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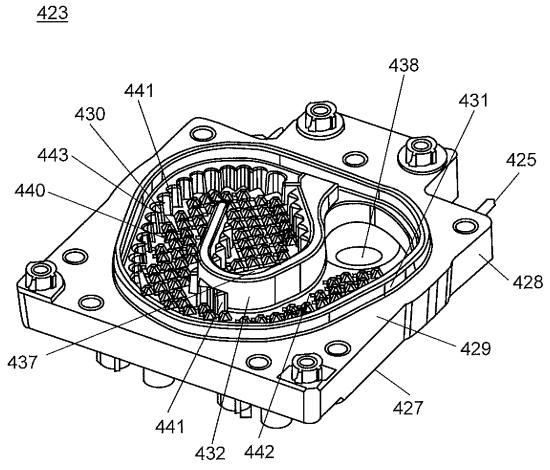
(54) **CLOTHES TREATMENT DEVICE**

(57) A clothes treatment device of the present invention includes: a housing tub for housing clothing; and a steam supply mechanism for supplying steam to the housing tub. The steam supply mechanism includes: a steam generator which has a wall surface defining a chamber for generating steam; a heater (425) which heats the wall surface; and a water supply mechanism which injects water to a wall surface. The water supply mechanism includes a connection tube connected to the steam generator, an inlet port (437) through which the water is injected into the steam generator; and a discharge port (438) through which the steam is discharged from the inside of the steam generator. An uneven-shape is formed on a wall surface of a steam flow passage from the inlet port (437) to the discharge port (438). Due to such a constitution, peel-off pieces of impurities generated in the steam flow passage are made small so that the peel-off pieces can be easily blown off by steam whereby clogging of the discharge port by impurities can be prevented.

FIG. 7



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Description

TECHNICAL FIELD

[0001] The present invention relates to a clothes treatment device which washes, spin-dries and/or dries clothing.

BACKGROUND ART

[0002] Recently, there has been developed a washing machine which sterilizes clothing by supplying steam to clothing efficiently (see patent literature 1, for example).

[0003] The washing machine described in patent literature 1 is configured such that steam is generated by a heater immersed in water and generated steam is efficiently supplied to a drum in which clothing is housed. However, in the washing machine described in patent literature 1, impurities (scales) contained in water are deposited in a steam flow passage from a water supply port to a discharge port in a chamber of a steam generator. Then, due to thermal contraction in the chamber, deposited impurities are peeled off so that peeled-off pieces of impurities are generated. At this point of time, there may be a case where peeled-off pieces having a size equal to or more than a discharge port diameter are generated. In this case, there may be a case that the discharge port of the steam generator is clogged by the peeled-off piece of impurities contained in water used for generating steam in the steam flow passage. As a result, the washing machine described in patent literature 1 has a drawback that steam cannot be efficiently supplied to the inside of the drum.

Citation List

Patent Literature

[0004] PTL 1: International Patent Publication No. 2006/126778

SUMMARY OF THE INVENTION

[0005] To overcome the above-mentioned drawback, a clothes treatment device of the present invention includes: a housing tub for housing clothing; and a steam supply mechanism for supplying steam to the housing tub. The steam supply mechanism includes: a water supply valve; and a steam generating part, wherein the steam generating part includes: a heater which heats a wall surface defining a chamber for generating steam; a water supply mechanism which injects water to the wall surface; an inlet port through which the water is injected into the chamber; and a discharge port through which the steam is discharged from the inside of the chamber. The steam supply mechanism is also configured such that an uneven-shape is formed on a wall surface of a steam flow passage from the inlet port to the discharge port.

[0006] Due to the above-mentioned constitution, although impurities (scales) are generated due to thermal contraction in the chamber when water supplied to the inside of the chamber is hard water, for example, a peeled-off piece of impurities can be made small. That is, when the steam flow passage is flat, a large impurity peel-off piece is liable to be formed. In view of the above, an uneven-shape is formed on the wall surface of the steam flow passage. Accordingly, impurities are made small or are divided into small pieces so that impurities are discharged from discharge port thus making impurities hardly clog the discharge port. As a result, it is possible to provide a clothes treatment device which can efficiently supply steam to the inside of a housing tub.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a schematic longitudinal cross-sectional view illustrating a washing machine exemplified as a clothes treatment device according to a first exemplary embodiment of the present invention.

FIG. 2 is a schematic perspective view illustrating the washing machine according to the exemplary embodiment with a part shown in a see-through manner.

FIG. 3 is a schematic perspective view illustrating a steam supply mechanism housed in a casing of the washing machine according to the exemplary embodiment.

FIG. 4A is a schematic perspective view showing a steam generating part of the steam supply mechanism according to the exemplary embodiment.

FIG. 4B is a schematic perspective view showing the steam generating part of the steam supply mechanism according to the exemplary embodiment.

FIG. 5A is a schematic perspective view illustrating the mounting structure for connecting a lid portion of the steam generating part and the casing to each other according to the exemplary embodiment.

FIG. 5B is a schematic perspective view illustrating the mounting structure for connecting a lid portion of the steam generating part and the casing to each other according to the exemplary embodiment.

FIG. 6A is a schematic perspective view illustrating a steam generator in the steam generating part according to the exemplary embodiment.

FIG. 6B is a schematic perspective view illustrating the steam generator in the steam generating part according to the exemplary embodiment.

FIG. 7 is a schematic perspective view illustrating a body portion of the steam generator according to the exemplary embodiment.

FIG. 8 is a schematic developed perspective view illustrating the steam generator according to the exemplary embodiment.

FIG. 9 is a schematic perspective view illustrating a

lid portion of the steam generator according to the exemplary embodiment.

FIG. 10 is a schematic plan view illustrating the body portion of the steam generator according to the exemplary embodiment.

FIG. 11 is a schematic view illustrating a water supply mechanism of the steam supply mechanism according to the exemplary embodiment.

FIG. 12 is a schematic back view illustrating a front portion of a housing tub of the washing machine according to the exemplary embodiment.

FIG. 13 is an explanatory view schematically showing the relationship between an intermittent operation of a pump of the water supply mechanism and a temperature in the inside of a chamber space according to the exemplary embodiment.

FIG. 14 is an explanatory view schematically showing a change in the temperature of water supplied to a water tub of the washing machine according to the exemplary embodiment.

FIG. 15A is a schematic timing chart expressing timing of supplying steam during spin-drying step according to the exemplary embodiment.

FIG. 15B is a schematic timing chart expressing timing of supplying steam during spin-drying step according to the exemplary embodiment.

FIG. 15C is a schematic timing chart expressing timing of supplying steam during spin-drying step according to the exemplary embodiment.

FIG. 16 is a block diagram schematically showing a control of a door body based on the temperature of the steam generator according to the exemplary embodiment.

FIG. 17 is a schematic developed perspective view illustrating a steam generator used in a washing machine exemplified as a clothes treatment device according to a second exemplary embodiment of the present invention.

FIG. 18 is a schematic perspective view illustrating the steam generator according to the exemplary embodiment.

DESCRIPTION OF EMBODIMENTS

[0008] Hereinafter, a clothes treatment device according to an exemplary embodiment of the present invention is described with reference to drawings. The present invention is not limited by the exemplary embodiment. Hereinafter, the description is made by taking a washing machine as an example of a clothes treatment device. Further, terms indicating the directions used in the description made hereinafter such as "upward", "downward", "leftward" and "rightward" are used merely for the clarification of the description and do not limit the principle of the clothes treatment device in any way. Further, the principle of the clothes treatment device is also applicable to a device which has an ability of washing and drying clothing and a device which dries clothing.

(FIRST EXEMPLARY EMBODIMENT)

<Constitution of washing machine>

[0009] Hereinafter, the constitution of a washing machine according to an exemplary embodiment of the present invention is described with reference to FIG. 1.

[0010] FIG. 1 is a schematic longitudinal cross-sectional view illustrating a washing machine exemplified as a clothes treatment device according to a first exemplary embodiment of the present invention.

[0011] As shown in FIG. 1, washing machine 100 of this exemplary embodiment includes at least: casing 110; and housing tub 200 for housing clothing in the inside of casing 110. Housing tub 200 includes rotary drum 210 having peripheral wall 211 which surrounds axis of rotation RX and has an approximately circular cylindrical shape (including a circular cylindrical shape), and water tub 220 which houses rotary drum 210.

[0012] Casing 110 is constituted of: front wall 111 in which a put-in opening through which clothing is put into housing tub 200 is formed; rear wall 112 disposed on a side opposite to front wall 111; casing ceiling wall 113 which extends approximately horizontally (including horizontally); casing bottom wall 114 disposed on a side opposite to casing ceiling wall 113; a left wall and a right wall described later and the like. In such structure, rotary drum 210 and water tub 220 of housing tub 200 are opened toward front wall 111.

[0013] Washing machine 100 further includes door body 120 mounted on front wall 111 of casing 110. Door body 120 is rotatable between a closed position where door body 120 closes the put-in opening formed in front wall 111 and an open position where door body 120 opens the put-in opening. Due to such a constitution, a user can put clothing into housing tub 200 through the put-in opening formed in front wall 111 after rotating door body 120 to the open position. Thereafter, the user moves door body 120 to the closed position, and the washing machine 100 washes the clothing already put into washing machine 100. FIG. 1 shows a state where door body 120 is at the closed position.

[0014] Rotary drum 210 includes peripheral wall 211 and bottom wall 212, and is rotated about axis of rotation RX which extends between front wall 111 and rear wall 112 of casing 110. Clothing put into housing tub 200 moves in the inside of rotary drum 210 along with the rotation of rotary drum 210. Due to such an operation, clothing is subjected to various processing such as washing processing, rinsing processing and/or spin-drying processing. Bottom wall 212 of rotary drum 210 is disposed in a state where the bottom wall 212 faces door body 120 at the closed position.

[0015] Water tub 220 is constituted of at least bottom portion 221, and front portion 222. Bottom portion 221 surrounds bottom wall 212 and a portion of peripheral wall 211 of rotary drum 210. Front portion 222 is disposed between bottom portion 221 of water tub 220 and door

body 120, and surrounds a remaining portion of peripheral wall 211 of rotary drum 210 which front portion 222 faces.

[0016] Housing tub 200 includes rotary shaft 230 mounted on bottom wall 212 of rotary drum 210, and extends toward rear wall 112 of casing 110 along axis of rotation RX. Accordingly, rotary shaft 230 is provided such that rotary shaft 230 penetrates bottom portion 221 of water tub 220 and projects into a space formed between water tub 220 and rear wall 112.

[0017] Washing machine 100 includes motor 231 mounted on a lower side of water tub 220, pulley 232 mounted on rotary shaft 230 exposed to the outside of water tub 220, and belt 233 which transmits power of motor 231 to pulley 232. Further, when motor 231 is operated, power of motor 231 is transmitted to rotary shaft 230 by way of belt 233 and pulley 232. As a result, rotary drum 210 rotates in the inside of water tub 220.

[0018] Washing machine 100 further includes packing structure 130 disposed between front portion 222 of water tub 220 and door body 120. When door body 120 is rotated to the closed position, packing structure 130 is compressed by door body 120. As a result, due to compressed packing structure 130, the watertight sealing structure is formed between door body 120 and front portion 222.

[0019] Washing machine 100 includes water supply port 140 connected to a faucet (not shown in the drawing), and distribution part 141 for distributing water introduced into washing machine 100 through water supply port 140. Water supply port 140 is formed in a state where water supply port 140 projects upward from casing ceiling wall 113, and distribution part 141 is disposed between casing ceiling wall 113 and housing tub 200.

[0020] As shown in FIG. 1, washing machine 100 includes a detergent housing part (not shown in the drawing) in which a detergent is housed, and steam supply mechanism 300 which injects steam to housing tub 200 (described later). Distribution part 141 includes a plurality of water supply valves for selectively supplying water to housing tub 200, detergent housing part and steam supply mechanism 300 through water supply passages (not shown in the drawing). It is needless to say that known techniques applied to washing machines are applicable to the supply of water to housing tub 200 and the detergent housing part.

<Constitution of steam supply mechanism>

[0021] Hereinafter, the constitution of the steam supply mechanism of the washing machine according to the exemplary embodiment of the present invention is described using FIG. 2 and FIG. 3 with reference to FIG. 1.

[0022] FIG. 2 is a schematic perspective view illustrating the washing machine according to the exemplary embodiment with a part shown in a see-through manner. FIG. 3 is a schematic perspective view illustrating the steam supply mechanism housed in the casing of the washing machine according to the exemplary embodiment. Casing 110 is indicated by a dotted line in FIG. 2 and FIG. 3, and housing tub 200 is not shown in FIG. 3. An arrow in FIG. 3 schematically shows the water supply passages which connect the respective parts to each other.

[0023] As shown in FIG. 2 and FIG. 3, steam supply mechanism 300 includes at least water supply valve 310 used as a part of distribution part 141, and water storage tank 320 disposed below housing tub 200. Water supply valve 310 controls the supply of water to water storage tank 320. That is, when water supply valve 310 is opened, water is supplied to water storage tank 320 from water supply port 140. When water supply valve 310 is closed, the supply of water to water storage tank 320 is stopped.

[0024] Steam supply mechanism 300 further includes pump 330 mounted on water storage tank 320, and steam generating part 400 which receives water discharged from pump 330. Pump 330 performs an operation to supply water to steam generating part 400 intermittently or continuously. During an intermittent water supply operation, pump 330 supplies a proper amount of water which is adjusted such that steam is generated instantaneously to steam generating part 400 described later. On the other hand, when water is continuously supplied to steam generating part 400 by pump 330, it is possible to wash away an impurity (scale) or the like contained in water used for steam generation from steam generating part 400.

[0025] As shown in FIG. 2, steam supply mechanism 300 further includes steam communication tube 340 which extends downward from steam generating part 400. As described above with reference to FIG. 1, front portion 222 of water tub 220 includes peripheral wall portion 223 which surrounds peripheral wall 211 of rotary drum 210, and annular portion 224 shown in FIG. 2 which forms the watertight sealing structure in cooperation with packing structure 130. Steam communication tube 340 of steam supply mechanism 300 is connected to peripheral wall portion 223 of front portion 222. Due to such a constitution, steam generated in steam generating part 400 is supplied to housing tub 200 through steam communication tube 340. It is preferable that steam communication tube 340 be formed such that at least a portion of steam communication tube 340 is formed into a bellows shape, for example, so as to prevent vibrations generated by the rotation of housing tub 200 from being transmitted to steam generating part 400.

[0026] As described above, according to steam supply mechanism 300 of this exemplary embodiment, it is possible to forcibly supply water to steam generator 420 disposed in the inside of steam generating part 400 from water storage tank 320 by pump 330. Accordingly, steam generator 420 can be disposed above water storage tank 320. On the other hand, when the supply of water to steam generator 420 from water storage tank 320 is performed without providing pump 330, it is necessary to feed water in water storage tank 320 to steam generator

420 by the action of gravity. Accordingly, it is always necessary to dispose steam generator 420 below water storage tank 320. That is, by disposing pump 330, water can be forcibly supplied to steam generator 420 from water storage tank 320 by making use of pressure generated by pump 330. Accordingly, the restriction imposed on the relationship in the vertical direction between steam generator 420 and water storage tank 320 in diposing steam generator 420 and water storage tank 320 can be eliminated. As a result, the degree of freedom in the arrangement of water storage tank 320 and steam generator 420 is increased and hence, the space defined in the inside of casing 110 can be effectively utilized.

[0027] Although steam generator 420 is disposed above water storage tank 320 as shown in FIG. 2, water can be supplied to steam generator 420 from water storage tank 320 by pump 330 without causing any problems.

[0028] When water flows into steam generator 420 inadvertently due to a factor such as an unexpected failure, steam more than necessary is generated. However, by disposing pump 330 as in the case of this exemplary embodiment, water storage tank 320 can be disposed below steam generator 420. Accordingly, even when pump 330 stops due to a trouble such as a failure so that the supply of water to steam generator 420 cannot be controlled, there is no possibility that water stagnating in a hose which makes water storage tank 320, pump 330 and steam generator 420 communicate with each other flows into steam generator 420 inadvertently. As a result, the generation of steam more than necessary can be prevented in advance.

[0029] On the other hand, in the constitution where pump 330 is not provided, it is always necessary to dispose steam generator 420 below water storage tank 320. Accordingly, when a failure occurs in a control part such as an open/close valve for controlling the supply of water to steam generator 420 from water storage tank 320, for example, the supply of water to steam generator 420 cannot be controlled. Further, water is inadvertently supplied to steam generator 420 from water storage tank 320 disposed above steam generator 420 due to the action of gravity. However, by disposing pump 330 as in the case of this exemplary embodiment, it is possible to previously prevent the occurrence of the case where water is inadvertently supplied from steam generator 420 disposed above water storage tank 320.

[0030] In this exemplary embodiment, as shown in FIG. 2, steam generator 420 of steam generating part 400 is disposed above housing tub 200. Usually, an impurity contained in water supplied to steam generator 420 adheres to or precipitates on a wall surface of chamber space 430 (also referred to as "chamber") which is defined by outer chamber wall 431, inner chamber wall 432 and upper surface 429 of body portion 423, and lower surface 434 of lid portion 424 which constitute steam generator 420 shown in FIG. 8 described later at the time of evaporating water. Then, because of such adhesion or precipitation of the impurity, the impurity is deposited on the wall surface which defines chamber space 430. In this case, the heat transfer between the wall surface of chamber space 430 and supplied water is not performed properly due to the impurity and hence, water supplied to steam generator 420 is difficult to be evaporated.

[0031] However, by disposing steam generator 420 above housing tub 200, an impurity which adheres to or precipitates on the wall surface is discharged or falls below steam generator 420 due to a pressure or the action of gravity at the time of evaporating water. Accordingly, an impurity can be easily discharged to housing tub 200 from the inside of chamber space 430. As a result, it is possible to prevent the deposition of an impurity which adheres to or precipitates on the wall surface of chamber space 430 of steam generator 420. Further, the lowering of an ability of evaporating water caused by the deposition of an impurity can be prevented in advance.

[0032] Further, in this exemplary embodiment, as shown in FIG. 2, as viewed from front wall 111 of casing 110, water storage tank 320 is disposed in a left lower space of casing 110, and steam generator 420 is disposed in a right upper space of casing 110. That is, steam generator 420 and water storage tank 320 are respectively disposed at approximately symmetrical positions (including completely symmetrical positions) with respect to the center axis of housing tub 200 (axis of rotation RX).

[0033] In the case of a general washing machine, a detergent housing part (not shown in the drawing) which houses a detergent is disposed on either one of a left side and a right side of an upper front portion of casing 110. Accordingly, a space defined by housing tub 200 having approximately circular cylindrical shape (including a circular cylindrical shape) excluding a position occupied by the detergent housing part and casing 110 can be effectively used as a space for disposing water storage tank 320 and steam generator 420 respectively. For example, in the case where the detergent housing part is disposed on a left side of the upper front portion of casing 110, as shown in FIG. 2, water storage tank 320 is disposed on a rear side of the left lower portion of casing 110. In this case, when steam generator 420 is disposed on a front side of the right upper portion of casing 110, a space defined between an inner surface of casing 110 having an approximately rectangular box shape (including a rectangular box shape) and an outer peripheral surface of housing tub 200 can be effectively used for disposing water storage tank 320 and steam generator 420. As a result, a design size of water storage tank 320 and a design size of steam generator 420 can be set to values which allow housing of water storage tank 320 and steam generator 420 having maximally large sizes in the space defined in washing machine 100.

[0034] In the case where the detergent housing part is at the position described above, water storage tank 320 may be disposed at a position approximately symmetrical with the detergent housing part with respect to the center axis of housing tub 200 (axis of rotation RX), and steam generator 420 may be disposed at a position approxi-

mately symmetrical with water storage tank 320 with respect to horizontal plane HP including axis of rotation RX of housing tub 200. Also in this case, the space formed in the inside of casing 110 can be effectively used in the same manner as described above.

[0035] In the case where the detergent housing part is at the position described above, water storage tank 320 may be disposed below the detergent housing part, and steam generator 420 may be disposed above water storage tank 320. In this case, steam generator 420 may be disposed at a position approximately symmetrical with water storage tank 320 with respect to a vertical plane including axis of rotation RX of housing tub 200. As a result, the space formed in the inside of casing 110 can be effectively used in the same manner as described above.

[0036] In the case where axis of rotation RX of housing tub 200 is inclined in the longitudinal direction of casing 110 (for example, in the case where axis of rotation RX of rotary drum 210 is inclined upward from rear wall 112 to front wall 111), water storage tank 320 and steam generator 420 may be disposed at approximately symmetrical positions with respect to axis of rotation RX of housing tub 200 or with respect to horizontal plane HP including axis of rotation RX. For example, water storage tank 320 and steam generator 420 are disposed at approximately symmetrical positions with respect to a vertical plane passing through the approximately center (including the center) in the longitudinal direction of casing 110. Due to such an arrangement, a space defined between the inner surface of casing 110 and the outer peripheral surface of housing tub 200 can be effectively used for disposing water storage tank 320 and steam generator 420.

[0037] Next, the constitution of steam generating part 400 of steam supply mechanism 300 is described using FIG. 4A and FIG. 4B with reference to FIG. 3.

[0038] FIG. 4A and FIG. 4B are schematic perspective views showing the steam generating part of the steam supply mechanism according to the exemplary embodiment.

[0039] As shown in FIG. 4A and FIG. 4B, steam generating part 400 includes casing 410 having an approximately rectangular box shape (including rectangular box shape), and steam generator 420 housed in casing 410. Casing 410 includes: vessel portion 411 which has bottom wall portion 414 and houses steam generator 420; and lid portion 412 constituted of upper wall 415 covering vessel portion 411 and lid portion peripheral wall 416 on which projecting member 417 is formed.

[0040] Steam generator 420 is connected to pump 330 by way of connection tube 421 and a tube (not shown in the drawing), and is connected to steam communication tube 340 by way of discharge tube 422. Opening portion 413 is formed on bottom wall portion 414 of vessel portion 411. Connection tube 421 and discharge tube 422 are disposed in a downwardly projecting manner through opening portion 413.

[0041] Next, the mounting structure for mounting steam generating part 400 of steam supply mechanism 300 on casing 110 of washing machine 100 is described using FIG. 5A with reference to FIG. 3 and FIG. 4A.

[0042] FIG. 5A and FIG. 5B are schematic perspective views of the mounting structure for connecting the lid portion and the casing of the steam generating part according to the exemplary embodiment to each other.

[0043] Firstly, as shown in FIG. 3, casing 110 is constituted of at least: front wall 111; rear wall 112; right wall 115 formed in a raised manner between front wall 111 and rear wall 112; and left wall 116 formed in a raised manner between front wall 111 and rear wall 112 on a side opposite to right wall 115. Casing 110 further includes first reinforcing frame 117 disposed along an upper edge of right wall 115, and second reinforcing frame 118 disposed along an upper edge of front wall 111.

[0044] As shown in FIG. 5B, lid portion 412 which forms a portion of steam generating part 400 includes: upper wall 415 having an approximately rectangular shape (including a rectangular shape); lid portion peripheral walls 416 which project downward (toward a casing 410 side) from edge portions of upper wall 415; and projecting member 417 which projects frontward (toward a front wall 111 side of casing 110) from lid portion peripheral wall 416.

[0045] Then, first reinforcing frame 117 mounted on casing 110 of washing machine 100 and upper wall 415 of lid portion 412 of steam generating part 400 are connected to each other by first mounting member 151 shown at right side of FIG. 5B. On the other hand, second reinforcing frame 118 and projecting member 417 are connected to each other by second mounting member 152 shown at left side of FIG. 5A.

[0046] That is, lid portion 412 of steam generating part 400 and casing ceiling wall 113 of casing 110 are mounted in a spaced-apart manner from each other by way of first mounting member 151 and second mounting member 152 which are mounted on lid portion 412 in an upwardly projecting manner. As a result, it is possible to alleviate (suppress) the transfer of heat generated by steam generating part 400 to casing 110.

[0047] Next, the constitution of steam generator 420 of steam generating part 400 of steam supply mechanism 300 is described using FIG. 6A and FIG. 6B.

[0048] FIG. 6A and FIG. 6B are schematic perspective views of a steam generator in the steam generating part according to the exemplary embodiment.

[0049] As shown in FIG. 6A and FIG. 6B, steam generator 420 is constituted of: body portion 423 having an approximately rectangular shape (including a rectangular shape); lid portion 424 disposed on body portion 423; and a linear heater 425, such as a sheathed heater, disposed in the inside of body portion 423 through peripheral surface 428 of body portion 423. In this exemplary embodiment, body portion 423 and lid portion 424 are formed using aluminum, for example. Due to such a constitution, body portion 423 and lid portion 424 are efficiently and properly heated by heater 425.

[0050] As shown in FIG. 6B, thermistor 426 is further mounted on body portion lower surface 427 of body portion 423 of steam generator 420. In the same manner, the above-mentioned connection tube 421 and discharge tube 422 are also mounted on body portion 423 which constitutes steam generator 420.

[0051] Heater 425 is controlled based on temperature information obtained by thermister 426. Due to such a control, the temperature of body portion 423 and the temperature of lid portion 424 are held at approximately fixed temperatures (including fixed temperatures). A thermostat which controls the turning on and off of electricity power to heater 425 at a predetermined temperature may be used in place of thermister 426. In this case, the substantially same effect can be obtained.

[0052] Next, the constitution of body portion 423 which constitutes steam generator 420 is described using FIG. 6B and FIG. 7.

[0053] FIG. 7 is a schematic perspective view illustrating the body portion of the steam generator according to this exemplary embodiment. As shown in FIG. 6B and FIG. 7, body portion 423 includes body portion lower surface 427, peripheral surface 428, and upper surface 429. Thermister 426, connection tube 421 and discharge tube 422 are mounted on body portion lower surface 427. Body portion lower surface 427 and heater 425 are disposed on peripheral surface 428.

[0054] Further, body portion 423 is formed on upper surface 429 in a raised manner toward lid portion 424 which constitutes one side of steam generator 420 thus forming chamber space 430 having an approximately triangular shape (including a triangular shape), for example. Chamber space 430 is formed in such a manner that chamber space 430 is defined by outer chamber wall 431 and inner chamber wall 432 having an approximately J shape (including a J shape), for example, which defines a steam flow passage in the inside of chamber space 430.

[0055] As shown in FIG.7, an uneven-shape is formed on a wall surface which surrounds chamber space 430 of body portion 423. To be more specific, on bottom surface 442 of chamber space 430 of body portion 423, an uneven-shape formed of square pyramids 440, for example, is continuously formed toward discharge port 438 from inlet port 437 of steam generator 420. Further, an uneven-shape formed of triangular columns 441, for example, is formed on outer peripheral side wall 443 of chamber space 430 of body portion 423. Due to such a constitution, as described later, impurities deposited in chamber space 430 of steam generator 420 at the time of evaporation of water can be made small and divided into small pieces. Due to the above-mentioned constitution having an uneven-shape, not only a mold can be formed easily but also the mold can be easily manufactured.

[0056] In the above-mentioned constitution, it is preferable that the number of uneven-shapes formed of triangular columns 441 and square pyramids 440 is large in an area closed to inlet port 437 compared to an area close to discharge port 438 in the steam flow passage. To be more specific, in chamber space 430, at an upstream side close to inlet port 437, the uneven-shape is formed over whole bottom surface 442 and the whole outer peripheral side wall 443. On the other hand, as a distance from a middle portion of the steam flow passage of chamber space 443 is increased toward discharge port 430, the number of the uneven-shapes is decreased or an uneven-shape is not locally formed. Due to such a constitution, the reduction in size and the division of impurities are accelerated on the upstream side of the steam generating part, and impurities which are made small on the downstream side can be effectively discharged. As a result, it is possible to suppress impurities which are made small or divided from being caught so that it is possible to easily discharge the impurity to the outside of the chamber space.

[0057] Next, the constitution and the manner of operation of steam generator 420 are described using FIG. 8 and FIG. 9 with reference to FIG. 3, FIG. 6B and FIG. 7.

[0058] FIG. 8 is a schematic developed perspective view illustrating the steam generator according to the exemplary embodiment. FIG. 9 is a schematic perspective view illustrating the lid portion of the steam generator according to the exemplary embodiment.

[0059] Firstly, as shown in FIG. 9, in the same manner as the bottom surface 442 which surrounds chamber space 430 of body portion 423 shown in FIG.8, an uneven-shape is formed on lower surface 434 of lid portion 424. For example, square pyramids 440 are formed on lower surface 434. Here, square pyramids 440 are formed on lower surface 434 of lid portion 424 in a state where square pyramids 440 are disposed continually, for example. As shown in FIG. 8, steam generator 420 includes packing ring 433 made of a heat-resistance rubber or the like, for example, mounted on body portion 423 in a state where packing ring 433 surrounds outer chamber wall 431.

[0060] As shown in FIG. 8 and FIG. 9, lid portion 424 includes lower surface 434 which faces body portion 423, and outer shield wall 435 which has the substantially same shape (including the same shape) as that of outer chamber wall 431 of body portion 423.

[0061] By pushing lid portion 424 to body portion 423, outer shield wall 435 of lid portion 424 compresses packing ring 433. As a result, air-tightness of chamber space 430 of steam generator 420 is maintained.

[0062] Inlet port 437 is formed in body portion 423. Inlet port 437 is formed so as to allow water supplied through connection tube 421 connected to body portion lower surface 427 to flow into the inside of chamber space 430. Inlet port 437 is formed at the approximately center (including the center) of chamber space 430, and the periphery of inlet port 437 is surrounded by inner chamber wall 432.

[0063] Steam generator 420 of this exemplary embodiment is constituted as described above.

[0064] Next, the manner of operation of steam gener-

ator 420 is described in detail.

[0065] Firstly, when a predetermined amount of water is supplied to steam generator 420 from water storage tank 320 by pump 330, water is injected upward (toward a lid portion 424 side) through connection tube 421 and inlet port 437. Water injected into chamber space 430 of steam generator 420 impinges on inner chamber wall 432, upper surface 429 of body portion 423 surrounded by inner chamber wall 432 and/or lower surface 434 of lid portion 424 positioned above inlet port 437. At this point of time, steam generator 420 is heated by heater 425 (for example, approximately 200°C) thus having high thermal energy.

[0066] Then, the water supply operation is performed intermittently using pump 330 of steam supply mechanism 300 so that a proper amount of water is supplied into the inside of chamber space 430 of steam generator 420 (for example, approximately 2cc/time). Accordingly, water injected upward from inlet port 437 of steam generator 420 is instantaneously evaporated by thermal energy which steam generator 420 possesses.

[0067] Further, due to the instantaneous evaporation of water, an inner pressure of chamber space 430 is sharply increased. Accordingly, an impurity contained in water supplied to steam generator 420 adheres to or precipitates on the wall surface which constitutes chamber space 430 when water evaporates, and then, the impurity is deposited on the wall surface. In this case, when a surface which constitutes the steam flow passage from inlet port 437 to discharge port 438 is flat, large impurities are liable to be formed. When the impurities are large, the impurities are difficult to be discharged from discharge port 438 and hence, there is a possibility that discharge port 438 is clogged.

[0068] In view of the above, in this exemplary embodiment, as shown in FIG. 8 and FIG. 9, an uneven-shape is formed on the surface of the steam flow passage from inlet port 437 to discharge port 438. For example, triangular columns 441 and square pyramids 440 are formed.

[0069] Usually, adhered or precipitated impurities are deposited in such a manner that impurities are deposited on recessed portions of the uneven-shape formed on the surface of the steam flow passage particularly.

[0070] However, a large number of recessed portions which are formed between square pyramids 440 and triangular columns 441 formed in the steam flow passage exist in plane of the steam flow passage, and sizes of the recessed portions are small (for example approximately 1mm). Accordingly, impurities are not adhered or deposited on the recessed portions at specific one portion, for example, and is adhered or deposited in a dispersed manner. As a result, impurities having a relatively small size are adhered or deposited on the large number of recessed portions in a dispersed manner.

[0071] Further, pyramid 440 and triangular column 441 have an acute-angled portion and hence, the recessed portion is also formed into an acute-angled shape. Accordingly, an impurity adhered to or deposited on the recessed portion is brittle and is liable to collapse and hence, an impurity having a relatively small size is adhered or deposited.

[0072] That is, as described previously, impurities are made small into peeled-off pieces of a size equal to or lower than a diameter of discharge port 438 due to square pyramids 440 and triangular pyramids 441. Accordingly, the impurities receive an action of pressure at the time of evaporation of water and hence, impurities easily flow in a flow passage. As a result, it is possible to easily discharge impurities to the outside from chamber space 430 through the discharge port.

[0073] In the inside of chamber space 430, it is preferable that the number of uneven-shapes formed in the steam flow passage on an upstream side of chamber space 430 close to inlet port 437 is set larger than the number of uneven-shapes formed in the steam flow passage on a downstream side of chamber space 430 close to discharge port 438. To be more specific, on the side of chamber space 430 close to inlet port 437, the uneven-shapes are formed substantially on whole bottom surface 442 and whole outer peripheral side wall 443. On the other hand, as a distance from a middle portion of the steam flow passage of chamber space 430 is increased toward discharge port 438, the number of the uneven-shapes is decreased or the uneven-shape is not locally formed. Due to such a constitution, in the steam flow passage ranging from inlet port 437 to discharge port 438 of chamber space 430, the reduction in size and the division of impurities are accelerated on the upstream side and impurities which are made small on the downstream side can be easily discharged. As a result, it is possible to prevent impurities from being caught on the downstream side so that it is possible to easily and smoothly discharge the impurity to the outside of chamber space 430.

[0074] Next, the constitution of the heater mounted on body portion 423 of steam generator 420 is described in detail using FIG. 10 with reference to FIG. 6B.

[0075] FIG. 10 is a schematic plan view illustrating the body portion of the steam generator according to the exemplary embodiment.

[0076] As shown in FIG. 10, heater 425 is disposed so as to extend along an approximately U-shaped (including a U shape) passage formed in the inside of body portion 423. Due to such an arrangement, heater 425 surrounds inlet port 437 to which connection tube 421 is mounted. Accordingly, the temperature of inner chamber wall 432 and the temperature of a region surrounded by inner chamber wall 432 become the highest temperature in the inside of chamber space 430 due to heating by heater 425. As a result, water injected into the inside of chamber space 430 through inlet port 437 is instantaneously evaporated.

[0077] Inner chamber wall 432 is disposed in the inside of chamber space 430 defined by outer chamber wall 431 in a state where inner chamber wall 432 extends in an approximately J-shape (including a J-shape). That is,

a spiral-shaped flow passage is formed in chamber space 430 by inner chamber wall 432. Discharge port 438 is formed in body portion 423 at a position in the vicinity of a terminal end of the flow passage through which water or steam passes. Due to such a constitution, steam generated in the space surrounded by inner chamber wall 432 moves toward discharge port 438 along with the increase of an inner pressure of chamber space 430. Then, steam which arrives at discharge port 438 is discharged downward in the vertical direction through discharge tube 422 mounted on discharge port 438.

[0078] Heater 425 is disposed such that heater 425 extends in an approximately U-shaped manner (including a U shaped manner) along an outside passage of the spiral-shaped flow passage. Due to such a constitution, steam generated in the space surrounded by inner chamber wall 432 moves toward discharge tube 422 while being heated. Accordingly, high-temperature steam is discharged from discharge tube 422 of steam generator 420.

[0079] Further, steam generator 420 of this exemplary embodiment can inject water to a heated wall surface and can instantaneously evaporate water. Accordingly, compared to a conventional case where steam is generated by a heater immersed in water, power consumption necessary for generating the same amount of steam in this exemplary embodiment can be made small. As a result, it is possible to realize a clothes treatment device with low power consumption.

<Constitution of water supply mechanism>

[0080] Hereinafter, the constitution and the manner of operation of the water supply mechanism of the washing machine of the exemplary embodiment of the present invention are described using FIG. 11.

[0081] FIG. 11 is a schematic view illustrating the water supply mechanism of the steam supply mechanism according to the exemplary embodiment.

[0082] As shown in FIG. 11, water supply mechanism 500 which injects water to chamber space 430 of steam generator 420 includes water supply valve 310, water storage tank 320, pump 330, connection tube 421, and water level sensor 321 for measuring a water level in water storage tank 320 all of which are described previously. Water supply valve 310 performs the supply of water to water storage tank 320 or the cutting off of the supply of water to water storage tank 320 in accordance with a water level detected by water level sensor 321.

[0083] Water supply valve 310 may be controlled in accordance with an operation time and/or an operation pattern (an intermittent water supply operation and/or a continuous water supply operation) of pump 330. For example, an amount of water supplied from water supply valve 310 may be adjusted such that water storage tank 320 becomes empty when an operation of pump 330 is finished. Due to such a constitution, even when an outside air temperature becomes low, water in water storage tank 320 is difficult to be frozen. As a result, the reliability of washing machine 100 can be further enhanced.

[0084] Pump 330 supplies water stored in the inside of water storage tank 320 to chamber space 430 of steam generator 420 through connection tube 421. In the intermittent water supply operation performed using pump 330, for example, a supply amount, a supply time, a supply interval and the like are adjusted such that water injected into the inside of chamber space 430 is instantaneously evaporated.

[0085] On the other hand, as described above, when water is evaporated in the inside of chamber space 430 of steam generator 420, there exists a possibility that an impurity contained in water is deposited in the inside of chamber space 430. In this case, the continuous water supply operation by pump 330 is adjusted such that water flows into the inside of chamber space 430 at a flow speed sufficient for washing away the deposited impurity. Due to such a constitution, it is possible to effectively remove an impurity. As a result, it is possible to prevent lowering of a heat exchange efficiency between steam generator 420 and water in advance.

[0086] Discharge tube 422 of steam generator 420 is connected to steam communication tube 340. Due to such a constitution, steam generated in the inside of chamber space 430 due to the intermittent water supply operation by pump 330 and water which flows into the inside of chamber space 430 due to the continuous water supply operation of pump 330 can be made to flow into housing tub 200 through discharge tube 422 and steam communication tube 340.

[0087] The water supply mechanism of the steam supply mechanism of washing machine 100 of this exemplary embodiment is configured as described above.

<Supply of steam and water to housing tub>

[0088] Hereinafter, the operation of supplying steam and water to the housing tub of the washing machine of the exemplary embodiment of the present invention is described using FIG. 12 with reference to FIG. 1 and FIG. 11.

[0089] FIG. 12 is a schematic back view illustrating a front portion of the housing tub of the washing machine according to the exemplary embodiment.

[0090] Firstly, as shown in FIG. 1, annular portion 224 of front portion 222 of water tub 220 includes: inner surface 225 which faces rotary drum 210; and outer surface 226 which faces front wall 111 of casing 110. FIG. 12 mainly shows inner surface 225 of annular portion 224 formed on front portion 222 of water tub 220.

[0091] As shown in FIG. 12, the above-mentioned steam supply mechanism 300 further includes: branched tube 351 mounted on inner surface 225; nozzle 352 disposed above branched tube 351; and steam tube 353 which connects branched tube 351 and nozzle 352 to each other. Steam communication tube 340 is connected to branched tube 351 through peripheral wall portion 223

of water tub 220.

[0092] Due to the above-mentioned constitution, steam and water generated by steam generator 420 are supplied to the inside of housing tub 200.

[0093] Next, the flow operation of steam and water generated by steam generator 420 is described.

[0094] Firstly, steam generated in the inside of chamber space 430 of steam generator 420 flows into steam communication tube 340 through discharge tube 422 along with the increase of a pressure in the inside of chamber space 430. Thereafter, the steam flows into branched tube 351 from steam communication tube 340.

[0095] The steam which arrives at branched tube 351 has a high temperature and hence, the steam is guided to steam tube 353 and flows into nozzle 352 disposed above branched tube 351. Lastly, the steam is injected downward into the inside of rotary drum 210 of housing tub 200 from nozzle 352.

[0096] In this exemplary embodiment, steam generated in the inside of chamber space 430 is guided to nozzle 352 through discharge tube 422, steam communication tube 340, branched tube 351 and steam tube 353.

[0097] That is, pump 330 which performs intermittent water supply operation injects a proper amount of water into the inside of chamber space 430 heated by heater 425 and has a high temperature and hence, water is instantaneously evaporated. At this point of time, an inner pressure of chamber space 430 of steam generator 420 is sharply increased due to the evaporation of the water. Accordingly, generated steam is injected from nozzle 352 at a high pressure. As a result, as shown in FIG. 1 and FIG. 12, steam is injected such that steam crosses an inner space of housing tub 200 in the vertical direction.

[0098] During drying, clothing stirred by the rotation of rotary drum 210 is liable to be collected to an area in the vicinity of a lower end of rotary drum 210 due to an own weight of the clothing. As described previously, steam injected from nozzle 352 mounted on the upper portion of housing tub 200 and crosses the inner space of housing tub 200 in the vertical direction reaches clothing collected in the vicinity of a lower end of rotary drum 210. As a result, steam is efficiently supplied to clothing.

[0099] Branched tube 351 which introduces steam into steam tube 353 from steam communication tube 340 includes: main tube 354 connected to steam communication tube 340; upper sub tube 355 bent upward from main tube 354; and lower sub tube 356 bent downward from main tube 354. Steam or water flows into main tube 354 through steam communication tube 340. Upper sub tube 355 is connected to steam tube 353, and forms an upwardly extending passage through which steam moves toward nozzle 352.

[0100] On the other hand, different from upper sub tube 355, lower sub tube 356 forms a downwardly extending passage. To be more specific, when the continuous water supply operation is performed by pump 330, mainly water flows into branched tube 351 through steam communication tube 340. Then, water which flows into branched tube 351 flows downward through lower sub tube 356 due to the action of gravity.

[0101] As shown in FIG. 12, main tube 354 and upper sub tube 355 of branched tube 351 are connected to each other at an included angle of $\theta 1$ which is an obtuse angle, while main tube 354 and lower sub tube 356 are connected to each other at an included angle of $\theta 2$ which is an acute angle. Since the included angle $\theta 2$ is an acute angle, a flow loss from main tube 354 to lower sub tube 356 is relatively large. Accordingly, steam which flows into the inside of main tube 354 hardly flows into lower sub tube 356, and the steam mainly flows into upper sub tube 355. On the other hand, upper sub tube 355 forms the upwardly extending flow passage and hence, due to the action of gravity, water which flows into main tube 354 hardly flows into upper sub tube 355 and the water mainly flows into lower sub tube 356. As a result, the flow passage for steam and the flow passage for water can be properly separated from each other by branched tube 351.

<Intermittent operation by pump>

[0102] Hereinafter, the intermittent operation of the pump which supplies water to the steam generating part of the washing machine of the exemplary embodiment of the present invention is described using FIG. 13 with reference to FIG. 8 and FIG. 11.

[0103] FIG. 13 is an explanatory view schematically showing the relationship between an intermittent operation by the pump of the water supply mechanism and a temperature in the inside of the chamber space according to the exemplary embodiment.

[0104] As shown in FIG. 13, in this exemplary embodiment, a period during which pump 330 is operated (ON period) is set shorter than a period during which pump 330 is stopped (OFF period). Accordingly, a proper amount of water can be injected into the inside of chamber space 430 of steam generator 420 in steam generating part 400.

[0105] It is needless to say that a length of the ON period and a length of the OFF period in Fig. 13 are relative values, and these lengths may be changed corresponding to a capacity of chamber space 340, an amount of heating by the heater, and a required amount of steam.

[0106] To be more specific, pump 330 supplies a predetermined amount of water to chamber space 430 in the ON period. The supplied water is evaporated so as to generate steam. At this point of time, as shown in FIG. 13, due to heat of vaporization attributed to a change in phase from water to steam, a temperature in chamber space 430 is temporarily lowered. However, in this exemplary embodiment, by setting the OFF period to a relatively long period, heater 425 can sufficiently increase a temperature in chamber space 430 during the OFF period. As a result, it is possible to continue the supply of high-pressure steam to housing tub 200 during a period where pump 330 performs the intermittent operation.

[0107] That is, a temperature in chamber space 430 is sufficiently increased during the OFF period. Then, in the ON period, a proper amount of water which can be evaporated instantaneously by thermal energy which steam generator 420 including chamber space 430 possesses (for example, approximately 2cc/time) is supplied to chamber space 430. Accordingly, it is possible to favorably continue the supply of high-pressure steam to housing tub 200.

<Effect of steam in washing step>

[0108] Hereinafter, effects of steam supplied to the housing tub through the steam supply mechanism of the exemplary embodiment of the present invention, particularly, such effects of steam in washing step are described using FIG. 14 with reference to FIG. 1, FIG. 8, and FIG. 11.

[0109] FIG. 14 is an explanatory view schematically showing a temperature change in water supplied to the water tub of the washing machine according to the exemplary embodiment.

[0110] Firstly, as shown in FIG. 1, hot water heater 160 for heating water supplied to the inside of water tub 220 is disposed in a lower portion of water tub 220.

[0111] As shown in FIG. 14, when washing step is started, a predetermined amount of water is supplied to water tub 220. During the supply of water, the temperature of water contained in clothing in the inside of water tub 220 takes an approximately fixed value (including a fixed value).

[0112] Thereafter, water in the inside of water tub 220 is heated using hot water heater 160. At this point of time, hot water heater 160 generates a large amount of heat value and hence, the temperature of water contained in clothing in the inside of water tub 220 is sharply increased. When the temperature of water reaches a predetermined temperature, heating of water in the inside of water tub 220 is stopped.

[0113] Thereafter, in this exemplary embodiment, washing step is carried out by introducing steam into the inside of housing tub 200 through steam supply mechanism 300.

[0114] A dotted line after heating is stopped shown in FIG. 14 indicates a change in the temperature of water contained in clothing when the heating by hot water heater 160 is stopped and steam is not supplied. A solid line after heating is stopped indicates a change in the temperature of water contained in clothing when heating by hot water heater 160 is stopped and steam is supplied to housing tub 200.

[0115] That is, in this exemplary embodiment, in washing step, high-temperature steam is directly supplied to housing tub 200 in a state where the steam is injected to clothing. Accordingly, lowering of the temperature of water contained in clothing in the inside of water tub 220 is alleviated (suppressed) by high-temperature steam. Further, power consumption of heater 425 used in steam generator 420 is smaller than that of hot water heater 160 mounted on water tub 220. As a result, heat retention by the supply of high-temperature steam can be realized with low power consumption compared to the case where heat retention of water in the inside of water tub 220 is performed using hot water heater 160. Accordingly, in washing step, it is preferable that high-temperature steam be supplied to the housing tub by performing intermittent water supply operation using pump 330 after hot water heater 160 is stopped.

<Effects of steam in spin-drying step>

[0116] Hereinafter, effects of steam supplied to the housing tub through the steam supply mechanism of the exemplary embodiment of the present invention, particularly, such effects of steam in spin-drying step are described by using FIG. 1, FIG. 11 and FIG. 12.

[0117] In spin-drying step, rotary drum 210 is rotated at a high speed by motor 231. As shown in FIG. 1, a large number of small holes 219 are formed in peripheral wall 211 of rotary drum 210.

[0118] Accordingly, clothing housed in the inside of rotary drum 210 is pressed to peripheral wall 211 due to a centrifugal force generated by the rotation of rotary drum 210, and moisture contained in clothing is discharged to the outside of rotary drum 210 through small holes 219. As a result, clothing is properly spin-dried.

[0119] At this point of time, fibers of spin-dried clothing are liable to be bonded together by hydrogen bonding, and hydrogen bonding of fibers becomes a factor which causes wrinkles in clothing.

[0120] In view of the above, in this exemplary embodiment, steam is supplied to the inside of rotary drum 210 in spin-drying step. Due to such supply of steam, hydrogen bonding of fibers can be released by steam. As a result, the generation of wrinkles in clothing can be decreased.

[0121] That is, during a period where clothing is subjected to spin-drying processing, it is preferable to supply high-temperature steam to the inside of rotary drum 210 by performing an intermittent water supply operation using pump 330. To be more specific, by performing the intermittent water supply operation using pump 330, steam is injected into the inside of rotary drum 210 from nozzle 352 at a high pressure. Steam injected from nozzle 352 crosses housing tub 200. Then, the injected steam is uniformly blown out to clothing which is rotating in a state where clothing is stuck on peripheral wall 211 of rotary drum 210. Due to such processing, hydrogen bonding of fibers can be released by steam over the whole clothing in the inside of rotary drum 210. As a result, the generation of wrinkles in clothing can be effectively suppressed.

[0122] Hereinafter, in the clothes treatment device of the exemplary embodiment, timing at which steam generated by the steam generator is supplied to the housing tub is described using three patterns as an example with

reference to FIG. 15A to FIG. 15C.

[0123] FIG. 15A to FIG. 15C are schematic timing charts expressing timing at which steam is supplied during spin-drying step according to the exemplary embodiment.

[0124] Firstly, in the first pattern, as shown in FIG. 15A, after a lapse of a predetermined time (T1) from starting of spin-drying step, the supply of steam is started by steam supply mechanism 300. In this case, an amount of moisture contained in clothing is small and hence, clothing can be efficiently made wet by a heat value of steam and moisture.

[0125] In the second pattern, as shown in FIG. 15B and FIG. 15C, steam may be supplied in synchronism with the starting of spin-drying step by steam supply mechanism 300. In this case, the temperature of clothing is elevated at an initial stage of spin-drying step and hence, clothing can be efficiently made wet at a high temperature.

[0126] In the third pattern, as shown in FIG. 15A and FIG. 15B, steam may be supplied for some time, for example, after a lapse of a predetermined time (T1) or by a predetermined time (T2) from the starting of spin-drying step by steam supply mechanism 300. In this case, as shown in FIG. 15C, the period during which steam is supplied by steam supply mechanism 300 may be the whole period from starting to the finishing of spin-drying step.

[0127] It is needless to say that the timing at which steam is supplied to the housing tub is not limited to the above-mentioned three patterns.

<Step of cooling steam generator>

[0128] Hereinafter, step of cooling the steam generator of the exemplary embodiment of the present invention is described using FIG. 8 and FIG. 11.

[0129] Usually, it is preferable to cool steam generator 420 when processing of clothing using steam is finished.

[0130] In view of the above, to cool steam generator 420, the unnecessary injection of high-temperature steam into the inside of housing tub 200 is prevented.

[0131] To be more specific, firstly, to cool steam generator 420, the supply of electric power to heater 425 is stopped. Thereafter, continuous water supply operation is started using pump 330. Due to such a water supply operation, water continuously flows into the inside of chamber space 430 of steam generator 420 from water storage tank 320. Water which flows into the inside of chamber space 430 takes heat away from steam generator 420 and, thereafter, flows into the inside of housing tub 200 from steam communication tube 340 through branched tube 351. As a result, it is possible to cool steam generator 420 within a short period.

[0132] Next, a control of the door body of the exemplary embodiment of the present invention is described using FIG. 16 with reference to FIG. 1 and FIG. 6B.

[0133] FIG. 16 is a block diagram schematically showing the control of the door body based on the temperature of the steam generator according to the exemplary embodiment.

[0134] As shown in FIG. 16, washing machine 100 of this exemplary embodiment includes: locking mechanism 121 which locks door body 120 at a closed position; and control part 122 for controlling locking using locking mechanism 121 and releasing of such locking. It is needless to say that the known structures of washing machines are utilized as mechanical and electric mechanisms used in locking mechanism 121.

[0135] As shown in FIG. 6B, steam generator 420 includes thermister 426.

[0136] As shown in FIG. 16, thermister 426 detects the temperature of body portion 423 of steam generator 420, and outputs a signal corresponding to a detected temperature to control part 122.

[0137] At this point of time, control part 122 maintains locking of door body 120 using locking mechanism 121 until a signal outputted from thermister 426 becomes a signal corresponding to a predetermined temperature or below. Due to such an operation, until the temperature of steam generator 420 becomes a predetermined temperature or below, the inner space of housing tub 200 is isolated from the outside. As a result, it is possible to prevent a user from being exposed to high-temperature steam in advance, thus realizing safe and highly reliable washing machine 100.

[0138] In the above-mentioned exemplary embodiment, the description has been made by taking triangular columns and square pyramids as examples of the uneven-shapes. However, the uneven-shapes are not limited to triangular columns and square pyramids and, for example, may be formed into projecting shapes such as cones, triangular pyramids or polygonal pyramids. Further, it is sufficient for the uneven-shape forming portion that a bottom surface of the portion has an area larger than an area in the vicinity of vertex and the shape of the uneven-shape forming portion may be arbitrarily set. Such uneven-shapes can acquire the substantially same advantageous effect.

[0139] In the above-mentioned exemplary embodiment, the description has been made with respect to the example where the uneven-shape is formed by disposing triangular columns, square pyramids or the like having the same shape. However, the present invention is not limited to such an example. For example, the uneven-shape may be formed by arbitrarily disposing triangular columns, square pyramids, cones, triangular pyramids, polygonal pyramids or like having the different shapes. Such uneven-shapes can acquire the substantially same advantageous effect.

(SECOND EXEMPLARY EMBODIMENT)

[0140] Hereinafter, the constitution of a clothes treatment device of a second exemplary embodiment of the present invention is described with reference to FIG. 17.

[0141] FIG. 17 is a schematic developed perspective

view illustrating a steam generator used in a washing machine exemplified as a clothes treatment device according to a second exemplary embodiment of the present invention.

[0142] As shown in FIG. 17, in the clothes treatment device of this exemplary embodiment, steam generator 420A of this exemplary embodiment differs from steam generator 420 of the first exemplary embodiment with respect to a point that heater 425A is provided to lid member 424A of steam generator 420A. Other constitutions and the manner of operation are substantially equal to the corresponding constitutions and the manner of operation of first exemplary embodiment and hence, the detailed description of other constitutions and the manner of operation is omitted. Constitutional elements identical with constitutional elements of steam generator 420 of first exemplary embodiment are described by giving the same symbols to the constitutional elements.

[0143] That is, as shown in FIG. 17, steam generator 420A of the clothes treatment device of this exemplary embodiment is at least constituted of: body portion 423A; lid portion 424A; and packing ring 433 sandwiched between body portion 423A and lid portion 424A. Heater 425A is mounted on lid portion 424A which constitutes steam generator 420A.

[0144] Hereinafter, the mounting structure of heater 425A of lid portion 424A of steam generator 420A of this exemplary embodiment is described with reference to FIG. 18.

[0145] FIG. 18 is a schematic perspective view illustrating the steam generator according to the exemplary embodiment.

[0146] As shown in FIG. 18, lid portion 424A of steam generator 420A includes inner shield wall 436 surrounded by outer shield wall 435. Inner shield wall 436 of lid portion 424A is formed with the approximately same shape (including the same shape) as inner chamber wall 432 of body portion 423A. Accordingly, inner shield wall 436 of lid portion 424A overlaps with inner chamber wall 432 of body portion 423A. As a result, a spiral flow passage is formed in chamber space 430 of steam generator 420A.

[0147] A region of lower surface 434 surrounded by inner shield wall 436 of lid portion 424A faces inlet port 437 formed in body portion 423A. Accordingly, in the description made hereinafter, the description is made by describing the region as "facing region 439".

[0148] That is, heater 425A is mounted in lid portion 424A such that heater 425A surrounds facing region 439.

[0149] Steam generator 420A of this exemplary embodiment is constituted as described above.

[0150] Steam generator 420A of this exemplary embodiment is operated as follows.

[0151] Firstly, when a predetermined amount of water is supplied to steam generator 420A from water storage tank 320 by pump 330, water is injected upwardly (lid portion 424A side) through connection tube 421 and inlet port 437 and reaches lid portion 424A.

[0152] Then, water injected into chamber space 430 of steam generator 420A impinges on inner chamber wall 432 and facing region 439 of lower surface 434 of lid portion 424A positioned above inlet port 437 on upper surface 429 of body portion 423A surrounded by inner chamber wall 432. At this point of time, lid portion 424A of steam generator 420A is heated by heater 425A so that the temperature of facing region 439 becomes particularly high.

[0153] Accordingly, a water supply operation is intermittently performed by pump 330 of steam generating mechanism 300 so that a flow speed of supplied water is adjusted whereby supplied water is instantaneously evaporated.

[0154] Due to the instantaneous evaporation of water, an internal pressure in chamber space 430 is sharply elevated. Accordingly, impurities contained in water supplied to steam generator 420A are deposited by adhesion or precipitation on a wall surface which forms chamber space 430 at the time of evaporation.

[0155] In this case, in the same manner as first exemplary embodiment, due to uneven-shape formed of square pyramids 440 and triangular columns 441 formed in chamber space 430 of body portion 423A of steam generator 420A, impurities are made small. As a result, it is possible to easily discharge impurities to the outside through the discharge port from chamber space 430.

[0156] As has been described heretofore, the clothes treatment device of the present invention includes: the housing tub for housing clothing; and the steam supply mechanism for supplying steam to the housing tub. The steam supply mechanism includes: the water supply valve; and a steam generating part. The steam generating part includes the heater which heats the wall surface defining the chamber for generating steam; the water supply mechanism which injects water to the wall surface; the inlet port through which the water is injected into the chamber; and the discharge port through which the steam is discharged from the inside of the chamber. The steam supply mechanism may be also configured such that the uneven-shape is formed on the wall surface of a steam flow passage from the inlet port to the discharge port.

[0157] Due to the above-mentioned constitution, although impurities (scales) are generated due to thermal contraction in the chamber when water supplied to the inside of the chamber is hard water, for example, a peeled-off piece of impurities can be made small. That is, when the steam flow passage is flat, a large impurity peel-off piece is liable to be formed. In view of the above, an uneven-shape is formed on the wall surface of the steam flow passage. Accordingly, impurities are made small or are divided into small pieces so that impurities are discharged from discharge port thus making impurities hardly clog the discharge port. As a result, it is possible to provide a clothes treatment device which can efficiently supply steam to the inside of a housing tub.

[0158] According to the clothes treatment device of the

present invention, the steam flow passage may have the structure where the uneven-shape is continuously disposed.

[0159] Due to such a constitution, since the uneven-shape is continuously formed, the reduction in size and the division of impurities can be further accelerated. As a result, it is possible to prevent the clogging of the discharge port of the steam generating part by impurities.

[0160] According to the clothes treatment device of the present invention, in the steam flow passage, the number of the uneven-shapes on a side close to the inlet port may be larger than the number of the uneven-shapes on a side close to the discharge port side.

[0161] Due to such a constitution, the reduction in size and the division of impurities are accelerated on the upstream side of the steam generating part, and impurities which are made small on the downstream side can be effectively discharged. As a result, it is possible to prevent impurities such as scales which are made small or divided from being caught, thereby easily smoothly discharging the impurity to the outside of the chamber space.

[0162] According to the clothes treatment device of the present invention, the uneven-shape may be either a triangular pyramid or a pyramid. Due to such a constitution, impurities can be made small in size so that the impurities can be easily discharged to the outside.

INDUSTRIAL APPLICABILITY

[0163] The present invention is preferably applicable to the device which processes clothing using steam.

REFERENCE MARKS IN THE DRAWINGS

[0164]

100	washing machine
110	casing
111	front wall
112	rear wall
113	casing ceiling wall
114	casing bottom wall
115	right wall
116	left wall
117	first reinforcing frame
118	second reinforcing frame
120	door body
121	locking mechanism
122	control part
130	packing structure
140	water supply port
141	distribution part
151	first mounting member
152	second mounting member
160	hot water heater
200	housing tub
210	rotary drum
211	peripheral wall
212	bottom wall
219	small hole
220	water tub
221	bottom portion
222	front portion
223	peripheral wall portion
224	annular portion
225	inner surface
226	outer surface
230	rotary shaft
231	motor
232	pulley
233	belt
300	steam supply mechanism
310	water supply valve
320	water storage tank
321	water level sensor
330	pump
340	steam communication tube
351	branched tube
352	nozzle
353	steam tube
354	main tube
355	upper sub tube
356	lower sub tube
400	steam generating part
410	casing
411	vessel portion
412	lid portion
413	opening portion
414	bottom wall portion
415	upper wall
416	lid portion peripheral wall
417	projecting member
420, 420A	steam generator
421	connection tube
422	discharge tube
423, 423A	body portion
424, 424A	lid portion
425, 425A	heater
426	thermister
427	lower surface of main body
428	peripheral surface
429	upper surface
430	chamber space
431	outer chamber wall
432	inner chamber wall
433	packing ring
434	lower surface
435	outer shield wall
436	inner shield wall
437	inlet port
438	discharge port
439	facing region
440	pyramid
441	triangular column
442	bottom surface
443	outer peripheral side wall

500 water supply mechanism

Claims

1. A clothes treatment device comprising:

   a housing tub for housing clothing; and
   a steam supply mechanism for supplying steam to the housing tub, wherein
   the steam supply mechanism includes a water supply valve, and a steam generating part,
   the steam generating part includes a heater which heats a wall surface defining a chamber for generating steam, a water supply mechanism which injects water to the wall surface, an inlet port through which the water is injected into the chamber, and a discharge port through which the steam is discharged from the inside of the chamber, and
   an uneven shape is formed on the wall surface of a steam flow passage from the inlet port to the discharge port.

2. The clothes treatment device according to claim 1, wherein the steam flow passage has a structure where the uneven shape is continuously disposed.

3. The clothes treatment device according to claim 1, wherein in the steam flow passage, a number of the uneven shapes on a side close to the inlet port is larger than a number of the uneven shapes on a side close to the discharge port.

4. The clothes treatment device according to claim 1, wherein the uneven shape is one of a triangular pyramid and a square pyramid.

FIG. 1

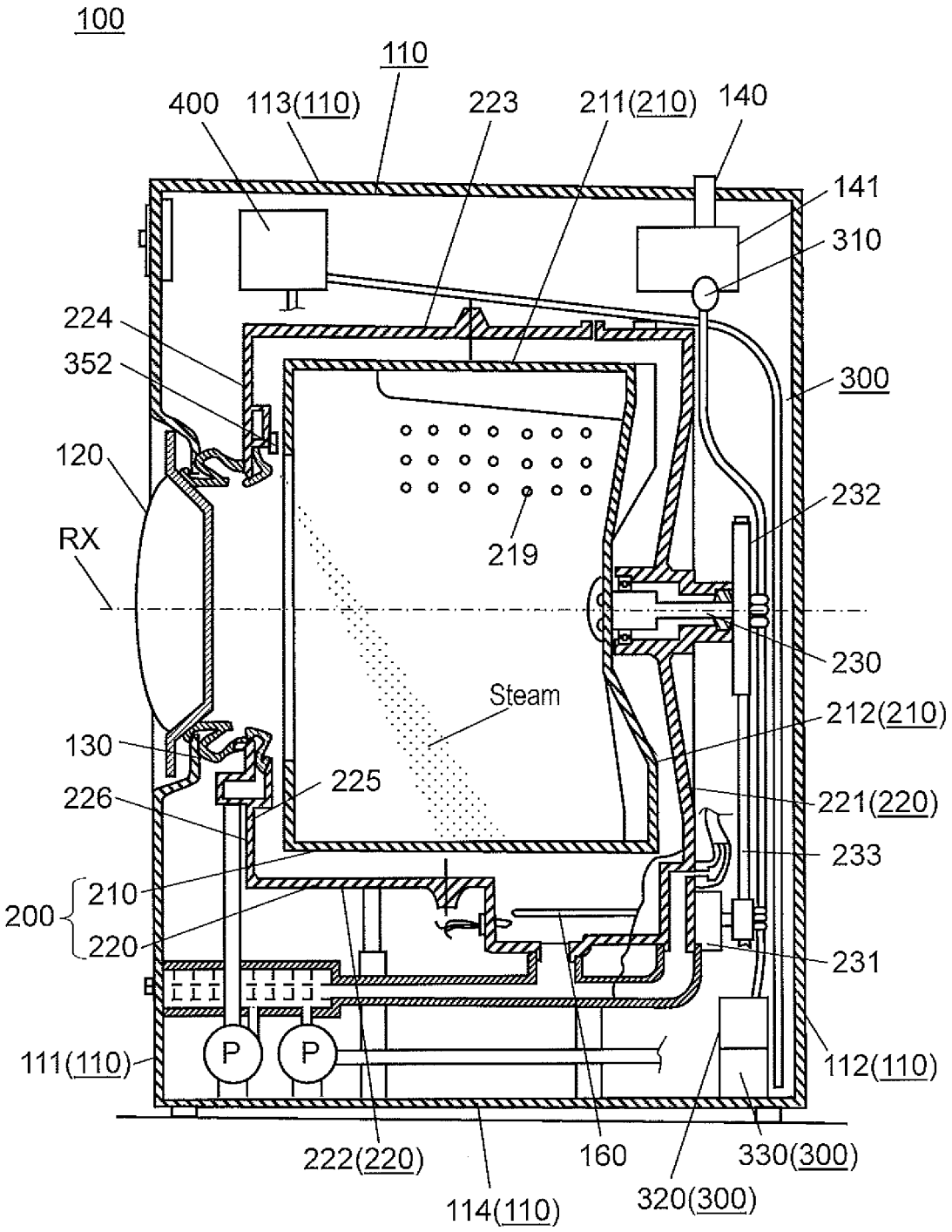

100
110
400
113(110)
223
211(210)
140
141
310
224
352
300
120
232
RX
219
230
Steam
212(210)
130
225
226
221(220)
233
200
210
220
231
111(110)
P
P
112(110)
222(220)
160
330(300)
114(110)
320(300)

FIG. 2

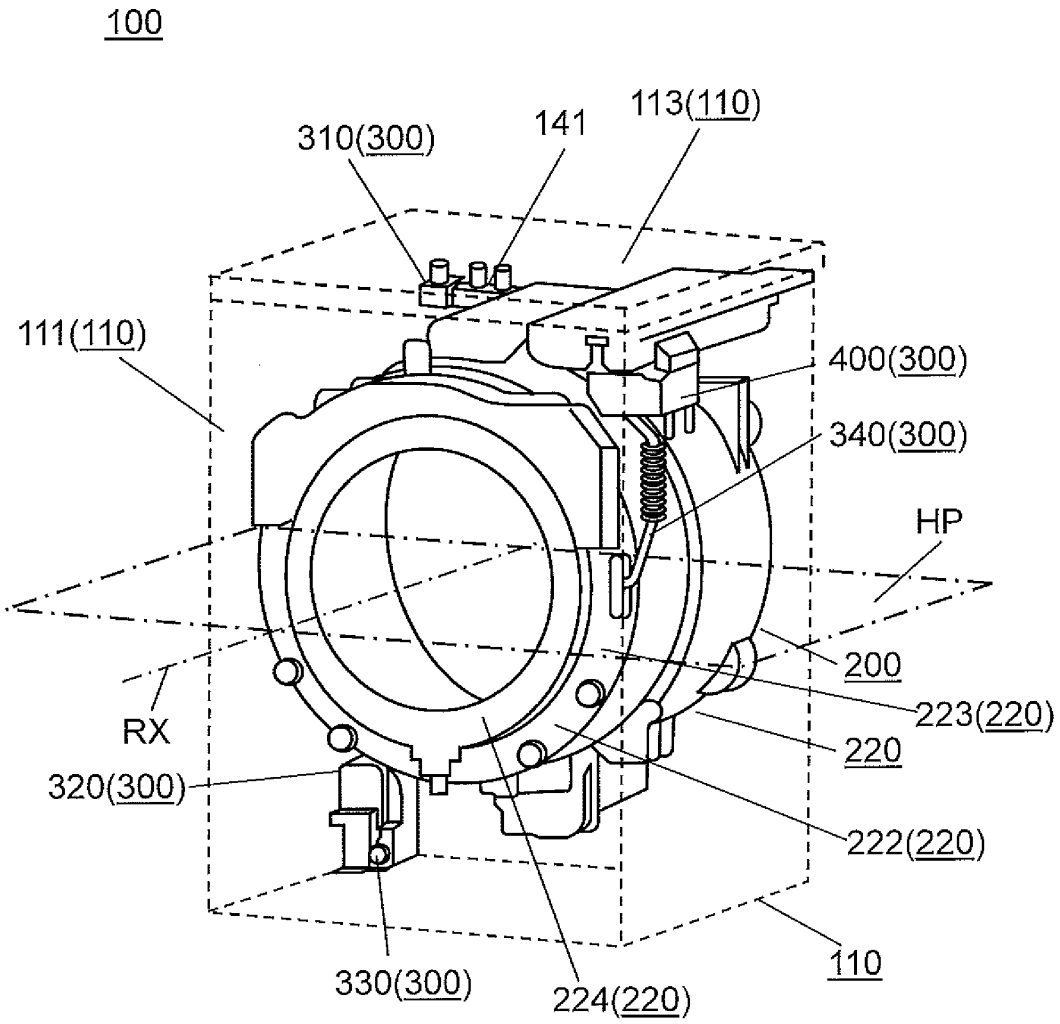

100
310(300)
141
113(110)
111(110)
400(300)
340(300)
HP
200
223(220)
RX
220
320(300)
222(220)
110
330(300)
224(220)

FIG. 3

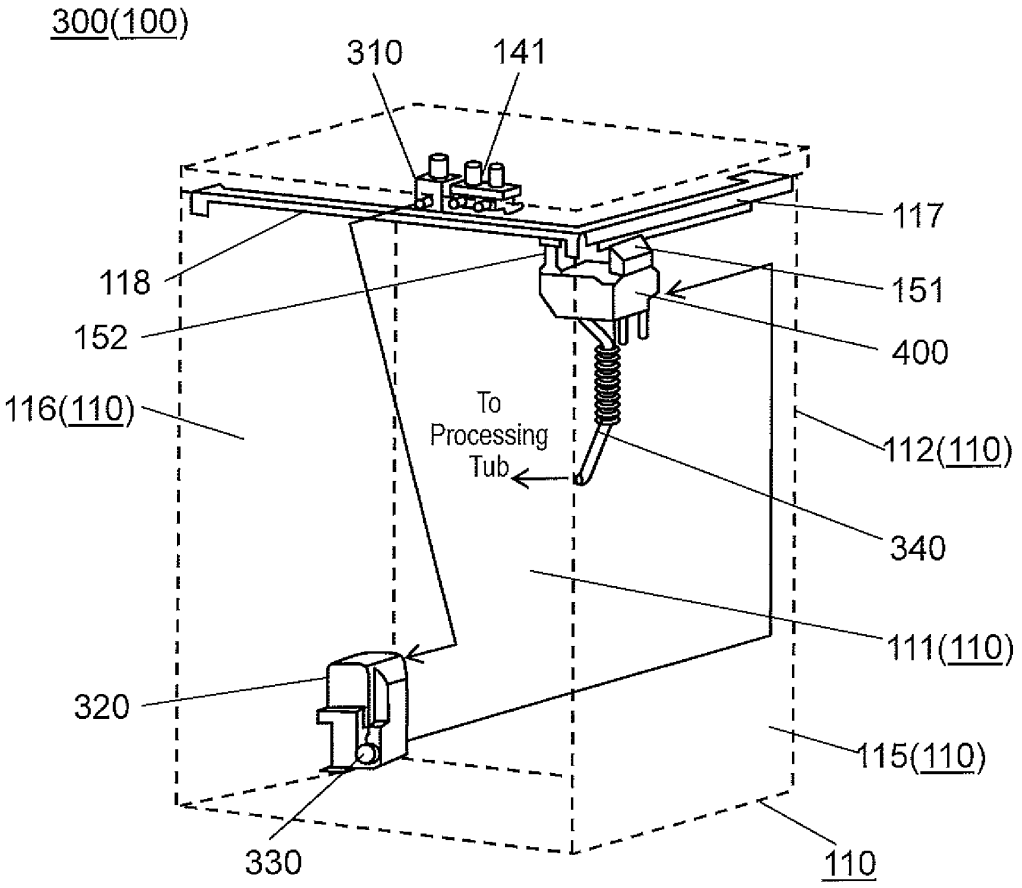

300(100)
310
141
117
118
151
152
400
116(110)
To
Processing
Tub
112(110)
340
111(110)
320
115(110)
330
110

FIG. 4A

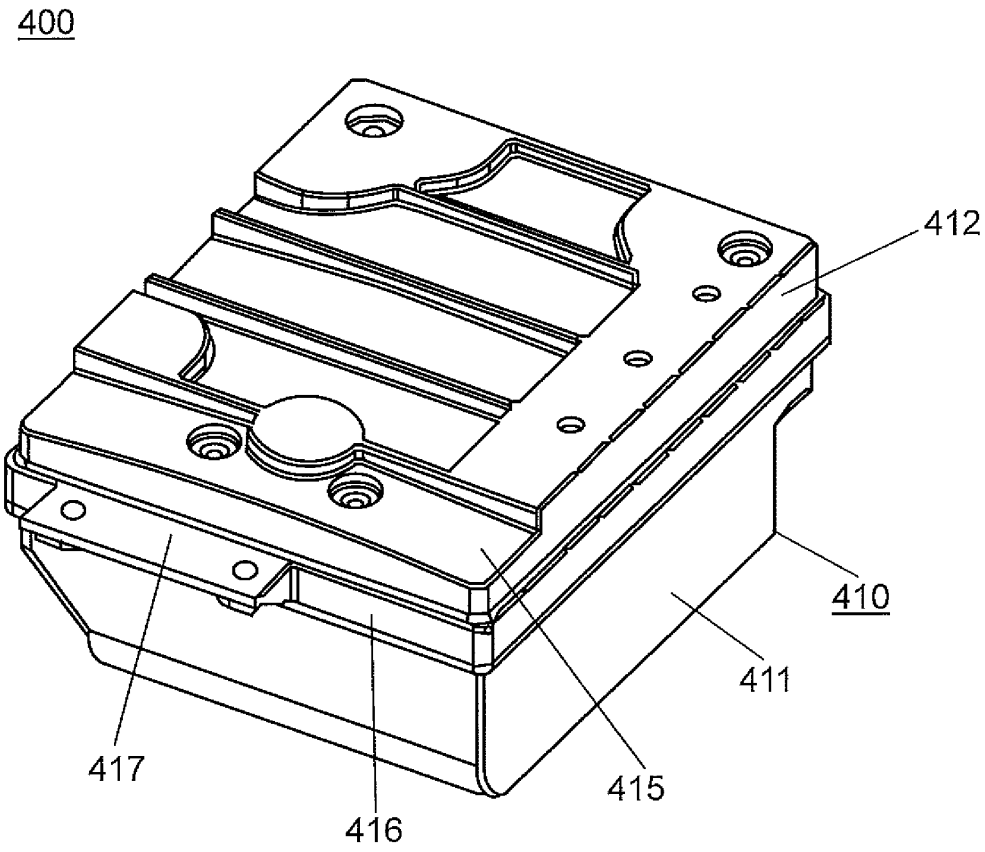


FIG. 4B

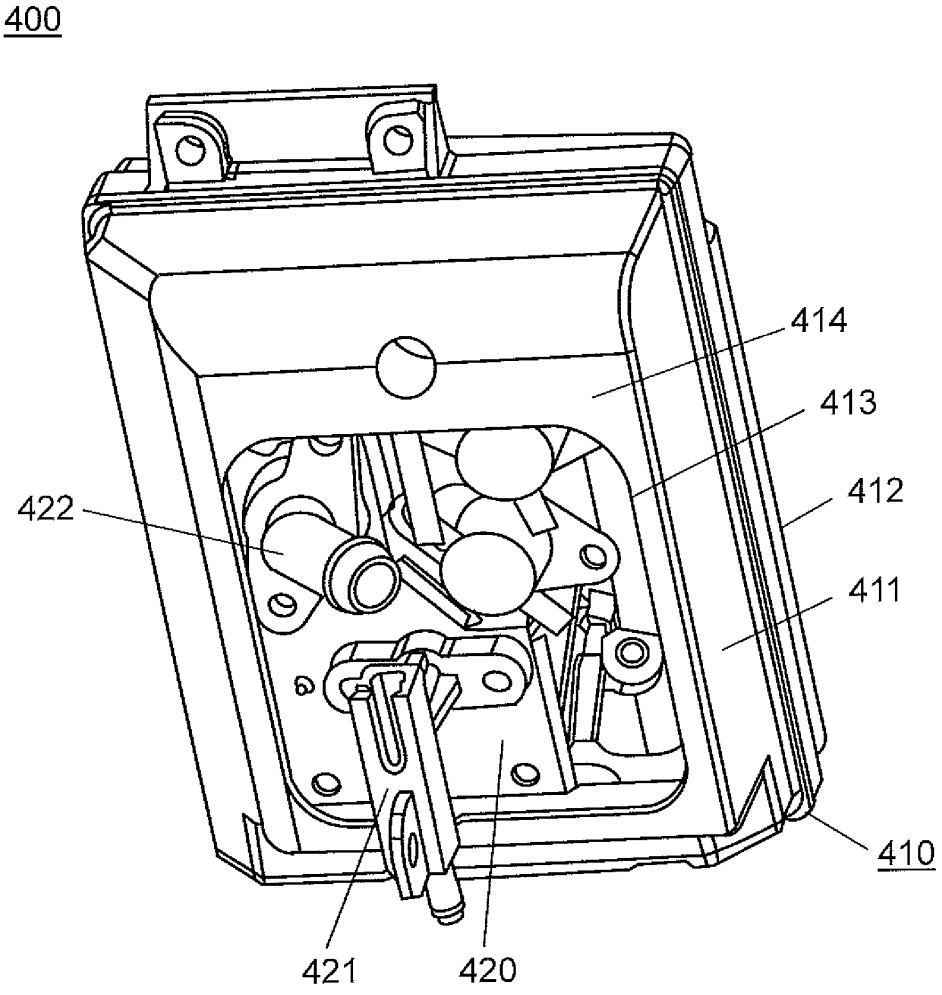


FIG. 5A

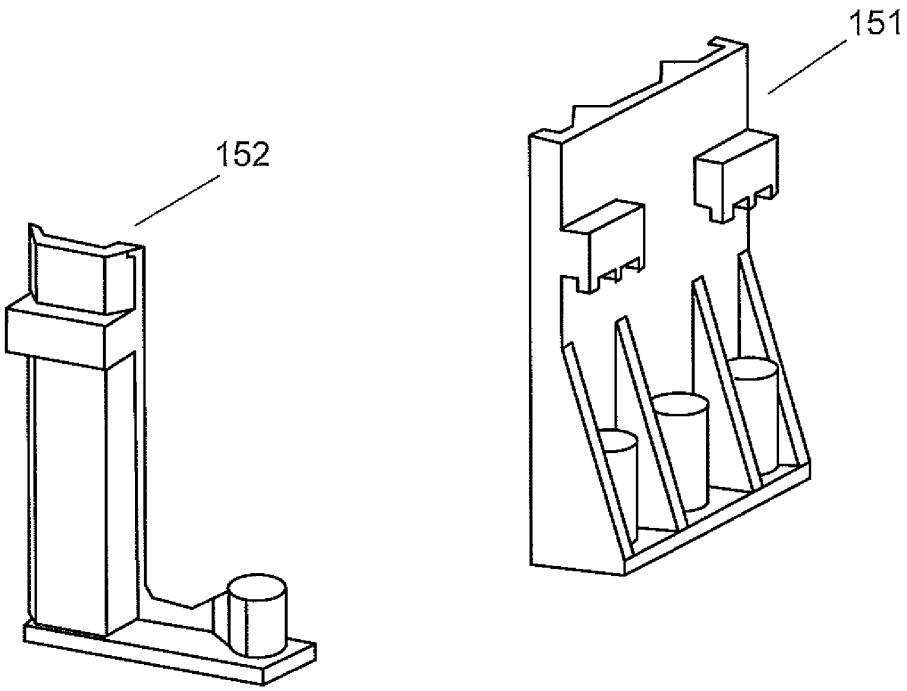


FIG. 5B

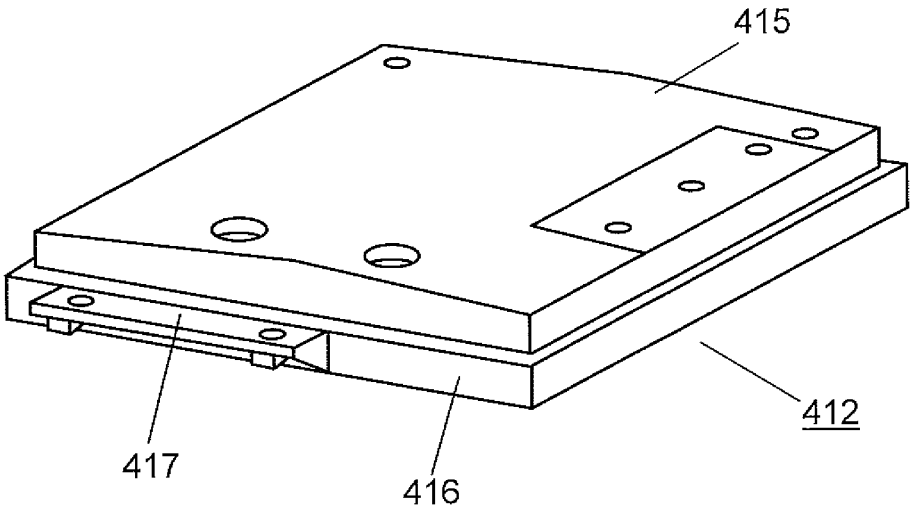


FIG. 6A

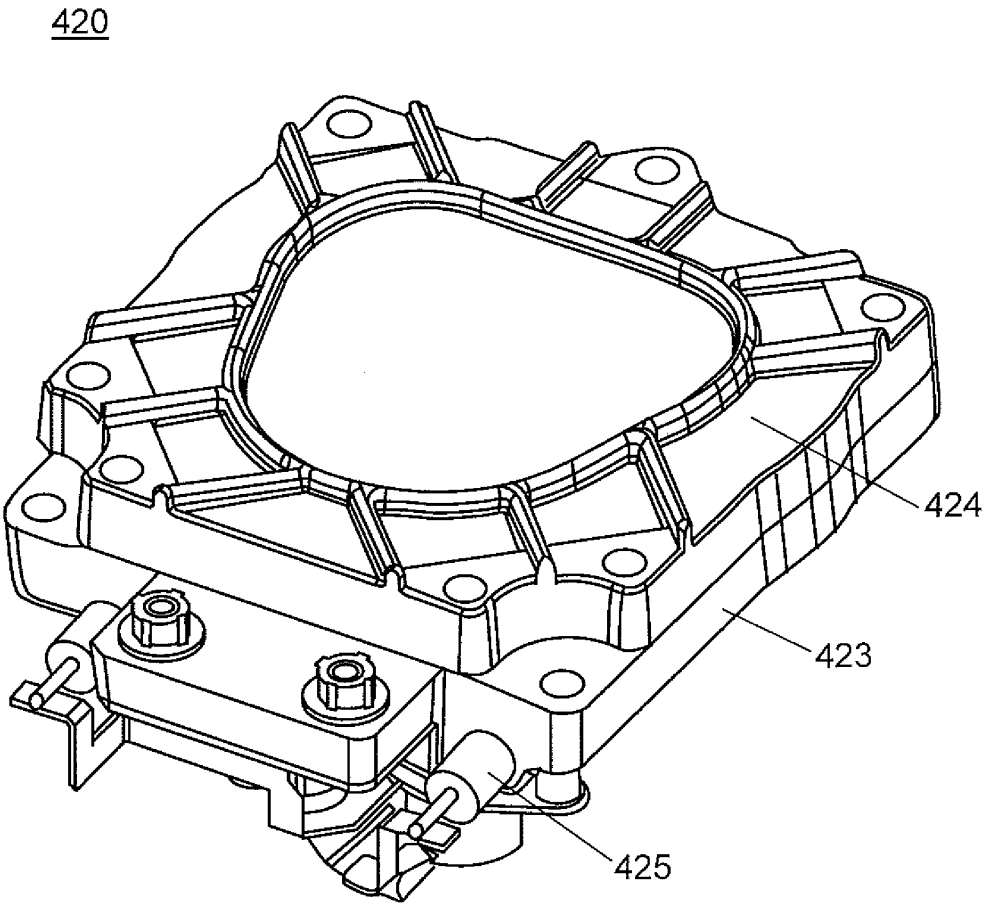


FIG. 6B

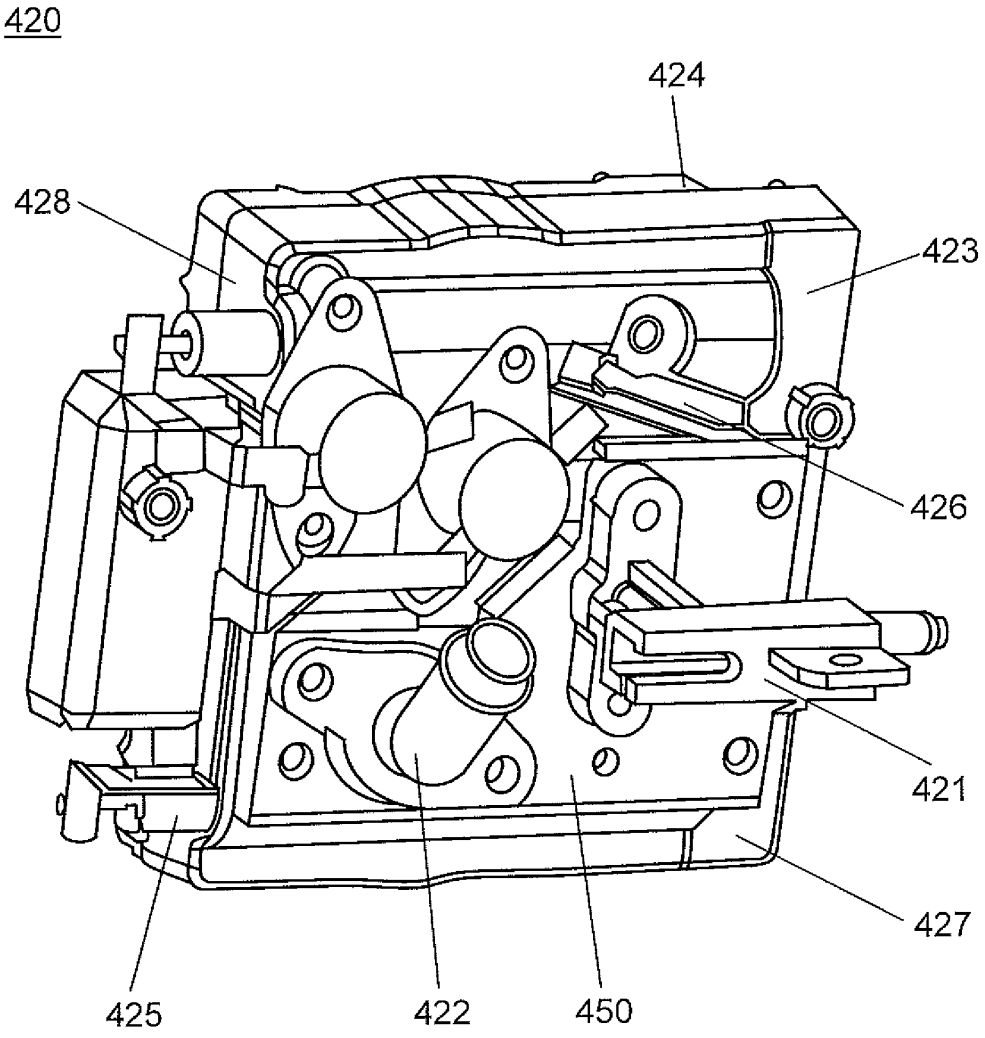


FIG. 7

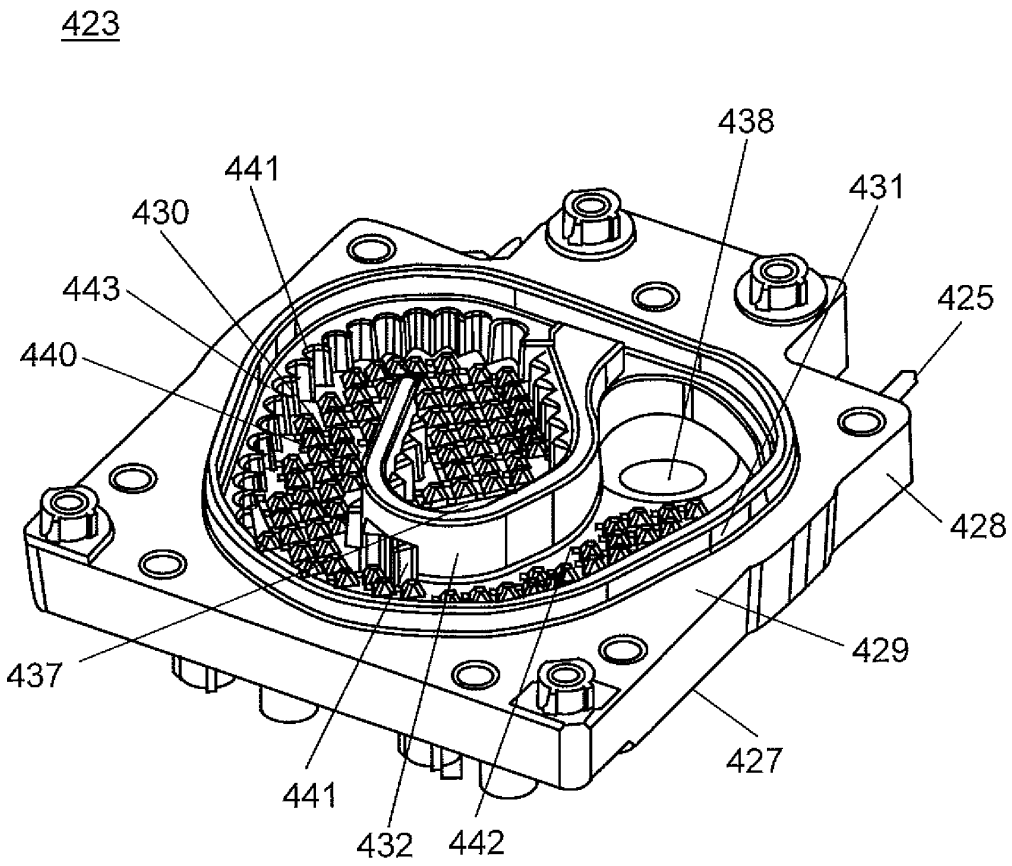


FIG. 8

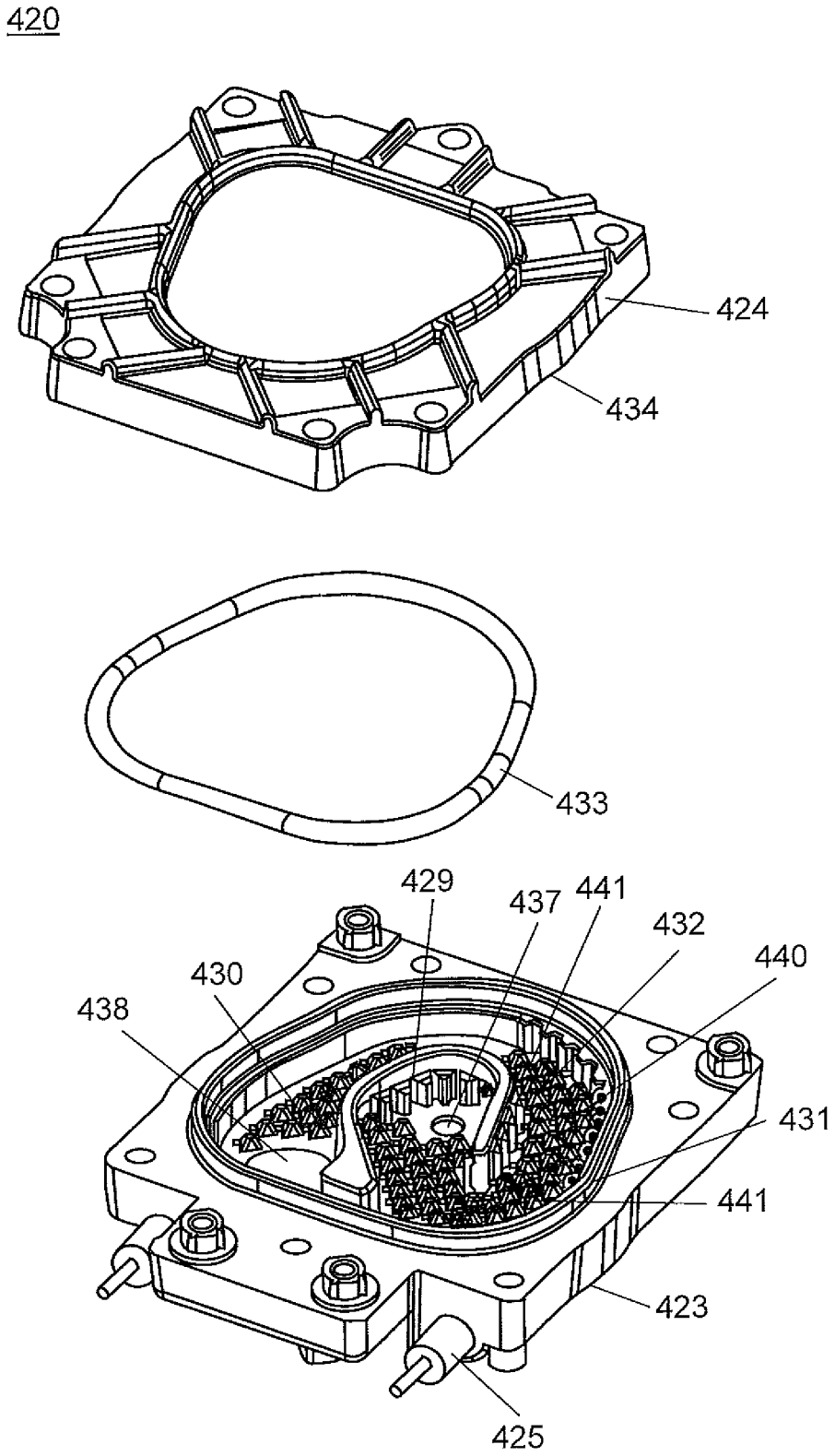


FIG. 9

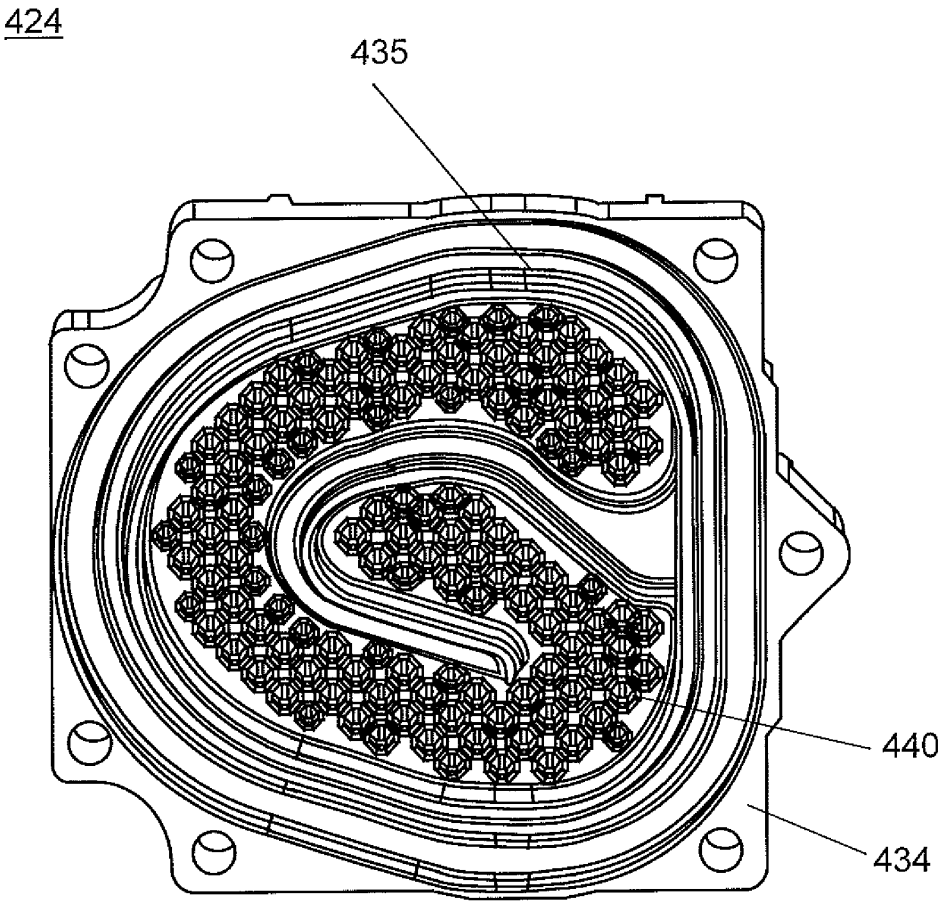


FIG. 10

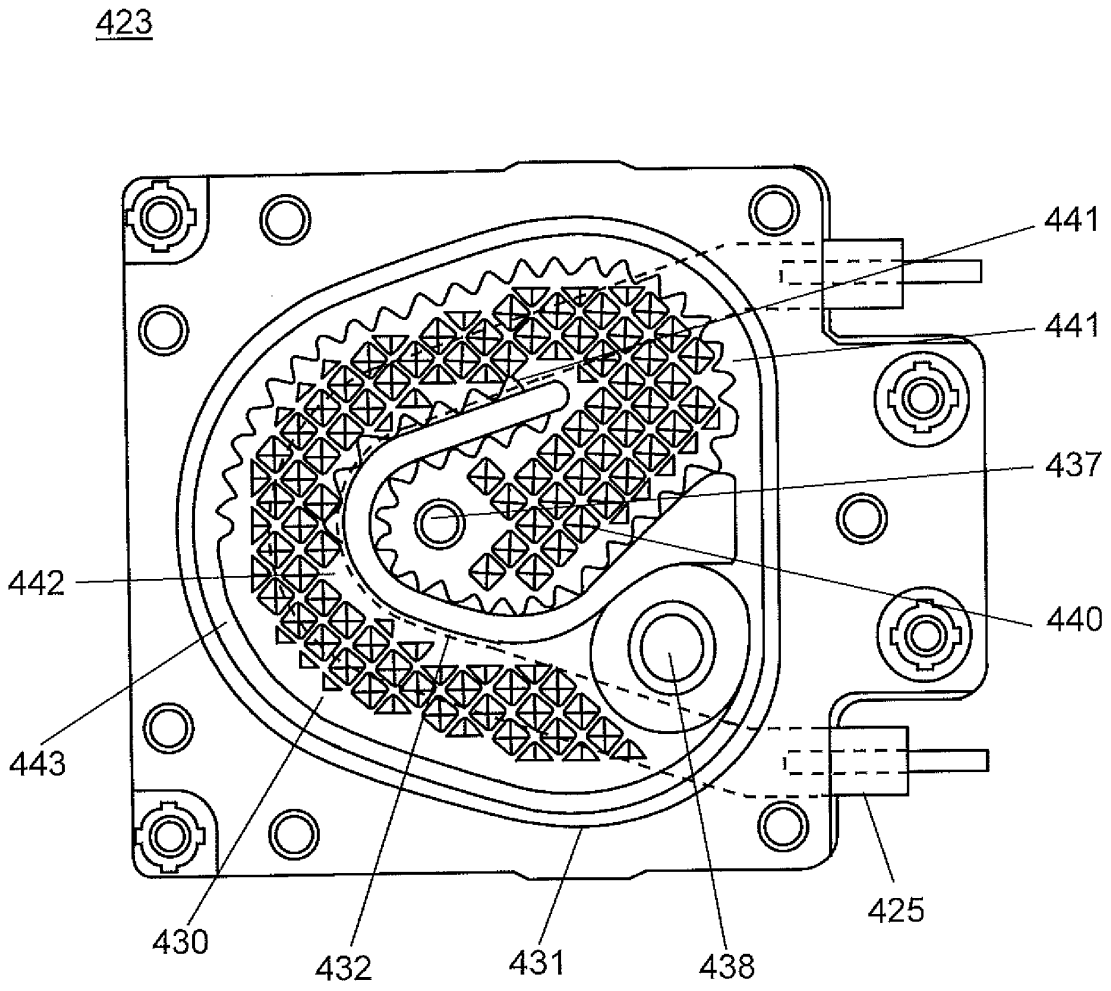


FIG. 11

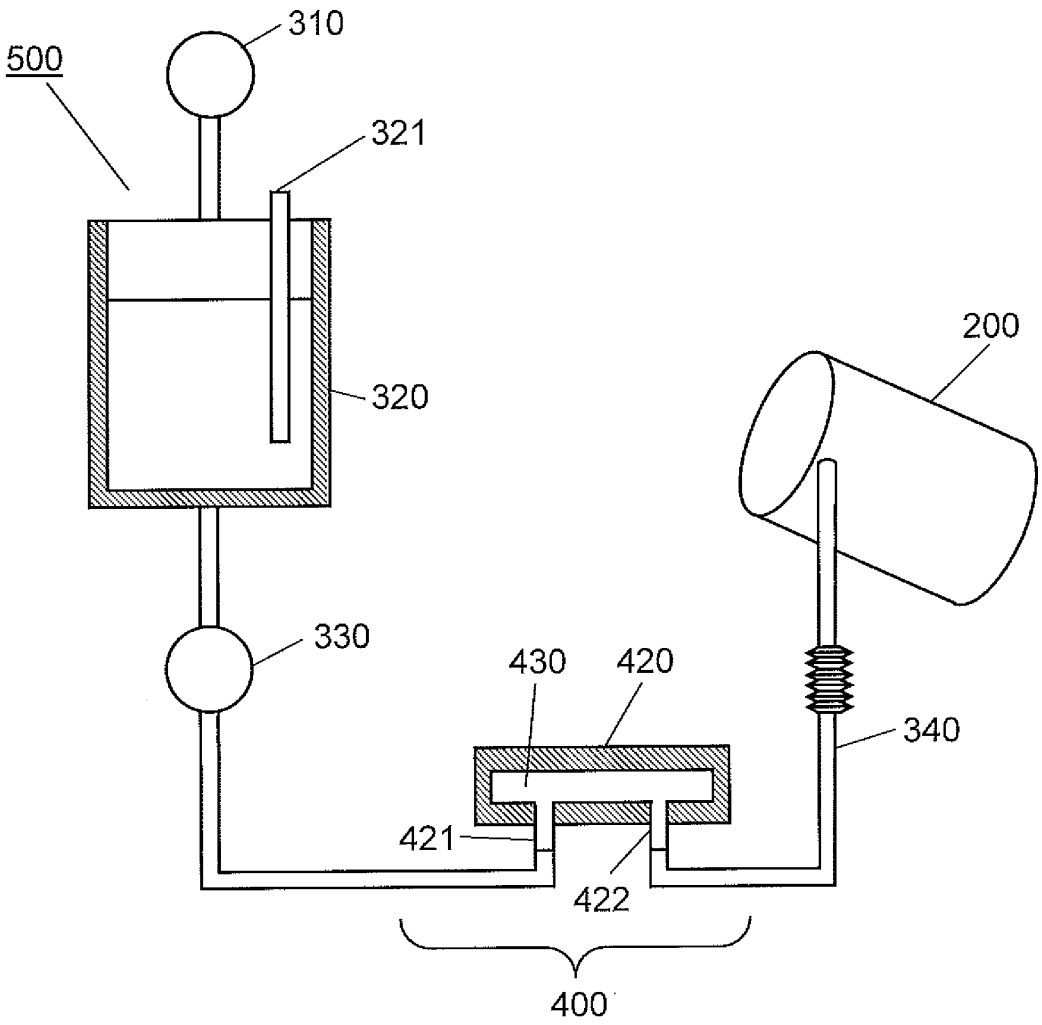


FIG. 12

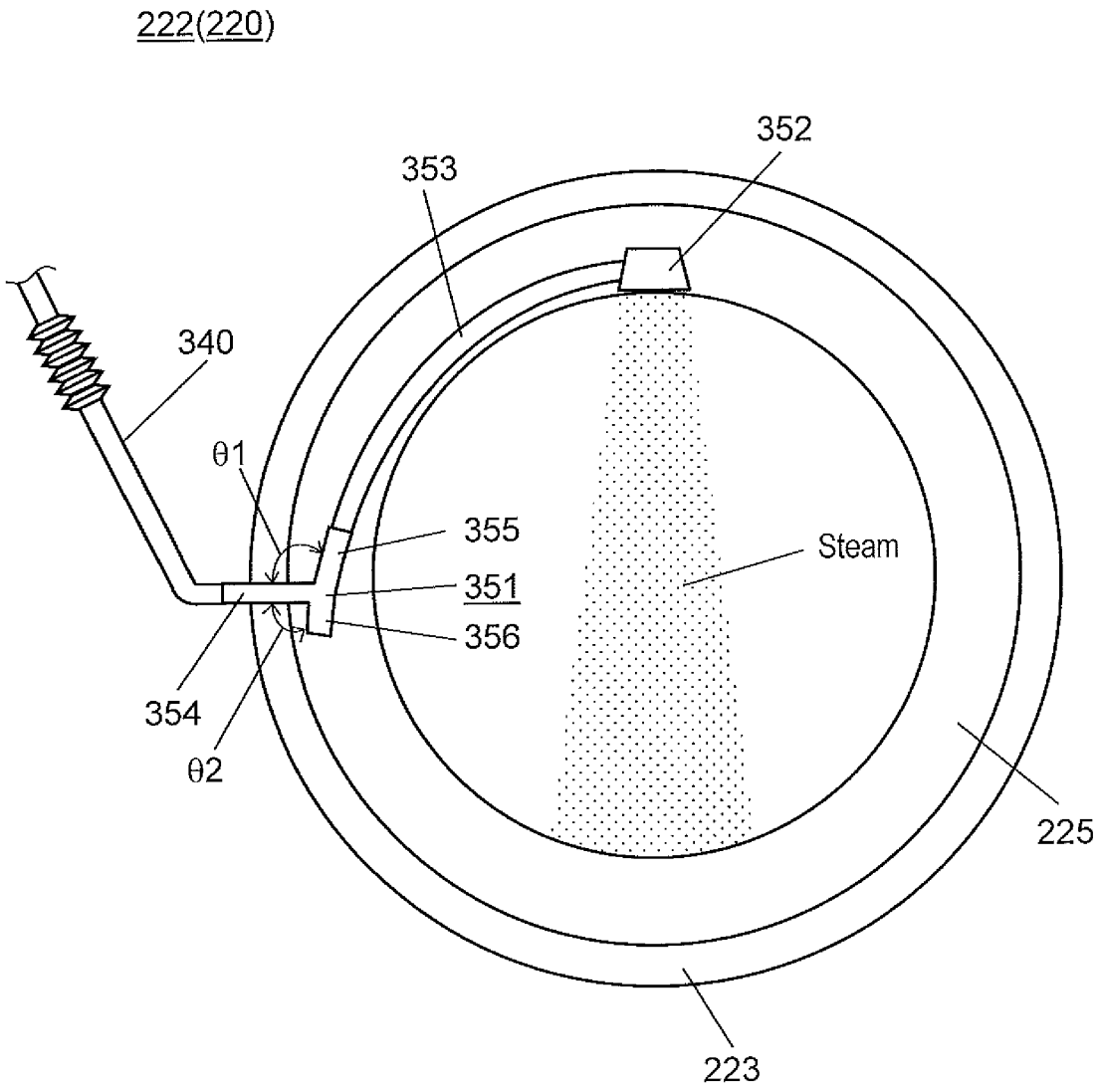


FIG. 13

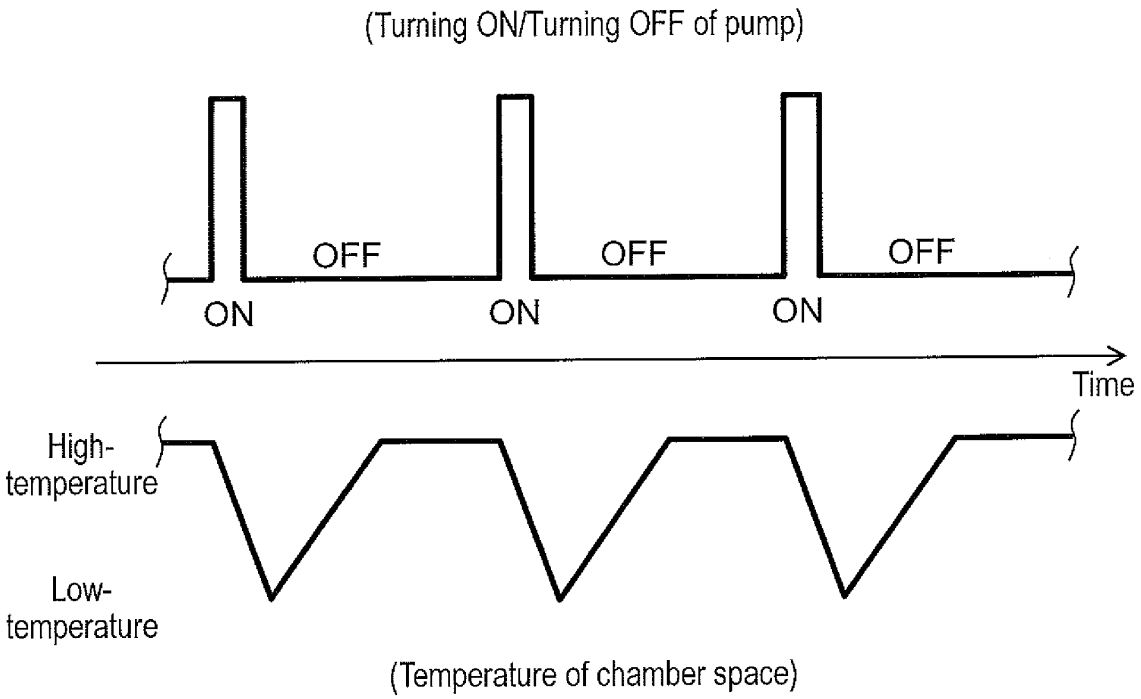

(Turning ON/Turning OFF of pump)
OFF
OFF
OFF
ON
ON
ON
Time
High-temperature
Low-temperature
(Temperature of chamber space)

FIG. 14

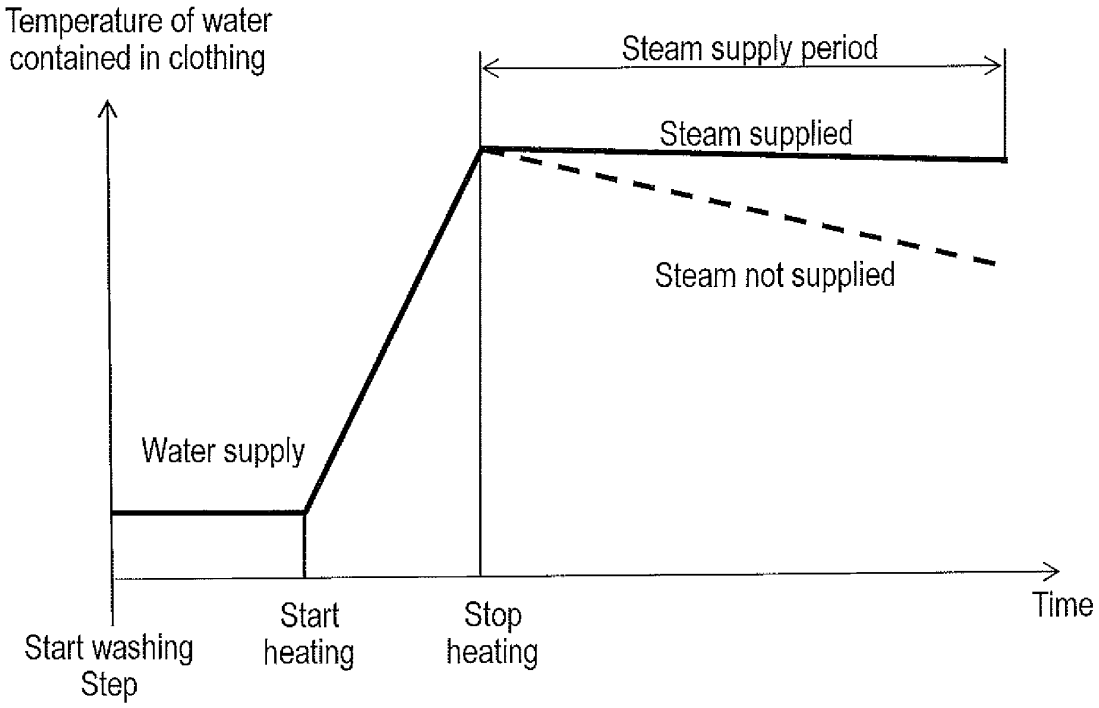

Temperature of water contained in clothing
Steam supply period
Steam supplied
Steam not supplied
Water supply
Time
Start washing Step
Start heating
Stop heating

FIG. 15A

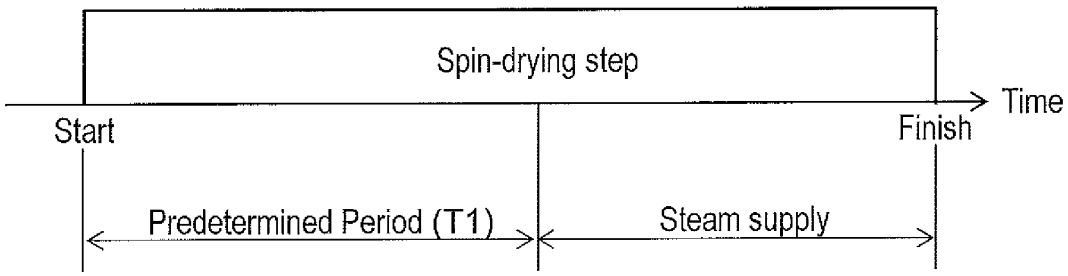


FIG. 15B

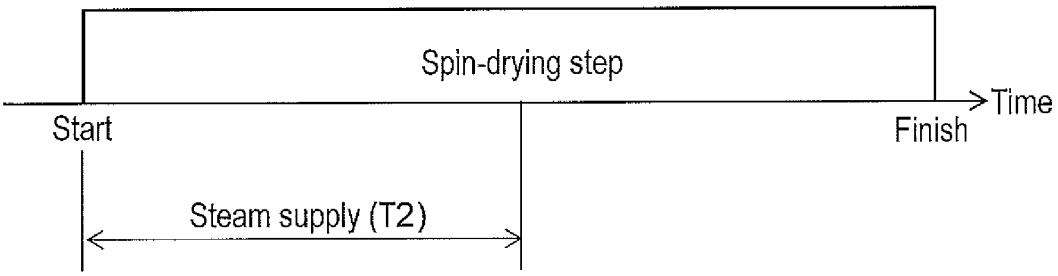


FIG. 15C

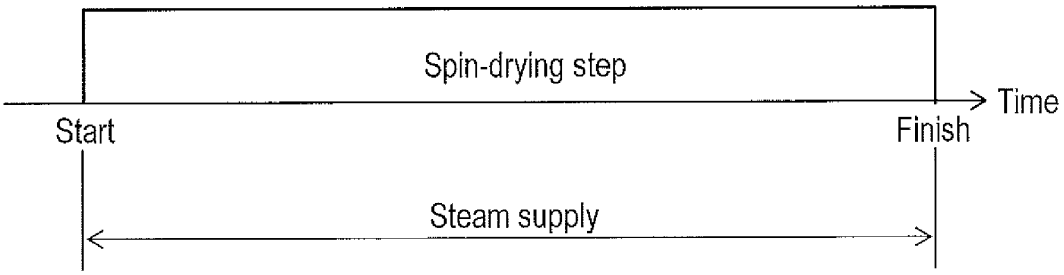


FIG. 16

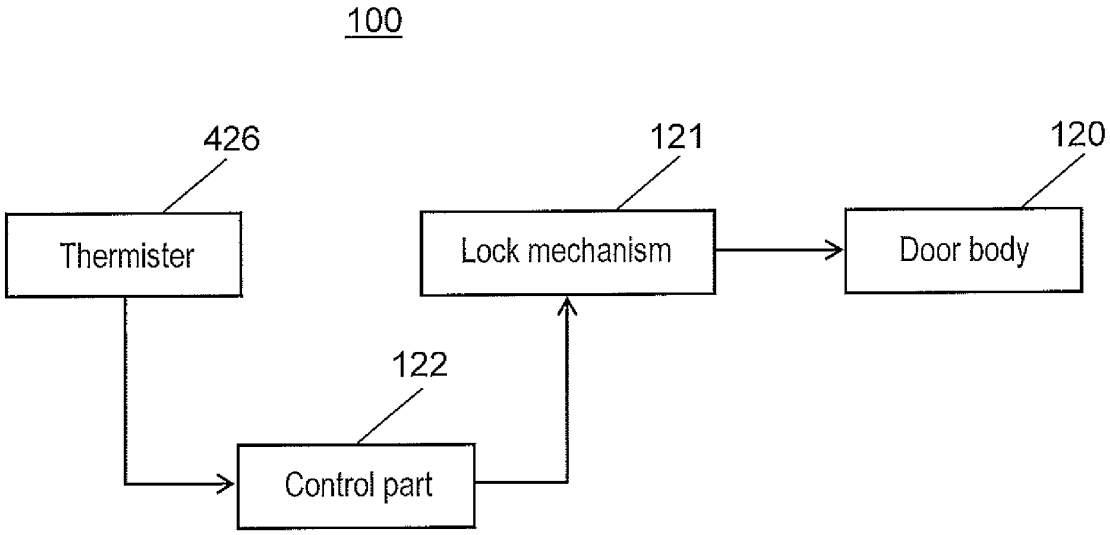

100
426
Thermister
121
Lock mechanism
120
Door body
122
Control part

FIG. 17

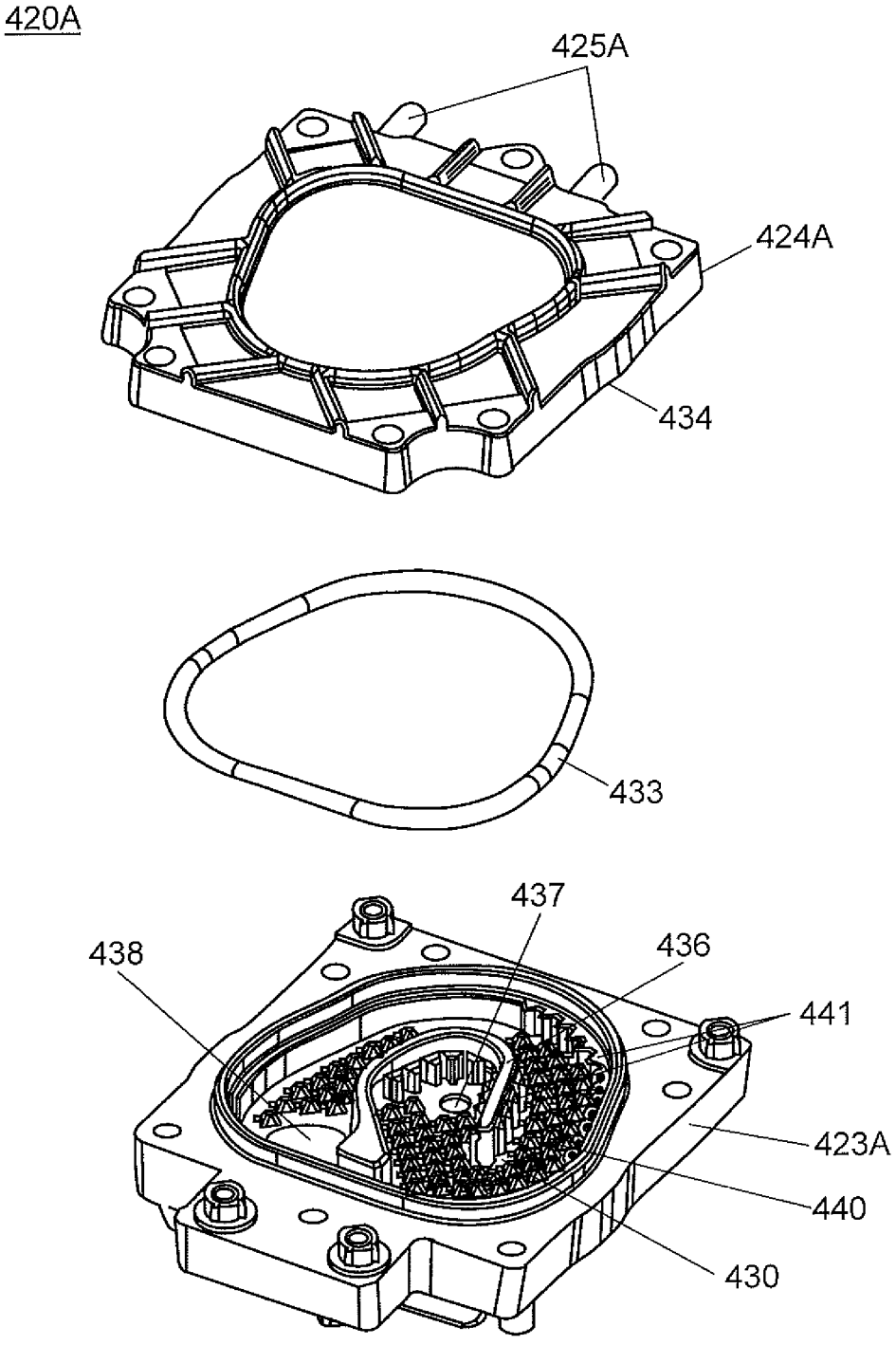
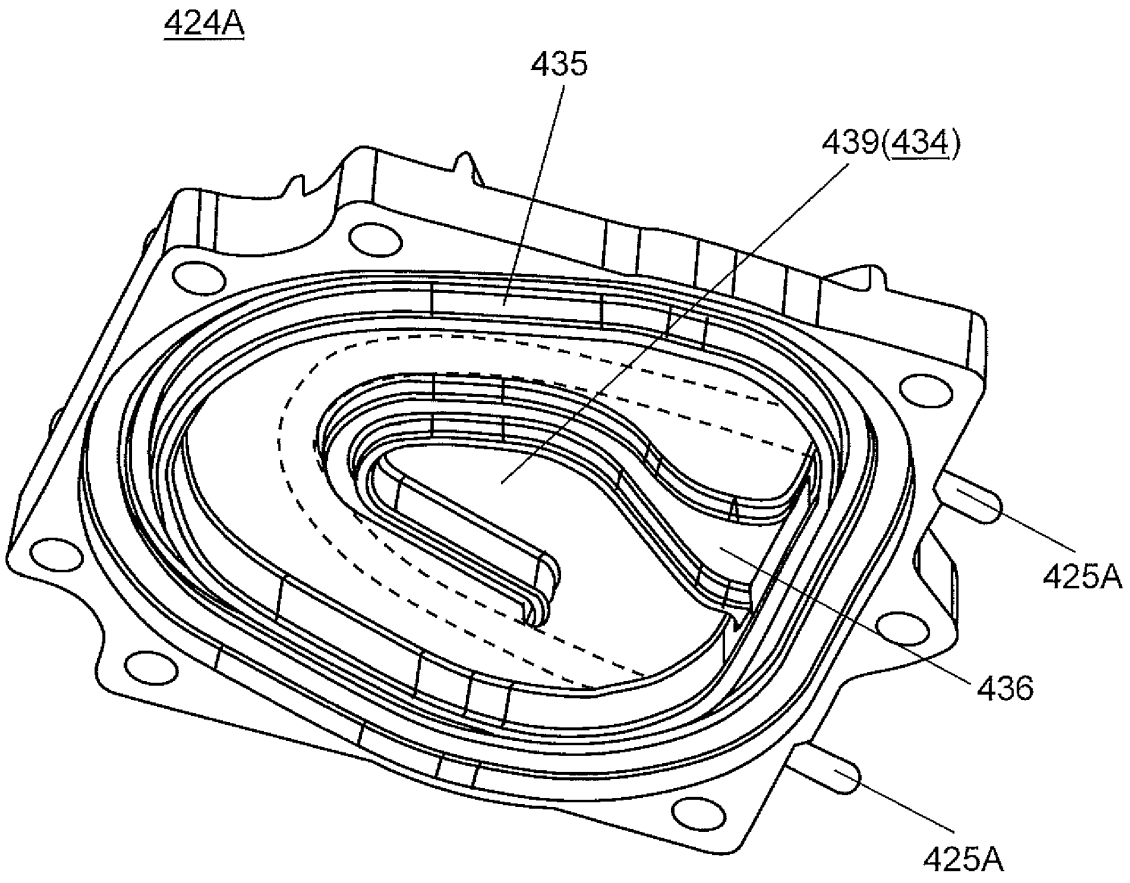


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/004498

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 4715532 B2 (Panasonic Corp.), 06 July 2011 (06.07.2011), fig. 1 (Family: none)	1-4

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

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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
15 October, 2013 (15.10.13)	29 October, 2013 (29.10.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/004498

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 174091/1980(Laid-open No. 99600/1982) (Hitachi Netsu Kigu Kabushiki Kaisha), 18 June 1982 (18.06.1982), fig. 3 (Family: none)	1-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 174083/1980(Laid-open No. 99599/1982) (Hitachi Netsu Kigu Kabushiki Kaisha), 18 June 1982 (18.06.1982), (Family: none)	1-4

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Patent documents cited in the description

- WO 2006126778 A **[0004]**