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(71) Applicants:
- **Qingdao Haier Washing Machine Co., Ltd.**
  Shandong 266101 (CN)
- **Aqua Co., Ltd**
  Chiyoda-ku
  Tokyo 100-0005 (JP)

(72) Inventors:
- **HATTA, Satoshi**
  Tokyo 100-0005 (JP)
- **KAWAKAMI, Takeshi**
  Tokyo 100-0005 (JP)
- **OTSUKI, Taro**
  Tokyo 100-0005 (JP)

(74) Representative: **Gill Jennings & Every LLP**
The Broadgate Tower
20 Primrose Street
London EC2A 2ES (GB)

(54) WASHING MACHINE

(57) In a washing machine of such a structure that a washing drum is pulled out from an external-mounted housing, vibration of the washing drum during dewatering is effectively suppressed. A full-automatic washing machine (1) includes: an external-mounted housing (10) having an inlet/outlet in the front surface of the external-mounted housing; a drawer capable of getting into and getting out of the external-mounted housing (10) through the inlet/outlet and including retainer plates (80) and a door part (90); a washing drum (20) arranged in the drawer through a suspension (60) and including a washing and dewatering drum having a fluid balancer and an outer drum (21) capable of accommodating the washing and dewatering drum in a free rotation manner; sliding rails (100) for enabling the drawer to move rectilinearly relative to the external-mounted housing (10); an acceleration sensor (110) arranged on the drawer; and a control part. The control part obtains inclination of a main body of the full-automatic washing machine (1) based on a static acceleration detected by the acceleration sensor (110), performs first dewatering control based on the inclination, and performs second dewatering control based on a dynamic acceleration which is detected by the acceleration sensor (110) and corresponds to the vibration of the drawer during dewatering.

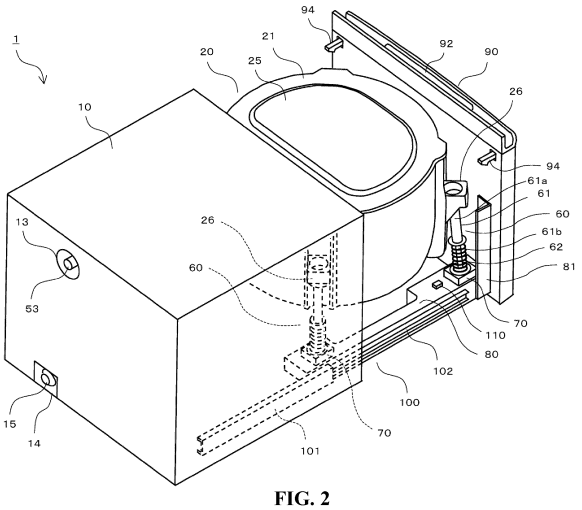

FIG. 2

EP 3 392 389 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine.

BACKGROUND

[0002] In the past, a drawer type washing machine has been proposed as described below. A housing, of which the front surface is opened, accommodates a cabinet with an opened upper side in a manner of pulling out the cabinet from the front side. A washing drum (see patent literature 1) capable of storing washing water and realizing washing and dewatering is arranged inside the cabinet. The washing drum is supported to a bottom surface of the cabinet through suspension having buffer function. Furthermore, the cabinet may move rectilinearly in a forward-backward direction through a sliding unit arranged between the cabinet and the housing.

[0003] In such a drawer type washing machine, the cabinet may be easily pulled out from the housing by reducing internal resistance (i.e., resistance between rollers and rails in a structure of the patent literature 1) of the sliding unit as much as possible. However, when the cabinet is easy to move in the forward-backward direction relative to the housing, and when the vibration, which is generated during dewatering, of the washing drum is transmitted to the cabinet without being completely attenuated through the suspension, the cabinet is easy to vibrate dramatically in the forward-backward direction.

[0004] Generally, a door fastener is arranged between the front surface portion (i.e., a door part) of the closed cabinet and the front surface of the housing, and is locked to close the door part. However, the door fastener has a certain clearance. As such, when the cabinet vibrates dramatically in the forward-backward direction, the door part and the front surface of the housing slightly collide with each other repeatedly, possibly resulting in generation of noise and damage to the door part and the like.

Related Technical Literature

Patent Literature

[0005] Patent Literature 1: Japanese Laid-open patent publication No. 2002-119786

SUMMARY

Problems to be solved by the invention

[0006] The present invention is completed in view of such problems and aims to effectively suppress vibration of a washing drum during dewatering in a washing machine of such a structure that the washing drum is pulled out from an external-mounted housing.

Solution for solving the problems

[0007] A washing machine according to a main implementation of the present invention includes: an external-mounted housing having an inlet/outlet in a front surface of the external mounted housing; a drawer capable of getting into and getting out of the external-mounted housing through the inlet/outlet; a washing drum arranged in the drawer through a suspension and including a washing and dewatering drum and an outer drum, the washing and dewatering drum has a fluid balancer, the outer drum is capable of accommodating the washing and dewatering drum in a free rotation manner; a sliding mechanism for enabling the drawer to move rectilinearly relative to the external-mounted housing; an acceleration sensor arranged on the drawer; and a control part. Here, the control part obtains inclination of a main body of the washing machine based on a static acceleration detected by the acceleration sensor, performs first dewatering control based on the inclination, and performs second dewatering control based on a dynamic acceleration, the dynamic acceleration is detected by the acceleration sensor and corresponds to the vibration of the drawer during dewatering.

[0008] According to the above-mentioned structure, the acceleration sensor may be used to detect whether the main body of the washing machine is in an inclined state or not and detect whether the washing drum vibrates dramatically or not during dewatering, and dewatering may be controlled according to respective detection results for suppressing the vibration of the washing drum. Therefore, the vibration of the washing drum during dewatering may be effectively suppressed.

[0009] In the washing machine according to the implementation, the following structure may be adopted: in the first dewatering control, when the inclination of the main body of the washing machine is greater than a threshold value of the inclination, the control part enables the washing and dewatering drum to rotate in such a manner that an offset load generated in the washing and dewatering drum is located in the upper side of the inclined main body of the washing machine, and then starts the rotation of the washing and dewatering drum for dewatering.

[0010] According to the above-mentioned structure, under a condition that the main body of the washing machine is in the inclined state, after a weight balance between fluid offset in the fluid balancer and the offset load of washings in the washing and dewatering drum is improved, the rotation of the washing and dewatering drum is started for dewatering. Therefore, it is not easy for the washing and dewatering drum to generate sharp vibration when the washing and dewatering drum starts to work, and it is not easy for the drawer to vibrate sharply in the forward-backward direction, thereby avoiding dramatic collision between the drawer and the external-mounted housing. In addition, when a rotating speed of

the washing and dewatering drum is close to a transverse resonance point, great transverse swinging of the washing drum may hardly occur under the resonance.

[0011] In the washing machine according to the mode, the following structure may be adopted: in the second dewatering control, when the dynamic acceleration detected by the acceleration sensor is greater than a threshold value of the dynamic acceleration, the control part stops the rotation of the washing and dewatering drum, and then performs unwrapping operation for unwrapping the washings in the washing and dewatering drum.

[0012] According to the above-mentioned structure, under a condition that the washing drum vibrates sharply during dewatering, the rotation of the washing and dewatering drum is stopped, and the unwrapping operation is performed. Therefore, the vibration of the washing drum may be attenuated when the dewatering is restarted.

Effects of the invention

[0013] According to the present invention, the vibration of the washing drum during dewatering may be effectively suppressed in the washing machine of such a structure that the washing drum is pulled out from the external-mounted housing.

[0014] The effects and significance of the present invention are further defined through description of the following embodiments, but the following embodiments are only examples during implementation of the present invention. The present invention will not be limited by any contents described in the following embodiments.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1(a) is a front stereogram illustrating a full-automatic washing machine according to an embodiment, and FIG. 1(b) is a front stereogram illustrating such a state where two full-automatic washing machines according to the embodiment are superposed vertically;

FIG. 2 is a rear stereogram illustrating a full-automatic washing machine in such a state where a washing drum is pulled out towards a front side of an external-mounted housing according to the embodiment;

FIG. 3 is a side sectional view of a full-automatic washing machine along a line A-A' of FIG. 1(a) according to the embodiment;

FIG. 4 is a block diagram illustrating a structure of a full-automatic washing machine according to the embodiment;

FIG. 5 is a flow chart illustrating a control action in a dewatering process according to the embodiment;

FIG. 6(a) is a diagram schematically illustrating states of the fluid in a fluid balancer subjected to water drainage and an offset load in a washing and dewatering drum when a main body of a full-automatic washing machine is inclined according to the embodiment, and FIG. 6(b) is a diagram schematically illustrating states of the fluid in the fluid balancer and an offset load in the washing and dewatering drum when the washing and dewatering drum rotates half a circle from the state in FIG. 6(a) according to the embodiment;

FIG. 7 is a flow chart illustrating a control action in a dewatering process according to variation example 1;

FIG. 8 is a flow chart illustrating a control action for balance adjustment operation according to variation example 1;

FIG. 9 is a diagram schematically illustrating such a situation that the offset load in the washing and dewatering drum during balance adjustment operation moves along with the rotation of the washing and dewatering drum according to variation example 1; and

FIGs. 10(a) and (b) are diagrams illustrating structures of retainer plates of other variation examples, and FIG. 10(c) is a diagram illustrating structures of cabinets of another variation example.

DETAILED DESCRIPTION

[0016] A full-automatic washing machine 1 of an embodiment of a washing machine of the present invention is described below with reference to drawings.

[0017] FIG. 1(a) is a front stereogram illustrating a full-automatic washing machine 1. FIG. 1(b) is a front stereogram illustrating such a state that two full-automatic washing machines 1 are superposed on top and bottom. FIG. 2 is a rear stereogram illustrating a full-automatic washing machine 1 in such a state that a washing drum 20 is pulled out towards the front side of an external-mounted housing 10. FIG. 3 is a side sectional view of a full-automatic washing machine 1 along a line A-A' of FIG. 1(a).

[0018] With reference to FIG. 1 to FIG. 3, the full-automatic washing machine 1 includes: an external-mounted housing 10, a washing drum 20, a driving unit 30, a water drainage unit 40, a water supply unit 50, front, rear, left and right suspensions 60, front, rear, left and right connecting parts 70, left and right retainer plates 80, a door part 90 and a group of left and right sliding rails 100. A drawer of the present invention is composed of the two retainer plates 80 and the door part 90. The sliding rails 100 are equivalent to sliding mechanism of the present invention.

[0019] The full-automatic washing machine 1 is a so-called drawer type washing machine. A user pulls out the washing drum 20 towards the front side from the external-mounted housing 10, puts washings into the pulled-out washing drum 20 from the upper side, and puts the washing drum 20 into the external-mounted housing 10, so as

to wash the washings. As shown in FIG. 1(b), since two full-automatic washing machines 1 may be arranged in a floor of a washroom and the like in a top-down superposing manner, the washings may be washed effectively in set spaces.

[0020] The external-mounted housing 10 has a substantially cuboid box shape, and the whole front surface of the external-mounted housing 10 is almost used as an opening of an inlet/outlet 11. Clamping parts 12 are arranged at the upper part near the inlet/outlet 11 on the left and right inner side surfaces of the external-mounted housing 10. In addition, a water supply connecting port 13 is formed in the upper part of the rear surface of the external-mounted housing 10, and a water drainage connecting port 14 is formed in the lower part. The water drainage connecting port 14 is provided with a water drainage connecting head 15. Furthermore, feet 16 are arranged at four corners of the bottom surface of the external-mounted housing 10.

[0021] The washing drum 20 includes an outer drum 21 and a washing and dewatering drum 22. A throwing opening 23 for washings is formed in the upper surface of the outer drum 21, and a water filling port 24 is formed behind the throwing opening 23. The throwing opening 23 is covered by an inner cover 25 capable of being opened and closed freely. On the peripheral surface of the outer drum 21, suspension mounting parts 26 are respectively arranged at right end and left end positions of the front side and the right end and left end positions of the rear side. The suspension mounting parts 26 may be integrated with the outer drum 21, and also may be independently formed together with the outer drum 21 and are fixed to the outer drum 21. It should be noted that in the external-mounted housing 10, a gap between the washing drum 20 and the external-mounted housing 10 in the forward-backward direction is designed to be larger than the gap in a left-right direction.

[0022] The washing and dewatering drum 22 is accommodated in the outer drum 21 in a free rotation manner. The washing and dewatering drum 22 rotates in the outer drum 21 about a rotating shaft which extends along a vertical direction. A plurality of dewatering holes 22a are formed in an inner circumferential surface of the washing and dewatering drum 22 all over the whole circumference. In addition, a fluid balancer 27 is arranged at the upper part of the washing and dewatering drum 22. Fluid such as salt water is contained inside the fluid balancer 27. Furthermore, an impeller 28 is arranged at a bottom of the washing and dewatering drum 22. A surface of the impeller 28 is provided with a plurality of blades 28a in a radial manner.

[0023] An outer bottom of the outer drum 21 is provided with the driving unit 30 and the water drainage unit 40. The driving unit 30 generates a torque for driving the washing and dewatering drum 22 and the impeller 28. The driving unit 30 includes a driving motor 31 and a transmission mechanism 32. The transmission mechanism 32 is provided with a clutch mechanism. Through switching operation of the clutch mechanism, in a washing process and a rinsing process, the torque of the driving motor 31 is only transmitted to the impeller 28, such that only the impeller 28 rotates; in a dewatering process, the torque of the driving motor 31 is transmitted to the impeller 28 and the washing and dewatering drum 22, such that the impeller 28 and the washing and dewatering drum 22 rotate integrally. In addition, the transmission mechanism 32 is provided with a speed reducing mechanism. In the washing process and the rinsing process, the impeller 28 rotates at a rotating speed obtained by reducing a rotating speed of the driving motor 31 according to a speed reducing ratio of the speed reducing mechanism.

[0024] The water drainage unit 40 includes a water drainage valve 41, a water drainage pipe 42 and an internal water drainage hose 43. One end of the water drainage valve 41 is connected with the water drainage pipe 42, and the other end of the water drainage valve 41 is connected with the internal water drainage hose 43. The water drainage pipe 42 is connected with a water drainage port (not shown) in the bottom of the outer drum 21. The internal water drainage hose 43 is connected to the water drainage connecting head 15 of the water drainage connecting port 14 from the inner side. The water drainage connecting head 15 is connected with an external water drainage hose (not shown) from the outer side. When the water drainage valve 41 is opened, water accumulated in the washing and dewatering drum 22 and the outer drum 21 is drained out of a machine body through the water drainage pipe 42, the internal water drainage hose 43 and the external water drainage hose.

[0025] In a state where the washing drum 20 is accommodated in the external-mounted housing 10, the internal water drainage hose 43 is accommodated in a rear part of the external-mounted housing 10 in a left-right snake crawling manner. When the washing drum 20 is pulled out from the external-mounted housing 10, the internal water drainage hose 43 is pulled out by the washing drum 20, and is changed from the crawling state into an approximately straight state.

[0026] The water supply unit 50 is disposed behind the upper part in the external-mounted housing 10. The water supply unit 50 includes a water supply valve 51, a water supply pipe 52 and a connecting pipe 53. One end of the water supply valve 51 is connected with the water supply pipe 52, and the other end of the water supply valve 51 is connected with the connecting pipe 53. In the state where the washing drum 20 is accommodated in the exterior housing 10, an outflow port 52a of the water supply pipe 52 faces the water filling port 24 of the outer drum 21. The connecting pipe 53 in the water supply connecting port 13 faces the outside, and is connected to a water supply hose (not shown) extending from a water faucet. When the water supply valve 51 is opened, tap water is supplied into the outer drum 21 through the water supply pipe 52 and the water filling port 24.

[0027] The washing drum 20 is retained on the left and

right retainer plates 80 arranged below the washing drum 20 through the front, rear, left and right suspensions 60. The upper ends of the suspensions 60 are fixed to the suspension mounting parts 26 of the washing drum 20, and the lower ends of the suspensions 60 are fixed to the retainer plates 80 through connecting parts 70. The suspensions 60 may support the washing drum 20 in a buffer manner. The retainer plates 80 are long in the forward-backward direction. The retainer plate 80 on the right side supports the front and rear suspensions 60 on the right side, and the retainer plate 80 on the left side supports the front and rear suspensions 60 on the left side.

[0028] The suspensions 60 each is provided with a damper 61 and a spiral spring 62. The dampers 61 is, for example, a hydraulic damper, and include a cylinder 61a and a piston rod 61b. The cylinder 61a is filled with oil. An upper end of the piston rod 61b is provided with a piston (not shown). When the piston rod 61b move up and down, the piston is in sliding contact with the inner circumferential surface of the cylinder 61a while moving up and down in the cylinder 61a. The cylinder 61a side is connected to a suspension mounting part 26, and the piston rod 61b side is connected to a connecting part 70. The spiral spring 62 is arranged between the cylinder 61a and the connecting part 70 in a manner of wrapping the piston rod 61b. The suspensions 60 elastically support the washing drum 20 through the spiral springs 62. Vibrations of the spiral springs 62 are attenuated through the dampers 61. It should be noted that the dampers 61 also may be air dampers.

[0029] An acceleration sensor 110 is mounted on the upper surface of the retainer plate 80 on the left side. The acceleration sensor 110 is a triaxial acceleration sensor capable of detecting dynamic accelerations and static accelerations in three axial directions, such as an up-down direction, a forward-backward direction and a left-right direction. When the retainer plate 80 is static, the acceleration sensor 110 detects static accelerations in three axial directions corresponding to an inclination direction and an inclination degree of a main body of the full-automatic washing machine 1. In addition, when the retainer plates 80 vibrate along with the vibration of the washing drum 20 due to conditions such as dewatering, the acceleration sensor 110 detects dynamic accelerations corresponding to a vibration direction and a vibration degree. It should be noted that in the present embodiment, the acceleration sensor 110 takes upper, front and left accelerations as positive values, and takes lower, rear and right accelerations as negative values, and is mounted on the retainer plates 80 in this way.

[0030] The door part 90 is fixed to the front ends of the left and right retainer plates 80 through L-shaped mounting metal pieces 81. The upper part of the door part 90 is provided with a locking apparatus 91 for keeping the door part 90 in a closed state relative to the external-mounted housing 10.

[0031] The locking apparatus 91 includes a rod 92, a connecting rod mechanism 93 and left and right door fasteners 94. As shown in FIG. 3, when the door part 90 is closed, the door fasteners 94 are clamped with the clamping parts 12 of the external-mounted housing 10. When the door part 90 tends to move forwards, the door fasteners 94 are blocked by the clamping parts 12, so that the door part 90 is kept in the closed state. When the user operates the rod 92 towards a releasing direction, the door fasteners 94 move upwards through an action of the connecting rod mechanism 93, so that clamping between the door fasteners 94 and the clamping parts 12 is released. Therefore, a state where the washing drum 20 and the door part 90 are pulled out together from the external-mounted housing 10 is realized. It should be noted that in the state where the door fasteners 94 and the clamping parts 12 are clamped, a gap with a slight clearance is reserved between the door fasteners 94 and the clamping parts 12 along the forward-backward direction.

[0032] The left and right retainer plates 80 may respectively enable the washing drum 20 and the door part 90 to move rectilinearly together in the forward-backward direction through the left and right sliding rails 100. The sliding rails 100 each includes a fixed rail 101 and a movable rail 102 which are long in the forward-backward direction. The fixed rails 101 are fixed to the lower part of the inner side surface of the external-mounted housing 10, and the movable rails 102 are fixed to the surfaces, which are opposite to the inner side surface of the external-mounted housing 10, of the retainer plates 80. Rollers (not shown) are arranged inside the fixed rails 101, and the movable rails 102 move in the fixed rails 101 along the forward-backward direction in a manner of being conveyed by the rollers. Therefore, the retainer plates 80 fixed to the movable rails 102, the washing drum 20 and the door part 90 may move successfully together in the forward-backward direction.

[0033] FIG. 4 is a block diagram illustrating a structure of the full-automatic washing machine 1.

[0034] In addition to the above-mentioned structure, the full-automatic washing machine 1 includes: an operation part 120, a water level sensor 130 and a control unit 200. The control unit 200 includes: a control part 201, a storage part 202, a motor driving part 203, a clutch driving part 204, a water supply driving part 205 and a water drainage driving part 206.

[0035] The operation part 120 outputs input signals corresponding to operations by a user on buttons, such as a power button 121, a start button 122 and a program selection button 123 to the control part 201. The water level sensor 130 detects a water level in the outer drum 21, and outputs a water level detection signal corresponding to the detected water level to the control part 201.

[0036] The motor driving part 203 supplies a driving current to the driving motor 31 according to a control signal from the control part 201. The motor driving part 203 is provided with a speed sensor for detecting the rotating

speed of the driving motor 31, an inverter circuit and the like, and adjusts the driving current in a manner of enabling the driving motor 31 to rotate at a rotating speed set by the control part 201. For example, as motor driving control, PWM (Pulse Width Modulation) control may be used. In this case, the control part 201 applies a pulse voltage having a duty ratio determined on the basis of the detected rotating speed to the driving motor 31, so as to supply the driving current corresponding to the pulse voltage to the driving motor 31.

[0037] The clutch driving part 204 drives the clutch mechanism 32a according to a control signal output from the control part 201. The water supply driving part 205 drives the water supply valve 51 according to a control signal from the control part 201. The water drainage driving part 206 drives the water drainage valve 41 according to a control signal from the control part 201.

[0038] The storage part 202 includes an EEPROM (Electrically Erasable Programmable Read-Only Memory), an RAM (Random Access Memory) and the like. The storage part 202 stores programs for executing washing operation of various operation modes. In addition, the storage part 202 stores various parameters for executing these programs, and various control marks.

[0039] The control part 201 controls the motor driving part 203, the clutch driving part 204, the water supply driving part 205, the water drainage driving part 206 and the like according to the programs stored in the storage part 202 on the basis of various signals from the operation part 120, the acceleration sensor 110, the water level sensor 130 and the like.

[0040] The full-automatic washing machine 1 performs washing operation in various operation modes corresponding to operation of the user through the operation part 120. During the washing operation, under the control by the control part 201, a washing process, an intermediate dewatering process, a rinsing process and a final dewatering process are performed in sequence.

[0041] In the washing process and the rinsing process, in such a state that water is accumulated in the washing and dewatering drum 22, the impeller 28 rotates towards the right side and the left side. A water flow is generated in the washing and dewatering drum 22 through the rotation of the impeller 28. In the washing process, the generated water flow and a detergent in the water are used to wash the washings. In the rinsing process, the generated water flow is used to rinse the washings.

[0042] In the intermediate dewatering process and the final dewatering process, the washing and dewatering drum 22 and the impeller 28 rotate integrally at a high speed. The washings are dewatered through the effect of a centrifugal force generated by the washing and dewatering drum 22.

[0043] FIG. 5 is a flow chart illustrating a control action in the dewatering process. The control action of the control part 201 in the dewatering process is described below with reference to FIG. 5.

[0044] When the dewatering process is stared, the control part 201 detects a degree and a direction of inclination of a main body of the full-automatic washing machine 1 relative to a horizontal direction based on the static accelerations detected by the acceleration sensor 110 in the three axial directions (S1). Then, the control part 201 judges whether the detected degree of the inclination is greater than a relevant threshold value of the inclination (S2). For example, under a condition that the main body of the full-automatic washing machine 1 is arranged on an arrangement surface inclined relative to the horizontal direction, the main body of the full-automatic washing machine 1 may be inclined to the horizontal direction.

[0045] Under a condition that the detected degree of the inclination is greater than the threshold value (S2: YES), the control part 201 enables the driving motor 31 to rotate, so as to enable the washing and dewatering drum 22 integrated with the impeller 28 to rotate by half a circle (S3). At this time, the control part 201 enables the washing and dewatering drum 22 to rotate at a speed lower than a speed of rotation of the washing and dewatering drum 22 started for dewatering.

[0046] FIG. 6(a) is a is a diagram schematically illustrating states of fluid in the fluid balancer 27 subjected to water drainage and an offset load in the washing and dewatering drum 22 when the main body of the full-automatic washing machine 1 is inclined, and FIG. 6(b) is a diagram schematically illustrating states of fluid in the fluid balancer 27 and an offset load in the washing and dewatering drum 22 when the washing and dewatering drum 22 rotates by half a circle from the state in FIG. 6(a). It should be noted that FIGs. 6(a) and (b) illustrate the states of the washing and dewatering drum 22 observed from the upper side.

[0047] When the main body of the full-automatic washing machine 1 is in the inclined state, as shown in FIG. 6(a), the fluid in the fluid balancer 27 is easy to offset on the lower side in the washing and dewatering drum 22. In addition, during water drainage before the dewatering process, as water in the washing and dewatering drum 22 is drained, the washings floated in the water are easy to offset on the lower side in the washing and dewatering drum 22 under the effect of the weight, so that it can be considered that: as shown in FIG. 6(a), after the water is drained, an offset load of the washings is easily generated on the lower side in the washing and dewatering drum 22. When the washing and dewatering drum 22 rotates by half a circle from this state, the offset load moves to the upper side of the main body of the full-automatic washing machine 1, namely the upper side in the washing and dewatering drum 22. In another aspect, the fluid would return to the lower side immediately after moving to the upper side once. As a result, as shown in FIG. 6(b), in a state where the offset load and the fluid are disposed at opposed positions, the weight balance in the washing and dewatering drum 22 is better.

[0048] The control part 201 enables the driving motor 31 to rotate, starts the washing and dewatering drum 22

to rotate for dewatering, and increases the rotating speed to 120 rpm (S4). Since the weight balance is better in the washing and dewatering drum 22, great transverse swinging, which is caused by resonance, of the washing drum 20 may be suppressed when the rotating speed of the washing and dewatering drum 22 is close to a transverse resonance point, i.e., 80 rpm.

[0049] When the main body of the full-automatic washing machine 1 is not in the inclined state, and the degree of the inclination is less than the threshold value (S2: NO), the control part 201 starts the washing and dewatering drum 22 to rotate instead of enabling the washing and dewatering drum 22 to rotate by half a circle, and increases the rotating speed to 120 rpm (S4). Under the condition that the main body of the full-automatic washing machine 1 is not in the inclined state, since the offset of the fluid and the offset load of the washings as shown in FIG. 6(a) are not generated in the washing and dewatering drum 22, the great transverse swinging of the washing drum 20 may hardly occur under the resonance when the rotating speed of the washing and dewatering drum 22 is close to 80 rpm.

[0050] When the rotating speed of the washing and dewatering drum 22 reaches 120 rpm, the control part 201 detects dynamic accelerations, which are generated in the forward-backward direction and the left-right direction of the full-automatic washing machine 1, of the retainer plates 80 through the acceleration sensor 110 in a state of maintaining the rotating speed at 120 rpm (S5). Then, the control part 201 judges whether absolute values, which are irrelevant to the directions (namely plus and minus) of the dynamic accelerations, of the detected dynamic accelerations are greater than the relevant threshold values of the dynamic accelerations or not (S6). The control part 201 performs detection on the dynamic accelerations and judges on whether the absolute values of the detected dynamic accelerations are greater than the threshold values or not till specified time (S7).

[0051] Under a condition that the washing and dewatering drum 22 vibrates sharply due to the offset load and the like in the washing and dewatering drum 22, the vibration is transmitted to the retainer plates 80 through the suspensions 60 and the connecting parts 70. The retainer plates 80 move easily in the forward-backward direction through the sliding rails 100, so that the retainer plates 80 may vibrate sharply in the forward-backward direction due to the transmission of the vibration. In this case, the absolute value of the dynamic acceleration in the forward-backward direction is easily greater than the threshold value.

[0052] It should be noted that in the present embodiment, the dynamic acceleration in the left-right direction is also detected, but the dynamic acceleration in the forward-backward direction is generally greater than that in the left-right direction, so that it is difficult for the absolute value of the dynamic acceleration in the left-right direction to be greater than the threshold value. Thus, it is unnecessary to detect the dynamic acceleration in the left-right direction.

[0053] When the absolute values of the dynamic accelerations are greater than the threshold values (S6: YES), the control part 201 stops the rotation of the washing and dewatering drum 22 (S8). Then. The control part 201 performs unwrapping operation (S9). Specifically, the control part 201 opens the water supply valve 51 to supply water, accumulates water into the washing and dewatering drum 22, and enables the impeller 28 to rotate left and right in the state that the washing and dewatering drum 22 is stopped. Through the unwrapping operation, the washings are dispersed, and the offset load is eliminated. The control part 201 goes back to Step S1 to restart the dewatering process after the water is drained from the washing and dewatering drum 22.

[0054] When the state where the absolute values of the dynamic accelerations are less than the threshold values (S6: NO) lasts for the specified time (S7: YES), the control part 201 increases the rotating speed of the washing and dewatering drum 22 to a highest rotating speed, for example, 900 rpm (S10). At this time, the rotating speed of the washing and dewatering drum 22 is close to a longitudinal resonance point, i.e., 240 rpm, but the offset load in the washing and dewatering drum 22 is low, so that great longitudinal swinging of the washing drum 20 hardly occurs due to the resonance.

[0055] When the rotating speed of the washing and dewatering drum 22 reaches the highest rotating speed, the control part 201 maintains the highest rotating speed for specified dewatering time to dewater the washings (S11).

(Effect of embodiments)

[0056] According to the present embodiment, the acceleration sensor 110 may be used to detect whether the main body of the full-automatic washing machine 1 is in the inclined state or not and whether the vibration of the washing drum 20 during dewatering is great or not, and the dewatering control for suppressing the vibration of the washing drum 20 may be performed according to various detection results. Therefore, the vibration of the washing drum 20 during dewatering may be effectively suppressed.

[0057] In addition, according to the present embodiment, under the condition that the main body of the full-automatic washing machine 1 is in the inclined state, after the weight balance between the fluid in the fluid balancer 27 and the offset load of the washings in the washing and dewatering drum 22 is improved, the washing and dewatering drum 22 is started to rotate for dewatering. Therefore, the washing and dewatering drum 22 is not easy to vibrate sharply when starting to work, and the phenomenon of dramatic collision hardly occurs between the door part 90 and the external-mounted housing 10 due to sharp vibration of the retainer plates 80 and the door part 90 in the forward-backward direction. In addition, when the rotating speed of the washing and dewa-

tering drum 22 is close to the transverse resonance point, the great transverse swinging of the washing drum 20 hardly occurs under the resonance.

[0058] Furthermore, according to the present embodiment, under the condition that the washing drum 20 vibrates sharply during dewatering, the rotation of the washing and dewatering drum 22 is stopped, and the unwrapping operation is performed. Therefore, the vibration of the washing drum 20 may be reduced during restart of dewatering. Particularly, in the state where the rotating speed of the washing and dewatering drum 22 is lower than the longitudinal resonance point, the acceleration sensor 110 detects the dynamic acceleration, i.e., the vibration, so that the great longitudinal swinging, which is caused by the resonance, of the washing drum 20 may be prevented when the rotating speed of the washing and dewatering drum 22 is close to the longitudinal resonance point.

[0059] Embodiments of the present invention are described above, but the present invention is not limited by above-mentioned embodiments. In addition, embodiments of the present invention also may be subjected to various variations in addition to the above-mentioned contents.

(Variation example 1)

[0060] FIG. 7 is a flow chart illustrating a control action in a dewatering process according to variation example 1. FIG. 8 is a flow chart illustrating a control action for balance adjustment operation according to variation example 1.

[0061] In above-mentioned embodiment, when the main body of the full-automatic washing machine 1 is in the inclined state, it deems that the offset load of the washings is generated on the lower side in the washing and dewatering drum 22, and the offset load moves to the upper side by enabling the washing and dewatering drum 22 to rotate by half a circle, so that the weight balance between the fluid offset at the lower side in the fluid balancer 27 and the offset load is improved.

[0062] In view of this, in the present variation example, the washing and dewatering drum 22 slowly rotates, and the position of the offset load is detected. The washing and dewatering drum 22 is stopped in a manner of enabling the offset load to be located on the upper side of the main body of the full-automatic washing machine 1, so that the balance adjustment operation for improving the weight balance between the offset fluid and the offset load is performed.

[0063] During the control action of FIG. 7 of the present variation example, treatment in Step S12 is executed instead of the treatment in Step S3 during the control action of FIG. 5 of the above-mentioned embodiment.

[0064] Under the condition that the degree of the inclination of the main body of the full-automatic washing machine 1 is greater than the threshold value (S2: YES), the control part 201 performs the balance adjustment operation (S12).

[0065] With reference to FIG. 8, firstly, the control part 201 starts the washing and dewatering drum 22 to rotate at a speed lower than a speed of rotation started for dewatering, and increses the rotating speed to 20 rpm (S101). At this time, even if the weight balance between the fluid skewed in the fluid balancer 27 and the offset load in the washing and dewatering drum 22 is not improved, since the washing and dewatering drum 22 starts to rotate slowly, the washing and dewatering drum 22 also hardly swings sharply, and the dramatic collision between the door part 90 and the external-mounted housing 10 hardly occurs.

[0066] Then, the control part 201 maintains the rotating speed of the washing and dewatering drum 22 at 20 rpm, and at the same time, the acceleration sensor 110 samples a dynamic acceleration in the forward-backward direction at specified time (for example, 15 seconds) (S102). The washing and dewatering drum 22 rotates for multiple times within a specified time period. For example, when the specified time is 15 seconds, the washing and dewatering drum 22 rotates for 5 times.

[0067] FIG. 9 is a diagram schematically illustrating such a situation that the offset load in the washing and dewatering drum 22 during the balance adjustment operation moves along with the rotation of the washing and dewatering drum 22. In FIG. 9, the washing and dewatering drum 22 is observed from the upper side, and a grey circle in the figure indicates the offset load of the washings in the washing and dewatering drum 22.

[0068] During the balance adjustment operation, the washing and dewatering drum 22 rotates clockwise. As shown in a circle A of FIG 9, when the offset load passes through the right side of the main body of the full-automatic washing machine 1, the washing and dewatering drum 22 swings forwards, and the retainer plates 80 swing forwards, so that the forward dynamic acceleration (i.e., the positive acceleration) detected by the acceleration sensor 110 is maximum. In addition, as shown in a circle C of FIG. 9, when the offset load passes through the left side of the main body of the full-automatic washing machine 1, the washing and dewatering drum 22 swings backwards, and the retainer plates 80 swing backwards, so that the dynamic acceleration (i.e., the negative dynamic acceleration) detected by the acceleration sensor 110 is the maximum. Furthermore, as shown in a circle B and a circle D of FIG. 9, when the offset load passes through the front side and the rear side of the main body of the full-automatic washing machine 1, the washing and dewatering drum 22 hardly swings in the forward-backward direction, and the absolute value of the dynamic acceleration detected by the acceleration sensor 110 is minimum.

[0069] The control part 201 extracts a positive maximum value, a negative maximum value and a minimum absolute value from the sampled dynamic accelerations which are obtained in every one circle of the rotation of the washing and dewatering drum 22, and determines a

positive maximum value, a negative maximum value and a minimum absolute value which are used for judging the position of the offset load according to these values (S103). For example, an average value of multiple positive maximum values, an average value of multiple negative maximum values and an average value of multiple absolute minimum values may be set as the positive maximum value, the negative maximum value and the minimum absolute value which are used for determine the position of the offset load. Or, a minimum value of the multiple positive maximum values, a minimum value of the multiple negative maximum values and a minimum value of the multiple absolute minimum values may be set as the positive maximum value, the negative maximum value and the minimum absolute value which are used for determining the position of the offset load.

[0070] The control part 201 judges which direction is the upper side among the front, back, left and right directions of the main body of the full-automatic washing machine 1 according to the inclination, which is detected in Step S1, of the main body of the full-automatic washing machine 1 (S104). Under a condition that the front side of the main body of the full-automatic washing machine 1 is the upper side (S104: front side), when the offset load in the washing and dewatering drum 22 passes through the front side of the main body of the full-automatic washing machine 1, the absolute value of the dynamic acceleration detected by the acceleration sensor 110 is a subsequent minimum value after the dynamic acceleration reaches the positive maximum value. Therefore, when detecting that the absolute value of the dynamic acceleration detected by the acceleration sensor 110 is the subsequent minimum value after the dynamic acceleration reaches the positive maximum value (S105: YES), the control part 201 stops the washing and dewatering drum 22 emergently through braking (S109). For example, the control part 201 may apply braking to the washing and dewatering drum 22 by applying electromagnetic braking to the driving motor 31. Therefore, in the state where the offset load is located on the upper side, i.e., the front side, of the main body of the full-automatic washing machine 1, the washing and dewatering drum 22 is stopped.

[0071] In another aspect, under a condition that the rear side of the main body of the full-automatic washing machine 1 is the upper side (S104: rear side), when the offset load in the washing and dewatering drum 22 passes through the rear side of the main body of the full-automatic washing machine 1, the absolute value of the dynamic acceleration detected by the acceleration sensor 110 is: the subsequent minimum value after the dynamic acceleration reaches the negative maximum value. Therefore, when detecting that the absolute value of the dynamic acceleration detected by the acceleration sensor 110 is the subsequent minimum value after the dynamic acceleration reaches the negative maximum value (S106: YES), the control part 201 stops the washing and dewatering drum 22 emergently through braking (S109). In addition, under a condition that the left side of the main body of the full-automatic washing machine 1 is the upper side (S104: left side), when the offset load in the washing and dewatering drum 22 passes through the left side of the main body of the full-automatic washing machine 1, the dynamic acceleration detected by the acceleration sensor 110 is the negative maximum value. Therefore, when detecting that the dynamic acceleration detected by the acceleration sensor 110 is the negative maximum value (S107: YES), the control part 201 stops the washing and dewatering drum 22 emergently through braking (S109). Furthermore, under a condition that the right side of the main body of the full-automatic washing machine 1 is the upper side (S104: right side), when the offset load in the washing and dewatering drum 22 passes through the right side of the main body of the full-automatic washing machine 1, the dynamic acceleration detected by the acceleration sensor 110 is the positive maximum value. Therefore, when detecting that the dynamic acceleration detected by the acceleration sensor 110 is the positive maximum value (S108: YES), the control part 201 stops the washing and dewatering drum 22 emergently through braking (S109).

[0072] Therefore, through the balance adjustment operation, a state where the offset load is located on the upper side in the washing and dewatering drum 22, and the fluid offset in the fluid balancer 27 is located on the lower side in the washing and dewatering drum 22 is realized in the washing and dewatering drum 22 as shown in FIG. 6(b). Therefore, the weight balance between the offset fluid and the offset load is better.

[0073] The structure of the present variation example above achieves the same effects as the above-mentioned embodiments. Furthermore, the present variation example detects the position of the offset load in the washing and dewatering drum 22, and enables the washing and dewatering drum 22 to rotate based on a detection result, so that adjustment of the weight balance between the skewed fluid and the offset load may be better performed.

(Other variation examples)

[0074] In above-mentioned embodiments, one retainer plate 80 is provided with the acceleration sensor 110, but the arrangement position is not limited to this. For example, the acceleration sensor 110 also may be arranged on the door part 90. In addition, the retainer plates 80 and the door part 90 also may be provided with other members such as metal parts, and the other members are provided with the acceleration sensor 110. In this case, the other members, the retainer plates 80 and the door part 90 form the drawer of the present invention together.

[0075] In addition, in above-mentioned embodiments, the washing drum 20 is held by the left and right retainer plates 80. However, the structure of the washing drum 20 is not limited to this. For example, as shown in FIG.

10(a), the following structure also may be adopted: front, rear, left and right retainer plates 80A are provided, and the two retainer plates 80A on the left side are mounted on left movable rails 102. Or, as shown in FIG. 10(b), the following structure also may be adopted: one retainer plate 80B is provided, and left and right movable rails 102 are mounted on the left and right side surfaces of the retainer plate 80B.

[0076] Furthermore, as a structure for retaining the washing drum 20, as shown in FIG. 10(c), a cabinet 80C, of which the upper surface is opened, also may be provided. In this case, the washing drum 20 is arranged inside the cabinet 80C through the suspensions 60. Furthermore, movable rails 102 are mounted at the lower parts of the left and right side surfaces of the cabinet 80C. The acceleration sensor 110, for example, may be arranged on the bottom surface or the front, rear, left and right side surfaces of the cabinet 80C. The cabinet 80C and the door part 90 form the drawer of the present invention together.

[0077] Furthermore, in above-mentioned embodiments, to enable the retainer plates 80 for holding the washing drum 20 to move in the forward-backward direction, sliding rails 100 including fixed rails 101 and movable rails 102 are used. However, the solution is not limited to this. For example, the sliding mechanism may also adopt the structure: rollers are arranged at the lower parts of the left and right inner side surfaces of the external-mounted housing 10, and the rollers are in contact with the rails on the bottom surfaces of the left and right retainer plates 80 and rotate, so that the rails are conveyed along the forward-backward direction.

[0078] Furthermore, in above-mentioned embodiments, the suspensions 60 are composed of the dampers 61 and the spiral springs 62. However, the suspensions 60 also may be only composed of the dampers 61 or the spiral springs 62.

[0079] Furthermore, in above-mentioned embodiments, when the rotating speed of the washing and dewatering drum 22 is maintained at 120 rpm, i.e., when the rotating speed of the washing and dewatering drum 22 is increased to the highest rotating speed, the acceleration sensor 110 is used to detect the dynamic acceleration, and the degree of the vibration of the washing drum 20 is determined on the basis of the detected dynamic acceleration. However, the following structure also may be adopted: in the entire period when the rotating speed of the washing and dewatering drum 22 is increased to the highest rotating speed, or during a period longer than that of above-mentioned embodiments, the acceleration sensor 110 is used to detect the dynamic acceleration, and the degree of the vibration of the washing drum 20 is determined on the basis of the detected dynamic acceleration.

[0080] Furthermore, in above-mentioned embodiments, the full-automatic washing machine 1 is exemplified, but the present invention may be also applied to a full-automatic clothes washing and drying machine having a clothes drying function in addition to the clothes washing function.

[0081] In addition, embodiments of the present invention may be properly changed within the scope of the technical idea described in the technical solution.

List of reference numerals:

[0082]

1: full-automatic washing machine (washing machine);
10: external-mounted housing;
20: washing drum
21: outer drum
22: washing and dewatering drum
60: suspension
80: retainer plate (drawer);
90: door part (drawer)
100: sliding rail (sliding mechanism)
110: acceleration sensor
201: control part

Claims

1. A washing machine, comprising:

an external-mounted housing having an inlet/outlet in the front surface of the external-mounted housing;
a drawer capable of getting into and getting out of the external-mounted housing through the inlet/outlet;
a washing drum arranged in the drawer through a suspension, wherein the washing drum comprises a washing and dewatering drum and an outer drum, the washing and dewatering drum has a fluid balancer, the outer drum is capable of accommodating the washing and dewatering drum in a free rotation manner;
a sliding mechanism for enabling the drawer to move rectilinearly relative to the external-mounted housing;
an acceleration sensor arranged on the drawer; and
a control part,
wherein the control part obtains inclination of a main body of the washing machine based on a static acceleration detected by the acceleration sensor, performs first dewatering control based on the inclination, and performs second dewatering control based on a dynamic acceleration, the dynamic acceleration is detected by the acceleration sensor and corresponds to vibration of the drawer during dewatering.

2. The washing machine according to claim 1, wherein

in the first dewatering control,
when the inclination of the main body of the washing machine is greater than a threshold value of the inclination, the control part enables the washing and dewatering drum to rotate in such a manner that an offset load generated in the washing and dewatering drum is located in the upper side of the inclined main body of the washing machine, and then starts rotation of the washing and dewatering drum for dewatering.

3. The washing machine according to claim 1 or 2, wherein in the second dewatering control,
when the dynamic acceleration detected by the acceleration sensor is greater than a threshold value of the dynamic acceleration, the control part stops the rotation of the washing and dewatering drum, and then performs unwrapping operation for unwrapping the washings in the washing and dewatering drum.

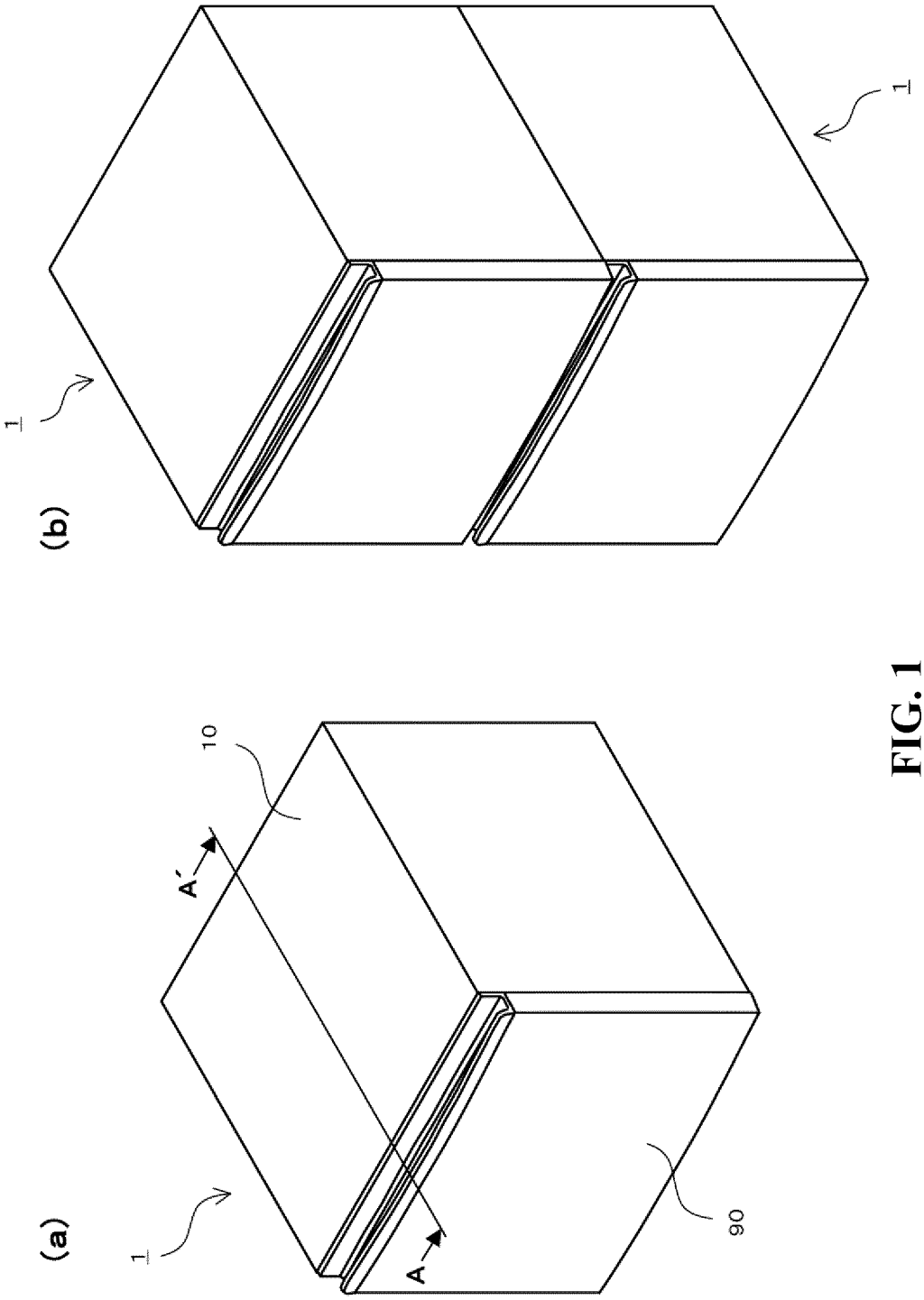

FIG. 1

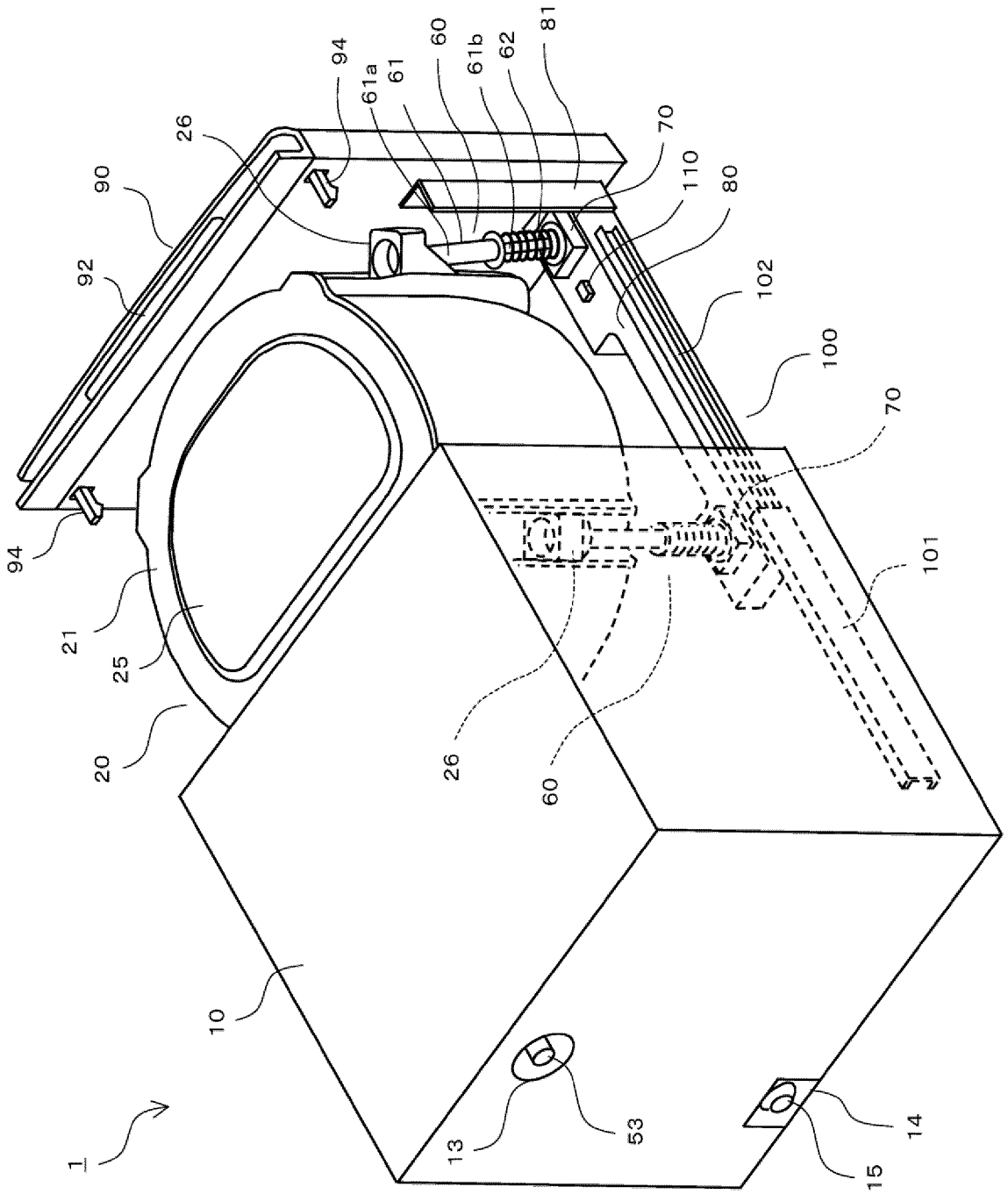
94
61a
61
60
61b
62
81
26
70
90
110
80
92
102
100
70
94
101
21
25
26
60
20
10
1
13
53
14
15

FIG. 2

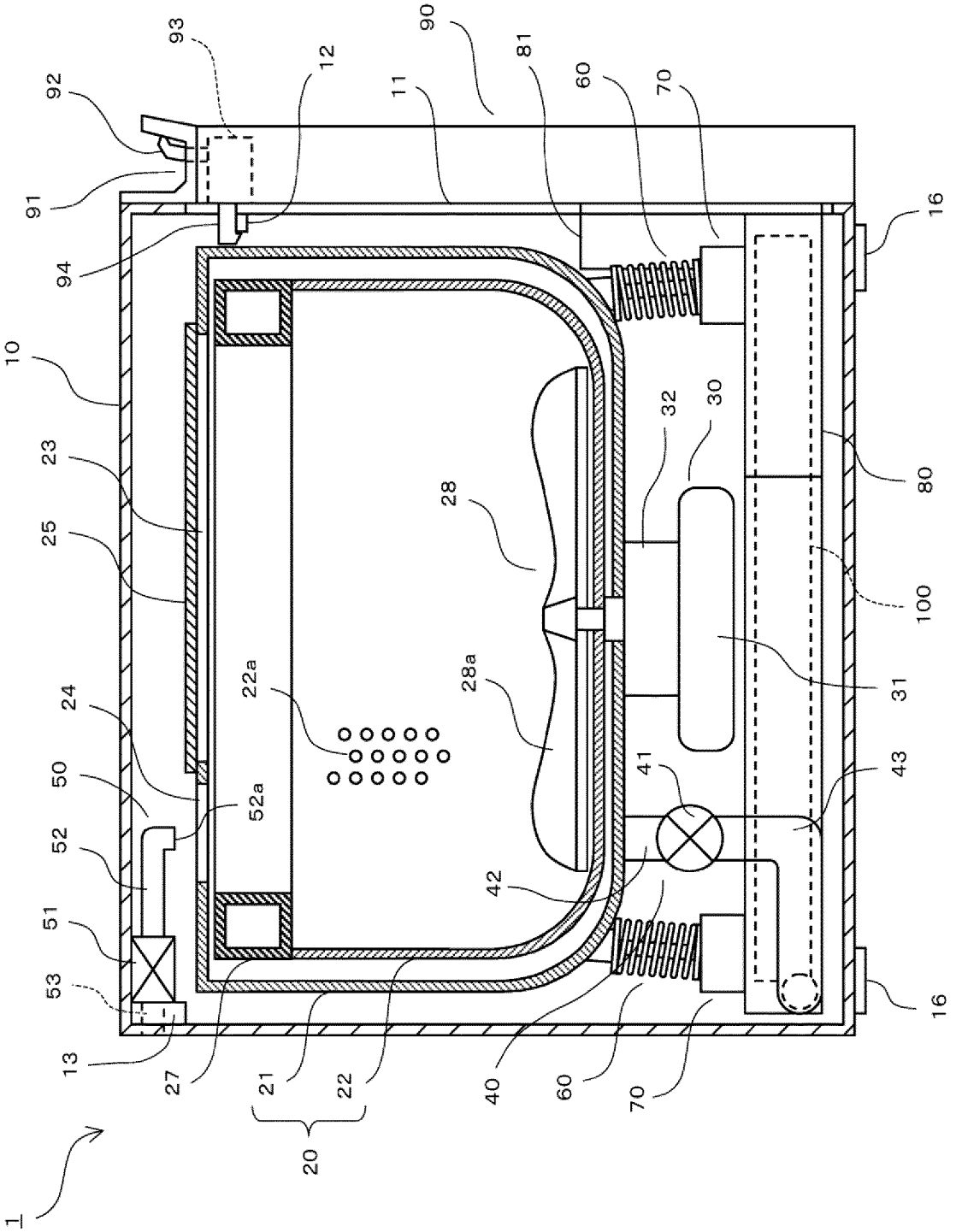
1
10
11
12
13
16
20
21
22
23
24
25
27
28
28a
30
31
32
40
41
42
43
50
51
52
52a
53
60
70
80
81
90
91
92
93
94
100

FIG. 3

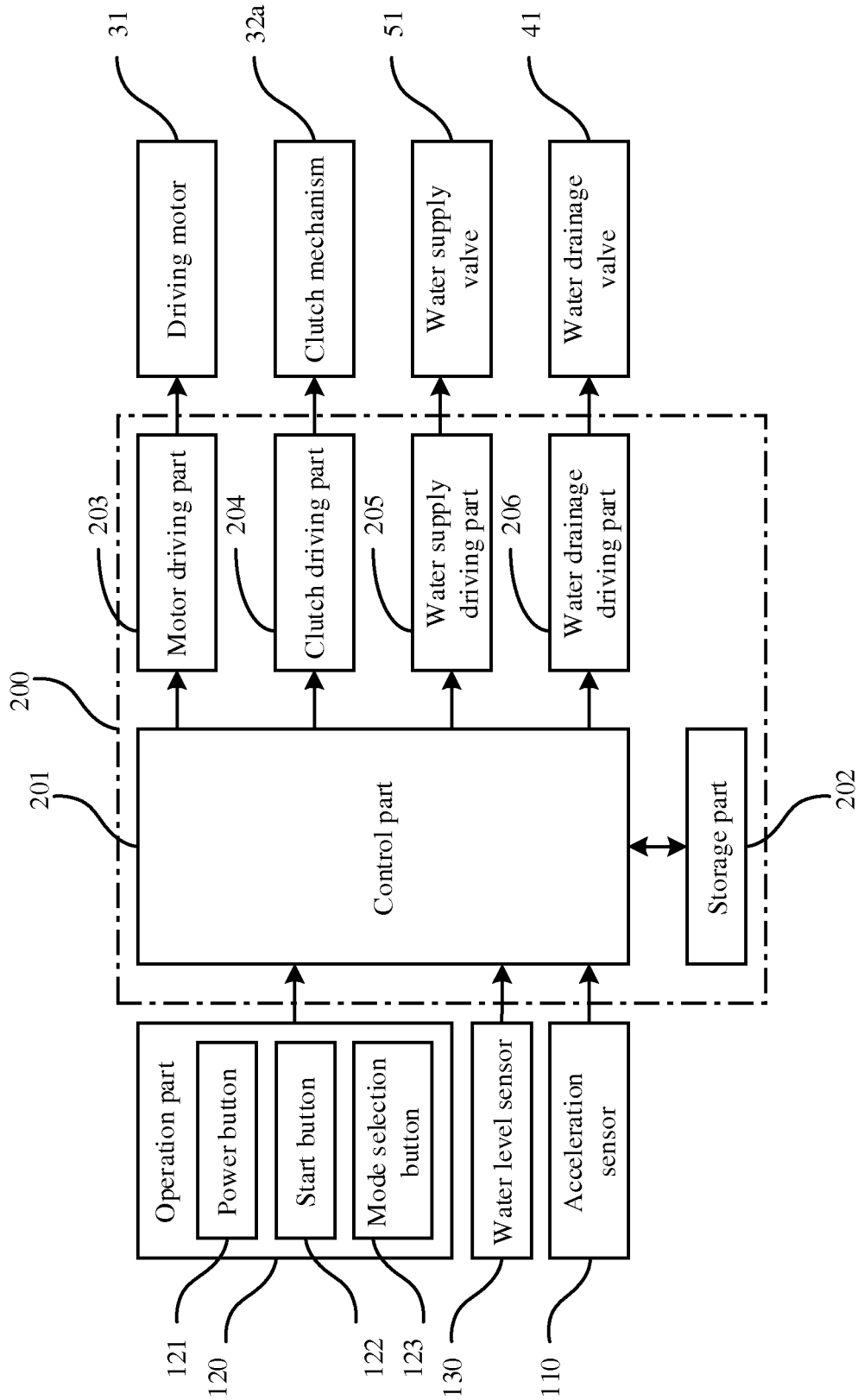
31
32a
51
41
Driving motor
Clutch mechanism
Water supply valve
Water drainage valve
203
204
205
206
Motor driving part
Clutch driving part
Water supply driving part
Water drainage driving part
200
201
Control part
Storage part
202
Operation part
Power button
Start button
Mode selection button
Water level sensor
Acceleration sensor
121
120
122
123
130
110

FIG. 4

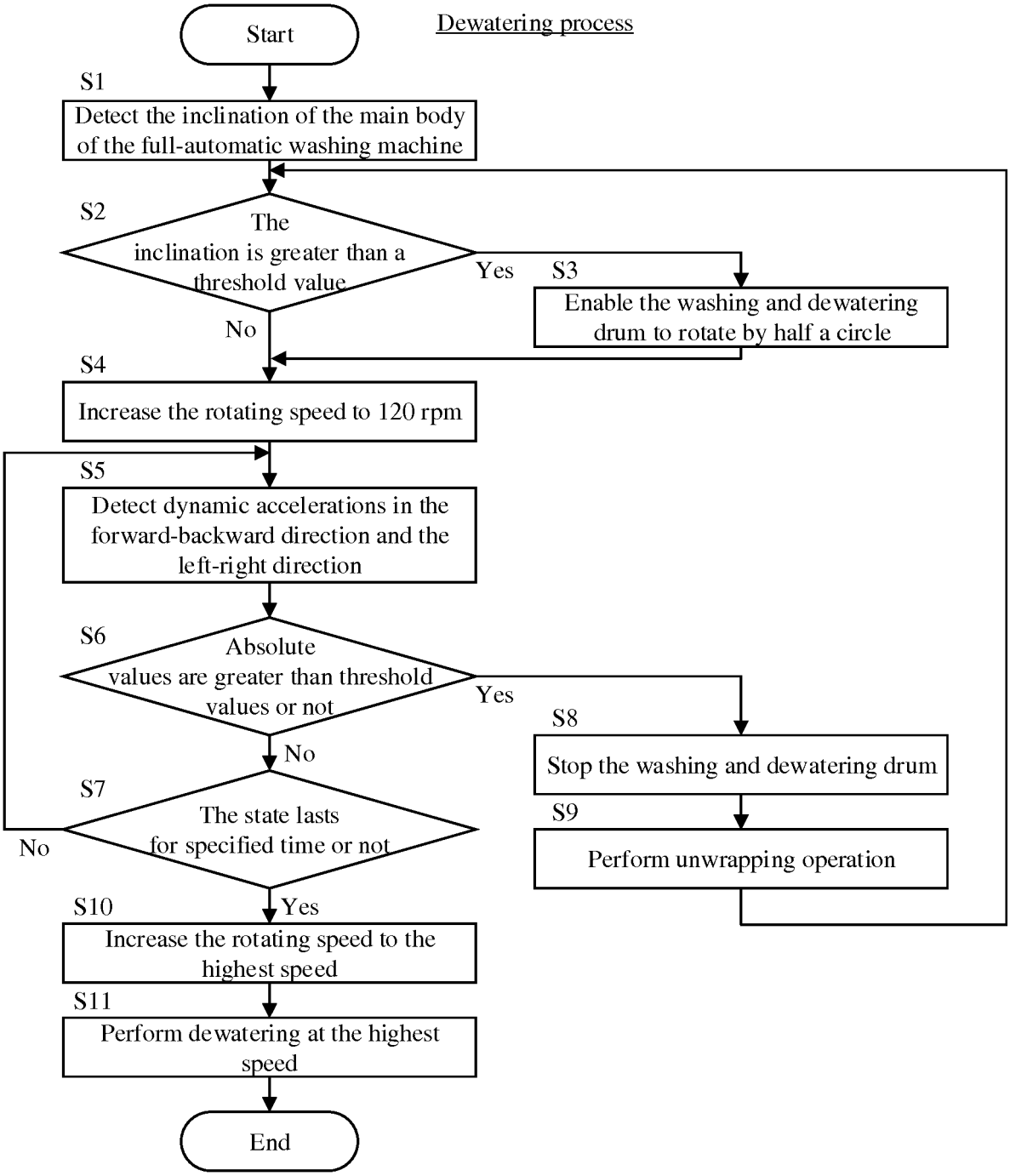
Dewatering process
Start
S1
Detect the inclination of the main body of the full-automatic washing machine
S2
The inclination is greater than a threshold value
Yes
S3
Enable the washing and dewatering drum to rotate by half a circle
No
S4
Increase the rotating speed to 120 rpm
S5
Detect dynamic accelerations in the forward-backward direction and the left-right direction
S6
Absolute values are greater than threshold values or not
Yes
S8
Stop the washing and dewatering drum
S9
Perform unwrapping operation
No
S7
The state lasts for specified time or not
No
S10
Yes
Increase the rotating speed to the highest speed
S11
Perform dewatering at the highest speed
End

FIG. 5

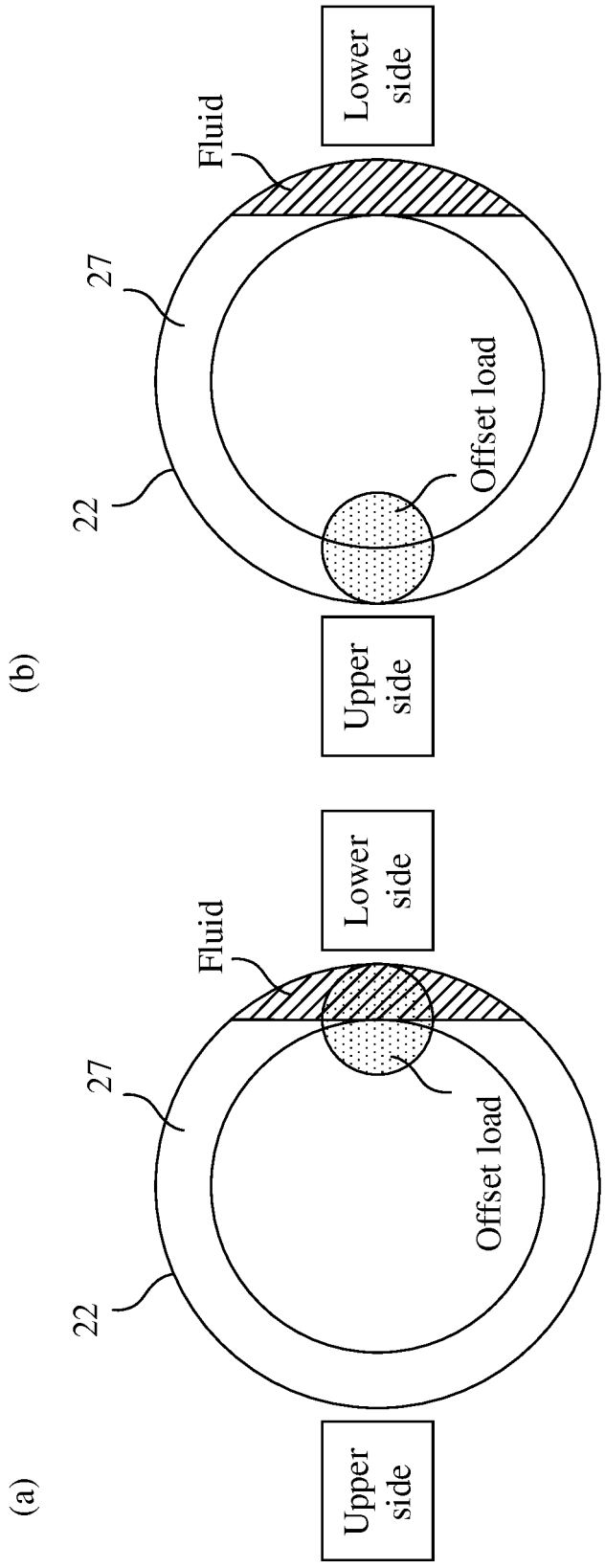
(a)
Upper side
22
27
Fluid
Lower side
Offset load
(b)
Upper side
22
27
Fluid
Lower side
Offset load

FIG. 6

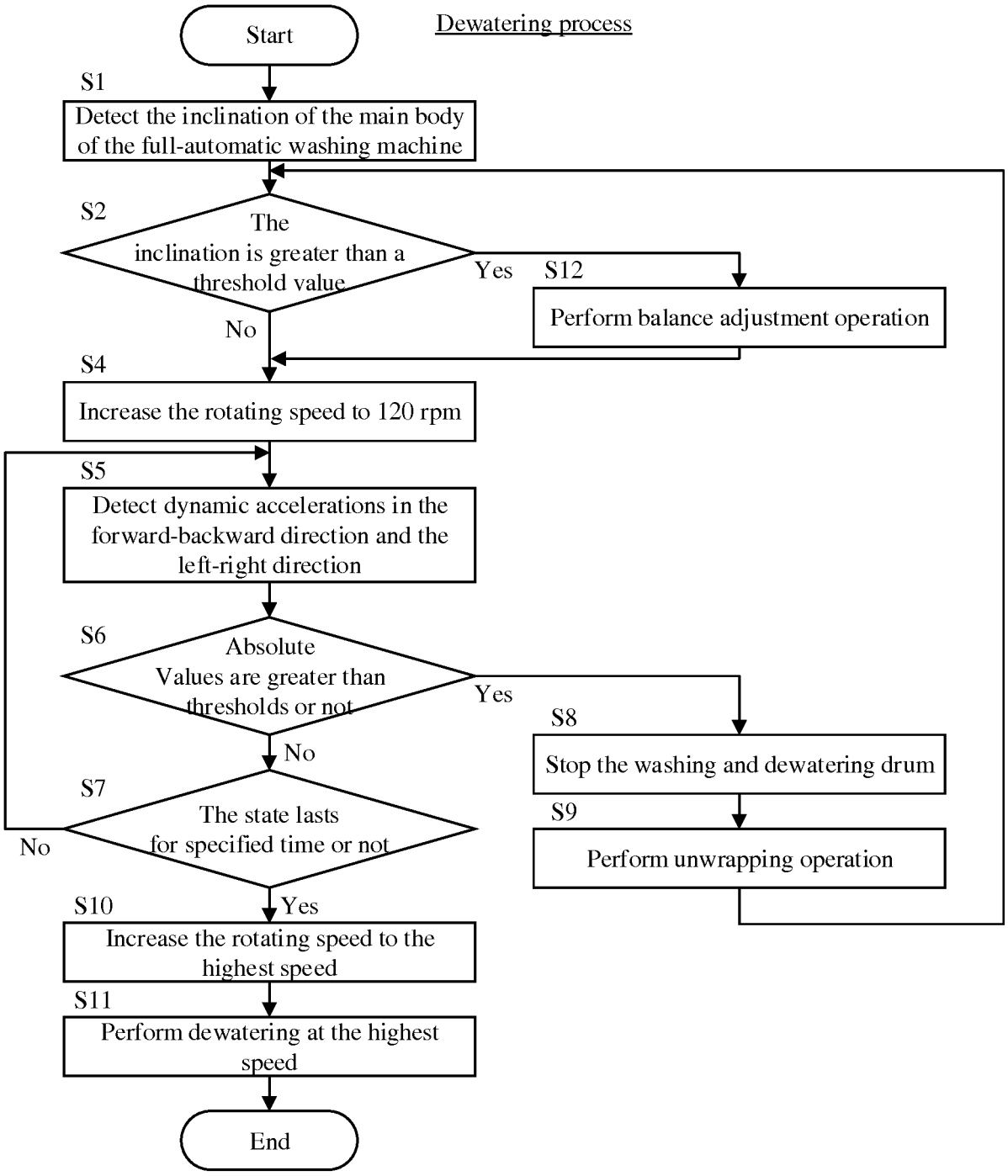
Dewatering process
Start
S1
Detect the inclination of the main body of the full-automatic washing machine
S2
The inclination is greater than a threshold value
Yes
S12
Perform balance adjustment operation
No
S4
Increase the rotating speed to 120 rpm
S5
Detect dynamic accelerations in the forward-backward direction and the left-right direction
S6
Absolute Values are greater than thresholds or not
Yes
S8
Stop the washing and dewatering drum
S9
Perform unwrapping operation
No
S7
The state lasts for specified time or not
No
Yes
S10
Increase the rotating speed to the highest speed
S11
Perform dewatering at the highest speed
End

FIG. 7

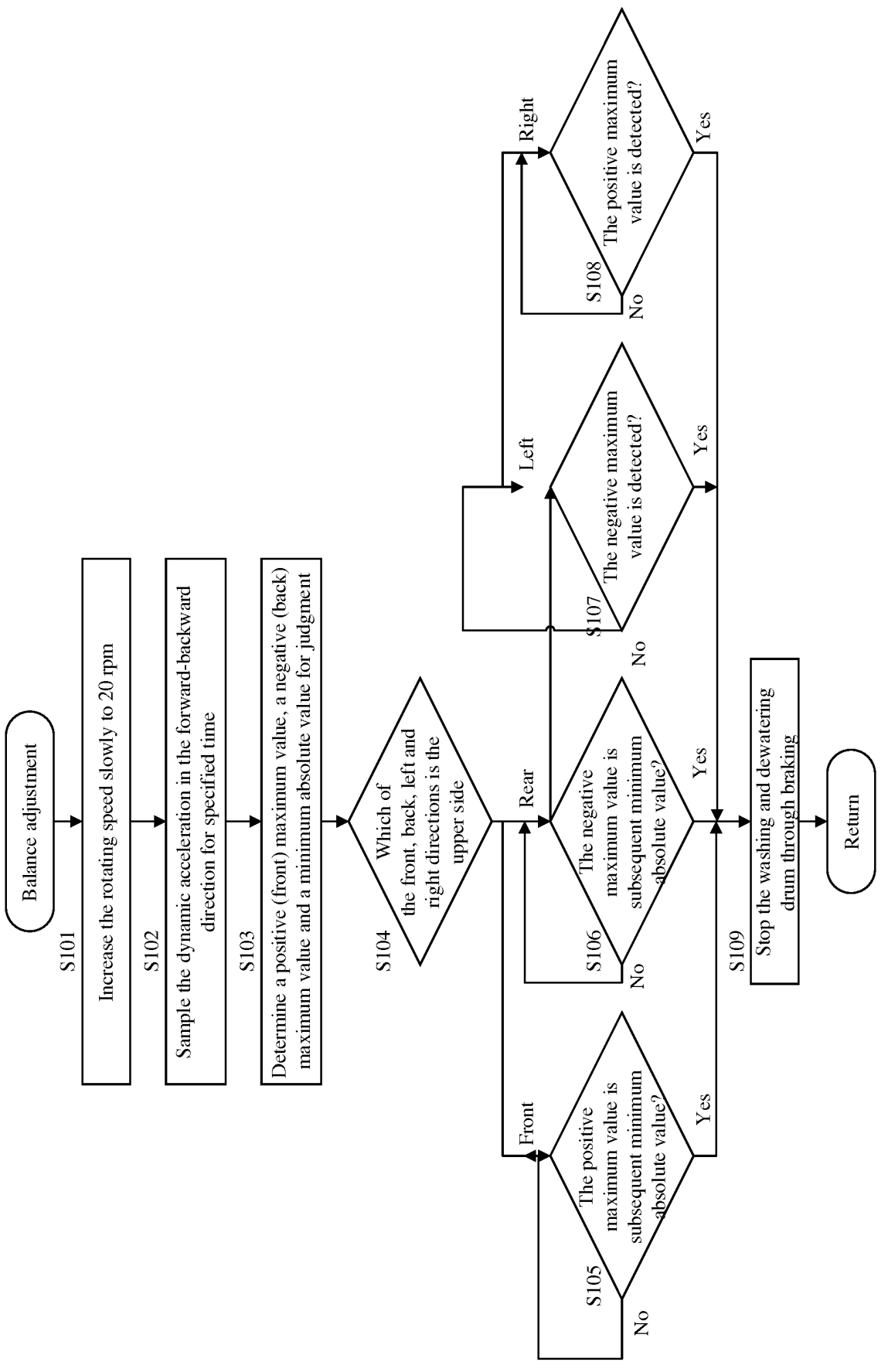
Balance adjustment
S101
Increase the rotating speed slowly to 20 rpm
S102
Sample the dynamic acceleration in the forward-backward direction for specified time
S103
Determine a positive (front) maximum value, a negative (back) maximum value and a minimum absolute value for judgment
S104
Which of the front, back, left and right directions is the upper side
Front
S105
The positive maximum value is subsequent minimum absolute value?
No
Yes
Rear
S106
The negative maximum value is subsequent minimum absolute value?
No
Yes
Left
S107
The negative maximum value is detected?
No
Yes
Right
S108
The positive maximum value is detected?
No
Yes
S109
Stop the washing and dewatering drum through braking
Return

FIG. 8

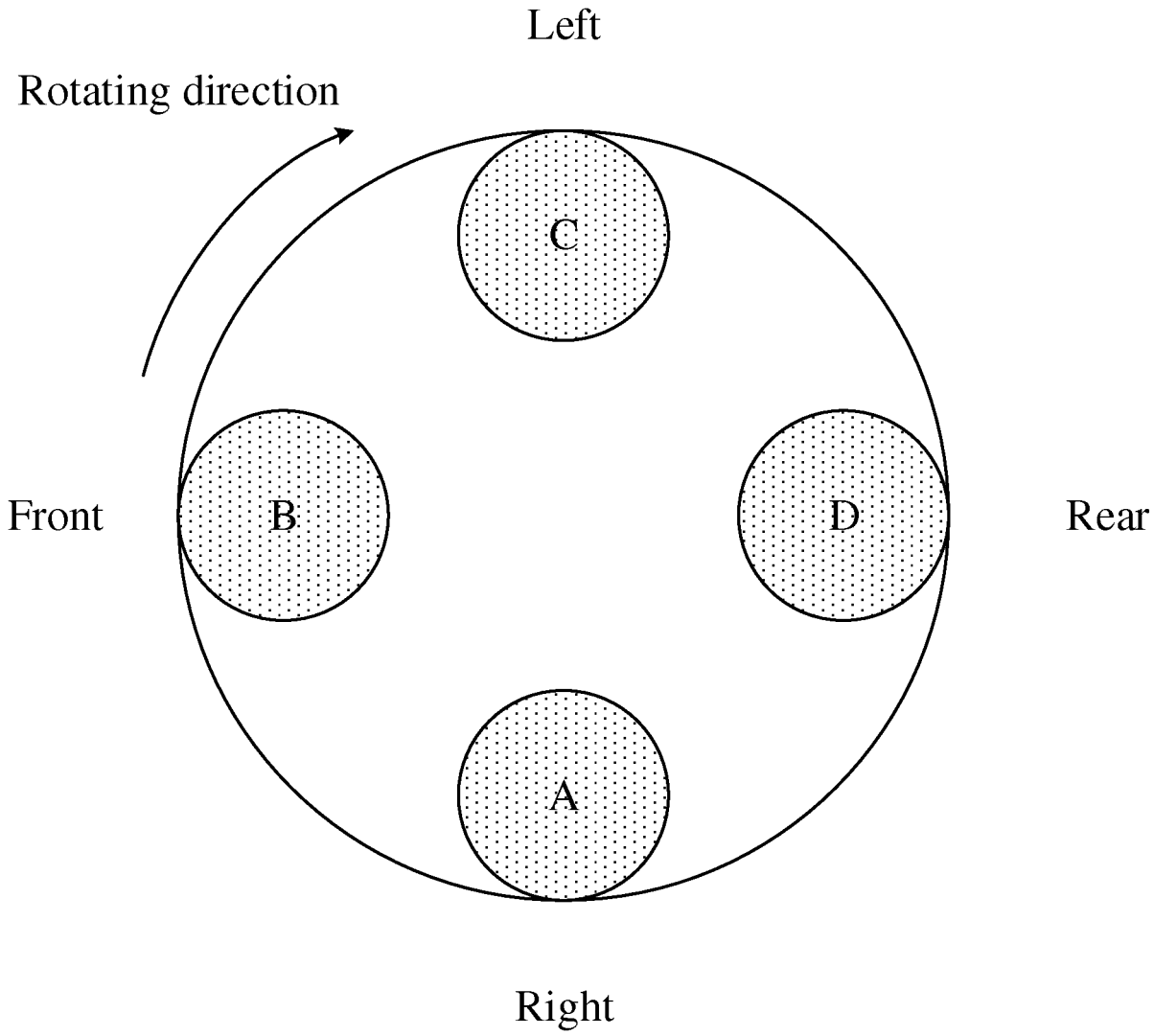

FIG. 9

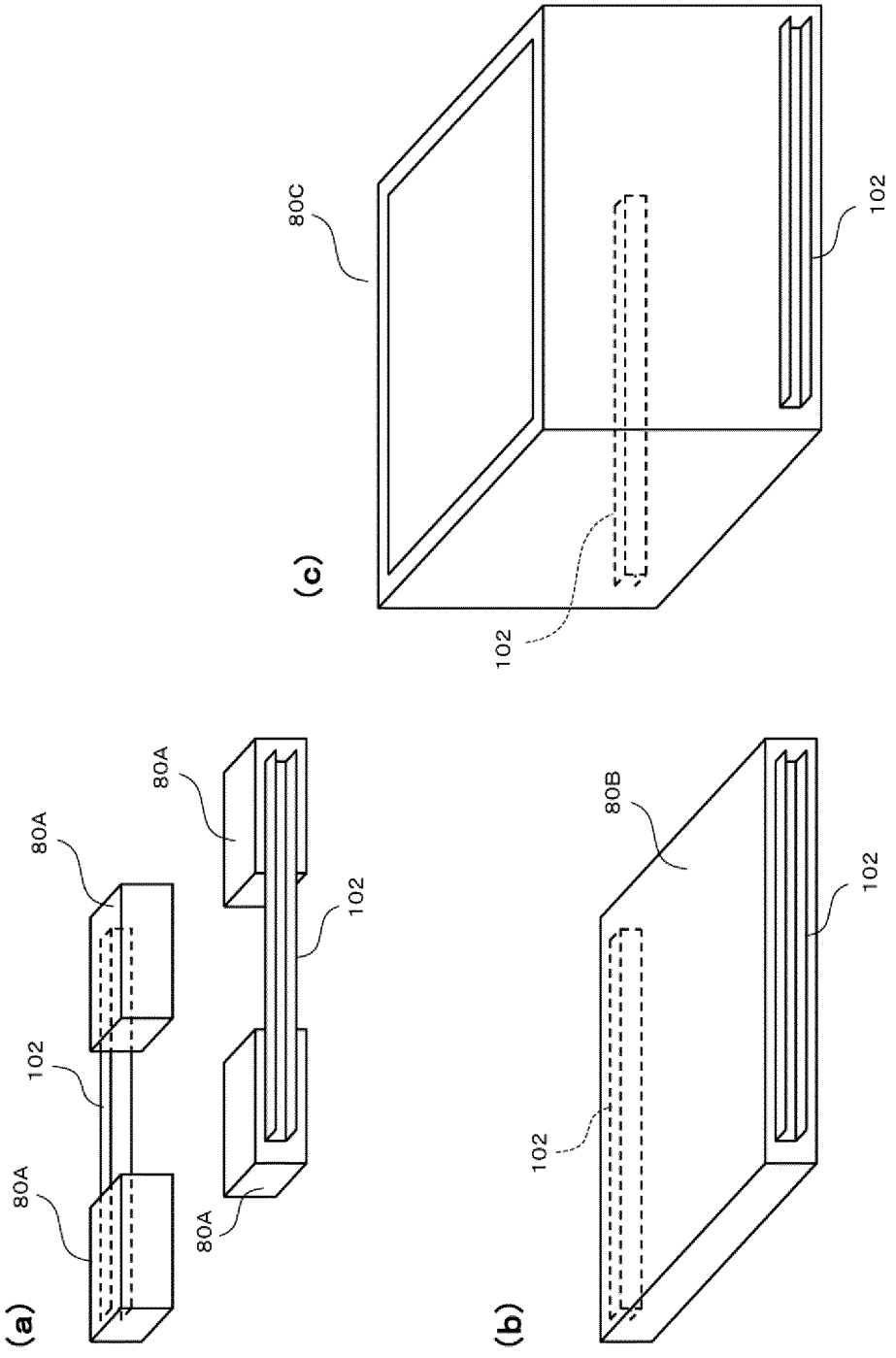

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/109810

A. CLASSIFICATION OF SUBJECT MATTER

D06F 37/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F

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

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

CNABS, CNTXT, EPODOC, DWPI: static acceleration, dynamic acceleration, washer, washing, static, dynamic, acceleration

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 1349012 A (LG ELECTRONICS INC.), 15 May 2002 (15.05.2002), description, page 5, line 4 to page 9, line 29, and figures 2-3	1, 3
Y	CN 1715500 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 04 January 2006 (04.01.2006), description, page 6, lines 5-8	1, 3
A	CN 1715497 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 04 January 2006 (04.01.2006), the whole document	1-3
A	KR 20050035389 A (LG ELECTRONICS INC.), 18 April 2005 (18.04.2005), the whole document	1-3

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

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 March 2017 (13.03.2017)	**28 March 2017 (28.03.2017)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **GUO, Xu** Telephone No.: (86-10) **62084600**

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/109810

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		DE 10134237 A1	02 May 2002
		JP 2002119786 A	23 April 2002
		US 6618887 B2	16 September 2003
		DE 10134237 B4	31 August 2006
		JP 3616356 B2	02 February 2005
		CN 1218082 C	07 September 2005
		AU 760902 B2	22 May 2003
		DE 10134237 B8	03 April 2014
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		KR 20020048003 A	22 June 2002
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CN 1715497 A	04 January 2006	None	
KR 20050035389 A	18 April 2005	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002119786 A **[0005]**