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(54) **Laundry processing apparatus**

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention is related to a laundry processing apparatus which has a door for closing and opening an opening to take laundry in and out.

Description of the Related Art

[0002] Laundry processing apparatuses such as washing machines, laundry dryers, and washing and drying machines which subject laundry to predetermined processes (washing, dewatering, rinsing, and drying processes) typically have a housing and a processing tub (a washing tub, a dewatering tub, or a drying tub) stored in the housing. The processing tub is rotated to perform the predetermined processes such as washing, rinsing, dewatering and drying processes. An opening for taking laundry in and out the processing tub is formed on the housing.

[0003] Document WO 2007/110441 A1 relates to a houshold appliance that comprises a door locked by a lock.

[0004] A washing machine disclosed in Japanese Patent Application Publication No. 2000-279679 or Japanese Patent Application Publication No. 2009-95529 have a door attached to a housing so as to rotate between a closing position where an opening is closed and an opening position where the opening is opened. When the door is at the opening position, laundry may be taken in and out a washing tub. The door at the closing position isolates a user from the washing tub during rotation of the washing tub and prevents the laundry from bouncing out the housing.

[0005] The washing machine disclosed in these patent documents has a lock mechanism configured to lock the door at the closing position. The lock mechanism prevents the door from accidentally rotating from the closing position to the opening position.

[0006] After unlocking the lock mechanism, a user may hold a handle attached to the outer surface of the door and turn the door from the closing position to the opening position.

[0007] The door of each washing machine is sensitive to a wrong operation by the user. As the wrong operation, it may be exemplified that the user attempts to turn the door to the opening position without unlocking the lock mechanism. In this case, relatively high local stress is caused in a connection between the handle attached to the outer surface of the door and the door, which results in damage to the handle and/or the door.

[0008] The aforementioned drawbacks on the damage to the handle and/or the door are also in common with laundry processing apparatuses such as laundry dryers, and washing and drying machines.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a laundry processing apparatus which has an attachment structure of a handle to suitably prevent damage to the handle and/or a door.

[0010] A laundry processing apparatus according to one aspect of the present invention has: a housing in which an opening for taking laundry in and out is formed; a door configured to rotate between a closing position where the door closes the opening and an opening position where the door opens the opening; and a handle used for rotating the door between the closing position and the opening position, wherein the handle includes a first piece pivotally supported by the door and a second piece protruding from the first piece and exposed outside the housing when the door is at the closing position, the door includes a restricting surface facing the housing when the door is at the closing position and restricting an angular motion of the first piece, and the first piece is positioned between the housing and the restricting surface when the door is at the closing position, and the first piece abuts the restricting surface when the door is rotated from the closing position to the opening position to restrict an angular motion of the handle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a schematic perspective view of a washing and drying machine according to one embodiment of a laundry processing apparatus;
FIG. 2 is a front view of the washing and drying machine shown in FIG. 1;
FIG. 3 is a schematic cross-sectional view of the washing and drying machine shown in FIG. 1;
FIG. 4 is a schematic cross-sectional view of a door of the washing and drying machine shown in FIG. 1;
FIG. 5 is a schematic perspective view of the exploded door shown in FIG. 4;
FIG. 6 is an inner perspective view of the door shown in FIG. 4;
FIG. 7 is a perspective view of an attachment ring of the door shown in FIG. 4;
FIG. 8 is a perspective view of the attachment ring of the door shown in FIG. 4;
FIG. 9 is a schematic enlarged cross-sectional view showing the door around a handle of the door shown in FIG. 4;
FIG. 10 is a schematic enlarged perspective view of the door around the handle shown in FIG. 9;
FIG. 11 is a schematic enlarged perspective view of the door around the handle shown in FIG. 9;
FIG. 12 is a schematic view showing a positional relationship between the handle shown in FIG. 9 and a lock mechanism;
FIG. 13A-13C are schematic cross-sectional views

of a lock control unit which forms a lock hole on the housing of the washing and drying machine shown in FIG. 1;

FIG. 14 is a block diagram showing a schematic configuration of a detector of the washing and drying machine shown in FIG. 1;

FIG. 15 is a flowchart schematically showing operations of the detector shown in FIG. 14;

FIG. 16 is a schematic enlarged cross-sectional view around a connection between the door and the housing of the washing and drying machine shown in FIG. 1;

FIG. 17 is a schematic enlarged cross-sectional view around the connection between the door and the housing of the washing and drying machine shown in FIG. 1; and

FIG. 18 is a schematic perspective view of a exploded left-hand door.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] The laundry processing apparatus according to one embodiment is described hereinafter with reference to the drawings. It should be noted that directional terms such as "upper/above," "lower/below," "left" and "right" hereinafter is to merely clarify the descriptions and not to limit the methodologies of the laundry processing apparatus in any way.

(Configuration of Laundry Processing Apparatus)

[0013] FIG. 1 is a perspective view of a washing and drying machine exemplified as the laundry processing apparatus. FIG. 2 is a front view of the washing and drying machine shown in FIG. 1. In the following descriptions, the washing and drying machine is exemplified as the laundry processing apparatus. However the laundry processing apparatus may be a washing machine without a drying function or a laundry dryer without a washing function. It should be noted that the term "washing and drying machine" means an apparatus which has both the washing function and the drying function.

[0014] A washing and drying machine 100 has a housing 200 and a door 300. The rectangular-boxed housing 200 includes an upright front wall 210, a back wall 220 opposite to the front wall 210, left and right walls 230, 240 which stand upright between the front and back walls 210, 220, a top wall 250 which forms the upper surface of the housing 200, and a bottom wall 260 which forms a bottom surface of the housing 200.

[0015] The front wall 210 includes a lower wall 211 disposed on a lower portion of the washing and drying machine 100, a main wall 212 disposed above the lower wall 211, and an upper wall 213 disposed above the main wall 212. The main and upper walls 212, 213 are upwardly curved and inclined toward the back wall 220. In the present embodiment, the outer surface of the main wall 212 is exemplified as the first surface. The outer surface of the back wall 220 is exemplified as the second surface.

[0016] The main wall 212 includes an annular concave surface 214 which forms a concave area complementary to a substantially disc-shaped door 300. The concave surface 214 surrounds an opening 215 formed on substantially the center of the main wall 212. The opening 215 is communicated with a washing and drying tub (described later) stored in the housing 200. A user may take laundry (clothes and alike) in and out the housing 200 through the opening 215. In the present embodiment, the washing and drying tub is exemplified as the processing tub. If the laundry processing apparatus is a washing machine without a drying function, a washing tub configured to perform wash, rinsing and/or dewatering processes may be used as the processing tub. If the laundry processing apparatus is a laundry dryer without a washing function, a drying tub configured to agitate the laundry to facilitate drying thereof may be used as the processing tub.

[0017] The washing and drying machine 100 has a hinge structure 400 configured to pivotally connect the door 300 to the housing 200. The hinge structure 400 allows the door 300 to rotate between a closing position where the door 300 closes the opening 215 and an opening position where the door 300 opens the opening 215. The door 300 rotated to the closing position is stored in the concave area surrounded by the concave surface 214. It should be noted that the door 300 shown in FIGS. 1 and 2 are positioned at the opening position.

[0018] FIG. 3 is a schematic cross-sectional view of the washing and drying machine 100 with the door 300 at the closing position. The entire structure of the washing and drying machine 100 is further described using FIGS. 1 to 3. It should be noted that other structures than the internal structure of the housing 200 shown in FIG. 3 may be applied to the laundry processing apparatus.

[0019] As shown in FIG. 3, the washing and drying tub 110 is disposed in the housing 200. The washing and drying tub 110 includes a one-end bottomed cylindrical water tub 111 which is supported in the housing 200 and allowed to be rolling, and a one-end bottomed cylindrical rotary drum 112 which is rotatably supported in the water tub 111. A motor 113 configured to rotate the rotary drum 112 is also disposed in the housing 200. The motor 113 is attached to the outer surface of the bottom of the water tub 111. An opening of the water tub 111 is formed by a substantially cylindrical tubular port 114 which projects toward the door 300 at the closing position. A substantially cylindrical seal member 115 is fitted into the tubular port 114.

[0020] As shown in FIGS. 1 and 2, the door 300 includes a one-end bottomed transparent window 310 which is in the shape of a substantially trapezoidal cone, and a substantially disc-shaped support frame 320 configured to support the window 310. As shown in FIG. 3, when the door 300 is situated at the closing position, the window 310 is inserted into the opening 215 formed on the housing 200 to push the seal member 115 attached

to the water tub 111. Accordingly, a watertight seal structure is formed between the water tub 111 and the window 310. A user may observe laundry in the washing and drying tub 110 through the transparent window 310 while the door 300 is at the closing position. It should be noted that a surface of the door 300 which faces the opening 215 and/or the concave surface 214 when the door 300 is at the closing position is referred to as "inner surface 313".

[0021] As shown in FIG. 3, a drain port 116 configured to drain washing liquid and an inflow port 117 into which the washing liquid flows are formed on the water tub 111. The washing liquid used for washing the laundry is circulated between the drain port 116 and the inflow port 117.

[0022] The housing 200 further stores a water supply system 120 configured to supply water into the water tub 111, a drainage system 130 configured to drain or circulate the washing liquid in the water tub 111, and a drying system 140 configured to send hot air to the washing and drying tub 110 to dry laundry. It should be noted that the drying system 140 is not required if the laundry processing apparatus is a washing machine without a drying function. Also, the water supply system 120 or the drainage system 130 may not be used if the laundry processing apparatus is a laundry dryer without a washing function.

[0023] The drying system 140 includes a circulation pipeline 142 which has one end connected to an exhaust port 141 of the water tub 111 and a vent for sending drying air from the bottom of the water tub 111, and a blower 143 disposed in the circulation pipeline 142 and allowing the air to flow in the circulation pipeline 142. Optionally, the drying system 140 may also include a filter for recovering lint to remove dust, a dehumidifier configured to dehumidify the air introduced after the dust removal, and a heater configured to heat the air after the dust removal to generate the dry and hot air.

[0024] As shown in FIGS. 1 and 2, the washing and drying machine 100 has an operation panel 500 disposed on the upper wall 213. The operation panel 500 allows a user to select a mode of an operation course or various other functions of the washing and drying machine 100. As shown in FIG. 3, the operation panel 500 includes a control circuit 510. The control circuit 510 displays information input by the user on a display of the operation panel 500. If a start of an operation of the washing and drying machine 100 is set by the operation panel 500, for example, detection signals are received from a liquid level sensor, which detects a liquid level of the water tub 111, an optical sensor 131, which is used as a turbidity sensor for detecting turbidity of the washing liquid, as well as from an electrode sensor 132, which is used as an electrical conductive sensor for detecting the electrical conductivity of the washing liquid. Based on these detection signals, devices such as a solenoid valve included in the water supply system 120 and a drain valve 133 included in the drainage system 130 are controlled. The motor 113, the water supply system 120, the drainage system 130 and the drying system 140 are automatically controlled by the control circuit 510 in accordance with the mode setting or a control program, so that the washing, rinsing, dewatering and drying processes may be executed.

[0025] As schematically shown in FIGS. 1 and 2, the washing and drying machine 100 has a lock mechanism 600 configured to lock the door 300 at the closing position. The control circuit 510 is used as a control element configured to control a lock control unit (described later), which locks the door at the closing position in cooperation with the lock mechanism 600.

[0026] As shown in FIG. 3, the water supply system 120 includes a water supply pipeline 121 connected to the water tub 111, and a detergent storage 122 configured to store detergent. As shown in FIG. 1, a cover 251 configured to close the detergent storage 122 is attached to the top wall 250 of the housing 200.

[0027] The water supply system 120 shown in FIG. 3 may supply water to the water tub 111 via the water supply pipeline 121 at appropriate timings by means of opening/closing operations of the solenoid valve (see the solid arrows in FIG. 3). In addition, the washing and drying machine 100 may introduce, into the water tub 111 at appropriate timings, the detergent stored in the detergent storage 122, which partially crosses the water supply pipeline 121, using water supplied by the water supply system 120.

[0028] The drainage system 130 includes a first pipeline 134 which has one end connected to the drain port 116 of the water tub 111, a drainage control unit 135 which is connected to the other end of the first pipeline 134 to receive the washing liquid from the water tub 111, and a second pipeline 137 which extends between a circulation pump 136 of the drainage control unit 135 and the water tub 111. The circulation pump 136 is fixed to a board 138 disposed in the housing 200. One end of the second pipeline 137 is connected to an ejection port of the circulation pump 136 while the other end of the second pipeline 137 is connected to the inflow port 117 of the water tub 111. The water tub 111, the first pipeline 134, the drainage control unit 135 and the second pipeline 137 form a circulation path for the washing liquid. The circulation pump 136 allows the washing liquid to flow and circulate from the drain port 116 toward the inflow port 117 in the circulation path.

[0029] In addition to the circulation pump 136, the drainage control unit 135 includes the optical sensor 131 which is used as a turbidity sensor for detecting turbidity of the washing liquid, the electrode sensor 132 which is used as an electrical conductive sensor for detecting the electrical conductivity of the washing liquid, a drainage pipeline 139 for draining the washing liquid to the outside, the drain valve 133 which is disposed in the middle of the drainage pipeline 139 and opens/closes the drainage pipeline 139, and a filter 191 which recovers lint (yarn wastes and alike) contained in the washing liquid flowing from the first pipeline 134.

[0030] The drain valve 133 opens as appropriate, for example, at the end of the washing or rinsing process. Consequently, washing water flowing from the first pipeline 134 into the drainage control unit 135 is subjected to a lint removal process by the filter 191, and then discharged to the outside.

[0031] If the drain valve 133 is closed and the circulation pump 136 is activated, the washing liquid in the water tub 111 flows into the drainage control unit 135 via the first pipeline 134. Thereafter, the washing liquid passes through the filter 191 in the drainage control unit 135, and is subjected to impurity removal. After passing through the filter 191, the washing liquid flows into the circulation pump 136 through a suction pipeline 192 connected to a suction port of the circulation pump 136, and then is returned to the water tub 111 through the second pipeline 137 connected to the ejection port of the circulation pump 136. The washing and rinsing processes are effectively performed by repeatedly carrying out this circulation of the washing liquid as appropriate during the washing or rinsing process.

[0032] The circulation pump 136 may vary in rotational speed. In the case of higher rotational speed of the circulation pump 136 (e.g., 3500 rpm), the washing liquid which flows into the inflow port 117 of the water tub 111 moves along a trajectory toward the rotary drum 112 (see the arrow Fi in FIG. 3). On the other hand, in the case of lower rotational speed of the circulation pump 136 (e.g., 1000 rpm), the washing liquid which flows into the inflow port 117 of the water tub 111 moves toward a space between the rotary drum 112 and the water tub 111 (see the arrow Fo in FIG. 3).

[0033] For example, the circulation pump 136 is rotated at lower speed at the beginning of at least one of the washing and rinsing processes, so that it becomes less likely that unresolved detergent remaining after the washing process or highly concentrated softener immediately after its introduction into the washing tub 111 spreads over the laundry in the rotary drum 112.

[0034] The washing liquid flowing into the space between the rotary drum 112 and the water tub 111 is drained from the drain port 116 to the drainage system 130, and again returns to the inflow port 117 of the water tub 111 (a water tub circulation process). It is likely that the repetitive water tub circulation process completely dissolves the detergent and makes the concentration of the softener uniform. Therefore it is less likely that problems such as stain on the laundry are caused by the unresolved detergent or the highly concentrated softener.

[0035] The water tub circulation process is preferably set to start, for example, about 10 seconds after the water supply process for the washing and/or rinsing processes. Alternatively, the water tub circulation processes is preferably started, for example, when a liquid level of about 40 mm from the lower end of the water tub 111 is detected. Thus it is less likely that the circulation pump 136 is activated without a sufficient amount of the washing liquid therein, so that abnormal noise such as bubble intrusion sound in the circulation pump 136, an abnormal temperature of the circulation pump 136 generated because of an insufficient amount of the washing liquid, and the activation of the circulation pump 136 under such abnormal temperature are less likely to occur.

[0036] The washing and drying machine 100 may further have a pump configured to supply bathwater to the water tub 111. In this case, it is preferred that the water tub circulation process is performed after supplying the bathwater to the water tub using the bathwater supply pump in order to prevent simultaneous operation of the bathwater supply pump and the circulation pump 136, which causes loud noise and makes a user uncomfortable.

[0037] A user may operate the operation panel 500 to set reserved operations on the washing and drying machine 100. Once the reserved operation is set on the washing and drying machine 100, for example, the water tub circulation process is preferably performed for a period of time, which is twice as long as usual. Consequently, the detergent solidified while the washing and drying machine 100 is on reservation standby (during a period of time from setting the reservation to actually starting the operation of the washing and drying machine 100) is dissolved thoroughly. This may not only cause great washing power but also prevent unresolved detergent during the reserved operation.

[0038] Optionally, the washing and drying machine 100 may further have a temperature sensor. The duration of the water tub circulation process may be changed according to the temperature of the washing water, which is measured by the temperature sensor. For instance, if the temperature sensor detects 5°C of the washing water temperature, the washing and drying machine 100 may execute the water tub circulation process for a period of time which is, for example, twice as long as the water tub circulation process executed when 20°C is detected as the washing water temperature. Therefore, the detergent may be dissolved thoroughly even under low water temperature.

[0039] As shown in FIGS. 1 and 2, the washing and drying machine 100 has a handle 700 attached to the support frame 320 of the door 300 beside the lock mechanism 600. A user may hold the handle 700 projecting from the support frame 320 to rotate the door 300 between the closing position and the opening position.

(Structure of Door)

[0040] FIG. 4 is a schematic cross-sectional view of the door 300. FIG. 5 is a schematic perspective view of the exploded door 300. The door 300 is described using FIGS. 1, 4 and 5.

[0041] The door 300 has the window 310 and the support frame 320, as described above. The glass-made window 310 is in the shape of a substantially trapezoidal cone. A leading wall 311, which is inserted first into the

opening 215 (see FIG. 1) when the door 300 is rotated to the closing position, is smaller in diameter than a circular space surrounded by a substantially circular rim 312 connected to the support frame 320. As described above, the seal member 115 (see FIG. 4) abuts a substantially annular inclined wall 314, which extends from the substantially circular leading wall 311 to the rim 312.

[0042] The support frame 320 includes a substantially annular attachment ring 321, a cover disc 322 which externally covers the attachment ring 321, and a substantially annular edge ring 323 which is fitted into the periphery of the cover disc 322. A surface of the cover disc 322 has substantially the same curved surface as the curved main wall 212. Because the surface of the cover disc 322 is curved along the main wall 212, a user may easily clean the cover disc 322. The handle 700, the lock mechanism 600 and the hinge structure 400 are attached to the attachment ring 321 in addition to the window 310. The hinge structure 400 and the lock mechanism 600 are roughly aligned along the horizontal diameter of the door 300. As shown in FIG. 1, the hinge structure 400 and the lock mechanism 600 are disposed on either end of the diameter of the door 300. The handle 700 is disposed adjacent to and above the lock mechanism 600.

[0043] As shown in FIGS. 4 and 5, the support frame 320 further has a substantially annular holding ring 324. The holding ring 324 nips the rim 312 of the window 310 with the attachment ring 321. The attachment ring 321 and the holding ring 324 are used as supporting portions configured to support the handle 700, the lock mechanism 600 and the hinge structure 400.

[0044] As shown in FIG. 5, the holding ring 324 has a substantially L-shaped cross section. A flat surface 325 of the holding ring 324 and a surface of the leading wall 31 of the window 310, which face the inside of the housing 200 when the door 300 is at the closing position, form the inner surface 313 of the door 300. An inclined surface 326 that extends at an angle from the flat surface 325 of the holding ring 324 toward the attachment ring 321 forms a part of the periphery zone of the door 300.

[0045] As shown in FIG. 4, the concave surface 214 of the housing 200 includes a connecting surface 216, which faces the flat surface 325 of the holding ring 324 when the door 300 is at the closing position, and an opposing surface 217, which faces the inclined surface 326 of the holding ring 324 when the door 300 is at the closing position. As shown in FIGS. 1 and 4, the opposing surface 217 faces the periphery of the door 300. As shown in FIG. 5, the hinge structure 400 has first and second connecting members 410, 420. As shown in FIG. 1, the first connecting member 410 is connected to the connecting surface 216. The second connecting member 420 is connected to a surface 327 of the attachment ring 321 facing the holding ring 324 (see FIG. 5).

(Structure of Hinge Structure)

[0046] FIG. 6 is a perspective view of the door 300 viewed from a side of the inner surface 313. It should be noted that the holding ring 324 and the handle 700 are removed from the door 300 shown in FIG. 6. FIGS. 7 and 8 are perspective views of the attachment ring 321 attached with the hinge structure 400, the lock mechanism 600 and the handle 700. The attachment rings 321 shown in FIGS. 7 and 8 are depicted from different angles. The structure of the hinge structure 400 is described with reference to FIGS. 5 to 8.

[0047] The hinge structure 400 includes a pair of arm pieces 430, which project toward the second connecting member 420 from the substantially crescent-shaped and highly rigid first connecting member 410, which is made of zinc alloy and attached to the connecting surface 216. The hinge structure 400 also includes a support shaft 440 of which ends are supported by the paired arm pieces 430, and a torsion coil spring 450 which is wound around the support shaft 440 between the paired arm pieces 430. The torsion coil spring 450 is exemplified as the biasing member through which the support shaft 440 extends and which biases the door 300 toward the opening position using the first and second connecting members 410, 420.

[0048] In the following descriptions, an open angle of the door 300 at the closing position defined as "0 degree" If the open angle of the door 300 is 30 degrees or more, the torsion coil spring 450 biases the door 300 toward the opening position. If the open angle of the door 300 is from 0 to 30 degrees, the door 300 moves toward the closing position. If the open angle of the door 300 is 30 degrees or less and a user releases his/her hand from the door 300, the door 300 gradually rotates to the closing position and then stops near the closing position. Thus, it becomes less likely that the door 300 rotates to the opening position when the user unintentionally releases his/her hand from the door 300.

[0049] The paired arm pieces 430 support the support shaft which is away from the first connecting member 410 attached to the connecting surface 216. The second connecting member 420 is highly rigid because it is formed from a galvanized steel plate with bending and drawing processes. The second connecting member 420 includes a connecting piece 422 in which an opening 421 is formed so that an end of the support shaft 440 is fitted into the opening 421. The stainless support shaft 440 is pivotally fitted to the opening 421 of the connecting piece 422. Therefore, since the support shaft 440 pivotally supports the second connecting member 420 connected to the door 300, the door 300 is pivotally attached to the housing 200 by the hinge structure 400. It should be noted that the arm pieces 430 are preferably made of metal. The hinge structure 400 may be downsized if the arm pieces 430 are made of highly rigid metal. The small hinge structure 400 may appropriately hold the door 300. In the present embodiment, the arm pieces 430 are formed by casting zinc alloy. Alternatively, the arm pieces may also be formed by using other metal. In addition, because the second connecting member 420 is formed

by bending a metallic steel plate, the second connecting member 420 may appropriately hold the heavy door 300 with the glass-made window 310 in cooperation with the arm pieces 430.

[0050] Substantially rectangular notches 328, into which the arm pieces 430 are inserted, are formed on the holding ring 324. Accordingly, the second connecting member 420 disposed inside the door 300 may be suitably coupled to the first connecting member 410 outside the door 300.

(Structure of Handle)

[0051] As shown in FIGS. 5 and 6, an outer rim area of the surface 327 of the attachment ring 321 facing the holding ring 324 includes a substantially flat restricting surface 329 and concave side surface 331, which form a recessed area to store the handle 700. When the door 300 is at the closing position, the restricting surface 329 faces the connecting surface 216 of the housing 200 (see FIG. 1).

[0052] FIG. 9 is a schematic cross-sectional view of the washing and drying machine 100 around the handle 700. It should be noted that the door 300 shown in FIG. 9 is present at the closing position. The handle 700 is described using FIGS. 1 and 5 to 9.

[0053] The handle 700 includes a first piece 710 between an enclosure, which includes the attachment ring 321, the cover disc 322 and the edge ring 323, and the connecting surface 216 forming the concave surface 214, and a second piece 720 which bends away from the opposing surface 217 forming the concave surface 214. The first piece 710 is situated between the restricting surface 329 and the housing 200 while the door 300 is at the closing position. The second piece 720 includes an exposed piece 721, which appears on the outer surface of the housing 200 when the door 300 is at the closing position, and a connecting piece 722 which connects the exposed piece 721 with the first piece 710. As shown in FIG. 6, a notch 332 is formed on the periphery of the holding ring 324. The notch 332 is depressed toward the center of the door 300. The connecting piece 722 along the periphery of the door 300 projects to the outside of the housing 200 through the notch 332. When the door 300 is at the closing position, a gap of about 20 mm is provided between the exposed piece 721 and the housing 200. A finger of a user may be easily inserted into this gap. In addition, the exposed piece 721 protrudes by about 20 mm from the periphery of the door 300. The user may turn the handle 700 and an insertion piece 190 (described later) with small force. The exposed piece 721 is visible from the front, and so easily operated. In addition, the first piece 710 is positioned on the back of the door 300 without hiding the door 300 and the edge ring 323, which results in quality design of the periphery of the door 300.

[0054] As shown in FIG. 5, a pair of support shafts 711 project from both edges of the first piece 710, respectively. The support shafts 711 are pivotally supported on the concave side surface 331. Accordingly, the first piece 710 is pivotally supported by the attachment ring 321. It should be noted that the first piece 710 between the attachment ring 321 and the holding ring 324 may be pivotally supported by the holding ring 324.

[0055] As shown in FIG. 9, a surface 333 of the attachment ring 321 facing the first piece 710 near the periphery of the attachment ring 321, and a rim surface 334 on the periphery of the attachment ring 321 facing the first piece 710, are substantially flush with each other to form the aforementioned restricting surface 329.

[0056] A user may pinch or hold the exposed piece 721 of the second piece 720 to rotate the door 300 from the closing position to the opening position. Meanwhile the first piece 710 pivotally supported by the attachment ring 321 turns to approach the restricting surface 329. Subsequently, the first piece 710 abuts the restricting surface 329, so that the angular motion of the first piece 710 is restricted. It should be noted that, for example, a torsion coil spring may be attached to the support shafts 711 so that the handle 700 is biased in a direction in which the first piece 710 moves away from the restricting surface 329.

(Lock Mechanism)

[0057] FIGS. 10 and 11 are enlarged perspective views of the door 300 around the lock mechanism 600. The door 300 shown in FIGS. 10 and 11 are depicted from different angles. The lock mechanism 600 is described using FIGS. 5, 7, 8, 10 and 11.

[0058] The lock mechanism 600 has a lock arm 610. The lock arm 610 forms the insertion piece 190 with a detection arm 810 provided beside the lock arm 610. The detection arm 810 integrally formed with the lock arm 610 is used for detecting position of the door 300. The washing and drying machine 100 may use the detection arm 810 to detect whether the door 300 is present in the opening or closing position.

[0059] As shown in FIG. 5, a substantially rectangular opening 335 is formed on the holding ring 324. The lock and detection arms 610, 810 project from the support frame 320 through the opening 335 formed on the holding ring 324 as shown in FIGS. 10 and 11,.

[0060] As shown in FIG. 5, the lock mechanism 600 has a shaft 620 configured to pivotally support the insertion piece 190, and a torsion coil spring 630 wound around the shaft 620. The attachment ring 321 has a pair of ribs 336 projecting toward the holding ring 324. Notches 337 are formed in the paired ribs 336, respectively. Both ends of the shaft 620 are inserted into the notches 337 and pivotally connected to the attachment ring 321. The insertion piece 190 is pivotally connected to the shaft 620 with the torsion coil spring 630. As shown in FIGS. 10 and 11, the insertion piece 190 turns about the shaft 620 between an engaging position and a disengaging position. When the insertion piece 190 turns toward the

periphery of the door 300, a tip end of the insertion piece 190 moves toward the engaging position in which the door 300 is locked. When the insertion piece 190 turns toward the center of the door 300, the tip end of the insertion piece 190 moves toward the disengaging position in which the door 300 is unlocked. The torsion coil spring 630 biases the insertion piece 190 towards the engaging position.

[0061] FIG. 12 schematically shows a positional relationship between the handle 700 and the insertion piece 190. The lock mechanism 600 is further described using FIGS. 1, 3, 5, 7, 8, and 10 to 12.

[0062] The insertion piece 190 includes a substantially rectangular base plate 611. The base plate 611 is used as a base shared by the lock and detection arms 610, 810, so that the lock and detection arms 610, 810 project from the base plate 611. The shaft 620 pierces through the base plate 611. A tip end 612 of the lock arm 610 is formed into a hook which projects toward the periphery of the door 300. The base plate 611 is wider than the opening 335. Therefore, even if the lock mechanism 600 comes off inside the door 300, the lock mechanism 600 stays inside the door 300. Consequently it becomes less likely that the lock mechanism 600 remains in a lock hole 218 while the door 300 is at the opening position.

[0063] As shown in FIG. 12, a corner of the base plate 611 (the corner closer to the center of the door 300 than the rotational axis C1 (the same as the shaft 620) of the insertion piece 190) is disposed between the attachment ring 321 and the first piece 710 of the handle 700. As shown in FIGS. 10 and 11, when the door 300 is rotated from the closing position to the opening position, the handle 700 is turned so that the first piece 710 approaches the restricting surface 329 formed in the attachment ring 321. Consequently the corner of the base plate 611 is pressed by the first piece 710 at a more central side of the door 300 than the shaft 620, so that the tip end 612 of the lock arm 610 moves toward the disengaging position (i.e., toward the center of the door 300).

[0064] As shown in FIG. 1, the substantially rectangular lock hole 218 and a detection hole 219 are formed on the connecting surface 216 of the housing 200. A lock control unit 640 is disposed inside the housing 200 (see FIG. 5). The lock control unit 640 is fixed to the inner surface of the housing 200. The lock control unit 640 incorporated in the housing 200 forms the lock hole 218 and the detection hole 219. It should be noted that the lock hole 218 and the detection hole 219 may be formed as an integrated opening or partitioned from each other by a wall portion of the housing 200. The lock control unit 640 is controlled by the control circuit 510.

[0065] FIG. 13A-13C are schematic cross-sectional views of the lock control unit 640. Operations performed by the lock control unit 640 are sequentially shown in FIGS. 13A to 13C. The right drawings from FIGS. 13A to 13C show the lock arm 610 inserted into the lock control unit 640, respectively. The left drawings from FIGS. 13A to 13C show the detection arm 810 inserted into the lock control unit 640, respectively. The lock control unit 640 is described using FIGS. 1, 3, 10 11 and 13A-13C.

[0066] As described above, the lock control unit 640 attached to the inner surface of the housing 200 forms the lock hole 218 on the housing 200. The tip end 612 of the lock arm 610 is inserted into the lock hole 218. The lock control unit 640 forms the detection hole 219 on the housing 200. When the door 300 is at the closing position, the tip end of the detection arm 810 is inserted into the detection hole 219.

[0067] The lock control unit 640 includes a housing 641 for storing a circuit or part for operating the lock control unit 640, and a lock box 642 disposed in the housing 641. In the housing 641, the lock box 642 forms a common internal space for storing the tip end 612 of the lock arm 610 and the tip end of the detection arm 810.

[0068] The position of the lock box 642 shown in FIG. 13A is called "allowable position." If the lock box 642 is at the allowable position, the lock arm 610 and the detection arm 810 may be removed from the lock hole 218 and the detection hole 219, respectively, as the door 300 is rotated from the closing position to the opening position. The position of the lock box 642 shown in FIG. 13C is called "unallowable position." If the lock box 642 is at the unallowable position, the tip end 612 of the lock arm 610 engages with the housing 641 of the lock control unit 640 and/or the housing 200 of the washing and drying machine 100 to prevent a user from rotating the door 300 from the closing position to the opening position. The position of the lock box 642 shown in FIG. 13B is called "intermediate position." When the lock box 642 is at the intermediate position, the internal space of the lock box 642 is partially communicated with the lock hole 218 and the detection hole 219. When the door 300 is rotated from the opening position to the closing position, the tip end 612 of the lock arm 610 and the tip end of the detection arm 810 may enter the internal space of the lock box 642 through the lock hole 218 and the detection hole 219, respectively. Meanwhile the lock box 642 comes contact with the tip end 612 of the lock arm 610 and instantaneously moves to the allowable position shown in FIG. 13A. The gentle curved shape of the tip end 612 of the lock arm 610 facilitates entry of the lock arm 610 into the lock box 642 and the instantaneous movement of the lock box 642 to the allowable position. Thereafter, the lock box 642 is returned to the intermediate position by biasing force acting on the lock arm 610 toward the engaging position (see FIGS. 10 and 11). While the lock box 642 is at the intermediate position, the tip end 612 of the lock arm 610 slightly engages with the housing 641 of the lock control unit 640 and/or the housing 200 of the washing and drying machine 100.

[0069] The housing 641 stores a drive source (e.g., a solenoid switch, a spring and alike although it is not shown) for moving the lock box 642. The control circuit 510, for example, controls the solenoid switch to move the lock box 642 in the housing 641 between the intermediate and unallowable positions. For instance, if a user

operates the operation panel 500 (see FIG. 1) to rotate the washing and drying tub 110 (e.g., in order to perform the washing, rinsing or drying process), the control circuit 510 moves the lock box 642 to the unallowable position. Once the washing, rinsing or dry process is completed and the rotation of the washing and drying tub 110 is stopped, the control circuit 510 moves the lock box 642 to the intermediate position.

[0070] If the lock box 642 moves from the intermediate position to the unallowable position, the tip end 612 of the lock arm 610 is pushed by the inner surface of the lock box 642. Consequently the lock arm 610 turns around the shaft 620. Meanwhile the detection arm 810, which is integrally formed with the lock arm 610 via the base plate 611, turns around the shaft 620 piercing through the insertion piece 190 together with the lock arm 610. Once the lock box 642 reaches the unallowable position, the hooked protrusion of the tip end 612 of the lock arm 610 completely engages with the housing 641 of the lock control unit 640 and/or the housing 200 of the washing and drying machine 100. Meanwhile even if a user holds the second piece 720 of the handle 700 to turn the handle 700 so that the first piece 710 approaches the restricting surface 329, the lock control unit 640 keeps the lock box 642 at the unallowable position. Therefore, the user may not rotate the door 300 to the opening position. Consequently, in cooperation with the lock arm 610, the lock hole 218 locks the door 300 at the closing position.

[0071] If the user holds the second piece 720 of the handle 700 to turn the handle 700 so that the first piece 710 approaches the restricting surface 329 after the lock box 642 is moved to the intermediate position under control of the control circuit 510, the tip end 612 of the lock arm 610 moves toward the disengaging position. Meanwhile the tip end 612 of the lock arm 610 abuts the inner surface of the lock box 642, so that the lock box 642 moves to the allowable position. If the door 300 is rotated to the opening position thereafter, the lock and detection arms 610, 810 are removed from the lock hole 218 and the detection hole 219, respectively. Thus in conjunction with the angular motion of the first piece 710 approaching the restricting surface 329, the lock arm 610 of the lock mechanism 600 may unlock the door 300 at the closing position.

(Detector)

[0072] FIG. 14 is a schematic block diagram of a detector configured to detect the position of the door 300. The detector is described with reference to FIGS. 1, 3 and 13A-14.

[0073] A detector 800 has a first detection element 820 configured to detect existence of the detection arm 810 in the lock box 642 (i.e., the detection hole 219). The first detection element 820 may be a transmissive optical sensor attached to the lock box 642, a push-button switch element, or any other element for detecting the existence of the detection arm 810 in the lock box 642. If the transmissive optical sensor is used as the first detection element 820, the detection arm 810 inserted in the lock control unit 640 interferes with an optical path of the optical sensor, so that the detection arm 810 inserted in the lock box 642 is detected. If the push-button switch element is used as the first detection element 820, the detection arm 810 inserted in the lock control unit 640 presses the switch element, so that the detection arm 810 inserted in the lock box 642 is detected.

[0074] The detector 800 has a second detection element 830 configured to detect existence of the lock arm 610 in the lock box 642 (i.e., the lock hole 218). The second detection element 830 may be a transmissive optical sensor attached to the lock box 642, a push-button switch element, or any other element for detecting the existence of the lock arm 510 in the lock box 642. If the transmissive optical sensor is used as the second detection element 830, the lock arm 610 inserted in the lock control unit 640 interferes with an optical path of the optical sensor, so that the lock arm 610 inserted in the lock box 642 is detected. If the push-button switch element is used as the second detection element 830, the lock arm 610 inserted in the lock control unit 640 presses the switch element, so that the lock arm 610 inserted in the lock box 642 is detected.

[0075] The control circuit 510 shown in FIG. 3 may be used as a part of the detector 800. The control circuit 510 has a determination portion 511 and a controller 512. Detection signals are input from the first and second detection elements 820, 830 to the determination portion 511. Operation information, which is input to the operation panel 500, may be output to the determination portion 511. Based on the detection signals from the first and second detection elements 820, 830, the determination portion 511 determines condition of the door 300 and outputs a result of the determination to the controller 512.

[0076] The detector 800 may have a warning portion 840 configured to warn a user about an abnormal condition of the door 300 (e.g., damage to the lock mechanism 600). For example, a buzzer configured to warn about the abnormal condition of the door 300 using sound or a lamp configured to warn about the abnormal condition of the door 300 using light may be used as the warning portion 840. If the determination portion 511 determines that the door 300 is abnormal, the controller 512 outputs, to the warning portion 840, a signal including information on the abnormality of the door 300. Thereafter, the warning portion 840 accordingly warns the user about the abnormality of the door 300. The determination portion 51 then outputs a result of the determination on the position of the door 300 (the closing position or the opening position) to the controller 512. If the door 300 is at the closing position, the controller 512 outputs an activation signal to the motor 113 for rotating the washing and drying tub 110 in accordance with inputs onto the operation panel 500 (see FIG. 1) by the user, so that the motor 113 rotates. On the other hand, if the door 300 is

at the opening position, the controller 512 does not output the activation signal to the motor 113 for rotating the washing and drying tub 110, despite operation on the operation panel 500 (see FIG. 1) performed by the user. Thus the washing and drying tub 110 is inhibited from rotating while the door 300 is at the opening position. In addition, if the user operates the operation panel 500 to rotate the washing and drying tub 110 while the door 300 is at the opening position, a signal indicating the presence of the door 300 at the opening position may be output to the warning portion 840. Consequently, the warning portion 840 outputs sound or light for warning the user about the presence of the door 300 at the opening position.

[0077] FIG. 15 is a flowchart schematically showing operations of the detector 800. The operations of the detector 800 are described with reference to FIGS. 13A to 15.

[0078] A user uses the operation panel 500 to input operation information for causing the washing and drying machine 100 to perform a desired operation (S100). Based on the detection signal from the first detection element 820, the determination portion 511 determines the position of the door 300 (S110). If the detection signal from the first detection element 820 includes information indicating the presence of the detection arm 810 in the lock box 642, the determination portion 511 determines that the door 300 is at the closing position. If the detection signal from the first detection element 820 includes information indicating the absence of the detection arm 810 from the lock box 642, the determination portion 511 determines that the door 300 is at the opening position.

[0079] After determining that the door 300 is at the closing position, the determination portion 511 determines whether or not the operation information, which is input to the operation panel 500, includes information requesting rotation of the washing and drying tub 110 (S120). If the determination portion 511 determines that the operation information, which is input to the operation panel 500, includes the information requesting the rotation of the washing and drying tub 110, the controller 512 activates the motor 113 on the basis of this determination result, and rotates the washing and drying tub 110 according to the operation information (S130). If the determination portion 511 determines that the operation information, which is input to the operation panel 500, does not include the information requesting the rotation of the washing and drying tub 110, the controller 512 performs control according to the operation information to cause the washing and drying machine 100 to execute an operation other than the rotation of the washing and drying tub 110 (S140).

[0080] After determining that the door 300 is at the opening position, the determination portion 511 determines whether the detection signal from the second detection element 830 includes information indicating the presence of the lock arm 610 in the lock box 642 (S150). If the detection signal from the second detection element 830 indicates absence of the lock arm 610 from the lock box 642, the determination portion 511 determines whether or not the operation information, which is input to the operation panel 500, includes the information requesting the rotation of the washing and drying tub 110 (S160). If the determination portion 511 determines that the operation information, which is input to the operation panel 500, does not include the information requesting the rotation of the washing and drying tub 110, the controller 512 performs control according to the operation information to cause the washing and drying machine 100 to execute an operation other than the rotation of the washing and drying tub 110 (S140). If the determination portion 511 determines that the operation information, which is input to the operation panel 500, includes the information requesting the rotation of the washing and drying tub 110, the controller 512 outputs a signal, which includes the information indicating the presence of the door 300 at the opening position, to the warning portion 840, instead of rotating the washing and drying tub 110. Accordingly, the warning portion 840 warns the user about the presence of the door 300 at the opening position and encourages the user to rotate the door 300 to the closing position (S170). The determination portion 511 then determines the position of the door 300 again (S110).

[0081] If the determination portion 511 outputs a determination result showing that the detection signal from the second detection element 830 indicates the presence of the lock arm 610 in the lock box 642, the controller 512 outputs a signal, which includes information indicating damage to the lock mechanism 600, to the warning portion 840. Thereafter, the warning portion 840 warns the user about the damage to the lock mechanism 600 (S 180). As a result, the user is encouraged to replace the lock mechanism 600.

(Connection Structure Between Door and Housing)

[0082] FIGS. 16 and 17 are schematic enlarged views showing a connection between the door 300 and the housing 200. The door 300 shown in FIG. 16 is present at the closing position. The door 300 shown in FIG. 17 is present at the opening position. The connection structure between the door 300 and the housing 200 is described with reference to FIGS. 16 and 17.

[0083] As described above, the door 300 is connected to the housing 200 by the hinge structure 400. The first connecting member 410 of the hinge structure 400 is made of zinc alloy and connected to the connecting surface 216 of the housing 200. The highly rigid second connecting member 420 formed from a galvanized steel plate by means of bending and drawing processes is connected to the attachment ring 321, The arm pieces 430, which project from the first connecting member 410 toward the second connecting member 420, support the support shaft 440 at a position away from the first connecting member 410 and/or the connecting surface 216. The stainless support shaft 440 is kept at a position so that

the stainless support shaft 440 projects from the concave area formed by the concave surface 214. The peripheries of the cover disc 322 and the edge ring 323 become a curved rim 338 which partially surrounds the support shaft 440.

[0084] The outer edge 423 of the second connecting member 420 turns as the door 300 rotates. The outer edge 423 abuts receiving edge 433 of each arm piece 430 to restrict the angular motion of the door 300. In addition, outer edges of the arm pieces 430 include curved edges 431, respectively, so that a tip end 339 may be moved therein as the door 300 is rotated. As shown in FIG. 16, the curved edge 431 is recessed toward the center of the door 300 present at the closing position (curved away from the opposing surface 217). If the door 300 is rotated to the opening position, the tip end 339 of the curved rim 338 is moved into the recess of the curved edge 431. It should be noted that, in the present embodiment, the tip end 339 of the curved rim 338 is made of resin and corresponds to the periphery of the edge ring 323. Thus the outer edge 423 abuts the receiving edge 433 of each arm piece 430 to restrict the angular motion of the door 300 from the closing position, so that the outer edge 423 fixes the opening position in a predetermined position.

[0085] As shown in FIG. 16, if the door 300 is at the closing position, the tip end 339 of the curved rim 338 is positioned between the opposing surface 217, which forms a bank 221 raised near each of right and left edge of the main wall 212, and the arm pieces 430. A distance between the tip end 339 of the curved rim 338 and the opposing surface 217 (the shortest distance) is preferably 5 mm or less. Therefore, a void between each arm piece 430 and the opposing surface 217 is narrowed by the tip end 339 of the curved rim 338. In addition, the tip end 339 of the curved rim 338 protrudes into the concave area formed by the concave surface 214 and is closer to a virtual planar surface P along the connecting surface 216 than the support shaft 440.

[0086] As shown in FIGS. 16 and 17, the curved edge 431 of each arm piece 430 forms a space R with the opposing surface 217 in which the tip end 339 of the curved rim 338 moves. If the door 300 is rotated between the closing position and the opening position, the tip end 339 of the curved rim 338 moves in the space R. The tip end 339 of the curved rim 338 moves along an arc trajectory toward the curved edge 431 while the door 300 is rotated from the closing position to the opening position. Even when the door 300 reaches the opening position, the tip end 339 of the curved rim 338 does not abut the curved edge 431. Therefore, it is less likely that damage to the tip end 339 because of the contact between the resin tip end 339 and the metallic curved edge 431 happens. In the present embodiment, the tip end 339 of the curved rim 338 does not abut the curved edge 431 even after the door 300 is rotated by 90° from the closing position (e.g., when the door 300 is rotated by 105° from the closing position) whereas the outer edge 423 of the second connecting member 420 abuts the receiving edge 433 of each arm piece 430 to restrict the angular motion of the door 300.

[0087] The connection between the door 300 and the housing 200 is further described with reference to FIGS. 2 and 5.

[0088] FIG. 2 shows a vertical line V and an inclined line L inclined from the vertical line V by an angle θ. FIG. 2 also shows a vertical line V0 which passes through the center of the opening 215 formed on the housing 200. The inclined line L is a virtual line which passes through the central axis of the support shaft 440 of the hinge structure 400 attached to the housing 200.

[0089] As shown in FIG. 5, the support shaft 440 includes a first end 441 and a second end 442 opposing the first end 441. The first end 441 is located above the second end 442 on the inclined line L shown in FIG. 2. Also, on the inclined line L shown in FIG. 2, the second end 442 is closer to the vertical line V0 than the first end 441. Thus, the door 300 in the opening position is kept there by the gravitational action.

[0090] As shown in FIG. 2, the first connecting member 410 of the hinge structure 400 is fixed to the connecting surface 216 by, for example, a screw 411 (or other appropriate fixture for attaching the first connecting member 410 to the connecting surface 216). Therefore, an attachment hole, which extends in a substantially perpendicular direction to the connecting surface 216, is formed on the connecting surface 216. This attachment hole is preferably positioned such that the window 310, which projects from the holding ring 324 of the door 300 turned by 90° from the closing position, does not interferes with the line of the central axis of the attachment hole (a virtual line which extends in a substantially perpendicular direction to the connecting surface 216). Thus the door 300 may be appropriately connected to the housing 200 without any interference of the window 310.

[0091] FIG. 18 is a schematic perspective view of an exploded left-hand door. It should be noted that the washing and drying machine 100 described in the context of FIGS. 1 to 17 has the right-hand door 300. The left-hand door is described by comparing FIG. 18 with FIG. 5.

[0092] The arm pieces 430 and the support shaft 440 supported by the arm pieces 430 are preferably formed in a substantially central position of an arc profile of the first connecting member 410. Thus parts other than an attachment ring 321A may be shared by the left-hand door 300A and the right-hand door 300.

[0093] The aforementioned embodiment includes a laundry processing apparatus which mainly has the following configurations. The laundry processing apparatus with the following configurations appropriately prevents damage to the handle and/or the door.

[0094] A laundry processing apparatus according to one aspect of the above embodiment has: a housing in which an opening for taking laundry in and out is formed; a door configured to rotate between a closing position where the door closes the opening and an opening po-

sition where the door opens the opening; and a handle used for rotating the door between the closing position and the opening position, wherein the handle includes a first piece pivotally supported by the door and a second piece protruding from the first piece and exposed outside the housing when the door is at the closing position, the door includes a restricting surface facing the housing when the door is at the closing position and restricting an angular motion of the first piece, and the first piece is positioned between the housing and the restricting surface when the door is at the closing position, and the first piece abuts the restricting surface when the door is rotated from the closing position to the opening position to restrict an angular motion of the handle.

[0095] According to the aforementioned configuration, a user may put laundry in and out the housing through the opening formed on the housing. The door of the laundry processing apparatus is rotated between the closing position where the door closes the opening and the opening position where the door opens the opening. The door at the closing position prevents the laundry from bouncing out the housing. In addition, the door at the opening position allows the user to take the laundry in and out the housing. The handle used for rotating the door between the closing position and the opening position includes the first piece pivotally supported by the door, and the second piece protruding from the first piece. The second piece is exposed outside the housing when door is at the closing position. The user may use the second piece exposed outside the housing to rotate the door from the closing position to the opening position. When the door is situated at the closing position, the restricting surface of the supporting portion faces the housing. Meanwhile the first piece is positioned between the housing and the restricting surface. When the door is turned from the closing position to the opening position, the first piece abuts the restricting surface to restrict the angular motion of the handle. Therefore, even if an excessively large force is applied to the handle as a result of a wrong operation performed by the user, the entire first piece comes into contact with the supporting portion to prevent a high local stress on the handle and/or the door. Thus, preferably, it is less likely that the handle and/or the door are damaged.

[0096] In the aforementioned configuration, it is preferred that the laundry processing apparatus further have a lock mechanism configured to lock the door at the closing position, wherein the lock mechanism unlocks the door at the closing position in conjunction with the angular motion of the first piece toward the restricting surface.

[0097] According to the aforementioned configuration, the lock mechanism configured to lock the door at the closing position works with the angular motion of the first piece toward the restricting surface of the door to unlock the door at the closing position. As a result, the door is unlocked in conjunction with an operation for rotating the door to the opening position, so that it becomes less likely that a wrong operation performed by the user causes an excessively large force.

[0098] In the aforementioned configuration, it is preferred that a lock hole for locking the door at the closing position in cooperation with the lock mechanism is formed on the housing, the lock mechanism has a lock arm which includes a base end pivotally connected to the door and a tip end inserted into the lock hole to engage with the housing when the door is at the closing position, the first piece approaching the restricting surface presses the base end of the lock arm so that the tip end of the lock arm is turned from an engaging position where the tip end engages with the housing, to a disengaging position where the tip end disengages from the housing, and the lock arm is removed from the lock hole by rotation of the door from the closing position to the opening position.

[0099] According to the aforementioned configuration, the lock hole for locking the door at the closing position in cooperation with the lock mechanism is formed on the housing. The lock arm of the lock mechanism includes the base end pivotally connected to the door and the tip end inserted into the lock hole and engaged with the housing when the door is at the closing position. The first piece approaching the restricting surface presses the base end of the lock arm so that the tip end of the lock arm is turned from the engaging position where the tip end engages with the housing, to the disengaging position where the tip end disengages from the housing. Thus, the lock mechanism may unlock the door at the closing position in conjunction with the angular motion of the first piece toward the supporting portion of the door. Then, when the user turns the door from the closing position to the opening position, the lock arm is removed from the lock hole, so that it becomes less likely that a wrong operation performed by the user causes an excessively large force.

[0100] In the aforementioned configuration, it is preferred that the laundry processing apparatus further have a detector configured to detect a position of the door; and a processing tub stored in the housing, wherein the door has a supporting portion configured to support the lock mechanism, and a detection arm projecting from the supporting portion, a detection hole, into which the detection arm is inserted when the door is at the closing position, is formed on the housing, when the door is at the opening position, the detection arm is removed from the detection hole, the detector includes a first detection element configured to detect existence of the detection arm in the detection hole, and a controller configured to control rotation of the processing tub based on the existence of the detection arm in the detection hole, and if the detection arm is absent from the detection hole, the controller inhibits rotation of the processing tub.

[0101] According to the aforementioned configuration, the detection arm projects from the supporting portion configured to support the lock mechanism. When the door is at the closing position, the detection arm is inserted into the detection hole formed in the housing. When

the door is at the opening position, the detection arm is removed from the detection hole. Thus, the detector may detect the position of the door by causing the first detection element to detect the existence of the detection arm in the detection hole. The controller of the detector inhibits the rotation of the processing tub if the detection arm is absent from the detection hole. It makes the laundry processing apparatus safer that the rotation of the processing tub is inhibited when the door is at the opening position

[0102] In the aforementioned configuration, it is preferred that the detector includes a second detection element configured to detect existence of the lock arm in the lock hole, and if the detection arm is absent from the detection hole whereas the lock arm is present in the lock hole, the controller outputs information on damage to the lock mechanism.

[0103] According to the aforementioned configuration, the detector includes the second detection element configured to detect the existence of the lock arm in the lock hole. If the detection arm is absent from the detection hole whereas the lock arm is present in the lock hole, the controller outputs information on damage to the lock mechanism, and so it becomes less likely that the laundry processing apparatus with the damaged lock mechanism is operated. Therefore the laundry processing apparatus becomes safer.

[0104] In the configuration described above, it is preferred that the detection arm is integrally formed with the lock arm adjacent to the detection arm.

[0105] According to the aforementioned configuration, because the detection arm is integrally formed with the lock arm adjacent to the detection arm, the lock and detection arms are situated under substantially the same dynamic environment. Therefore, stress on the detection arm is kept lower than that on the lock arm engaged with the housing. Thus, it becomes less likely that the detection arm is damaged earlier than the lock arm, which results in more accurate detection for damage to the lock mechanism. It becomes less likely that the laundry processing apparatus with the damaged lock mechanism, so that the laundry processing apparatus becomes safer.

Industrial Applicability

[0106] The methodologies according to the present embodiment are suitably utilized in washing machines, laundry dryers, and washing and drying machines.

Claims

1. A laundry processing apparatus (100), comprising:

a housing (200) in which an opening (215) for taking laundry in and out is formed;
a door (300, 300A) configured to rotate between a closing position where the door (300, 300A) closes the opening (215) and an opening position where the door (300, 300A) opens the opening (215); and
a handle (700) used for rotating the door (300, 300A) between the closing position and the opening position,
characterized in that
the handle (700) includes a first piece (7 10) pivotally supported by the door (300, 300A) and a second piece (720) protruding from the first piece (710) and exposed outside the housing (200) when the door (300, 300A) is at the closing position,
the door (300, 300A) includes a restricting surface (329) facing the housing (200) when the door (300, 300A) is at the closing position and restricting an angular motion of the first piece (710), and
the first piece (710) is positioned between the housing (200) and the restricting surface (329) when the door (300, 300A) is at the closing position, and
the first piece (710) abuts the restricting surface (329) when the door (300, 300A) is rotated from the closing position to the opening position to restrict an angular motion of the handle (700).

2. The laundry processing apparatus (100) according to claim 1, further comprising:

a lock mechanism (600) configured to lock the door (300, 300A) at the closing position,
wherein the lock mechanism (600) unlocks the door (300, 300A) at the closing position in conjunction with the angular motion of the first piece (710) toward the restricting surface (329).

3. The laundry processing apparatus (100) according to claim 2, wherein
a lock hole (218) for locking the door (300, 300A) at the closing position in cooperation with the lock mechanism (600) is formed on the housing (200),
the lock mechanism (600) has a lock arm (610) which includes a base end (611) pivotally connected to the door (300, 300A) and a tip end (612) inserted into the lock hole (218) to engage with the housing (200) when the door (300, 300A) is at the closing position,
the first piece (710) approaching the restricting surface (329) presses the base end (611) of the lock arm (610) so that the tip end (612) of the lock arm (610) is turned from an engaging position where the tip end (612) engages with the housing (200), to a disengaging position where the tip end (612) disengages from the housing (200), and
the lock arm (610) is removed from the lock hole (218) by rotation of the door (300, 300A) from the closing position to the opening position.

4. The laundry processing apparatus (100) according to claim 3, further comprising:

a detector (800) configured to detect a position of the door (300, 300A); and
a processing tub (110) stored in the housing (200),
wherein the door (300, 300A) has a supporting portion (321, 321A, 324) configured to support the lock mechanism (600), and a detection arm (810) projecting from the supporting portion (321, 321A, 324),
a detection hole (219), into which the detection arm (810) is inserted when the door (300, 300A) is at the closing position, is formed on the housing (200),
when the door (300, 300A) is at the opening position, the detection arm (810) is removed from the detection hole (219),
the detector (800) includes a first detection element (820) configured to detect existence of the detection arm (810) in the detection hole (219), and a controller (512) configured to control rotation of the processing tub (110) based on the existence of the detection arm (810) in the detection hole (219), and
if the detection arm (810) is absent from the detection hole (219), the controller (512) inhibits rotation of the processing tub (110).

5. The laundry processing apparatus (100) according to claim 4, wherein
the detector (800) includes a second detection element (830) configured to detect existence of the lock arm (610) in the lock hole (218), and
if the detection arm (810) is absent from the detection hole (219) whereas the lock arm (610) is present in the lock hole (218), the controller (512) outputs information on damage to the lock mechanism (600).

6. The laundry processing apparatus (100) according to claim 5, wherein the detection arm (810) is integrally formed with the lock arm (610) adjacent to the detection arm (810).

Patentansprüche

1. Wäschebearbeitungsapparat (100), aufweisend:

ein Gehäuse (200), in welchem eine Öffnung (215) zum Hineinbringen und Herausnehmen von Wäsche gebildet ist;
eine Tür (300, 300A), konfiguriert, um sich zwischen einer Schließposition, wo die Tür (300, 300A) die Öffnung (215) schließt, und einer Öffnungsposition, wo die Tür (300, 300A) die Öffnung (215) öffnet, zu drehen; und
einen Griff (700), der zum Drehen bzw. Schwenken der Tür (300, 300A) zwischen der Schließposition und der Öffnungsposition verwendet wird, **dadurch gekennzeichnet, dass** der Griff (700) ein erstes Stück bzw. Teil (710), das drehbar durch die Tür (300, 300A) getragen bzw. gestützt wird, und ein zweites Stück bzw. Teil (720) enthält, das von dem ersten Stück bzw. Teil (710) vorsteht und herausragend außerhalb des Gehäuses (200) ist, wenn die Tür (300, 300A) in der Schließposition ist,
wobei die Tür (300, 300A) eine Beschränkungsoberfläche (329) enthält, die dem Gehäuse (200) gegenüberliegend bzw. zugewandt ist, wenn die Tür (300, 300A) in der Schließposition ist, und eine Winkelbewegung bzw. Drehbewegung von dem ersten Stück bzw. Teil (710) beschränkt, und
wobei das erste Stück bzw. Teil (710) zwischen dem Gehäuse (200) und der Beschränkungsoberfläche (329) positioniert ist, wenn die Tür (300, 300A) in der Schließposition ist, und
wobei das erste Stück bzw. Teil (710) an die Beschränkungsoberfläche (329) angrenzt, wenn die Tür (300, 300A) von der Schließposition in die Öffnungsposition gedreht bzw. geschwenkt wird, um eine Winkelbewegung bzw. Drehbewegung von dem Griff (700) zu beschränken.

2. Wäschebearbeitungsapparat (100) gemäß Anspruch 1, ferner aufweisend:

einen Verriegelungsmechanismus bzw. Rastungsmechanismus (600), der konfiguriert ist, um die Tür (300, 300A) in der Schließposition zu verriegeln bzw. zu verrasten,
wobei der Verriegelungsmechanismus bzw. Rastungsmechanismus (600) die Tür (300, 300A) in der Schließposition entriegelt, und zwar zusammen mit der Winkelbewegung bzw. Drehbewegung von dem ersten Stück bzw. Teil (710) in Richtung der Beschränkungsoberfläche (329).

3. Wäschebearbeitungsapparat (100) gemäß Anspruch 2, wobei
ein Verriegelungsloch bzw. Rastungsloch (218) zum Verriegeln bzw. Verrasten der Tür (300, 300A) in der Schließposition in Kooperation mit dem Verriegelungsmechanismus bzw. Rastungsmechanismus (600) auf dem Gehäuse (200) gebildet ist,
wobei der Verriegelungsmechanismus bzw. Rastungsmechanismus (600) einen Verriegelungsarm bzw. Rastungsarm (610) hat, welcher ein Basisende (611), das drehbar mit der Tür (300, 300A) verbunden ist und ein Kopfende bzw. Spitzenende (612) enthält, das in das Verriegelungsloch bzw. Ras-

tungsloch (218) eingefügt wird, um mit dem Gehäuse (200) im Eingriff zu sein, wenn die Tür (300, 300A) in der Schließposition ist,
wobei das erste Stück bzw. Teil (710), das sich der Beschränkungsoberfläche (329) nähert, das Basisende (611) von dem Verriegelungsarm bzw. Rastungsarm (610) drückt bzw. presst, so dass das Kopfende bzw. Spitzenende (612) von dem Verriegelungsarm bzw. Rastungsarm (610) von einer Eingriffsposition, wo das Kopfende bzw. Spitzenende (612) mit dem Gehäuse (200) im Eingriff ist, in eine Außer-Eingriff-Position bzw. Auslöseposition gedreht wird, wo das Kopfende bzw. Spitzenende (612) von dem Gehäuse (200) außer Eingriff kommt, und wobei der Verriegelungsarm bzw. Rastungsarm (610) von dem Verriegelungsloch bzw. Rastungsloch (218) entfernt wird, und zwar durch Drehung bzw. Schwenkung von der Tür (300, 300A) von der Schließposition zu der Öffnungsposition.

4. Wäschebearbeitungsapparat (100) gemäß Anspruch 3, ferner aufweisend:

einen Detektor (800), der konfiguriert ist, um eine Position von der Tür (300, 300A) zu detektieren; und
einen Bearbeitungsbottich (110), der in dem Gehäuse (200) gelagert bzw.
untergebracht ist,
wobei die Tür (300, 300A) einen Trag- bzw. Stützabschnitt (321, 321A, 324) hat, der konfiguriert ist, um den Verriegelungsmechanismus bzw. Rastungsmechanismus (600) zu tragen bzw. zu stützen, und einen Detektierungsarm (810) hat, der von dem Trag- bzw. Stützabschnitt (321, 321A, 324) vorsteht,
wobei ein Detektierungsloch (219), in welches der Detektierungsarm (810) eingefügt wird, wenn die Tür (300, 300A) in der Schließposition ist, auf dem Gehäuse (200) gebildet ist,
wenn die Tür (300, 300A) in der Öffnungsposition ist, wird der Detektierungsarm (810) von dem Detektierungsloch (219) entfernt,
wobei der Detektor (800) ein erstes Detektierungselement (820), das konfiguriert ist, um das Vorhandensein von dem Detektierungsarm (810) in dem Detektierungsloch (219) zu detektieren, und eine Steuer- bzw. Regelungseinrichtung (512) enthält, die konfiguriert ist, um Drehung bzw. Rotation von dem Bearbeitungsbottich (110) zu steuern bzw. regeln, und zwar basierend auf dem Vorhandensein von dem Detektierungsarm (810) in dem Detektierungsloch (219), und
falls der Detektierungsarm (810) von dem Detektierungsloch (219) abwesend ist, verhindert die Steuer- bzw. Regelungseinrichtung (512) Drehung bzw. Rotation von dem Bearbeitungsbottich (110).

5. Wäschebearbeitungsapparat (100) gemäß Anspruch 4, wobei
der Detektor (800) ein zweites Detektierungselement (830) enthält, das konfiguriert ist, um das Vorhandensein von dem Verriegelungsarm bzw. Rastungsarm (610) in dem Verriegelungsloch bzw. Rastungsloch (218) zu detektieren, und
falls der Detektierungsarm (810) von dem Detektierungsloch (219) abwesend ist, wobei der Verriegelungsarm bzw. Rastungsarm (610) in dem Verriegelungsloch bzw. Rastungsloch (218) vorhanden ist, gibt die Steuer- bzw. Regelungseinrichtung (512) Informationen über Schaden bzw. Beschädigung an dem Verriegelungsmechanismus bzw. Rastungsmechanismus (600) aus.

6. Wäschebearbeitungsapparat (100) gemäß Anspruch 5, wobei der Detektierungsarm (810) integral mit dem Verriegelungsarm bzw. Rastungsarm (610) gebildet ist, und zwar angrenzend an den Detektierungsarm (810).

Revendications

1. Appareil de traitement du linge (100) comprenant:

une carcasse (200) dans laquelle une ouverture (215) pour faire entrer et sortir le linge, est formée;
une porte (300, 300A) configurée pour tourner entre une position de fermeture dans laquelle la porte (300, 300A) ferme l'ouverture (215) et une position d'ouverture dans laquelle la porte (300, 300A) ouvre l'ouverture (215); et
une poignée (700) utilisée pour faire tourner la porte (300, 300A) entre la position de fermeture et la position d'ouverture,
caractérisé en ce que la poignée (700) comprend une première pièce (710) supportée de manière pivotante par la porte (300, 300A) et une seconde pièce (720) faisant saillie de la première pièce (710) et exposée à l'extérieur de la carcasse (200) lorsque la porte (300, 300A) est dans la position de fermeture,
la porte (300, 300A) comprend une surface de limitation (329) faisant face à la carcasse (200) lorsque la porte (300, 300A) est dans la position de fermeture et limitant un mouvement angulaire de la première pièce (710), et
la première pièce (710) est positionnée entre la carcasse (200) et la surface de limitation (329) lorsque la porte (300, 300A) est dans la position de fermeture, et
la première pièce (710) vient en butée contre la surface de limitation (329) lorsque la porte (300,

300A) est entraînée en rotation de la position de fermeture à la position d'ouverture pour limiter un mouvement angulaire de la poignée (700).

2. Appareil de traitement du linge (100) selon la revendication 1, comprenant en outre:

un mécanisme de verrouillage (600) configuré pour verrouiller la porte (300, 300A) dans la position de fermeture,
dans lequel le mécanisme de verrouillage (600) déverrouille la porte (300, 300A) dans la position de fermeture conjointement avec le mouvement angulaire de la première pièce (710) vers la surface de limitation (329).

3. Appareil de traitement du linge (100) selon la revendication 2, dans lequel:

un trou de verrouillage (218) pour verrouiller la porte (300, 300A) dans la position de fermeture en coopération avec le mécanisme de verrouillage (600) est formé sur la carcasse (200),
le mécanisme de verrouillage (600) a un bras de verrouillage (610) qui comprend une extrémité de base (611) raccordée de manière pivotante à la porte (300, 300A) et une extrémité de pointe (612) insérée dans le trou de verrouillage (218) pour se mettre en prise avec la carcasse (200) lorsque la porte (300, 300A) est dans la position de fermeture,
la première pièce (710) s'approchant de la surface de limitation (329) comprime l'extrémité de base (611) du bras de verrouillage (610) de sorte que l'extrémité de pointe (612) du bras de verrouillage (610) est entraînée en rotation d'une position de mise en prise dans laquelle l'extrémité de pointe (612) se met en prise avec la carcasse (200), jusqu'à une position de dégagement dans laquelle l'extrémité de pointe (612) se dégage de la carcasse (200), et
le bras de verrouillage (610) est retiré du trou de verrouillage (218) par la rotation de la porte (300, 300A) de la position de fermeture à la position d'ouverture.

4. Appareil de traitement du linge (100) selon la revendication 3, comprenant en outre:

un détecteur (800) configuré pour détecter une position de la porte (300, 300A); et
une cuve de traitement (110) stockée dans la carcasse (200),
dans lequel la porte (300, 300A) a une partie de support (321, 321A, 324) configurée pour supporter le mécanisme de verrouillage (600), et un bras de détection (810) faisant saillie de la partie de support (321, 321A, 324),
un trou de détection (219) dans lequel le bras de détection (810) est inséré lorsque la porte (300, 300A) est dans la position de fermeture, est formé sur la carcasse (200),
lorsque la porte (300, 300A) est dans la position d'ouverture, le bras de détection (810) est retiré du trou de détection (219),
le détecteur (800) comprend un premier élément de détection (820) configuré pour détecter la présence du bras de détection (810) dans le trou de détection (219), et un organe de commande (512) configuré pour commander la rotation de la cuve de traitement (110) en fonction de la présence du bras de détection (810) dans le trou de détection (219), et
si le bras de détection (810) est absent du trou de détection (219), l'organe de commande (512) empêche la rotation de la cuve de traitement (110).

5. Appareil de traitement du linge (100) selon la revendication 4, dans lequel:

le détecteur (800) comprend un second élément de détection (830) configuré pour détecter la présence du bras de verrouillage (610) dans le trou de verrouillage (218), et
si le bras de détection (810) est absent du trou de détection (219), alors que le bras de verrouillage (610) est présent dans le trou de verrouillage (218), l'organe de commande (512) transmet l'information concernant l'endommagement au mécanisme de verrouillage (600).

6. Appareil de traitement du linge (100) selon la revendication 5, dans lequel le bras de détection (810) est formé de manière solidaire avec le bras de verrouillage (610) de manière adjacente au bras de détection (810).

FIG.1

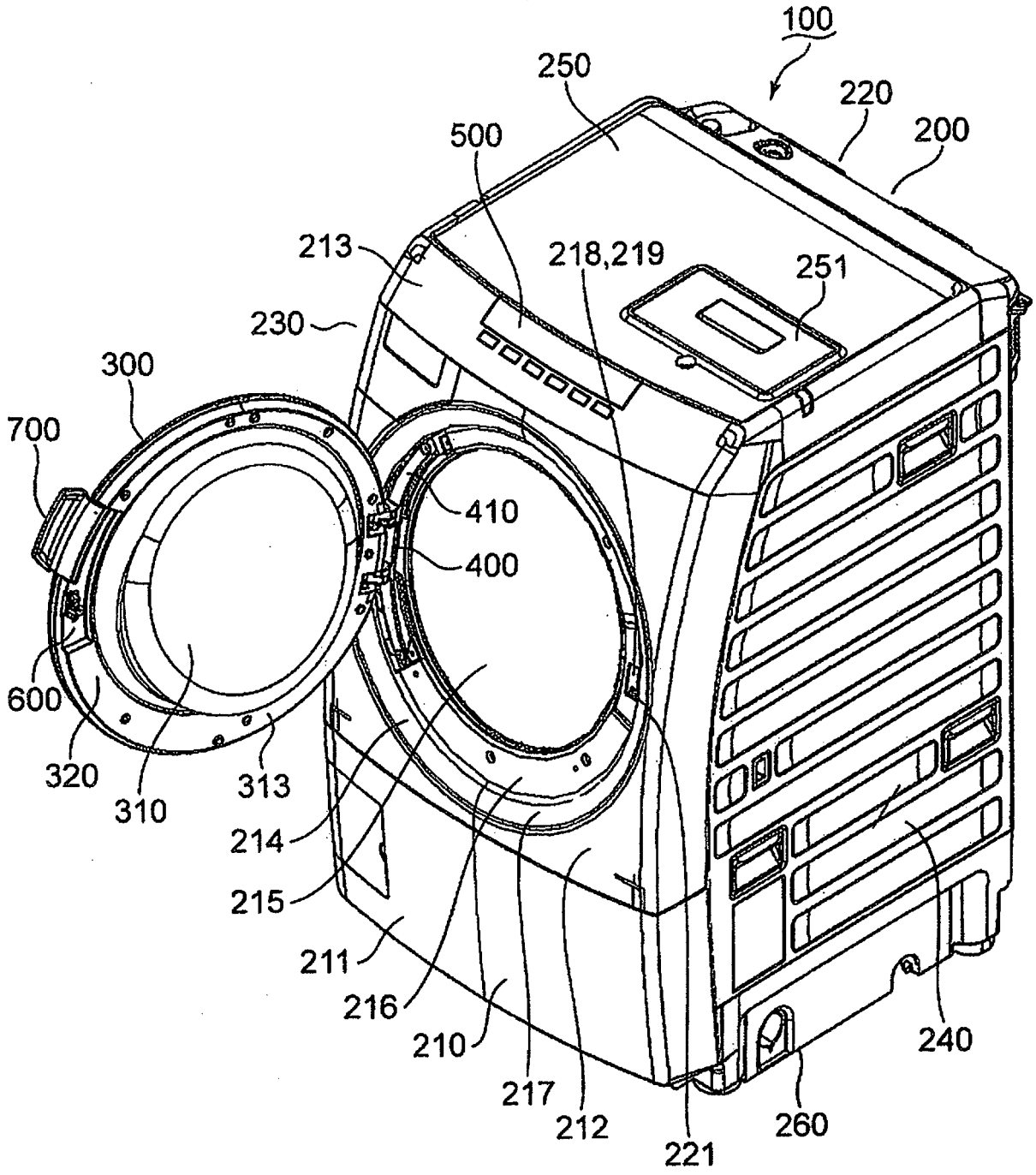

100
250
220
200
500
213
218,219
251
230
300
700
410
400
600
320
310
313
214
215
211
216
210
217
212
221
260
240

FIG.2

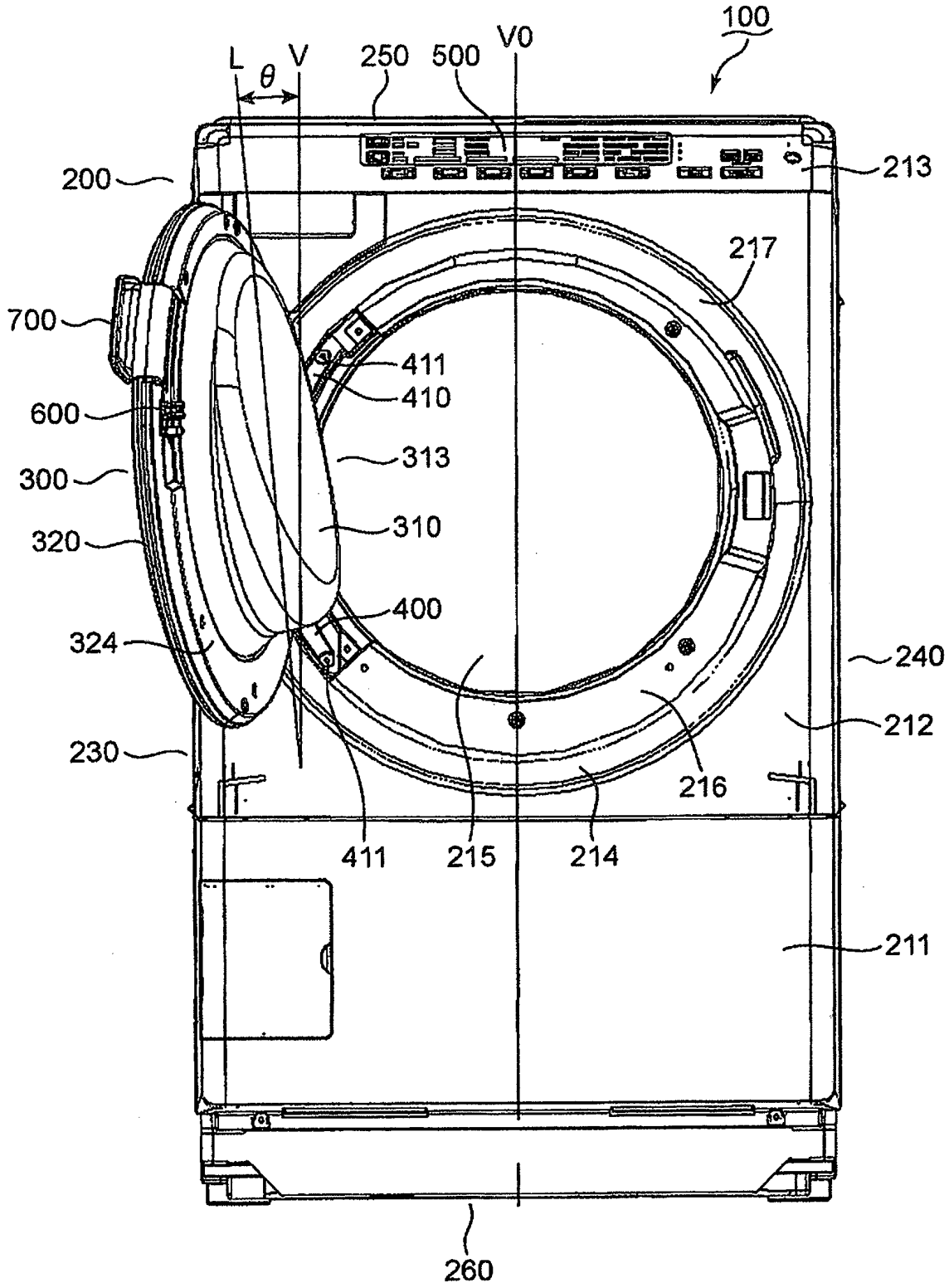

100
L
θ
V
250
500
V0
200
213
217
700
411
410
600
313
300
310
320
400
324
240
212
230
216
411
215
214
211
260

FIG.3

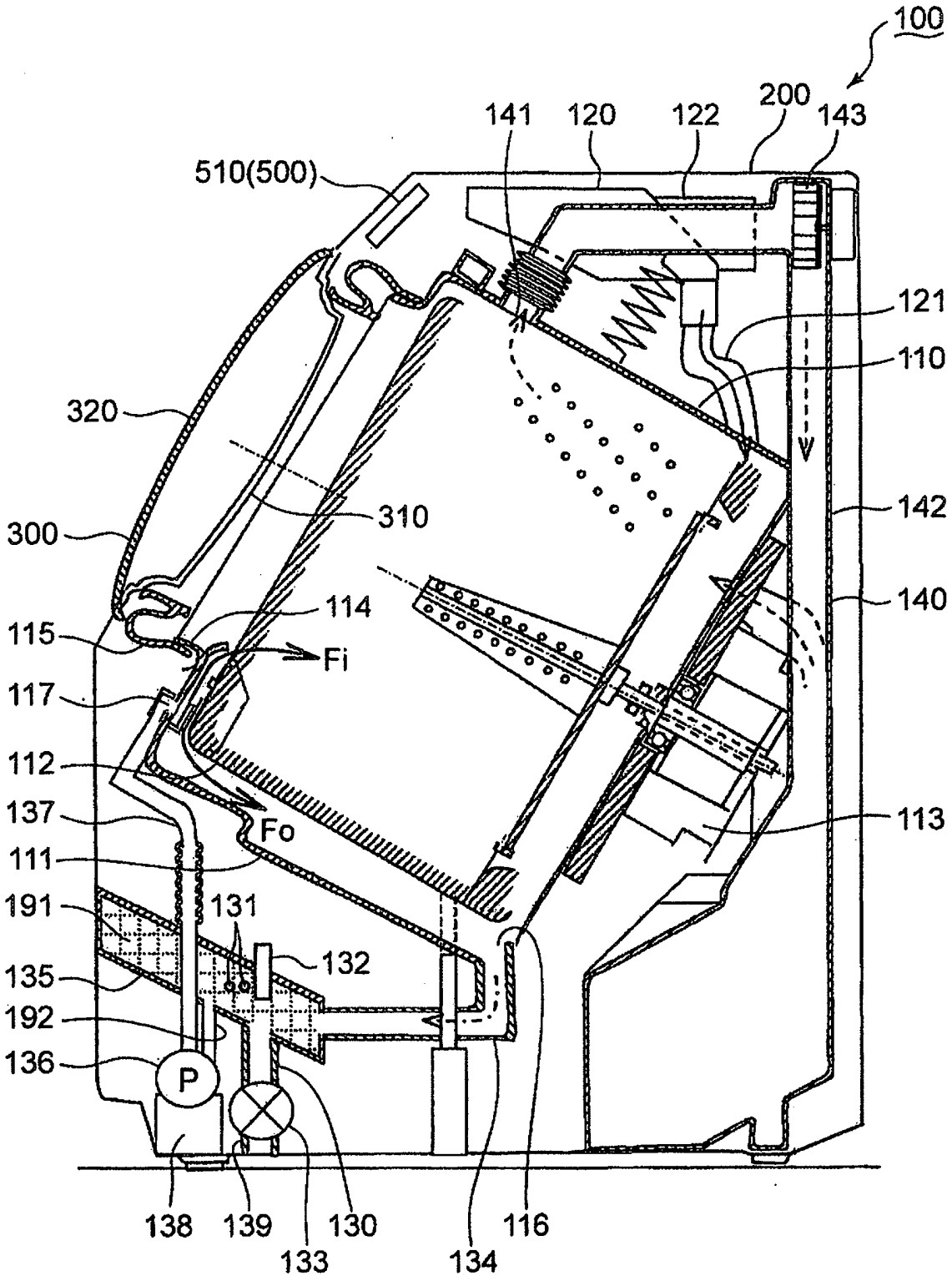

100
200
143
141
120
122
510(500)
121
110
320
310
142
300
140
114
115
Fi
117
112
137
Fo
113
111
191
131
132
135
192
136
P
138
139
130
133
134
116

FIG.4

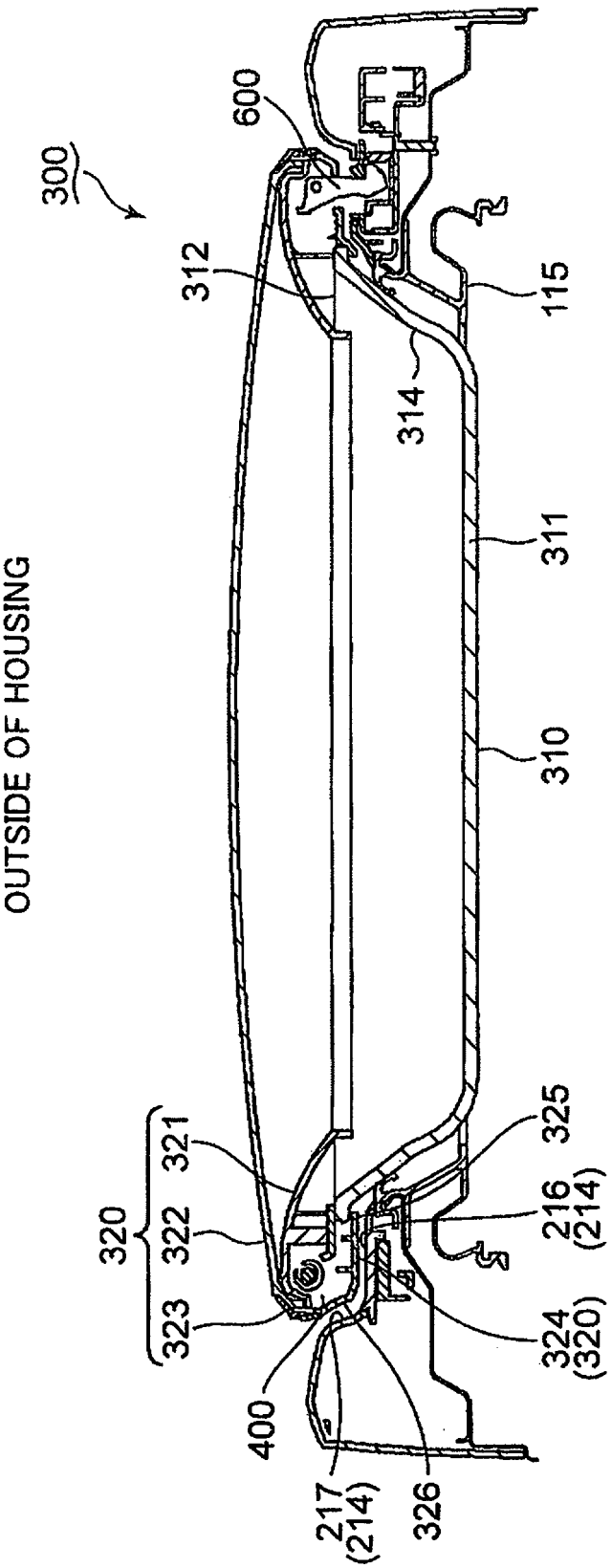

300
600
312
115
314
311
310
320
321
322
323
325
216
(214)
324
(320)
400
217
(214)
326
OUTSIDE OF HOUSING
INSIDE OF HOUSING

FIG.5

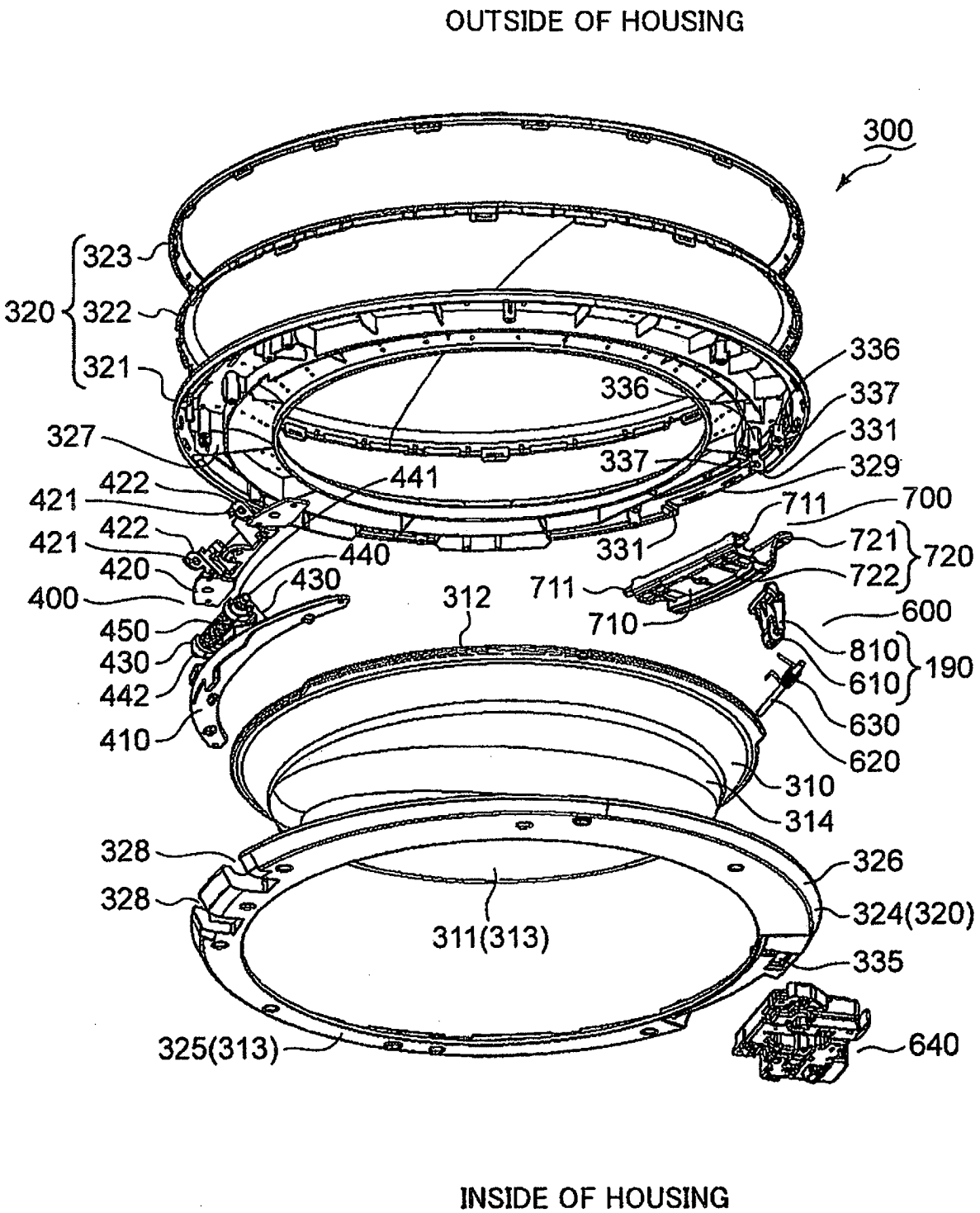

OUTSIDE OF HOUSING
300
323
320
322
321
327
421
422
421
422
420
400
450
430
442
410
441
440
430
312
328
328
325(313)
311(313)
336
336
337
337
331
329
331
711
700
721
720
722
711
710
600
810
610
190
630
620
310
314
326
324(320)
335
640
INSIDE OF HOUSING

FIG.6

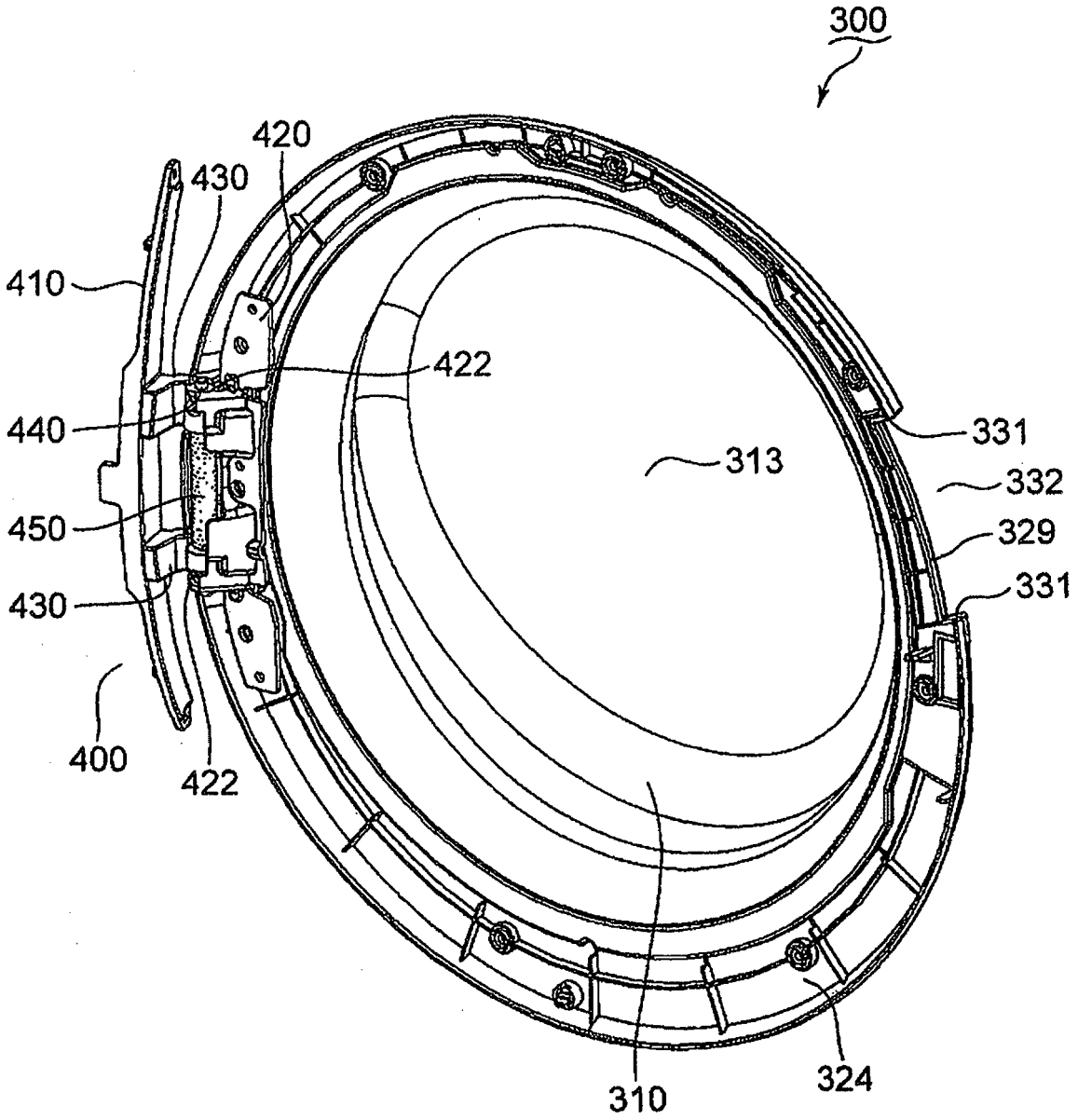
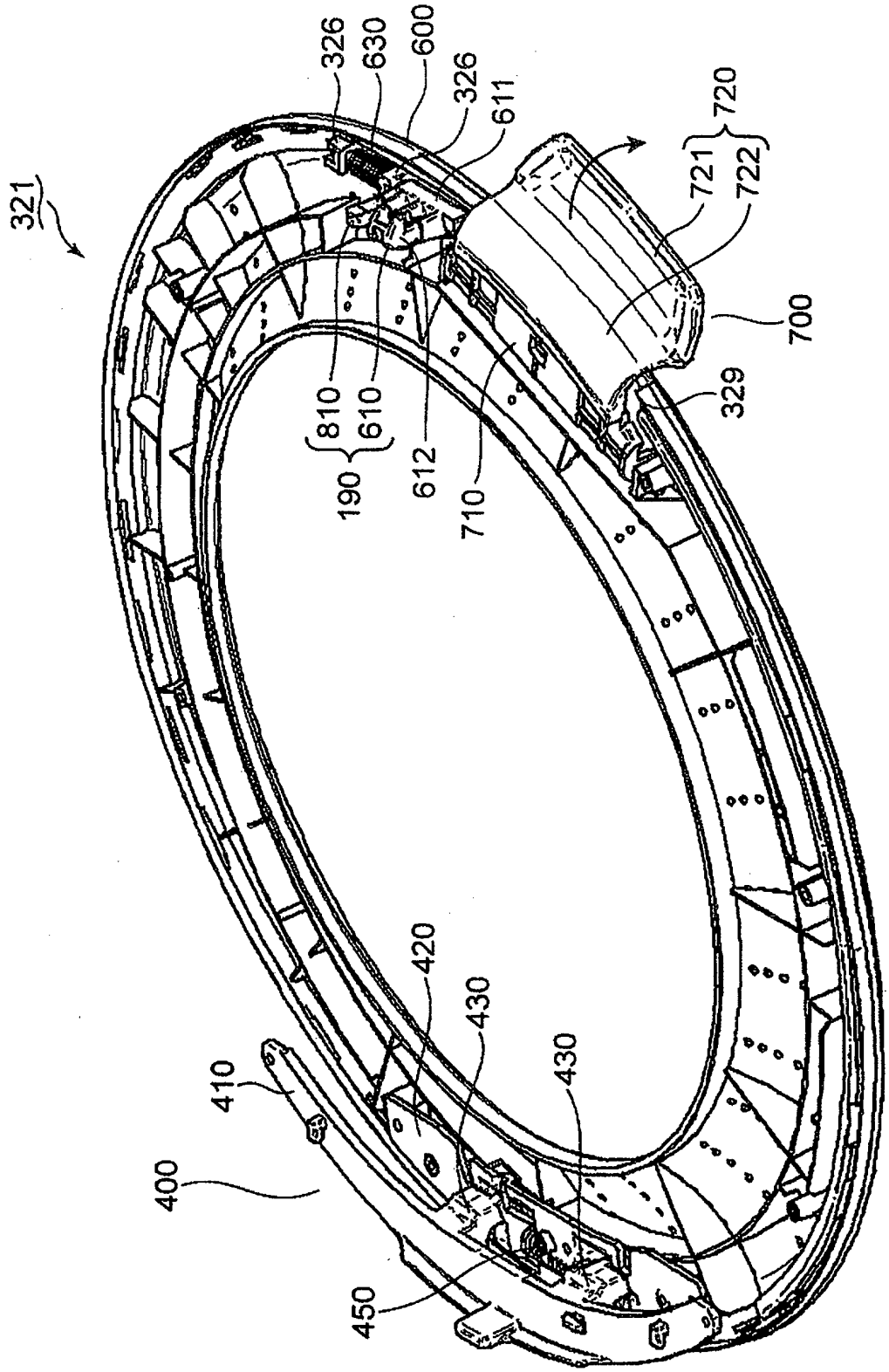

300
420
430
410
422
440
313
331
450
332
329
430
331
400
422
310
324

FIG.7


321
326
630
600
326
611
720
721
722
700
329
810
610
190
612
710
420
430
430
410
400
450

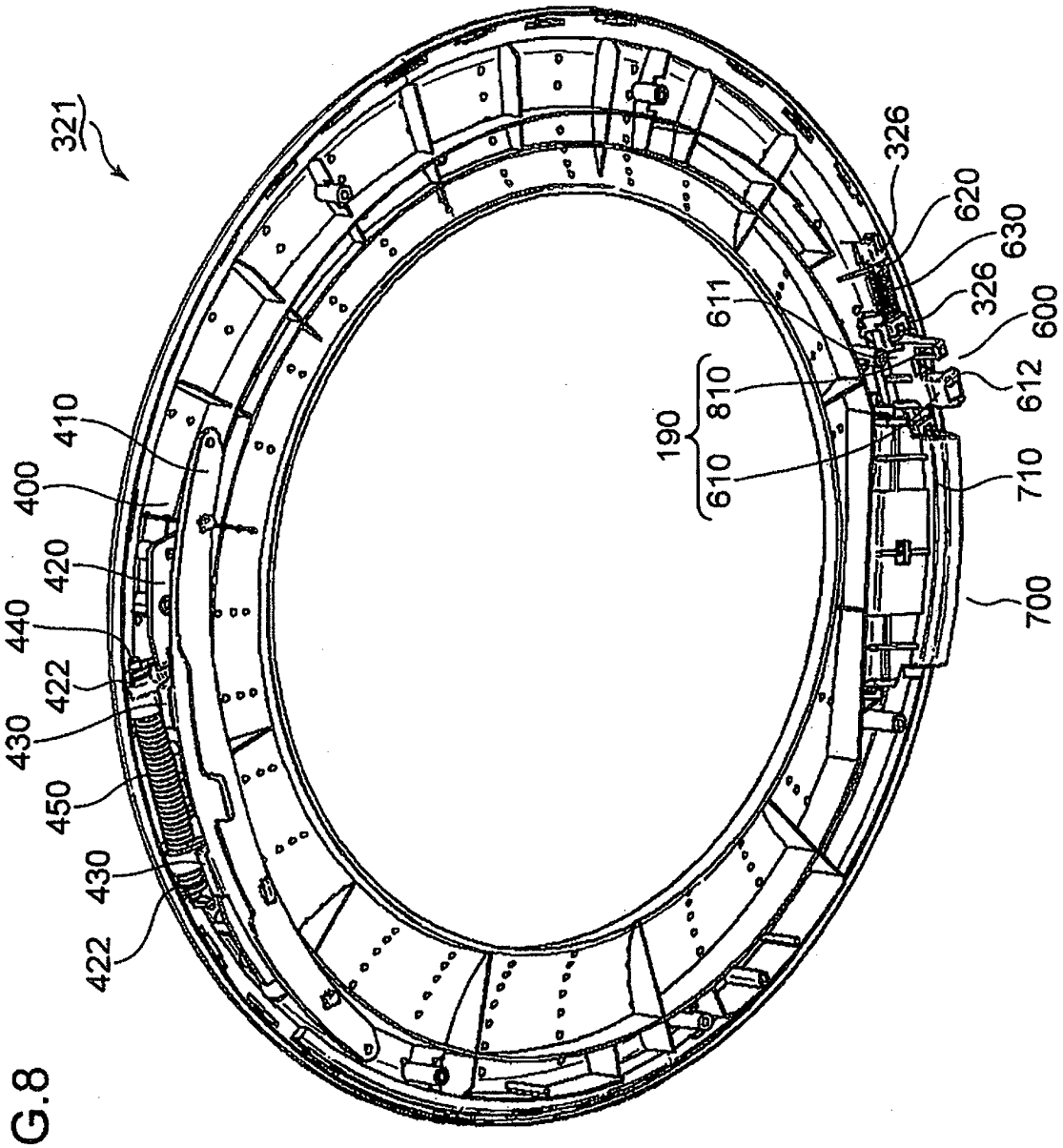

321
326
620
630
326
600
611
612
810
190
610
710
700
410
400
420
440
422
430
450
430
422

FIG.8

FIG.9

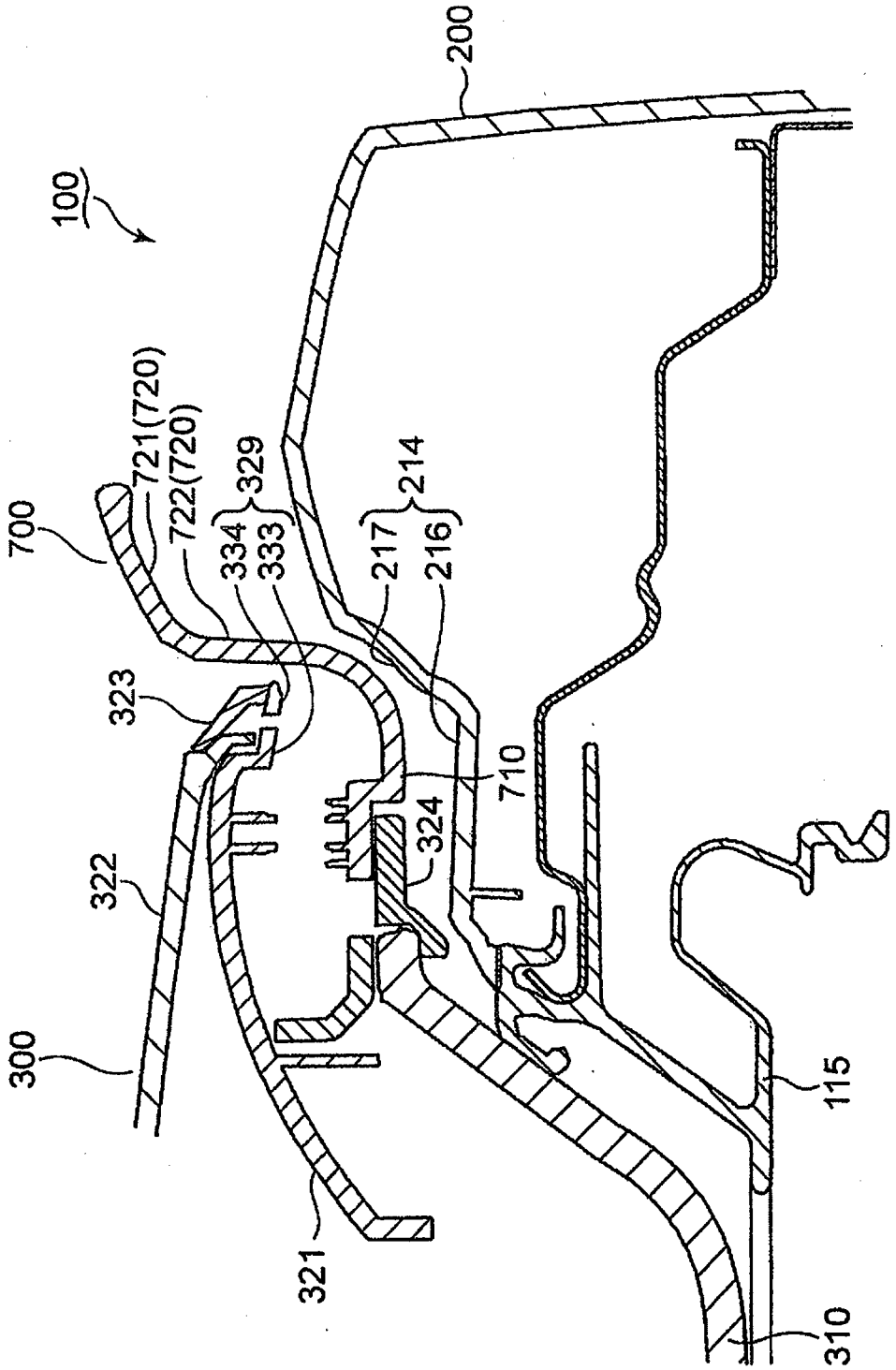

200
100
721(720)
722(720)
329
334
333
214
217
216
700
323
710
324
322
300
321
115
310

FIG.10

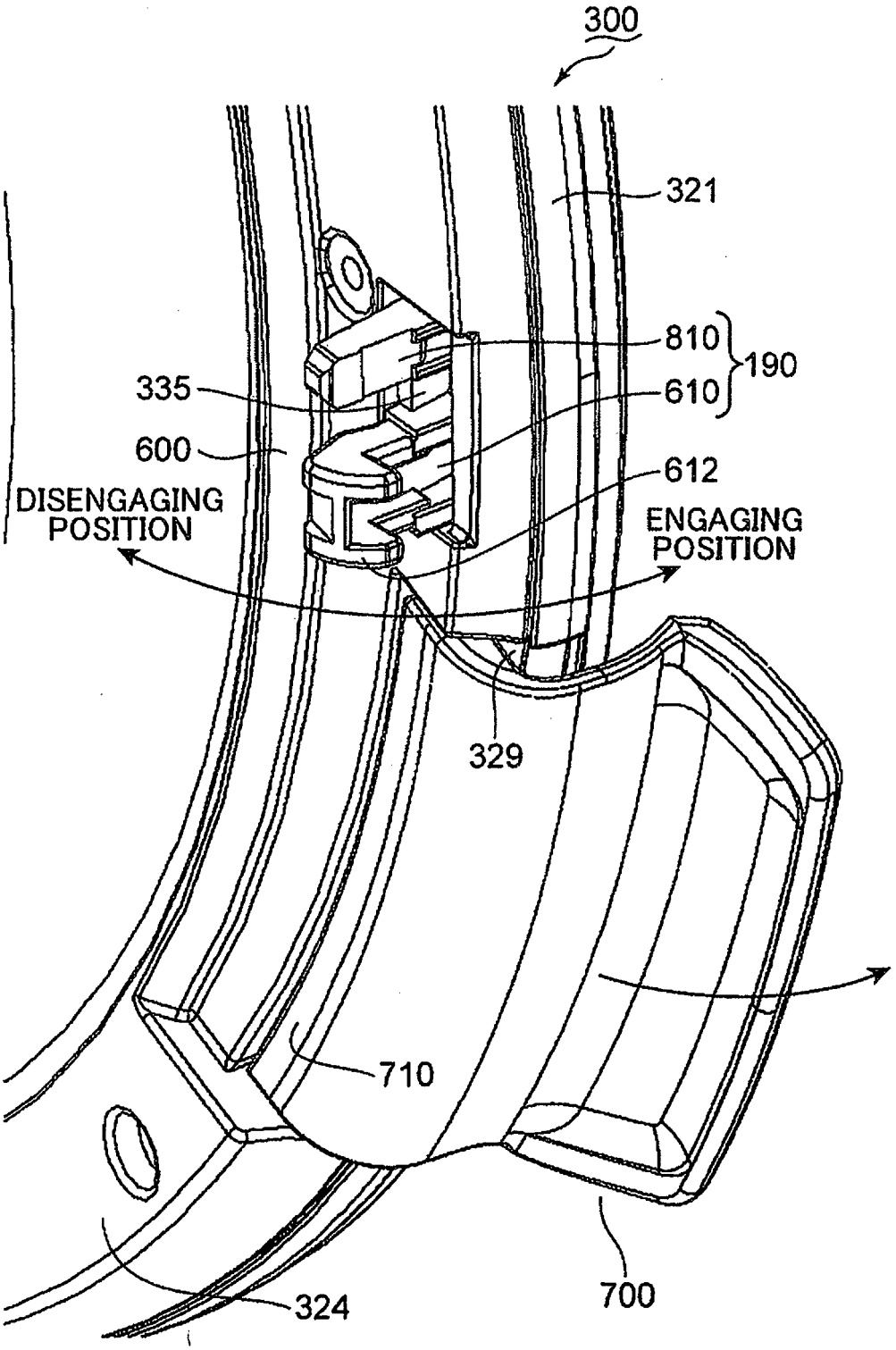

300
321
810
190
610
335
600
612
DISENGAGING POSITION
ENGAGING POSITION
329
710
324
700

FIG.11

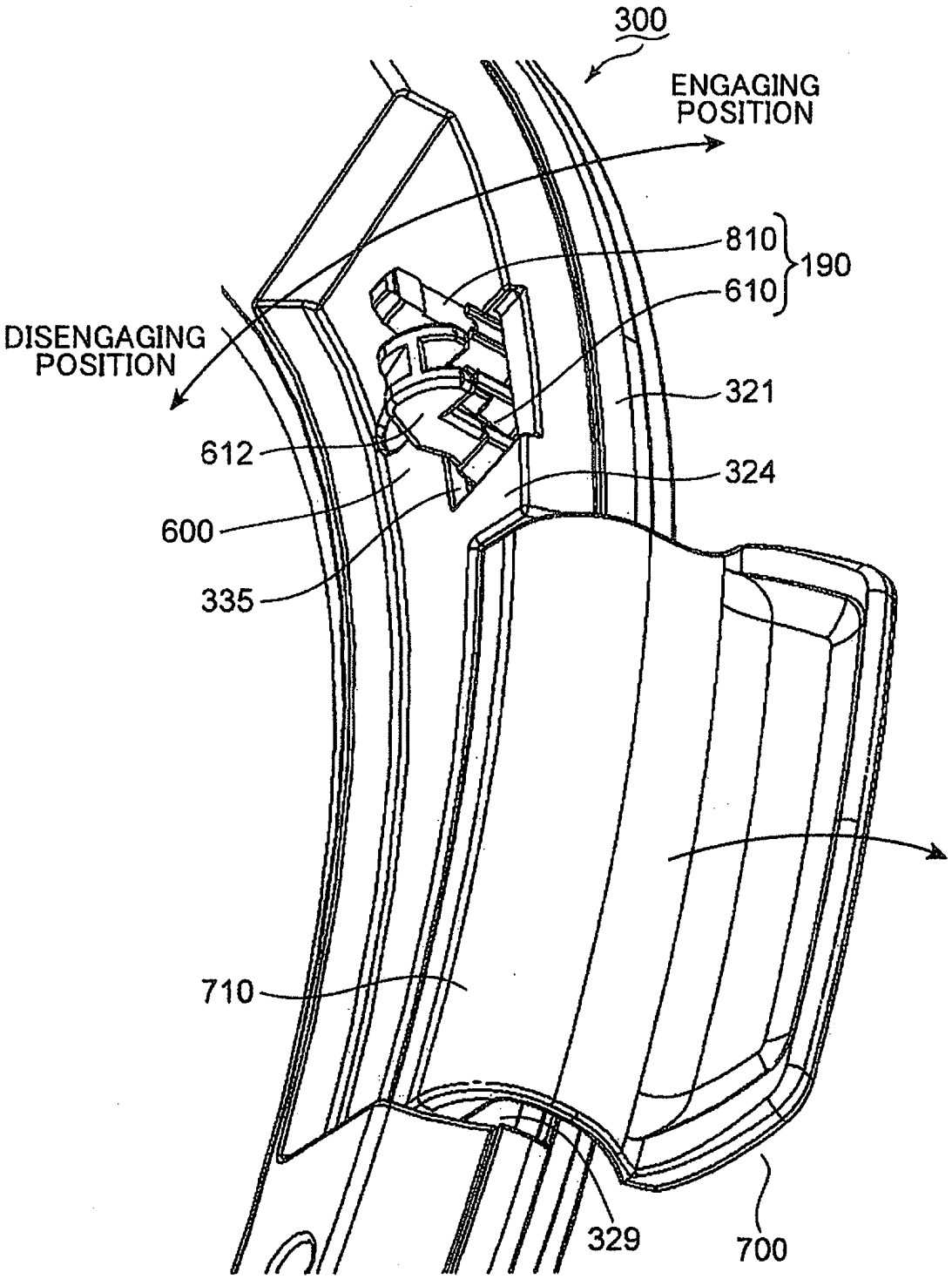
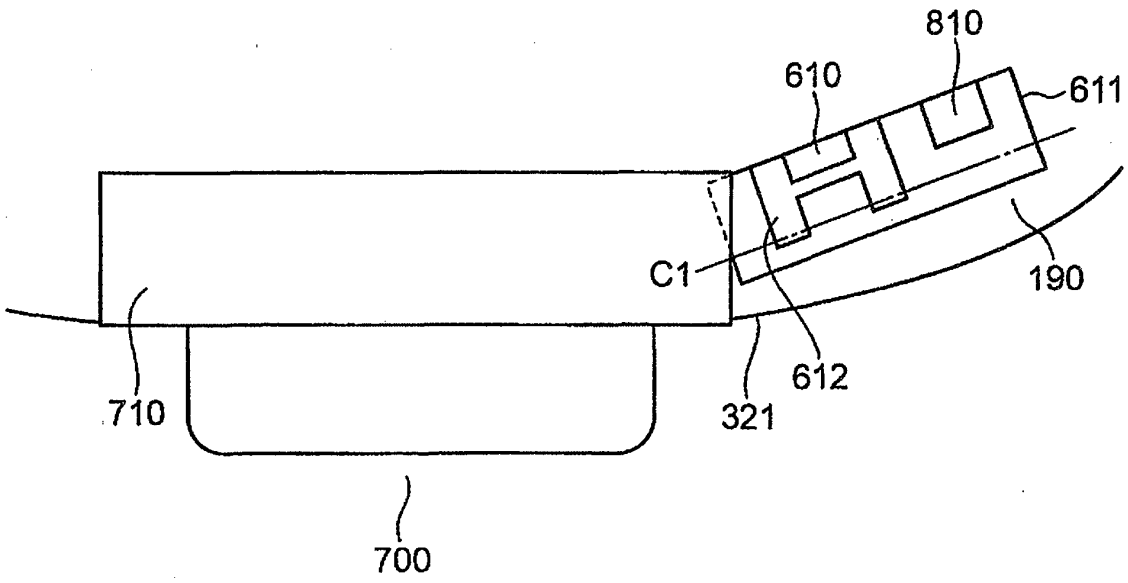

300
ENGAGING POSITION
810
610
190
DISENGAGING POSITION
321
612
324
600
335
710
329
700

FIG.12



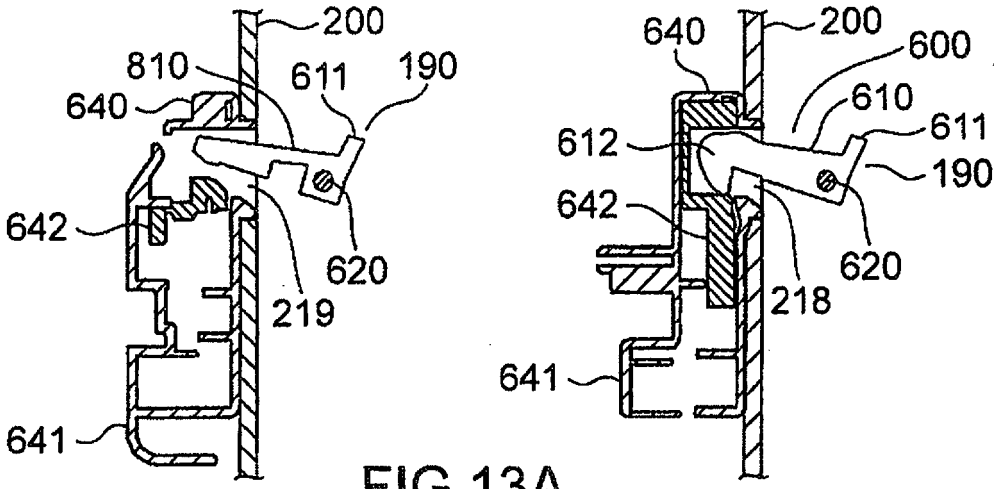


FIG.13A

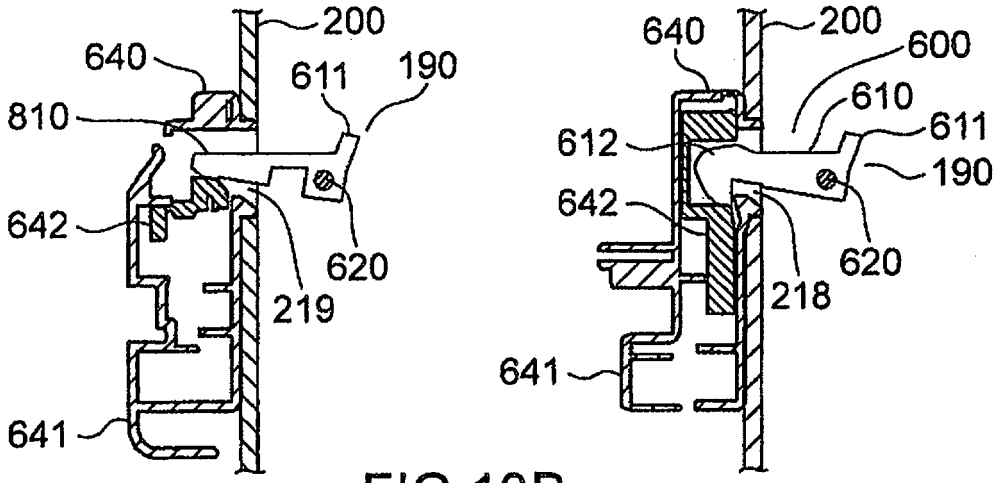


FIG.13B

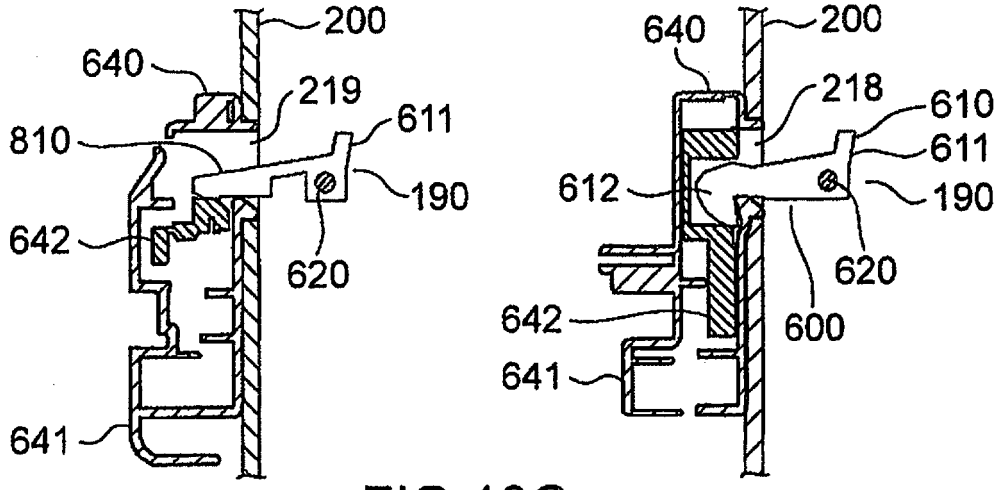


FIG.13C

FIG.14

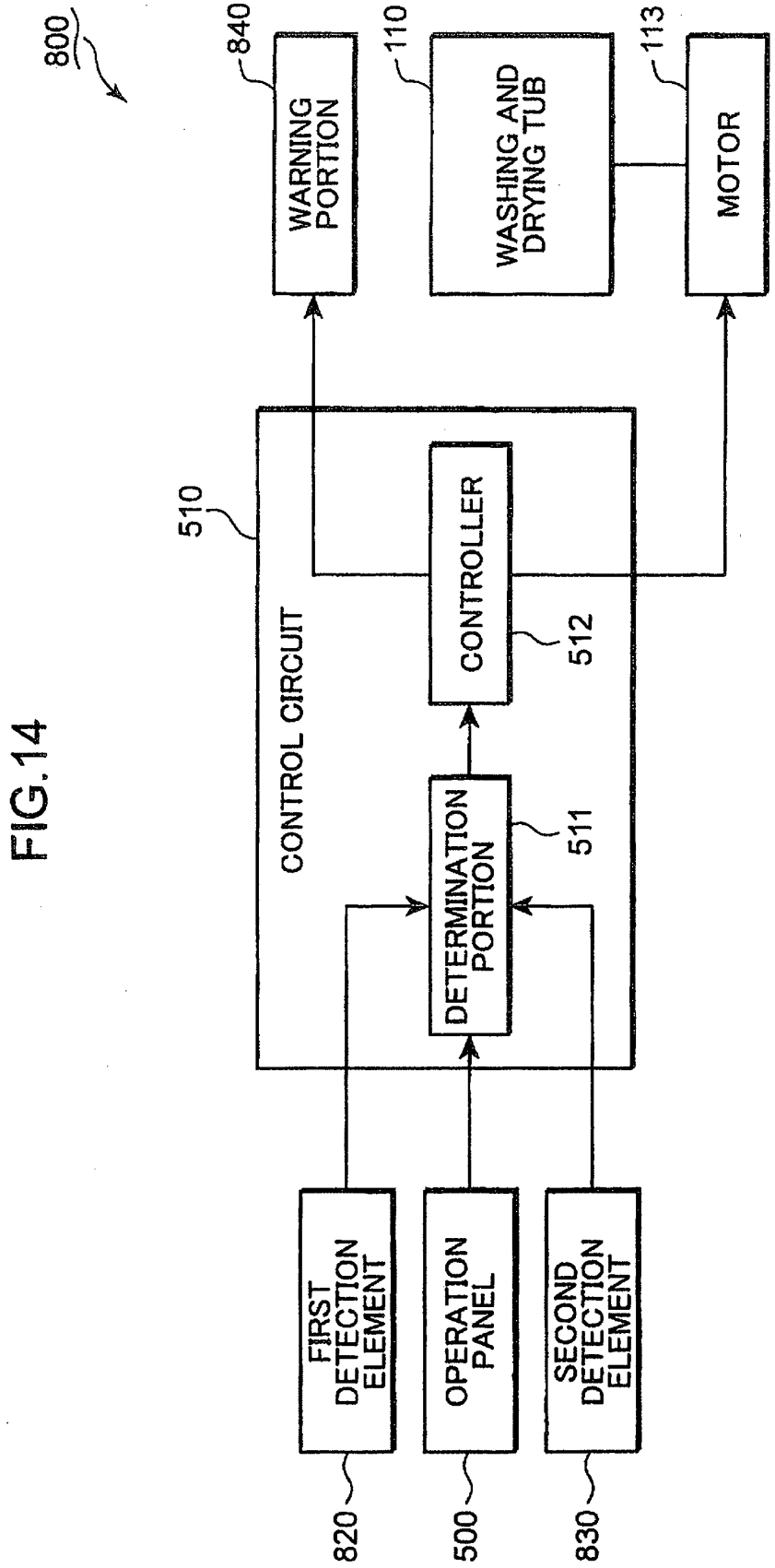

800
840
WARNING PORTION
110
WASHING AND DRYING TUB
113
MOTOR
510
CONTROL CIRCUIT
CONTROLLER
512
DETERMINATION PORTION
511
FIRST DETECTION ELEMENT
OPERATION PANEL
SECOND DETECTION ELEMENT
820
500
830

FIG.15

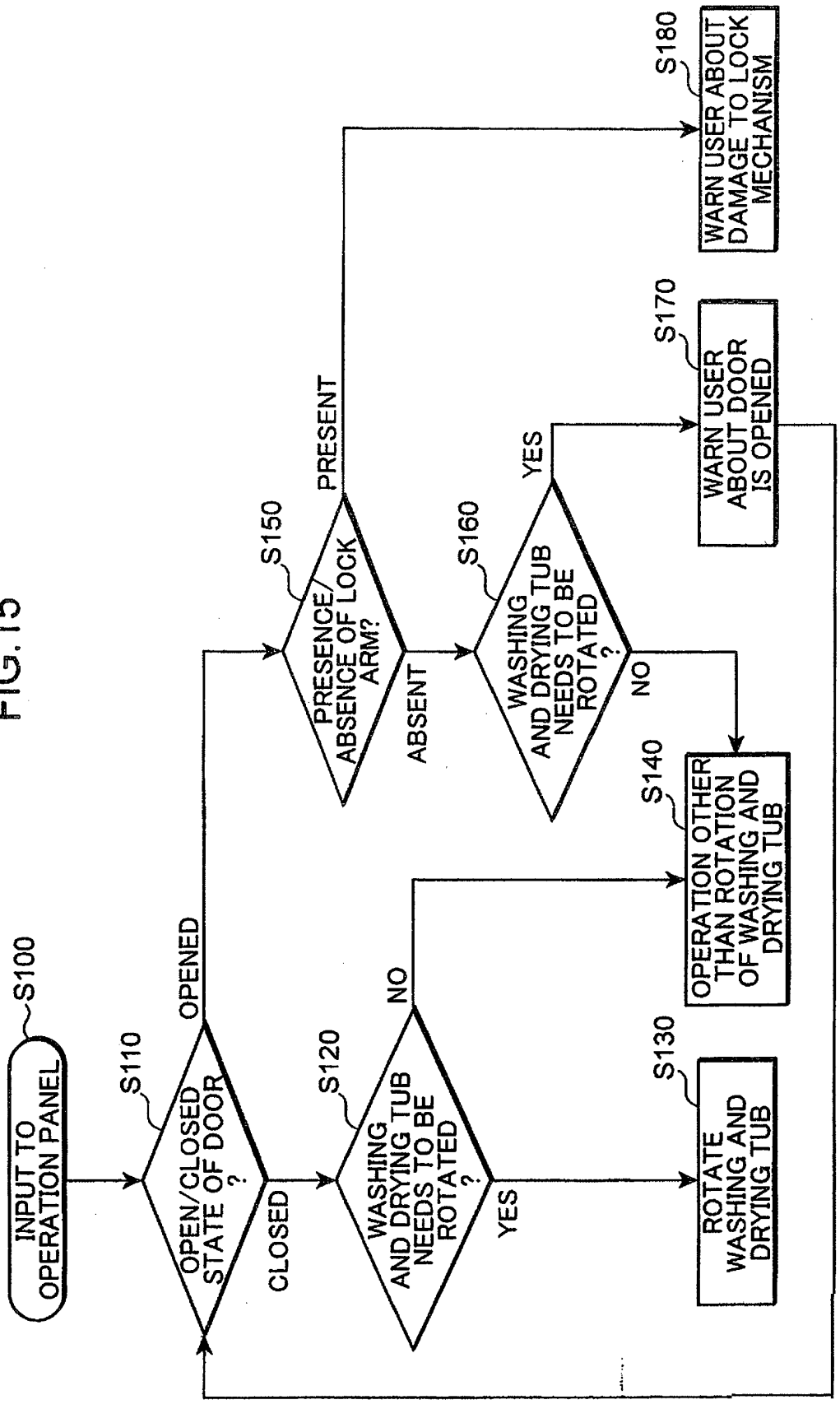

S100
INPUT TO OPERATION PANEL
S110
OPEN/CLOSED STATE OF DOOR ?
OPENED
CLOSED
S120
WASHING AND DRYING TUB NEEDS TO BE ROTATED ?
NO
YES
S130
ROTATE WASHING AND DRYING TUB
S140
OPERATION OTHER THAN ROTATION OF WASHING AND DRYING TUB
S150
PRESENCE/ ABSENCE OF LOCK ARM?
PRESENT
ABSENT
S160
WASHING AND DRYING TUB NEEDS TO BE ROTATED ?
YES
NO
S170
WARN USER ABOUT DOOR IS OPENED
S180
WARN USER ABOUT DAMAGE TO LOCK MECHANISM

FIG.16

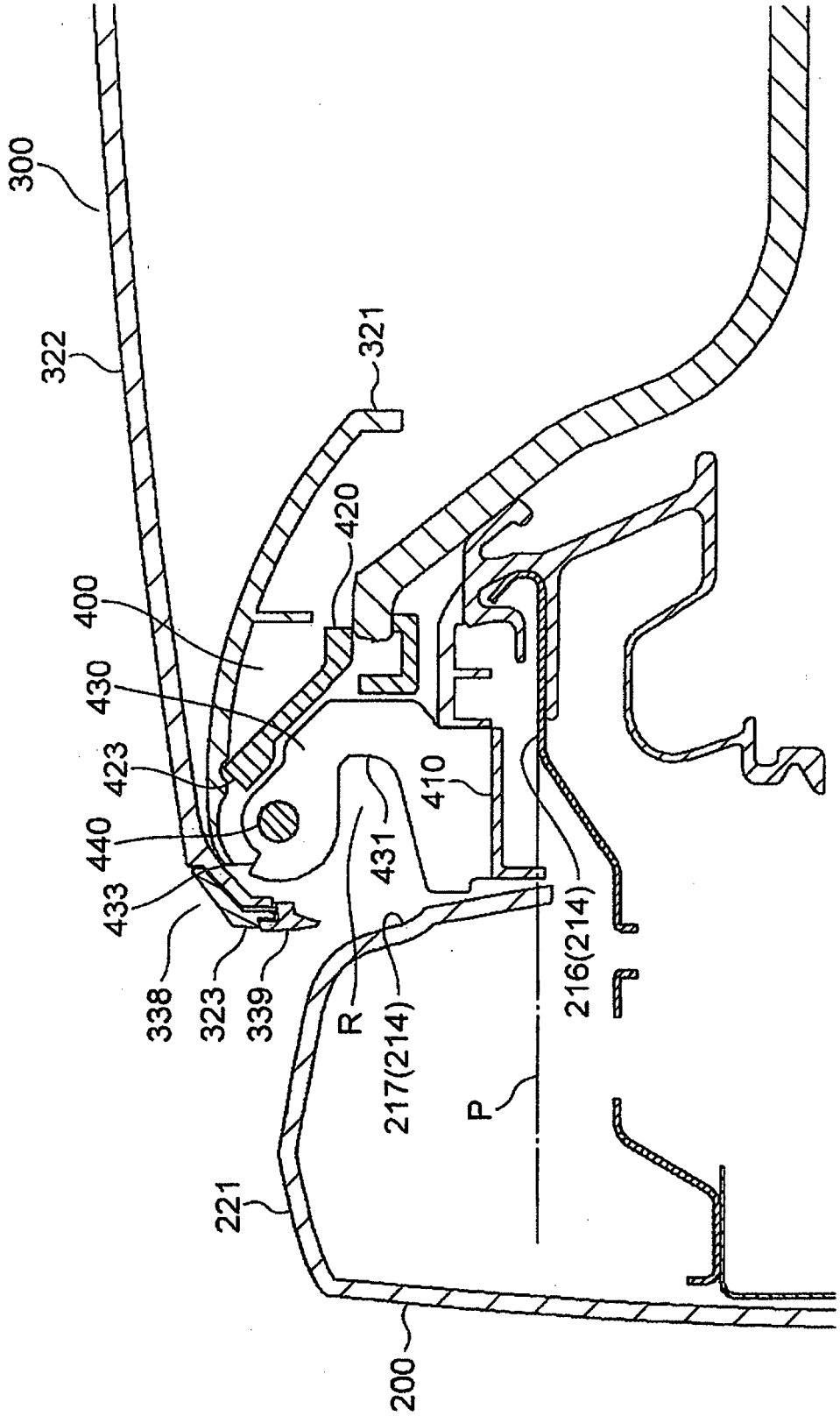

300
322
321
420
400
430
423
440
433
338
323
339
410
431
R
217(214)
216(214)
P
221
200

FIG.17

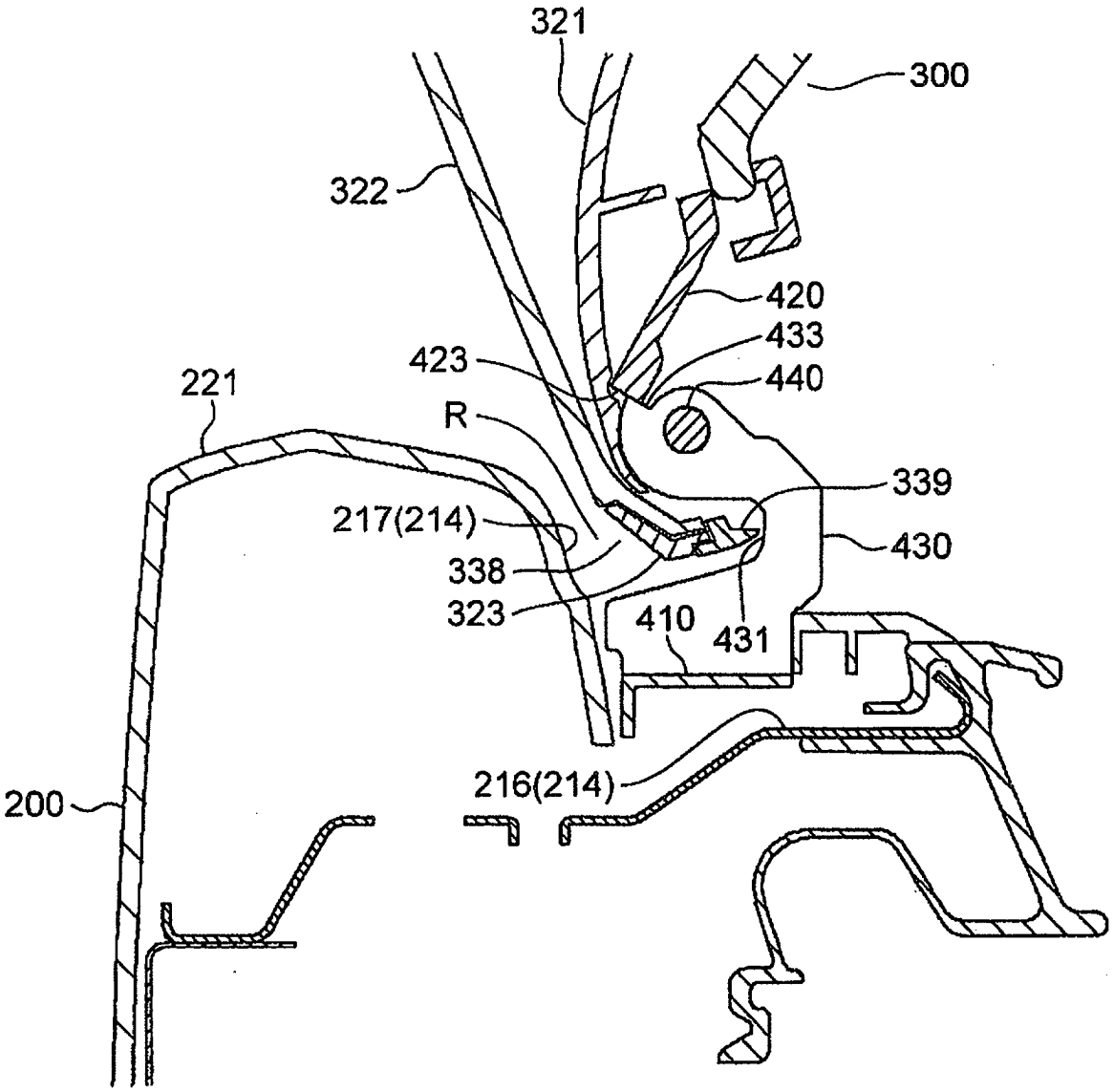
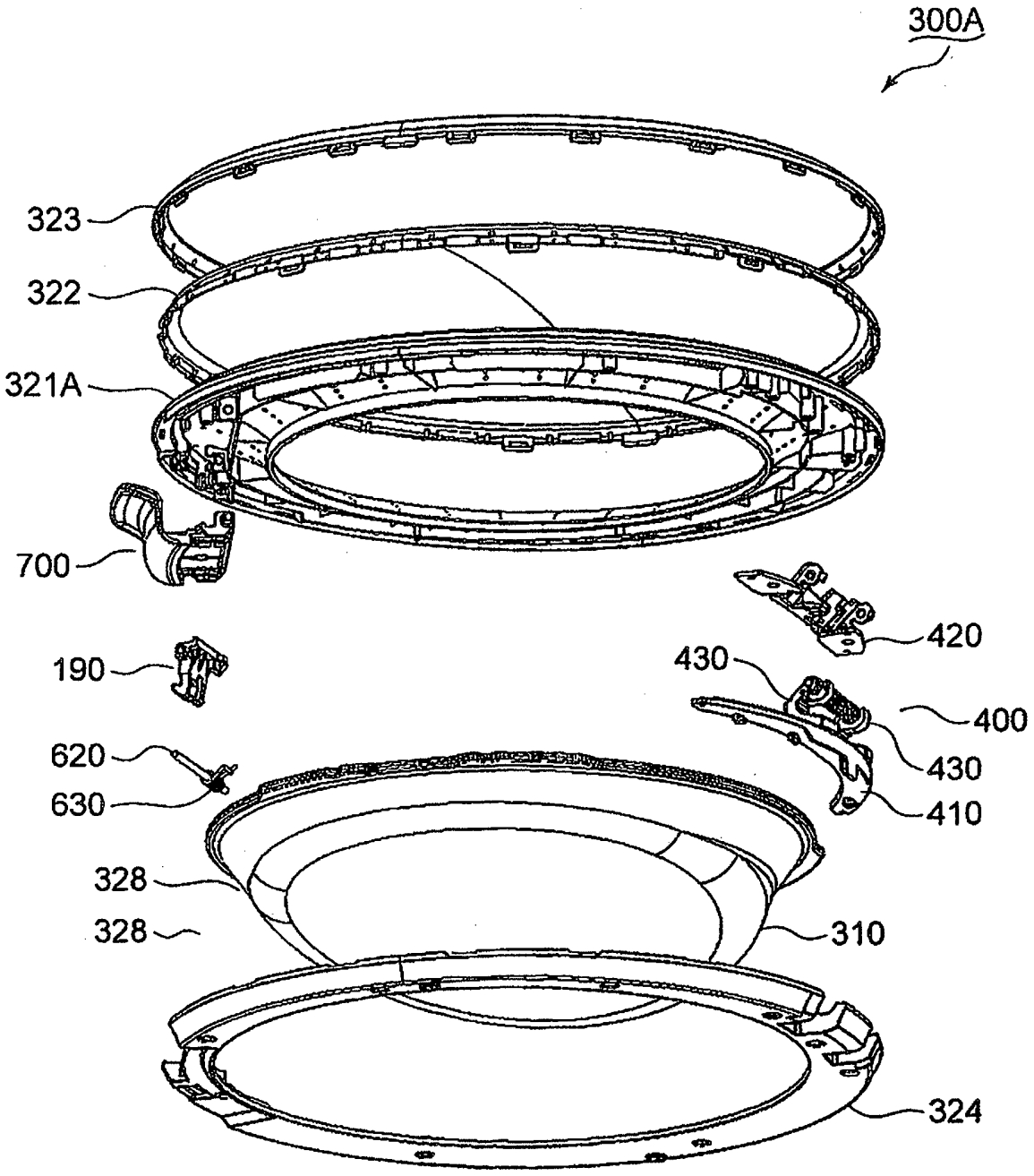

321
300
322
420
433
423
440
221
R
339
217(214)
430
338
323
410
431
216(214)
200

FIG.18


300A
323
322
321A
700
190
620
630
328
328
420
430
400
430
410
310
324

REFERENCES CITED IN THE DESCRIPTION

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- JP 2000279679 A **[0004]**
- JP 2009095529 A **[0004]**