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(54) **WASHING MACHINE**

(57) The object of the present invention is to provide a washing machine capable of detecting that washings in a washing drum are in a state unsuitable for a dewatering process in a phase earlier than the dewatering process. The washing machine (1) includes: a washing drum (4) for accommodating washings (Q); a stirring component (5) configured to face the washings (Q) from a lower side Z2 inside the washing drum (4); a motor (6) for rotating the stirring component (5); and a microcomputer (30) for controlling water supply and drainage for the washing drum (4) or controlling a voltage applied to the motor (6) to rotate the stirring component (5). During a washing process in which the stirring component (5) is rotated in a state that water is stored in the washing drum (4), the microcomputer (30) obtains an index which indicates a size of resistance generated by the washings (Q) in the washing drum (4) to rotation of the stirring component (5). When the index exceeds a specified threshold since the resistance in the washing process is less than a specified resistance, the microcomputer (30) judges that the washings (Q) in the washing drum (4) are in a state unsuitable for the dewatering process.

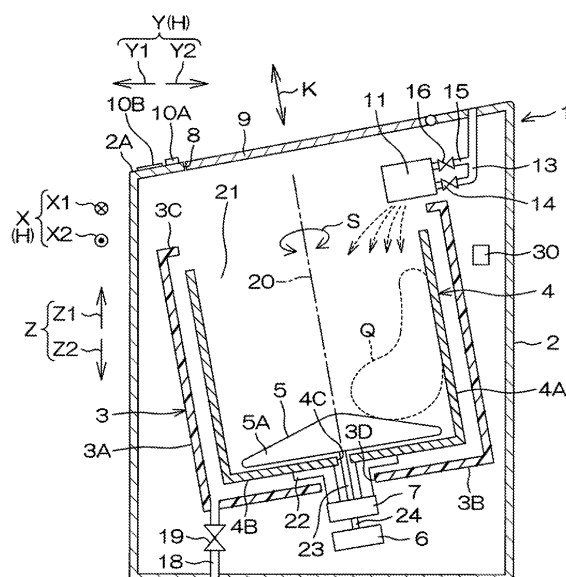


FIG. 1

Description

TECHNICAL FIELD

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

BACKGROUND

[0002] In a washing machine described in the following patent document 1, stirring blades arranged at a bottom in a washing and dewatering drum are rotationally driven by a motor. Since the stirring blades are rotated in a state that water is supplied into the washing and dewatering drum to generate a water flow in the washing and dewatering drum, washings in the washing and dewatering drum are stirred by the water flow and then are washed.

Current Technical Document

Patent Document

[0003] Patent Document 1: Japanese Patent Publication No. 2006-68275 Problems to be solved in invention

[0004] Although a dewatering process of rotating the washing and dewatering drum for dewatering the washings is performed after a washing process of washing the washings in general washing operation performed by the washing machine, a state of the washings in the washing and dewatering drum may affect the dewatering process. Specifically, when the washings in the washing and dewatering drum are gathered together, the washings may be abruptly dispersed during rotation of the washing and dewatering drum in the dewatering process, and then are biased inside the washing and dewatering drum. In this case, it is difficult to effectively dewater the washings, and vibration may be generated in the dewatering process.

SUMMARY

[0005] In view of this, the present invention achieves a technical solution. An object of the present invention is to provide a washing machine capable of detecting a state that washings in a washing drum are not suitable for a dewatering process in a phase earlier than the dewatering process.

[0006] In addition, another object of the present invention is to provide a washing machine capable of eliminating a state that washings in a washing drum are not suitable for a dewatering process under a condition that the washings are in the state.

Solution for solving the problems

[0007] In the present invention, the washing machine includes: a washing drum for accommodating washings; a stirring component configured to face the washings

from a lower side inside the washing drum and capable of rotating in a manner of stirring the washings in the washing drum; a motor for rotating the stirring component; an execution unit for executing water supply and drainage for the washing drum or controlling a voltage applied to the motor to rotate the stirring component, and for executing washing operation comprising a washing process for rotating the stirring component in a state that water is stored in the washing drum and a dewatering process after the washing process; a threshold setting unit for setting a specified threshold according to a size of a load of the washings in the washing drum; an acquirement unit for acquiring an index which indicates a size of resistance generated by the washings in the washing drum to rotation of the stirring component during the washing process; and a judgment unit for judging that the washings in the washing drum are in a state unsuitable for the dewatering process when the index exceeds the specified threshold since the resistance in the washing process is less than the specified resistance.

[0008] In addition, in the present invention, the acquirement unit calculates the index according to inertial rotation quantity of the motor after the execution unit stops applying the voltage to the motor during the rotation process of the stirring component.

[0009] In addition, in the present invention, the acquirement unit calculates the index according to a maximum rotating speed of the motor within a specified period in the rotation process of the stirring component.

[0010] In addition, in the present invention, the washing machine further includes a second acquirement unit for acquiring a second index which indicates a size of a load of the washings in the washing drum; and under a condition that the second index exceeds another threshold different from the specified threshold since the load is large enough to exceed the specified threshold, the judgment unit judges that the washings in the washing drum are in a state unsuitable for the dewatering process.

[0011] In addition, in the present invention, under a condition that the judgment unit judges that the washings in the washing drum are in a state unsuitable for the dewatering process, the execution unit executes special drainage of the washing drum during the washing process so that a water level in the washing drum is decreased to a specified water level.

[0012] In addition, in the present invention, the washing drum is rotatable and the motor enable the washing drum to rotate; the execution unit controls the voltage applied to the motor during the dewatering process so as to rotate the washing drum; under a condition that the washings are biased in the washing drum during the dewatering process, the execution unit executes correction treatment for rotating the stirring component in a state that the water is stored in the washing drum to a set water level in order to correct a bias of the washings; the washing machine further includes a setting unit for setting the set water level in the correction treatment after the washing process to be lower than a water level that the special

drainage is not executed under a condition that special drainage is executed in the washing process,.

[0013] In addition, in the present invention, during the washing process, when the index acquired by the acquirement unit exceeds the specified threshold after the special drainage, the execution unit executes the special drainage again, and then executes at least one of treatment of strengthening a water flow in the washing drum and treatment of prolonging the washing process.

Effects of the invention

[0014] Through the washing machine in the present invention, during a washing process of a phase earlier than a dewatering process, the execution unit controls a voltage applied to the motor to rotate the stirring component in a state that water is stored in the washing drum. Thus, a water flow is generated in the washing drum. Since the washings are stirred through mechanical force generated by the rotating stirring component and the water flow to eliminate dirt from the washings, the washings can be clearly washed.

[0015] During the washing process, the acquirement unit acquires an index which indicates a size of resistance generated by the washings in the washing drum to rotation of the stirring component. When the washings in the washing drum are in a state unsuitable for the dewatering process since the washings are gathered together, a contact region between the washings and the stirring component becomes narrow, so the resistance is decreased to be less than the specified resistance. When the index exceeds the specified threshold which is set according to the size of the load of the washings since the resistance is less than the specified resistance, the judgment unit judges that the washings in the washing drum are in a state unsuitable for the dewatering process.

[0016] As a result, the washings in the washing drum can be detected in a state unsuitable for the dewatering process in the phase earlier than the dewatering process.

[0017] In addition, through the present invention, the inertial rotation quantity of the motor after the execution unit stops applying the voltage to the motor is increased with the decrease of the resistance generated by the washings to the rotation of the stirring component and is decreased with the increase of the resistance during the rotation process of the stirring component. Therefore, the index is calculated according to the inertial rotation quantity which is changed with the increase and the decrease of the resistance, thereby acquiring a correct index.

[0018] In addition, through the present invention, the maximum rotating speed of the motor within the specified period in the rotation process of the stirring component is increased with the decrease of the resistance generated by the washings to the rotation of the stirring component and is decreased with the increase of the resistance. Therefore, the index is calculated according to the maximum rotating speed which is changed with the increase and the decrease of the resistance, thereby ac-

quiring a correct index.

[0019] In addition, through the present invention, under a condition that the load of the washings in the washing drum is less than the specified load, the washings are difficult to present a state unsuitable for the dewatering process. Therefore, under a proper condition that the second index exceeds another threshold since the load of the washings is large enough to exceed the specified load, it can be judged whether the washings are in a state unsuitable for the dewatering process.

[0020] In addition, through the present invention, under a condition of judging that the washings in the washing drum are in a state unsuitable for the dewatering process, special drainage is executed in the washing process so that the water level in the washing drum is decreased to the specified water level. Thus, the washings gathering together in the washing drum are easy to contact with the stirring component since the washings are lowered with the decrease of the water level, and therefore, the washings are easy to be dispersed by the stirring component. As a result, the state of the washings unsuitable for the dewatering process can be eliminated.

[0021] In addition, through the present invention, during the dewatering process, the execution unit controls the voltage applied to the motor so that the washing drum rotates. Thus, the centrifugal force acts on the washings in the washing drum, thereby dewatering the washings.

[0022] Under a condition that the washings are biased in the washing drum during the dewatering process, the execution unit executes correction treatment for rotating the stirring component in a state that the water is stored in the washing drum to a set water level. Thus, the washings which become soft after being wetted are dispersed by the stirring component, so that the bias of the washings can be corrected.

[0023] Under a condition that special drainage is executed in the washing process, during the dewatering process after the washing process, the washings sometimes are in a state unsuitable for continuing to perform the dewatering process since the washings are kept being gathered together. Therefore, the set water level in the correction treatment in this case is set to be lower than a water level that the special drainage is not executed. Thus, since the washings gathering together in the washing drum are located at a stirring component side and are easy to contact with the stirring component, the washings are easy to be dispersed by the stirring component. As a result, the state of the washings unsuitable for the dewatering process can be eliminated.

[0024] In addition, through the present invention, under a condition that the index acquired after the special drainage exceeds the specified threshold, i.e., under a condition that the state of the washings unsuitable for the dewatering process is not eliminated through the special drainage, the special drainage is executed again. Then, since at least one of treatment of strengthening the water flow in the washing drum and treatment of prolonging the washing process is executed, the washings gathered to-

gether in the washing drum are easy to be dispersed through stirring. As a result, the state of the washings unsuitable for the dewatering process can be eliminated.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

Fig. 1 is a schematic longitudinal section right view illustrating a washing machine according to an embodiment of the present invention;

Fig. 2 is a block diagram illustrating an electrical structure of a washing machine;

Fig. 3 is a schematic perspective diagram illustrating a washing drum of a washing machine;

Fig. 4 is a schematic perspective diagram illustrating a washing drum;

Fig. 5 is a flow chart illustrating a control action in a washing process;

Fig. 6 is a flow chart illustrating a relevant control action of detection of a load in a washing process;

Fig. 7 is a flow chart illustrating a relevant control action of detection of an inertial rotation state of a washing process;

Fig. 8 is a flow chart illustrating a control action in a first embodiment shown in a washing process;

Fig. 9 is a flow chart illustrating a control action in a second embodiment shown in a washing process;

Fig. 10 is a flow chart illustrating a relevant control action of detection of an accumulated value of a maximum rotating speed in a washing process;

Fig. 11 is a flow chart illustrating a control action in a third embodiment shown in a washing process;

Fig. 12 is a flow chart illustrating a control action in a fourth embodiment shown in a washing process; and

Fig. 13 is a flow chart illustrating a relevant control action of correction treatment executed when a dewatering process is discontinued.

List of reference numerals:

[0026] 1: washing machine; 4: washing drum; 5: stirring component; 6: motor; 30: microcomputer; c: inertial rotation amount; d: inertial rotation amount; e: maximum rotating speed; f: maximum rotating speed; A: detection value; C: detection value; D: detection value; E: detection value; F: accumulated value of maximum rotating speed; Q: washing; Z2: lower side.

DETAILED DESCRIPTION

[0027] Embodiments of the present invention are specifically described below with reference to drawings. Fig. 1 is a schematic longitudinal section right view illustrating a washing machine 1 of an embodiment of the present invention. An up-down direction in Fig. 1 is referred to as an up-down direction Z of the washing machine 1. A left-

right direction in Fig. 1 is referred to as a front-rear direction Y of the washing machine 1. A direction perpendicular to a paper surface in Fig. 1 is referred to as a left-right direction X. The washing machine 1 is first briefly described. In the up-down direction Z, an upper side in Fig. 1 is referred to as an upper side Z1 and a lower side in Fig. 1 is referred to as a lower side Z2. In the front-rear direction Y, a left side in Fig. 1 is referred to as a front side Y1 and a right side in Fig. 1 is referred to as a rear side Y2. In the left-right direction X, a side of the paper surface away from an observer in Fig. 1 is referred to as a left side X1, and a side of the paper surface near the observer in Fig. 1 is referred to as a right side X2. A horizontal direction H includes the left-right direction X and the front-rear direction Y.

[0028] Although the washing machine 1 also includes a washing and drying machine having a drying function, the washing machine 1 will be described by taking the washing machine which omits the drying function and only performs washing operation as an example. The washing machine 1 includes a housing 2, an outer drum, a washing drum 4, a stirring component 5, an electric motor 6 and a transferring mechanism 7.

[0029] The housing 2 is made of, for example, metal, and has a box shape. An upper surface 2A of the housing 2 is formed by inclining relative to a horizontal direction H, for example, in a manner of extending toward the upper side Z1 when getting closer to the rear side Y2. An opening 8 is disposed on the upper surface 2A for communicating the interior with the exterior of the housing 2. A door 9 is disposed on the upper surface 2A for opening and closing the opening 8. An operation portion 10A including a switch for example, and a display portion 10B including a liquid crystal panel for example are disposed in a region around the opening 8 on the upper surface 2A. In Fig. 1, the operation portion 10A and the display portion 10B are configured to be closer to the front side Y1 than the opening 8, but can also be configured, for example, to be closer to the right side X2 than the opening 8. A user can freely select operation conditions of the washing operation or can give instructions such as washing operation starting or washing operation stopping to the washing machine 1 by operating the operation portion 10A. The display portion 10B visibly displays information relevant to the washing operation.

[0030] The outer drum 3 is made of, for example, resin, and has a closed bottomed cylindrical shape. The outer drum 3 includes: a circumferential wall 3A which is of a substantially cylindrical shape and is configured in an inclination direction K of inclining to the front side Y1 relative to the up-down direction Z; a bottom wall 3B, which blocks a hollow portion of the circumferential wall 3A from the lower side Z2; and an annular wall 3C, which is protruded toward a circle center of the circumferential wall 3A while being around an entire end edge at an upper side Z1 of the circumferential wall 3A. The inclination direction K not only is inclined relative to the up-down direction Z, but also is inclined relative to a horizontal

direction H. The hollow portion of the circumferential wall 3A is exposed to the upper side Z1 from an inner side of the annular wall 3C. The bottom wall 3B is configured to be a circular plate shape which is orthogonal to the inclination direction K and obliquely extends relative to the horizontal direction H. A through hole 3D is disposed in a circle center position of the bottom wall 3B for penetrating through the bottom wall 3B.

[0031] The outer drum 3 can store water. For example, a box-shaped detergent storage chamber 11 is disposed at the upper side Z1 of the outer drum 3 in the housing 2. The detergent storage chamber 11 is connected with a water supply path 13 connected with a faucet (not shown) from the upper side Z1 and from the rear side Y2, so that the water is supplied into the outer drum 3 through the detergent storage chamber 11 from the water supply path 13. The water from the detergent storage chamber 11 can also be supplied into the outer drum 3 by flowing down in a manner of splashing water as shown by dotted arrows. A water supply valve 14 is disposed in the water supply path 13 for opening and closing for a purpose of starting or stopping water supply.

[0032] The detergent storage chamber 11 is further connected with a branch path 15 which is branched from a portion of the water supply path 13 closer to an upstream side of the faucet than the water supply valve 14. The water flows into the branch path 15 from the water supply path 13 and then is supplied into the outer drum 3 through the detergent storage chamber 11 from the branch path 15. A softener supply valve 16 is disposed in the branch path 15 for opening and closing for a purpose of starting or stopping the water supply. The interior of the detergent storage chamber 11 is divided into a first region (not shown) for accommodating a softener and a second region (not shown) without accommodating the softener. When the softener supply valve 16 is opened, the water flowing from the water supply path 13 into the branch path 15 passes through the first region of the detergent storage chamber 11 and then is supplied into the outer drum 3. Thus, the softener in the detergent storage chamber 11 is mixed with the water and is supplied into the outer drum 3. On the other hand, when the water supply valve 14 is opened, the water directly flowing from the water supply path 13 passes through the second region of the detergent storage chamber 11 and then is supplied into the outer drum 3. In this case, the water without mixing with the softener is supplied into the outer drum 3.

[0033] The outer drum 3 is connected with a drainage path 18 from the lower side Z2. The water in the outer drum 3 is discharged out of the washing machine from the drainage path 18. A drain valve 19 is disposed in the drainage path 18 for opening and closing for a purpose of starting or stopping drainage.

[0034] The washing drum 4 is made of, for example, metal, and has a central axis 20 extending toward the inclination direction K. The washing drum 4 forms a closed bottomed cylindrical shape and is smaller than

the outer drum 3, and can accommodate the washings Q therein. The washing drum 4 has a substantially cylindrical circumferential wall 4A disposed along the inclination direction K and a bottom wall 4B for blocking the hollow portion of the circumferential wall 4A from the lower side Z2.

[0035] An inner circumferential surface of the circumferential wall 4A is the inner circumferential surface of the washing drum 4. An upper end portion of the inner circumferential surface of the circumferential wall 4A is an inlet/outlet 21 for exposing the hollow portion of the circumferential wall 4A to the upper side Z1. The inlet/outlet 21 is opposed to an inner side region of the annular wall 3C of the outer drum 3 from the lower side Z2 and is communicated with the opening 8 of the housing 2 from the lower side Z2. The user of the washing machine 1 takes the washings Q into and out of the washing drum 4 through the opened opening 8 and the inlet/outlet 21.

[0036] The washing drum 4 is coaxially accommodated in the outer drum 3 and is obliquely configured relative to the up-down direction Z and the horizontal direction H. The washing drum 4 accommodated in the outer drum 3 can be rotated about the central axis 20. A plurality of through holes (not shown) are formed in the circumferential wall 4A and the bottom wall 4B of the washing drum 4. The water in the outer drum 3 can flow between the outer drum 3 and the washing drum 4 through the through holes. Therefore, a water level in the outer drum 3 is the same as that in the washing drum 4. In addition, the water flowing out of the detergent storage chamber 11 is directly supplied into the washing drum 4 from the upper side Z1 through the inlet/outlet 21 of the washing drum 4.

[0037] The bottom wall 4B of the washing drum 4 forms a circular plate shape extending substantially parallel to the bottom wall 3B of the outer drum 3 at intervals at the upper side Z1. A through hole 4C penetrating through the bottom wall 4B is formed in a circle center position of the bottom wall 4B being identical to the central axis 20. A tubular supporting shaft 22 is disposed on the bottom wall 4B for surrounding the through hole 4C and extending toward the lower side Z2 along the central axis 20. The supporting shaft 22 is inserted into the through hole 3D of the bottom wall 3B of the outer drum 3. A lower end portion of the supporting shaft 22 is located closer to the lower side Z2 than the bottom wall 3B.

[0038] The stirring component 5, i.e., an impeller, forms a disc shape centering on the central axis 20, and is configured to be concentric with the washing drum 4 along the bottom wall 4B at a lower portion in the washing drum 4. A plurality of radially configured blades 5A are disposed on the upper surface of the stirring component 5 facing the inlet/outlet 21 of the washing drum 4 from the lower side Z2. The washings Q are located on the upper surface of the stirring component 5 when the washings being stored in the washing drum 4. In other words, the stirring component 5 in the washing drum 4 is configured to face the washings Q from the lower side Z2. A rotating shaft 23 is disposed in the stirring component 5

for extending from its circle center to the lower side Z2 along the central axis 20. The rotating shaft 23 is inserted into the hollow portion of the supporting shaft 22. The lower end portion of the rotating shaft 23 is located closer to the lower side Z2 than the bottom wall 3B of the outer drum 3.

[0039] In the present embodiment, the motor 6 is composed of a variable frequency motor. The motor 6 is disposed at the lower side Z2 of the outer drum 3 in the housing 2. The motor 6 has an output shaft 24 which rotates centering on the central axis 20. The transferring mechanism 7 is disposed between a lower end portion of each of the supporting shaft 22 and the rotating shaft 23 and an upper end portion of the output shaft 24. The transferring mechanism 7 selectively transfers the driving force outputted from the output shaft 24 by the motor 6 to one or both of the supporting shaft 22 and the rotating shaft 23. A well-known transferring mechanism can be used as the transferring mechanism 7.

[0040] When the driving force from the motor 6 is transferred to the supporting shaft 22 and the rotating shaft 23, the washing drum 4 and the stirring component 5 are rotated about the central axis 20. Rotating directions of the washing drum 4 and the stirring component 5 is identical to a circumferential direction S of the washing drum 4.

[0041] Fig. 2 is a block diagram illustrating an electrical structure of the washing machine 1. As shown in Fig. 2, the washing machine 1 includes an execution unit, a threshold value setting unit, an acquirement unit, a judgment unit, a second acquirement unit and a microcomputer 30 serving as a setting unit. The microcomputer 30 includes a memory portion such as a CPU, an ROM and an RAM, and is disposed in the housing 2 (see Fig. 1).

[0042] The washing machine 1 further includes a water level sensor 31, a rotation sensor 32 and a buzzer 33. The water level sensor 31, the rotation sensor 32 and the buzzer 33 as well as the above operation portion 10A and the display portion 10B are electrically connected with the microcomputer 30. The motor 6, the transferring mechanism 7, the water supply valve 14, the softener supply valve 16 and the drain valve 19 are electrically connected with the microcomputer 30 through, for example, a driving circuit 34.

[0043] The water level sensor 31 is used for detecting water levels of the outer drum 3 and the washing drum 4. Detection results of the water level sensor 31 are inputted into the microcomputer 30 in real time.

[0044] The rotation sensor 32 is used for reading the rotating speed of the motor 6, strictly for reading the rotating speed of the output shaft 24 of the motor 6, and is composed of, for example, a plurality of Hall ICs (not shown) which output pulses when the output shaft 24 rotates at a specified rotating angle each time. The rotating speed read by the rotation sensor 32 is inputted into the microcomputer 30 in real time. The microcomputer 30 controls the voltage applied to the motor 6, specifically, a duty ratio of a voltage applied to the motor 6

according to the inputted rotating speed, to control the rotation of the motor 6 in such a manner that the motor 6 is rotated at a desired rotating speed. In the present embodiment, to facilitate description, the rotating speed of the motor 6 is the same as the rotating speed of each of the washing drum 4 and the stirring component 5.

[0045] In addition, the microcomputer 30 can control the rotation direction of the motor 6. Therefore, the motor 6 can be rotated forward or backward. In the present embodiment, the rotation direction of the output shaft 24 of the motor 6 is identical to the rotation direction of each of the washing drum 4 and the stirring component 5. For example, when the motor 6 is rotated forward, the washing drum 4 and the stirring component 5 are rotated in a clockwise direction as observed from the upper side Z1; and when the motor 6 is rotated backward, the washing drum 4 and the stirring component 5 are rotated in a counterclockwise direction observed from the upper side Z1.

[0046] As described above, when the user operates the operation portion 10A to select the operation conditions of the washing operation for example, the microcomputer 30 receives the selection. The microcomputer 30 visibly displays necessary information to the user through the display portion 10B. The microcomputer 30 informs the user of, for example, the start and the end of the washing operation by a predetermined sound emitted from the buzzer 33.

[0047] The microcomputer 30 switches a transferring target of the driving force of the motor 6 to one or both of the supporting shaft 22 and the rotating shaft 23 by controlling the transferring mechanism 7. Under a condition that the transferring target of the driving force of the motor 6 is the supporting shaft 22, the microcomputer 30 controls the voltage applied to the motor 6 so that the washing drum 4 is rotated or stopped. Under a condition that the transferring target of the driving force of the motor 6 is the rotating shaft 23, the microcomputer 30 controls the voltage applied to the motor 6 so that the stirring component 5 is rotated or stopped.

[0048] The microcomputer 30 controls the opening and closing of the water supply valve 14, the softener supply valve 16 and the drain valve 19. Thus, the microcomputer 30 can supply the water to the washing drum 4 by opening the water supply valve 14, can supply the softener to the washing drum 4 by opening the softener supply valve 16, and can drain the washing drum 4 by opening the drain valve 19. The microcomputer 30 can store water into the washing drum 4 by opening the water supply valve 14 in a state that the drain valve 19 is closed.

[0049] Next, the washing operation performed by the microcomputer 30 in the washing machine 1 will be described. The washing operation includes a washing process of washing the washings Q, a rinsing process of rinsing the washings Q after the washing process, and a dewatering process of dewatering the washings Q at the end of the washing operation. It should be noted that the user can use tap water only and can also use bath water

as needed in the washing operation.

[0050] It will be described later in detail that in the washing process, the microcomputer 30 rotates the stirring component 5 in a state that the water is stored in the washing drum 4 to a specified water level. At this moment, the washing drum 4 is in a static state. The washings Q in the washing drum 4 are stirred by contacting with the blades 5A of the rotating stirring component 5 or moving along with a water flow generated in the washing drum 4 by the rotating stirring component 5. In this way, the washings Q are stirred by mechanical force generated by the rotating stirring component 5 and the water flow so as to eliminate dirt from the washings Q, cleaning the washings Q. In addition, the dirt on the washings Q in the washing drum 4 is decomposed through detergents thrown into the washing drum 4. In this way, the washings Q in the washing drum 4 can also be cleaned.

[0051] In the rinsing process after the washing process, the microcomputer 30 rotates the stirring component 5 in a state that water is restored in the washing drum 4. Thus the washings Q in the washing drum 4 are stirred by the blades 5A of the rotating stirring component 5 in a state that the washings Q are immersed in the water, so that the washings Q are rinsed. The washing drum 4 and the stirring component 5 can also rotate together in the rinsing process.

[0052] In the dewatering process, the microcomputer 30 rotates the washing drum 4 in a state that the drain valve 19 is opened. At this moment, the stirring component 5 can also rotate together with the washing drum 4. In the dewatering process, the microcomputer 30 rotates the motor 6 at low constant speed of 120 rpm after accelerating the rotating speed of the motor 6 to a first rotating speed of 120 rpm from 0 rpm for example in a state that the drain valve 19 is opened. The first rotating speed is higher than a rotating speed (e.g., 50 rpm to 60 rpm) at which the washing drum 4 generates transverse resonance, and is lower than a rotating speed (e.g., 200 rpm to 220 rpm) at which the washing drum 4 generates longitudinal resonance.

[0053] After rotation at the constant speed of 120 rpm, the microcomputer 30 rotates the motor 6 at medium constant speed of 240 rpm after accelerating the rotating speed of the motor 6 to a second rotating speed of 240 rpm from 120 rpm. The second rotating speed is slightly higher than the rotating speed at which the washing drum 4 generates longitudinal resonance. Then, the microcomputer 30 rotates the motor 6 at maximum constant speed after accelerating the rotating speed of the motor 6 to a maximum rotating speed of 800 rpm from 240 rpm. Thus, since the washing drum 4 rotates at high speed, the washings Q are dewatered through the centrifugal force acting on the washings Q in the washing drum 4. Water that leaks from the washings Q through dewatering is discharged out of the machine from the drainage path 18 of the outer drum 3. The dewatering process is ended, and thus the washing operation is ended.

[0054] Fig. 3 and Fig. 4 are schematic perspective di-

agrams illustrating a washing drum 4. In Fig. 3 and Fig. 4, to facilitate description, the washing drum 4 is shown by dotted lines, the stirring component 5 is shown by dot dash lines, and the washings Q are shown by solid lines.

The washings Q in the washing drum 4 have a state suitable for the dewatering process and a state unsuitable for the dewatering process. As shown in Fig. 3, the substantially cylindrical washings Q along the circumferential wall 4A of the washing drum 4 are in the state suitable for the dewatering process. In this case, the washings Q are in a state of balanced distribution in the washing drum 4 in such a manner that a spacing 40 between the substantially cylindrical washings Q and the circumferential wall 4A is decreased throughout an entire region of the circumferential direction S and an entire region of an inclined direction K. If the dewatering process is started while the washings Q are in this state, since the washing drum 4 can smoothly accelerate to a maximum rotating speed without vibrating and the centrifugal force effectively acts on the washings Q, the dewatering process can be efficiently executed.

[0055] On the other hand, the washings Q gathered together as shown in Fig. 4 are in the state unsuitable for the dewatering process. Specifically, a large gap 41 is generated between both side portions of the washings Q in the inclined direction K and the circumferential wall 4A. If the dewatering process is started when the washings Q are in this state, during the acceleration of the washing drum 4, for example, during medium-speed rotation from 120 rpm to 240 rpm, the washings Q gathered together sometimes are abruptly dispersed towards an unexpected direction and are biased inside the washing drum 4. Since the washing drum 4 cannot stably rotate when the washings Q are in a biased state, the centrifugal force is difficult to effectively act on the washings Q to dewater and great vibration may be generated during dewatering.

[0056] The washings Q have a trend of gathering together in an initial phase of washing operation, i.e., in the washing process, due to various factors. Therefore, the washing machine 1 is configured to detect in the washing process that the washings Q in the washing drum 4 are in the state unsuitable for the dewatering process and to realize the elimination of the state.

[0057] Fig. 5 is a flow chart illustrating a control action in a washing process. With reference to Fig. 5, the microcomputer 30 detects the load of the washings Q in the washing drum 4 as the washing process starts (step S1).

[0058] Fig. 6 is a flow chart illustrating a relevant control action of detection of a load. With reference to Fig. 6, as the detection of the load starts, the microcomputer 30 applies the voltage to the motor 6 to rotationally drive the stirring component 5 in a forward direction at low speed for a specified time, and then stops applying the voltage to the motor 6 to stop driving the motor 6 (step S101). Then, since the stirring component 5 and the motor 6 rotate with an inertia, the microcomputer 30 measures

the inertial rotation amount of the motor 6 in step S101. The inertial rotation amount is, for example, a total number of pulses outputted by the Hall IC (not shown) of the rotating sensor 32 during the inertial rotation of the motor 6. The inertial rotation amount herein is the inertial rotation amount of the motor 6 as well as the inertial rotation amount of the stirring component 5. The inertial rotation amount of the motor 6 in the forward direction during detection of the load as step S101 is referred as "inertial rotation amount a".

[0059] Next, the microcomputer 30 stops driving the motor 6 after rotationally driving the stirring component 5 backward at low speed only for a specified time, so as to measure the inertial rotation amount of the motor 6 at this moment (step S102). The inertial rotation amount of the motor 6 in the backward direction during detection of the load as step S102 is referred as "inertial rotation amount b".

[0060] Then, the microcomputer 30 uses a value obtained by adding the inertial rotation amount a measured in step S101 and the inertial rotation amount b measured in step S102 as a detection value A (step S103). The larger the load of the washings Q is, the smaller the inertial rotation amount of the stirring component 5 loading heavy washings Q and the inertial rotation amount of the motor 6 connected with the stirring component 5 are, and therefore, the smaller the detection value A is. The smaller the load of the washings Q is, the larger the inertial rotation amount of the stirring component 5 loading light washings Q and the inertial rotation amount of the motor 6 are, and therefore, the larger the detection value A is. In other words, the detection value A is an example that indicates an index of the size of the load. It should be noted that a sequence of step S101 and step S102 can also be reversed, the inertial rotation amounts a and b can also be measured repeatedly, and the value obtained by adding the inertial rotation amounts a and b totally is used as the detection value A.

[0061] Returning to Fig. 5, in step S1, the microcomputer 30 that acquires the detection value A sets a specified threshold value according to the size of the obtained detection value A, i.e., according to the size of the load of the washings Q in the washing drum 4. The specified threshold value herein refers to a second threshold value, a third threshold value, a fourth threshold value, a fifth threshold value, a sixth threshold value and a seventh threshold value described below which are predetermined according to the size of the load and stored in a memory portion of the microcomputer 30. After step S1, the microcomputer 30 supplies water into the washing drum 4 to a specified water level (step S2), and starts rotation of the stirring component 5 (step S3). The rotating stirring component 5 strictly rotates in a manner of alternate repetition of forward and reverse rotations. Thus, the washings Q are cleaned as mentioned above.

[0062] In the washing process of the washings Q, the microcomputer 30 performs the detection of the inertial rotation state for many times, for example, three times

(step S4 to step S6). Fig. 7 is a flow chart illustrating a relevant control action of detection of the inertial rotation state. With reference to Fig. 7, as the detection of the inertial rotation state starts, the microcomputer 30 stops driving the motor 6 after rotationally driving the stirring component 5 forward only for the specified time in a state that the water in the washing drum 4 is stored to the specified water level, so as to measure the inertial rotation amount of the motor 6 at this moment (step S201). It should be noted that the specified time herein is the same as the time of forward rotation performed by the stirring component 5 for cleaning the washings Q. In other words, detection of the inertial rotation state is performed as a link of forward rotation of the stirring component 5 for cleaning. The inertial rotation amount of the motor 6 in forward direction during detection of the inertial rotation state as step S201 is referred as "inertial rotation amount c".

[0063] Next, the microcomputer 30 stops driving of the motor 6 after rotationally driving the stirring component 5 backward only for the specified time in a state that the water in the washing drum 4 is stored to the specified water level, so as to measure the inertial rotation amount of the motor 6 at this moment (step S202). It should be noted that the specified time herein is the same as the time of backward rotation performed by the stirring component 5 for cleaning the washings Q. In other words, detection of the inertial rotation state is performed as a link of backward rotation of the stirring component 5 for cleaning. The inertial rotation amount of the motor 6 in backward direction during detection of the inertial rotation state as step S202 is referred as "inertial rotation amount d". It should be noted that a sequence of step S201 and step S202 can also be reversed.

[0064] Then, the microcomputer 30, when step S201 and step S202 are repeatedly performed for many times, for example, 16 times (step S203: Yes), uses a value obtained by adding the inertial rotation amount c and the inertial rotation amount d for a total of 16 times as a detection value for detection of the inertial rotation state (step S204). The smaller the resistance to the rotation of the stirring component 5 due to the washings Q in the washing drum 4 (hereinafter referred to as "resistance") is, the larger the inertial rotation amount is, and therefore, the larger the detection value is. On the other hand, the larger the resistance is, the smaller the inertial rotation amount is, and therefore, the smaller the detection value is. In this way, the detection value is an index that indicates the size of the resistance, i.e., is an example of the index that indicates a rotation state of the stirring component 5. The microcomputer 30 calculates the detection value according to the inertial rotation quantity of the motor 6 after the voltage is not applied to the motor 6 in the rotation process of the stirring component 5.

[0065] Returning to Fig. 5, the microcomputer 30 acquires a detection value B in the first detection of the inertial rotation state in step S4, acquires a detection value C in the second detection of the inertial rotation state

in step S5, and acquires a detection value D in the third detection of the inertial rotation state in step S6. When the washings Q in the washing drum 4 are in a state unsuitable for the dewatering process since the washings Q are gathered together (with reference to Fig. 4), by narrowing a contact region between the washings Q and the stirring component 5, the resistance is decreased to be less than the specified resistance such that the stirring component 5 smoothly rotates. Therefore, the detection value for the detection of the inertial rotation state is increased over time according to a sequence of the detection value B, the detection value C and the detection value D.

[0066] Therefore, under the condition that the load is large to the extent that the detection value A is lower than the first threshold value, the microcomputer 30 judges whether an extent that the resistance is small to be below the specified resistance reaches an extent that a summing value of the detection value C and the detection value D exceeds the third threshold value no matter whether the resistance is large to the extent that the detection value B is lower than the second threshold value (step S7). The first threshold value, the second threshold value and the third threshold value are respectively different specified threshold values. For example, under a condition that the first threshold value is 200, the second threshold value is 2000 and the third threshold value is 5000.

[0067] In the washing process, under a condition that the load is large to be above the specified load so that the detection value A exceeds the first threshold value, when the resistance is lower than the specified resistance so that the summing value of the detection value C and the detection value D exceeds the third threshold value (step S7: Yes), the microcomputer 30 judges that the washings Q in the washing drum 4 are gathered together and are in the state unsuitable for the dewatering process (step S8). As a result, the washings Q in the washing drum 4 can be detected in the state unsuitable for the dewatering process in the washing process in a phase earlier than the dewatering process.

[0068] Especially, the above inertial rotation amount is increased with the decrease of the resistance, and is decreased with the increase of the resistance. Therefore, in the detection of the inertial rotation state, the detection values B-D are calculated according to the inertial rotation quantity which is changed with the increase and the decrease of the resistance like this, thereby acquiring the detection values B-D as correct indexes suitable for judgment in step S7. In addition, the difference between the detection of the load the detection of the inertial rotation state lies in that the inertial rotation amounts a and b are measured before water supply during the detection of the load while the inertial rotation amounts c and d are measured after water supply during the detection of the inertial rotation state. When considering that dry washings and wet washings are mixed together under a condition of detection of the load, the inertial rotation amounts

c and d for detection of the inertial rotation state executed in a state that all the washings are uniformly wetted are reliable values when the judgment in step S7.

[0069] In addition, under a condition that the extent that the load of the washings Q in the washing drum 4 is less than the specified load is the extent that the detection value A is lower than the first threshold value, the washings Q are difficult to become the state unsuitable for the dewatering process. Therefore, in step S7, under a proper condition that the load of the washings Q is large enough to exceed the specified load so that the second index referred as the detection value A exceeds the first threshold, it can be judged whether the washings Q are in the state unsuitable for the dewatering process.

[0070] The microcomputer 30 stops the stirring component 5 and executes special drainage (step S8) under a condition of judging that the washings Q in the washing drum 4 are gathered together to be in the state unsuitable for the dewatering process. As special drainage, the microcomputer 30 discharges part of water in the washing drum 4 out of the machine, so that the water level in the washing drum 4 is reduced to the specified water level. After special drainage, the microcomputer 30 restarts the rotation of the stirring component 5, to continue to clean the washings Q (step S9). Thus, the washings Q gathering together in the washing drum 4 are easy to contact with the stirring component 5 since the washings Q are lowered with the decrease of buoyancy as the water level is reduced, and therefore, the washings Q are easy to be dispersed by restarting the rotation of the stirring component 5. As a result, the state of the washings Q unsuitable for the dewatering process can be eliminated. As long as the washings Q become the state suitable for the dewatering process, washing operation can smoothly move to the dewatering process.

[0071] Regarding to the treatment after step S9 in the washing process, first to fourth embodiments below can be illustrated. In a first embodiment shown in Fig. 8, the microcomputer 30 enables the stirring component 5 to continue to rotate from the start of the washing process to the end of a specified time, such as 10 minutes, thereby continuing to operate (step S10). It should be noted that the washings Q are in the state suitable for the dewatering process when the resistance is hardly decreased so that a summing value of the detection value B and the detection value C is below the third threshold value (step S7: No). Therefore, the microcomputer 30 does not perform the treatments of step S8 and step S9, but rotates the stirring component 5 by following step S3, thereby continuing to operate (step S10). Then, when an end time is reached, the microcomputer 30 ends the washing process. It should be noted that under a condition that the washing process is performed for 10 minutes, for example, the treatment from step S1 to step S7 is executed within approximately former 5 minutes and the treatment from step S8 to step S10 is executed within approximately latter 5 minutes.

[0072] Fig. 9 is a flow chart illustrating a control action

of a second embodiment. It should be noted that in Fig. 9 and all drawings following Fig. 9, identical step numbers are given to the treatment steps identical with the treatment steps in Fig. 5 to Fig. 8, and detailed description about these treatment steps is omitted. In a second embodiment shown in Fig. 9, the microcomputer 30 re-executes the detection of the inertial rotation state in a state of restarting the rotation of the stirring component 5 in step S9, and executes detection of an accumulated value of the maximum rotating speed (step S11). The microcomputer 30 acquires a detection value E according to a flow described in Fig. 7 in the detection of the inertial rotation state.

[0073] Fig. 10 is a flow chart illustrating a relevant control action of detection of the accumulated value of the maximum rotating speed. With reference to Fig. 10, as the detection of the accumulated value of the maximum rotating speed starts, the microcomputer 30 measures the maximum rotating speed of the motor 6 when the stirring component 5 only is rotationally driven forward for the specified time in a state that the water in the washing drum 4 is stored to the specified water level (step S301). It should be noted that the specified time herein is the same as the time of forward rotation performed by the stirring component 5 for cleaning the washings Q. In other words, detection of the accumulated value of the maximum rotating speed is performed as a link of forward rotation of the stirring component 5 for cleaning. The maximum rotating speed under the condition that the motor 6 forward rotates during detection of the accumulated value of the maximum rotating speed as step S301 is referred as "a maximum rotating speed e".

[0074] Next, the microcomputer 30 measures the maximum rotating speed of the motor 6 when the stirring component 5 only is rotationally driven backward for the specified time in a state that the water in the washing drum 4 is stored to the specified water level (step S302). It should be noted that the specified time herein is the same as the time of backward rotation performed by the stirring component 5 for cleaning the washings Q. In other words, detection of the accumulated value of the maximum rotating speed is performed as a link of backward rotation of the stirring component 5 for cleaning. The maximum rotating speed under the condition that the motor 6 backward rotates during detection of the accumulated value of the maximum rotating speed as step S302 is called as "a maximum rotating speed f". It should be noted that a sequence of step S301 and step S302 can also be reversed.

[0075] Then, the microcomputer 30, when step S301 and step S302 are repeatedly performed for many times, for example, 16 times (step S303: Yes), use a value obtained by adding the maximum rotating speed e and the maximum rotating speed f for a total of 16 times as the accumulated value F of the maximum rotating speed (step S304). The smaller the resistance is, the larger the maximum rotating speeds e and f are, and therefore, the larger the accumulated value F of the maximum rotating

speed is. On the other hand, the larger the resistance is, the lower the maximum rotating speeds e and f are, and therefore, the smaller the accumulated value F of the maximum rotating speed is. In this way, the accumulated value F of the maximum rotating speed is an example of an index that indicates a size of the resistance. The microcomputer 30 calculates the accumulated value F of the maximum rotating speed according to the maximum rotating speed of the motor 6 within a specified period in the rotation process of the stirring component 5.

[0076] By returning to Fig. 9, the microcomputer 30 acquires the detection value E through the detection of the inertial rotation state, and detects and acquires the accumulated value F of the maximum rotating speed through the accumulated value of the maximum rotating speed in step S11.

[0077] Therefore, the microcomputer 30 confirms whether the resistance is small to such a degree that the detection value E exceeds the fourth threshold value or a degree that the accumulated value F of the maximum rotating speed exceeds the fifth threshold value (step S12) no matter whether a first special drainage is executed (step S8). The fourth threshold value and the fifth threshold value are different specified threshold values, and both are specified threshold values which are also different from the first threshold value, the second threshold value and the third threshold value. For example, under a condition that the first threshold value is 200 as mentioned above, the fourth threshold value is 18000 and the fifth threshold value is 1200.

[0078] After first special drainage (step S8), when the detection value E exceeds the fourth threshold value or the accumulated value F of the maximum rotating speed exceeds the fifth threshold value (step S12: Yes) since the resistance is smaller than the specified resistance, the microcomputer 30 judges that the washings Q in the washing drum 4 are in the state unsuitable for the next dewatering process since the washings Q are not dispersed. As a result, the washings Q in the washing drum 4 can be detected in the state unsuitable for the dewatering process in the washing process in a phase earlier than the dewatering process. Especially, the above maximum rotating speed of the motor 6 is increased with the decrease of the resistance, and is decreased with the increase of the resistance. Therefore, the accumulated value F of the maximum rotating speed is calculated according to the maximum rotating speed which is changed with the increase and the decrease of the resistance in this way, thereby acquiring the accumulated value F of the maximum rotating speed as correct indexes suitable for judgment in step S12.

[0079] According to a condition of judging that the washings Q are in the state unsuitable for the next dewatering process, the microcomputer 30 stops the stirring component 5, and executes a second special drainage so that a water level in the washing drum 4 is lowered (step S13). Where, in the second special drainage, the water level in the washing drum 4 is lowered to a specified

water level lower than the water level of the first special drainage. After the second special drainage, the microcomputer 30 restarts the rotation of the stirring component 5, to continue to clean the washings Q (step S14). At this moment, the microcomputer 30 prolongs the respective rotation times of forward rotation and backward rotation of the stirring component 5, for example, from current 1.8 seconds to 2.1 seconds, thereby continuing to clean the washings Q in a state of strengthening a water flow in the washing drum 4 (step S14).

[0080] Then, the microcomputer 30 continues to operate until the end time (step S10). It should be noted that when the resistance is hardly decreased so that the summing value of the detection value C and the detection value D exceeds the third threshold value (step S7: No), the microcomputer 30 does not perform the treatments of step S8, step S9 and steps S11-S14, but follows step S3 so that the stirring component 5 rotates, thereby continuing to operate (step S10). Then, when the end time is reached, the microcomputer 30 ends the washing process.

[0081] In a third embodiment shown in Fig. 11, the microcomputer 30 re-executes the detection of the inertial rotation state in a state of restarting the rotation state of the stirring component 5 in step S9 to acquire the detection value E, and executes the detection of the accumulated value of the maximum rotating speed to acquire the accumulated value F of the maximum rotating speed (step S11). When the detection value E exceeds the fourth threshold value or the accumulated value F of the maximum rotating speed exceeds the fifth threshold value (step S12: Yes), the microcomputer 30 stops the stirring component 5 to execute the second special drainage (step S13).

[0082] Then, after the second special drainage, the microcomputer 30 restarts the rotation of the stirring component 5, to continue to clean the washings (step S15). At this moment, unlike the step S14 in the second embodiment, the microcomputer 30 prolongs the washing process by setting the delay of the end time of the washing process (step S15). The delay time is, for example, 2 minutes under a condition of performing the washing process for 10 minutes like above.

[0083] Then, the microcomputer 30 continues to operate until the delayed end time (step S10). It should be noted that when the resistance is hardly decreased so that the summing value of the detection value C and the detection value D exceeds the third threshold value (step S7: No), the microcomputer 30 does not perform the treatments of step S8, step S9, steps S11-S13 and step S15, but follows step S3 so that the stirring component 5 rotates, thereby continuing to operate until the usual end time before delay (step S10). Then, when the end time is reached, the microcomputer 30 ends the washing process.

[0084] In a fourth embodiment shown in Fig. 12, the microcomputer 30 re-executes the detection of the inertial rotation state in a state of restarting the rotation state

of the stirring component 5 in step S9 to acquire the detection value E, and executes the detection of the accumulated value of the maximum rotating speed to acquire the accumulated value F of the maximum rotating speed (step S11). When the detection value E exceeds the fourth threshold value or the accumulated value F of the maximum rotating speed exceeds the fifth threshold value (step S12: Yes), the microcomputer 30 stops the stirring component 5 to execute the second special drainage (step S13).

[0085] Then, after the second special drainage, the microcomputer 30 restarts the rotation of the stirring component 5, to continue to clean the washings (step S16). At this moment, the microcomputer 30 sets the delay of the end time of the washing process as step S15 in the third embodiment, and continues to clean the washings in a state of strengthening the water flow in the washing drum 4 (step S16) as step S14 in the second embodiment.

[0086] Then, the microcomputer 30 continues to operate until the delayed end time (step S10). It should be noted that when since the resistance is hardly decreased so that the summing value of the detection value C and the detection value D exceeds the third threshold value (step S7: No), the microcomputer 30 does not perform the treatments of step S8, step S9, steps S11-S13 and step S16, but follows step S3 so that the stirring component 5 rotates. Thus, the microcomputer 30 continues to operate until the usual end time before delay (step S10) in a state that the water flow in the washing drum 4 keeps a usual state. Then, when the end time is reached, the microcomputer 30 ends the washing process.

[0087] In the second embodiment to the fourth embodiment, under a condition that the state of the washings Q unsuitable for the dewatering process is not eliminated through the first special drainage, after the special drainage is executed again through step S13, the microcomputer 30 at least executes at least one of treatment of strengthening a water flow in the washing drum 4 and treatment of prolonging the washing process in steps S14-S16. Therefore, the washings Q gathering together in the washing drum 4 are easier to contact with the stirring component 5 compared with the first special drainage since the washings Q are lowered with the decrease of the water level in the second special drainage in step S13, and therefore, the washings Q are easy to be dispersed by restarting the rotating stirring component 5. In addition, the washings Q are also easy to be dispersed by the strong water flow in the washing drum 4. In addition, since the above mechanical force sufficiently acts on the washings Q along with the prolongation of the washing process, the washings Q are easy to be dispersed. As a result, the state of the washings Q unsuitable for the dewatering process can be eliminated.

[0088] In the dewatering process after the washing process, the microcomputer 30 in a state of opening the drain valve 19, as mentioned above, accelerates the rotating speed of the motor 6 in three phases including a

first rotating speed of 120 rpm, a second rotating speed of 240 rpm and a third rotating speed of 800 rpm, so that the washing drum 4 is rotated. At this moment, when the washings Q in the washing drum 4 are in a state of being biased, it may occur a phenomenon that a duty ratio of a voltage applied to the motor 6 is very difficult to decrease or a phenomenon that the rotating speed of the motor 6 is very difficult to increase. When the phenomena are generated in the dewatering process, the microcomputer 30 judges the bias of the washings Q in the washing drum 4, i.e., so-called imbalance. Under a condition that the bias of the washings Q is above the specified bias, the microcomputer 30 discontinues the dewatering process and executes correction treatment shown in Fig. 13 to correct the bias of the washings Q.

[0089] Specifically, the microcomputer 30 firstly confirms (step S21) whether special drainage (step S8) is executed in this washing operation. An execution history of the special drainage is stored in a memory portion (not shown) of the microcomputer 30.

[0090] Under a condition of not performing the special drainage in this washing operation (step S21: No), the microcomputer 30 supplies water into the washing drum 4 so that the water is stored to a predetermined usual set water level (step S22). In a state that the water is stored in the washing drum 4 to the set water level, the microcomputer 30 rotates the stirring component 5 for the specified time (step S23). Thus, since the washings Q which become soft after being wetted are dispersed by the stirring component 5, the bias of the washings Q can be corrected. When the specified time herein elapses, the microcomputer 30 opens the drain valve 19 to execute drainage of the washing drum 4 (step S24). Thus, the correction treatment is ended. After the correction treatment, the dewatering process is restarted.

[0091] On the other hand, under a condition that the special drainage is executed in the washing process of this washing operation (step S21: Yes), in the dewatering process after the washing process, the washings Q may be in the state unsuitable for the dewatering process since the washings Q are kept being gathered together and biased. Therefore, the microcomputer 30 sets a set water level for storing water into the washing drum 4 in the correction treatment after the washing process to be lower than the usual water level that the special drainage is not executed (step S25). Then, the microcomputer 30 supplies water into the washing drum 4, so that the water is stored to the set water level lower than the usual water level (step S22). Then, the stirring component 5 rotates for the specified time (step S23). Thus, the washings Q gathering together in the washing drum 4 are easy to decline towards a stirring component 5 side and contact with the stirring component 5 during the correction treatment since buoyancy is weakened. Therefore, the washings Q are easy to be dispersed by the stirring component 5. As a result, the state of the washings Q unsuitable for the dewatering process can be eliminated. When the specified time elapses, the microcomputer 30 executes

the drainage of the washing drum 4 (step S24) and ends the correction treatment.

[0092] The present invention is not limited to embodiment described above, and various changes can be made within a scope in appended claims.

[0093] For example, in above step S7 (with reference to Fig. 5), the summing value of the detection value C and the detection value D may not be used, but one of the detection value C and the detection value D is only used. Specifically, in step S7, under a condition that the load is large to the extent that the detection value A is lower than the first threshold value, the microcomputer 30 confirms whether the resistance is small to the extent that the detection value C or D is higher than the specified sixth threshold value no matter whether the resistance is large to the extent that the detection value B is lower than the second threshold value. Moreover, when the detection value A exceeds the first threshold value since the load is large enough to exceed the specified load and the detection value C or D exceeds the sixth threshold value since the resistance is less than the specified resistance (step S7: Yes), the microcomputer 30 judges that the washings Q in the washing drum 4 are in the state unsuitable for the dewatering process since the washings Q are gathered together.

[0094] Further, in step S7, judgment can be made based on the accumulated value F of the maximum rotating speed, not based on the detection value C, the detection value D and the summing value of the detection value C and the detection value D. Specifically, in step S7, under a condition that the load is large to the extent that the detection value A is lower than the first threshold value, the microcomputer 30 confirms whether the resistance is small to the extent that the accumulated value F of the maximum rotating speed is higher than the specified seventh threshold value no matter whether the resistance is large to the extent that the detection value B is lower than the second threshold value. Moreover, when the detection value A exceeds the first threshold value since the load is large enough to exceed the specified load and the accumulated value F of the maximum rotating speed exceeds the seventh threshold value since the resistance is less than the specified resistance (step S7: Yes), the microcomputer 30 judges that the washings Q in the washing drum 4 are in the state unsuitable for the dewatering process since the washings Q are gathered together.

[0095] In addition, in above embodiments, during special drainage in steps S8 and S13, the rotation of the stirring component 5 is stopped. However, the rotation of the stirring component 5 may continue to rotate until the end time.

[0096] In addition, in above embodiments, the detection of the load, the detection of the inertial rotation state and the detection of the accumulated value of the maximum rotating speed are executed according to the inertial rotation state and the maximum rotating speed of the motor 6 measured by the rotation sensor 32. Alternative-

ly, a special sensor for measuring the rotation state of the stirring component 5 can be additionally provided, and the detection of the load, the detection of the inertial rotation state and the detection of the accumulated value of the maximum rotating speed are executed according to the inertial rotation state and the maximum rotating speed of the stirring component 5 measured by the sensor.

[0097] In addition, although the final dewatering process finally executed in the washing operation is described with respect to the dewatering process in above embodiments, the dewatering process can also be executed as the intermediate dewatering process immediately after the washing process, and correction treatment shown in Fig. 13 can also be executed in the intermediate dewatering process.

[0098] In addition, in the washing machine 1, central axes 20 of the outer drum 3 and the washing drum 4 are configured to extend towards the inclination direction K (with reference to Fig. 1), but can also be configured to extend towards the up-down direction Z.

Claims

1. A washing machine, comprising:

a washing drum for accommodating washings;
 a stirring component configured to face the washings from a lower side inside the washing drum and capable of rotating in a manner of stirring the washings in the washing drum;
 a motor for rotating the stirring component;
 an execution unit for executing water supply and drainage for the washing drum or controlling a voltage applied to the motor to rotate the stirring component, and for executing washing operation comprising a washing process for rotating the stirring component in a state that water is stored in the washing drum and a dewatering process after the washing process;
 a threshold setting unit for setting a specified threshold according to a size of a load of the washings in the washing drum;
 an acquirement unit for acquiring an index which indicates a size of resistance generated by the washings in the washing drum to rotation of the stirring component during the washing process; and
 a judgment unit for judging that the washings in the washing drum are in a state unsuitable for the dewatering process when the index exceeds the specified threshold since the resistance in the washing process is less than the specified resistance.

2. The washing machine according to claim 1, wherein the acquirement unit calculates the index according

to inertial rotation quantity of the motor after the execution unit stops applying the voltage to the motor during the rotation process of the stirring component.

3. The washing machine according to claim 1 or 2, wherein the acquirement unit calculates the index according to a maximum rotating speed of the motor within a specified period in the rotation process of the stirring component.

4. The washing machine according to any one of claims 1-3, wherein the washing machine further comprises a second acquirement unit for acquiring a second index which indicates a size of a load of the washings in the washing drum; and under a condition that the second index exceeds another threshold different from the specified threshold since the load is large enough to exceed the specified threshold, the judgment unit judges that the washings in the washing drum are in a state unsuitable for the dewatering process.

5. The washing machine according to any one of claims 1-4, wherein under a condition that the judgment unit judges that the washings in the washing drum are in a state unsuitable for the dewatering process, the execution unit executes special drainage of the washing drum during the washing process so that a water level in the washing drum is decreased to a specified water level.

6. The washing machine according to claim 5, wherein the washing drum is rotatable and the motor enable the washing drum to rotate, and the execution unit controls the voltage applied to the motor during the dewatering process so as to rotate the washing drum; under a condition that the washings are biased in the washing drum during the dewatering process, the execution unit executes correction treatment for rotating the stirring component in a state that the water is stored in the washing drum to a set water level in order to correct a bias of the washings; and the washing machine further comprises a setting unit for setting the set water level in the correction treatment after the washing process to be lower than a water level that the special drainage is not executed under a condition that special drainage is executed during the washing process.

7. The washing machine according to claim 5 or 6, wherein during the washing process, when the index acquired by the acquirement unit exceeds the specified threshold after the special drainage, the execution unit executes the special drainage again, and then

executes at least one of treatment of strengthening a water flow in the washing drum and treatment of prolonging the washing process.

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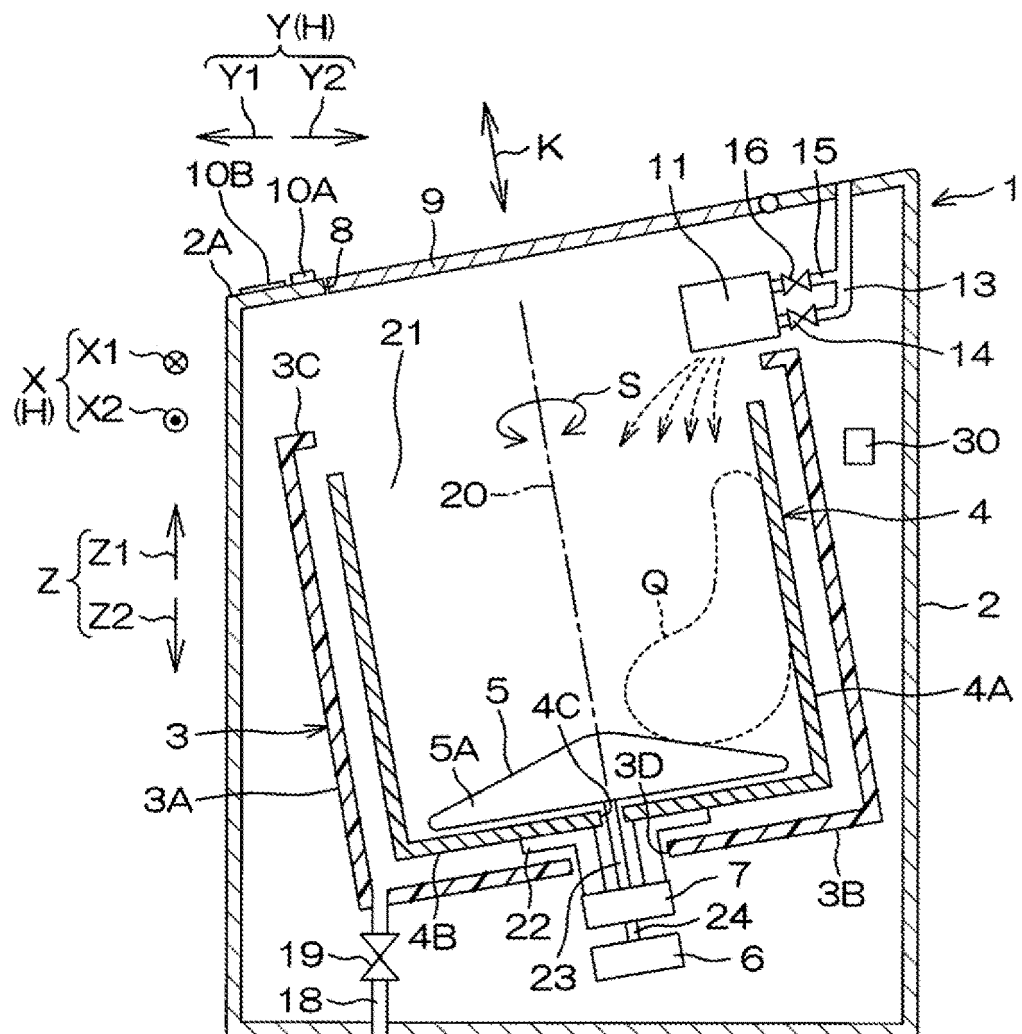


FIG. 1

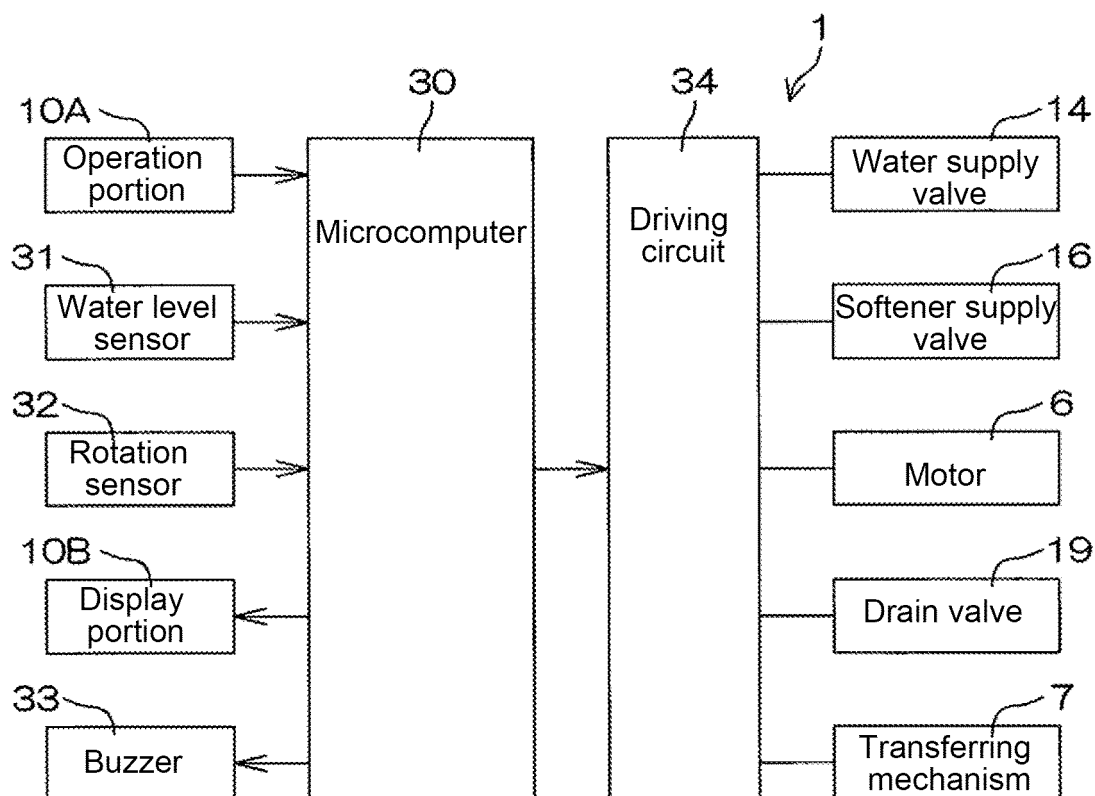


FIG. 2

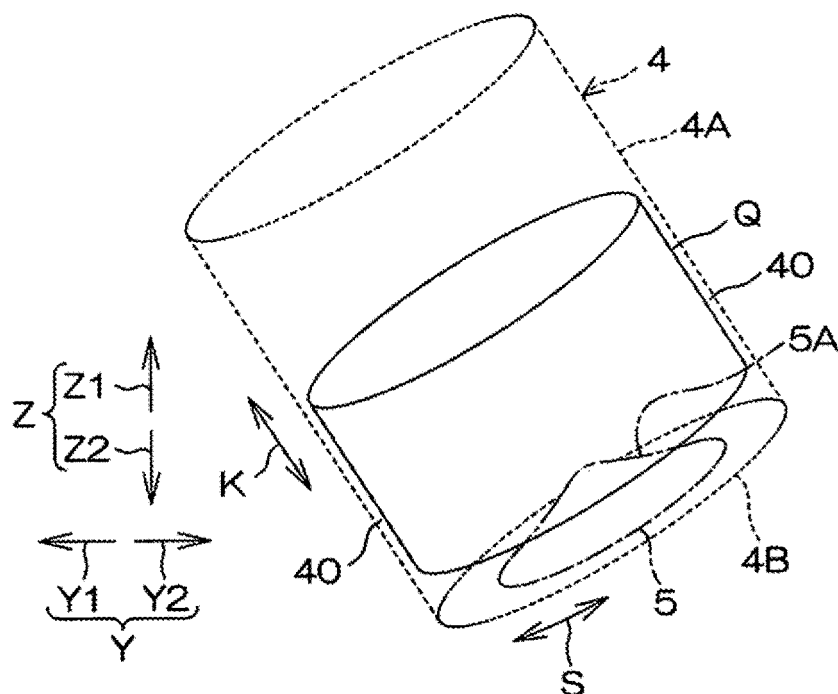


FIG. 3

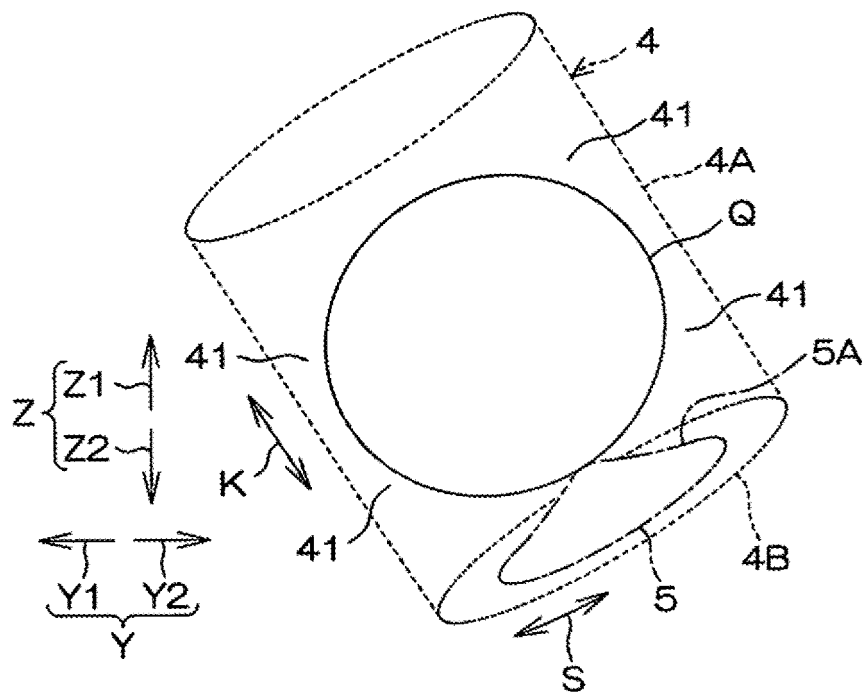


FIG. 4

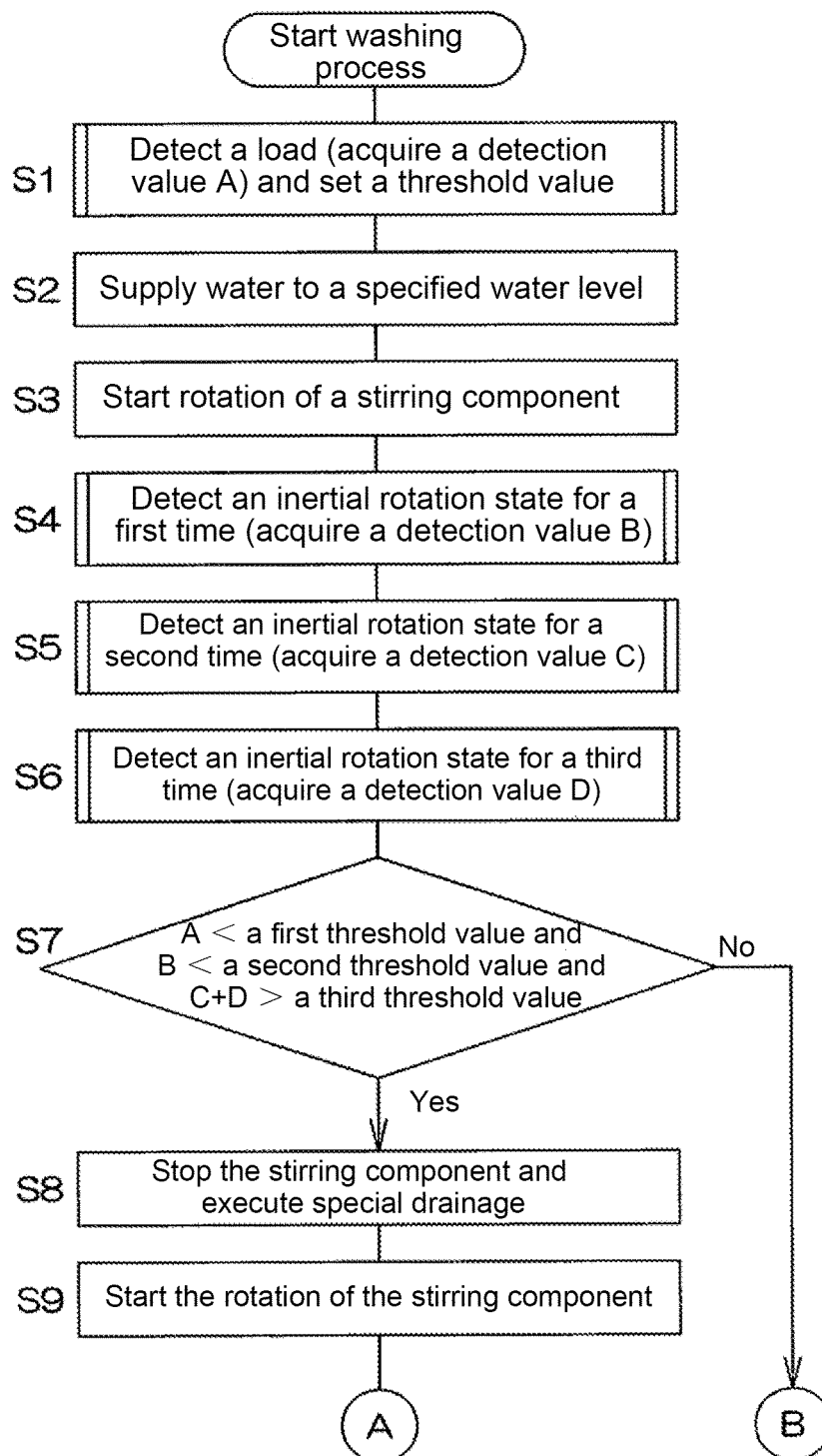


FIG. 5

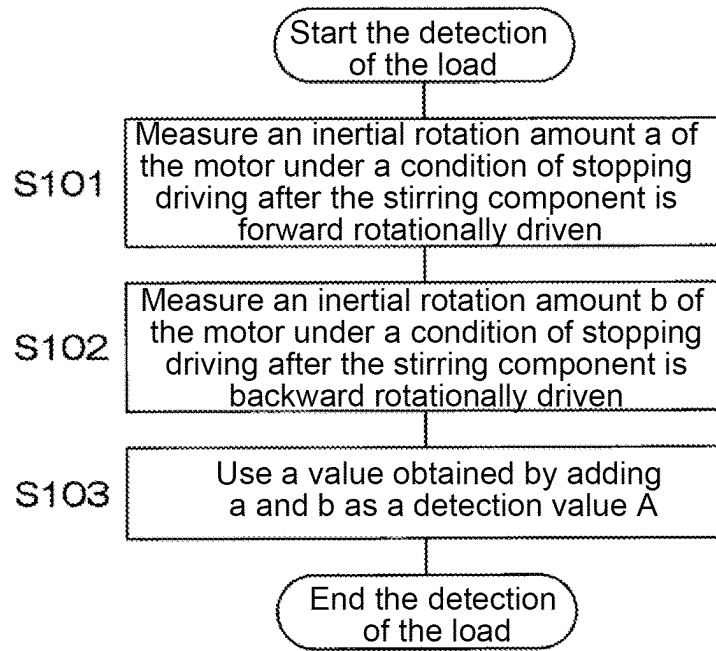


FIG. 6

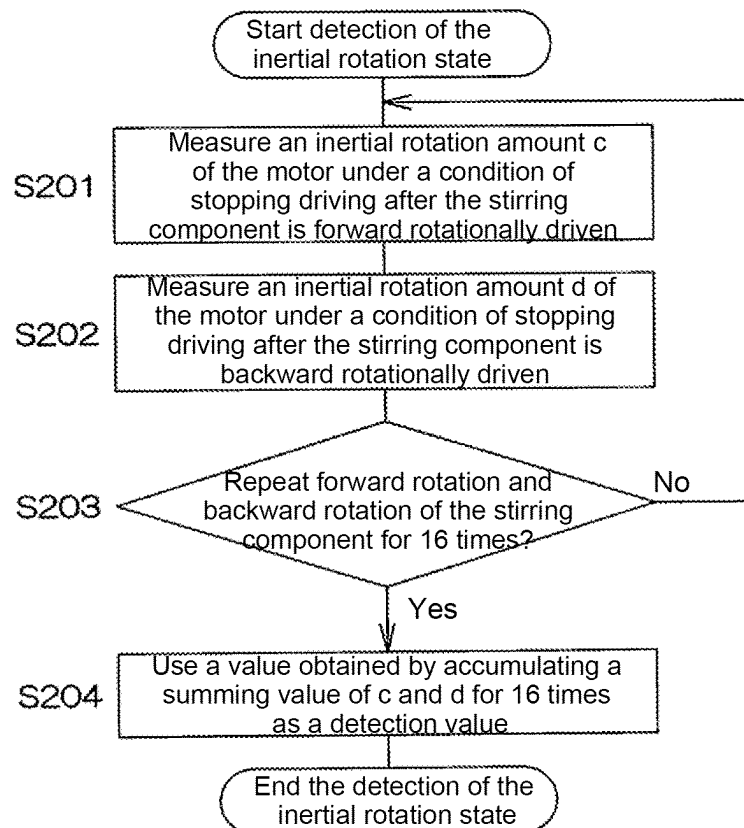


FIG. 7

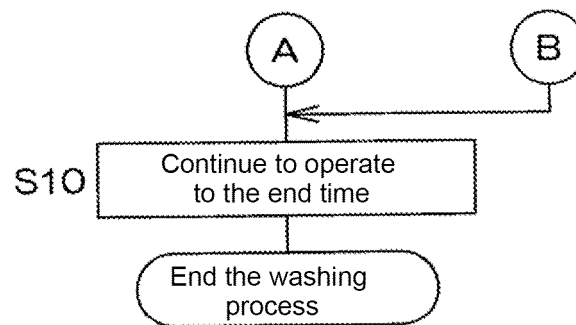


FIG. 8

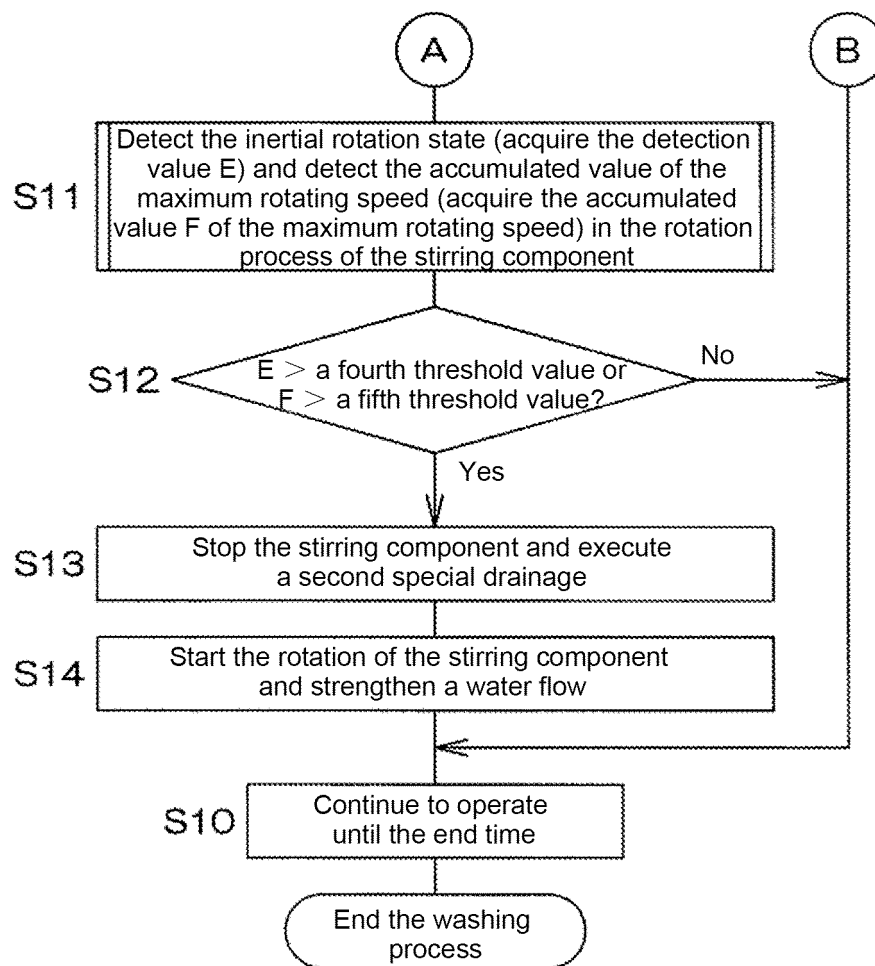


FIG. 9

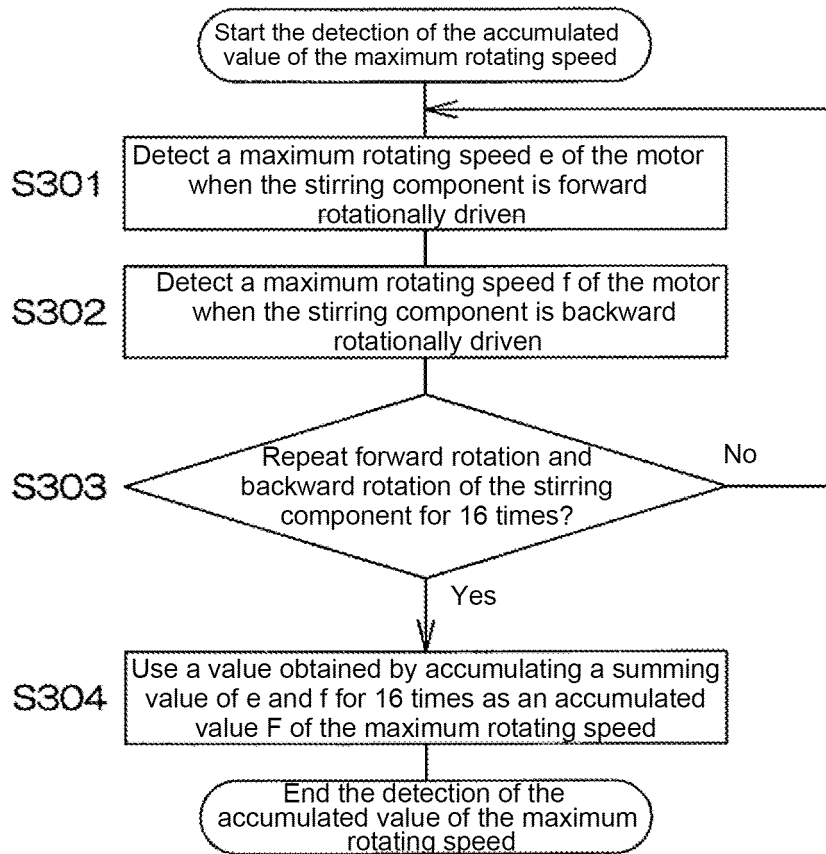


FIG. 10

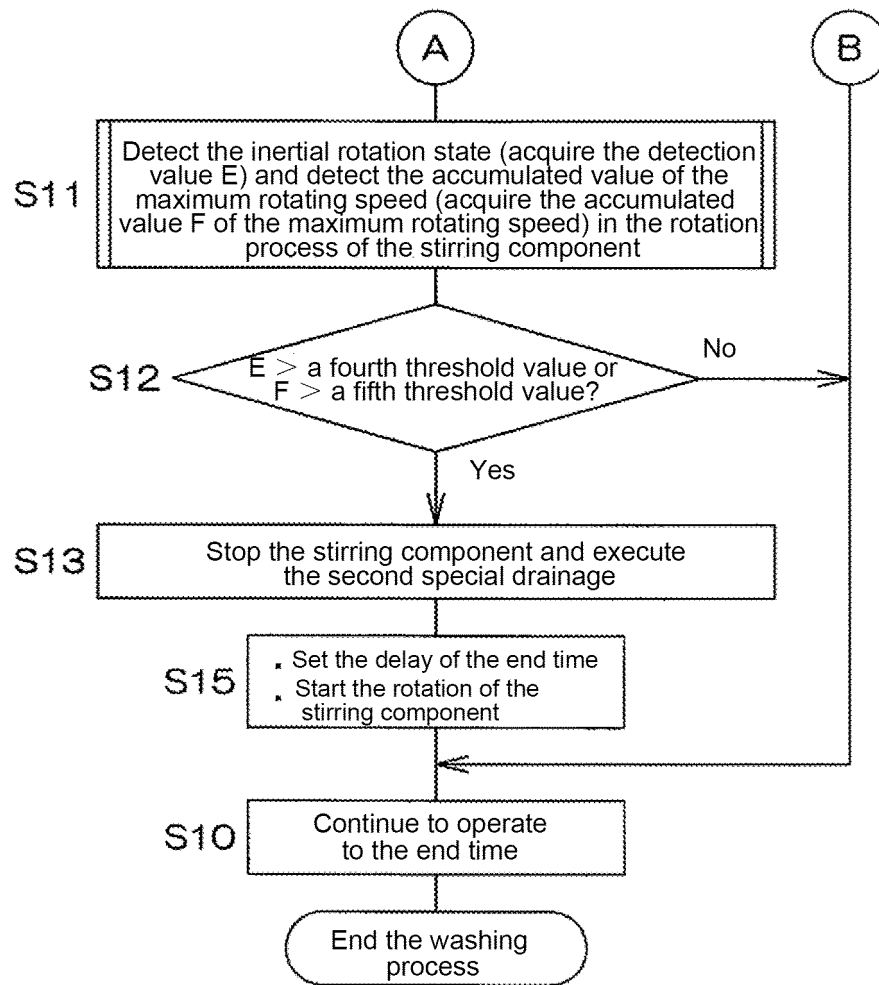


FIG. 11

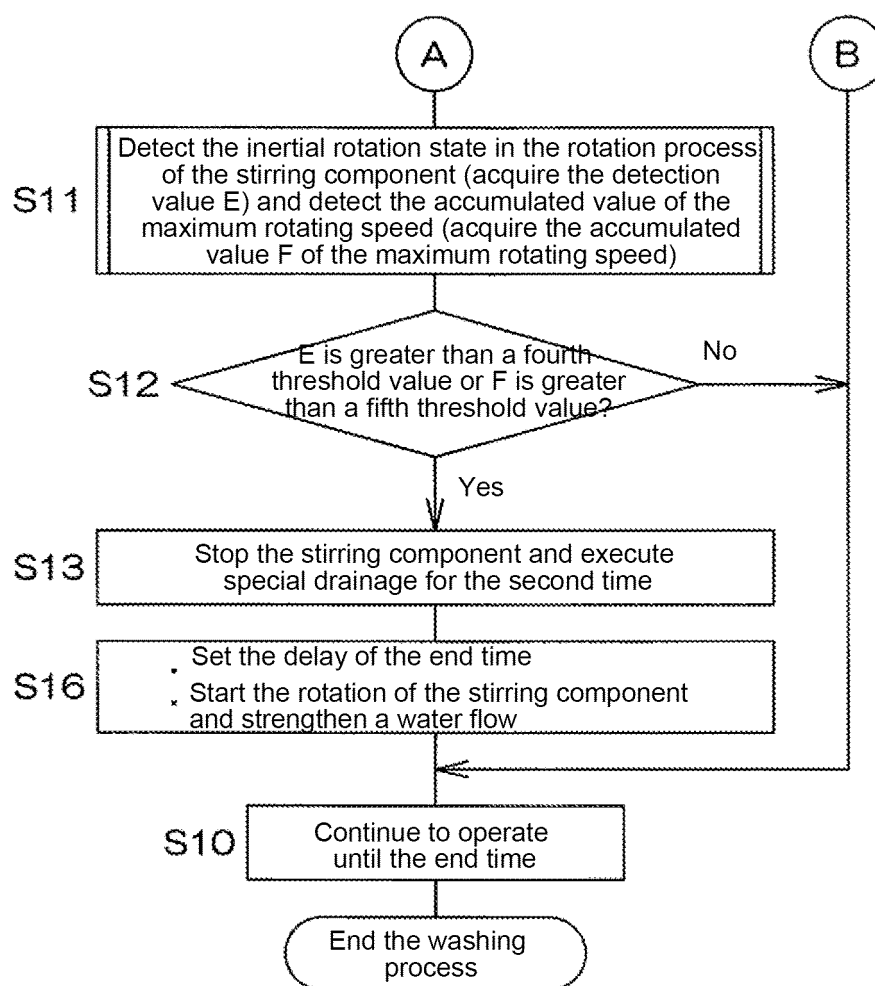
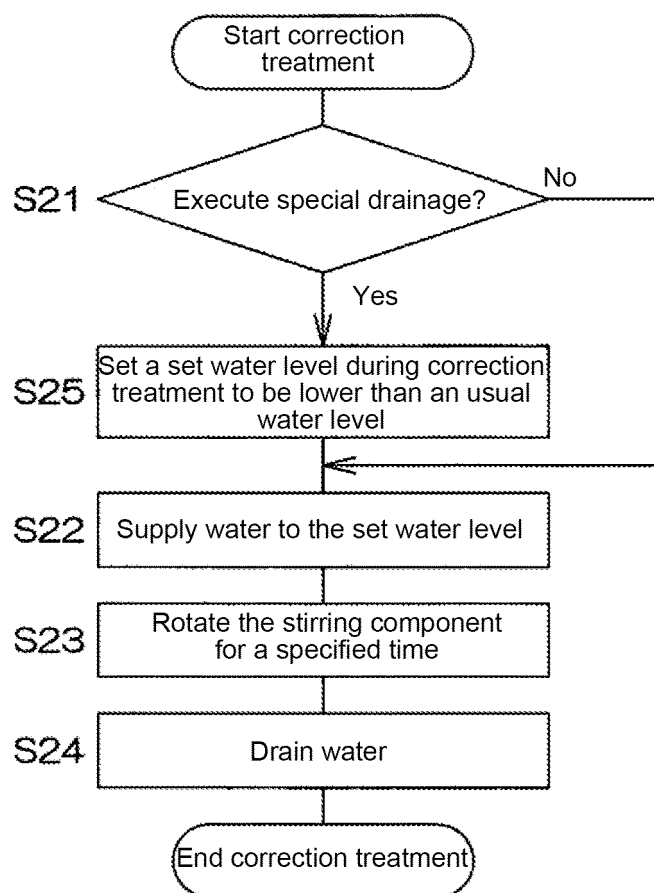


FIG. 12

**FIG. 13**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/085656

A. CLASSIFICATION OF SUBJECT MATTER

D06F 33/02 (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)

CNTXT; CNABS; DWPI; SIPOABS: HAIER; wash clothes, group, ball, torque, speed, revolution, offset, offset load, spin-dry, wash???, spin+, dehydrat+, dewater+, enlace+, enwind+, intertwist+, bunch+, ball, eccentric+, inertia+, inertance, puls???, impuls???, resistanc+, confriction, friction, force

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1096833 A (GOLD STAR CO., LTD.), 28 December 1994 (28.12.1994), description, page 6, paragraph 3 and page 7, paragraphs 5-7, and figures 6-7	1-7
A	CN 101220552 A (WHIRLPOOL CORPORATION), 16 July 2008 (16.07.2008), the whole document	1-7
A	CN 1316564 A (LG ELECTRONICS INC.), 10 October 2001 (10.10.2001), the whole document	1-7
A	CN 1888216 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 03 January 2007 (03.01.2007), the whole document	1-7
A	JP 2001327789 A (HITACHI LTD.), 27 November 2001 (27.11.2001), the whole document	1-7

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

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"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search 09 September 2016 (09.09.2016)	Date of mailing of the international search report 20 September 2016 (20.09.2016)
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 LIU, Jing Telephone No.: (86-10) 62084545

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/085656

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CN 1888216 A	03 January 2007	None	
JP 2001327789 A	27 November 2001	None	

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

REFERENCES CITED IN THE DESCRIPTION

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