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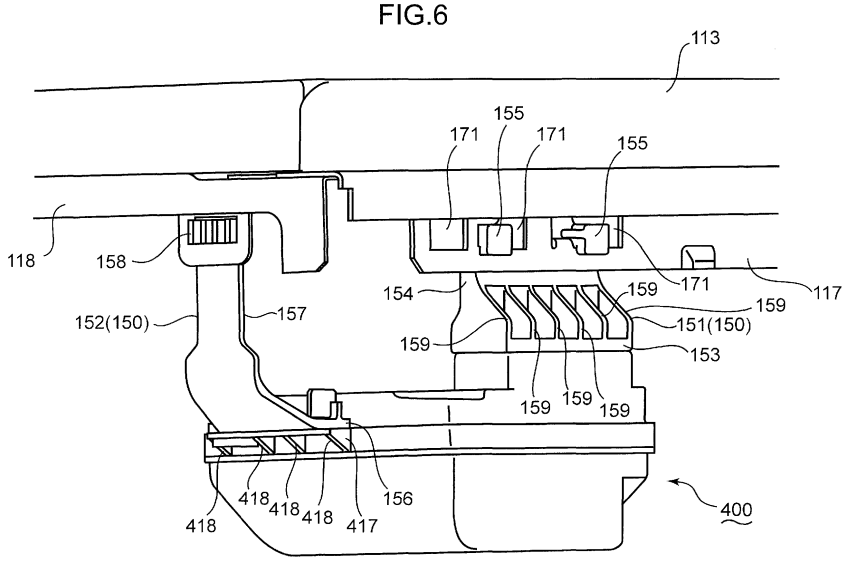
(54) **CLOTHES TREATMENT DEVICE**

(57) The present application discloses a laundry processing apparatus (100) including: a storage tub (200) for storing laundry; a steam generation portion (400) with a steam generator (420) for generating steam to be sprayed into the storage tub (200); and a housing (110) for storing the storage tub (200) and the steam generator (420). The steam generator (420) is held apart from the housing (110). The steam generator (420) may have a wall surface (429, 431, 432, 434) defining a chamber (430) for generating the steam. The steam generation portion (400) including a heater (425) for heating the wall surface (429, 431, 432, 434) may be held apart from the housing (110).

FIG.6

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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]** A washing machine which supplies steam to sterilize laundry has been developed (c.f.

**[0003]** Patent Document 1). The washing machine in Patent Document 1 includes a steam generator which uses a heater immersed in water to generate steam. The steam leaks from the steam generator to a storage tub which stores laundry. Consequently, the storage tub is filled with the steam.

**[0004]** The washing machine of Patent Document 1 includes a housing which stores the storage tub and the steam generator. The steam generator is attached directly to an inner surface of the housing. Therefore, the housing becomes a high temperature. A user may touch the housing while the user operates the washing machine.

**[0005]** Patent Document 1: WO 2006/126778

### Summary of Invention

**[0006]** It is an object of the present invention to provide a laundry processing apparatus with a structure to cause little heat transfer to a housing.

**[0007]** The laundry processing apparatus according to one aspect of the present invention includes: a storage tub configured to store laundry; a steam generation portion including a steam generator configured to generate steam which is sprayed into the storage tub; and a housing which stores the storage tub and the steam generator. The steam generator is held apart from the housing.

**[0008]** The laundry processing apparatus according to the present invention may cause little heat transfer to the housing.

**[0009]** The objects, features and advantages of the present invention will become more evident from the following detailed description and the accompanying drawings.

### Brief Description of Drawings

**[0010]**

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 transparent 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 generation portion of the steam supply mechanism shown in Fig. 3.

Fig. 4B is a schematic perspective view of the steam generation portion of the steam supply mechanism shown in Fig. 3.

Fig. 5 is a schematic perspective view of an attachment portion for connecting a lid of the steam generation portion shown in Figs. 4A and 4B to the housing.

Fig. 6 is a schematic perspective view of the steam generation portion, which is fixed to a housing top wall by the attachment portion shown in Fig. 5.

Fig. 7 is a schematic perspective view of a steam generation portion which is connected to first and second reinforcing frames.

Fig. 8A is a schematic perspective view of a steam generator of the steam generation portion shown in Figs. 4A and 4B.

Fig. 8B is a schematic perspective view of the steam generator of the steam generation portion shown in Figs. 4A and 4B.

Fig. 9 is a schematic perspective view of a main piece of the steam generator shown in Figs. 8A and 8B.

Fig. 10 is a schematic exploded perspective view of the steam generator shown in Figs. 8A and 8B.

Fig. 11 is a schematic perspective view of a lid piece of the steam generator shown in Fig. 10.

Fig. 12 is a schematic plan view of the main piece shown in Fig. 9.

Fig. 13 is a schematic view of a water supply mechanism of the steam supply mechanism shown in Fig. 3.

Fig. 14 is a schematic rear view of a front portion of a storage tub in the washing machine shown in Fig. 1.

Fig. 15 is a graph schematically showing a relationship between intermittent operation of a pump of the water supply mechanism shown in Fig 13 and a temperature inside a chamber space.

Fig. 16 is a graph schematically showing a change in a temperature of the water supplied to a water tub of the washing machine shown in Fig. 1.

Fig. 17A is a schematic timing chart showing a timing of steam supply during a spin-drying process.

Fig. 17B is a schematic timing chart showing a timing of steam supply during the spin-drying process.

Fig. 17C is a schematic timing chart showing a timing of steam supply during the spin-drying process.

Fig. 18 is a block diagram schematically showing control for a door in response to a temperature of the steam generator shown in Fig. 8B.

Fig. 19 is a schematic exploded perspective view of a steam generator used in a washing machine exemplified as the laundry processing apparatus according to the second embodiment.

Fig. 20 is a schematic perspective view of the steam

generator shown in Fig. 19.

Description of Embodiments

**[0011]** Washing machines exemplified as the laundry processing apparatus are described below with reference to the drawings. Directional terms such as "top", "bottom", "left" and "right" which are used in the following description are intended to clarify the explanation, and do not in any way limit principles of the laundry processing apparatus. The principles of the laundry processing apparatus may be applied to apparatuses (washer/drier) having functions for washing and drying laundry, and apparatuses (drier) which dry laundry.

<First Embodiment>

<Washing Machine>

**[0012]** Fig. 1 is a schematic vertical cross-sectional view of a washing machine 100 according to the first embodiment. The washing machine 100 is described with reference to Fig. 1.

**[0013]** 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 having a substantially cylindrical peripheral wall 211, which surrounds the rotational axis RX, and a water tub 220, which stores the rotary drum 210. The storage tub 200 is substantially cylindrical so that the storage tub 200 surrounds the rotational axis RX. In the present embodiment, the central axis is exemplified by the rotational axis RX.

**[0014]** The housing 110 includes a front wall 111, which is provided with a feed opening 119 for feeding laundry into the storage tub 200, and a rear wall 112 opposite to the front wall 111. The housing 110 includes a housing top wall 113, which substantially horizontally extends between the front and rear walls 111, 112, and a housing bottom wall 114 opposite to the housing top wall 113. The rotary drum 210 and the water tub 220 are provided with openings 213, 227, respectively, in communication with the feed opening 119 formed in the front wall 111.

**[0015]** The washing machine 100 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 feed opening 119 formed in the front wall 111, and an open position, at which the door 120 opens the feed opening 119. A user may rotate the door 120 towards the open position to feed laundry into the storage tub 200 through the feed opening 119 of the front wall 111. The user may then move the door 120 towards the closed position to wash the laundry in the washing machine 100. The door 120 shown in Fig. 1 is situated at the closed position.

**[0016]** The rotary drum 210 rotates about the rotational axis RX which extends between the front and rear walls 111, 112. The laundry fed into the storage tub 200 moves inside the rotary drum 210 due to rotation of the rotary drum 210, and is subjected to various processes such as washing, rinsing and/or spin-drying.

**[0017]** The rotary drum 210 includes a bottom wall 212 facing the door 120 at the closed position. The water tub 220 includes a bottom portion 221, which surrounds the bottom wall 212 of the rotary drum 210 and a part of the peripheral wall 211, and a front portion 222, which surrounds the other portion of the peripheral wall 211 of the rotary drum 210 between the bottom portion 221 and the door 120.

**[0018]** The storage tub 200 includes a rotary shaft 230 which is attached to the bottom wall 212 of the rotary drum 210. The rotary shaft 230 extends toward the rear wall 112 along the rotational axis RX. The rotary shaft 230 extends through the bottom portion 221 of the water tub 220 and appears between the water tub 220 and the rear wall 112.

**[0019]** The washing machine 100 further includes a motor 231 situated below the water tub 220, a pulley 232 attached to the rotary shaft 230 appearing outside the water tub 220, and a belt 233 for transmitting drive power of the motor 231 to the pulley 232. When the motor 231 operates, the drive power of the motor 231 is transmitted to the belt 233, the pulley 232 and the rotary shaft 230. Accordingly, the rotary drum 210 rotates inside the water tub 220.

**[0020]** The washing machine 100 further includes a packing structure 130 situated between the front portion 222 of the water tub 220 and the door 120. The door 120 compresses the packing structure 130 when the door 120 is rotated to the closed position. Accordingly, the packing structure 130 forms a water-tight sealing structure between the door 120 and the front portion 222.

**[0021]** The washing machine 100 further includes a water supply port 140, which is connected to a faucet (not shown), and a distribution portion 141 for distributing water supplied through the water supply port 140. The water supply port 140 appears on the housing top wall 113 situated above the storage tub 200. The distribution portion 141 is situated between the housing top wall 113 and the storage tub 200. In the present embodiment, the top wall is exemplified by the housing top wall 113.

**[0022]** The washing machine 100 further includes a detergent storage portion (not shown), in which detergent is stored, and a steam supply mechanism 300 (described below), which sprays steam into the storage tub 200. The distribution portion 141 includes water supply valves for supplying water selectively to the storage tub 200, the detergent storage portion and the steam supply mechanism 300. Fig. 1 does not show water supply paths to the storage tub 200 and the detergent storage portion. Technologies used in a conventional washing machine may be suitably used for the water supply to the storage tub 200 and the detergent storage portion.

<Steam Supply Mechanism>

**[0023]** Fig. 2 is a schematic transparent 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. The housing 110 is indicated by dotted lines in Figs. 2 and 3. The storage tub 200 is not shown in Fig. 3. The arrows in Fig. 3 schematically show a water supply path. The steam supply mechanism 300 is described with reference to Figs. 1 to 3.

**[0024]** The steam supply mechanism 300 includes a water supply valve 310, which is used as a part of the distribution portion 141, and a reservoir tank 320, which is situated below the storage tub 200. The water supply valve 310 is used to control water supply to the reservoir tank 320. When the water supply valve 310 is opened, water is supplied from the water supply port 140 to the reservoir tank 320. The water supply to the reservoir tank 320 stops when the water supply valve 310 is closed.

**[0025]** The steam supply mechanism 300 further includes a pump 330, which is attached to the reservoir tank 320, and a steam generation portion 400, which receives water discharged from the pump 330. The pump 330 carries out an intermittent or continuous water supply operation to the steam generation portion 400. During the intermittent water supply operation, the pump 330 supplies an appropriately adjusted amount of water to the steam generation portion 400 to cause instantaneous steam generation. If the pump 330 supplies water continuously to the steam generation portion 400, impurities (scale) contained in the water used to generate steam are flushed from the steam generation portion 400.

**[0026]** The steam generation portion 400 is heated to a high temperature in order to generate steam which is sprayed into the storage tub 200. The storage tub 200 and the steam generation portion 400 are appropriately isolated from a user since the housing 110 stores the storage tub 200, which contains the rotary drum 210 configured to perform rotary movement, and a steam generation portion 400, which is heated to a high temperature. Consequently, the user may safely operate the washing machine 100.

**[0027]** As shown in Fig. 2, the steam supply mechanism 300 further includes a steam conduit 340 which extends downwards from the steam generation portion 400. As shown in Fig. 1, the front portion 222 of the water tub 220 includes a peripheral wall portion 223, which surrounds the peripheral wall 211 of the rotary drum 210, and an annular 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 generation portion 400 is supplied to the storage tub 200 through the steam conduit 340. It is preferable that the steam conduit 340 may be bellows configured to transmit little vibration to the steam generation portion 400 under rotation of the storage tub 200.

**[0028]** Figs. 4A and 4B are schematic perspective views of the steam generation portion 400. The steam generation portion 400 is described with reference to Figs. 2 to 4B.

**[0029]** The steam generation portion 400 includes a substantially rectangular box-shaped case 410, and a steam generator 420 which is surrounded by the case 410. The case 410 includes a container 411 for storing the steam generator 420, and a lid 412 which closes the container 411. In the present embodiment, the case 410 is formed from thermally-resistant resin. The term "thermally-resistant" means that there is no remarkable change in characteristics such as thermal deformation under heating by the heater 425.

**[0030]** 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 connected to the steam conduit 340 by an exhaust pipe 422. The container 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.

**[0031]** The steam generator 420 is situated above the reservoir tank 320 since the pump 330 forcibly supplies water from the reservoir tank 320 to the steam generator 420 inside the steam generation portion 400. If water is supplied from the reservoir tank 320 to the steam generator 420 without the pump 330, the water in the reservoir tank 320 has to be supplied to the steam generator 420 by the action of gravity. In this case, the steam generator 420 has to be situated below the reservoir tank 320.

**[0032]** In the present embodiment, water supply from the reservoir tank 320 to the steam generator 420 is carried out by the pump 330. Since the water is supplied from the reservoir tank 320 to the steam generator 420 forcibly by a pressure of the pump 330, there are few restrictions on a vertical relationship about an arrangement design of the steam generator 420 and the reservoir tank 320. With increased freedom in a layout design of the reservoir tank 320 and the steam generator 420, an internal space of the housing 110 is used efficiently.

**[0033]** The pump 330 may appropriately supply water from the reservoir tank 320 to the steam generator 420 although the steam generator 420 is situated above the reservoir tank 320 as shown in Fig. 2.

**[0034]** If water flows accidentally into a steam generator because of unexpected failures or other problems, steam is generated unnecessarily. In the present embodiment, the reservoir tank 320 is situated below the steam generator 420 due to usage of the pump 330. Even if the pump 330 is stopped by failures so that water supply to the steam generator 420 becomes uncontrollable, water remaining inside a hose connecting the reservoir tank 320/the pump 330 to the steam generator 420 does not flow into the steam generator 420 unnecessarily. Without the pump 330, the steam generator 420 has to be situated below the reservoir tank 320 as described above. For example, if there are failures of control parts such as on-

off valves for controlling water supply from the reservoir tank 320 to the steam generator 420, water supply to the steam generator 420 becomes out-of-control so that water is supplied unnecessarily from the reservoir tank 320 to the steam generator 420 because of the action of gravity. In the present embodiment, unnecessary water supply to the steam generator 420 and the reservoir tank 320 is less likely to occur due to usage of the pump 330.

**[0035]** As shown in Fig. 2, the housing 110 includes a right wall 115 standing between the front and rear walls 111, 112, and a left wall 116 opposite to the right wall 115. The rotational axis RX extends along the right and left walls 115, 116 (i.e. the rotational axis RX extends substantially in parallel to the right and left walls 115, 116).

**[0036]** Single-dotted lines are used in Fig. 2 to depict a vertical plane VP which passes through the rotational axis RX. The reservoir tank 320 is situated in a space on the bottom left of the housing 110 (a space between the vertical plane VP and the left wall 116). The steam generator 420 is situated in a space on the top right of the housing 110 (a space between the vertical plane VP and the right wall 115). The steam generator 420 and the reservoir tank 320 are arranged at substantially symmetrical positions with respect to the central axis of the storage tub 200 (the rotational axis RX). The reservoir tank 320 is situated near the rear wall 112 whereas the steam generator 420 is closer to the front wall 111 than the rear wall 112.

**[0037]** With regard to a general washing machine, a detergent storage portion in which detergent is stored is situated in one of the left and right portions of an upper front portion of the housing. A space outside the substantially cylindrical storage tub 200 except for a position occupied by the detergent portion is used efficiently for arranging each of the reservoir tank 320 and the steam generator 420. For example, if the detergent storage portion is situated in a left portion of the upper front portion of the housing 110, the reservoir tank 320 is situated at a rear position in a left lower portion of the housing 110 as shown in Fig. 2. In this case, if the steam generator 420 is situated at a front position in an upper right portion of the housing 110, an internal space between an inner surface of the substantially rectangular housing 110 and an outer surface of the substantially cylindrical storage tub 200 is utilized efficiently for arranging the reservoir tank 320 and the steam generator 420. Consequently, the reservoir tank 320 and the steam generator 420 may be maximally sized in an acceptable space.

**[0038]** The reservoir tank 320 may be situated at a position substantially symmetrical with respect to the detergent storage portion about the central axis (rotational axis RX) of the storage tub 200 whereas the steam generator 420 may be arranged at a substantially symmetrical position to the reservoir tank 320 with respect to the horizontal plane HP containing the rotational axis RX of the storage tub 200 if the detergent storage portion is arranged at the aforementioned position. Like the aforementioned layout design, the internal space of the housing 110 is utilized efficiently.

**[0039]** If the detergent storage portion is arranged at the aforementioned position, the reservoir tank 320 may be situated below the detergent storage portion. In this case, the steam generator 420 may be situated above the reservoir tank 320. Accordingly, the steam generator 420 may be arranged in a substantially symmetrical position to the reservoir tank 320 with respect to the vertical plane containing the rotational axis RX of the storage tub 200. Accordingly, like the aforementioned layout design, the internal space of the housing 110 is utilized efficiently.

**[0040]** If the rotational axis RX of the storage tub 200 is inclined in the front/rear direction of the housing 110 (e.g. if the rotational axis RX of the rotary drum 210 is inclined upwards from the rear wall 112 towards the front wall 111), the reservoir tank 320 and the steam generator 420 may be arranged at substantially symmetrical positions with respect to the rotational axis RX of the storage tub 200 or the horizontal plane HP containing the rotational axis RX. If the reservoir tank 320 and the steam generator 420 are arranged at substantially symmetrical positions with respect to the vertical plane passing through the approximate centre of the housing 110 in the front/rear direction, an internal space between the inner surface of the housing 110 and the outer surface of the storage tub 200 is utilized efficiently for arranging the reservoir tank 320 and the steam generator 420.

<Attachment Structure to Housing>

**[0041]** Fig. 5 is a schematic perspective view of an attachment portion 150 which is attached to the lid 412. The attachment portion 150 is described with reference to Figs. 3 and 5.

**[0042]** The lid 412 includes a substantially rectangular upper wall 415, a lid peripheral wall 416, which extends 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 the attachment portion 150 which is attached to the lid 412. The attachment portion 150 includes a first attachment piece 151, which is fixed to the upper wall 415, and a second attachment piece 152, which is fixed to the projecting piece 417. The first and second attachment pieces 151, 152 project upwards from the lid 412. Like the case 410, the attachment portion 150 is formed from thermally-resistant resin in the present embodiment.

**[0043]** The first attachment piece 151 includes a first connecting plate 153, which is connected to the upper wall 415, a first upright plate 154, which projects upwards from the first connecting plate 153, and a pair of first engagement pieces 155, which project rightwards from the first upright plate 154. The second attachment piece 152 includes a second connecting plate 156, which is connected to the projecting piece 417, a second upright plate 157, which projects upwards from the second con-

necting plate 156, and a second engagement piece 158, which projects forwards from the second upright plate 157.

**[0044]** Fig. 6 is a schematic perspective view of the steam generation portion 400 which is fixed to the housing top wall 113 by the attachment portion 150. Attachment of the steam generation portion 400 to the housing top wall 113 is described with reference to Figs. 3 and 6.

**[0045]** As shown in Fig. 3, the housing 110 further includes a first reinforcing frame 117 situated along the upper edge of the right wall 115, and a second reinforcing frame 118 situated along the upper edge of the front wall 111. In the present embodiment, the reinforcing frame is exemplified by the first and second reinforcing frames 117, 118.

**[0046]** As shown in Fig. 6, the reinforcing frame 117 is provided with openings 171. The first engagement pieces 155 of the first attachment piece 151 are inserted into the openings 171. Accordingly, the first attachment piece 151 is engaged with the first reinforcing frame 117.

**[0047]** The first attachment piece 151 includes first fins 159 which are formed at the corner between the first connecting plate 153 and the first upright plate 154. Since a large part of the heat from the steam generation portion 400 is radiated from the first fins 159, there is a small heat amount to be transmitted to the first reinforcing frame 117 and the housing top wall 113.

**[0048]** The second reinforcing frame 118 is provided with an opening. As shown in Fig. 6, the second engagement piece 158 of the second attachment piece 152 is inserted into the opening of the second reinforcing frame 118. Consequently, the second attachment piece 152 is engaged with the second reinforcing frame 118. Therefore, the steam generation portion 400 is fixed to the housing top wall 113 by the first and second attachment pieces 151, 152. The steam generation portion 400 is distant from the housing top wall 113 due to the first and second upright plates 154, 157 which stand upward. Consequently, there is an air layer between the lid 412 and the housing top wall 113. Therefore, there is little heat transfer from the steam generation portion 400 to the housing top wall 113.

**[0049]** The projecting piece 417 to which the second connecting plate 156 of the second attachment piece 152 is connected includes second fins 418 which project downwards. Since a large part of heat from the steam generation portion 400 is radiated from the second fins 418, there is a small heat amount to be transmitted to the second connecting plate 156. The second upright plate 157 is narrower than the second connecting plate 156. Therefore, there is a small amount of heat transfer from the second connecting plate 156 to the second upright plate 157. Accordingly, there is a small heat amount to be transmitted to the second reinforcing frame 118 and the housing top wall 113 through the second upright plate 157.

**[0050]** Fig. 7 is a schematic perspective view of the steam generation portion 400 which is connected to the first and second reinforcing frames 117, 118. The attachment of the steam generation portion 400 is described with reference to Fig. 7.

**[0051]** In Fig. 7, the contour of the housing 110 is represented by a single-dotted line. The first reinforcing frame 117 includes an outer edge 172 near the right wall 115, which extends downwards from the housing top wall 113, and an inner edge 173, which is more distant from the right wall 115 than the outer edge 172 is. The first reinforcing frame 117 further includes a rib 174 which extends downwards from the inner edge 173. The rib 174 is provided with the aforementioned openings 171. The first engagement pieces 155 of the first attachment piece 151 are inserted into the openings 171 and project towards the right wall 115. The first attachment piece 151 is connected along the right edge of the lid 412. Therefore, the steam generation portion 400 is distant appropriately from the right wall 115 of the housing 110 due to the first attachment piece 151. Accordingly, there is little heat transfer from the steam generation portion 400 to the right wall 115. In the present embodiment, the side wall is exemplified by the right wall 115.

**[0052]** The front wall 111 adjacent to the right wall 115 projects downwards from the housing top wall 113. The second attachment piece 152 suspended from the second reinforcing frame 118 bends in the opposite direction to the front wall 111 and is connected to the steam generation portion 400. Therefore, the steam generation portion 400 is distant appropriately from the front wall 111 of the housing 110 due to the second attachment piece 152. Accordingly, the steam generation portion 400 is distant from the housing 110 and is held by the attachment portion 150.

<Steam Generator>

**[0053]** Figs. 8A and 8B are schematic perspective views of the steam generator 420. The steam generator 420 is described with reference to Figs. 8A and 8B.

**[0054]** 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 linear heater 425, which is situated on the main piece 423. In the present embodiment, the main piece 423 and the lid piece 424 are made from aluminium. Consequently, the main piece 423 and the lid piece 424 are heated appropriately by the heater 425.

**[0055]** The steam generator 420 further includes a thermistor 426. The thermistor 426 is also attached to the main piece 423, in addition to the abovementioned connecting pipe 421, exhaust pipe 422 and heater 425. The heater 425 is controlled by means of the thermistor 426, on the basis of temperature information which is obtained by the thermistor 426. Therefore, the main piece 423 and the lid piece 424 are kept substantially at a certain temperature. Instead of the thermistor 426, a thermostat which controls to turn on and off the heater 425 at a certain temperature may be used to obtain similar

effects.

**[0056]** Fig. 9 is a schematic perspective view of the main piece 423. The main piece 423 is described with reference to Figs. 8B and 9.

**[0057]** 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, to which the heater 425 is attached, 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 from the upper surface 429 towards the lid piece 424 to define a substantially triangular chamber space 430, and a substantially J-shaped inner chamber wall 432, which defines a flow path of the steam in the chamber space 430.

**[0058]** Fig. 10 is a schematic exploded perspective view of the steam generator 420. Fig. 11 is a schematic perspective view of the lid piece 424. The steam generator 420 is described with reference to Figs. 2, 3, 8B to 11.

**[0059]** The steam generator 420 includes a packing ring 433 which is attached to the main piece 423 so as to surround the outer chamber wall 431. The packing ring 433 is made from heat-resistant rubber.

**[0060]** The lid piece 424 includes a lower surface 434 facing the main piece 423 and an outer shield wall 435 which has substantially the same shape as the outer chamber wall 431. The lid piece 424 is pressed against the main piece 423. Accordingly, the outer shield wall 435 compresses the packing ring 433 to keep the chamber space 430 airtight.

**[0061]** The main piece 423 is provided with an inflow port 437, through which water supplied via the connecting pipe 421 flows into the chamber space 430. The inflow port 437 formed at substantially the centre of the chamber space 430 is surrounded by the inner chamber wall 432. If the pump 330 supplies a prescribed amount of water to the steam generator 420, the water is injected upwards via the connecting pipe 421 and the inflow port 437. Consequently, 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, which is situated above the inflow port 437. The steam generator 420 is heated by the heater 425 (e.g. to approximately 200°C) so that the steam generator 420 has high thermal energy. The pump 330 which executes intermittent water supply operation supplies a suitable amount of water for the thermal energy of the steam generator 420 (e.g. approximately 2 cc every dosage). Therefore, the water injected upwards from the inflow port 437 evaporates instantaneously. In the present embodiment, the chamber is exemplified by the chamber space 430 which is used to generate steam. The wall surface is exemplified by the inner chamber wall 432, the upper surface 429 of the main piece 423 surrounded by the inner chamber wall 432 and/or the lower surface 434 of the lid piece 424 situated above the inflow port 437 which the water supplied via the inflow port 437 hits.

**[0062]** Impurities contained in water supplied to the steam generator 420 may adhere or be precipitated at water vaporization onto the wall surfaces which form the chamber space 430. Since an internal pressure of the chamber space 430 rises suddenly as a result of the instantaneous evaporation of the water, the adhering or precipitated impurities are easily discharged from the chamber space 430 by an action of a pressure caused at the vaporization.

**[0063]** As shown in Fig. 2, the steam generator 420 is situated above the storage tub 200. As described above, impurities contained in water, which is supplied to the steam generator 420, may adhere or be precipitated at vaporization onto the wall surfaces forming the chamber space 430 such as the outer chamber wall 431 of the main piece 423, the inner chamber wall 432, the upper surface 429 and the lower surface 434 of the lid piece 424. Accumulation of the impurities worsens thermal conductivity between the wall surfaces and the supplied water. Accordingly, less water evaporates. However, if the steam generator 420 is situated above the storage tub 200, the adhering or precipitated impurities are discharged or drop down below the steam generator 420 under a pressure at the vaporization and the action of gravity. Consequently, the impurities are easily discharged from the chamber space 430 to the storage tub 200. Accordingly, the accumulation of adhering or precipitated impurities inside the chamber of the steam generator 420 is removed appropriately. Therefore, a resultant decline from the accumulation of impurities is less likely to happen to vaporization capability.

**[0064]** Fig. 12 is a schematic plan view of the main piece 423. The main piece 423 is described with reference to Figs. 8B and 12.

**[0065]** The heater 425 extends along a substantially U-shaped path inside the main piece 423. Therefore, the heater 425 surrounds the inflow port 437 to which the connecting pipe 421 is connected. Consequently, the inner chamber wall 432 and the region surrounded by the inner chamber wall 432 become the highest temperature in the chamber space 430. Therefore, the water injected through the inflow port 437 evaporates instantaneously.

**[0066]** Since the substantially J-shaped inner chamber wall 432 extends in the chamber space 430, which is defined by the outer chamber wall 431, the chamber space 430 draws a whorl flow path. The main piece 423 is provided with an exhaust port 438 formed at the terminal end of the flow path. Steam generated in the space surrounded by the inner chamber wall 432 flows towards the exhaust port 438 with an internal pressure rise in the chamber space 430. The exhaust pipe 422 is connected to the exhaust port 438. The steam arriving at the exhaust port 438 is discharged downward through the exhaust pipe 422.

**[0067]** The heater 425 extends in a U-shape along the outer path of the whorl flow path. Consequently, steam generated in the space surrounded by the inner chamber wall 432 flows towards the exhaust pipe 422 while being

heated. Therefore, hot steam is exhausted.

**[0068]** Since the steam generator 420 injects water onto the heated wall surfaces to evaporate the water instantaneously, it takes less power to generate a certain amount of steam, in comparison with conventional technologies with a heater immersed in water for steam generation.

<Water Supply Mechanism>

**[0069]** Fig. 13 is a schematic view of the water supply mechanism 500. The water supply mechanism 500 is described with reference to Fig. 13.

**[0070]** The water supply mechanism 500 which injects water into the chamber space 430 of the steam generator 420 includes the aforementioned water supply valve 310, reservoir tank 320, pump 330 and connecting pipe 421. The water supply mechanism 500 further includes a level sensor 321 configured to measure a water level in the reservoir tank 320. The water supply valve 310 may supply water to the reservoir tank 320 or stop the water supply to the reservoir tank 320 in response to the water level detected by the level sensor 321.

**[0071]** The water supply valve 310 may be controlled in response to an operating time and/or an operating pattern of the pump 330 (intermittent water supply operation and/or continuous water supply operation). For example, a water dosage from the water supply valve 310 may be adjusted so that the reservoir tank 320 becomes empty at the end of the operation of the pump 330. Therefore, the water is less likely to freeze in the reservoir tank 320.

**[0072]** The pump 330 supplies water stored in the reservoir tank 320 to the chamber space 430 through the connecting pipe 421. The intermittent water supply operation of the pump 330 is adjusted so as to cause instantaneous evaporation of the water injected into the chamber space 430.

**[0073]** As a result of the evaporation of the water in the chamber space 430, impurities contained in the water may accumulate inside 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 flush the accumulated impurities.

**[0074]** The exhaust pipe 422 is connected to the steam conduit 340. Steam generated in the chamber space 430 by the intermittent water supply operation of the pump 330 and water flowing into the chamber space 430 under the continuous water supply operation of the pump 330 flows into the storage tub 200 through the exhaust pipe 422 and the steam conduit 340.

<Supply of Steam and Water to Storage Tub >

**[0075]** Fig. 14 is a schematic rear view of the front portion 222 of the storage tub 200. Supply of steam and water to the storage tub 200 is described with reference to Figs. 1, 13 and 14.

**[0076]** As shown in Fig. 1, the annular portion 224 of the front portion 222 includes an inner surface 225 facing the rotary drum 210 and an outer surface 226 facing the front wall 111 of the housing 110. Fig. 14 mainly shows the inner surface 225.

**[0077]** The steam supply mechanism 300 includes a branching pipe 351 and a nozzle 352 which are fixed 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 via the peripheral wall portion 223.

**[0078]** Steam generated in the chamber space 430 flows into the steam conduit 340 through the exhaust pipe 422 with a pressure rise inside the chamber space 430. Subsequently, the steam reaches the branching pipe 351 from the steam conduit 340. The nozzle 352 is situated above the branching pipe 351. Since the steam arriving at the branching pipe 351 is hot, the steam is guided to the steam tube 353 and then reaches the nozzle 352. Eventually, the steam is sprayed downwards from the nozzle 352. Accordingly, the steam is blown directly onto the laundry stored in the storage tub 200 via the opening 213 of the rotary drum 210. In the present embodiment, the steam generated in the chamber space 430 is led to the nozzle 352 by the exhaust pipe 422, the steam conduit 340, the branching pipe 351 and the steam tube 353.

**[0079]** As described above, since the pump 330 injects a suitable amount of water into the hot chamber space 430 under the intermittent water supply operation, the water evaporates instantaneously. Therefore, there is a rapid increase in an internal pressure in the chamber space 430. Consequently, the steam is sprayed at a high pressure from the nozzle 352 so that the steam vertically traverses the internal space of the storage tub 200. Laundry is likely to gather near the lower end of the rotary drum 210 due to the gravity. Since the steam sprayed from the nozzle 352 attached to an upper portion of the storage tub 200 gets around to the lower end of the rotary drum 210, the steam is supplied efficiently to the laundry.

**[0080]** The branching pipe 351 includes a trunk pipe 354 connected to the steam conduit 340, an upper subsidiary pipe 355, which bends upwards from the trunk pipe 354, and a lower subsidiary pipe 356, which bends downwards from the trunk pipe 354. The steam or water flows into the trunk pipe 354 through the steam conduit 340. The upper subsidiary pipe 355 is connected to the steam tube 353 to define an upward path of the steam towards the nozzle 352.

**[0081]** Unlike the upper subsidiary pipe 355, the lower subsidiary pipe 356 defines a downward path. The water flowing into the branching pipe 351 through the steam conduit 340 under the continuous water supply operation of the pump 330 flows down via the lower subsidiary pipe 356 due to the action of gravity.

**[0082]** Fig. 14 shows an included angle $\theta 1$ between the trunk pipe 354 and the upper subsidiary pipe 355. Fig. 14 also shows the included angle $\theta 2$ between the

trunk pipe 354 and the lower subsidiary pipe 356. The included angle θ1 is obtuse whereas the included angle θ2 is acute. Since the included angle θ2 is acute, there is relatively large flow loss from the trunk pipe 354 to the lower subsidiary pipe 356. Therefore, steam flowing into the trunk pipe 354 is less likely to flow into the lower subsidiary pipe 356 so that the steam mainly flows into the upper subsidiary pipe 355. On the other hand, since the upper subsidiary pipe 355 defines an upward flow path, water flowing into the trunk pipe 354 is less likely to flow into the upper subsidiary pipe 355 so that the water mainly flows into the lower subsidiary pipe 356 due to the action of gravity. Consequently, the flow path of the steam is separated from the flow path of the water appropriately.

<Intermittent Pump Operation>

**[0083]** Fig. 15 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. 10, 13 and 15.

**[0084]** As shown in Fig. 15, a time length during which the pump 330 is operated (ON period) is set to be shorter than a time length during which the pump 330 is stopped (OFF period). Consequently, an appropriate amount of water is injected into the chamber space 430.

**[0085]** A prescribed amount of water is supplied to the chamber space 430 during the ON period. Consequently, the water is evaporated and becomes steam. Vaporization heat resultant from the phase change from water to steam causes a temporal decrease in a temperature in the chamber space 430. Since the OFF period is set to be relatively long as described above, the heater 425 may increase a temperature of the chamber space 430 sufficiently during the OFF period. Therefore, steam supply at a high pressure to the storage tub 200 continues under the intermittent operation of the pump 330. In short, the chamber space 430 is heated sufficiently during the OFF period, and a suitable amount of water for thermal energy of the steam generator 420 including the chamber space 430 is supplied in the ON period to cause instantaneous evaporation (e.g. approximately 2 cc/dosage), so that steam supply at an appropriately high pressure to the storage tub 200 continues.

<Use of Steam in Washing Process>

**[0086]** Fig. 16 is a graph schematically showing a change in a temperature of the water supplied to the water tub 220 in the washing process. Effects of steam used in the washing process are described with reference to Figs. 1, 10, 13 and 16.

**[0087]** As shown in Fig. 1, a water heater 160 is situated in a lower portion of the water tub 220. The water heater 160 is used to heat water supplied into the water tub 220.

**[0088]** As shown in Fig. 16, when the washing process is started, water is supplied to the water tub 220. Meanwhile, a temperature of the water contained in the laundry in the water tub 220 is substantially uniform. The water in the water tub 220 is then heated by the water heater 160. Since a large amount of heat is generated by the water heater 160, the temperature of the water contained in the laundry in the water tub 220 rises rapidly. Heating the water in the water tub 220 is then stopped at a prescribed temperature.

**[0089]** In Fig. 16, the dotted line shows a change in a temperature of water contained in the laundry after the water heater 160 stops heating without steam supply. The solid line shows a change in a temperature of water contained in the laundry after the water heater 160 stops heating with steam supply to the storage tub 200.

**[0090]** As described above, since hot steam into the storage tub 200 is supplied directly to the laundry, a temperature decrease is less likely to happen to the water contained in the laundry in the water tub 220. The heater 425 used in the steam generator 420 consumes a smaller power amount than the water heater 160 attached to the water tub 220 does. Consequently, in comparison to maintaining a water temperature in the water tub 220 by means of the water heater 160, the steam supply may achieve smaller power consumption to maintain a temperature. Therefore, it is preferable that the pump 330 carries out the intermittent water supply operation after the water heater 160 stops.

<Usage of Steam in Spin-Drying Process>

**[0091]** Effects of steam used in the spin-drying process are described with reference to Figs. 1, 13 and 14.

**[0092]** In the spin-drying process, the rotary drum 210 rotates at high speed. As shown in Fig. 1, the peripheral wall 211 of the rotary drum 210 is provided with a lot of small holes 219. The laundry stored in the rotary drum 210 is pressed against the peripheral wall 211 due to a centrifugal force resultant from rotation of the rotary drum 210. Consequently, moisture contained in the laundry is discharged from the rotary drum 210 through the small holes 219. Therefore, the laundry is suitably spin-dried.

**[0093]** Fibres of the spin-dried laundry are likely to form hydrogen bonds. The hydrogen bonds between the fibres result in wrinkles in the laundry. If steam is supplied into the rotary drum 210, the steam removes the hydrogen bonds between the fibres. Therefore, there are decreased wrinkles of the laundry. Accordingly, it is preferable that the pump 330 carries out the 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 sprayed from the nozzle 352 into the rotary drum 210. Since the steam sprayed from the nozzle 352 traverses the storage tub 200 as described above, the steam is blown uniformly onto the whole of the laundry which is stuck over the rotating peripheral wall 211. Therefore, few wrinkles happen to the

whole of the laundry in the rotary drum 210.

**[0094]** Figs. 17A to 17C are schematic timing charts showing steam supply timings during the spin-drying process. The timings of the steam supply are described with reference to Figs. 1, 17A to 17C.

**[0095]** As shown in Fig. 17A, 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 little water is contained in the laundry, the laundry is humidified efficiently by heat and moisture of the steam. As shown in Figs. 17B and 17C, the steam supply mechanism 300 may start steam supply in synchronization with the start of the spin-drying process. In this case, since the laundry is heated at the start of the spin-drying process, the laundry is humidified efficiently at high temperature. As shown in Figs. 17A and 17B, the steam supply mechanism 300 may supply steam during a part of a period of the spin-drying process. As shown in Fig. 17C, the time period during which the steam supply mechanism 300 supplies steam may coincide with the time period from the start to the end of the spin-drying process.

<Cooling of Steam Generator>

**[0096]** The cooling process of the steam generator 420 is described with reference to Figs. 10 and 13.

**[0097]** It is preferable that the steam generator 420 is cooled at the end of processing laundry with steam. If the steam generator 420 is cooled, hot steam is prevented from unnecessarily being sprayed into the storage tub 200.

**[0098]** Power supply to the heater 425 is stopped in order to cool the steam generator 420. The pump 330 then starts the continuous water supply operation. Consequently, water flows into the chamber space 430 continuously from the reservoir tank 320. The water flowing into the chamber space 430 absorbs heat from the steam generator 420, and then flows into the storage tub 200. Therefore, the steam generator 420 is cooled in a short period of time.

**[0099]** Fig. 18 is a block diagram schematically showing control of the door 120 on the basis of a temperature of the steam generator 420. The control of the door 120 is described with reference to Figs. 1, 8B and 18.

**[0100]** The washing machine 100 includes a locking mechanism 121, which locks the door 120 at the closed position, and a controller 122 for controlling locking and unlocking of the locking mechanism 121. Mechanical and electrical mechanisms of the locking mechanism 121 may be a structure used in a generally known washing machine.

**[0101]** As shown in Fig. 8B, the steam generator 420 includes the thermistor 426. The thermistor 426 detects a temperature of the main piece 423 so that signals in correspondence to the detected temperature are output to the controller 122.

**[0102]** The controller 122 keeps the door 120 locked by the locking mechanism 121 until the signals output from the thermistor 426 indicates that a temperature is no more than a prescribed value. Accordingly, the internal space of the storage tub 200 is isolated from the outside until the steam generator 420 reaches the prescribed temperature or lower. Therefore, the washing machine 100 becomes very safe.

<Second Embodiment>

**[0103]** Fig. 19 is a schematic exploded perspective view of a steam generator 420A 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 a similar structure to the washing machine 100 according to the first embodiment, except for a structure of the steam generator 420A. Therefore, differences from the first embodiment are described below. Except for the differences described below, the description in the first embodiment is applicable to the washing machine according to the second embodiment. Elements which are the same as the first embodiment are labelled with the same reference numerals. Therefore, the description of the first embodiment is also applicable to the elements which are labelled with the same reference numerals.

**[0104]** 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 attached to the main piece 423A. Instead, a heater 425A is attached to the lid piece 424A.

**[0105]** Fig. 20 is a schematic perspective view of the lid piece 424A. An attachment structure of the heater 425A is described with reference to Figs. 19 and 20.

**[0106]** The lid piece 424A includes an inner shield wall 436 which is surrounded by an outer shield wall 435. The inner shield wall 436 has substantially the same shape as the inner chamber wall 432 of the main piece 423A. The inner shield wall 436 may overlap with the inner chamber wall 432. Consequently, a whorl flow path is formed in the chamber space 430. A region of the lower surface 434 which is surrounded by the inner shield wall 436 faces the inflow port 437 formed in the main piece 423A. Therefore, the region is called "facing region 439" in the following description. The heater 425A is situated inside the lid piece 424A so as to surround the facing region 439. If a flow rate of the water is adjusted so that water flowing from the inflow port 437 reaches the lid piece 424A, there is instantaneous evaporation since the facing region 439 is a very high temperature.

**[0107]** The aforementioned embodiments mainly include the following features.

**[0108]** The laundry processing apparatus according to the aforementioned embodiments includes: a storage tub which stores laundry; a steam generation portion including a steam generator configured to generate steam

which is sprayed into the storage tub; and a housing configured to store the storage tub and the steam generator. The steam generator is held apart from the housing.

**[0109]** According to the aforementioned configuration, the steam generator generates steam. The steam is sprayed into the storage tub configured to store laundry. Since the housing stores the storage tub and the steam generation portion, the storage tub and the steam generation portion are appropriately isolated from the user. Since the steam generator is held apart from the housing, there is an air layer between the steam generator and the housing. Therefore, there is little heat transfer from the steam generator to the housing. Accordingly, the user may safely operate the laundry processing apparatus.

**[0110]** In the aforementioned configuration, the steam generator may have a wall surface defining a chamber for generating the steam. The steam generation portion including a heater which heats the wall surface may be held apart from the housing.

**[0111]** According to the aforementioned configuration, since the heater of the steam generation portion heats the wall surface which defines the chamber for generating steam, the steam is generated appropriately in the chamber. Since the steam generation portion is held apart from the housing, there is an air layer between the steam generation portion and the housing. Therefore, there is little heat transfer from the steam generation portion to the housing. Accordingly, the user may safely operate the laundry processing apparatus.

**[0112]** In the aforementioned configuration, the steam generation portion may include a case surrounding the steam generator; and an attachment portion which fixes the case to the housing.

**[0113]** According to the aforementioned configuration, since the case surrounds the steam generator, there is little heat transfer from the steam generator to the housing. The attachment portion fixes the case appropriately to the housing. Consequently, the user may safely operate the laundry processing apparatus.

**[0114]** In the aforementioned configuration, the laundry processing apparatus may further include a reinforcing frame situated along an upper edge of the housing. The attachment portion may be attached to the reinforcing frame.

**[0115]** According to the aforementioned configuration, since the attachment portion is attached to the reinforcing frame which is situated along the upper edge of the housing, the case is fixed stably to the housing. Consequently, the user may safely operate the laundry processing apparatus.

**[0116]** In the aforementioned configuration, the housing may include a top wall situated above the storage tub. The attachment portion connected to the top wall may make the steam generation portion distant from the top wall.

**[0117]** According to the aforementioned configuration, since the attachment portion makes the steam generation portion distant from the top wall situated above the storage tub, there is little heat transfer from the steam generation portion to the top wall. Therefore, the user may safely operate the laundry processing apparatus.

**[0118]** In the aforementioned configuration, the case may include a container, which stores the steam generation portion, and a lid, which closes the container. The attachment portion may be fixed to the lid.

**[0119]** According to the aforementioned configuration, since the lid to which the attachment portion is fixed closes the container which stores the steam generation portion, the lid may partition the top wall from the steam storage portion. Since the lid reduces heat transfer from the steam generation portion to the top wall, the user may safely operate the laundry processing apparatus.

**[0120]** In the aforementioned configuration, the housing may include a side wall which extends downwards from the top wall. The attachment portion may make the steam generation portion distant from the side wall.

**[0121]** According to the aforementioned configuration, since the attachment portion makes the steam generation portion distant from the side wall which extends downwards from the top wall, there is little heat transfer from the steam generation portion to the top wall. Therefore, the user may safely operate the laundry processing apparatus.

**[0122]** In the aforementioned configuration, the storage tub may be cylindrical so that the storage tub surrounds a central axis extending along the side wall. The steam generation portion may be situated between a vertical plane passing through the central axis and the side wall.

**[0123]** According to the aforementioned configuration, the storage tub is cylindrical so that the storage tub surrounds a central axis extending along the side wall. The steam generation portion is situated between a vertical plane passing through the central axis and the side wall. Since the steam generation portion is situated in a broad space between the top and/or side walls and the storage tub, the steam generation portion may be distant significantly from the top and/or side walls. Accordingly, there is little heat transfer from the steam generation portion to the top and/or side walls. Therefore, the user may safely operate the laundry processing apparatus.

**[0124]** In the aforementioned configuration, the housing may include a front wall which extends downwards next to the side wall from the top wall. The attachment portion may make the steam generation portion distant from the side wall.

**[0125]** According to the aforementioned configuration, the front wall adjacent to the side wall extends downwards from the top wall. Since the attachment portion separates the steam generation portion from the front wall, there is little heat transfer from the steam generation portion to the front wall. Therefore, the user may safely operate the laundry processing apparatus.

**[0126]** In the aforementioned configuration, the laundry processing apparatus may further include a nozzle configured to spray the steam downwards inside the stor-

age tub. The housing may include a rear wall opposite to the front wall. The steam generation portion may be closer to the front wall than the rear wall. The front wall may be provided with a feed opening for feeding the laundry into the storage tub. The storage tub may be provided with an opening in communication with the feed opening. The steam may be sprayed from the nozzle into the storage tub through the opening.

**[0127]** According to the aforementioned configuration, since the nozzle of the laundry processing apparatus sprays steam downwards in the storage tub, the nozzle is situated near the top wall. Since the attachment portion is connected to the top wall, there is a short distance between the nozzle and the steam generation portion. Since a temperature and a flow rate of the steam sprayed into the storage tub are kept at a high level, the steam is supplied efficiently to the laundry.

**[0128]** The front wall is provided with a feed opening for feeding the laundry into the storage tub. The storage tub is provided with an opening in communication with the feed opening. Since the steam is sprayed into the storage tub from the nozzle through the opening, the nozzle is situated near the front wall. The housing includes a rear wall opposite to the front wall. Since the steam generation portion is closer to the front wall than the rear wall, there is a short distance between the nozzle and the steam generation portion. Since a temperature and a flow rate of the steam sprayed into the storage tub are kept at a high level, the steam is supplied efficiently to the laundry.

**[0129]** In the aforementioned configuration, the attachment portion and the case may be formed from thermally-resistant resin.

**[0130]** According to the aforementioned configuration, since the attachment portion and the case are formed from thermally-resistant resin, the steam generation portion is appropriately held in the housing under a heated condition for generating steam.

Industrial Applicability

**[0131]** The principles of the aforementioned embodiments may be applied suitably to devices which use steam to process laundry.

## Claims

**1.** A laundry processing apparatus, comprising:

a storage tub configured to store laundry;
a steam generation portion including a steam generator configured to generate steam which is sprayed into the storage tub; and
a housing configured to store the storage tub and the steam generator, wherein
the steam generator is held apart from the housing.

**2.** The laundry processing apparatus according to claim 1, wherein
the steam generator has a wall surface defining a chamber for generating the steam; and the steam generation portion including a heater configured to heat the wall surface is held apart from the housing.

**3.** The laundry processing apparatus according to claim 2, wherein the steam generation portion includes a case surrounding the steam generator, and an attachment portion which fixes the case to the housing.

**4.** The laundry processing apparatus according to claim 3, further comprising a reinforcing frame situated along an upper edge of the housing, wherein
the attachment portion is attached to the reinforcing frame.

**5.** The laundry processing apparatus according to claim 3 or 4, wherein
the housing includes a top wall situated above the storage tub; and
the attachment portion connected to the top wall makes the steam generation portion distant from the top wall.

**6.** The laundry processing apparatus according to claim 5, wherein
the case includes a container, which stores the steam generation portion, and a lid, which closes the container; and
the attachment portion is fixed to the lid.

**7.** The laundry processing apparatus according to claim 5 or 6, wherein
the housing includes a side wall which extends downwards from the top wall; and
the attachment portion makes the steam generation portion distant from the side wall.

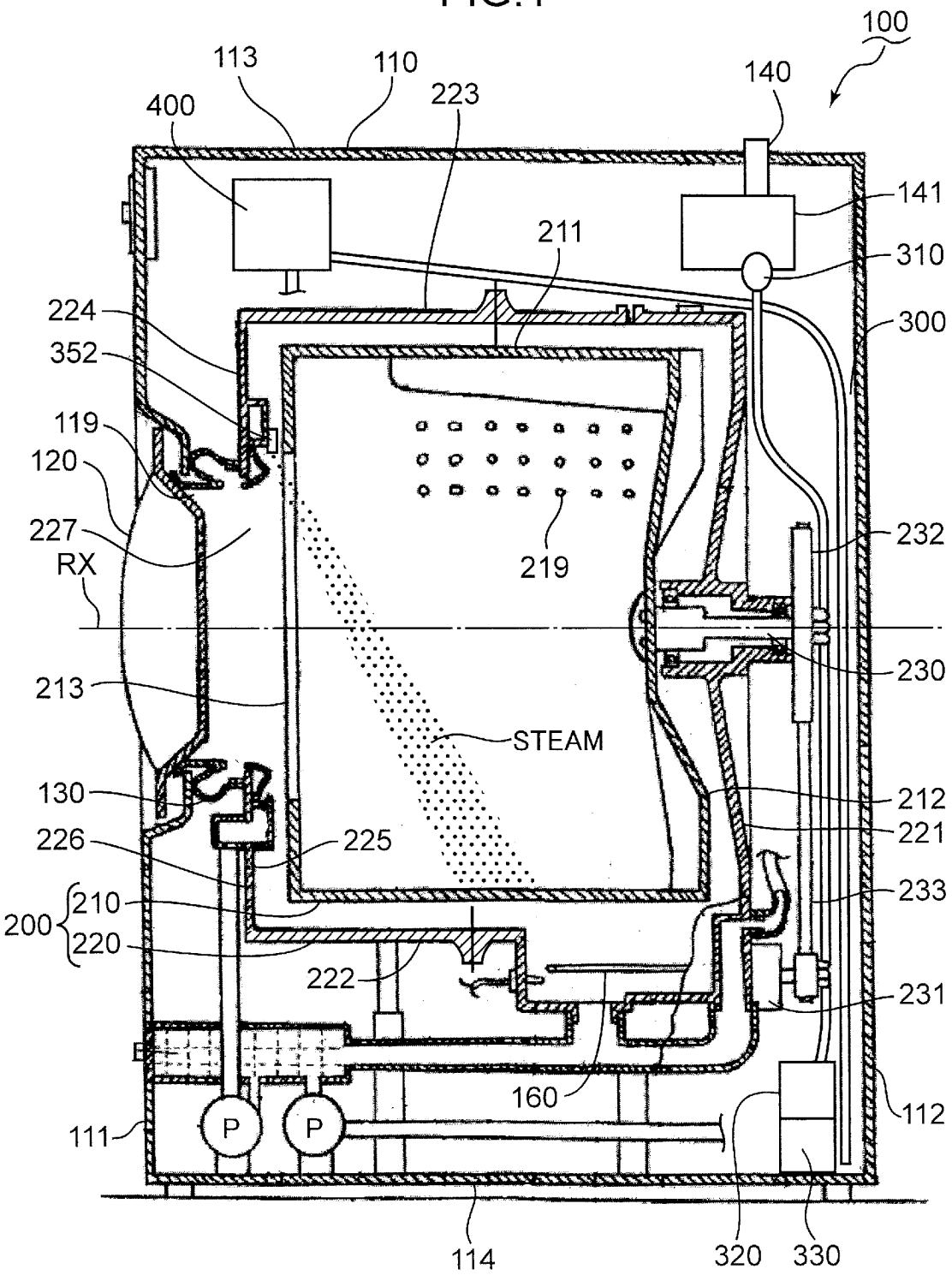
**8.** The laundry processing apparatus according to claim 7, wherein
the storage tub is cylindrical so that the storage tub surrounds a central axis extending along the side wall; and
the steam generation portion is situated between a vertical plane extending through the central axis and the side wall.

**9.** The laundry processing apparatus according to claim 7 or 8, wherein
the housing includes a front wall which extends downwards next to the side wall from the top wall; and
the attachment portion makes the steam generation portion distant from the front wall.

**10.** The laundry processing apparatus according to claim 9, further comprising a nozzle configured to spray the steam downwards in the storage tub, wherein
the housing includes a rear wall opposite to the front wall,
the steam generation portion is closer to the front wall than the rear wall,
the front wall is provided with a feed opening for feeding the laundry into the storage tub, the storage tub is provided with an opening in communication with the feed opening, and the steam is sprayed into the storage tub from the nozzle through the opening.

**11.** The laundry processing apparatus according to any one of claims 4 to 10, wherein the attachment portion and the case are formed from thermally-resistant resin.

FIG.1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330

FIG.2

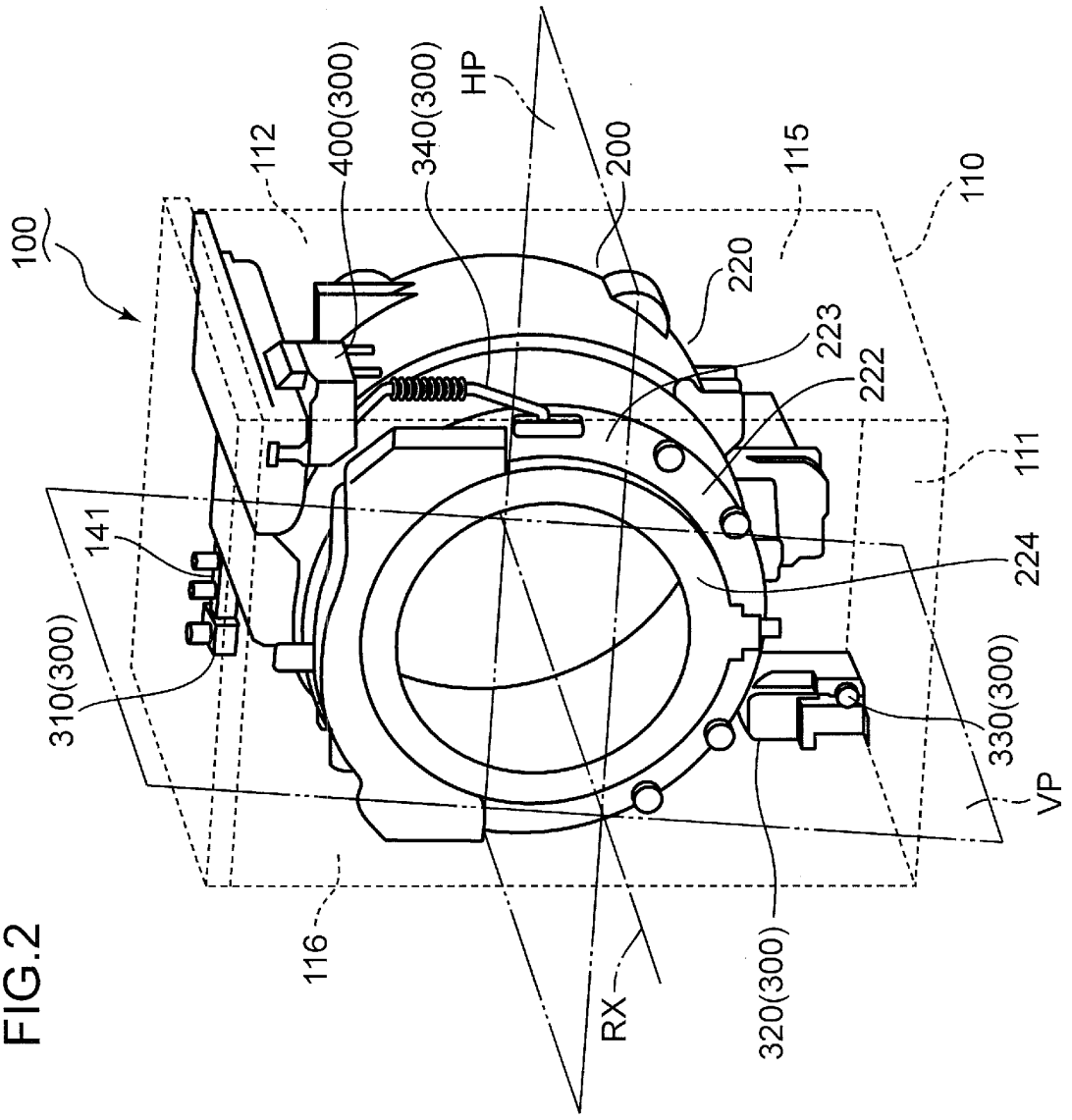
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FIG.3

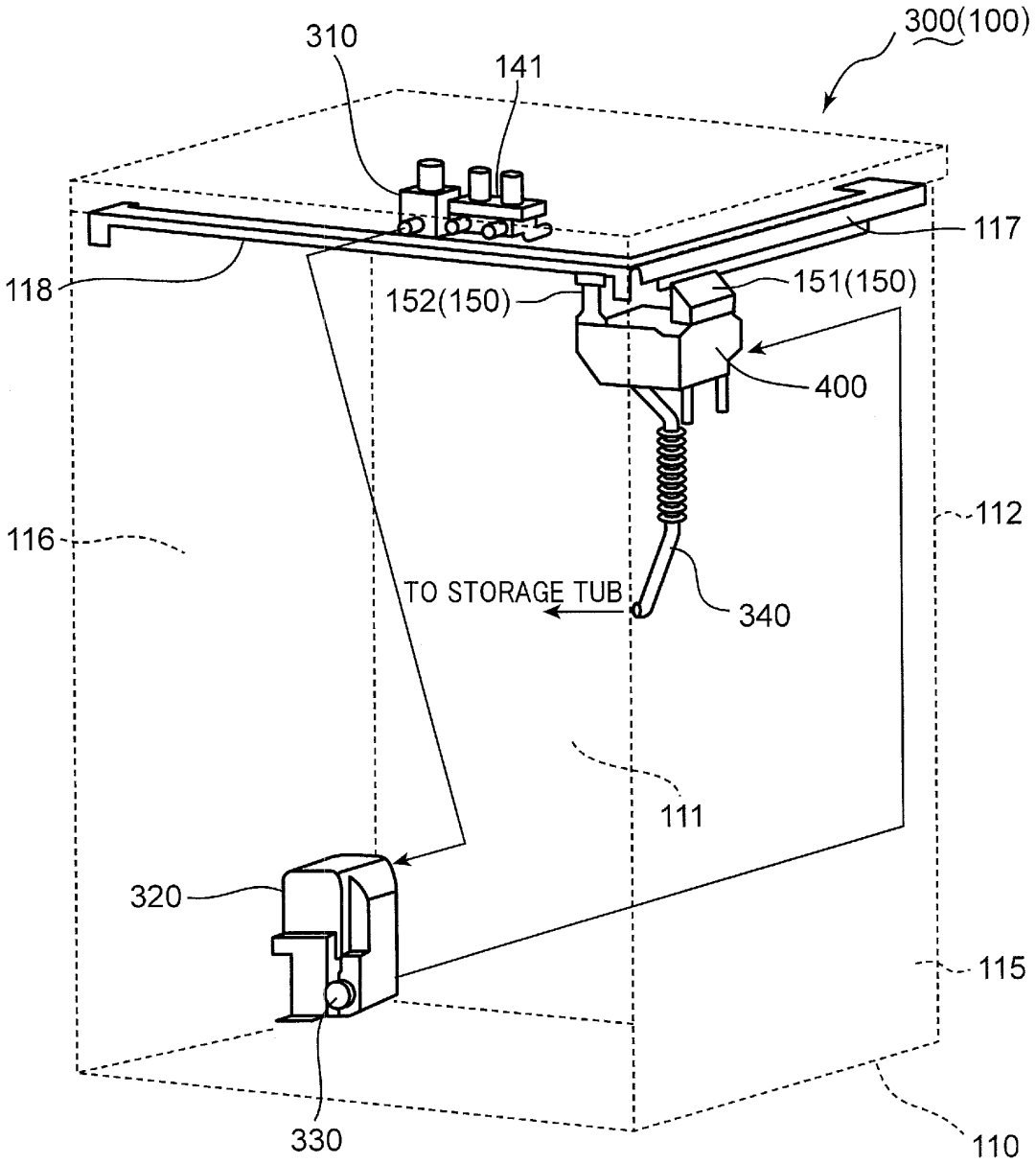
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FIG.4A

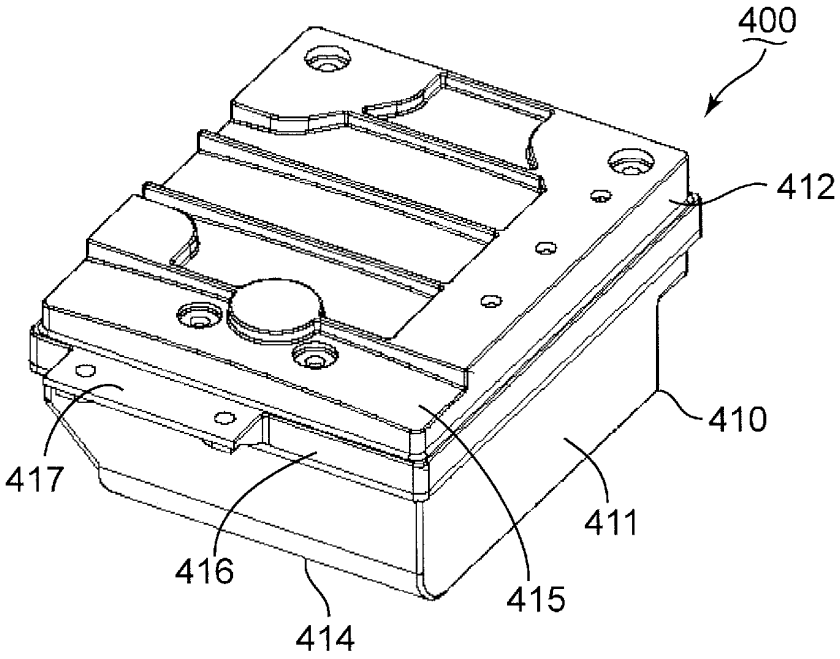
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FIG.4B

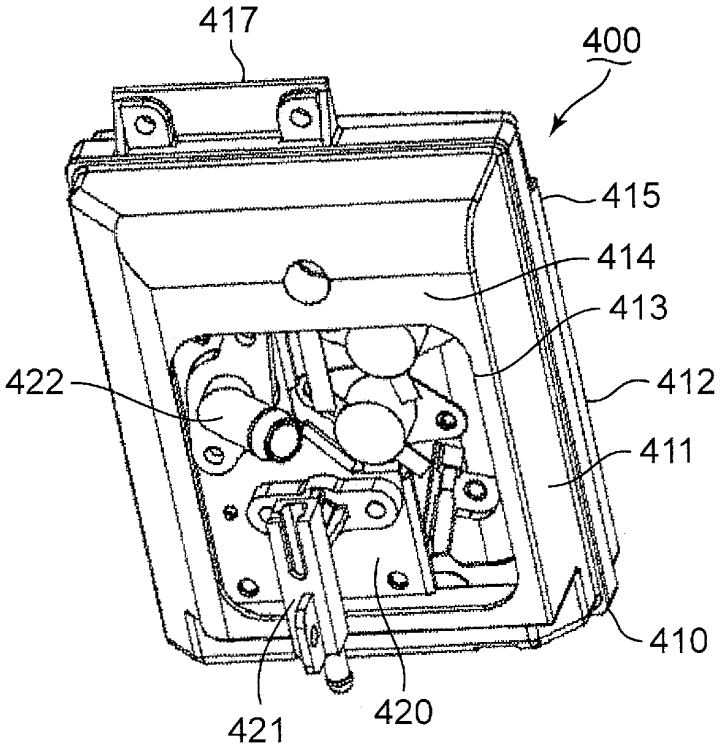
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FIG.5

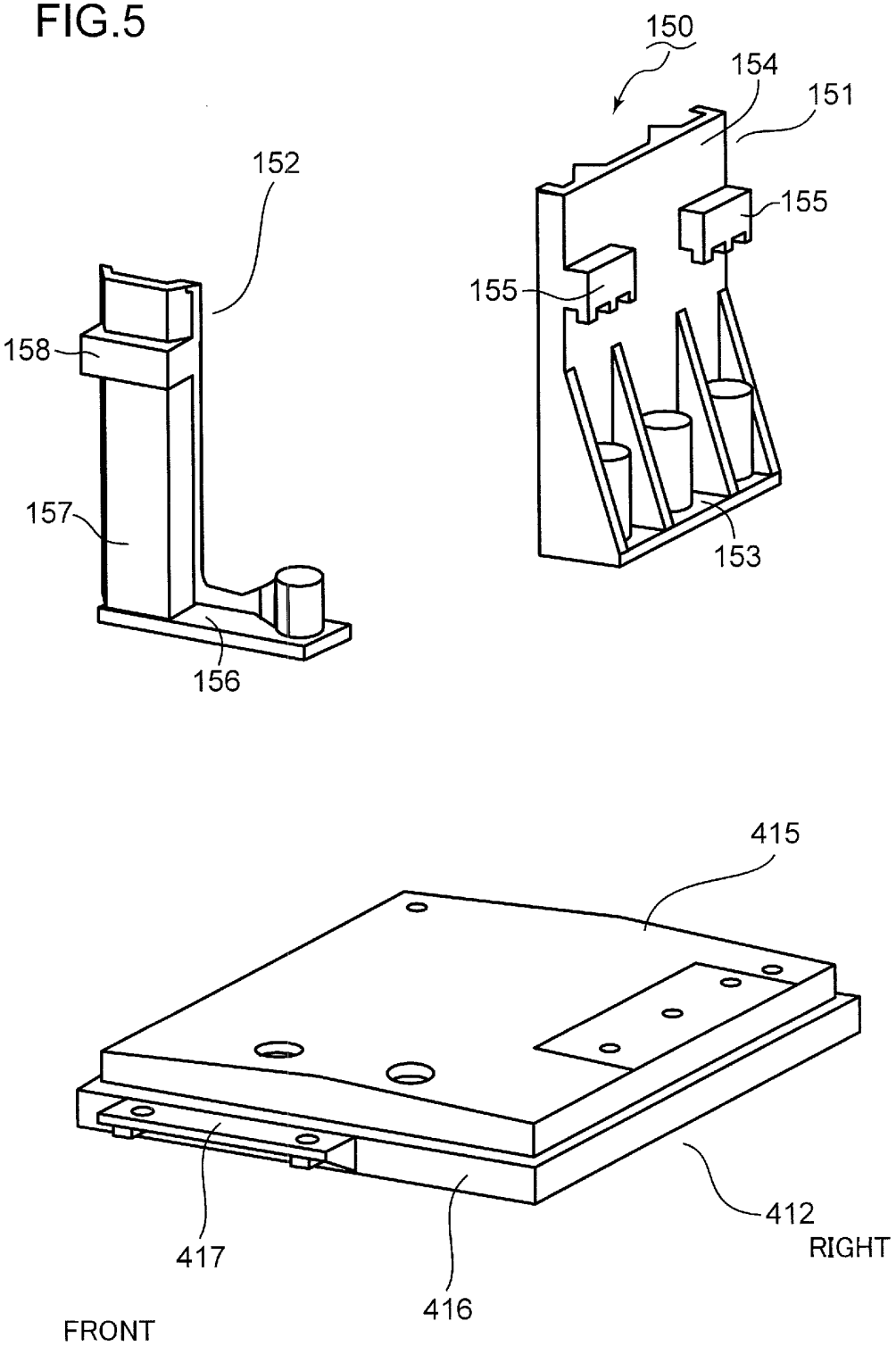
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FIG.6

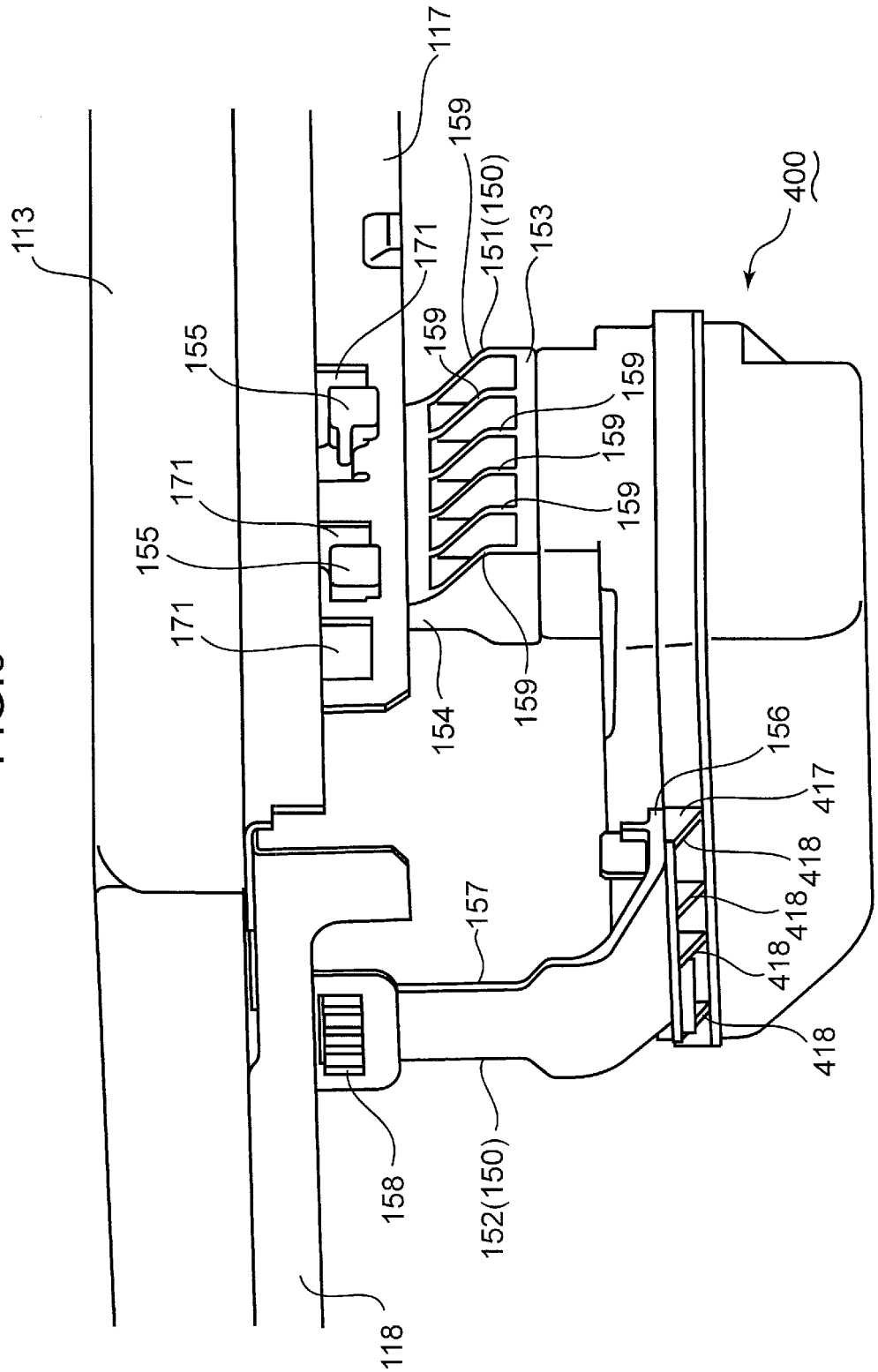
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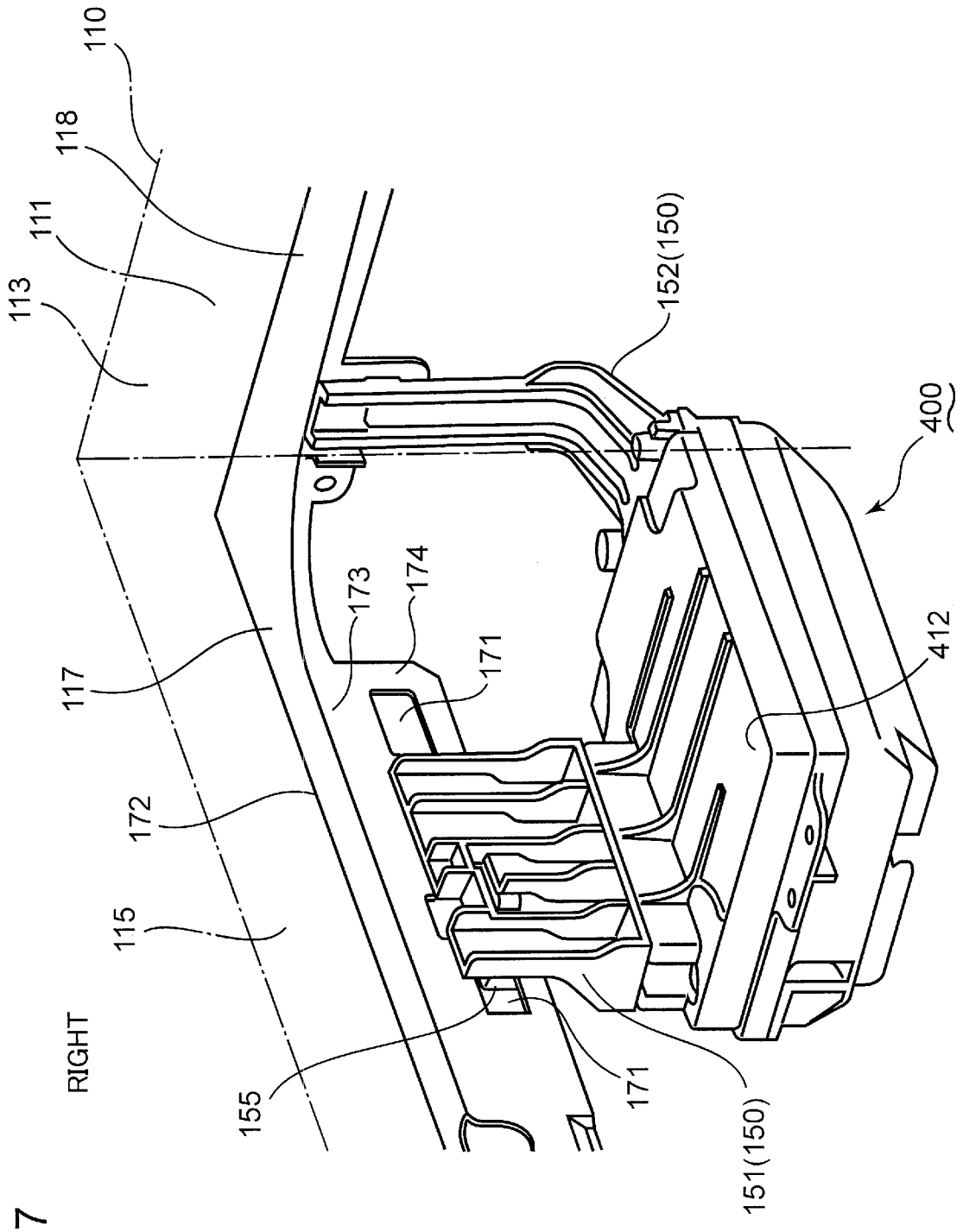
FIG.7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RIGHT
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171
151(150)

FIG.8A

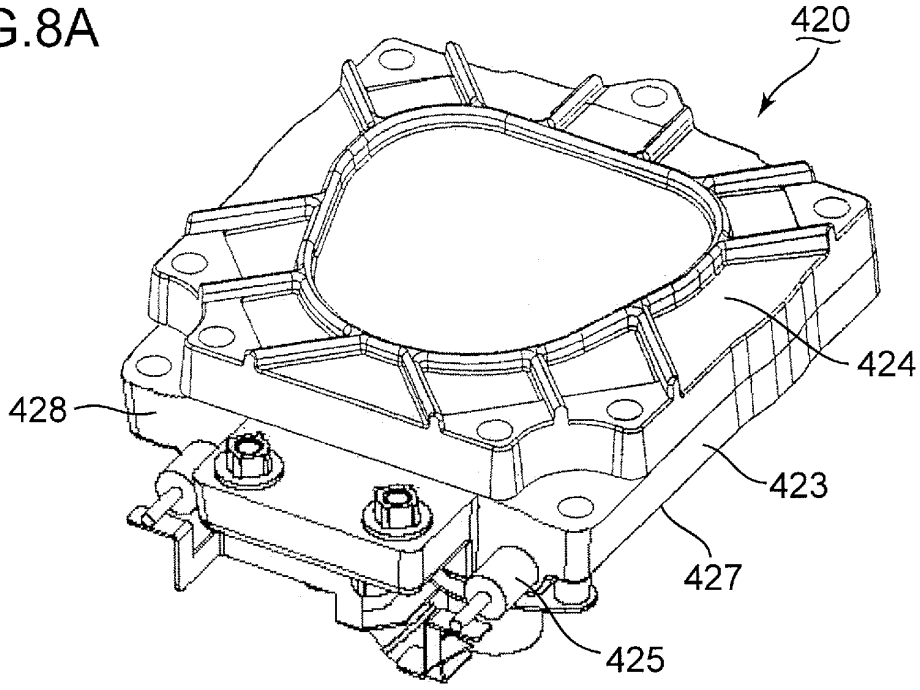



FIG.8B

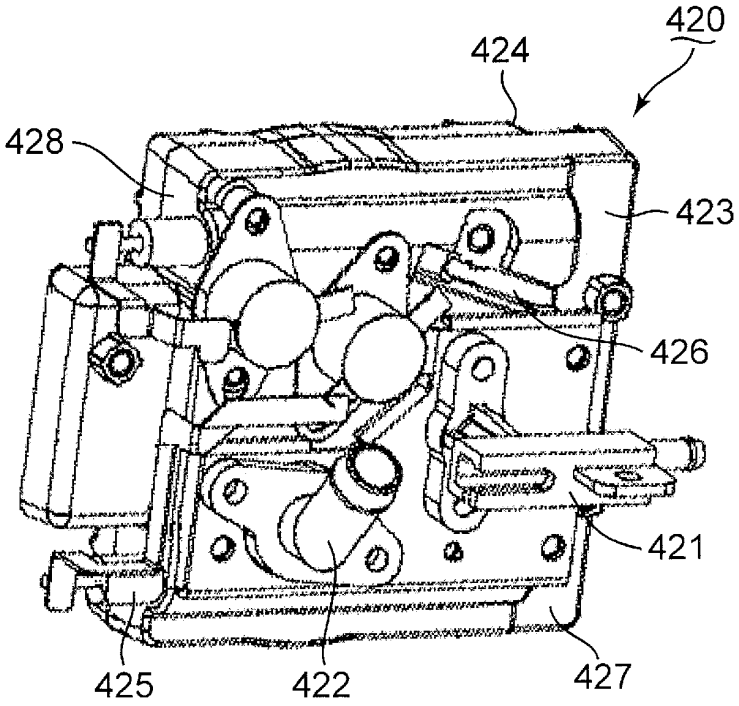


FIG.9

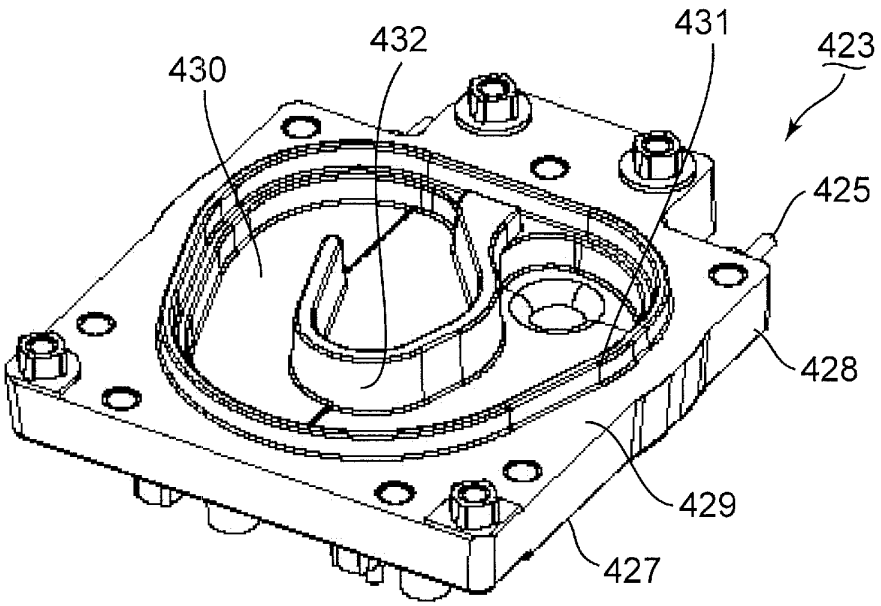


FIG.10

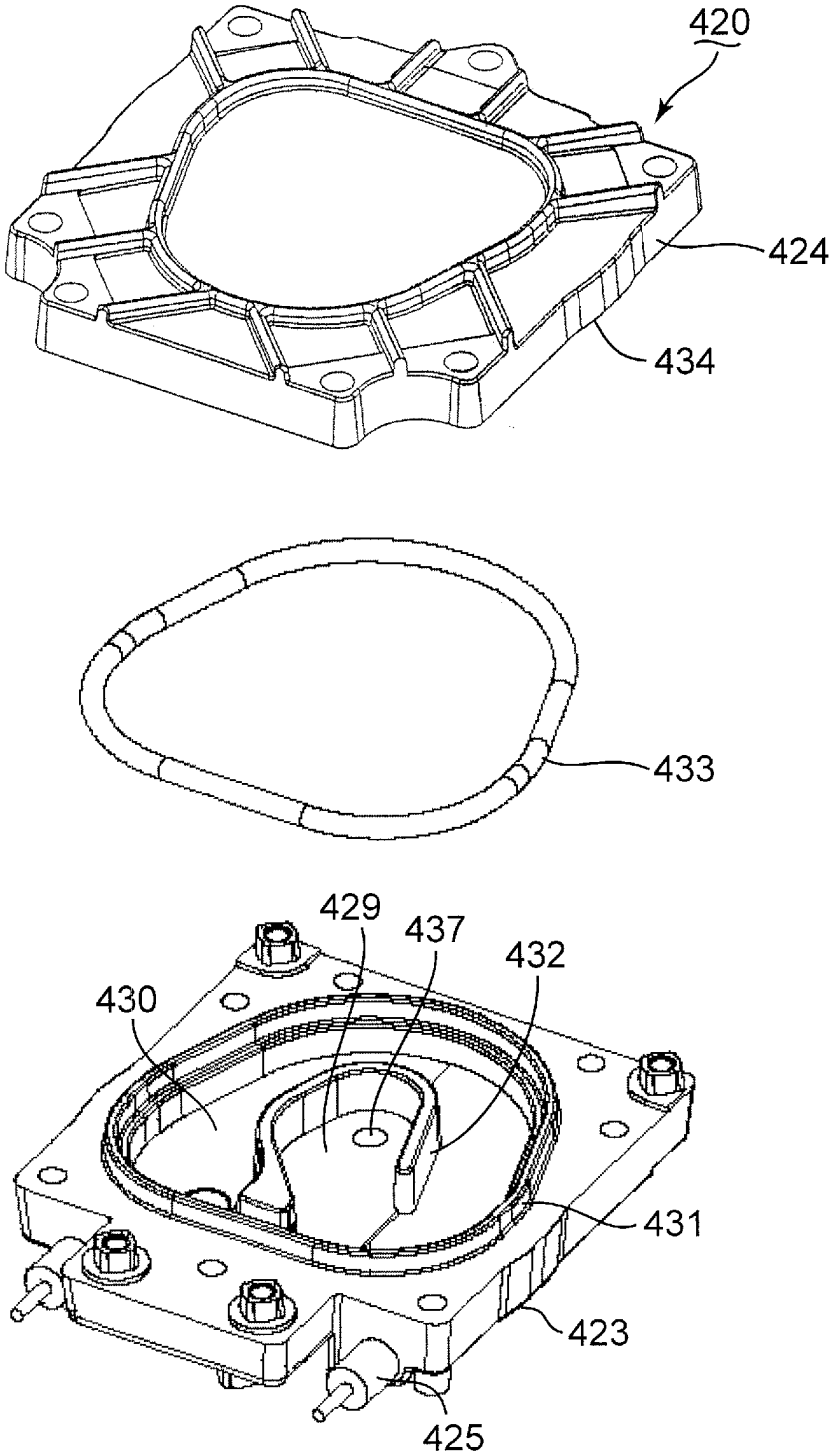


FIG.11

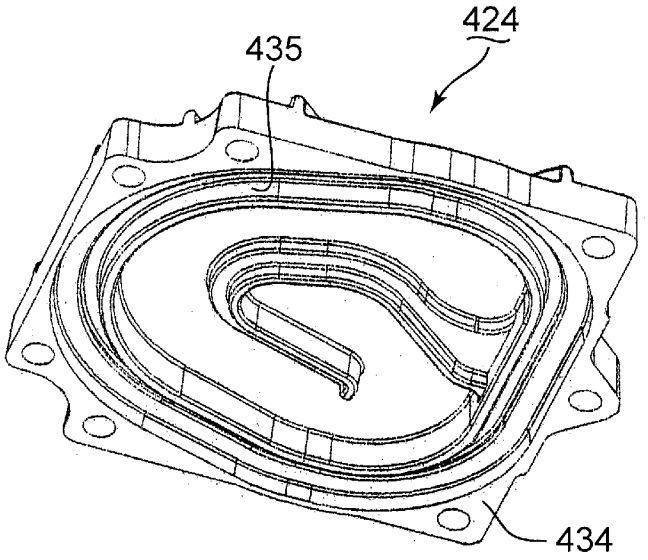



FIG.12

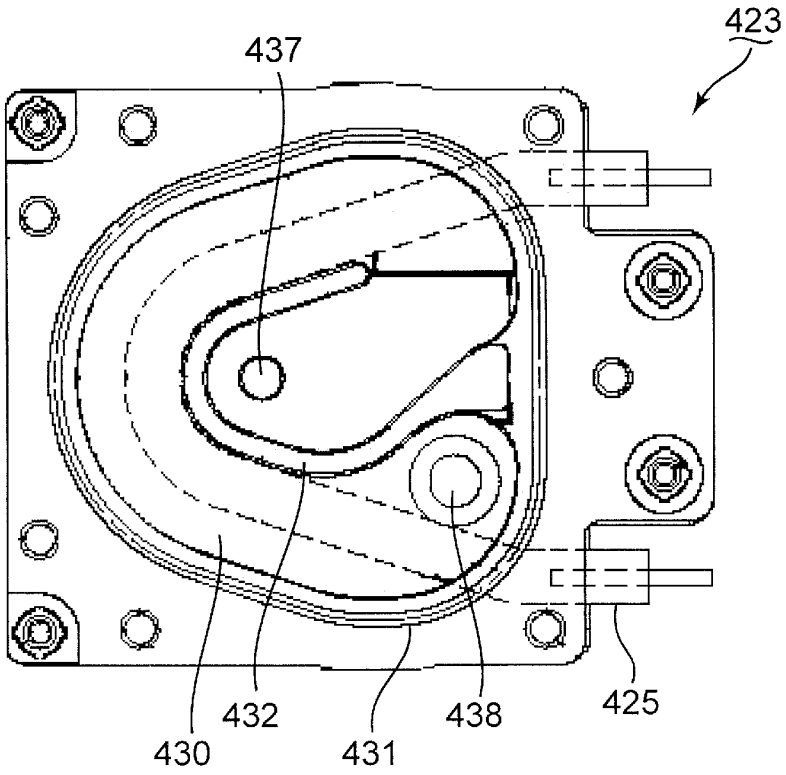


FIG.13

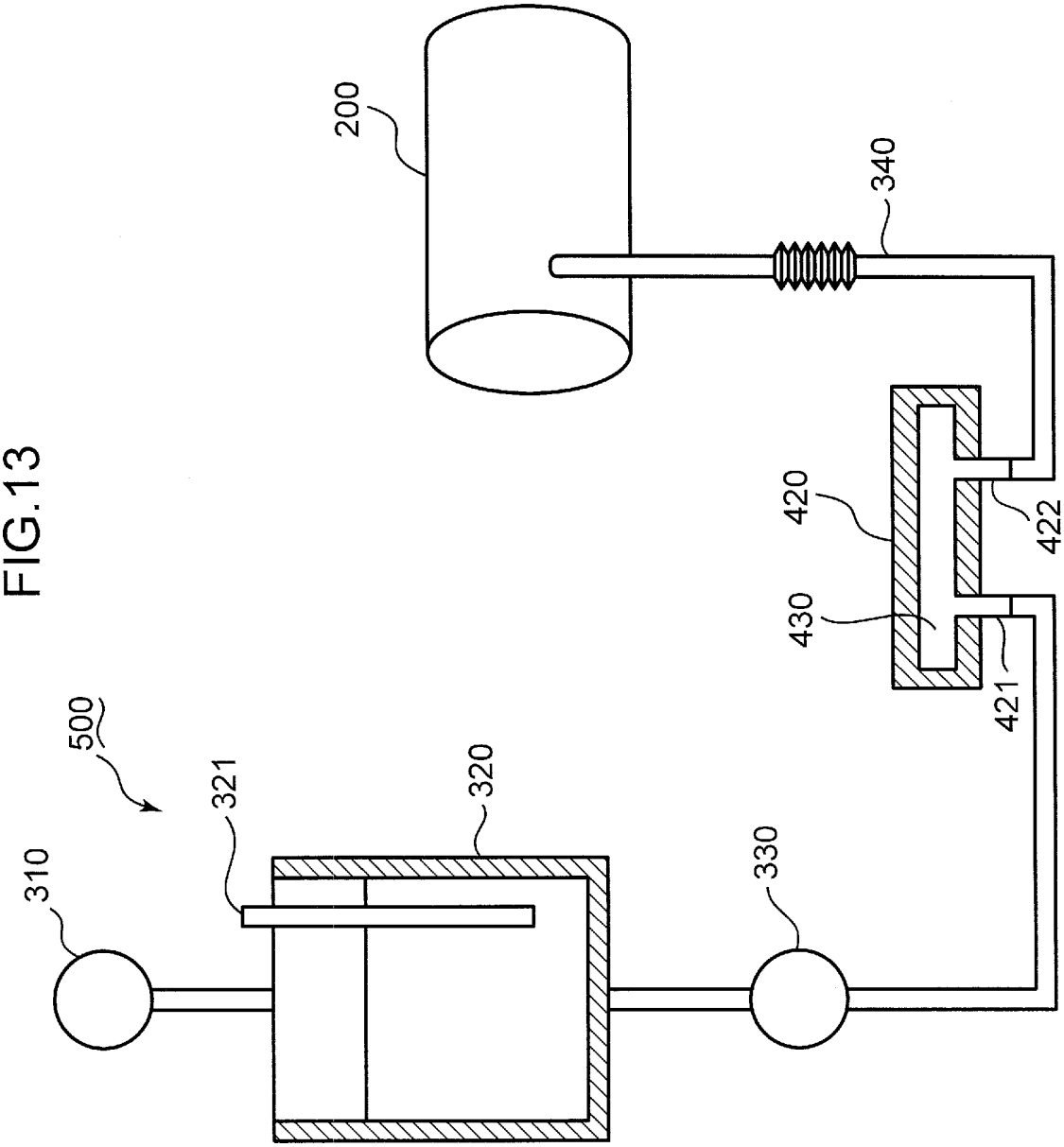


FIG.14

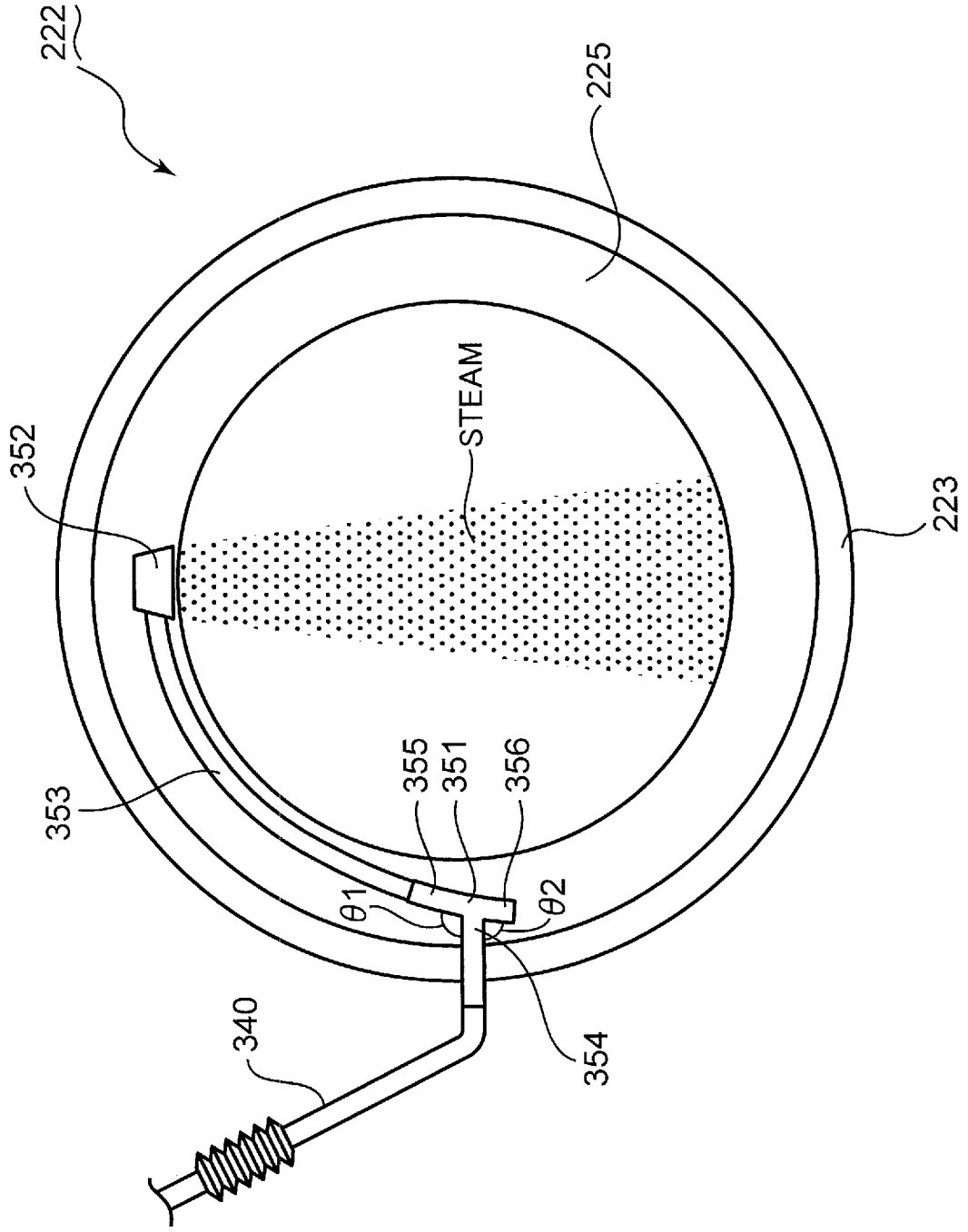


FIG. 15

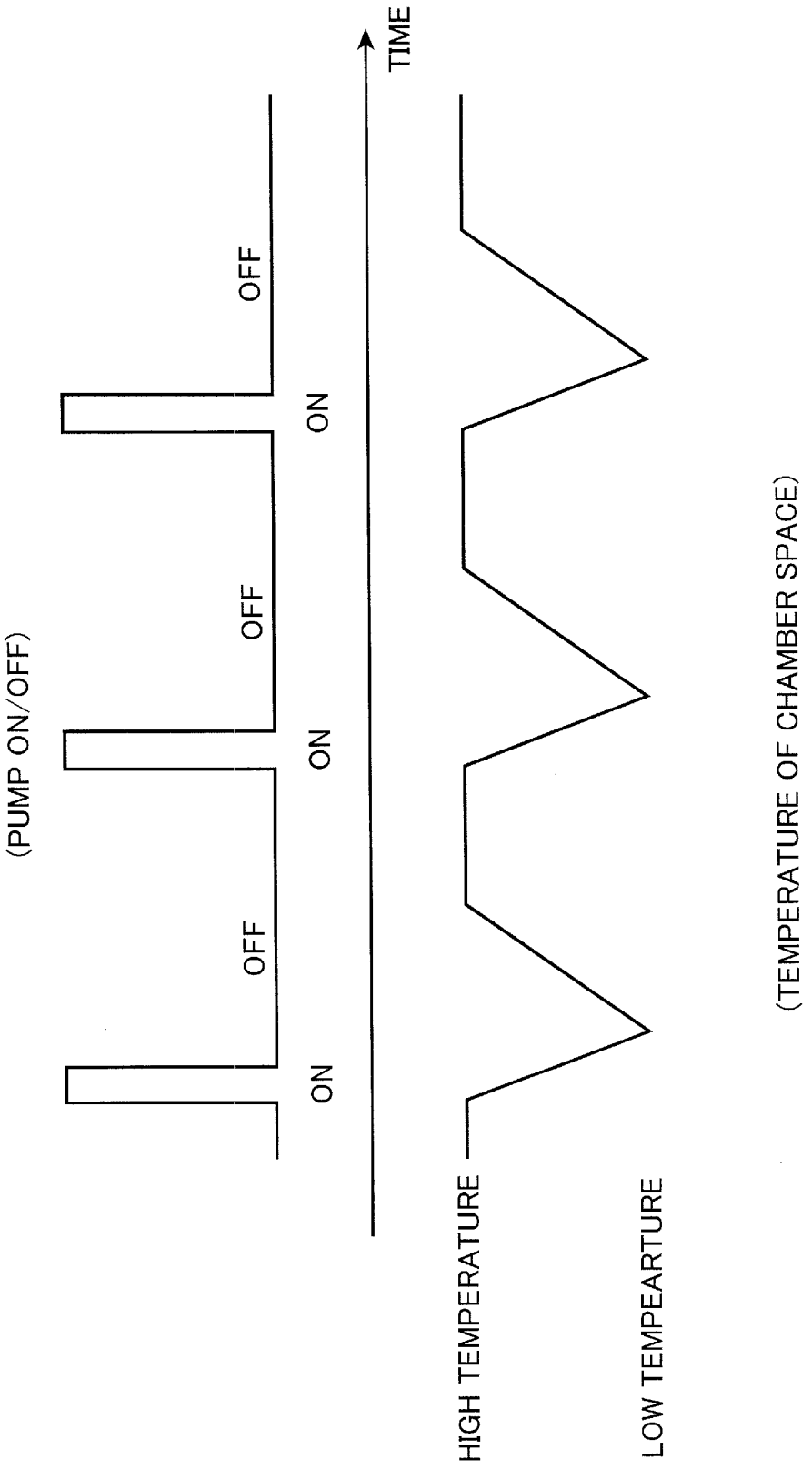

(PUMP ON/OFF)
ON
OFF
ON
OFF
ON
OFF
TIME
HIGH TEMPERATURE
LOW TEMPEARTURE
(TEMPERATURE OF CHAMBER SPACE)

FIG. 16

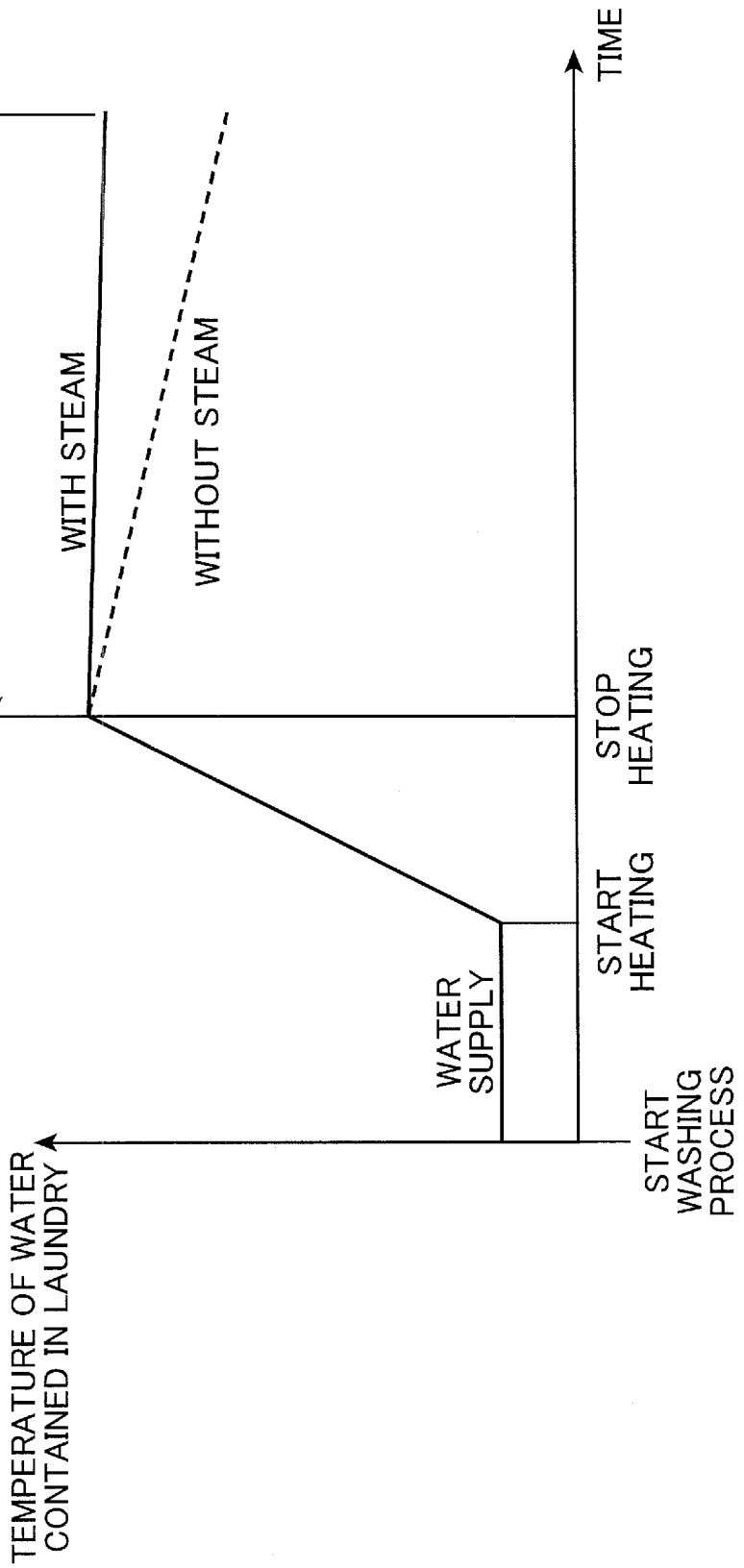

TIME
STEAM SUPPLY TIME
WITH STEAM
WITHOUT STEAM
STOP HEATING
START HEATING
WATER SUPPLY
START WASHING PROCESS
TEMPERATURE OF WATER CONTAINED IN LAUNDRY

FIG. 17A

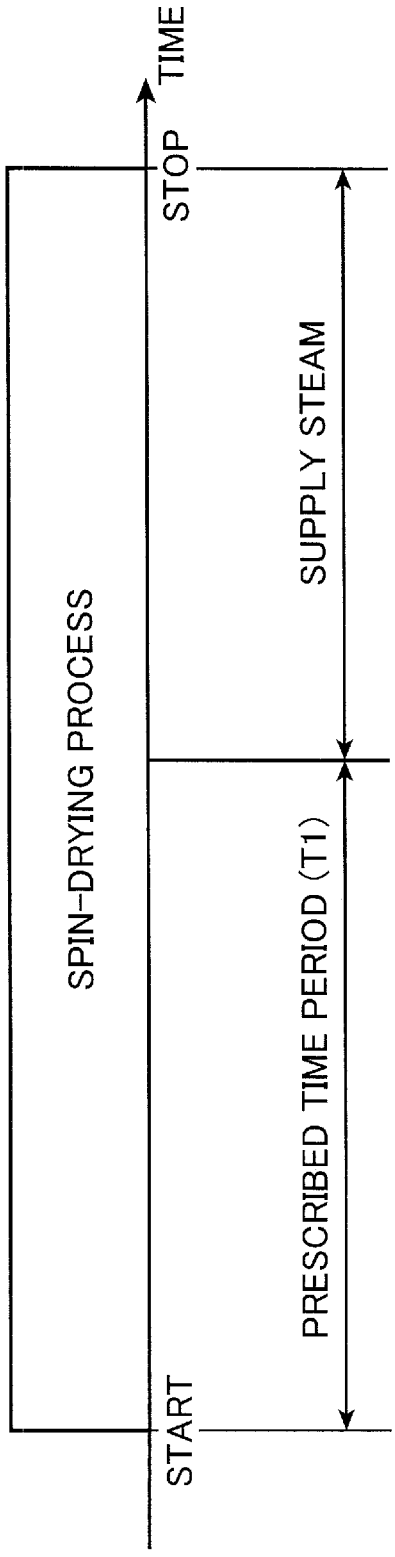

TIME
STOP
SUPPLY STEAM
SPIN-DRYING PROCESS
PRESCRIBED TIME PERIOD (T1)
START

FIG. 17B

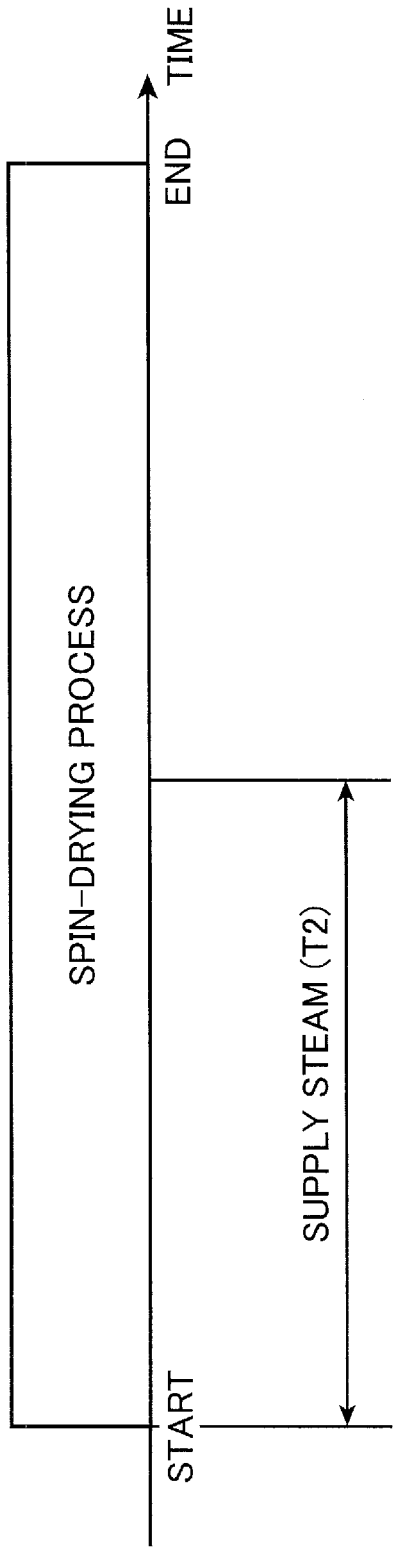


FIG. 17C

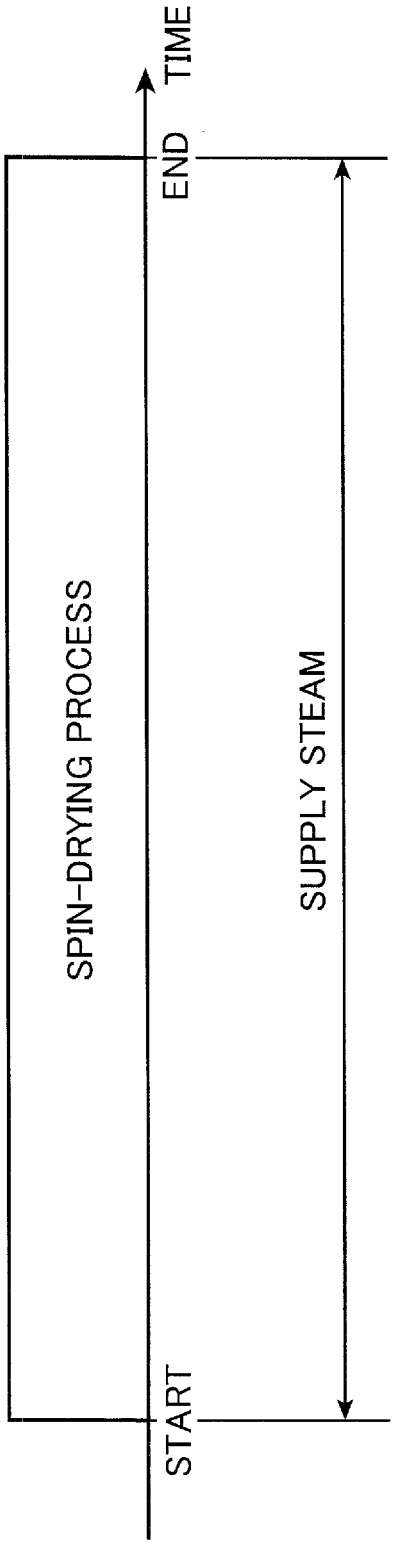


FIG. 18

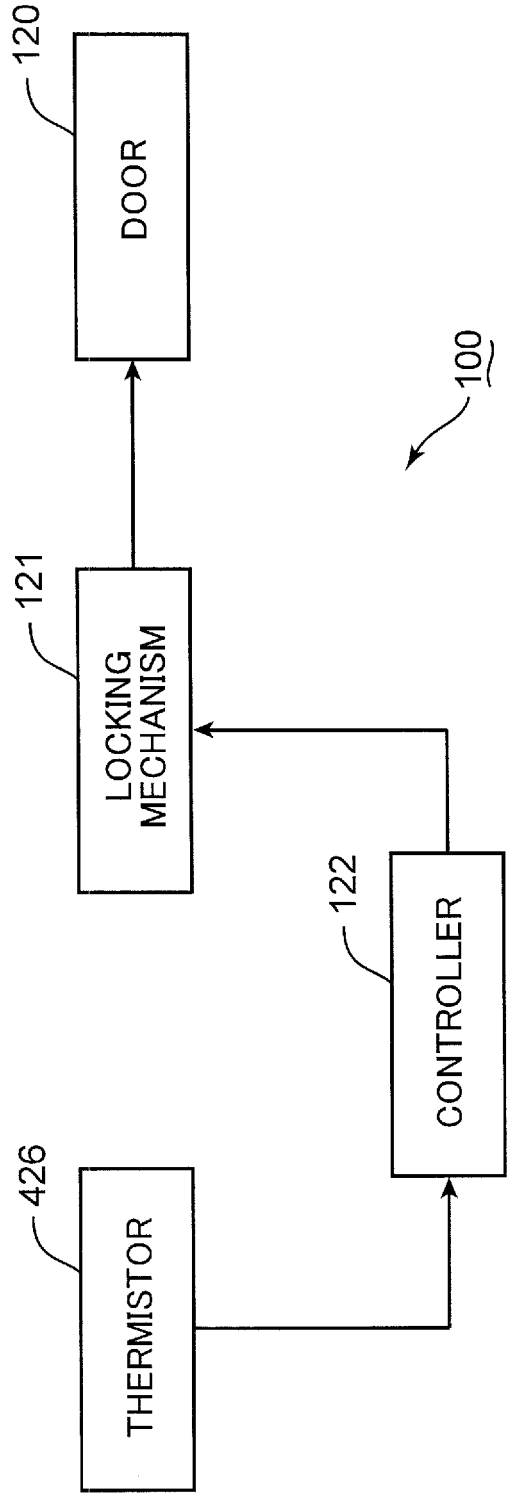

120
DOOR
100
121
LOCKING MECHANISM
122
CONTROLLER
426
THERMISTOR

FIG.19

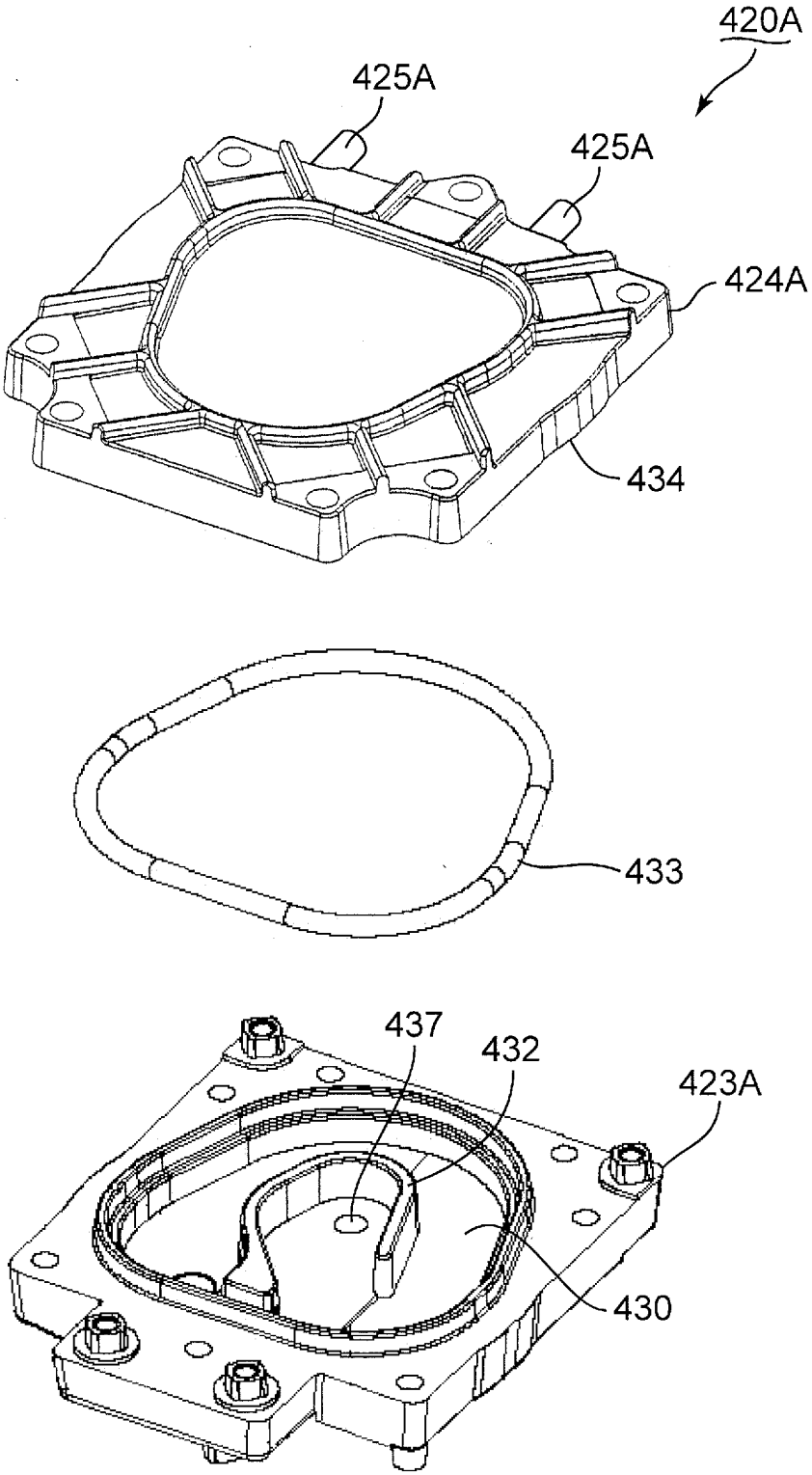
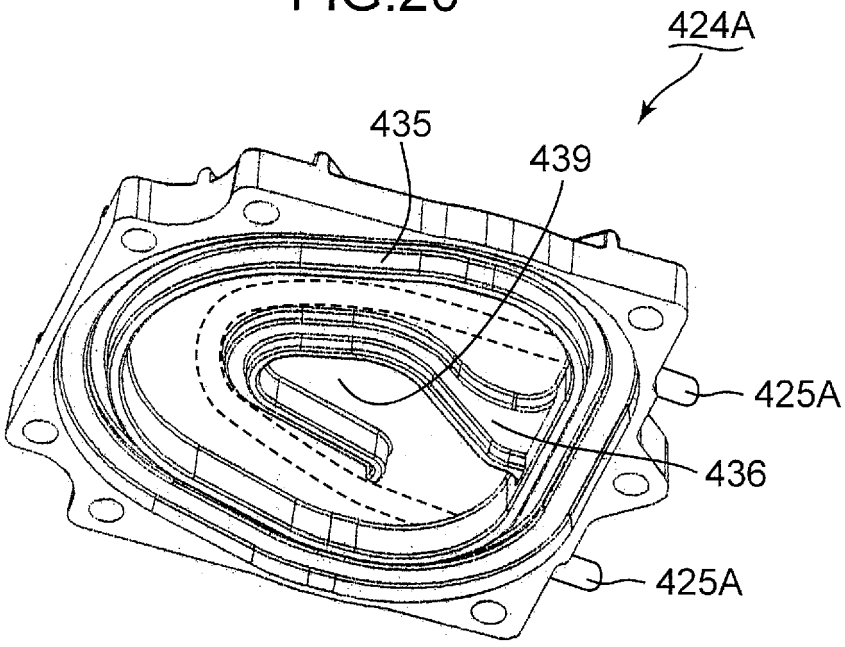


FIG.20



**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2013/003406

A. CLASSIFICATION OF SUBJECT MATTER
*D06F39/04*(2006.01)i, *D06F25/00*(2006.01)i, *D06F39/12*(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)
D06F39/04, D06F25/00, D06F39/12

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. |
|---|---|---|
| X<br>Y | JP 2011-092540 A (Sharp Corp.),<br>12 May 2011 (12.05.2011),<br>paragraphs [0033] to [0041]; fig. 1 to 3<br>& CN 102051794 A | 1-2<br>3-11 |
| Y | JP 2005-058741 A (LG Electronics Inc.),<br>10 March 2005 (10.03.2005),<br>paragraph [0011]; fig. 1 to 2<br>& US 2005/0034249 A1 & EP 1507032 A1<br>& KR 10-2005-0017490 A & CN 1580353 A | 3-11 |

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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 |
|---|---|
| 22 August, 2013 (22.08.13) | 03 September, 2013 (03.09.13) |
| Name and mailing address of the ISA/<br>Japanese Patent Office<br><br>Facsimile No. | Authorized officer<br><br>Telephone No. |

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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2013/003406

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP 2008-534049 A (LG Electronics Inc.), 28 August 2008 (28.08.2008), paragraph [0052]; fig. 7 to 9 & JP 4908494 B & US 2009/0077755 A1 & EP 1861533 A & WO 2006/101362 A1 & KR 10-2006-0102990 A & KR 10-2006-0102992 A & KR 10-2006-0102965 A & KR 10-2007-0002435 A & CN 1969077 A & AU 2006225475 A | 8-11 |
| Y | JP 2009-504307 A (LG Electronics Inc.), 05 February 2009 (05.02.2009), paragraph [0037] & JP 4880689 B & US 2008/0244922 A1 & EP 1915480 A & WO 2007/021134 A2 & KR 10-2007-0021615 A & CN 101258282 A & AU 2006280592 A & RU 2008110500 A & TWB 00I360597 | 11 |

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### Patent documents cited in the description


- WO 2006126778 A **[0005]**