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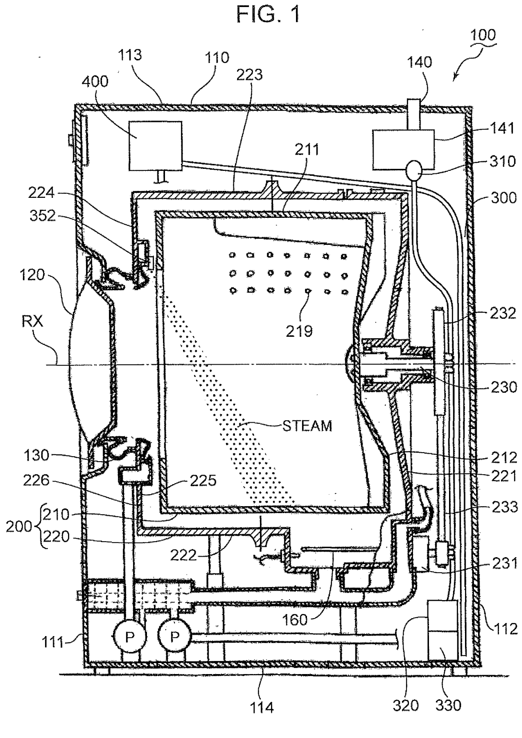
# (54) CLOTHES TREATMENT DEVICE

(57) The instant application discloses a laundry processing apparatus including a storage tub (200) configured to store laundry, and a steam supply mechanism (300) configured to supply steam into the storage tub. The steam supply mechanism includes a steam generator (420) with a wall surface defining a chamber for generating the steam, a heater (425) configured to heat the wall surface, a water supply mechanism (437) configured to supply water to the wall surface heated by the heater, a nozzle (352) configured to inject the steam into the storage tub, and a guide pipe (422, 340, 351, 353) configured to guide the steam from the steam generator to the nozzle. The steam injected from the nozzle traverses the storage tub.

FIG. 1

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## Description

### Technical Field

**[0001]** The present invention relates to a laundry processing apparatus for washing, spin-drying and/or drying laundry.

### Background Art

**[0002]** Washing machines, which supply steam to laundry for sterilization, have been developed (Patent Documents 1 to 3). The washing machine according to Patent Documents 1 to 3 generates steam by using a heater immersed in water.

**[0003]** The washing machine according to Patent Documents 1 to 3 supplies steam to a drum in which laundry is stored. However, because of a low pressure of steam supplied to the drum, a space inside the drum has to be filled with the steam. Consequently, the washing machine according to Patent Documents 1 to 3 consumes a large amount of power in order to generate steam.

**[0004]**

Patent Document 1: US2009/126423A
Patent Document 2: US2009/172967A
Patent Document 3: EP1939349B

### Summary of the Invention

**[0005]** It is an object of the present invention to provide a laundry processing apparatus with a structure to efficiently supply steam to laundry.

**[0006]** The laundry processing apparatus according to one aspect of the present invention includes a storage tub configured to store laundry, and a steam supply mechanism configured to supply steam into the storage tub. The steam supply mechanism includes a steam generator with a wall surface defining a chamber for generating the steam, a heater configured to heat the wall surface, a water supply mechanism configured to supply water to the wall surface heated by the heater, a nozzle configured to inject the steam into the storage tub, and a guide pipe configured to guide the steam from the steam generator to the nozzle. The steam injected from the nozzle traverses the storage tub.

**[0007]** The laundry processing apparatus according to the present invention may supply steam to laundry efficiently.

**[0008]** The objects, features and advantages of the present invention will become more apparent from the following detailed description and accompanying drawings.

### Brief Description of the Drawings

**[0009]**

Fig. 1 is a schematic vertical cross-sectional view of a washing machine exemplified as the laundry processing apparatus according to the first embodiment.
Fig. 2 is a schematic perspective view of the washing machine shown in Fig. 1.
Fig. 3 is a schematic perspective view of a steam supply mechanism stored in a housing of the washing machine shown in Fig. 1.
Fig. 4A is a schematic perspective view of a steam generating portion of the steam supply mechanism shown in Fig. 3.
Fig. 4B is a schematic perspective view of the steam generating portion of the steam supply mechanism shown in Fig. 3.
Fig. 5 is a schematic perspective view of an attachment structure which connects a lid portion of the steam generating portion shown in Figs. 4A and 4B to the housing.
Fig. 6A is a schematic perspective view of a steam generator of the steam generating portion shown in Figs. 4A and 4B.
Fig. 6B is a schematic perspective view of the steam generator of the steam generating portion shown in Figs. 4A and 4B.
Fig. 7 is a schematic perspective view of a main piece of the steam generator shown in Figs. 6A and 6B.
Fig. 8 is a schematic exploded perspective view of the steam generator shown in Figs. 6A and 6B.
Fig. 9 is a schematic perspective view of a lid piece of the steam generator shown in Fig. 8.
Fig. 10 is a schematic plan view of the main piece shown in Fig. 7.
Fig. 11 is a schematic view of a water supply mechanism in the steam supply mechanism shown in Fig. 3.
Fig. 12 is a schematic back view of a front portion of a storage tub of the washing machine shown in Fig. 1.
Fig. 13 is a graph schematically showing a relationship between intermittent operation of a pump of the water supply mechanism shown in Fig. 11 and an internal temperature in a chamber space.
Fig. 14 is a graph schematically showing a change in a temperature of the water supplied to a water tank of the washing machine shown in Fig. 1.
Fig. 15A is a schematic timing chart showing steam supply timings during a spin-drying process.
Fig. 15B is a schematic timing chart showing steam supply timings during the spin-drying process.
Fig. 15C is a schematic timing chart showing steam supply timings during the spin-drying process.
Fig. 16 is a block diagram schematically showing control of a door, in response to a temperature of the steam generator shown in Fig. 6B.
Fig. 17 is a schematic expanded perspective view of a steam generator which is used in a washing machine exemplified as the laundry processing apparatus according to the second embodiment.

Fig. 18 is a schematic perspective view of the steam generator shown in Fig. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0010]** A laundry machine exemplified as the laundry processing apparatus is described hereinafter with reference to the drawings. Following directional terms such as "up", "down", "left" and "right" are simply intended to clarify the description. Therefore, these terms do not limit principles of the laundry processing apparatus in any way. The principles of the laundry processing apparatus may be applied to an apparatus having a washing function and drying function for laundry (washing and drying machine), an apparatus having only a function for drying laundry (drying machine) and an apparatus having only a function for washing laundry (washing machine).

<First Embodiment>

<Washing Machine>

**[0011]** Fig. 1 is a schematic vertical cross-sectional view of the washing machine 100 according to the first embodiment. The washing machine 100 is described with reference to Fig. 1.

**[0012]** The washing machine 100 includes a housing 110 and a storage tub 200 which stores laundry in the housing 110. The storage tub 200 includes a rotary drum 210, which has a substantially cylindrical peripheral wall 211 surrounding a rotational axis RX, and a water tank 220, which stores the rotary drum 210.

**[0013]** The housing 110 includes a front wall 111 provided with a loading opening to load laundry into the storage tub 200, and a rear wall 112 opposite to the front wall 111. The rotary drum 210 and the water tank 220 open towards the front wall 111.

**[0014]** The washing machine 100 further includes a door 120 which is attached to the front wall 111. The door 120 rotates between a closed position, at which the door 120 closes the loading opening formed in the front wall 111, and an open position, at which the door 120 opens the loading opening. A user may rotate the door 120 to the open position and load laundry into the storage tub 200 through the loading opening in the front wall 111. The user may then move the door 120 to the closed position and make the washing machine 100 wash the laundry. The door 120 shown in Fig. 1 is in the closed position.

**[0015]** The rotary drum 210 rotates about the rotational axis RX which extends between the front and rear walls 111, 112. The laundry loaded into the storage tub 200 moves in the rotary drum 210 with rotation of the rotary drum 210, and is subjected to various processes such as washing, rinsing and/or spin-drying.

**[0016]** The rotary drum 210 includes a bottom wall 212 which faces the door 120 at the closed position. The water tank 220 includes a bottom portion 221, which surrounds the bottom wall 212 and a part of the peripheral wall 211 of the rotary drum 210, and a front portion 222, which surrounds the other part of the peripheral wall 211 of the rotary drum 210 between the bottom portion 221 and the door 120.

**[0017]** The storage tub 200 includes a rotary shaft 230 which is mounted on the bottom wall 212 of the rotary drum 210. The rotary shaft 230 extends towards the rear wall 112 along the rotational axis RX. The rotary shaft 230 passes through the bottom portion 221 of the water tank 220 and appears between the water tank 220 and the rear wall 112.

**[0018]** The washing machine 100 further includes a motor 231, which is mounted below the water tank 220, a pulley 232, which is mounted on the rotary shaft 230 exposed outside the water tank 220, and a belt 233 for transmitting a drive force of the motor 231 to the pulley 232. When the motor 231 operates, the drive force of the motor 231 is transmitted to the belt 233, the pulley 232 and the rotary shaft 230. Consequently, the rotary drum 210 rotates in the water tank 220.

**[0019]** The washing machine 100 further includes a packing structure 130 which is situated between the front portion 222 of the water tank 220 and the door 120. The door 120 rotated to the closed position compresses the packing structure 130. Consequently, the packing structure 130 forms a watertight sealing structure between the door 120 and the front portion 222.

**[0020]** The housing 110 includes a housing top wall 113, which extends substantially horizontally between the front and rear walls 111, 112, and a housing bottom wall 114 opposite to the housing top wall 113. The washing machine 100 further includes a water supply port 140, which is connected to a faucet (not shown), and a distributing portion 141, which distributes water supplied through the water supply port 140. The water supply port 140 appears above the housing top wall 113. The distributing portion 141 is situated between the housing top wall 113 and the storage tub 200. In the present embodiment, the faucet is exemplified as the external water source.

**[0021]** The washing machine 100 further includes a detergent storage portion (described hereinafter), in which detergent is stored, and a steam supply mechanism 300 (described hereinafter) which injects steam towards the storage tub 200. The distributing portion 141 includes a few water supply valves for supplying water selectively to the storage tub 200, the detergent storage portion and the steam supply mechanism 300. In Fig. 1, the water supply path to the storage tub 200 and the detergent storage portion are not shown. Technologies used in commonly known washing machines are suitable for supplying water to the storage tub 200 and the detergent storage portion.

<Steam Supply Mechanism>

**[0022]** Fig. 2 is a schematic perspective view of the washing machine 100. Fig. 3 is a schematic perspective view of the steam supply mechanism 300 which is stored in the housing 110. In Figs. 2 and 3, the housing 110 is indicated by dotted lines. In Fig. 3, the storage tub 200 is not shown. The arrow in Fig. 3 schematically represents the water supply path. The steam supply mechanism 300 is described with reference to Figs. 1 to 3.

**[0023]** The steam supply mechanism 300 includes a water supply valve 310, which is used as a part of the distributing portion 141, and a water storage tank 320, which is situated below the storage tub 200. The water supply valve 310 is used in order to control water supply to the water storage tank 320. When the water supply valve 310 is open, water is supplied from the water supply port 140 to the water storage tank 320. When the water supply valve 310 is closed, the water supply to the water storage tank 320 is halted.

**[0024]** The steam supply mechanism 300 further includes a pump 330, which is installed in the water storage tank 320, and a steam generating portion 400 which receives the water discharged from the pump 330. The pump 330 performs water supply operation intermittently or continuously to the steam generating portion 400. During the intermittent water supply operation, the pump 330 adjusts a water dosage so as to cause instantaneous steam generation, and then a suitable water dosage is supplied to the steam generating portion 400. If the pump 330 supplies water continuously to the steam generating portion 400, impurities (scale) contained in the water used for the steam generation is flushed from the steam generating portion 400. The steam generating portion 400 is described hereinafter.

**[0025]** As shown in Fig. 2, the steam supply mechanism 300 further includes a steam conduit 340 which extends downwards from the steam generating portion 400. As shown in Fig. 1, the front portion 222 of the water tank 220 includes a peripheral wall portion 223, which surrounds the peripheral wall 211 of the rotary drum 210, and a ring portion 224 which forms a water-tight sealing structure in conjunction with the packing structure 130. The steam conduit 340 is connected to the peripheral wall portion 223. Steam generated by the steam generating portion 400 is supplied to the storage tub 200 through the steam conduit 340. The steam conduit 340 may include a bellows pipe. The bellows pipe may decrease vibration which is caused by rotation of the storage tub 200 and transmitted to the steam generating portion 400. Since the ring portion 224 defines a loading opening, the ring portion 224 is exemplified as the front end. Since the bottom wall 212 of the rotary drum 210 and the bottom portion 221 of the water tank 220 are opposite to the ring portion 224, the bottom wall 212 of the rotary drum 210 and the bottom portion 221 of the water tank 220 are exemplified as the bottom portion.

**[0026]** Figs. 4A and 4B are schematic perspective views of the steam generating portion 400. A structure and arrangement of the steam generating portion 400 are described with reference to Figs. 2 to 4B.

**[0027]** The steam generating portion 400 includes a substantially rectangular box-shaped case 410, and a steam generator 420 which is stored in the case 410. The case 410 includes a container portion 411, which stores the steam generator 420, and a lid portion 412, which covers the container portion 411.

**[0028]** The steam generator 420 is connected to the pump 330 by a connecting pipe 421 and a tube (not shown). The steam generator 420 is also connected to the steam conduit 340 by an exhaust pipe 422. The container portion 411 includes a bottom wall portion 414 provided with an opening 413. The connecting pipe 421 and the exhaust pipe 422 project downwards through the opening 413.

**[0029]** Since the pump 330 forcibly supplies water from the water storage tank 320 to the steam generator 420 in the steam generating portion 400, the steam generator 420 may be situated above the water storage tank 320. If water is supplied from the water storage tank to the water generator without a pump, the water in the water storage tank may be sent to the steam generator by the action of gravity. In this case, the steam generator has to be situated below the water storage tank. In the present embodiment, the pump 330 is used to supply water to the steam generator 420. The water is supplied from the water storage tank 320 to the steam generator 420 forcibly by a pressure of the pump 330. Consequently, in a design of the washing machine 100 according to the present embodiment, there are few restrictions on a positional relationship in the vertical direction between the steam generator 420 and the water storage tank 320. Since there is a high degree of design freedom about the arrangement of the steam generator 420 and the water storage tank 320, the internal space of the housing 110 may be used efficiently.

**[0030]** As shown in Fig. 2, the steam generator 420 is situated above the water storage tank 320. The pump 330 may supply water appropriately from the water storage tank 320 to the steam generator 420.

**[0031]** If the steam generator is situated below the water storage tank, water may flow accidentally into the steam generator because of failures in a water supply path to the stream generator. Consequently, steam may be generated unnecessarily.

**[0032]** In the present embodiment, since the pump 330 is used to supply water to the steam generator 420, the water storage tank 320 may be situated below the steam generator 420. Even after an accidental stop of water supply to the steam generator 420 because of failures in the pump 330, stagnant water in hoses, which are connected to the water storage tank 320, the pump 330 and the steam generator 420, is less likely to flow into the steam generator 420.

**[0033]** As described above, if the water supply path from the water storage tank to the steam generator is designed without a pump, the steam generator has to be situated below the water storage tank. For example, if there are failures in control components such as an opening/closing valve for controlling water supply from the water storage tank to the steam generator, the water supply to the steam generator may become out of control. Consequently, water flows unnecessarily into the steam generator from the water storage tank because of the action of gravity. In the present embodiment, the pump 330 is used to supply water from the water storage tank 320 to the steam generator 420, so that unnecessary water supply from the water storage tank 320 to the steam generator 420 is less likely to happen.

**[0034]** As shown in Fig. 2, the housing 110 includes a right wall 115, which stands between the front and rear walls 111, 112, and a left wall 116 opposite to the right wall 115. The water storage tank 320 is situated at the corner defined by the housing bottom wall 114, the rear wall 112 and the left wall 116. The steam generator 420 is situated in the corner defined by the right wall 115, the housing top wall 113 and the front wall 111. Thus, the steam generator 420 and the water storage tank 320 are arranged in substantially symmetrical positions with respect to the central axis of the storage tub 200 (rotational axis RX).

**[0035]** As shown in Fig. 2, the detergent storage portion 101 is situated in the corner defined by the front wall 111, the housing top wall 113 and the left wall 116. Other corners of the housing 110 are used efficiently for arrangement of the water storage tank 320 and the steam generator 420. As shown in Fig. 2, the water storage tank 320 is situated at the corner defined by the housing bottom wall 114, the rear wall 112 and the left wall 116. The steam generator 420 is situated in the corner defined by the right wall 115, the housing top wall 113 and the front wall 111. Since the housing 110 has a substantially rectangular-box shape and the storage tub 200 is cylindrical, wide spaces are formed in the corners of the housing 110. As described above, the wide spaces in the corners are used efficiently for the arrangement of the detergent storage portion 101, the water storage tank 320 and the steam generator 420, respectively. The water storage tank 320 and the steam generator 420 may be designed to a large size in accordance with the corners of the housing 110.

**[0036]** The detergent storage portion may be situated at the corner defined by the front wall, the housing top wall and the right wall. In this case, the steam generator may be situated at the corner defined by the left wall, the housing top wall and the front wall. The water storage tank may be situated at one of the corners defined by the bottom wall of the housing in accordance with a piping design for the steam generator.

**[0037]** For example, the water storage tank may be situated at a substantially rotationally symmetrical position with respect to the detergent storage portion about the rotational axis of the storage tub. The steam generator may be situated symmetrically with the water storage tank with respect to the horizontal plane including the rotational axis of the storage tub. With such a layout design, the internal space of the housing is used effectively as well, like the layout design shown in Fig. 2.

**[0038]** The water storage tank may be situated below the detergent storage portion, which is placed at the corner defined by the front wall, the housing top wall and the left or right wall. In this case, the steam generator may be situated in a substantially rotationally symmetrical position with respect to the water storage tank about the rotational axis of the storage tub. With such a layout design, the internal space of the housing is used effectively as well, like the layout design shown in Fig. 2.

**[0039]** In the present embodiment, the rotational axis RX of the storage tub 200 is substantially horizontal. Alternatively, the storage tub may rotate about an inclined rotational axis. For example, the rotational axis may be inclined upwards from the rear wall towards the front wall. The water storage tank may be situated below a plane including the inclined rotational axis whereas the steam generator may be situated above this plane. If the water storage tank is arranged to the left or right with respect to the vertical plane including the inclined rotational axis, the steam generator may be arranged to the right or left with respect to the vertical plane. With such a layout design, the space between the housing and the storage tub is used efficiently.

**[0040]** Fig. 5 is a schematic perspective view of an attachment structure for connecting the lid portion 412 to the housing 110. The attachment structure between the lid portion 412 and the housing 110 is described with reference to Figs. 3, 4A and 5.

**[0041]** The housing 110 further includes a first reinforcing frame 117, which is arranged along the upper edge of the right wall 115, and a second reinforcing frame 118, which is arranged along the upper edge of the front wall 111.

**[0042]** The lid portion 412 includes a substantially rectangular upper wall 415, a lid peripheral wall 416, which projects downwards from the edges of the upper wall 415, and a projecting piece 417, which projects forwards from the lid peripheral wall 416. The washing machine 100 further includes a first attachment piece 151, which is connected to the first reinforcing frame 117 and the upper wall 415, and a second attachment piece 152, which is connected to the second reinforcing frame 118 and the projecting piece 417. The first and second attachment pieces 151, 152 protrude upwards from the lid portion 412 to make the housing top wall 113 distant from the steam generating portion 400, which results in little thermal transmission from the steam generating portion 400 to the housing 110. In the present embodiment, the first and second attachment pieces 151, 152 are exemplified as the holder.

**[0043]** Figs. 6A and 6B are schematic perspective views of the steam generator 420. The steam generator 420 is described with reference to Figs. 6A and 6B.

**[0044]** The steam generator 420 includes a substantially rectangular main piece 423, a lid piece 424, which is situated above the main piece 423, and a line heater 425 which is situated in the main piece 423. In the present embodiment, the main piece 423 and the lid piece 424 are made from aluminium. Therefore, the main piece 423 and the lid piece 424 are heated appropriately by the heater 425.

**[0045]** The steam generator 420 further includes a thermistor 426. The thermistor 426 is also installed on the main piece 423, in addition to the connecting pipe 421, the exhaust pipe 422 and the heater 425. The heater 425 is controlled in response to thermal information obtained by the thermistor 426. Therefore, a temperature of the main piece 423 and the lid piece 424 is kept substantially uniform. Similar advantageous effects are also obtained if a thermostat configured to control switching on and off of the heater 425 at a prescribed temperature is used instead of the thermistor 426.

**[0046]** Fig. 7 is a schematic perspective view showing the main piece 423. The main piece 423 is described with reference to Figs. 6B and 7.

**[0047]** The main piece 423 includes a main piece lower surface 427 to which the connecting pipe 421, the exhaust pipe 422 and the thermistor 426 are attached, a peripheral surface 428 in which the heater 425 is situated, and an upper surface 429 opposite to the main piece lower surface 427. The main piece 423 further includes an outer chamber wall 431, which stands towards the lid piece 424 from the upper surface 429 and defines a substantially triangular chamber space 430, and a substantially J-shaped inner chamber wall 432, which defines a flow path of steam in the chamber space 430.

**[0048]** Fig. 8 is a schematic exploded perspective view of the steam generator 420. Fig. 9 is a schematic perspective view of the lid piece 424. The steam generator 420 is described with reference to Figs. 3, 6B to 9.

**[0049]** The steam generator 420 includes a packing ring 433, which is mounted on the main piece 423 so as to surround the outer chamber wall 431. The packing ring 433 is made of heat-resistant rubber.

**[0050]** The lid piece 424 includes a lower surface 434, which faces the main piece 423, and an outer shield wall 435 of which shape is substantially the same as the outer chamber wall 431. The lid piece 424 is pressed against the main piece 423. Consequently, the outer shield wall 435 compresses the packing ring 433 to keep the chamber space 430 hermetically sealed.

**[0051]** The main piece 423 is provided with an inflow port 437 which allows water supplied through the connecting pipe 421 to flow into the chamber space 430. The inflow port 437 is formed at substantially the centre of the chamber space 430 and surrounded by the internal chamber wall 432. When the pump 330 supplies a prescribed water dosage to the steam generator 420, the water is spouted upwards through the connecting pipe 421 and the inflow port 437. Accordingly, the water hits the inner chamber wall 432, the upper surface 429 of the main piece 423, which is surrounded by the inner chamber wall 432, and/or the lower surface 434 of the lid piece 424 above the inflow port 437. The steam generator 420 is heated by the heater 425 (e.g. to approximately 200°C), and has high thermal energy. The pump 330 which performs intermittent water supply operation supplies a suitable water dosage in accordance with the thermal energy of the steam generator 420 (e.g. approximately 2 cc per supply action). Accordingly, the water which is spouted upwards from the inflow port 437 evaporates instantaneously. In the present embodiment, the chamber space 430 used for steam generation is exemplified as the chamber. The inner chamber wall 432, which is hit by the water supplied through the inflow port 437, and the upper surface 429 of the main piece 423, which is surrounded by the internal chamber wall 432, and/or the lower surface 434 of the lid piece 424 above the inflow port 437 are exemplified as the wall surface. The inflow port 437, to which the connecting pipe 421 is attached, is exemplified as the attachment portion.

**[0052]** The water supplied by the pump 330 may contain impurities. When the water is vaporized, the impurities in the water may adhere or be precipitated onto the wall surfaces which form the chamber space 430. The instantaneous vaporization of the water rapidly increases an internal pressure of the chamber space 430. As a result of the rapid increase in the internal pressure of the chamber space 430, the impurities adhering or precipitated onto the wall surfaces, which form the chamber space 430, are subjected to a strong pressure and separated from the wall surfaces. Accordingly, the impurities are easily discharged outside the chamber space 430.

**[0053]** Fig. 10 is a schematic plan view showing the main piece 423. The main piece 423 is described with reference to Figs. 2, 6B and 10.

**[0054]** The heater 425 extends along a substantially U-shaped path inside the main piece 423. Consequently, the heater 425 surrounds the inflow port 437 to which the confection pipe 421 is attached. Accordingly, the inner chamber wall 432 and a region surrounded by the inner chamber wall 432 become the hottest in the chamber space 430. Consequently, the water spouted through the inflow port 437 evaporates instantaneously.

**[0055]** Since the substantially J-shaped inner chamber wall 432 projects inside the chamber space 430 which is defined by the outer chamber wall 431, the chamber space 430 forms a whorl flow path. The main piece 423 is provided with an exhaust port 438 at the end of the flow path. Steam generated in the space surrounded by the inner chamber wall 432 is guided to the exhaust port 438 as the internal pressure in the chamber space 430 increases. An exhaust pipe 422 is attached to the exhaust port 438. The steam arriving at the exhaust port 438 is exhausted downwards through the exhaust pipe 422.

**[0056]** The heater 425 extends in U-shape along the outer path of the whorl flow path. Consequently, steam generated in the space surrounded by the inner chamber wall 432 is heated while the steam moves to the exhaust pipe 422. Therefore, the steam at high temperature is exhausted.

**[0057]** When water is spouted onto the heated wall surfaces, the steam generator 420 generates steam instantaneously with less power consumption than prior art technologies, in which steam is generated by a heater immersed in water, if the steam generator 420 is required to generate the same amount of steam.

**[0058]** As shown in Fig. 2, the steam generator 420 is situated above the storage tub 200. When the water vaporizes in the chamber space 430, impurities contained in the water supplied to the steam generator 420 adhere or are precipitated onto the wall surfaces which form the chamber space 430 (i.e. the outer chamber wall 431, the inner chamber wall 432 and the upper surface 429 of the main piece 423, and the lower surface 434 of the lid piece 424). If the impurities accumulate on the wall surfaces which form the chamber space 430, thermal transmission efficiency between the wall surfaces and the water supplied to the chamber space 430 declines. Accordingly, water becomes less likely to evaporate in the chamber space 430. However, in the present embodiment, the steam generator 420 is situated above the storage tub 200, so that the adhering or precipitated impurities are discharged or dropped off below the steam generator 420 due to the internal pressure generated by the vaporization of water or the action of gravity. Therefore, the impurities are easily discharged from the interior of the chamber space 430 into the storage tub 200. Accordingly, there may be little accumulation of the adhering or precipitated impurities in the chamber of the steam generator 420, which results in little decline in vaporization capability because of impurity accumulation.

<Water Supply Mechanism>

**[0059]** Fig. 11 is a schematic view of a water supply mechanism 500. The water supply mechanism 500 is described with reference to Fig. 11.

**[0060]** The water supply mechanism 500 which pumps water into the chamber space 430 of the steam generator 420 includes the water supply valve 310, the water storage tank 320, the pump 330 and the connecting pipe 421 which are described above. The water supply mechanism 500 further includes a level sensor 321 configured to detect a water level in the water storage tank 320. The water supply valve 310 may allow or stop water supply to the water storage tank 320 in response to the water level detected by the level sensor 321. In the present embodiment, the level sensor 321 is exemplified as the first detection element.

**[0061]** The water supply valve 310 may be controlled on the basis of an operating time and/or an operating pattern of the pump 330 (i.e. intermittent and/or continuous water supply operation). For example, a water supply amount from the water supply valve 310 may be adjusted so that the water storage tank 320 becomes empty at the end of operation of the pump 330. Consequently, the water is less likely to freeze in the water storage tank 320.

**[0062]** The pump 330 supplies the water stored in the water storage tank 320 to the chamber space 430 through the connecting pipe 421. The intermittent water supply operation of the pump 330 is adjusted so that the water pumped into the chamber space 430 evaporates instantaneously.

**[0063]** As a result of the water evaporation in the chamber space 430, impurities contained in the water accumulate in the chamber space 430. The continuous water supply operation of the pump 330 is adjusted so that water flows into the chamber space 430 at a sufficient flow rate to push out the accumulated impurities.

**[0064]** The exhaust pipe 422 is connected to the steam conduit 340. Steam generated in the chamber space 430 during the intermittent water supply operation of the pump 330 and water flowed into the chamber space 430 during the continuous water supply operation of the pump 330 flow into the storage tub 200 through the exhaust pipe 422 and the steam conduit 340.

<Supply of Steam and Water to Storage Tub >

**[0065]** Fig. 12 is a schematic back view of the front portion 222 of the storage tub 200. The supply of steam and water to the storage tub 200 is described with reference to Figs. 1, 11 and 12.

**[0066]** As shown in Fig. 1, the ring portion 224 of the front portion 222 includes an inner surface 225, which faces the rotary drum 210, and an outer surface 226, which faces the front wall 111 of the housing 110. Fig. 12 principally shows the inner surface 225.

**[0067]** The steam supply mechanism 300 includes a branching pipe 351 and a nozzle 352, which are attached to the inner surface 225. The steam supply mechanism 300 further includes a steam tube 353 which connects the branching pipe 351 to the nozzle 352. The steam conduit 340 is connected to the branching pipe 351 through the peripheral wall portion 223.

**[0068]** Steam generated in the chamber space 430 flows into the steam conduit 340 through the exhaust pipe 422 in accordance with a pressure rise in the chamber space 430. The steam is then guided from the steam conduit 340 to the branching pipe 351. The nozzle 352 is situated above the branching pipe 351. The hot steam arriving at the branching pipe 351 is guided to the steam tube 353 and arrives at the nozzle 352. Eventually, the steam is injected downwards from the nozzle 352. In the present embodiment, the exhaust pipe 422, the steam conduit 340, the branching pipe 351 and the steam tube 353 lead the steam generated in the chamber space 430 to the nozzle 352. Therefore, the exhaust pipe 422, the steam conduit 340, the branching pipe 351 and the steam tube 353 are exemplified as the guide pipe.

**[0069]** As described above, the pump 330 which performs intermittent water supply operation supplies a suitable water dosage into the hot chamber space 430, so that the water evaporates instantaneously. Accordingly, the internal pressure in the chamber space 430 increases rapidly. Consequently, the steam is injected at high pressure from the nozzle 352 and traverses the internal space of the storage tub 200 in the vertical direction. Due to the gravity, laundry is likely to gather near a lower end of the rotary drum 210. The steam injected from the nozzle 352, which is attached to an upper portion of the storage tub 200, arrives at the vicinity of the lower end of the rotary drum 210. Therefore, the steam is supplied efficiently to the laundry.

**[0070]** The nozzle 352 attached to the ring portion 224 directs the steam not only downward but also toward the bottom wall 212 of the rotary drum 210. Therefore, the steam flows from the ring portion 224 to the bottom wall 212 while the steam moves from a region of an internal space above a plane including the rotational axis RX to another region of the internal space below the plane including the rotational axis RX. Eventually, the steam hits the peripheral wall 211 near the bottom wall 212.

**[0071]** The branching pipe 351 includes a parent tube 354, which is connected to the steam conduit 340, an upper child tube 355, which bends upwards from the parent tube 354, and a lower child tube 356, which bends downwards from the parent tube 354. Steam or water flows into the parent tube 354 through the steam conduit 340. The upper child tube 355 is connected to the steam tube 353 and defines an upward path of the steam towards the nozzle 352. In the present embodiment, the upward path defined by the upper child tube 355 and the steam tube 353 is exemplified as the first path. The parent tube 354 is exemplified as the inflow pipe. The upper child tube 355 is exemplified as the first pipe.

**[0072]** Unlike the upper child tube 355, the lower child tube 356 defines a downward path. While the pump 330 carries out continuous water supply operation, the water flowing into the branching pipe 351 through the steam conduit 340 flows down through the lower child tube 356 due to the action of gravity. In the present embodiment, the downward path defined by the lower child tube 356 is exemplified as the second path. The lower child tube 356 is exemplified as the second pipe.

**[0073]** In Fig. 12, an intersection angle $\theta 1$ is shown between the parent tube 354 and the upper child tube 355. Fig. 12 shows an intersection angle 02 between the parent tube 354 and the lower child tube 356. The intersection angle 01 is an obtuse angle whereas the intersection angle 02 is an acute angle. Since the intersection angle 02 is an acute angle, flow loss from the parent tube 354 to the lower child tube 356 is relatively large. Consequently, there is little steam flowing from the parent tube 354 to the lower child tube 356 whereas most of the steam flows into the upper child tube 355. On the other hand, since the upper child tube 355 defines the upward flow path, there is little water flowing from the parent tube 354 to the upper child tube 355 whereas the water flows mainly into the lower child tube 356 due to the action of gravity. Consequently, the flow path of the steam and the flow path of the water are appropriately distinguished.

<Intermittent Operation of Pump>

**[0074]** Fig. 13 is a graph schematically showing a relationship between the intermittent operation of the pump 330 and a temperature in the chamber space 430. The intermittent operation of the pump 330 is described with reference to Figs. 8, 11 and 13.

**[0075]** As shown in Fig. 13, a time period during which the pump 330 operates (ON period) is set to be shorter than a time period during which the pump 330 is halted (OFF period). Accordingly, a suitable water dosage is pumped into the chamber space 430.

**[0076]** During the ON period, a prescribed water dosage is supplied to the chamber space 430. Consequently, the water evaporates and becomes steam. Due to the resultant heat of vaporization from phase change from water to steam, a temperature of the chamber space 430 declines temporarily. Since the OFF period is set to be relatively long as described above, the heater 425 may heat the chamber space 430 sufficiently during the OFF period. Therefore, high-pressure steam continues to be supplied to the storage tub 200 while the pump 330 performs the intermittent operation. In particular, since the chamber space 430 is heated sufficiently during the OFF period and a suitable water dosage, which evaporates instantaneously due to the thermal energy of the steam generator 420 including the chamber space 430, is supplied (e.g. approximately 2 cc per supply action) during the ON period, high-pressure steam continues to be appropriately supplied to the storage tub 200.

<Usage of Steam during Washing Process>

**[0077]** Fig. 14 is a graph schematically showing a change in a temperature of the water supplied to the water tank 220 in the washing process. Effects of steam used in the washing process are described with reference to Figs. 1, 8, 11 and 14.

**[0078]** As shown in Fig. 1, a water heater 160 is situated below the water tank 220. The water heater 160 is used for heating water supplied to the interior of the water tank 220. In the present embodiment, the water heater 160 is exemplified as the second heater.

**[0079]** As shown in Fig. 14, when the washing process is started, water is supplied to the water tank 220. Meanwhile, a temperature of the water contained in the laundry inside the water tank 220 is substantially uniform. Subsequently, the water inside the water tank 220 is heated by the water heater 160. The water heater 160 generates a large amount of heat. Therefore, the temperature of the water contained in the laundry inside the water tank 220 rises rapidly. When the water then reaches a prescribed temperature, the heating of the water inside the water tank 220 is halted.

**[0080]** In Fig. 14, the dotted line after halting heating indicates a change in the temperature of the water contained in the laundry when the heating performed by the water heater 160 is halted without steam supply. The solid line after halting heating indicates a change in the temperature of the water contained in the laundry when the heating performed by the water heater 160 is halted and steam is supplied to the storage tub 200.

**[0081]** As described above, since the steam supplied to the storage tub 200 is high temperature and supplied directly to the laundry, a fall in the temperature of the water contained in the laundry in the water tank 220 is diminished. The heater 425 used in the steam generator 420 consumes a smaller amount of power than the water heater 160 which is installed in the water tank 220. Therefore, temperature maintenance by supplying steam may be achieved with smaller power consumption than temperature maintenance of the water in the water tank 220 using the water heater 160. Consequently, it is preferable that the pump 330 carries out intermittent water supply operation after halting the water heater 160.

<Usage of Steam in Spin-Drying Process >

**[0082]** Effects of steam used in the spin-drying process are described with reference to Figs. 1, 11 and 12.

**[0083]** In the spin-drying process, the rotary drum 210 rotates at high speed. As shown in Fig. 1, many small holes 219 are formed in the peripheral wall 211 of the rotary drum 210. The laundry stored in the rotary drum 210 is pressed against the peripheral wall 211 by the centrifugal force, which is caused by the rotation of the rotary drum 210. Accordingly, water contained in the laundry is discharged outside the rotary drum 210 through the small holes 219. Therefore, the water is squeezed out suitably from the laundry.

**[0084]** Hydrogen bonds are likely to occur between fibers of the laundry subjected to the spin-drying. The hydrogen bonds between the fibers result in wrinkles in the laundry. If steam is supplied to the interior of the rotary drum 210, the steam breaks the hydrogen bonds between the fibers to decrease the wrinkles in the laundry. Therefore, it is preferable that the pump 330 carries out intermittent water supply operation while the laundry is subjected to the spin-drying process. As a result of the intermittent water supply operation, the steam is injected into the rotary drum 210 at high pressure from the nozzle 352. As described above, the steam injected from the nozzle 352 traverses the storage tub 200, so that the steam is sprayed evenly onto the rotating laundry sticking to the peripheral wall 211. Consequently, wrinkles are less likely to occur over the laundry in the rotary drum 210.

**[0085]** Figs. 15A to 15C are schematic timing charts which represent steam supply timings during the spin-drying process. The steam supply timings are described with reference to Fig. 1 and 15A to 15C.

**[0086]** As shown in Fig. 15A, the steam supply mechanism 300 may start steam supply a prescribed time period (T1) after the start of the spin-drying process. In this case, since the laundry contains only a small amount of water, the laundry is moistened efficiently in accordance with a heat amount of the steam and a water dosage. As shown in Figs. 15B and 15C, the steam supply mechanism 300 may start the steam supply in synchronism with the start of the spin-drying process. In this case, since the laundry is heated at the beginning of the spin-drying process, the laundry is moistened at a relatively high temperature. As shown in Figs. 15A and 15B, the steam supply mechanism 300 may supply steam during a part of the time period of the spin-drying process. As shown in Fig. 15C, the time period during which the steam supply mechanism 300 supplies steam may match the time period from the start to the end of the spin-drying process.

<Cooling of Steam Generator>

**[0087]** A cooling process of the steam generator 420 is described with reference to Figs. 8 and 11.

**[0088]** It is preferable that the steam generator 420 is cooled at the end of processing the laundry with steam. If the steam generator 420 is cooled, unnecessary injection of hot steam into the storage tub 200 is prevented.

**[0089]** Power supply to the heater 425 is halted in order to cool the steam generator 420. The pump 330 then starts continuous water supply operation. Consequently, the water flows continuously from the water storage tank 320 into the chamber space 430. The water flowed into the chamber space 430 draws heat from the heat generator 420 and flows into the storage tub 200. Consequently, the steam generator 420 is cooled rapidly.

**[0090]** Fig. 16 is a block diagram schematically showing control of the door 120 in response to a temperature of the steam generator 420. The control of the door 120 is described with reference to Figs. 1, 6B and 16.

**[0091]** The washing machine 100 includes a locking mechanism 121, which locks the door 120 at the closed position, and a controller 122, which controls locking and unlocking of the locking mechanism 121. The mechanical and electrical mechanisms of the locking mechanism 121 may employ structures used in commonly known washing machines.

**[0092]** As shown in Fig. 6B, the steam generator 420 is equipped with the thermistor 426. The thermistor 426 detects a temperature of the main piece 423 and outputs to the controller 122 signals corresponding to the detected temperature. In the present embodiment, the thermistor 426 is exemplified as the second detection element.

**[0093]** The controller 122 keeps the door 120 locked by the locking mechanism until the signals output from the thermistor 426 indicate a temperature no more than a prescribed value. Accordingly, the internal space of the storage tub 200 is isolated from the exterior until the steam generator 420 becomes the prescribed temperature or lower. Consequently, the washing machine 100 is very safe.

<Second Embodiment>

**[0094]** Fig. 17 is a schematic exploded perspective view of a steam generator 420A which is used in a washing machine exemplified as the laundry processing apparatus according to the second embodiment. The washing machine according to the second embodiment has similar structures to the washing machine 100 according to the first embodiment, except for structures of the steam generator 420A. Therefore, differences from the first embodiment are described below. The description of the first embodiment may be applied to the washing machine of the second embodiment, except for the differences described below. The same reference numerals are assigned to the same elements as the first embodiment. Consequently, the description of the first embodiment may be applied to the elements to which the same reference numerals are assigned.

**[0095]** The steam generator 420A includes a main piece 423A, a lid piece 424A, and a packing ring 433 which is sandwiched between the main piece 423A and the lid piece 424A. Unlike the main piece 423 described in the context of the first embodiment, no heater is installed in the main piece 423A. On the other hand, a heater 425A is installed in the lid piece 424A.

**[0096]** Fig. 18 is a schematic perspective view of the lid piece 424A. An attachment structure of the heater 425A is described with reference to Figs. 17 and 18.

**[0097]** The lid piece 424A includes an inner shield wall 436 which is surrounded by the outer shield wall 435. The inner shield wall 436 has substantially the same shape as the internal chamber wall 432 of the main piece 423A. The inner shield wall 436 overlaps with the inner chamber wall 432. Accordingly, a whorl flow path is formed in the chamber space 430. A region of the lower surface 434 surrounded by the inner shield wall 436 faces the inflow port 437 which is formed in the main piece 423A. Therefore, this region is called the "facing region 439" in the following description. The heater 425A is installed inside the lid piece 424A so as to surround the facing region 439. If a water flow rate is adjusted so that the water flowed from the inflow port 437 reaches the lid piece 424A, the facing region 439 achieves instantaneous evaporation because of a particularly high temperature of the facing region 439.

**[0098]** In the various embodiments described above, water is spouted upwards and converted into steam in the chamber space. Alternatively, the water may be dripped downwards and converted into steam in the chamber space. The water may be applied from the side in accordance to requirements. The supply direction of the water does not in any way limit the principles of the disclosed embodiments.

**[0099]** The aforementioned embodiments mainly include the following features.

**[0100]** The laundry processing apparatus according to one aspect of the aforementioned embodiment includes a storage tub configured to store laundry, and a steam supply mechanism configured to supply steam into the storage tub. The steam supply mechanism includes a steam generator with a wall surface defining a chamber for generating the steam, a heater configured to heat the wall surface, a water supply mechanism configured to supply water to the wall surface heated by the heater, a nozzle configured to inject the steam into the storage tub, and a guide pipe configured to guide the steam from the steam generator to the nozzle. The steam injected from the nozzle traverses the storage tub.

**[0101]** According to the aforementioned configuration, the steam generator has the wall surface which defines a chamber for generating steam. The water supply mechanism supplies water to the wall surface heated by the heater. The supplied water hits the wall surface heated by the heater and becomes steam. The resultant vaporization pressure of the water causes a rapid pressure rise in the chamber. The guide pipe guides the steam to the nozzle to inject the steam into the storage tube in which laundry is stored. Since the steam injected from the nozzle traverses the storage tub, the steam is supplied directly to the laundry which faces the nozzle, unlike prior arts which leak steam to make laundry subjected to steam atmosphere. In addition, the laundry processing apparatus may supply the steam very efficiently to the laundry since the steam pervades the storage tub entirely.

**[0102]** In the aforementioned configuration, the nozzle may inject the steam downward.

**[0103]** According to the aforementioned configuration, since the nozzle injects the steam downward, the steam is evenly injected to the laundry which gathers in a lower potion of the storage tub. Therefore, the laundry processing apparatus may supply the steam to the laundry very efficiently.

**[0104]** In the aforementioned configuration, the water supply mechanism may adjust a water dosage to cause instantaneous evaporation and a pressure rise in the chamber.

**[0105]** According to the aforementioned configuration, the water supply mechanism adjusts a water dosage suitable for a heat amount which the chamber has. Consequently, the water hitting the wall surface is vaporized to rapidly increase a pressure in the chamber. Therefore, the steam supply mechanism may instantaneously inject the steam at high pressure into the storage tube in which the laundry is stored. The steam at high pressure is supplied to the laundry facing the nozzle, unlike prior arts which leak steam to make laundry subjected to steam atmosphere. Thus, the laundry processing apparatus may supply the steam to the laundry very efficiently.

**[0106]** In the aforementioned configuration, the storage tub may include a front end defining a loading opening through which the laundry is loaded, and a bottom portion opposite to the front end. The steam may be injected from the front end to the bottom portion.

**[0107]** According the aforementioned configuration, since the steam is injected from the front end to the bottom portion, the steam is appropriate hit the laundry.

Industrial Applicability

**[0108]** The principles of the various embodiments described above are applicable to apparatuses configured to process laundry by using steam.

## Claims

1. A laundry processing apparatus, comprising:

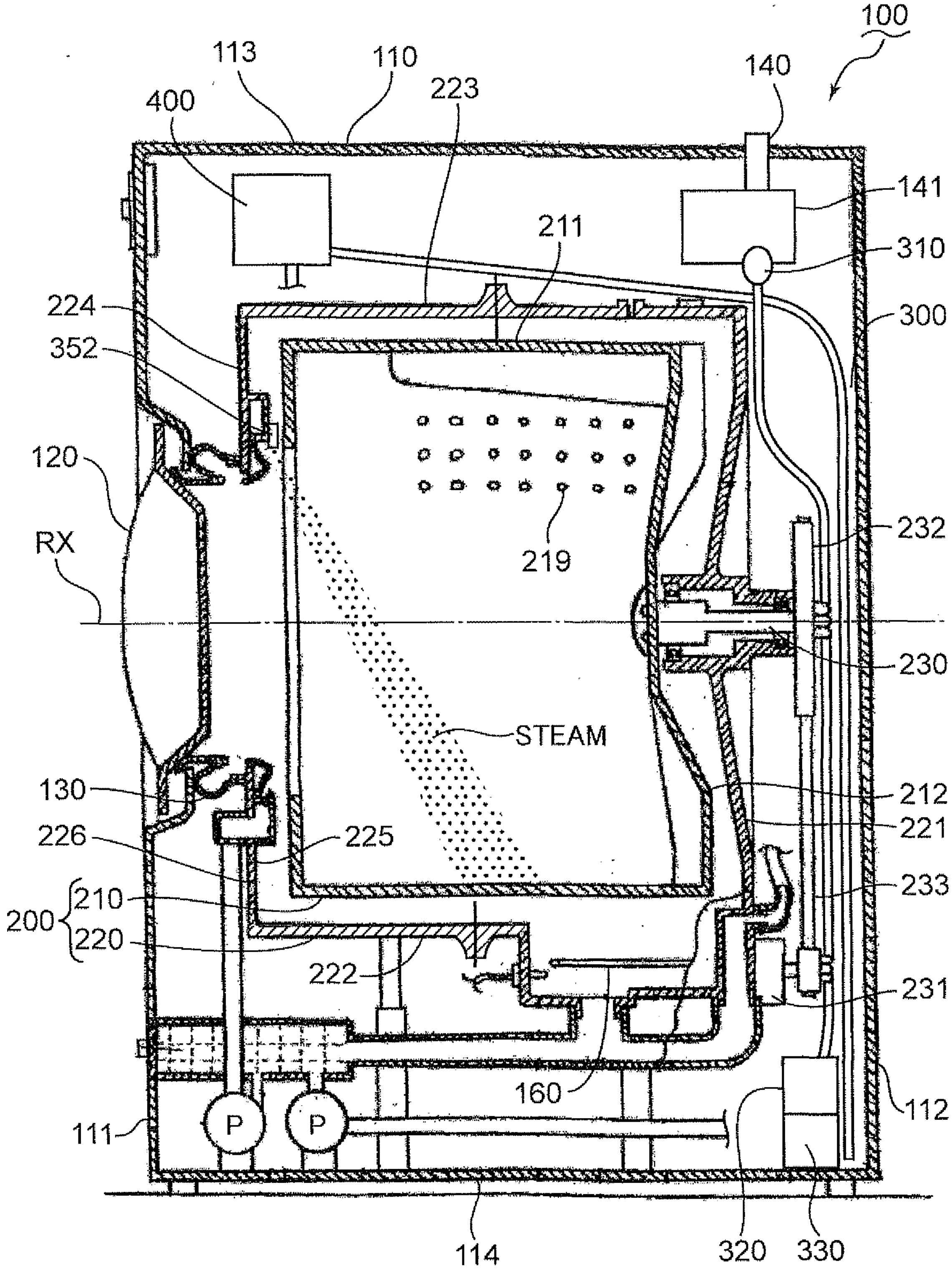
   a storage tub configured to store laundry, and
   a steam supply mechanism configured to supply steam into the storage tub, wherein
   the steam supply mechanism includes a steam generator with a wall surface defining a chamber for generating the steam, a heater configured to heat the wall surface, a water supply mechanism configured to supply water to the wall surface heated by the heater, a nozzle configured to inject the steam into the storage tub, and a guide pipe configured to guide the steam from the steam generator to the nozzle, and
   the steam injected from the nozzle traverses the storage tub.

2. The laundry processing apparatus according to claim 1, wherein
   the nozzle injects the steam downward.

3. The laundry processing apparatus according to claim 1 or 2, wherein
   the water supply mechanism adjusts a water dosage to cause instantaneous evaporation and a pressure rise in the chamber.

4. The laundry processing apparatus according to claim 2, wherein
   the storage tub includes a front end defining a loading opening through which the laundry is loaded, and a bottom portion opposite to the front end, and
   the steam is injected from the front end to the bottom portion.

FIG. 1


100
113
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223
141
211
310
224
300
352
120
232
RX
219
230
STEAM
130
212
221
226
225
233
200
210
220
222
231
160
112
111
P
P
114
320
330

FIG. 2

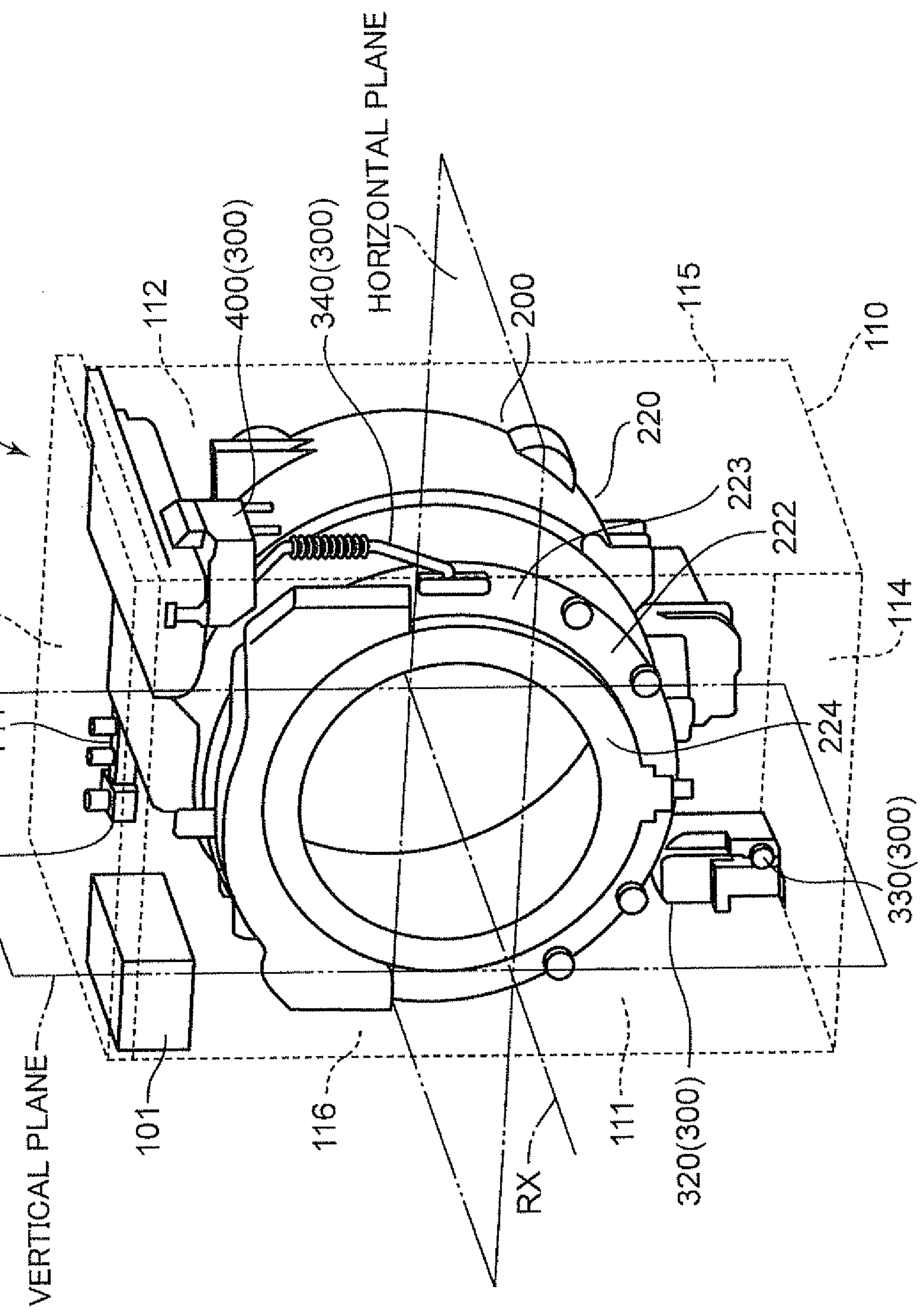

100
112
400(300)
340(300)
HORIZONTAL PLANE
200
115
110
220
223
222
114
224
330(300)
320(300)
111
RX
116
101
VERTICAL PLANE
310(300)
141
113

FIG. 3

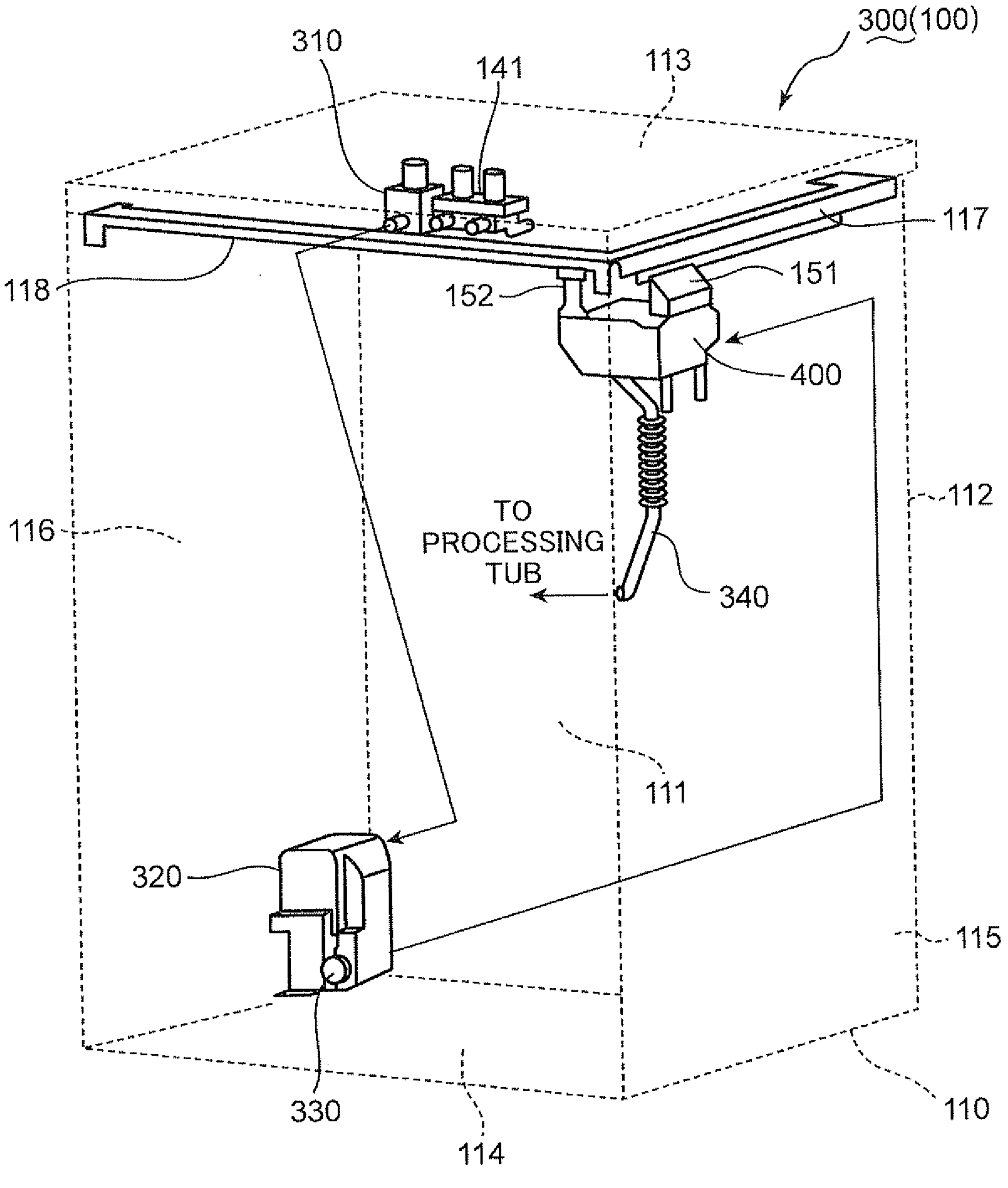
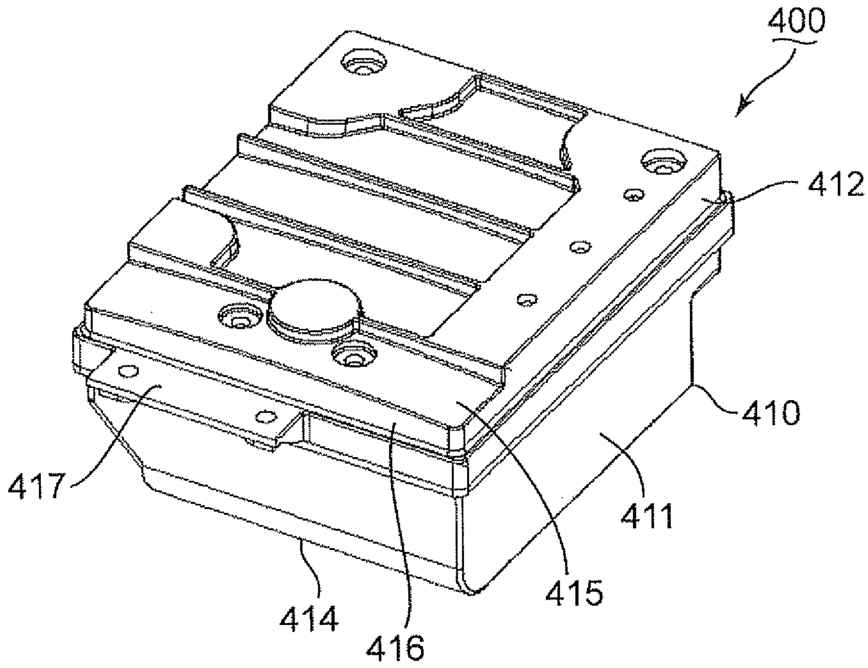

300(100)
310
141
113
117
118
152
151
400
112
116
TO
PROCESSING
TUB
340
111
320
115
330
114
110

FIG. 4A


400
412
410
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417
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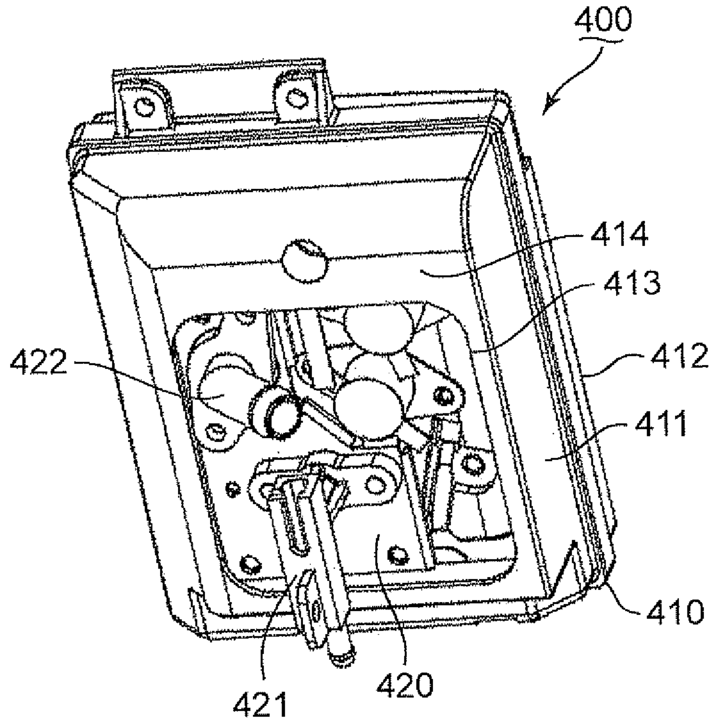
414
416

FIG. 4B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413
422
412
411
410
421
420

FIG. 5

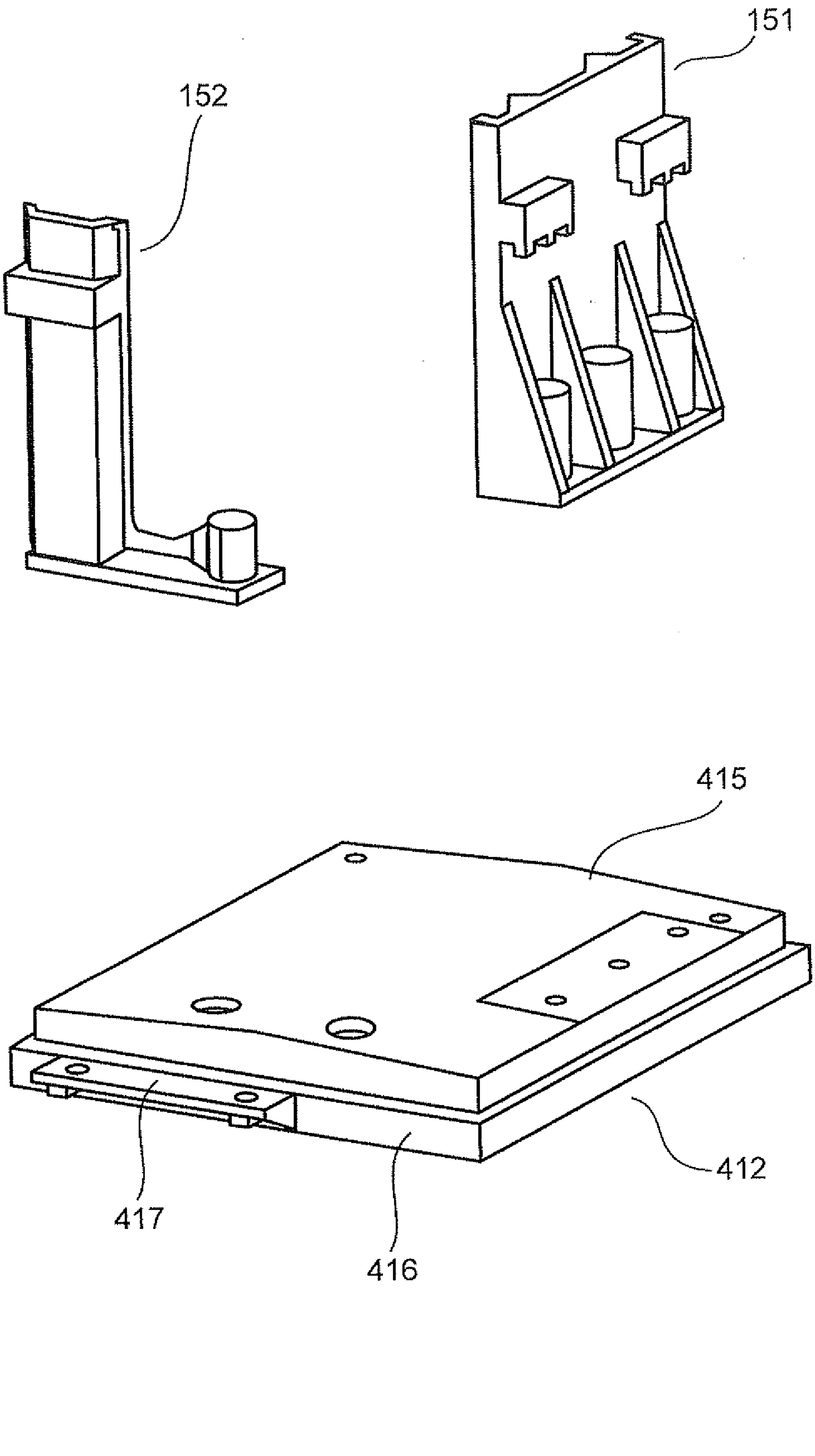


FIG. 6A

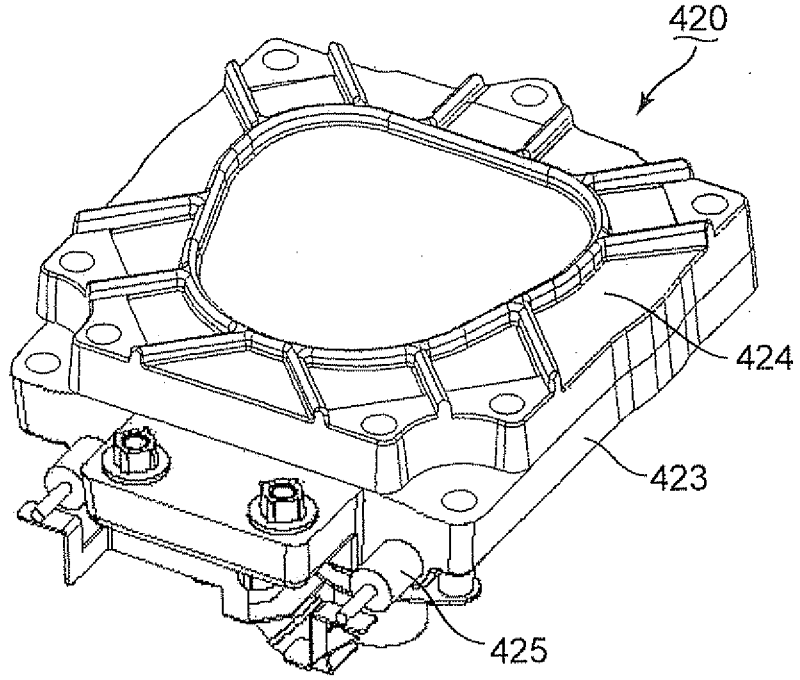



FIG. 6B

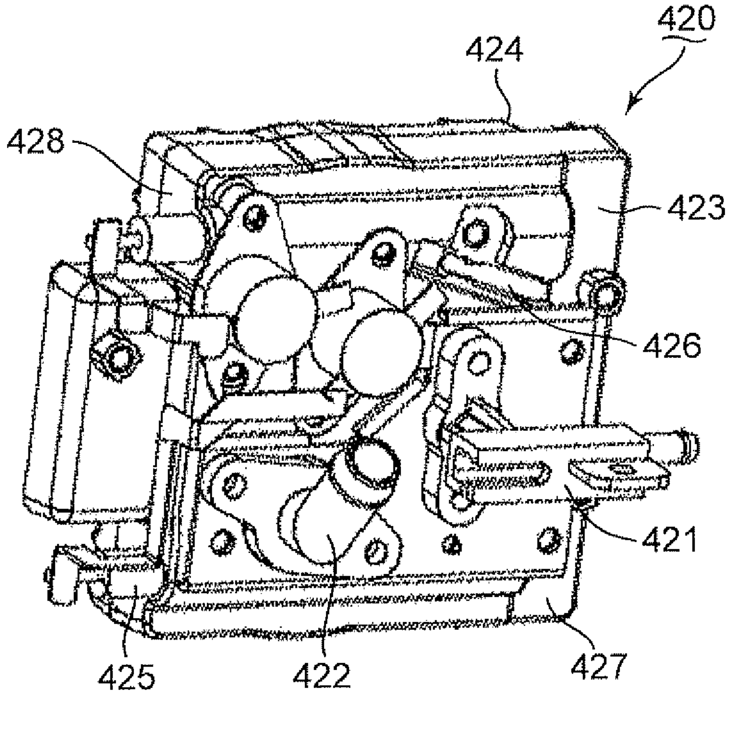


FIG. 7

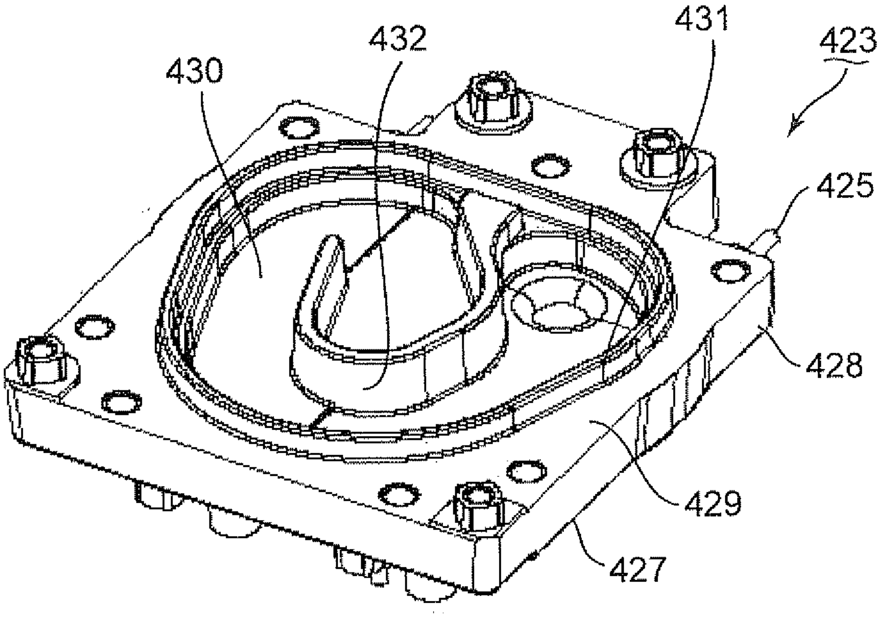


FIG. 8

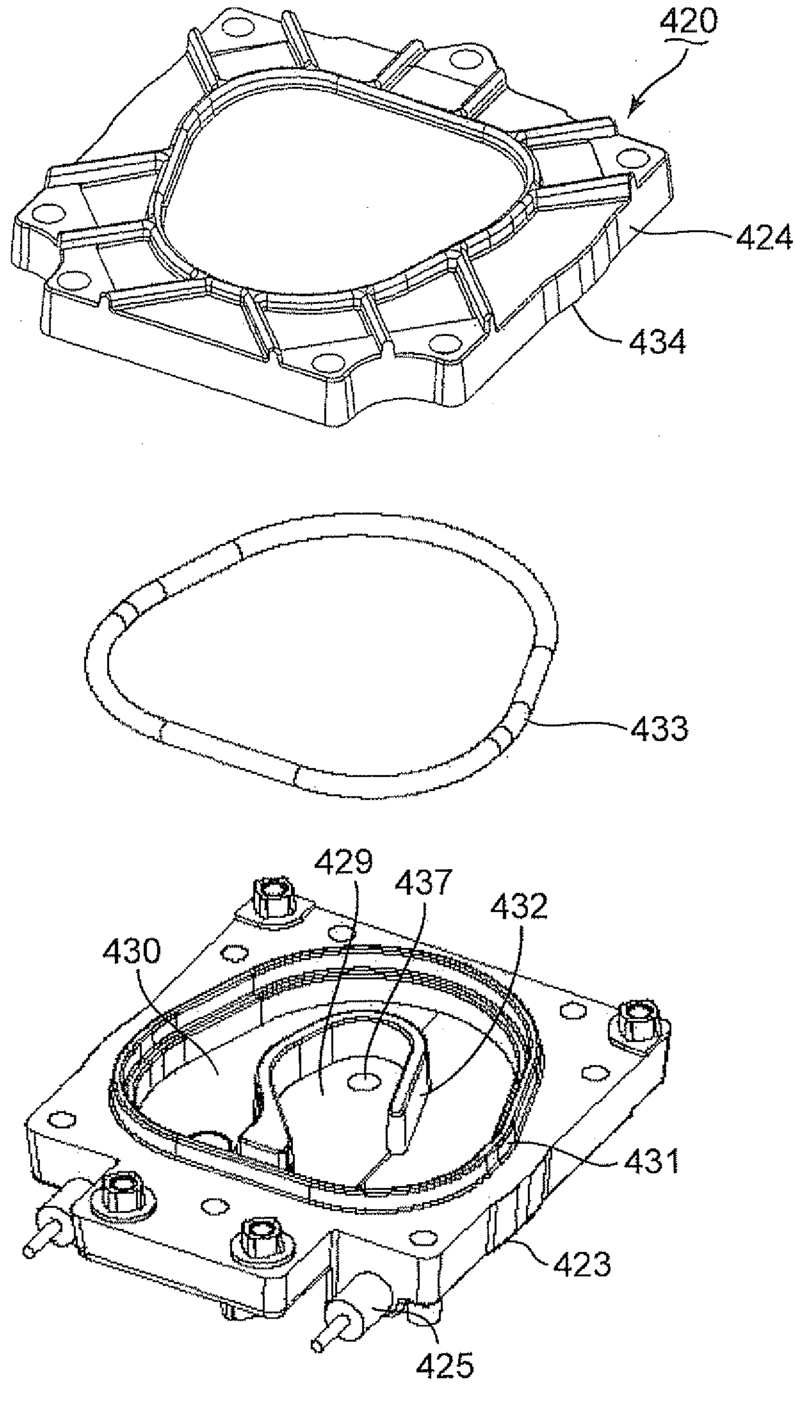


FIG. 9

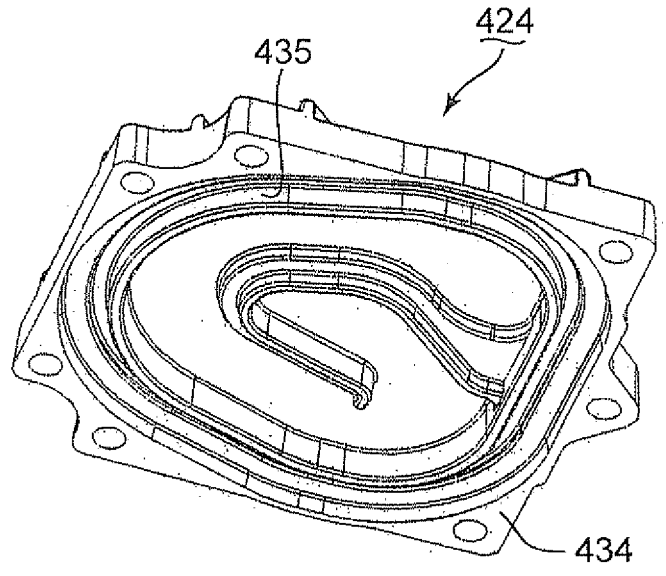



FIG. 10

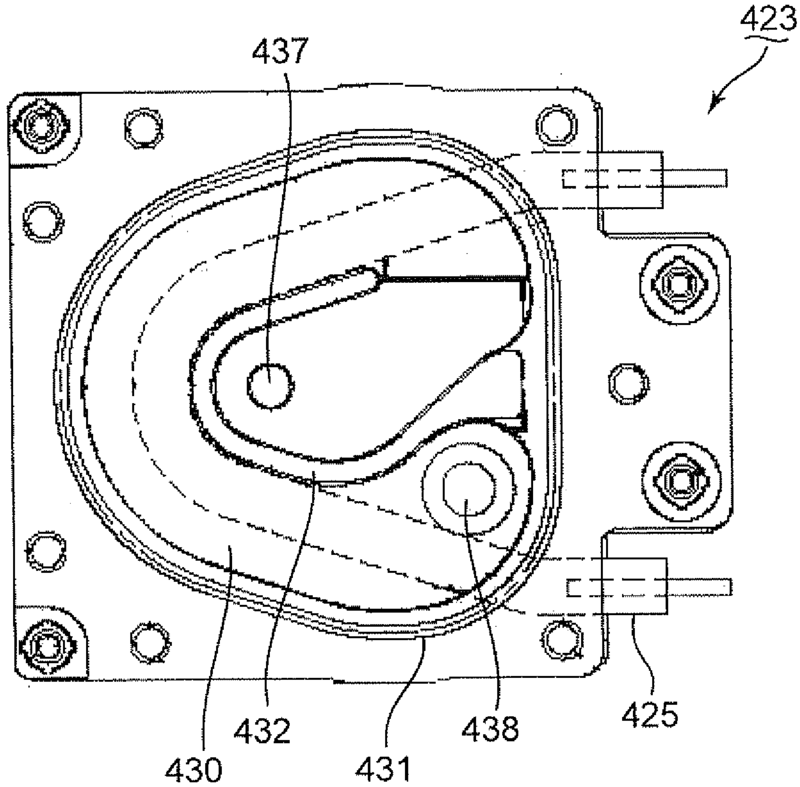


FIG. 11

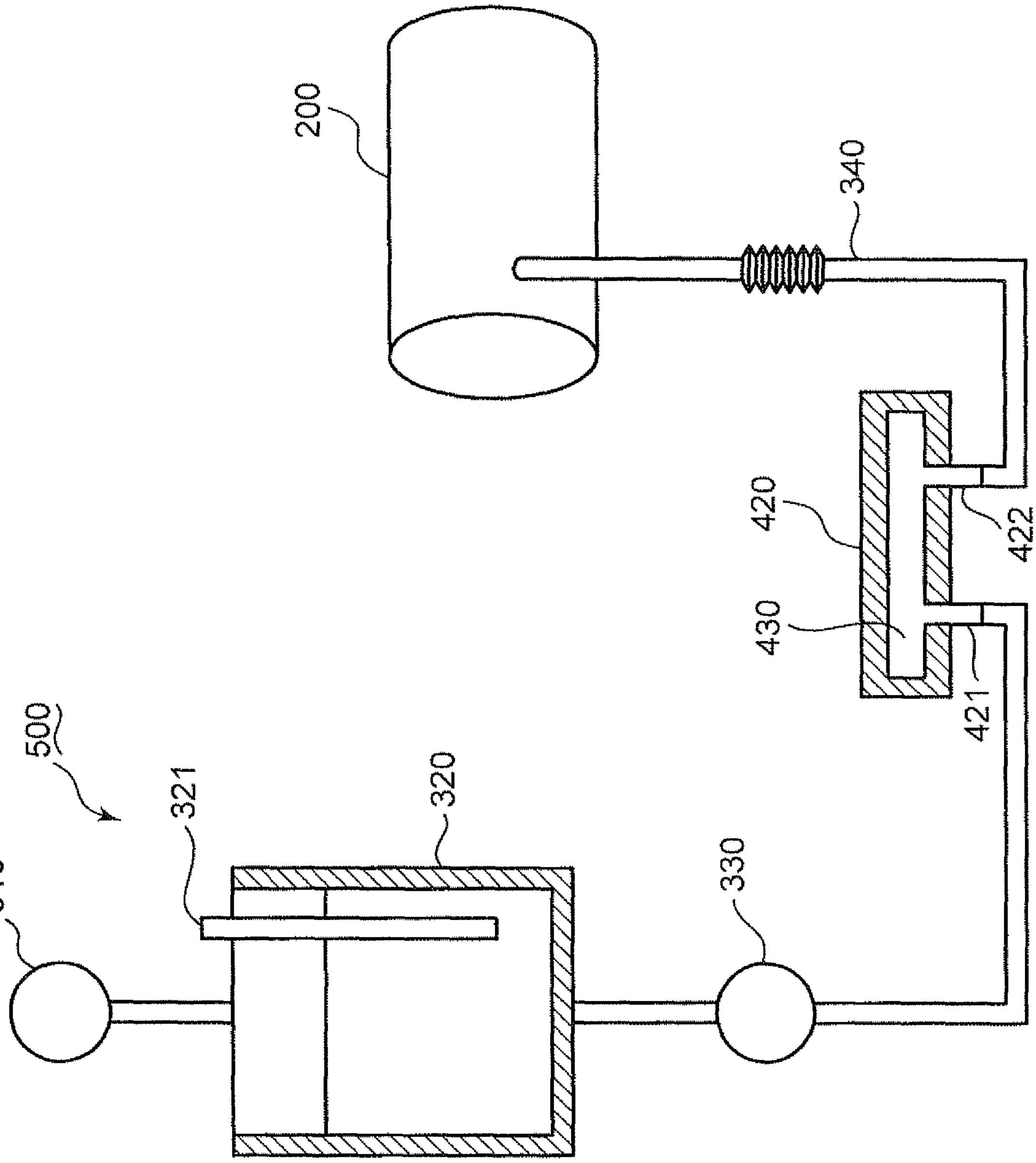


FIG. 12

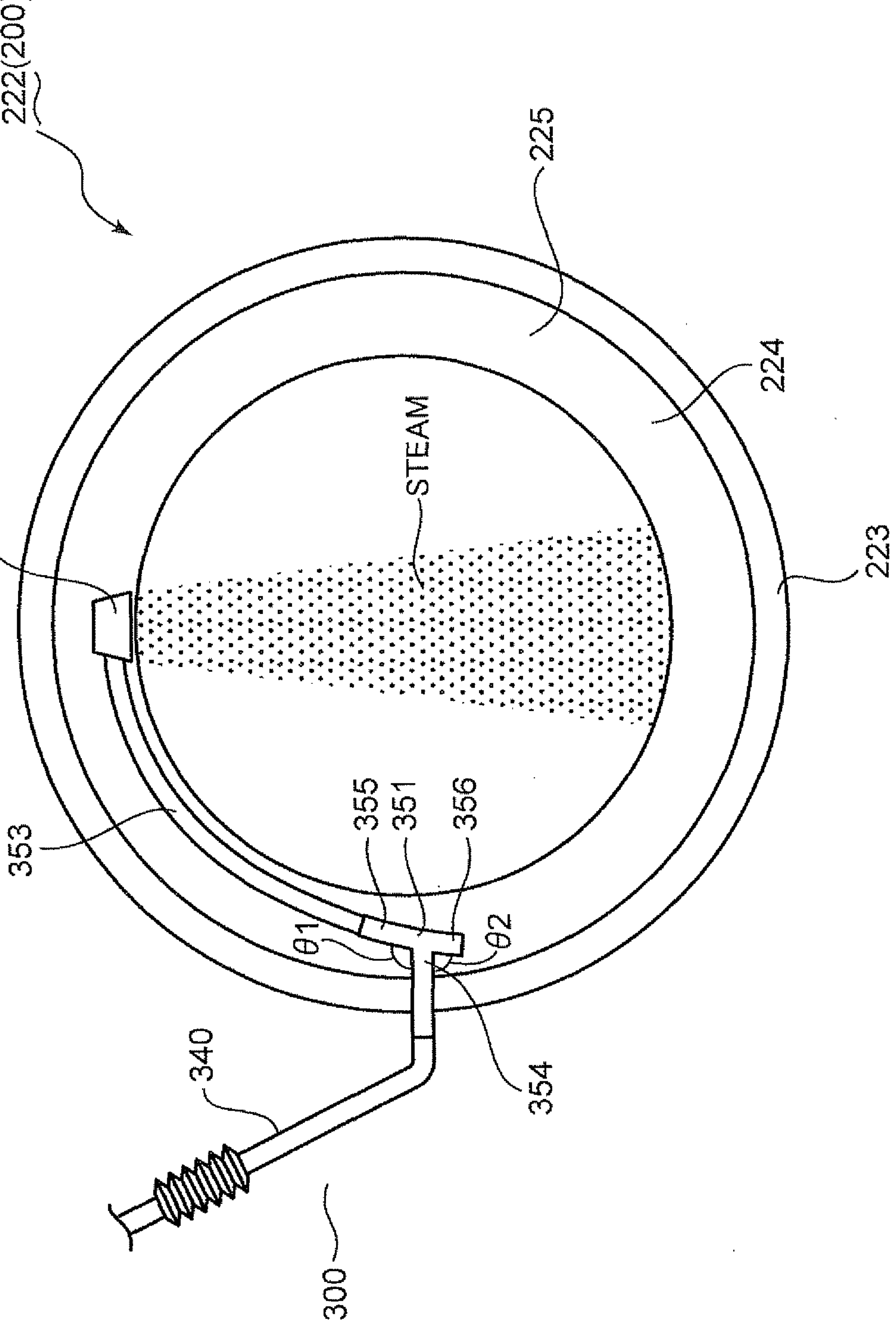


FIG. 13

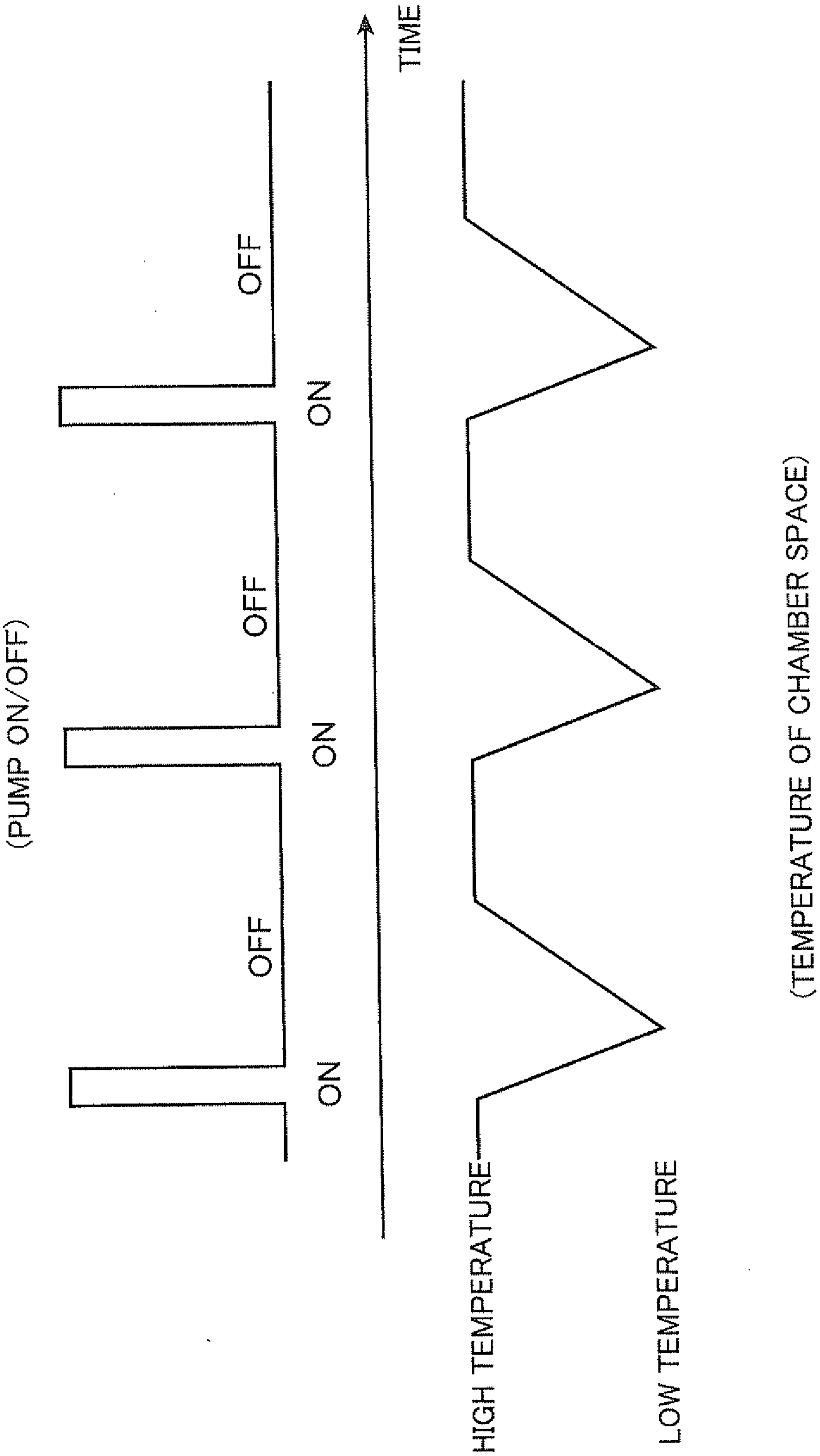

(PUMP ON/OFF)
ON
OFF
ON
OFF
ON
OFF
TIME
HIGH TEMPERATURE
LOW TEMPERATURE
(TEMPERATURE OF CHAMBER SPACE)

FIG. 14

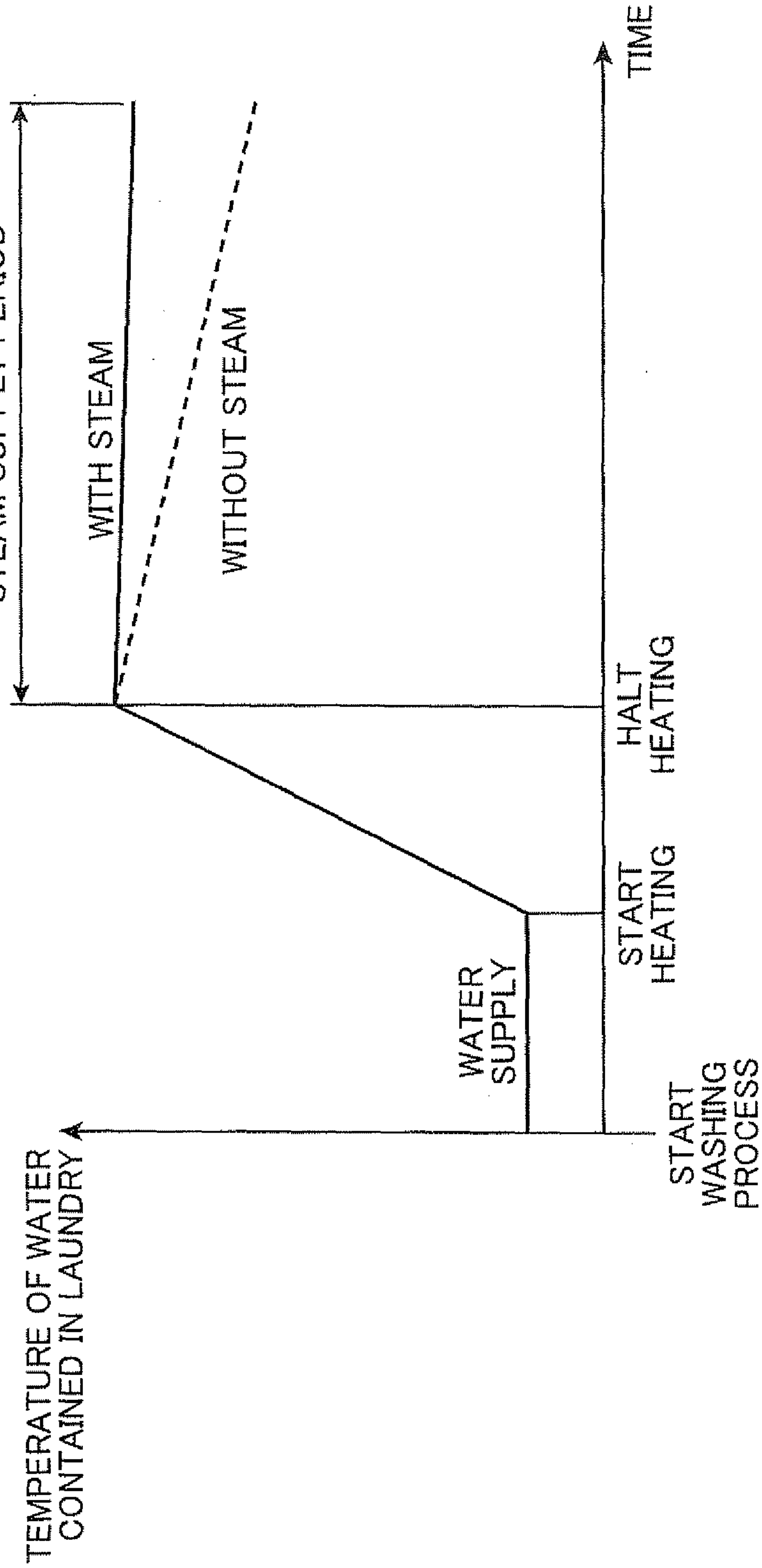

TEMPERATURE OF WATER CONTAINED IN LAUNDRY
STEAM SUPPLY PERIOD
WITH STEAM
WITHOUT STEAM
WATER SUPPLY
TIME
START WASHING PROCESS
START HEATING
HALT HEATING

FIG. 15A

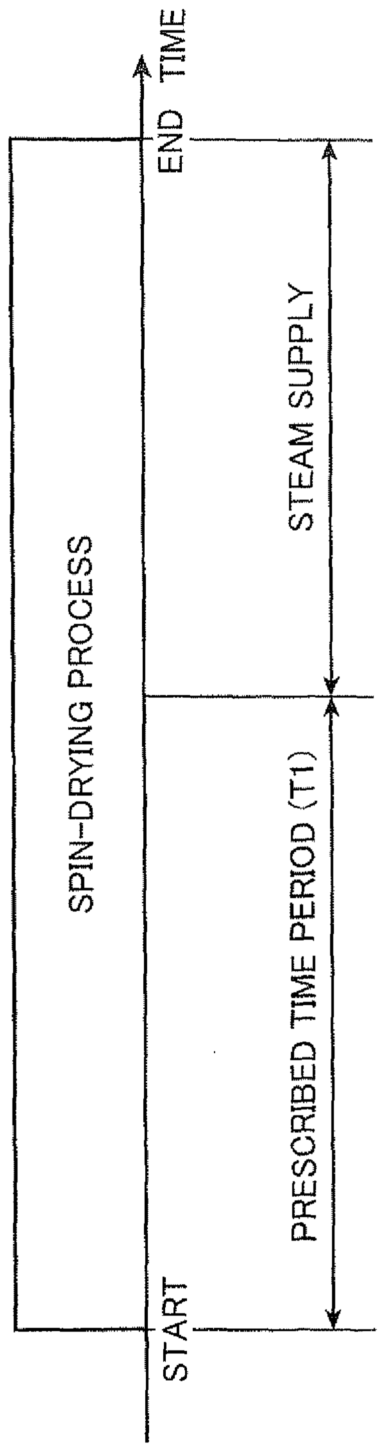

SPIN-DRYING PROCESS
START
END
TIME
STEAM SUPPLY
PRESCRIBED TIME PERIOD (T1)

FIG. 15B

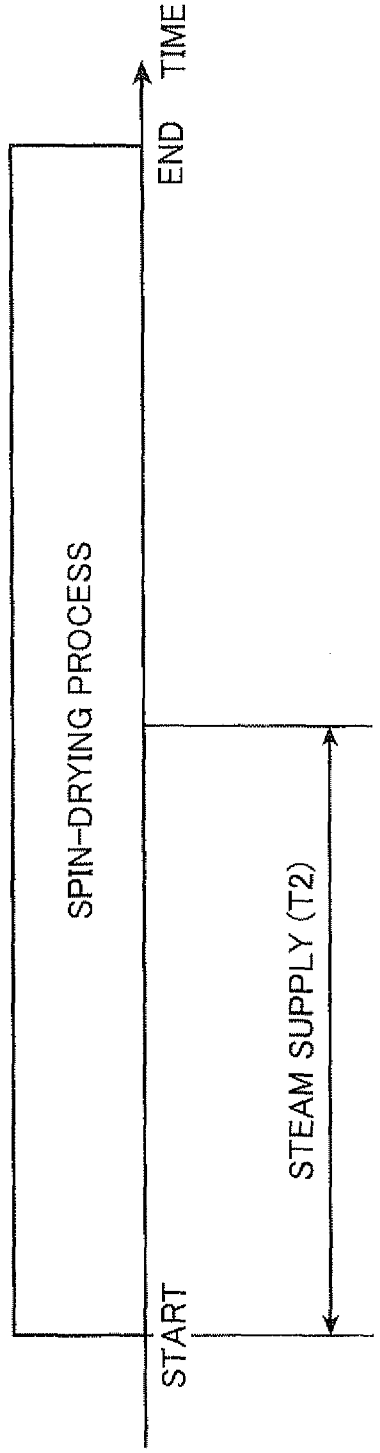


FIG. 15C

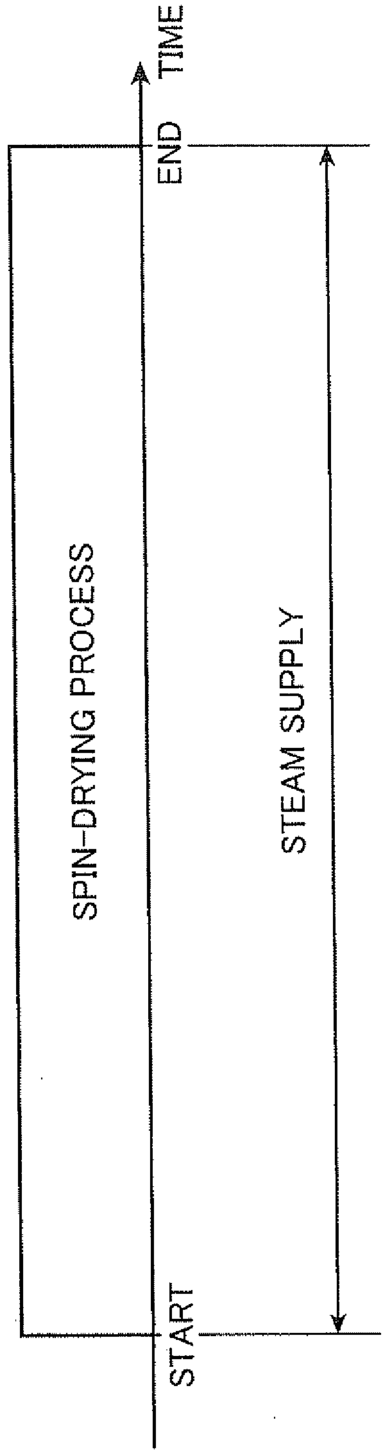


FIG. 16

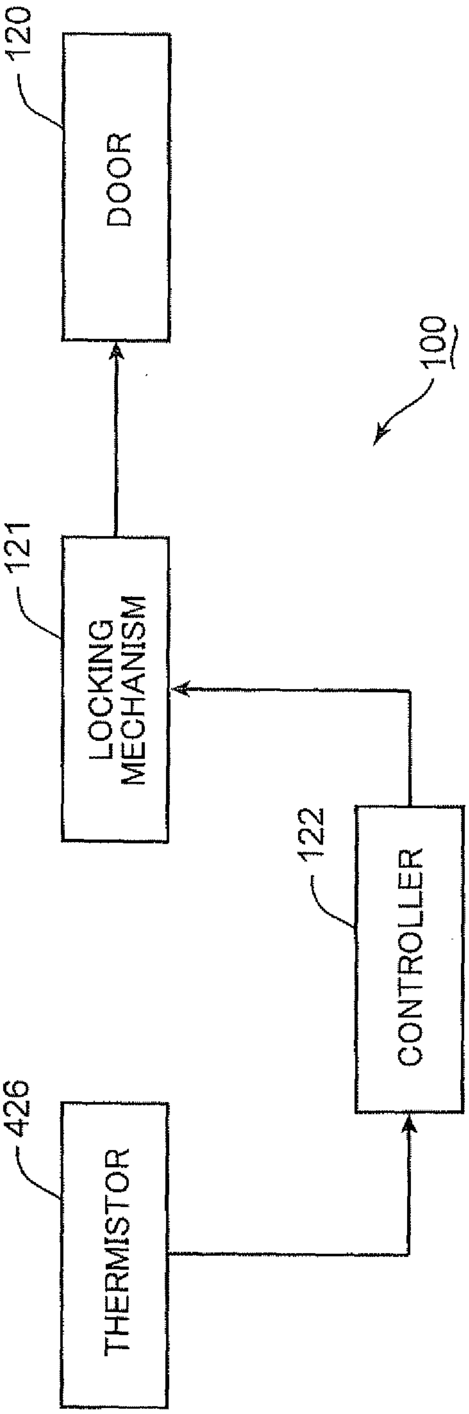

THERMISTOR
426
CONTROLLER
122
LOCKING MECHANISM
121
DOOR
120
100

FIG. 17

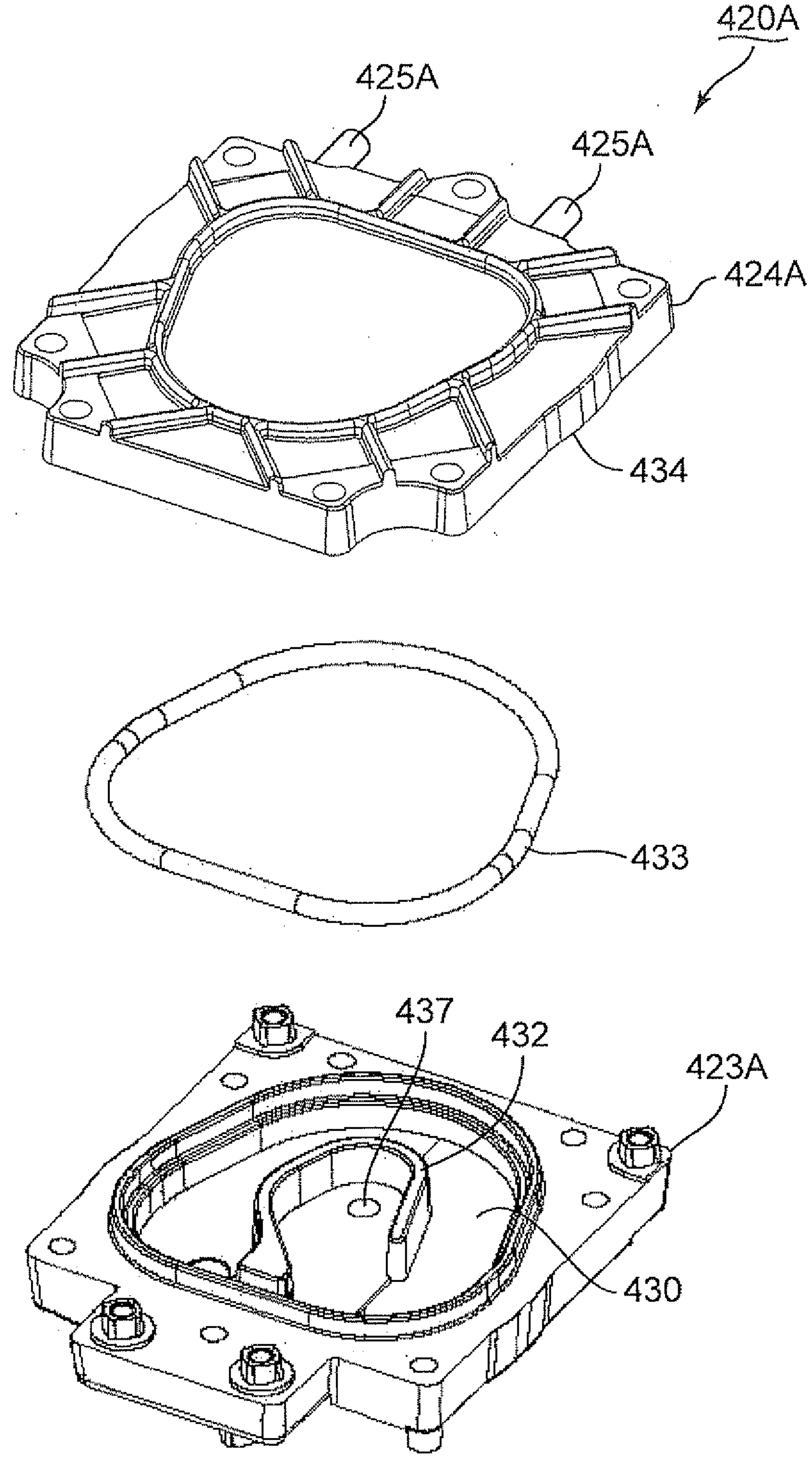
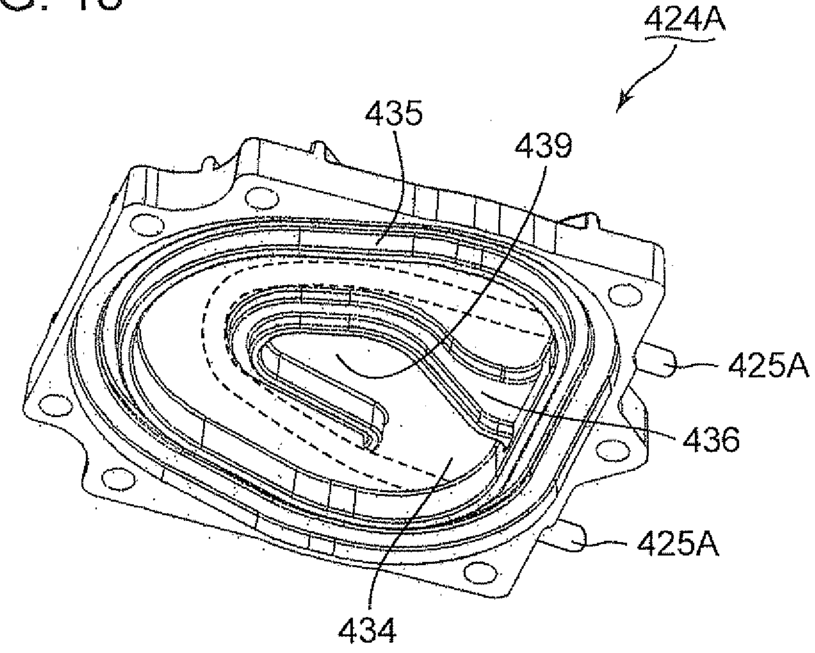


FIG. 18



## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/008451

A. CLASSIFICATION OF SUBJECT MATTER
*D06F25/00*(2006.01)i, *D06F39/04*(2006.01)i, *D06F39/08*(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)
D06F25/00, D06F39/04, D06F39/08

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

| | | | |
|---|---|---|---|
| Jitsuyo Shinan Koho | 1922-1996 | Jitsuyo Shinan Toroku Koho | 1996-2013 |
| Kokai Jitsuyo Shinan Koho | 1971-2013 | Toroku Jitsuyo Shinan Koho | 1994-2013 |

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP 2011-92540 A (Sharp Corp.), 12 May 2011 (12.05.2011), paragraphs [0033], [0034], [0038], [0040], [0041], [0056]; fig. 2, 3 & CN 102051794 A | 1-4 |
| Y | JP 2009-213693 A (Toshiba Corp.), 24 September 2009 (24.09.2009), paragraph [0029]; fig. 2, 3 (Family: none) | 1-4 |
| Y | JP 60-34498 A (Matsushita Electric Industrial Co., Ltd.), 22 February 1985 (22.02.1985), fig. 3 to 5 (Family: none) | 1-4 |

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

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

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 14 March, 2013 (14.03.13) | 26 March, 2013 (26.03.13) |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| Japanese Patent Office | |
| Facsimile No. | Telephone No. |

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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2012/008451

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 2011-92541 A (Sharp Corp.), 12 May 2011 (12.05.2011), (Family: none) | 1-4 |
| A | JP 2005-58740 A (LG Electronics Inc.), 10 March 2005 (10.03.2005), & US 2005/0034487 A1 & EP 1507029 A2 & EP 1795644 A1 & DE 602004027871 D & KR 10-2005-0018182 A & CN 1580352 A & CN 101195959 A | 1-4 |

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## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 2009126423 A **[0004]**
- US 2009172967 A **[0004]**
- EP 1939349 B **[0004]**