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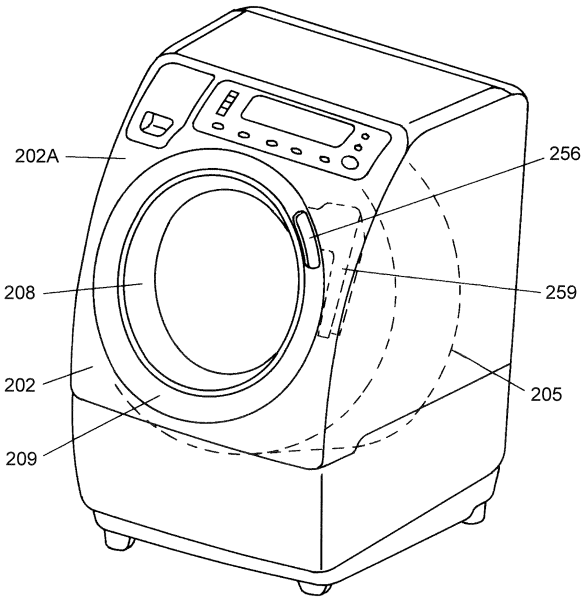
(54) Drum type washing machine

(57) A drum type washing machine has a cabinet (202), a washing drum (205) which serves as a dewatering bin, a door unit (208), a door opening button (256), an opening/closing actuator (293) and a locking unit (259). The cabinet (202) is provided with an opening in the front side thereof. The door unit (208) of a circular shape covers the opening of the cabinet. The door opening button (256) has a first rotary shaft (256A). The opening/closing actuator (293) has a second rotary shaft (293A), and it is turned by a pressing force applied to the door opening button (256). The locking unit (259) for holding the door unit in a position to close the opening of the cabinet operates in a linked motion with the opening/closing actuator (293), and it releases the door unit (208) to open from the closed position by the pressing force applied to the door opening button. The door opening button (256) is disposed in an orientation that a normal line of the first rotary shaft (256A) is tilted with respect to the second rotary shaft (293A) and points toward the center of the door unit (208).

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a drum type washing machine having a door unit disposed on a front side of a cabinet so as to be freely opened or closed.

BACKGROUND ART

[0002] In a conventional drum type washing machine, a washing drum which also used for dewatering is disposed horizontally or obliquely, and driven for a rotational motion. An opening is formed in the front side of a cabinet for taking laundry in and out of the cabinet. This opening is closed with a door unit.

[0003] The door unit is opened by operation of a push button. The door unit is locked so as not to be opened during operation to prevent the user from inserting a hand into the rotating washing drum and to avoid washing water and laundry from coming outside.

[0004] Fig. 5 is an exterior view of a conventional drum type washing machine. Cabinet 2 has upwardly-tilted sloped surface 2A formed on an upper front side thereof, on which door unit 8 of a circular shape is attached. A user can open door unit 8 by pressing door opening button 56 provided on sloped surface 2A.

[0005] Fig. 6 shows the washing machine in which door unit 8 is opened by pressing door opening button 56. Door unit 8 is provided with latch 90 in a protruding manner on an interior side thereof. There is locking unit 59 assembled behind sloped surface 2A of cabinet 2. There is also latch catcher 91 provided next to the opening of cabinet 2, and latch catcher 91 constitutes a part of locking unit 59.

[0006] The user puts laundry into washing drum 5 which also used for drying with door unit 8 open, closes door unit 8, and starts the operation. At that time, latch 90 snaps into latch catcher 91, and door unit 8 is held in a closed position by locking unit 59.

[0007] Next, description is provided of a detailed structure of locking unit 59 and relevant components. Fig. 7 is a plan view of the washing machine with a portion of outer enclosure around sloped surface 2A removed to show a structure contrived for opening and closing the door unit. Fig. 8 is a vertical sectional view taken along a line A - B in Fig. 7, and Fig. 9 is a horizontal sectional view taken along a line C - D in Fig. 7.

[0008] As shown in Figs. 8 and 9, thrust spring 92, opening/closing actuator 93 and pressing boss 94 are provided behind door opening button 56. Opening/closing actuator 93 is connected with spring 69 formed as a tension spring, so that opening/closing actuator 93 and locking unit 59 are engaged with spring 69 as shown in Fig. 7. Locking unit 59 is provided with latch catcher 91 formed therein, as discussed above. Latch catcher 91 and door opening button 56 are exposed on sloped surface 2A. Door opening button 56 is retained by rotary shaft 56A in a manner to turn within a limited range.

[0009] Description provided hereinafter is an operating sequence, in which door unit 8 is opened from its closed position when the user presses door opening button 56. In the normal state, thrust spring 92 abuts against opening/closing actuator 93 and holds opening button 56 at the foremost position by the thrust force, as shown in Fig. 7 and Fig. 9.

[0010] When the user presses door opening button 56 with a force of P in the direction of an arrow shown in Fig. 8 and Fig. 9, thrust spring 92 is compressed, and pressing boss 94 provided next to thrust spring 92 comes to abut upon opening/closing actuator 93. This causes opening/closing actuator 93 to turn about rotary shaft 93A serving a fulcrum, and this motion of opening/closing actuator 93 exerts a tensile force on spring 69.

[0011] Spring 69 is attached between opening/closing actuator 93 and locking unit 59 in a manner to maintain a predetermined amount of tension. The other end of spring 69 disposed inside locking unit 59 is engaged with tension pin 111. Therefore, spring 69 acts upon tension pin 111 when the tensile force is exerted on spring 69. This action causes lock plate 113 linked to tension pin 111 to turn about support shaft 114 and, as a result, releases latch 90 held in latch catcher 91.

[0012] Lock plate 113 is under a thrust force of lock spring 112 provided inside locking unit 59 in a direction of holding latch 90 within latch catcher 91, as shown in Fig. 8.

[0013] As discussed above, an amount of the force required to press door opening button 56 must be sufficient to overcome the reactive force of thrust spring 92 to turn opening/closing actuator 93 and also the thrust force of lock spring 112 to turn lock plate 113 through the tension of spring 69.

[0014] When the pressing force to door opening button 56 is removed, lock plate 113 is turned by the thrust force of lock spring 112, and this returns protruding portion 113A to the position inside latch catcher 91. Since tension pin 111 moves downward at the same time, opening/closing actuator 93 pulled by spring 69 turns and brings back door opening button 56 to the original position by the force of thrust spring 92.

[0015] The user pushes door unit 8 to close door unit 8 from its open position. When this occurs, latch 90 of door unit 8 presses lock plate 113 and turns it against the thrust force of lock spring 112. This makes latch 90 engage with protruding portion 113A and brings it again into the state of being locked.

[0016] There is a rising demand in recent years for improvement of operational ease for this type of washing machines. It is desired, in particular, to increase the size of door opening button 56 for ease of the operation since opening and closing operation of door unit 8 is always necessary when using the washing machine. It is also desired to reduce an amount of the required pressing force in order to improve the operability.

[0017] In the structure discussed above, however,

door opening button 56 and opening/closing actuator 93 are constructed in a compact form and shape, and disposed in a limited space and location. Door opening button 56 especially requires a pressing force large enough to overcome the reactive force to turn lock plate 113 thrust by spring 112 in addition to the force to turn opening/closing actuator 93. As a result, the force required to press door opening button 56 is considerably large.

[0018] A force exerted on locking unit 59 through door opening button 56 can be given as follows on an assumption that central pressing point M where the pressing force is applied to door opening button 56 lies in the same position as a central point of actuation on opening/closing actuator 93 in a plane geometry of Fig. 7. Assume here that a distance from the central pressing point M to rotary shaft 56A and another distance from the central point of actuation of opening/closing actuator 93 to rotary shaft 93A are denoted by characters K and J, respectively. According to the principle of leverage, a force exerted on a point of action is proportional to a distance of the point of action from the center of turning. Therefore, force Q that acts upon locking unit 59 by the force P applied to door opening button 56 can be expressed by the equation (1):

$$Q = P \times (K/J) \cdots (1)$$

[0019] In the equation (1), an amount of force Q required for locking unit 59 to let door unit 8 open remains fixed. It is therefore necessary for improvement of the operability to increase a value of K/J in order to reduce the force P, which is the operating force for the user to press door opening button 56.

[0020] However, it is difficult to increase the value of K, which is the distance from the central pressing point M on door opening button 56 to rotary shaft 56A. There is not an enough room to increase the distance K since cabinet 2 has a limited space, because distance N from rotary shaft 56A to side wall 70 is small, as is obvious from Fig. 7. In order to reduce the value of J, on the other hand, it is necessary to make opening/closing actuator 93 extremely small in size. In this case, variations in the value of J can significantly influence the force Q acting upon locking unit 59, and this is therefore not practicable.

[0021] In addition, door opening button 56 turns horizontally whereas opening/closing actuator 93 turns vertically. Since they turn along their respective axes that are different by about 90 degrees, there is also a large loss of force at the pressing point.

SUMMARY OF THE INVENTION

[0022] The present invention is a drum type washing machine featuring high operability by providing a door opening button of large size with a less pressing force to operate. The drum type washing machine of this invention has a cabinet, a washing drum which serves as a dewatering bin, a door unit, a door opening button, an opening/closing actuator and a locking unit. The cabinet is provided with an opening formed in the front side thereof. The washing drum is disposed inside the cabinet and driven for a rotational motion. The door unit of a circular shape covers the opening of the cabinet. The door opening button operable by a pressing force has a first rotary shaft. The opening/closing actuator has a second rotary shaft, and it is turned by the pressing force to the door opening button. The locking unit for locking the door unit in a closed position operates in a linked motion with the opening/closing actuator, and it releases the door unit to open from its closed position by a pressing operation of the door opening button. The door opening button is disposed in such an orientation that a normal line of the first rotary shaft is tilted with respect to the second rotary shaft and points toward the center of the door unit. In this structure, it becomes possible to ensure the required force to the locking unit through the opening/closing actuator even when the pressing force delivered from the door opening button is small. The operability of the door opening button can thus be improved.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

Fig. 1 is an exterior view of a drum type washing machine according to an exemplary embodiment of the present invention.

Fig. 2 is a plan view showing in detail a part of the drum type washing machine shown in Fig. 1.

Fig. 3 is a plan view showing a structure of a locking unit of the drum type washing machine shown in Fig. 1.

Fig. 4 is an exploded perspective view of an area around a door opening button of the drum type washing machine shown in Fig. 1.

Fig. 5 is an exterior view of a conventional drum type washing machine.

Fig. 6 is another exterior view of the drum type washing machine shown in Fig. 5 with a door unit in open position.

Fig. 7 is a plan view showing a structure contrived for opening and closing the door unit of the drum type washing machine shown in Fig. 5.

Fig. 8 is a partially sectioned view showing a section taken along a line A - B in Fig. 7.

Fig. 9 is another partially sectioned view showing a section taken along a line C - D in Fig. 7.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Description is provided hereinafter of an exemplary embodiment of the present invention with reference to the accompanying drawings. The exemplary embodiment described herein is illustrative and not intended to

limit the scope of this invention.

[0025] Fig. 1 is an exterior view of a drum type washing machine according to the exemplary embodiment of the present invention. This drum type washing machine has cabinet 202, washing drum 205 which serves as a dewatering bin, door unit 208, door opening button 256, opening/closing actuator 293 and locking unit 259.

[0026] Cabinet 202 has upwardly-tilted sloped surface 202A formed on an upper front side thereof. Sloped surface 202A is provided with an opening. In other words, cabinet 202 has the opening formed in the front side thereof. Door unit 208 of a circular shape is provided so as to be attached to sloped surface 202A and cover the opening of cabinet 202. Washing drum 205 is disposed inside cabinet 202, and driven for a rotational motion. That is, washing 205 is housed inside cabinet 202 in a rotatable manner.

[0027] Door opening button 256 is operable by a pressing force, and is located in the proximity of door unit 208 at the front side of cabinet 202. That is, door opening button 256 is provided on sloped surface 202A. Locking unit 259 is assembled behind sloped surface 202A. Locking unit 259 keeps door unit 208 in a position to close the opening of cabinet 202.

[0028] When a user presses door opening button 256, locking unit 259 releases the lock and opens door unit 208. In other words, the pressing operation of door opening button 256 causes locking unit 259 to open door unit 208 from the closed position. This allows the user to put clothes in and out of washing 205. Referring to Figs. 2 and 3, description is provided next of a structure related to opening and closing operation of door unit 208. Fig. 2 is a plan view showing in detail a part of the structure around door opening button 256 and locking unit 259. Fig. 3 is a plan view showing a structure of locking unit 259.

[0029] Opening/closing actuator 293 is installed on the back side of door opening button 256 within cabinet 202. Opening/closing actuator 293 is turned by a pressing force to door opening button 256. In the normal state, a thrust spring, though not shown in the figures, abuts on opening/closing actuator 293 and holds door opening button 256 at the foremost position by the thrust force thereof. Locking unit 259, which operates in a linked motion with opening/closing actuator 293, is located under opening/closing actuator 293 inside cabinet 202. Door unit 208 is provided with a latch (not shown) in a protruding manner on the inner side thereof. There is also latch catcher 291 disposed next to the opening of cabinet 202, and it constitutes a part of locking unit 259.

[0030] Locking unit 259 has tension pin 311 and lock plate 313, as shown in Fig. 3. Spring 269 connects opening/closing actuator 293 and tension pin 311. Locking unit 259 has a similar structure as that of locking unit 59 shown in Fig. 7.

[0031] When the user presses door opening button 256, it turns about shaft 256A designated as a first rotary shaft. This causes opening/closing actuator 293 to turn about shaft 293A designated as a second rotary shaft in a linked motion with the turning movement of door opening button 256. At the same time, opening/closing actuator 293 actuates locking unit 259 via connected spring 269. That is, when a tensile force is exerted on spring 269, spring 269 pulls up tension pin 311. This motion causes lock plate 313 linked to tension pin 311 to turn about shaft 314 serving a fulcrum. As a result, the latch held in latch catcher 291 is released.

[0032] Lock plate 313 is thrust in a direction of holding the latch in latch catcher 291 by a lock spring (not shown) provided inside locking unit 259. Therefore, lock plate 313 is turned by the thrust force of this lock spring, and protruding portion 313A shifts back to the position within latch catcher 291 when the pressing force to door opening button 256 is removed. Since tension pin 311 also shifts downward, opening/closing actuator 293 pulled by spring 269 is turned, so that door opening button 256 returns to the original position.

[0033] To close door unit 208 from the open position, the user pushes it. This makes the latch of door unit 208 push and turn lock plate 313. As a consequence, the latch becomes engaged with protruding portion 313A, and it is locked again.

[0034] Here, a distance from central pressing point G of door opening button 256 to shaft 256A is denoted by character E. The central pressing point G represents a point of action of door opening button 256. Door opening button 256 is so constructed and disposed that a line normal to an axis of shaft 256A and extended from point G, i.e., the normal line H of shaft 256A, points toward the center of door unit 208.

[0035] Description is provided next of an angular relation between door opening button 256 and opening/closing actuator 293 by referring to Fig. 4. Fig. 4 is an exploded perspective view of door opening button 256.

[0036] Door opening button 256 is disposed in cut-out portion 209A of ring-shaped door frame 209 in a pivotable manner. Opening/closing actuator 293 is located on the back side of door opening button 256, and it is turned in a linked motion with the pivot movement of door opening button 256.

[0037] The normal line H of shaft 256A of door opening button 256 is tilted by angle R, which is different from 90 degrees, with respect to shaft 293A of opening/closing actuator 293 disposed generally horizontally. This can therefore reduce a loss of actuating force. In this point of view, it is preferable the angle R is at least 20 degrees and at most 45 degrees.

[0038] Description is provided next of an amount of force required in this structure to release the lock by locking unit 259. In Fig. 2, a distance from point G, the central point of action of opening/closing actuator 293, to shaft 293A serving as the turning fulcrum of opening/closing actuator 293 is denoted by character L. According to the principle of leverage, a force exerted on a point of action is proportional to a distance of the point of action from the center of turning. Therefore, force T that acts upon

locking unit 259 by force S applied to door opening button 256 can be expressed by the equation (2):

$$T = S \times (E/L) \cdots (2)$$

[0039] Here, a value of L is equal to the value of J discussed in the background art. Door opening button 256 is disposed in an orientation along the periphery of ring-shaped door frame 209 so that the normal line H of shaft 256A points toward the center of door unit 208. There is thus made available a sufficient extra space of distance F from shaft 256A to side wall 270 of cabinet 202. This can therefore make possible to set a value of E as to be larger than the value of K discussed in the background art. As the result, this structure can reduce the value of depressing force S for the user to apply to door opening button 256 without changing the force T required to actuate locking unit 259.

[0040] Door opening button 256 is disposed at an upper right position of ring-shaped door frame 209 formed around door unit 208, as viewed from the front side confronting sloped surface 202A. It is preferable that door opening button 256 is located at an obliquely upper position in the peripheral part of ring-shaped door frame 209, as mentioned above. By locating door opening button 256 inward of the washing machine in this fashion, there can be made available even more space of the distance F to side wall 270. This helps increase the value of distance E from the central pressing point G to shaft 256A, and it can thereby reduce the force required to press door opening button 256. In other words, this improves the operability of the drum type washing machine.

[0041] It is also preferable that door opening button 256 is disposed in the orientation along the periphery of ring-shaped door frame 209. This arrangement is useful in the case of design alteration such as a change in the outer shape of door opening button 256, since such change can be accommodated easily by changing a shape of door frame 209 in a portion corresponding to door opening button 256. This helps avert the need to alter upwardly sloped surface 202A at the upper front side of cabinet 202, which is one of the largest size components, so as to improve adaptability to diversification in design.

[0042] It is further preferable that door opening button 256 is formed into such a shape so that a length in the direction along the periphery of door unit 208 is larger than a length in the radial direction of door unit 208. Such shape is suitable to enlarge the overall size of door opening button 256. Even in this case, door opening button 256 of such shape is still capable of actuating opening/closing actuator 293 reliably since the normal line of shaft 256A points toward the center of door unit 208. Door opening button 256 of the increased size can reduce the pressing force required to operate door opening button 256. In addition, the distance E does not change even when the user presses the edge of door opening button 256 instead of the central pressing point G. This helps stabilize the force S even though door opening button 256 is formed larger in width, so as to improve the operability.

[0043] Meanwhile, the structure of locking unit 259 described above is illustrative and not restrictive. The invention may be embodied in many other ways as long as the structure operable in a linked motion with opening/closing actuator 293 so that a pressing force to door opening button 256 provides the function of opening door unit 208 from the closed position.

[0044] As described above, the drum type washing machine of the present invention has an advantage of reducing the pressing force required to apply to the door opening button while also reducing the loss of the force. Accordingly, the invention improves the operability. The present invention is also adaptable to many applications such as drum type dryers and the like appliances equipped with door locking mechanisms.

Claims

1. A drum type washing machine comprising:

   a cabinet provided with an opening in a front side thereof;
   a washing drum serving as a dewatering bin, the drum disposed inside the cabinet and driven for a rotational motion;
   a door unit of a circular shape, the door unit covering the opening of the cabinet;
   a door opening button having a first rotary shaft and operable by a pressing force;
   an opening/closing actuator having a second rotary shaft and turnable by the pressing force to the door opening button; and
   a locking unit for holding the door unit in a position to close the opening of the cabinet,
   wherein, the door unit is disposed in such orientation that a normal line of the first rotary shaft is tilted with respect to the second rotary shaft and points toward a center of the door unit, and
   the locking unit is operable in a linked motion with the opening/closing actuator to release the door unit to open from a closed position by the pressing force applied to the door opening button.

2. The drum type washing machine according to claim 1, further comprising a ring-shaped door frame formed around the door unit,
   wherein the door opening button is disposed at an obliquely upper position in a peripheral part of the ring-shaped door frame, and
   the door opening button is so shaped that a length in a direction along the periphery of the door unit is

larger than a length in a radial direction of the door unit.

FIG. 1

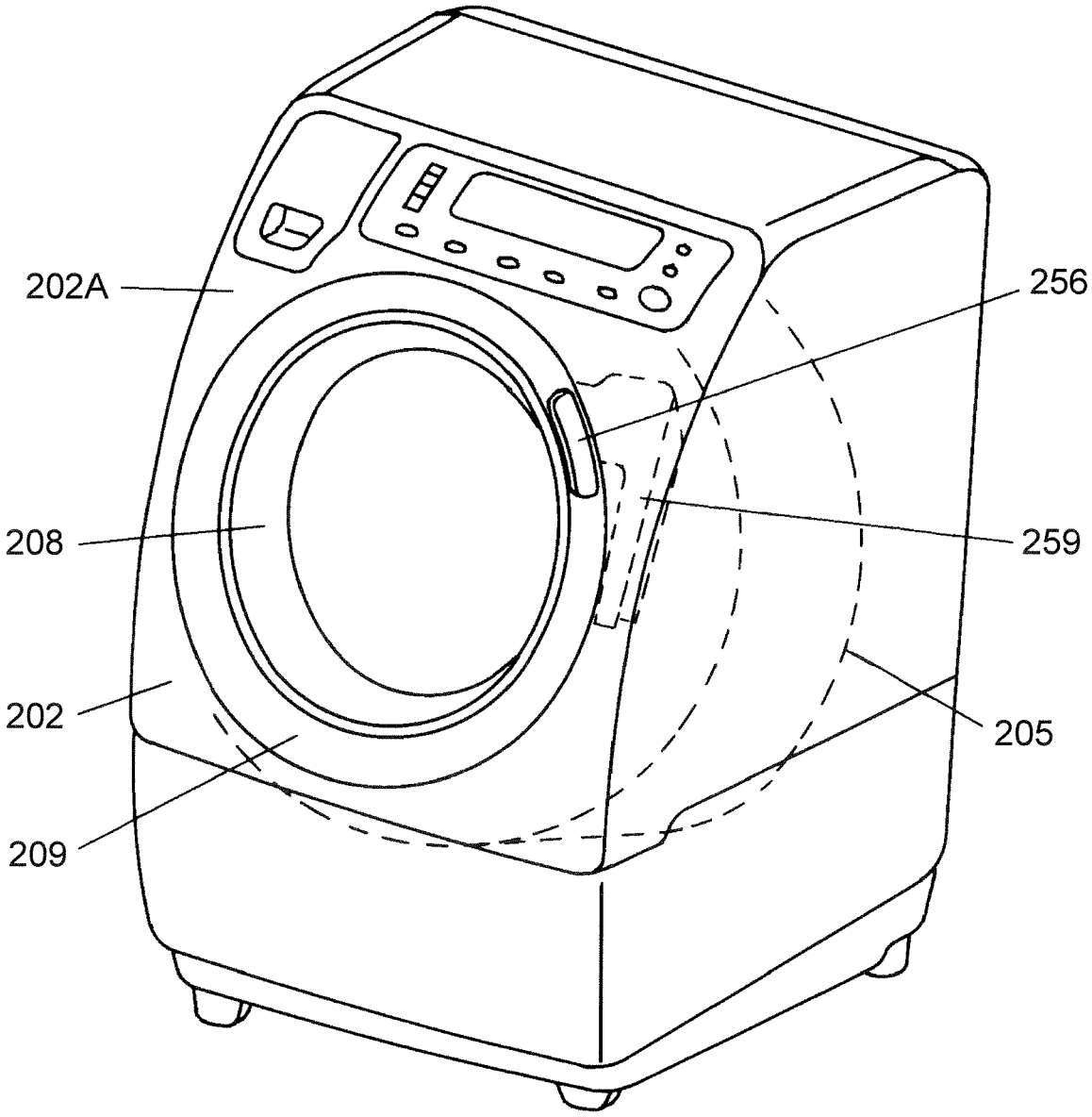

FIG. 2

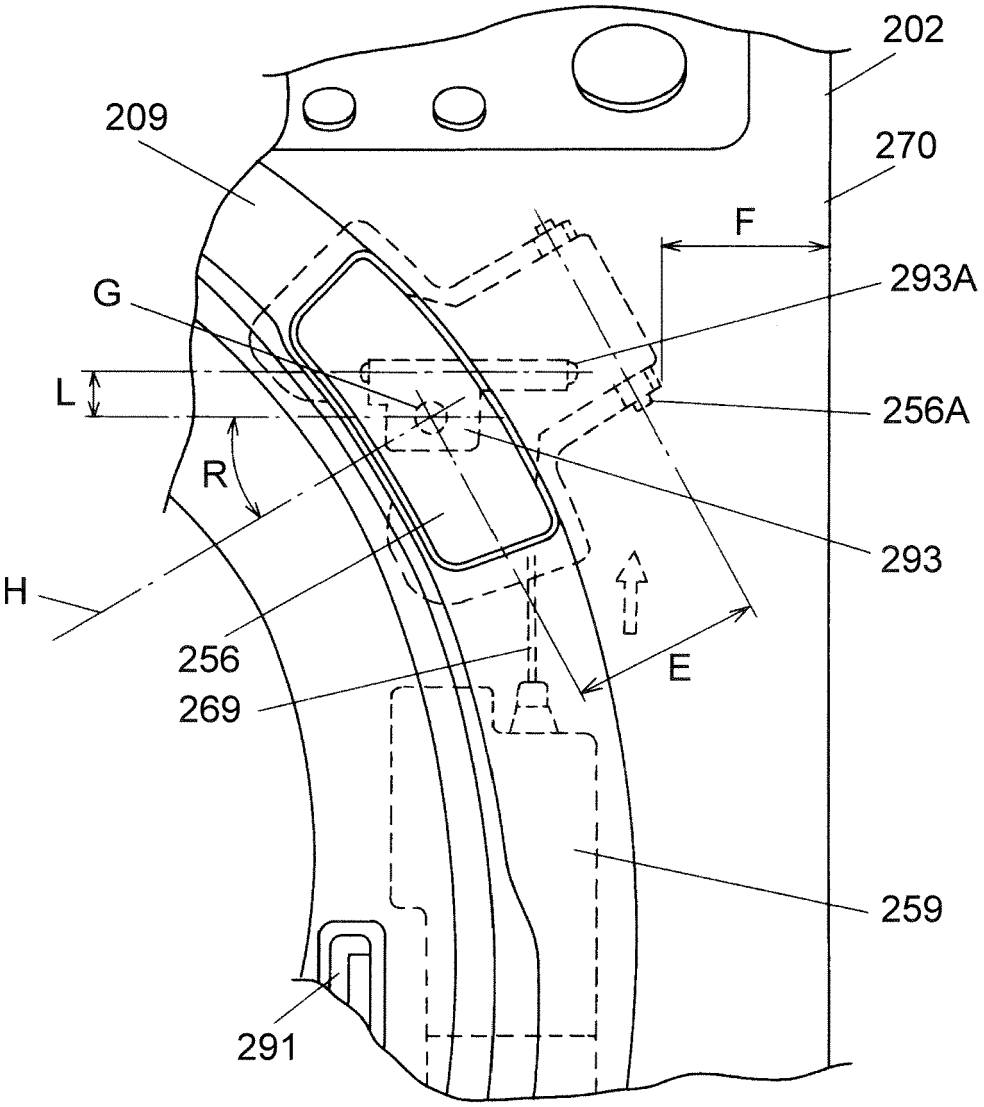

FIG. 3

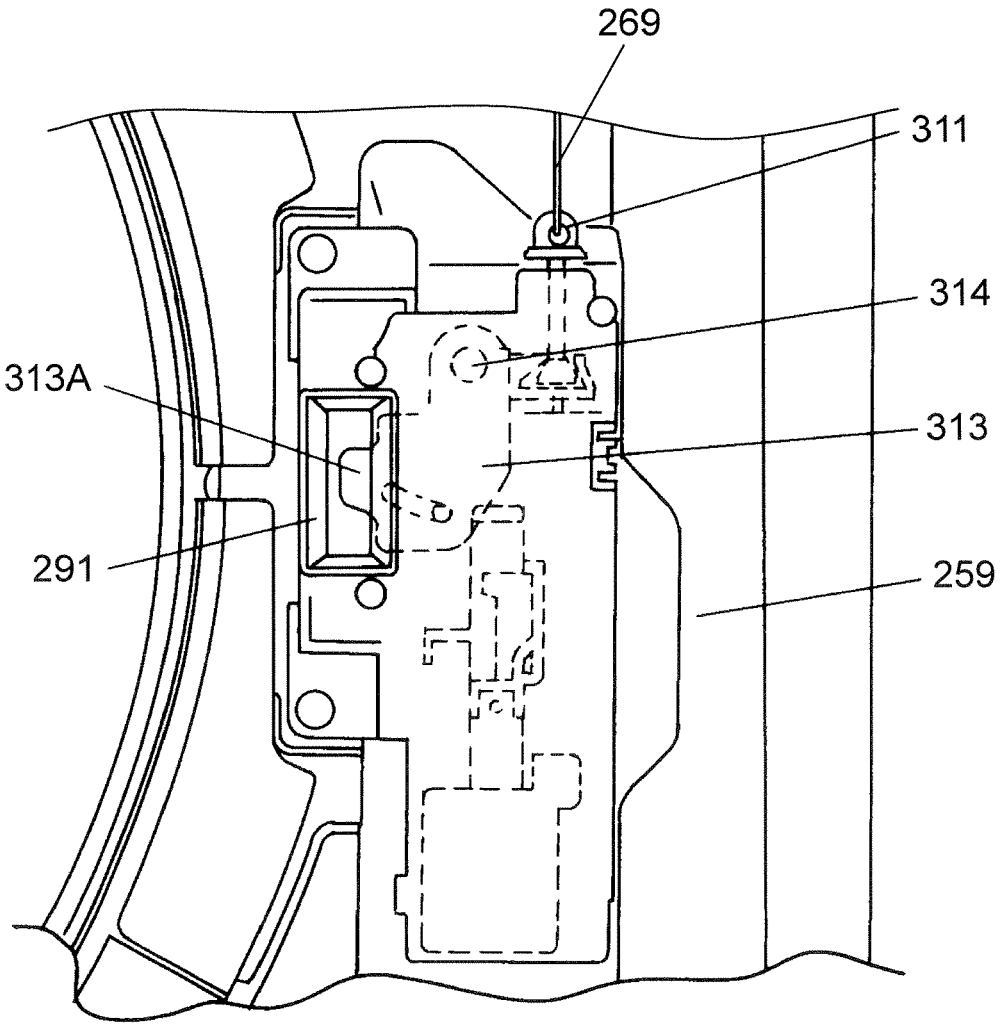

FIG. 4

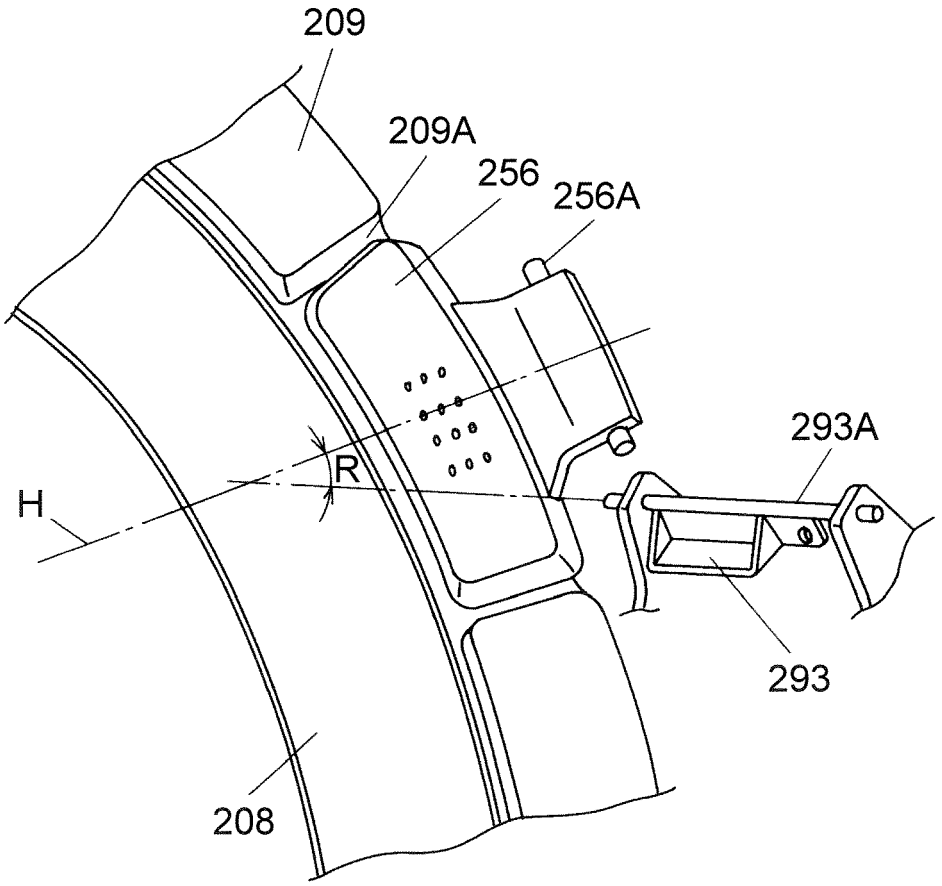

FIG. 5

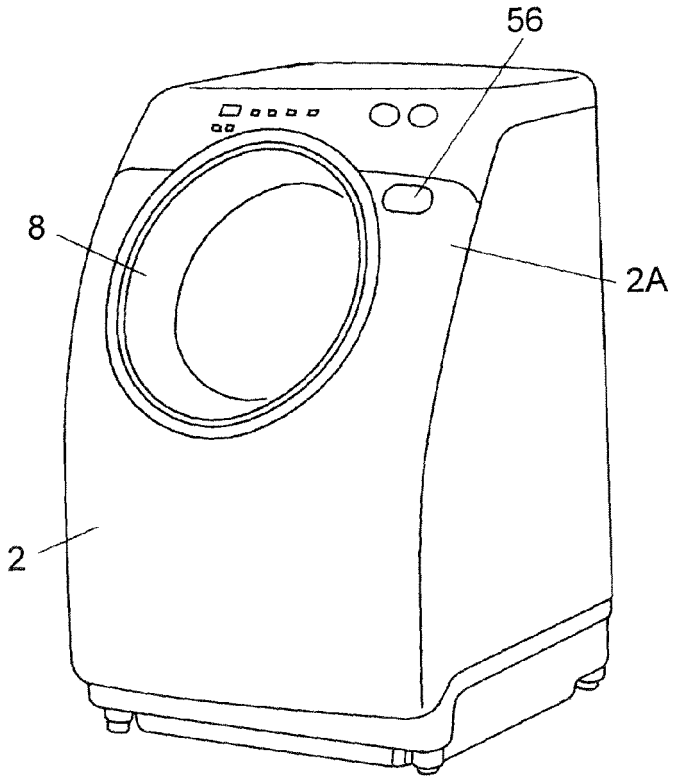

FIG. 6

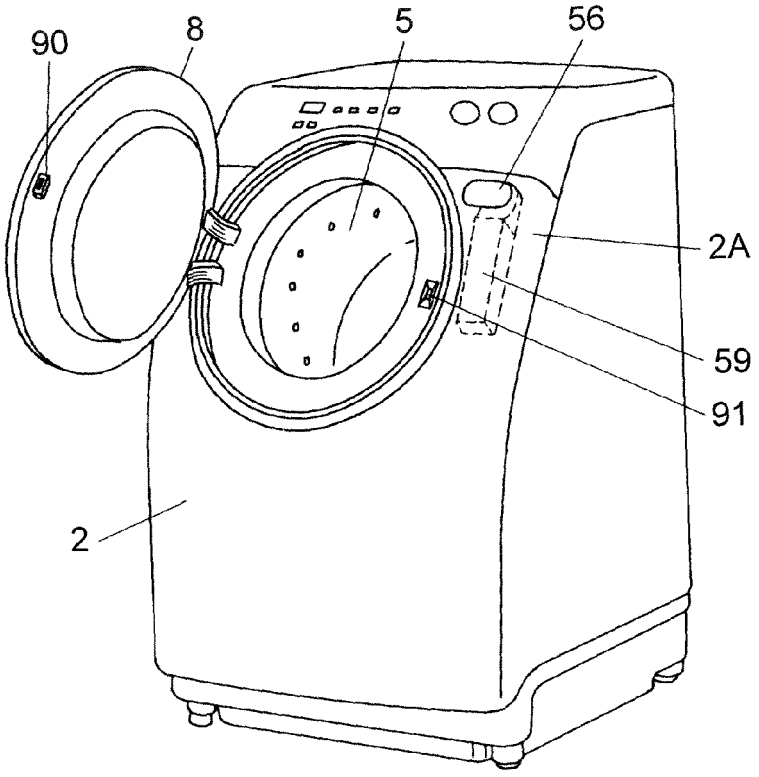

FIG. 7

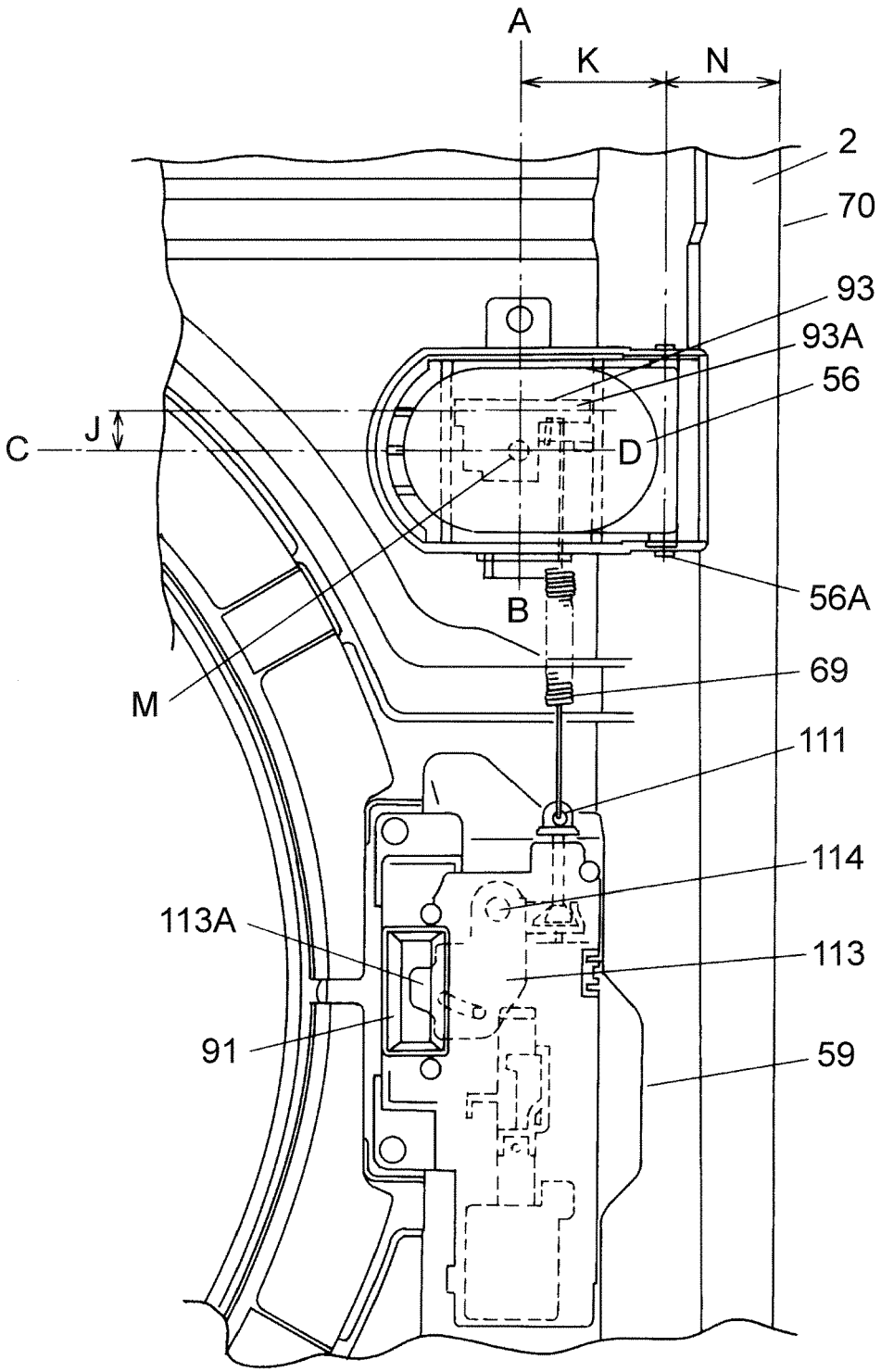

FIG. 8

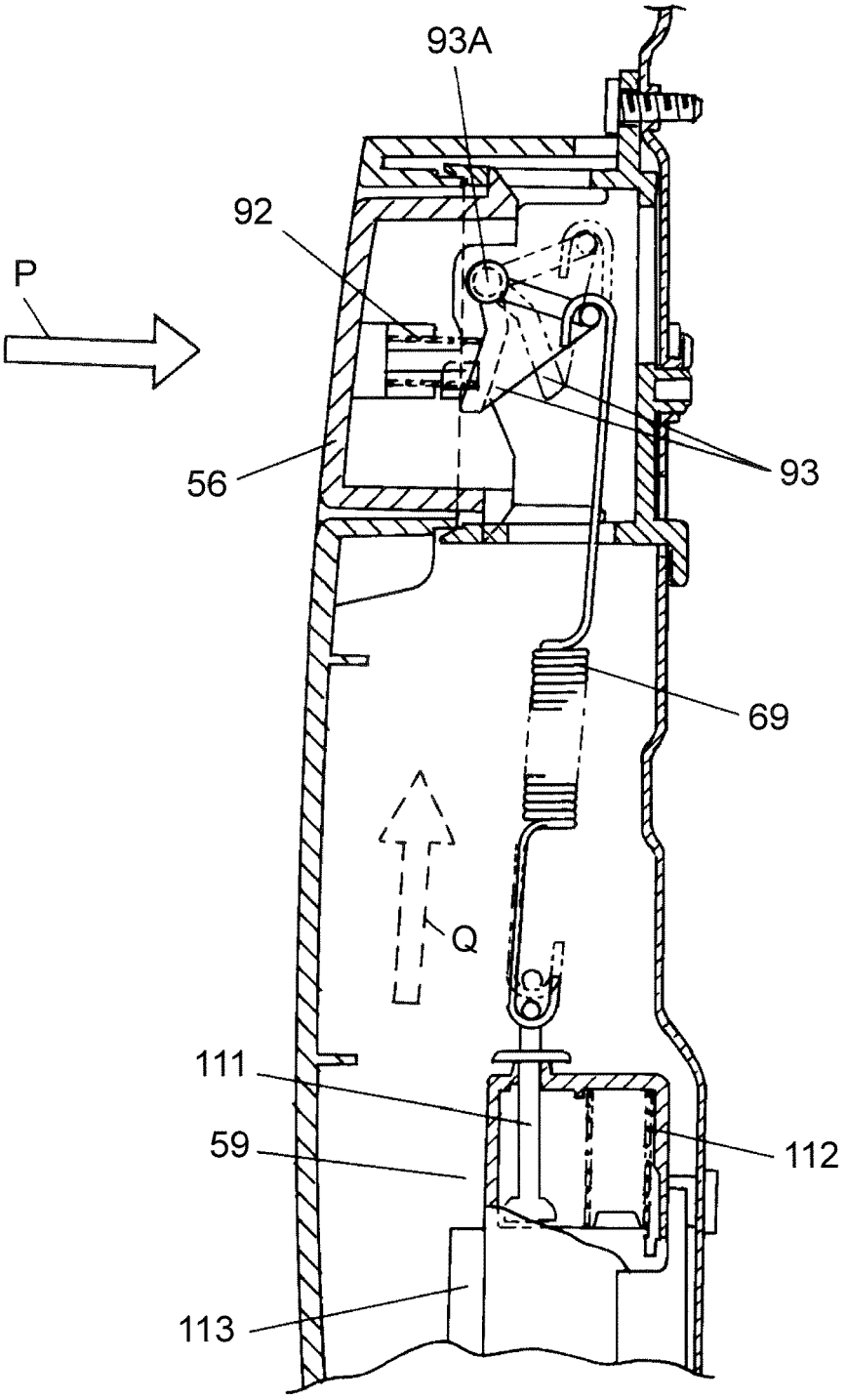

FIG. 9