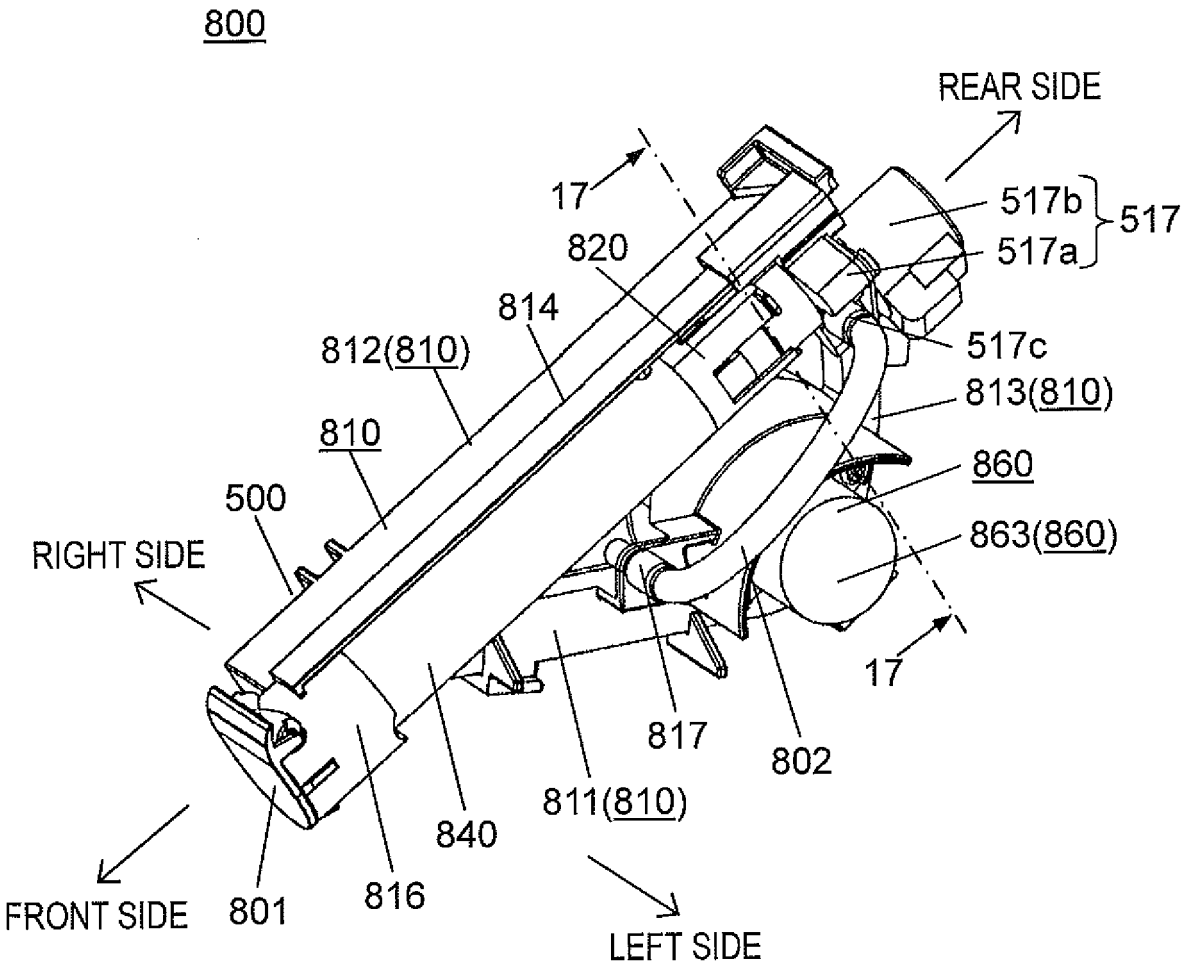

800
REAR SIDE
17
517b
517
820
517a
814
812(810)
517c
813(810)
810
860
500
RIGHT SIDE
863(860)
17
817
802
811(810)
840
FRONT SIDE
801
816
LEFT SIDE

FIG. 17

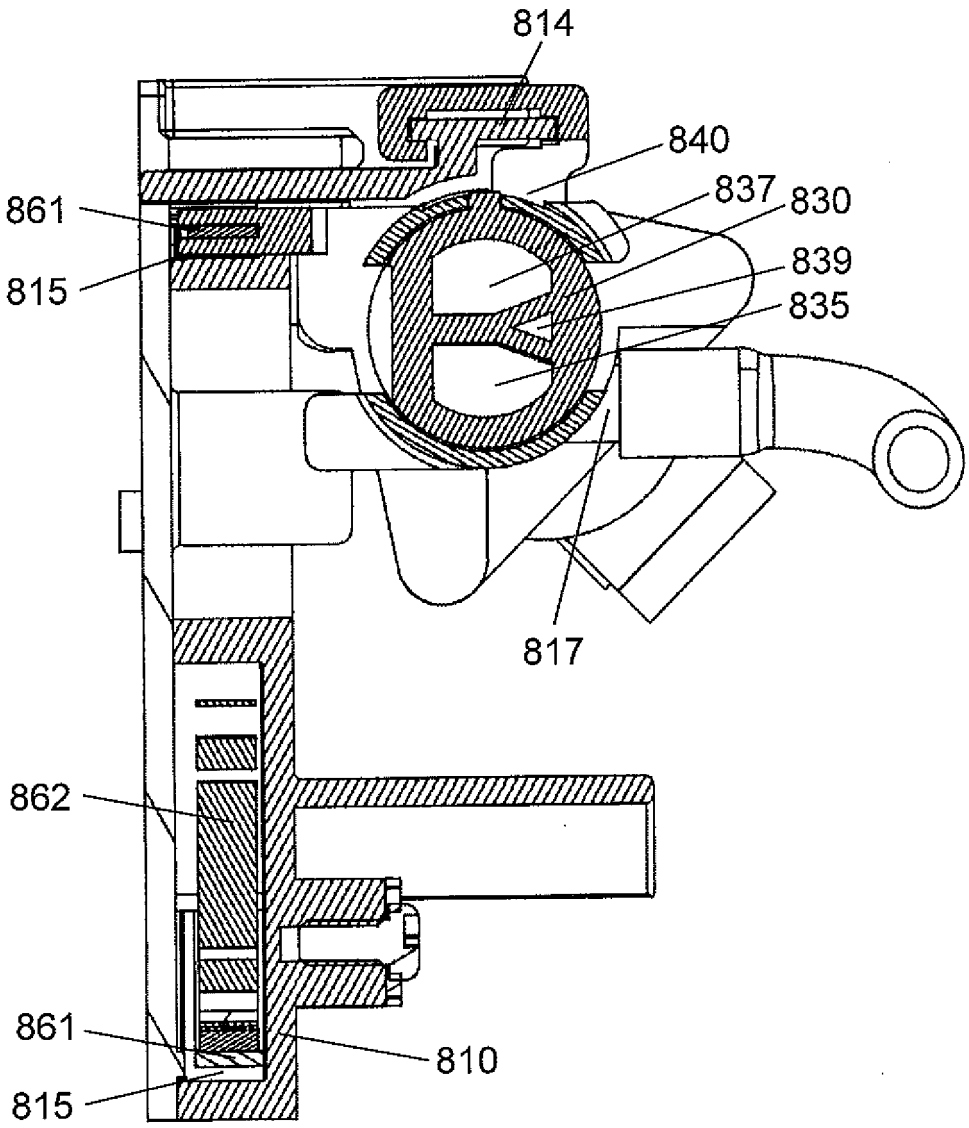


FIG. 18

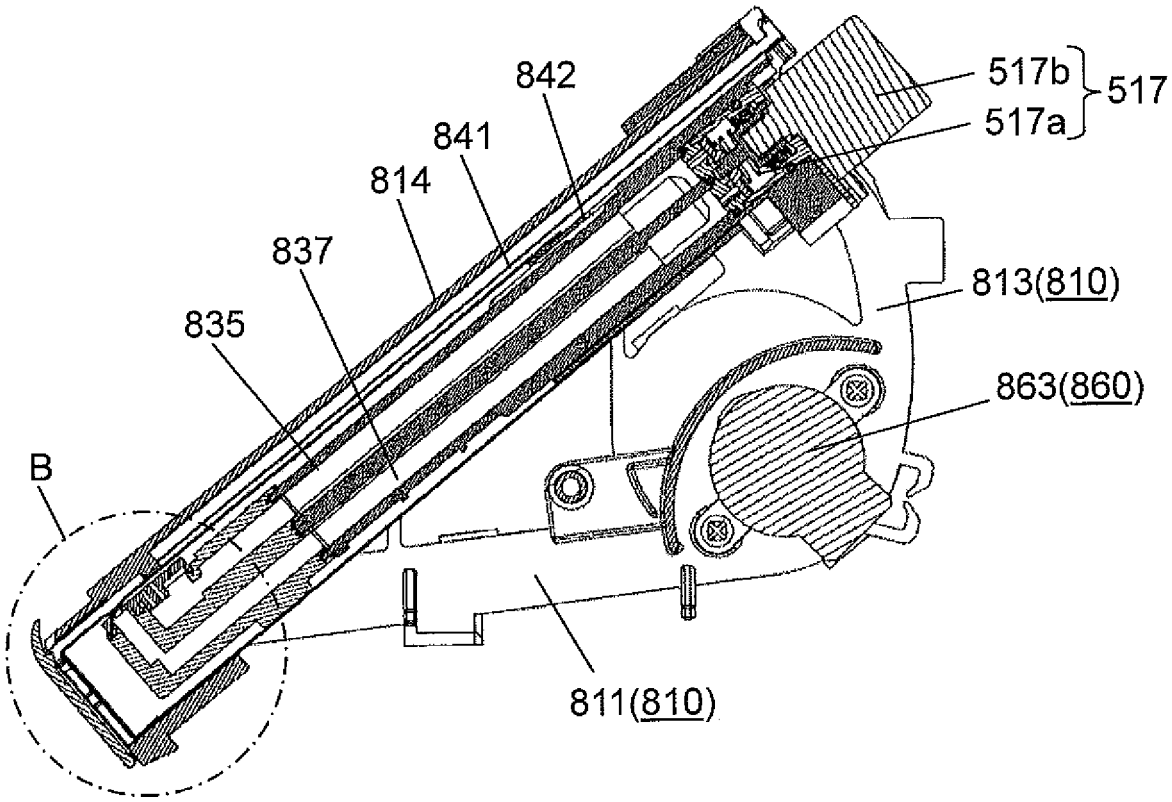


FIG. 19

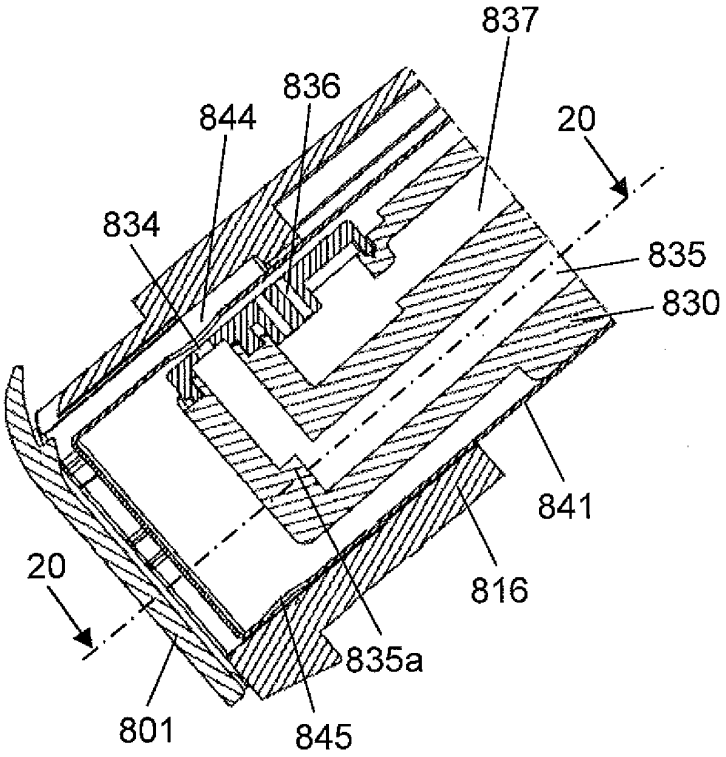
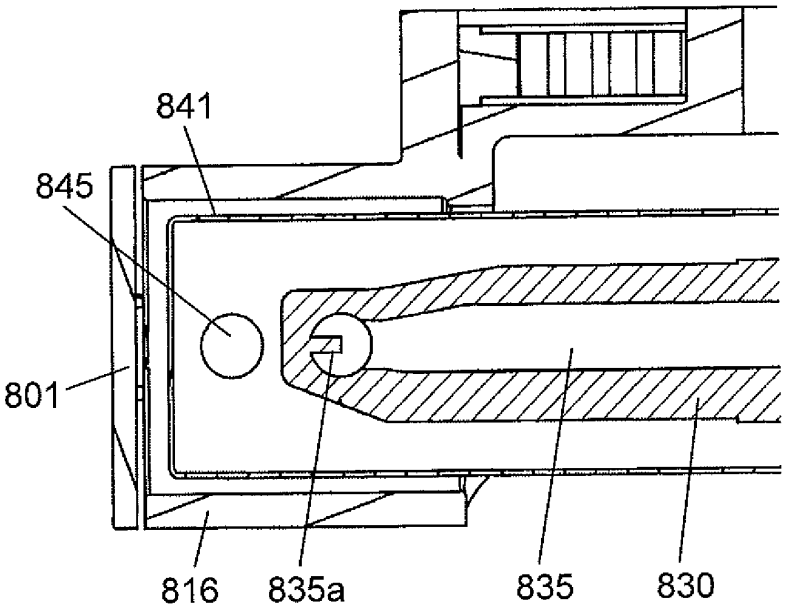

837
836
844
20
834
835
830
841
20
816
835a
801
845

FIG. 20


841
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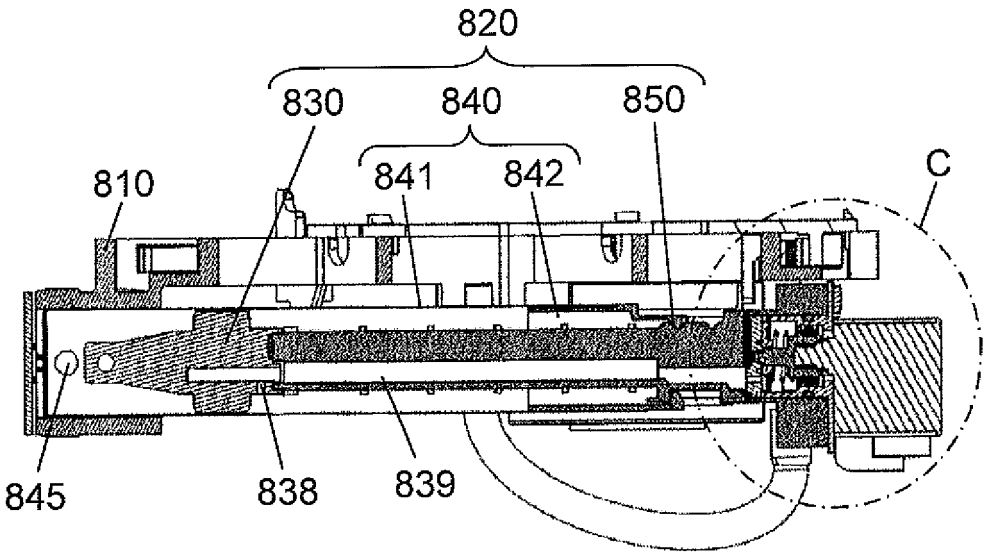
835a
835
830

FIG. 21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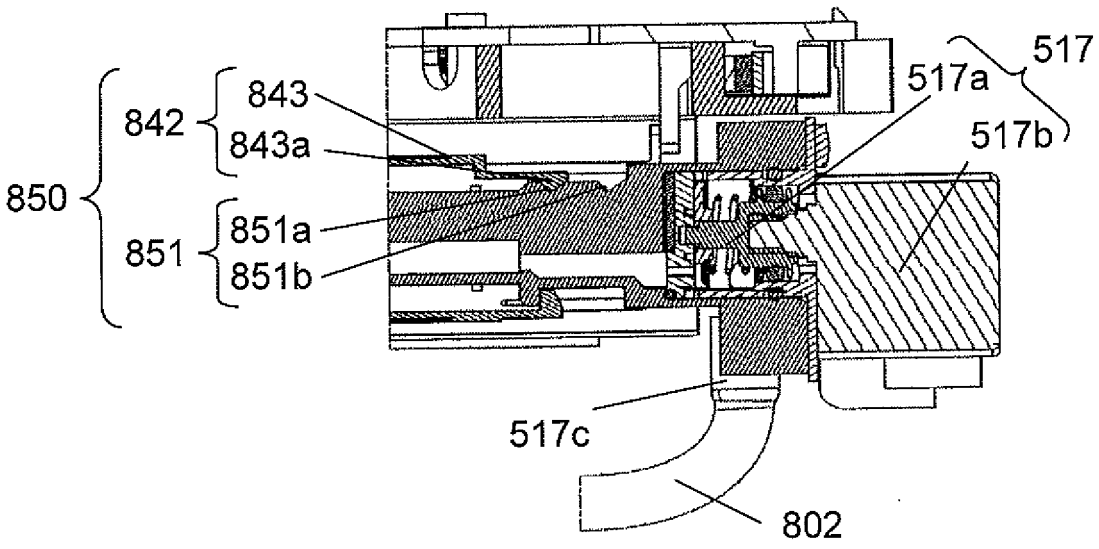
810
C
845
838
839

FIG. 22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517a
517b
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843a
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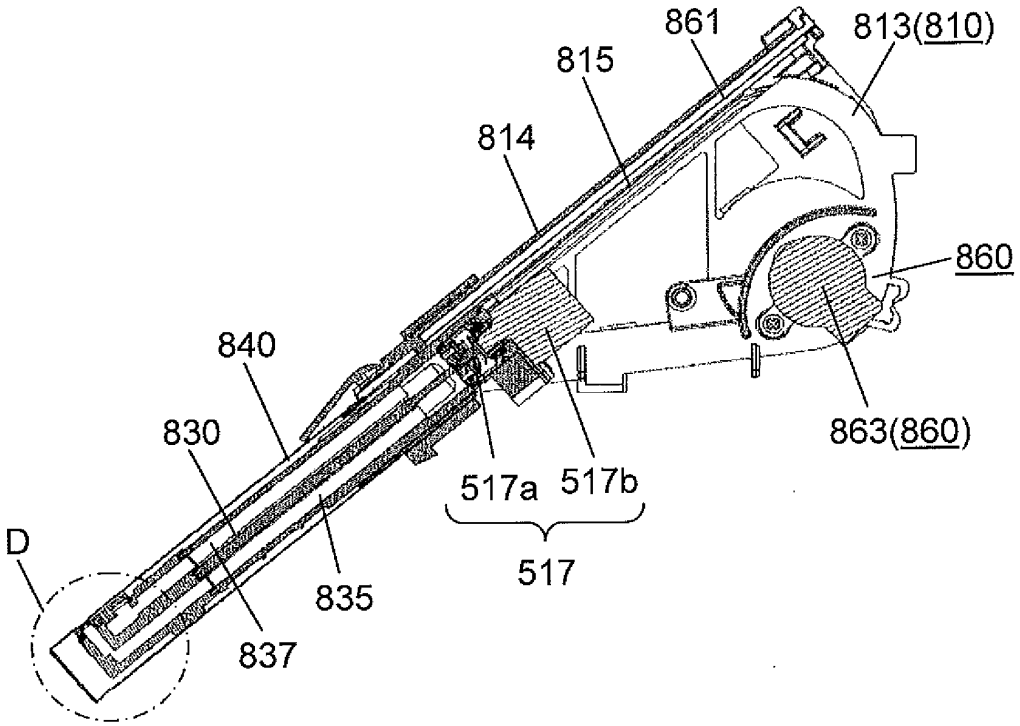
851a
851
851b
517c
802

FIG. 23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813(810)
815
814
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840
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863(860)
517a
517b
517
D
835
837

FIG. 24

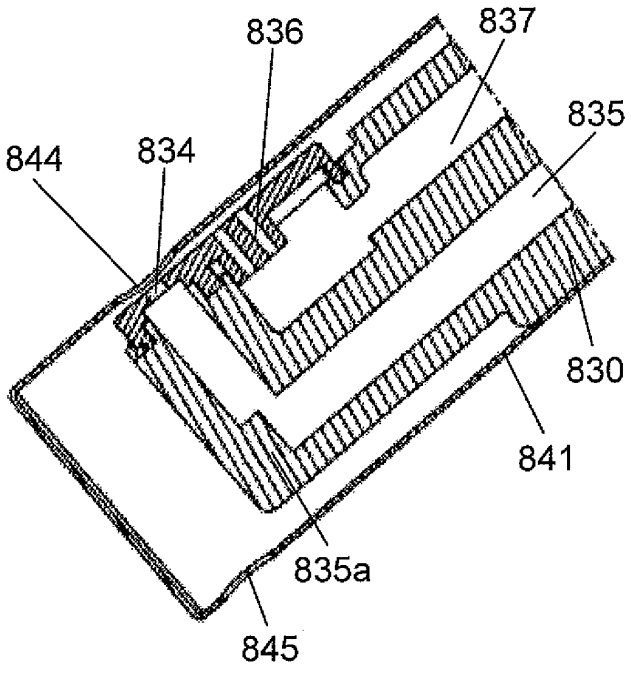
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FIG. 25

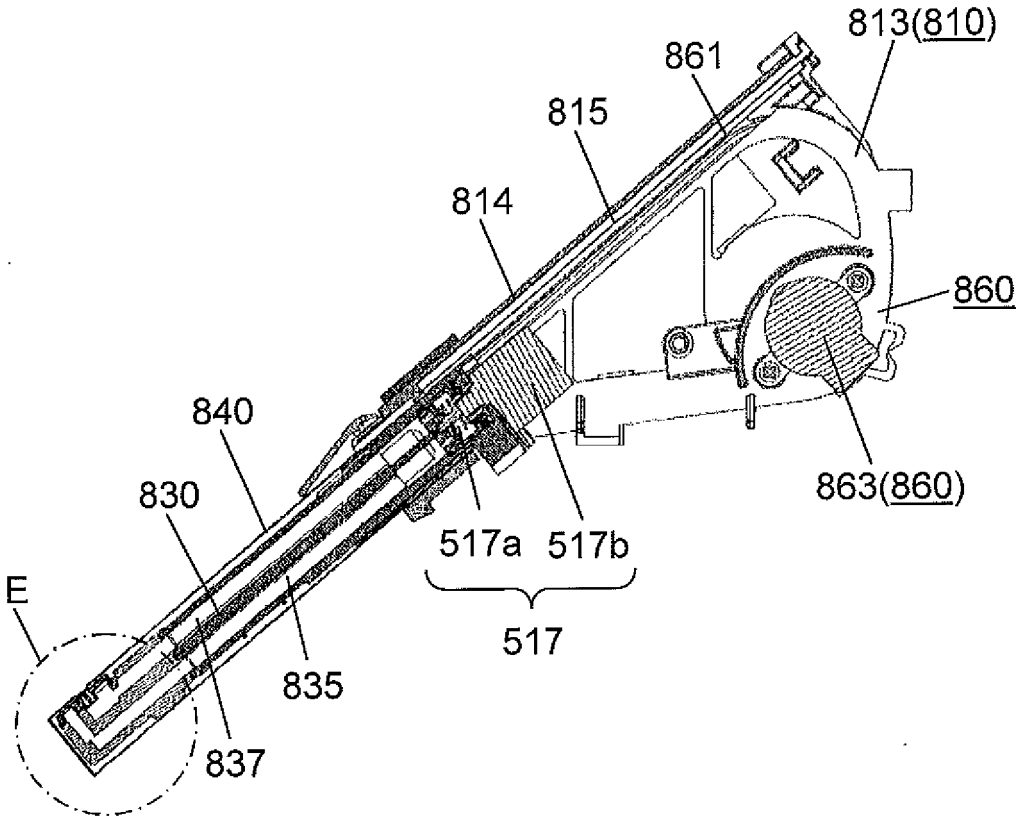


FIG. 26

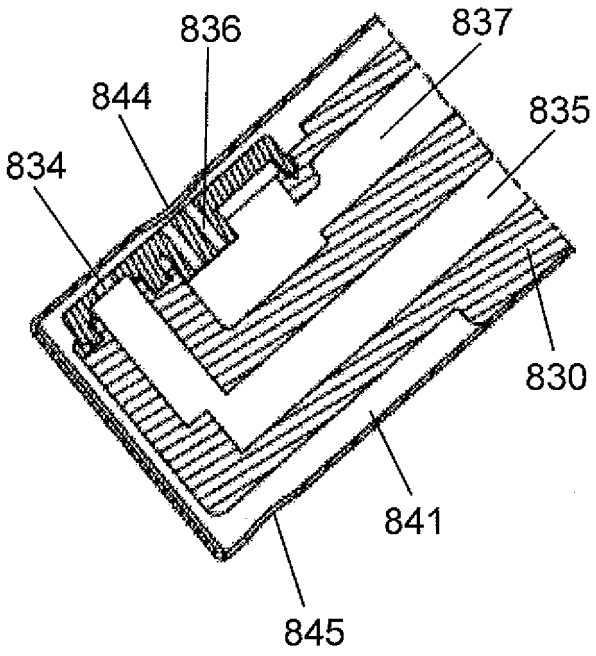


FIG. 27

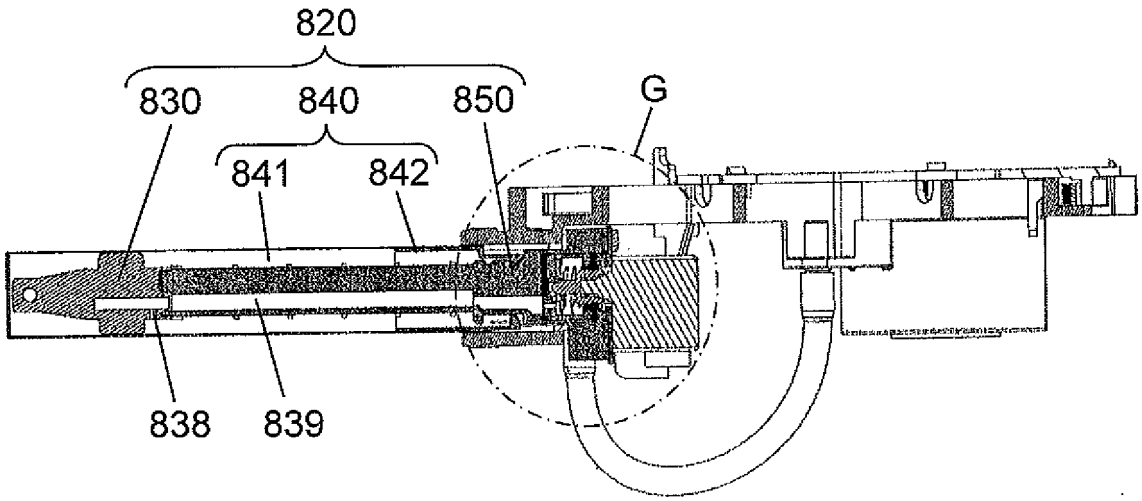


FIG. 28

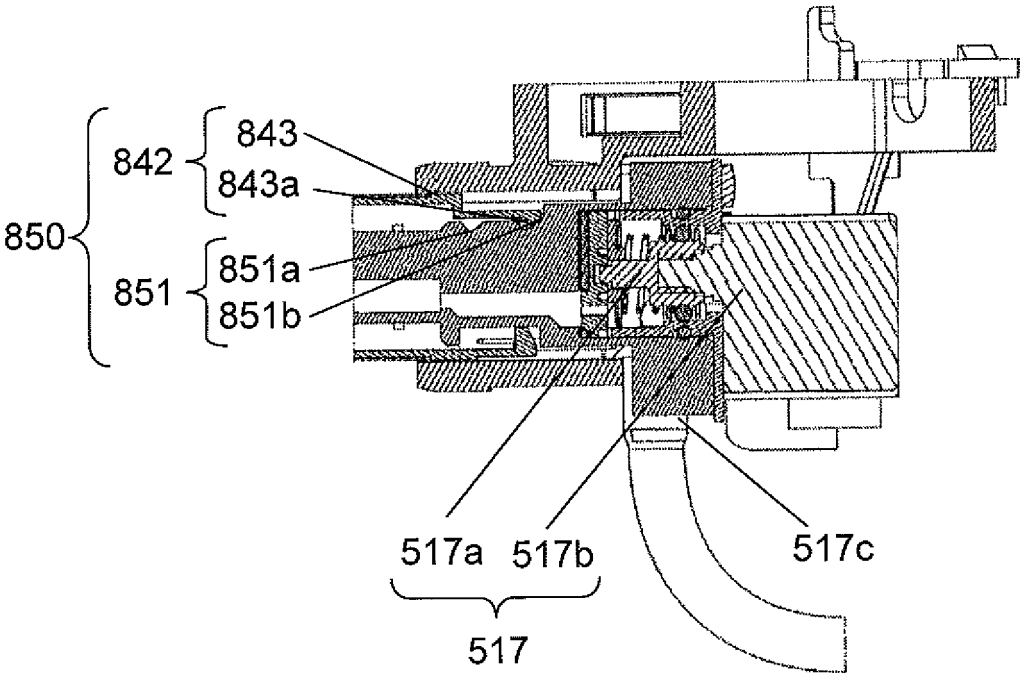
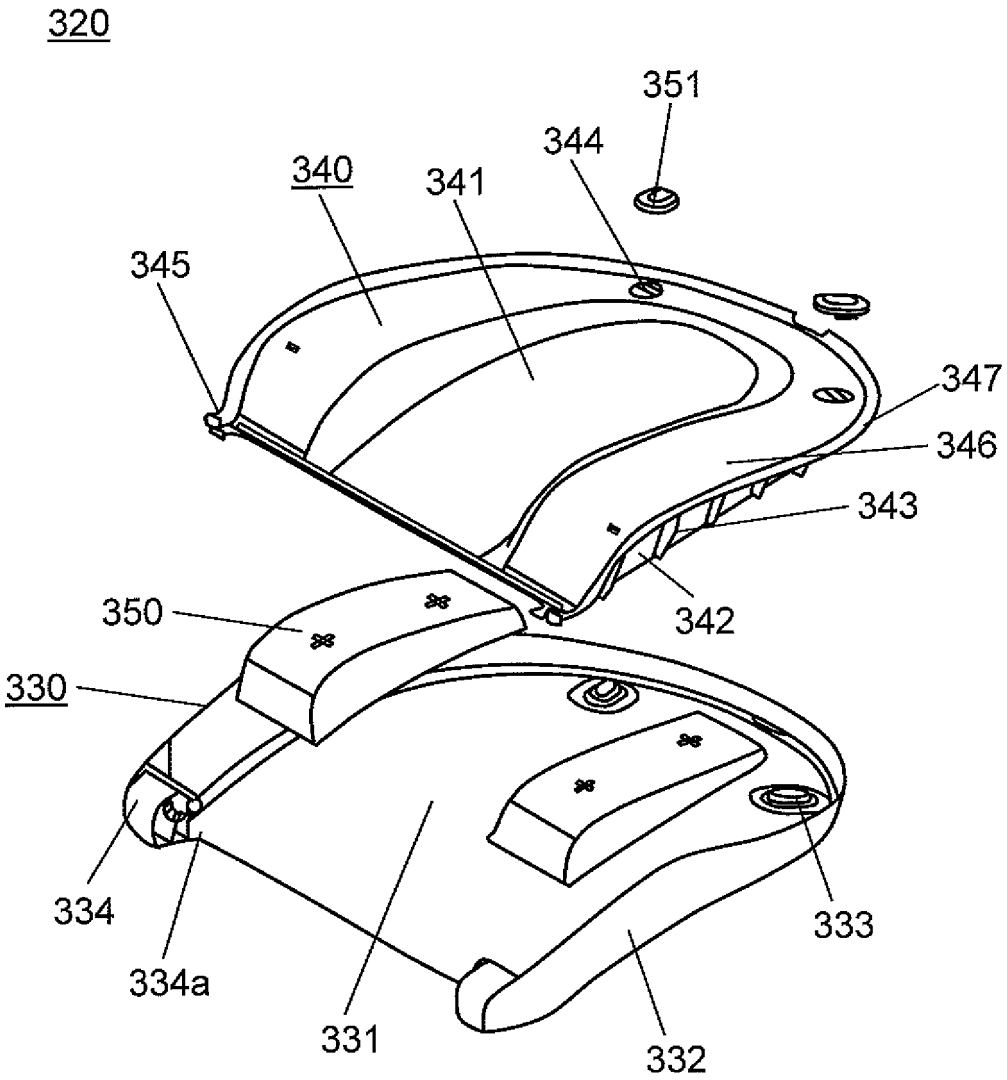


FIG. 29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344
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342
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334
334a
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332
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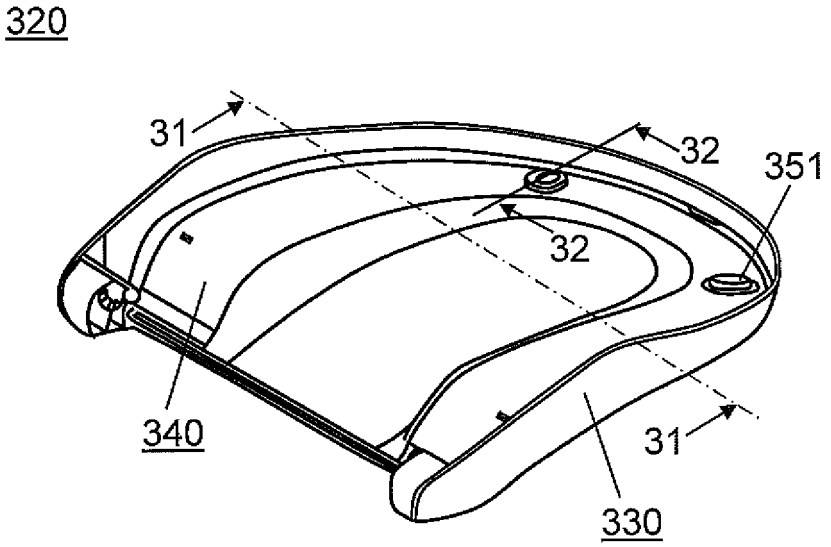
FIG. 30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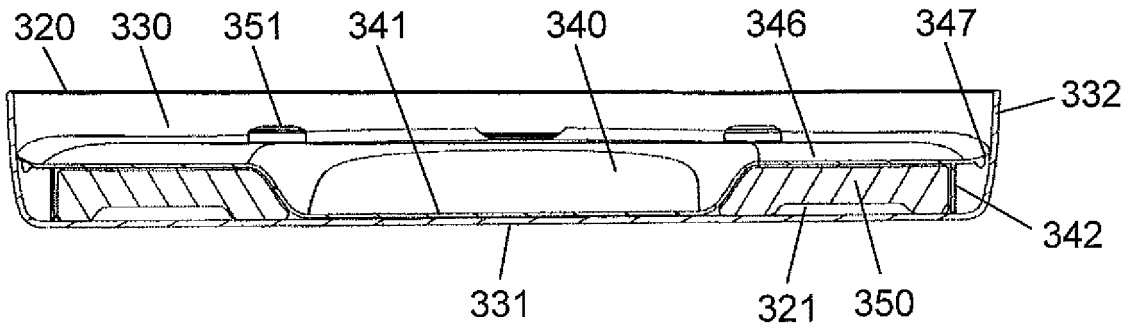
31
32
351
32
340
31
330

FIG. 31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321
350

FIG. 32

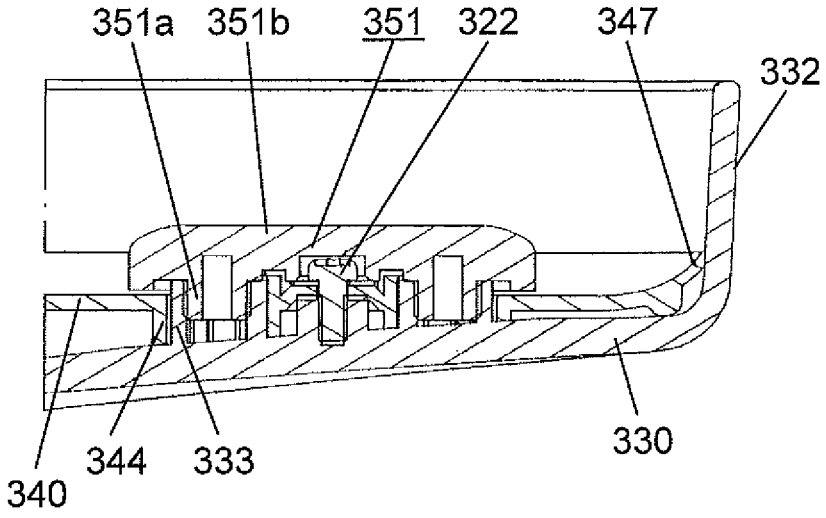


FIG. 33

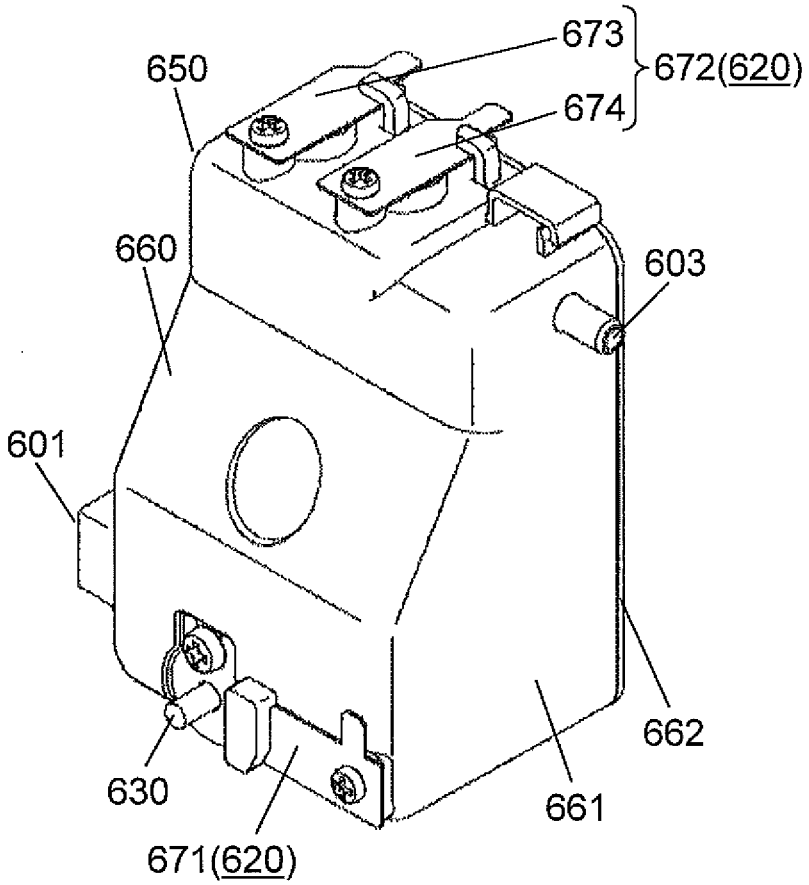
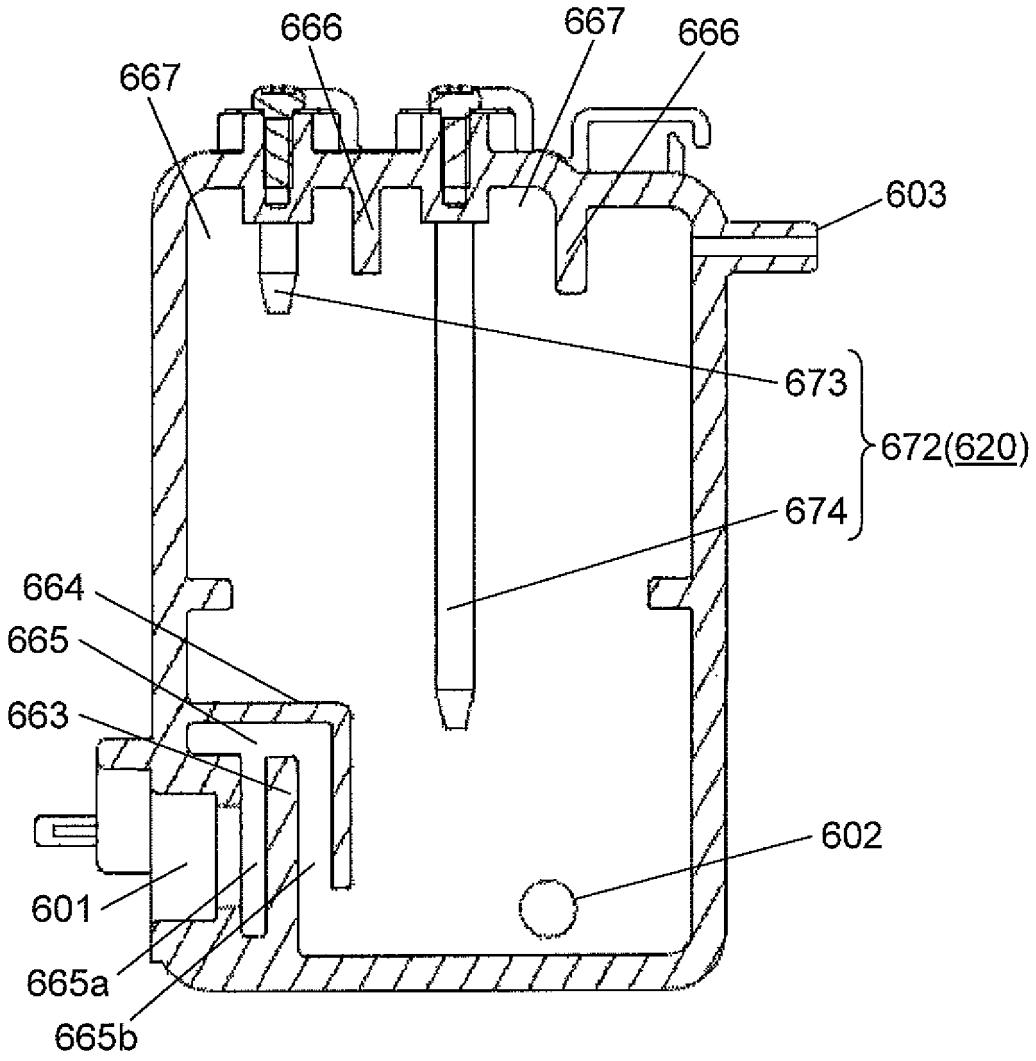


FIG. 34


666
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603
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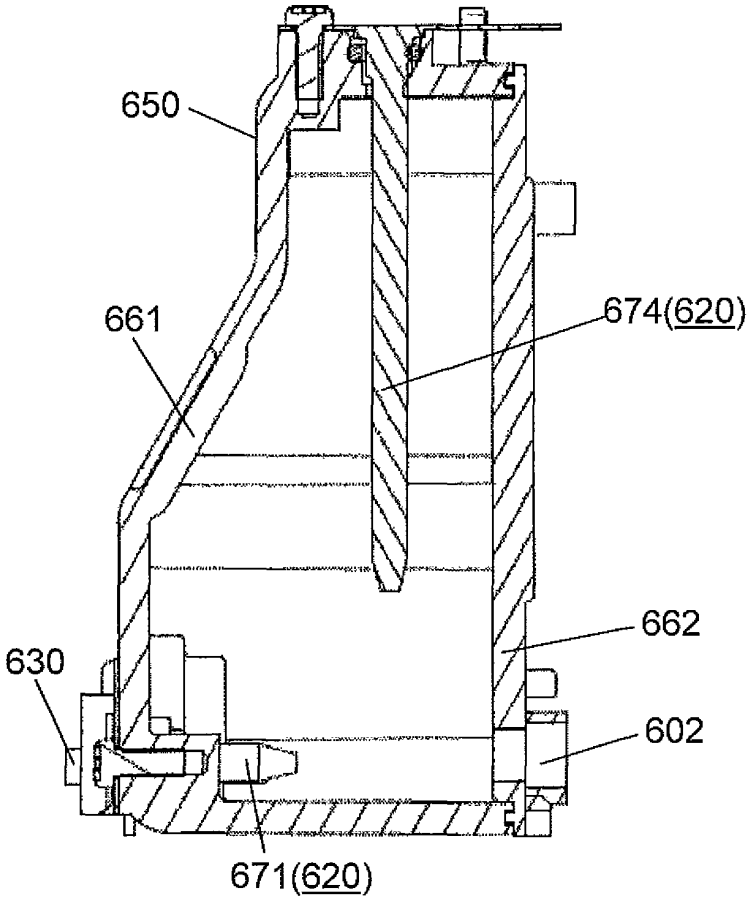
672(620)
674
664
665
663
602
601
665a
665b

FIG. 35


650
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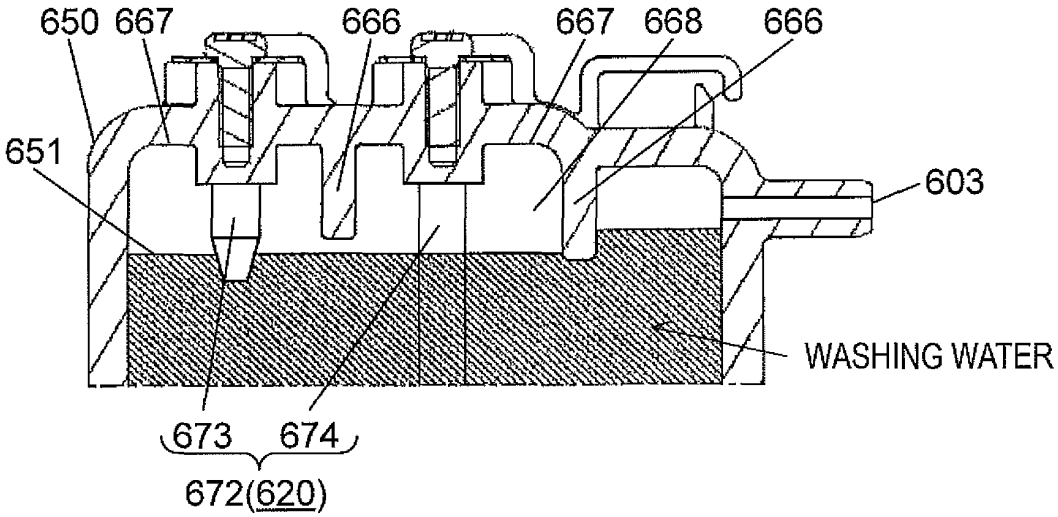
674(620)
662
630
602
671(620)

FIG. 36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667
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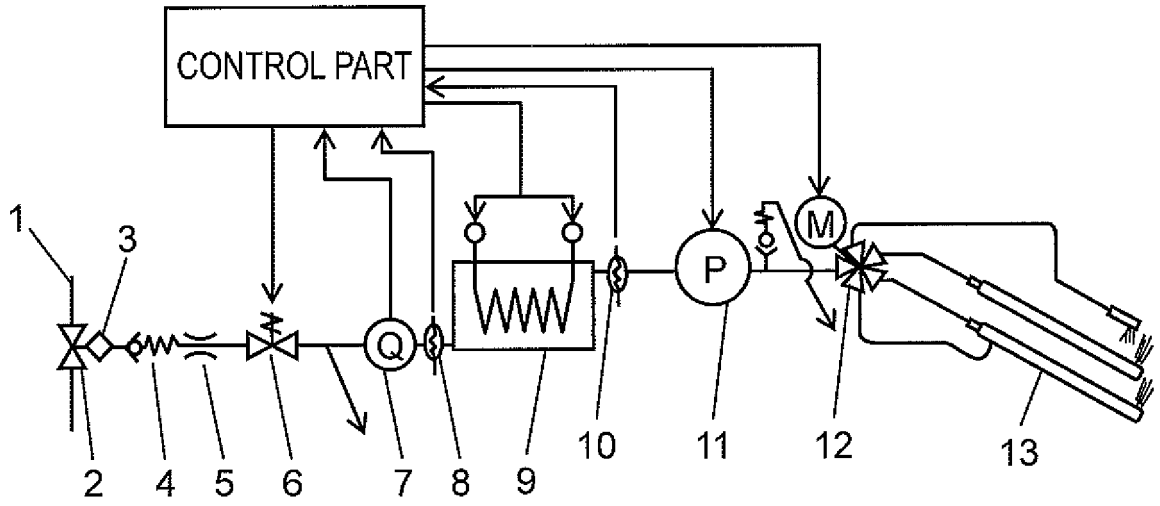
667
668
666
651
603
WASHING WATER
673
674
672(620)

FIG. 37



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/004391

A. CLASSIFICATION OF SUBJECT MATTER
E03D9/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E03D9/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 60-155855 A (Matsushita Electric Industrial Co., Ltd.), 15 August 1985 (15.08.1985), page 2, upper left column, line 17 to lower left column, line 1 (Family: none)	1-7
A	JP 60-133134 A (Matsushita Electric Industrial Co., Ltd.), 16 July 1985 (16.07.1985), page 2, lower right column, line 7 to page 3, lower left column, line 7 & US 4559651 A & EP 151779 A2 & DE 3474329 D	1-7

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"O" document referring to an oral disclosure, use, exhibition or other means
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Date of the actual completion of the international search	Date of mailing of the international search report
28 October, 2014 (28.10.14)	11 November, 2014 (11.11.14)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/004391

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-154579 A (Toto Ltd.), 06 June 2000 (06.06.2000), paragraphs [0029] to [0037] (Family: none)	1-7
A	JP 2-18127 Y2 (Kyushu Hitachi Maxell, Ltd.), 22 May 1990 (22.05.1990), page 1, right column, line 10 to page 2, left column, line 2; page 2, left column, line 37 to page 2, right column, line 9 (Family: none)	1-7

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Patent documents cited in the description

- JP 2005076417 A **[0008]**