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(54) **DRUM-TYPE WASHING MACHINE**

TROMMELWASCHMASCHINE

LAVE-LINGE DU TYPE A TAMBOUR

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Description

TECHNICAL FIELD

[0001] The present invention relates to drum-type washing machine for washing a laundry contained in a rotary drum.

BACKGROUND ART

[0002] Conventionally, as a drum-type washing machine of this type, for example, there has been known a washing machine described in Patent Document 1. The washing machine in Patent Document 1 employs a control scheme for performing, a predetermined number of times, operations for temporarily interrupting spin-drying, further stopping the rotation of the rotary drum and modifying unevenness of clothes and, thereafter, rotating the rotary drum again, for performing spin-drying, in order to resolve imbalance abnormalities induced during spin-drying.

[0003] Fig. 5 is a flow chart of a spin-drying process in the conventional drum-type washing machine described in Patent Document 1.

[0004] After a spin-drying process is started in a step 100, a drainage operation is performed in a step 101. Thereafter, in a step 102, the rotary drum is operated to rotate forwardly and reversely (disentangling processes) at a predetermined rotation speed (e.g., about 40 r/min), in order to disentangle laundries such as clothes which are unevenly laid.

[0005] Next, in a step 103, the rotation speed of the rotary drum is mildly increased to a rotation speed (about 70 r/min) which is enough to cause the laundries to be adhered to the inner surface of the rotary drum. Thereafter, in a step 104, the rotation speed of the rotary drum is increased to a rotation speed (e.g., about 80 r/min) which is lower than the primary resonance rotation speed, and the rotary drum is controlled to be maintained at this rotation speed for a predetermined time period. Further, at this time, detections of the presence or absence of rotational unevenness, namely imbalance abnormalities, are performed. If there is an imbalance abnormality equal to or higher than a predetermined level, it is determined that there is larger rotational unevenness and the laundries are in a poor balance state, and the control shifts to a step 105.

[0006] In the step 105, it is determined whether or not N has gotten to be equal to 4 (N indicates the number of times the steps 102 to 104 have been performed). If N is less than 4, the rotary drum is temporarily stopped in a step 106, further, 1 value is added to the current N value in a step 107, and the control returns to the step 102. When N has gotten to be 4 or more after the operations in the steps 102 to 107 have been repeated, it is regarded that the unevenness of the laundries could not be resolved in the disentangling process in the step 102, and the control shifts to a step 108.

[0007] In the step 108, it is determined whether or not N has gotten to be equal to 10. If N is less than 10, the control shifts to a step 110. In the step 110, an operation for supplying washing water into the rotary drum to modifying the unevenness of the laundries is performed. After the completion of this operation, the control returns to the step 101. On the other hand, if N is 10 or more in the step 108, the control shifts to a step 109. In the step 109, it is regarded that the unevenness of the laundries could not be resolved and, thus, the occurrence of an imbalance abnormality is displayed, and the running is stopped.

[0008] On the other hand, if there is no imbalance abnormality equal to or higher than the predetermined level in the step 104, it is determined that there is smaller rotational unevenness, and the laundries are in a preferable balance state, and the control shifts to a step 111.

[0009] In the step 111, the rotation speed of the rotary drum is increased to near the primary resonance rotation speed (e.g., 120 to 140 r/min), and the presence or absence of an imbalance abnormality at this rotation speed is determined, based on output signals (which are also referred to as vibration output values) from the vibration detector. If there has occurred an imbalance abnormality, the control shifts to a step 105. If there has occurred no imbalance abnormality and the operation is normal, the control shifts to a step 112.

[0010] In the step 112, the rotation speed of the rotary drum is increased to near the secondary resonance rotation speed (e.g., 141 to 330 r/min), and the presence or absence of an imbalance abnormality at this rotation speed is determined, based on output signals from the vibration detector. If there has occurred an imbalance abnormality, the control shifts to the step 105. If there has occurred no imbalance abnormality and the operation is normal, the control shifts to a step 113.

[0011] In the step 113, the rotation speed of the rotary drum is increased to near a rotation speed (e.g., 800 to 900 r/min) which makes it harder to resolve the adhesion of the laundries to the rotary drum, and the presence or absence of an imbalance abnormality at this rotation speed is determined, based on output signals from the vibration detector. If there has occurred an imbalance abnormality, the control shifts to the step 105. If there has occurred no imbalance abnormality and the operation is normal, the control shifts to a step 114.

[0012] In the step 114, the rotation speed of the rotary drum is increased to a rotation speed (e.g., 900 r/min or more) which makes it harder to resolve the adhesion of the laundries to the rotary drum, and the presence or absence of an imbalance abnormality at this rotation speed is determined, based on output signals from the vibration detector. If there has occurred no imbalance abnormality and the operation is normal, the control shifts to a step 115.

[0013] In the step 115, the rotation speed of the rotary drum is gradually increased toward a maximum rotation speed, and every time the rotation speed has been in-

creased, the control returns to the step 114 where the presence or absence of an imbalance abnormality at this rotation speed is determined. If there has occurred no imbalance abnormality and the operation is normal, the control shifts to the step 115 where the rotation speed of the rotary drum is increased to the maximum rotation speed. Thereafter, the control shifts to a step 117. On the other hand, if there has occurred an imbalance abnormality, the control shifts to a step 116 where the rotary drum is operated for a predetermined time period while being maintained at the rotation speed which has induced the imbalance abnormality. Thereafter, the control shifts to the step 117. In the step 117, the rotation of the rotary drum is stopped. Thereafter, the control shifts to a subsequent process in a step 118.

[0014] JP 2009 050349 A discloses a washing machine including a rotary drum, a water tub resiliently supported and internally having the rotor drum so as to be rotated, a driving motor for rotatably driving the rotary drum, acceleration-sensing means for sensing the vibration of the water tub, and control means for controlling the driving motor and successively controlling the rinsing and spin-drying steps. In the spin-drying step, imbalance is sensed from the rate of the centrifugal force of the laundry, which is larger than the center of gravity, and when the vibration of the water tub, which has a predetermined threshold or more, is sensed by the acceleration-sensing means, the controlling means reversely rotates the rotary drum at a rate where the center of gravity and centrifugal force of the laundry are substantially equal to each other.

[0015] JP 2007 236585 A discloses a washing machine provided with a vibration detecting means detecting vibration of a receiving cylinder, an unbalance amount estimation means estimating an unbalance amount according to an output of the vibration detecting means in a state capable of detecting a resonance characteristic of a support means, and a control means controlling the driving of a motor. The control means outputs a controlled variable based on the outputs of the vibration detecting means and the unbalance amount estimation means can highly precisely estimate the unbalance amount in the dewatering, and reduce the unbalance amount by a motor rotating operation so as to reduce the vibration and noise due to the unbalance and shorten the dewatering.

PATENT DOCUMENT

[0016] Patent Document 1: JP No. 2009-213803 A

SUMMARY OF THE INVENTION

Problems to be solved by the Invention

[0017] The aforementioned conventional drum-type washing machine is adapted such that it temporality stops the rotation of the rotary drum, further performs a disentangling process and, thereafter, restarts a spin-drying operation, in the event of the occurrence of an imbalance abnormality. In this case, the rotary drum is always rotated in the same direction. Therefore, the water tank is vibrated in substantially the same manner, every time. As a result thereof, even when spin-drying operations have been restarted a predetermined number of times, imbalance abnormalities cannot be resolved and, thus, the running of the washing machine is stopped before the completion of spin-drying processes, in many cases. This occurs frequently in cases of spin-drying smaller amounts of clothes. Namely, the aforementioned conventional drum-type washing machine has the problem of a higher possibility that running of the washing machine is stopped before the completion of spin-drying processes.

[0018] It is an object of the present invention to provide a drum-type washing machine having an improved damping characteristic.

Means to Solve the Problem

[0019] In order to solve the above problem, a dram-type washing machine of the invention comprise the features of claim 1.

Effects of the Invention

[0020] The drum-type washing machine according to the present invention can improve the damping characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] These aspects and features of the invention will be apparent from the following description concerning a preferred embodiment with respect to the accompanying drawings, in which:

Fig. 1 is a longitudinal cross-sectional view of a drum-type washing machine according to an embodiment of the present invention;

Fig. 2 is a front view of the inside of the drum-type washing machine in Fig. 1, when viewed at its front surface;

Fig. 3 is a circuit diagram illustrating structures relating to a control device in the drum-type washing machine in Fig. 1, by indicating a portion thereof in a block manner;

Fig. 4A is a flowchart of control in the drum-type washing machine in Fig. 1 during a spin-drying process;

Fig. 4B is a flowchart of control in the drum-type washing machine in Fig. 1 during the spin-drying process; and

Fig. 5 is a flowchart of control in a conventional drum-type washing machine, during a spin-drying process.

DESCRIPTION OF EMBODIMENTS

[0022] According to a first aspect of the present invention, there is provided a drum-type washing machine, comprising:

a rotary drum having an axis of rotation which is horizontal or inclined downwardly from a front-surface side toward a rear-surface side;
a water tank containing the rotary drum;
a motor rotating the rotary drum;
a washing machine housing elastically supporting the water tank at lower side, through an anti-vibration damper and two support dampers;
a vibration detector provided in the water tank; and
a controller controlling the motor to perform laundering processes including a spin-drying process;
wherein, in the spin-drying process, the controller controls the motor to rotate the rotary drum in a forward direction, and when a vibration value of the water tank which has been detected by the vibration detector exceeds a predetermined threshold value, the controller controls the motor to stop the rotation of the rotary drum and, thereafter, to restart a spin-drying operation by rotating the rotary drum in a reverse direction.

[0023] According to a second aspect of the present invention, there is provided the drum-type washing machine according to the first aspect, wherein
a compression force received by the anti-vibration damper from the rotary drum being rotated in the forward direction is larger than those received by the two support dampers from the rotary drum being rotated in the forward direction.

[0024] According to a third aspect of the present invention, there is provided the drum-type washing machine according to the first or second aspect, wherein,
in the spin-drying process, after stopping the rotation of the rotary drum since a vibration value of the water tank which has been detected by the vibration detector has exceeded a predetermined threshold value, the controller controls the motor to restart, a predetermined number of times, a spin-drying operation in a forward direction for rotating the rotary drum in the forward direction again, and, thereafter, when a vibration value of the water tank which has been detected by the vibration detector exceeds a predetermined threshold value, the controller controls the motor to stop the rotation of the rotary drum and, then, to restart a spin-drying operation in a reverse direction for rotating the rotary drum in the reverse direction.

[0025] According to a fourth aspect of the present invention, there is provided the drum-type washing machine according to any one of the first to third aspects, wherein
the anti-vibration damper is provided in a right side with respect to the axis of rotation in the rotary drum when viewed at the front surface, and the forward direction corresponds to counterclockwise rotations.

[0026] According to a fifth aspect of the present invention, there is provided the drum-type washing machine according to any one of the first to third aspects, wherein the anti-vibration damper is provided in a left side with respect to the axis of rotation in the rotary drum when viewed at the front surface, and the forward direction corresponds to clockwise rotations.

[0027] Hereinafter, an embodiment of the present invention will be described with reference to the drawings. It should be noted that the present invention is not limited to this embodiment.

(Embodiment)

[0028] Fig. 1 is a longitudinal cross-sectional view of a drum-type washing machine according to an embodiment of the present invention. Fig. 2 is a front view of the inside of the drum-type washing machine in Fig. 1, when viewed at its front surface.

[0029] As illustrated in Fig. 1 and Fig. 2, within a washing machine housing 41, there is provided a water tank unit 49. The water tank unit 49 includes a water tank 42, a rotary drum 43, and a motor 45. The water tank 42 is placed swingably inside the washing machine housing 41. Within the water tank 42, the rotary drum 43 is rotatably placed. The rotary drum 43 is provided, at the rotational center portion thereof, with a rotation shaft (a rotational center shaft) 44 which extends in the horizontal direction. The motor 45, which is placed near the rear surface of the water tank 42, is coupled to the rotation shaft 44 via a belt 46. The motor 45 drives and rotates the rotary drum 43 in the forward direction or in the reverse direction. On the inner wall surface of the rotary drum 43, there are provided a plurality of protuberances 47 for stirring laundries. Further, the rotary drum 43 is provided, in its outer peripheral surface, with a plurality of water passage holes 48.

[0030] The water tank 42 is supported by a single anti-vibration damper 91 and two support dampers 51 for attenuating and preventing vibrations, which are mounted to a lower portion of the washing machine housing 41. Between the water tank 42 and the upper portion of the washing machine housing 41, a plurality of spring bodies 50 are provided, as illustrated in Fig. 2. The water tank 42 is swingably supported, in an anti-vibration manner, by the plurality of the spring bodies 50.

[0031] The two support dampers 51 are dampers provided for the sake of supporting the water tank 42 and suppressing vibrations therein. The two support dampers 51 are placed symmetrically in the right and left direction when viewed at the front surface, as illustrated in Fig. 2. Further, as illustrated in Fig. 1, the two support dampers 51 are placed closer to the front surface than the position G of the center of gravity of the water tank unit 49 in the forward and rearward direction. The anti-vibration damper 91 is a damper provided mainly for the sake of sup-

pressing vibrations in the water tank 42. The anti-vibration damper 91 is placed closer to the rear surface than the position G of the center of gravity, as illustrated in Fig. 1. Further, the anti-vibration damper 91 is coupled to the washing machine housing 41 through a housing support portion 93 and, further, is coupled to the water tank 42 through a water tank support portion 94. Further, the anti-vibration damper 91 may be also coupled indirectly to the washing machine housing 41 and the water tank support portion 94 through other members. The water tank 42 is supported by the respective dampers 51 and 91 in a preferably-balanced manner, so that vibrations therein are attenuated and prevented.

[0032] Further, in the present embodiment, the dampers 51 and 91 are constituted by friction dampers. The friction dampers interiorly contain friction pads (not illustrated). These friction pads are adapted to produce friction between the pads and tubes (not illustrated) to generate friction forces, and these friction forces become attenuation forces for suppressing vibrations in the water tank 42.

[0033] Further, as illustrated in Fig. 2, the anti-vibration damper 91 is provided such that it receives larger compression forces than those received by the two support dampers 51, from the rotary drum 43 rotating in the forward direction (the counterclockwise rotation) A. In other words, the anti-vibration damper 91 is provided such that the straight line connecting the housing support portion 93 and the water tank support portion 94 to each other is inclined by an angle α toward the upstream side in the direction A of forward rotations, with respect to the straight line connecting the housing support portion 93 and the center position O of the water tank 42 to each other.

[0034] Further, the anti-vibration damper 91 is provided such that the angle of inclination thereof with respect to the bottom surface of the washing machine housing 41, which extends in the horizontal direction, is smaller than those of the support dampers 51. Accordingly, the anti-vibration damper 91 exerts a larger attenuation effect, particularly, on vibrations in the horizontal direction (the right and left direction in Fig. 2).

[0035] Further, the attenuation forces of the support dampers 51 can be made equal to the attenuation force of the anti-vibration damper 91 and, also, the attenuation force of the anti-vibration damper 91 can be made slightly smaller than the attenuation forces of the support dampers 51.

[0036] Further, the washing machine housing 41 is provided with a housing opening portion, at a position faced to a load outlet/inlet 53 in the rotary drum 43. A lid body 52 is provided so as to cover the housing opening portion, in an openable and closable manner. By opening the lid body 52, it is possible to remove or put laundries from or into the rotary drum 43 through the load outlet/inlet 53. Further, the housing opening portion is coupled to a front portion of the water tank 42 through a seal packing 92. The seal packing 92 is provided to suppress vibrations in the water tank unit 49 and, to form watertight sealing for preventing intrusion of water into the space between the washing machine housing 41 and the water tank 42. When the lid body 52 is closed, the lid body 52 and the seal packing 92 come in close contact with each other, so that the washing machine housing 41 is interiorly enclosed.

[0037] Further, a control device 81 is provided, at an upper portion within the washing machine housing 41. The control device 81 is constituted by a microcomputer or the like. The control device 81 controls the motor 45, a first electromagnetic valve 57, a second electromagnetic valve 58, a drainage pump 63, and a circulation pump 67, according to mode settings and control programs, in order to execute laundering processes including washing processes, rinsing processes, and spin-drying processes.

[0038] Further, within the washing machine housing 41, there are provided a water supply passage 54 for supplying a washing water (e.g., such as a tap water) into the water tank 42, a drainage passage 55 for discharging the washing water within the water tank 42 to the outside of the washing machine housing 41, and a water circulation passage 56 for circulating the washing water within the water tank 42.

[0039] The water supply passage 54 is constituted by a first water supply hose 59, a second water supply hose 60, a detergent accommodating portion 61, and a water supply passage 62.

[0040] The first water supply hose 59 is provided with the first electromagnetic valve 57. The second water supply hose 60 is provided with the second electromagnetic valve 58. The detergent accommodating portion 61 accommodates a drawer portion (not illustrated) which contains a detergent or a softening agent, such that it can be pulled out therefrom from the outside. By opening the first electromagnetic valve 57 or the second electromagnetic valve 58, a washing water is flowed into the first water supply hose 59 or the second water supply hose 60. The washing water having flowed into the first water supply hose 59 or the second water supply hose 60 passes through the detergent accommodating portion 61 and the water supply passage 62 and, further, is supplied to the inside of the water tank 42.

[0041] The drainage passage 55 is constituted by a drainage tube 64, a filter case 88, a drainage pump 63, and a drainage hose 66.

[0042] The drainage tube 64 is connected to the filter case 88 and to a drainage port 95 provided in a recessed portion 71 in the bottom portion of the water tank 42. The filter case 88 is provided, inside thereof, with a lint filter 65 for collecting lint and the like within the washing water. The lint filter 65 is adapted such that it can be detached therefrom by outwardly pulling a filter grip 89 provided in a lower portion of the front surface of the washing machine housing 41.

[0043] The drainage pump 63 is connected to the filter case 88 and to the drainage hose 66. The drainage hose

66 is provided to extend from the inside of the washing machine housing 41 up to outside and above the washing machine housing 41. At predetermined timings such as when a washing process has been completed or when a rinsing process has been completed, the drainage pump 63 is driven, which causes the washing water within the water tank 42 to be discharged to the outside by passing through the drainage tube 64, the filter case 88, the drainage pump 63, and the drainage hose 66, in the mentioned order.

[0044] Further, in the present embodiment, the filter case 88 is placed at a lower right portion of the front surface of the washing machine housing 41, in order to make the filter grip 89 have preferable manipulability. Further, in the present embodiment, the drainage port 95 is provided in the right side of the water tank 42 with respect to the longitudinal center thereof, when viewed at the front surface, in order to efficiently place the drainage tube 64.

[0045] The water circulation passage 56 is provided for circulating the washing water within the water tank 42, at predetermined timings such as during a pre-washing process, a washing process or a rinsing process. With the water circulation passage 56, it is possible to cause the detergent to be early dissolved in the washing water and, also, it is possible to prevent unevenness of the detergent. This results in improvement of the washing and rinsing abilities of the drum-type washing machine.

[0046] The water circulation passage 56 is constituted by the drainage tube 64, the filter case 88, an inflow side passage 68, the circulation pump 67, a discharge side passage 69, and jet ports 70. The inflow side passage 68 is a passage for connecting the filter case 88 and the circulation pump 67 to each other. The discharge side passage 69 is a passage for connecting the circulation pump 67 and the jet ports 70 to each other. The jet ports 70 are provided in a front portion of the water tank 42 in such a manner as to eject, into the rotary drum 43, the washing water passing through the discharge side passage 69.

[0047] When the circulation pump 67 is driven, the washing water within the water tank 42 is passed through the drainage tube 64, the filter case 88, the inflow side passage 68, the circulation pump 67, the discharge side passage 69, and the jet ports 70, in the mentioned order, and is ejected into the rotary drum 43 as a circulated water indicated by a solid-line arrow. Further, a plurality of jet ports 70 are provided such that they are arranged in the circumferential direction of the rotary drum 43. Thus, the circulated water is sprinkled, in plural directions, toward the laundries within the rotary drum 43.

[0048] Further, in the recessed portion 71 which is formed in the bottom portion of the water tank 42 and is connected to the drainage tube 64, there is provided a heater 72 constituted by a sheathed heater or the like, in order to heat the washing water. The heater 72 is placed such that its longitudinal direction is coincident with or substantially coincident with the horizontal direction. The heater 72 heats the washing water within the water tank 42.

[0049] The washing water having been heated by the heater 72 is circulated through the water circulation passage 56, further is ejected into the rotary drum 43 and is sprinkled onto the laundries. Thereafter, the washing water having been sprinkled onto the laundries is moved into the water tank 42 through the water passage holes 48 and the washing water is heated by the heater 72. These operations are repeated. Since the washing water is heated, molecular activities in the washing water are revitalized and, also, the detergent is activated. This results in improvement of the washing ability of the washing water, thereby reducing washing unevenness in the laundries. Further, near the heater 72, there is provided a temperature detector 73 such as a thermistor for detecting the temperature of water.

[0050] Further, the water tank 42 is provided, in its side wall in the rear side of the bottom portion, with an air trap 74 so as to communicate with the drainage tube 64. The air trap 74 is connected to an air tube 75. The air tube 75 is connected to a water level detector 76 which is provided at an upper portion within the washing machine housing 41. For example, the water level detector 76 is constituted by a pressure sensor. The water level detector 76 is adapted to detect the water level of the washing water within the water tank 42, based on the water pressure of the washing water within the water tank 42, namely based on the pressure within the air trap 74 which corresponds thereto.

[0051] Further, at an upper portion within the washing machine housing 41, there is provided a coupling hose 77 which couples an upper portion of the water tank 42 to an upper portion of the rear surface of the detergent accommodating portion 61. The coupling hose 77 has the function of removing air within the water tank 42 which has been pressurized during laundering processes.

[0052] Further, at a rear portion of the upper surface of the water tank 42, there is placed a vibration detector 78 for detecting vibrations in the water tank unit 49. In the present embodiment, an acceleration sensor is employed as the vibration detector 78, wherein the acceleration sensor is adapted to detect vibration components in three-dimensional directions, which are the forward and rearward direction (the X-axis direction), the right and left direction (the Y-axis direction), and the upward and downward direction (the Z-axis direction), rather than vibrations only in a single direction. In actual, vibrations in the water tank unit 49 do not always occur only in a single direction. Therefore, by employing, as the vibration detector 78, the acceleration sensor adapted to detect vibrations in plural directions, it is possible to detect vibrations in the water tank unit 49 with higher accuracy. The control device 81 controls operations, based on results of detections by the vibration detector 78.

[0053] Further, the washing machine housing 41 is provided with an operation display portion 79, at an upper portion of its front surface. The operation display portion

79 is provided with an input setting portion 80 which enables making settings (selections) of various functions and modes such as running courses, and a display portion 96 (see Fig. 3) which displays information having been inputted to the input setting portion 80. The user can make settings of various functions and modes such as running courses, by performing inputting to the input setting portion 80.

[0054] Fig. 3 is a circuit diagram illustrating the structures relating to the control device in the drum-type washing machine according to the embodiment of the present invention, by indicating portions thereof in a block manner.

[0055] As illustrated in Fig. 3, the control device 81 includes a controller 82, and a load drive portion 86. If a power switch 84 is turned on, the controller 82 starts controlling respective portions, by being supplied with electric power from a commercial power source 83. The controller 82 controls the load drive portion 86, based on output signals from the water level detector 76, the temperature detector 73, a cloth amount detector 85, the vibration detector 78, and a rotation speed detector 90. The load drive portion 86 is constituted by a bidirectional thyristor, a relay, and the like. The load drive portion 86 operates the motor 45, the heater 72, the first electromagnetic valve 57, the second electromagnetic valve 58, the drainage pump 63, the circulation pump 67, and the like, under the control of the controller 82. Thus, washing processes, rinsing processes, and spin-drying processes are performed. Further, the cloth amount detector 85 is adapted to detect the amount of laundries within the rotary drum 43. Further, the rotation speed detector 90 is adapted to detect the rotation speed of the rotary drum 43, by detecting the number of rotations of the rotary drum 43 per unit time.

[0056] Further, the controller 82 displays, information based on the contents of settings having been inputted to the input setting portion 80 on the display portion 96. Further, when some sorts of abnormalities in operations of the respective portions occur, the controller 82 displays the fact that there have occurred such abnormalities on the display portion 96 and, further, generates a notification through a notification portion 87.

[0057] The drum-type washing machine having the aforementioned structure will be described, with respect to operations thereof.

[0058] Figs. 4A and 4B illustrate flow charts of control in spin-drying process in the drum-type washing machine according to the embodiment of the present invention.

[0059] As illustrated in Fig. 4A, if a spin-drying process is started in a step S1, the motor 45 is driven to rotate the rotary drum 43 at a predetermined rotation speed (e.g., about 50 r/min), while reversing the direction of rotations thereof (changing the direction of rotations thereof in such a way as to alternately rotate it clockwise and counterclockwise), in a step S2. Thus, the clothes having been entangled with one another during washing processes and rinsing processes within the rotary drum 43 are disentangled (a disentangling process).

[0060] Thereafter, in a step S3, the rotary drum 43 is rotated counterclockwise (rotated in the forward direction), and the rotation speed thereof is increased. In a step S4, the vibration detector 78 detects vibration values of the water tank unit 49 (vibration values in three directions, which are the forward and rearward direction, the right and left direction, and the upward and downward direction) when the rotation speed of the rotary drum 43 is 85 to 90 r/min, and the controller 82 compares these detected vibration values with a threshold value "a". If the vibration values of the water tank unit 49 which have been detected in the step S4 are equal to or larger than the threshold value "a" (in the case of NO), the control shifts to a step S19.

[0061] In the step S19, the rotation of the rotary drum 43 is stopped. Subsequently, in a step S20, the controller 82 determines whether or not the number of times the rotation of the rotary drum 43 has been stopped is less than 20. If the number of times the rotation of the rotary drum 43 has been stopped is less than 20 in the step S20 (in the case of YES), the control returns to the step S2, in order to disentangle the clothes having been entangled with one another. If the number of times the rotation of the rotary drum 43 has been stopped has reached 20 in the step S20 (in the case of NO), the control shifts to a step S21 (see Fig. 4B) which will be described later.

[0062] On the other hand, if the vibration values of the water tank unit 49 which have been detected in the step S4 are smaller than the threshold value "a" (in the case of YES), the control shifts to a step S5. In the step S5, the rotary drum 43 is kept rotating counterclockwise, and the rotation speed thereof is increased. In a step S6, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 90 to 200 r/min, and the controller 82 compares these detected vibration values with a threshold value "b". If the vibration values of the water tank unit 49 which have been detected in the step S6 are equal to or larger than the threshold value "b" (in the case of NO), the control shifts to the aforementioned step S19.

[0063] If the vibration values of the water tank unit 49 which have been detected in the step S6 are smaller than the threshold value "b" (in the case of YES), the control shifts to a step S7. In the step S7, the rotary drum 43 is kept rotating counterclockwise, and the rotation speed thereof is increased. In a step S8, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 200 to 300 r/min, and the controller 82 compares these detected vibration values with a threshold value "c". If the vibration values of the water tank unit 49 which have been detected in the step S8 are equal to or larger than the threshold value "c" (in the case of NO), the control shifts to the aforementioned step S19.

[0064] If the vibration values of the water tank unit 49 which have been detected in the step S8 are smaller than

the threshold value "c" (in the case of YES), the control shifts to a step S9. In the step S9, the rotary drum 43 is kept rotating counterclockwise, and the rotation speed thereof is increased. In a step S10, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 300 to 320 r/min, and the controller 82 compares these detected vibration values with a threshold value "d". If the vibration values of the water tank unit 49 which have been detected in the step S10 are equal to or larger than the threshold value "d" (in the case of NO), the control shifts to the aforementioned step S19.

[0065] If the vibration values of the water tank unit 49 which have been detected in the step S10 are smaller than the threshold value "d" (in the case of YES), the control shifts to a step S11. In the step S11, the rotary drum 43 is kept rotating counterclockwise, and the rotation speed thereof is increased to 400 r/min. Thereafter, in a step S12, the rotation speed of the rotary drum 43 is further increased. In a step S13, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 410 to 420 r/min, and the controller 82 compares these detected vibration values with a threshold value "e". If the vibration values of the water tank unit 49 which have been detected in the step S13 are equal to or larger than the threshold value "e" (in the case of NO), the control shifts to the aforementioned step S19.

[0066] If the vibration values of the water tank unit 49 which have been detected in the step S13 are smaller than the threshold value "e" (in the case of YES), the control shifts to a step S14. In the step S14, the rotary drum 43 is kept rotating counterclockwise, and the rotation speed thereof is increased to 700 r/min. In a step S15, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 700 r/min, and the controller 82 compares these detected vibration values with a threshold value "f". If the vibration values of the water tank unit 49 which have been detected in the step S15 are equal to or larger than the threshold value "f" (in the case of NO), the controller 82 determines that it is dangerous to further increase the rotation speed of the rotary drum 43 and, thus, maintains the rotation speed of the rotary drum 43 at 700 r/min. Thereafter, the control shifts to a step S18.

[0067] If the vibration values of the water tank unit 49 which have been detected in the step S15 are smaller than the threshold value "f" (in the case of YES), the control shifts to a step S16. In the step S16, the controller 82 determines a maximum rotation speed which can be reached, from the vibration values of the water tank unit 49 which have been detected in the step S15. In the step S17, the rotation speed of the rotary drum 43 is increased to the maximum rotation speed determined in the step S16.

[0068] In the step S18, the rotary drum 43 is rotated counterclockwise at the aforementioned rotation speed (700 r/min or the maximum rotation speed), for a predetermined time period. After the elapse of the predetermined time period, the rotation of the rotary drum 43 is stopped, and the spin-drying process is completed.

[0069] Next, there will be described the flow of the control from a step S21 illustrated in Fig. 4B.

[0070] As described above, if the number of times the rotation of the rotary drum 43 has been stopped has reached 20 in the step S20 (in the case of NO), the control shifts to the step S21. In the step S21, the motor 45 is driven to rotate the rotary drum 43 at a predetermined rotation speed (e.g., about 50 r/min), while reversing the direction of rotations thereof. Thus, the clothes having been entangled with one another during washing processes and rinsing processes within the rotary drum 43 are disentangled (a disentangling process).

[0071] Thereafter, in a step S22, the rotary drum 43 is rotated clockwise (rotated in the reverse direction) in the opposite direction from the direction of normal counterclockwise rotations (the direction of rotations for standard spin-drying), and the rotation speed thereof is increased.

[0072] In this case, in the step S22, the rotary drum 43 is rotated clockwise in the opposite direction from the direction of normal counterclockwise rotations, for the following reasons. In the step S20, the number of times the rotation of the rotary drum 43 has been stopped has reached 20, frequently, in cases of performing spin-drying processes on smaller amounts of clothes, which tend to be brought into imbalance states within the rotary drum 43. When the rotary drum 43 is being rotated counterclockwise, the clothes are liable to move, at a dash, from lower left portions toward upper right portions when viewed at the front surface (see Fig. 2). Accordingly, the water tank unit 49 is liable to vibrate in ellipses having longitudinal directions coincident with directions from lower left portions to upper right portion when viewed at the front surface. This reduces the attenuation force of the anti-vibration damper 91 which exerts on the water tank unit 49, which obstructs the suppression of vibrations in the water tank unit 49. On the contrary, when the rotary drum 43 is being rotated clockwise, the clothes are liable to move, at a dash, from lower right portions toward upper left portions when viewed at the front surface. Accordingly, the water tank unit 49 is liable to vibrate in ellipses having longitudinal directions coincident with direction from lower right portions to upper left portion when viewed at the front surface. This increases the attenuation force of the anti-vibration damper 91 which exerts on the water tank unit 49, which facilitates the suppression of vibrations in the water tank unit 49. Accordingly, in the step S22, the rotary drum 43 is changed, in direction of rotations, to be rotated clockwise in the opposite direction from the direction of normal counterclockwise rotations.

[0073] In a step S23, the vibration detector 78 detects vibration values of the water tank unit 49 (in three directions, which are the forward and rearward direction, the right and left direction, and the upward and downward direction) when the rotation speed of the rotary drum 43

is 85 to 90 r/min, and the controller 82 compares these detected vibration values with a threshold value "a". If the vibration values of the water tank unit 49 which have been detected in the step S23 are equal to or larger than the threshold value "a" (in the case of NO), the control shifts to a step S34.

[0074] In the step S34, the rotation of the rotary drum 43 is stopped. Subsequently, in a step S35, the controller 82 determines whether or not the number of times the rotation of the rotary drum 43 has been stopped (the cumulative number of times it has been stopped since the start of the spin-drying process) is less than 30. If the number of times the rotation of the rotary drum 43 has been stopped is less than 30 in the step S35 (in the case of YES), the control returns to the step S21, in order to disentangle the clothes having been entangled with one another. If the number of times the rotation of the rotary drum 43 has been stopped has reached 30 (in the case of NO), the controller 82 determines that it is hard to disentangle the clothes having been entangled with each other, and the control shifts to a step S36. In the step S36, the controller 82 interrupts the spin-drying process, further causes the display portion 96 to display the fact that an abnormality has occurred and, further, causes the notification portion 87 to generate a notification thereof.

[0075] On the other hand, if the vibration values of the water tank unit 49 which have been detected in the step S23 are smaller than the threshold value "a" (in the case of YES), the control shifts to a step S24. In the step S24, the rotary drum 43 is kept rotating clockwise, and the rotation speed thereof is increased. In a step S25, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 90 to 200 r/min, and the controller 82 compares these detected vibration values with a threshold value "b". If the vibration values of the water tank unit 49 which have been detected in the step S25 are equal to or larger than the threshold value "b" (in the case of NO), the control shifts to the aforementioned step S34.

[0076] If the vibration values of the water tank unit 49 which have been detected in the step S25 are smaller than the threshold value "b" (in the case of YES), the control shifts to a step S26. In the step S26, the rotary drum 43 is kept rotating clockwise, and the rotation speed thereof is increased. In a step S27, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 200 to 300 r/min, and the controller 82 compares these detected vibration values with a threshold value "c". If the vibration values of the water tank unit 49 which have been detected in the step S27 are equal to or larger than the threshold value "c" (in the case of NO), the control shifts to the aforementioned step S34.

[0077] If the vibration values of the water tank unit 49 which have been detected in the step S27 are smaller than the threshold value "c" (in the case of YES), the control shifts to a step S28. In the step S28, the rotary drum 43 is kept rotating clockwise, and the rotation speed thereof is increased. In a step S29, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 300 to 320 r/min, and the controller 82 compares these detected vibration values with a threshold value "d". If the vibration values of the water tank unit 49 which have been detected in the step S29 are equal to or larger than the threshold value "d" (in the case of NO), the control shifts to the aforementioned step S34.

[0078] If the vibration values of the water tank unit 49 which have been detected in the step S29 are smaller than the threshold value "d" (in the case of YES), the control shifts to a step S30. In the step S30, the rotary drum 43 is kept rotating clockwise, and the rotation speed thereof is increased to 400 r/min. Thereafter, in a step 31, the rotation speed of the rotary drum 43 is further increased. In a step S32, the vibration detector 78 detects vibration values of the water tank unit 49 when the rotation speed of the rotary drum 43 is 410 to 420 r/min, and the controller 82 compares these detected vibration values with a threshold value "e". If the vibration values of the water tank unit 49 which have been detected in the step S32 are equal to or larger than the threshold value "e" (in the case of NO), the control shifts to the aforementioned step S34.

[0079] If the vibration values of the water tank unit 49 which have been detected in the step S32 are smaller than the threshold value "e" (in the case of YES), the control shifts to a step S33. In the step S33, the controller 82 determines that the entanglement of the clothes has been resolved and, thus, stops the rotation of the rotary drum 43. Thereafter, the control shifts to the aforementioned step S14, further executes the operations in the steps S15 to S18 and completes the spin-drying process.

[0080] Further, in the step S14, the rotary drum 43 is returned, in terms of the direction of rotations thereof, from clockwise rotations to counterclockwise rotations, because the drainage port 95 at a lower portion of the water tank 42 is provided in the right side with respect to the longitudinal center of the water tank 42 when viewed at the front surface. Namely, this is because, in this structure, water separated from the clothes is inhibited from being discharged through the drainage port 95, when the rotation speed has been increased while the rotary drum 43 has been kept rotating clockwise.

[0081] As described above, the drum-type washing machine according to the present embodiment is adapted such that it restarts spin-drying operations of a predetermined number of times and, if the number of these restarts exceeds a predetermined number, it restarts spin-drying operations by rotating the rotary drum 43 in the reverse direction. This can prevent spin-drying processes from being interrupted halfway therethrough, since spin-drying operations are disabled due to imbalance abnormalities, particularly, in cases of performing spin-drying on smaller amounts of clothes. This enables performing spin-drying processes to the end. Namely, with the

drum-type washing machine according to the present embodiment, it is possible to suppress the occurrence of imbalance abnormalities and, thus, it is possible to suppress the running from being stopped before the completion of spin-drying processes.

[0082] Further, the present invention is not limited to the aforementioned embodiment and can be implemented in other various aspects. For example, while the threshold value of the number of times the rotation of the rotary drum 43 has been stopped is 20 in the aforementioned step S20, the present invention is not limited thereto. For example, the threshold value of the number of times the rotation of the rotary drum 43 has been stopped can be set to be either less than 20 (for example, 1) or larger than 20.

[0083] Further, while, in the aforementioned description, the anti-vibration damper 91 is provided in the right side with respect to the rotational center as illustrated in Fig. 2, the anti-vibration damper 91 can be provided in the left side with respect to the rotational center. In this case, the direction of rotations of the rotary drum 43 can be set such that it is rotated clockwise (rotated in the forward direction) in the aforementioned steps S3 to S18, while the direction of rotations of the rotary drum 43 can be set such that it is rotated counterclockwise (rotated in the reverse direction) in the aforementioned steps S22 to S31, which can also obtain the same effects.

[0084] Further, while, in the aforementioned description, the vibration detector 78 is adapted to detect vibrations in the water tank unit 49, the vibration detector 78 can be also adapted to detect vibrations in the water tank 42, since vibrations in the water tank unit 49 are substantially the same as vibrations in the water tank 42. In this case, similarly, it is possible to obtain the same effects.

[0085] Further, while, in the aforementioned description, the rotary drum 43 is provided such that the axis of rotation 44 extends in the horizontal direction (see Fig. 1), the present invention is not limited thereto. For example, the rotary drum 43 may be provided such that the axis of rotation is inclined downwardly from the front-surface side toward the rear-surface side. In this case, similarly, it is possible to provide the same effects.

[0086] Although the present invention has been fully described in connection with the preferred embodiment thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

[0087] The entire disclosure of Japanese Patent Application No. 2011-036741 filed on February 23, 2011, including specification, drawings, and claims is incorporated herein by reference in the entirety.

INDUSTRIAL APPLICABILITY

[0088] As described above, the drum-type washing machine according to the present invention is capable of suppressing the occurrence of imbalance abnormalities, thereby suppressing the running from being stopped before the completion of spin-drying processes. Accordingly, the drum-type washing machine according to the present invention can be also applied to applications of other washing machines having spin-drying functions, and the like.

Claims

1. A drum-type washing machine comprising:

a rotary drum (43) having an axis of rotation which is horizontal or inclined downwardly from a front-surface side toward a rear-surface side;
a water tank (42) containing the rotary drum (43);
a motor (45) rotating the rotary drum (43);
a vibration detector (78) provided in the water tank (42); and
a controller (81) controlling the motor (45) to perform laundering processes including a spin-drying process;
characterised by
a washing machine housing (41) elastically supporting the water tank (42) at lower side, through an anti-vibration damper (91) and two support dampers (51);
wherein the anti-vibration damper (91) is provided in a right side with respect to the axis of rotation in the rotary drum (43) when viewed at the front surface, and the forward direction corresponds to counterclockwise rotations;
or
wherein the anti-vibration damper (91) is provided in a left side with respect to the axis of rotation in the rotary drum (43) when viewed at the front surface, and the forward direction corresponds to clockwise rotations.

2. The drum-type washing machine according to claim 1, wherein
a compression force received by the anti-vibration damper (91) from the rotary drum (43) being rotated in the forward direction is larger than those received by the two support dampers (51) from the rotary drum (43) being rotated in the forward direction.

3. The drum-type washing machine according to claim 1 or 2, wherein,
in the spin-drying process, after stopping the rotation of the rotary drum (43) since a vibration value of the water tank (42) which has been detected by the vibration detector (78) has exceeded a predetermined threshold value, the controller (81) controls the motor (45) to restart, a predetermined number of times, a spin-drying operation in a forward direction for rotat-

ing the rotary drum (43) in the forward direction again, and, thereafter, when a vibration value of the water tank (42) which has been detected by the vibration detector (78) exceeds a predetermined threshold value, the controller (81) controls the motor (45) to stop the rotation of the rotary drum (43) and, then, to restart a spin-drying operation in a reverse direction for rotating the rotary drum (43) in the reverse direction.

4. The drum-type washing machine according to any one of claims 1 to 3, wherein
the anti-vibration damper is provided in a right side with respect to the axis of rotation in the rotary drum when viewed at the front surface, and the forward direction corresponds to counterclockwise rotations.

5. The drum-type washing machine according to any one of claims 1 to 3, wherein
the anti-vibration damper is provided in a left side with respect to the axis of rotation in the rotary drum when viewed at the front surface, and the forward direction corresponds to clockwise rotations.

Patentansprüche

1. Trommelwaschmaschine mit:

einer Drehtrommel (43) mit einer Drehachse, welche horizontal verläuft oder von einer Vorderoberflächenseite zu einer Rückoberflächenseite nach unten geneigt ist;
einem Wassertank (42), welcher die Drehtrommel (43) enthält;
einem Motor (45), welcher die Drehtrommel (43) dreht;
einem Vibrationsdetektor (78), welcher in dem Wassertank (42) vorgesehen ist; und
einer Steuerung (81), welche den Motor (45) steuert, um Waschprozesse einschließlich eines Trockenschleuderprozesses durchzuführen;
gekennzeichnet durch
ein Waschmaschinengehäuse (41), welches den Wassertank (42) bei einer unteren Seite **durch** einen Anti-Vibrations-Dämpfer (91) und zwei Trage-Dämpfer (51) stützt;
wobei der Anti-Vibrations-Dämpfer (91) auf einer rechten Seite in Bezug auf die Drehachse der Drehtrommel (43) vorgesehen ist, wenn von der Vorderseite betrachtet, und die Vorwärts-Richtung entspricht Drehungen gegen den Uhrzeigersinn; oder
wobei der Anti-Vibrations-Dämpfer (91) auf einer linken Seite in Bezug auf die Drehachse der Drehtrommel (43) vorgesehen ist, wenn von der Vorderseite betrachtet, und die Vorwärtsrichtung entspricht Drehungen im Uhrzeigersinn.

2. Trommelwaschmaschine nach Anspruch 1, wobei eine Kompressionskraft, welche durch den Anti-Vibrations-Dämpfer (91) von der Drehtrommel (43), welche sich in der Vorwärtsrichtung dreht, aufgenommen wird, größer ist, als diejenige, welche von den zwei Trage-Dämpfern (51) von der Drehtrommel (43) aufgenommen wird, welche sich in die Vorwärtsrichtung dreht.

3. Trommelwaschmaschine nach Anspruch 1 oder 2, wobei
in dem Trockenschleuder-Prozess, nachdem die Drehung der Drehtrommel (43) gestoppt wurde, weil ein Vibrationswert des Wassertanks (42), welcher durch den Vibrationsdetektor (78) detektiert wurde, einen vorgegebenen Grenzwert überschritten hat, steuert die Steuerung (81) den Motor (45) so, dass er wieder startet, eine vorgegebene Anzahl, einer Trockenschleuder-Operation in einer Vorwärtsrichtung zum Drehen der Drehtrommel (43) wieder in der Vorwärtsrichtung, und danach, wenn ein Vibrationswert des Wassertanks (42), welcher durch den Vibrationsdetektor (78) detektiert wurde, einen vorgegebenen Grenzwert überschreitet, steuert die Steuerung (81) den Motor (45), um die Drehung der Drehtrommel (43) zu stoppen und danach eine Trockenschleuder-Operation in einer Gegenrichtung zum Drehen der Drehtrommel (43) in die Gegenrichtung neu zu starten.

Revendications

1. Lave-linge à tambour comprenant :

un tambour rotatif (43) ayant un axe de rotation horizontal ou incliné vers le bas s'étendant d'une face avant vers une face arrière ;
une cuve à eau (42) contenant le tambour rotatif (43) ;
un moteur (45) faisant tourner le tambour rotatif (43) ;
un détecteur de vibrations (78) prévu dans la cuve à eau (42) ; et
un contrôleur (81) contrôlant le moteur (45) pour exécuter des processus de lavage comportant un processus d'essorage ;
caratérisé par
un boîtier de lave-linge (41) soutenant la cuve à eau (42) de manière élastique sur un côté inférieur, via un amortisseur anti-vibrations (91) et deux amortisseurs de soutien (51) ;
où, dans une vue de face, l'amortisseur anti-vibrations (91) est prévu sur un côté droit par rapport à l'axe de rotation du tambour rotatif (43), et la marche avant correspond à une rotation

contre le sens des aiguilles d'une montre ;
ou bien
où, dans une vue de face, l'amortisseur anti-vibrations (91) est prévu sur un côté gauche par rapport à l'axe de rotation du tambour rotatif (43), et la marche avant correspond à une rotation dans le sens des aiguilles d'une montre.

2. Lave-linge à tambour selon la revendication 1, où
une force de compression reçue par l'amortisseur anti-vibrations (91) en provenance du tambour rotatif (43) mis en rotation dans le sens de la marche avant est plus grande que celles reçues par les deux amortisseurs de support (51) en provenance du tambour rotatif (43) mis en rotation dans le sens de la marche avant.

3. Lave-linge à tambour selon la revendication 1 ou 2, où
lors du processus d'essorage, après l'arrêt de la rotation du tambour rotatif, étant donné qu'une valeur de vibration de la cuve à eau (42) détectée par le détecteur de vibrations (78) a dépassé une valeur seuil prédéterminée, le contrôleur (81) contrôle le moteur (45) de manière à ce qu'il recommence pour un nombre de fois prédéterminé une opération d'essorage en marche avant pour refaire tourner le tambour rotatif (43) en marche avant, et, ensuite, lorsqu'une valeur de vibration de la cuve à eau (42) détectée par le détecteur de vibrations (78) dépasse une valeur de seuil prédéterminée, le contrôleur (81) contrôle le moteur (45) de manière à ce qu'il arrête la rotation du tambour rotatif (43) et de manière à ce qu'il redémarre ensuite une opération d'essorage en marche arrière dans laquelle il fait tourner le tambour rotatif (43) en marche arrière.

Fig.1

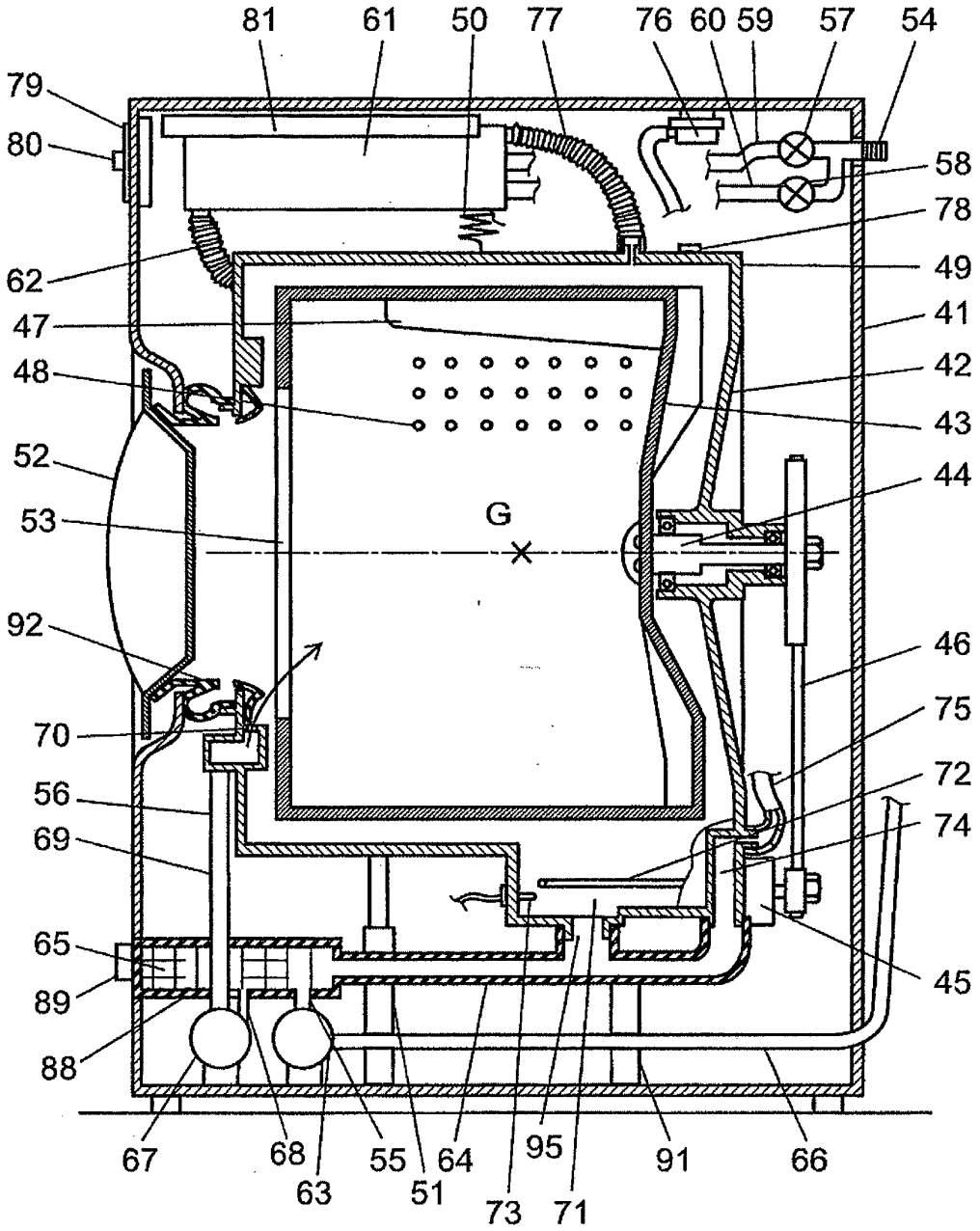

81
61
50
77
76
60
59
57
54
79
80
58
78
62
49
47
41
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43
52
44
53
G
92
46
70
75
56
72
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74
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45
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67
68
63
55
51
64
73
95
71
91
66

Fig.2

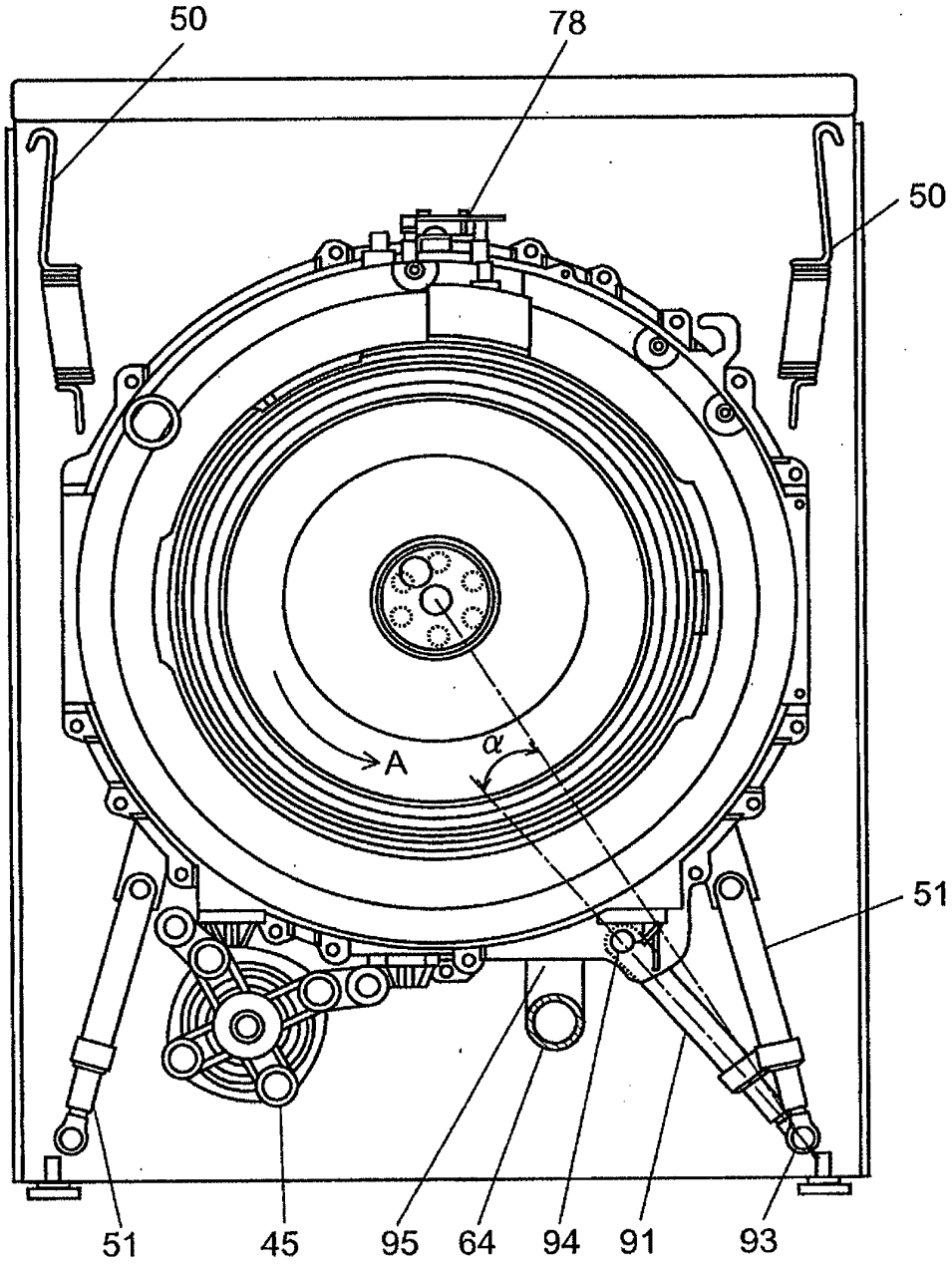


Fig.3

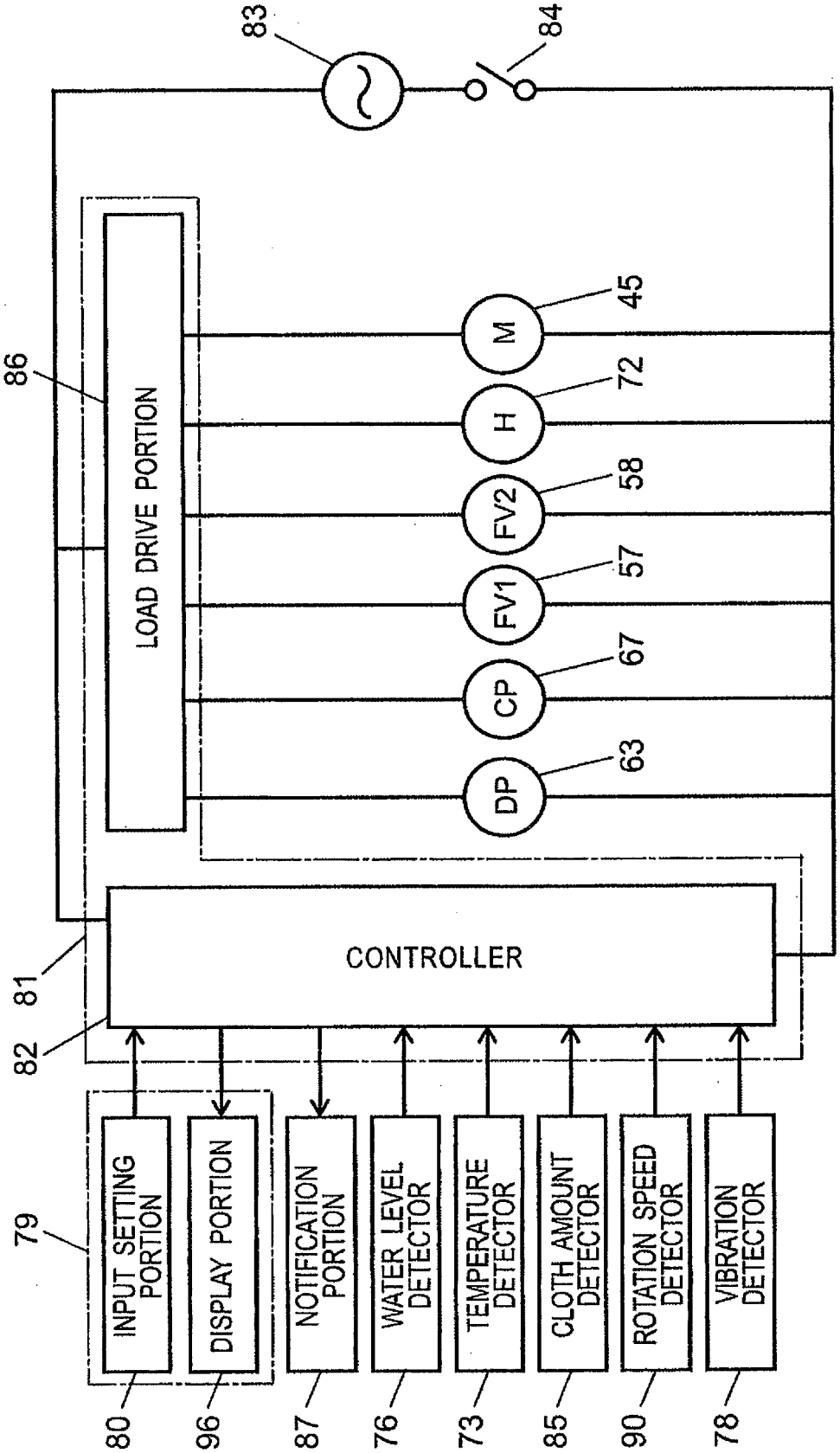

83
84
86
LOAD DRIVE PORTION
M
45
H
72
FV2
58
FV1
57
CP
67
DP
63
CONTROLLER
81
82
79
INPUT SETTING PORTION
DISPLAY PORTION
NOTIFICATION PORTION
WATER LEVEL DETECTOR
TEMPERATURE DETECTOR
CLOTH AMOUNT DETECTOR
ROTATION SPEED DETECTOR
VIBRATION DETECTOR
80
96
87
76
73
85
90
78

Fig.4A

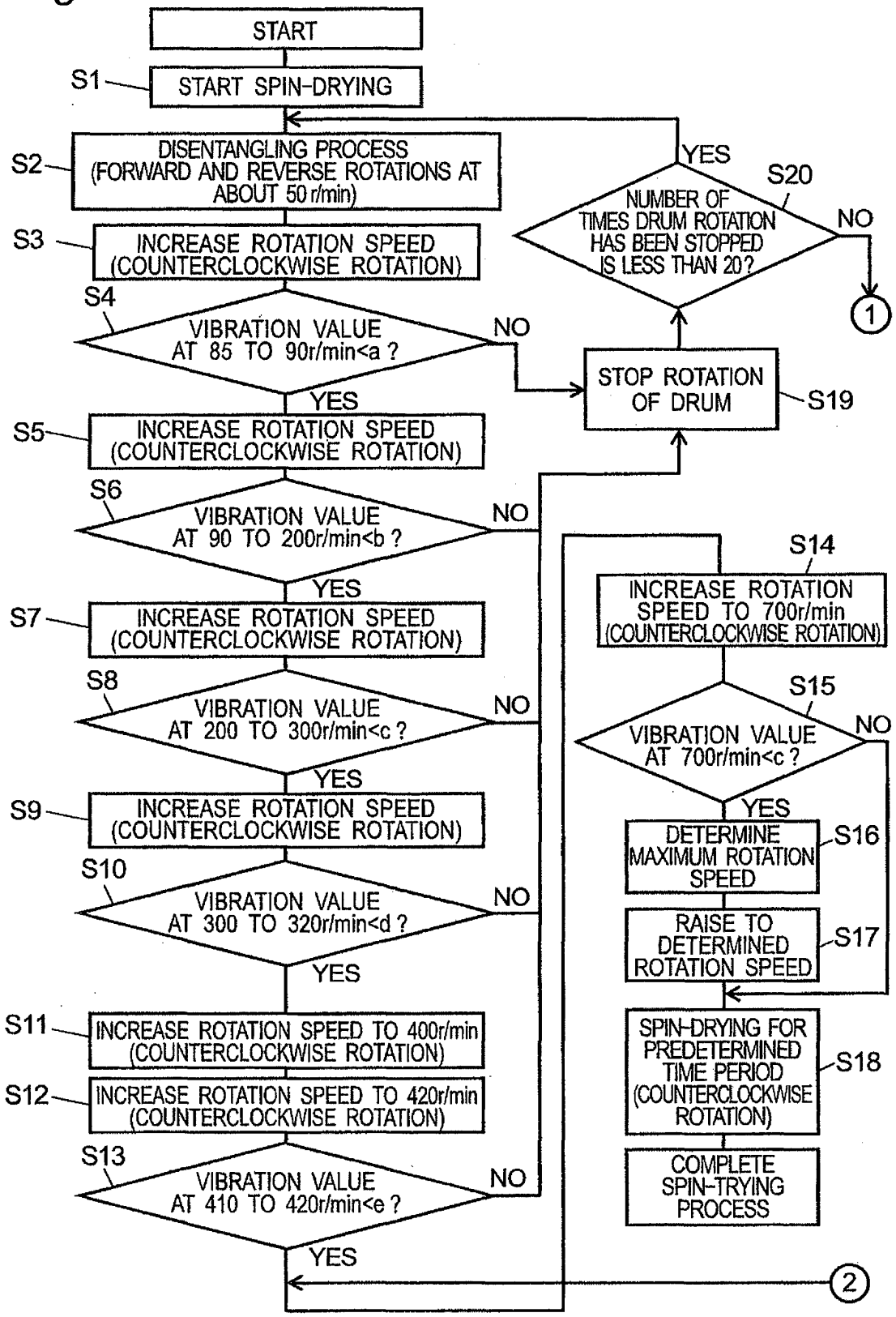

START
S1
START SPIN-DRYING
S2
DISENTANGLING PROCESS (FORWARD AND REVERSE ROTATIONS AT ABOUT 50 r/min)
S3
INCREASE ROTATION SPEED (COUNTERCLOCKWISE ROTATION)
S4
VIBRATION VALUE AT 85 TO 90r/min<a ?
NO
YES
S5
INCREASE ROTATION SPEED (COUNTERCLOCKWISE ROTATION)
S6
VIBRATION VALUE AT 90 TO 200r/min<b ?
NO
YES
S7
INCREASE ROTATION SPEED (COUNTERCLOCKWISE ROTATION)
S8
VIBRATION VALUE AT 200 TO 300r/min<c ?
NO
YES
S9
INCREASE ROTATION SPEED (COUNTERCLOCKWISE ROTATION)
S10
VIBRATION VALUE AT 300 TO 320r/min<d ?
NO
YES
S11
INCREASE ROTATION SPEED TO 400r/min (COUNTERCLOCKWISE ROTATION)
S12
INCREASE ROTATION SPEED TO 420r/min (COUNTERCLOCKWISE ROTATION)
S13
VIBRATION VALUE AT 410 TO 420r/min<e ?
NO
YES
S14
INCREASE ROTATION SPEED TO 700r/min (COUNTERCLOCKWISE ROTATION)
S15
VIBRATION VALUE AT 700r/min<c ?
NO
YES
S16
DETERMINE MAXIMUM ROTATION SPEED
S17
RAISE TO DETERMINED ROTATION SPEED
S18
SPIN-DRYING FOR PREDETERMINED TIME PERIOD (COUNTERCLOCKWISE ROTATION)
COMPLETE SPIN-TRYING PROCESS
S19
STOP ROTATION OF DRUM
S20
NUMBER OF TIMES DRUM ROTATION HAS BEEN STOPPED IS LESS THAN 20?
YES
NO
1
2

Fig.4B

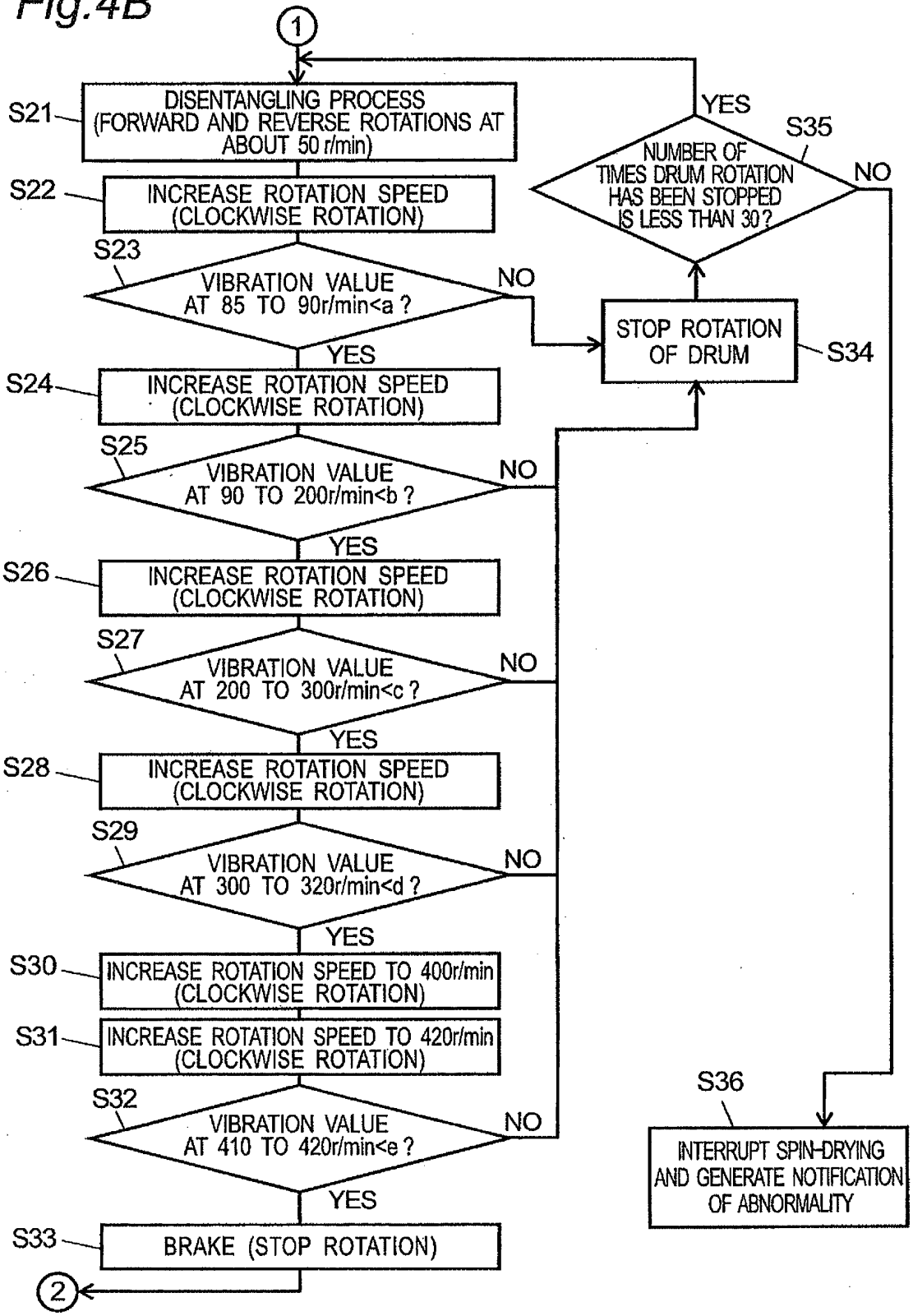
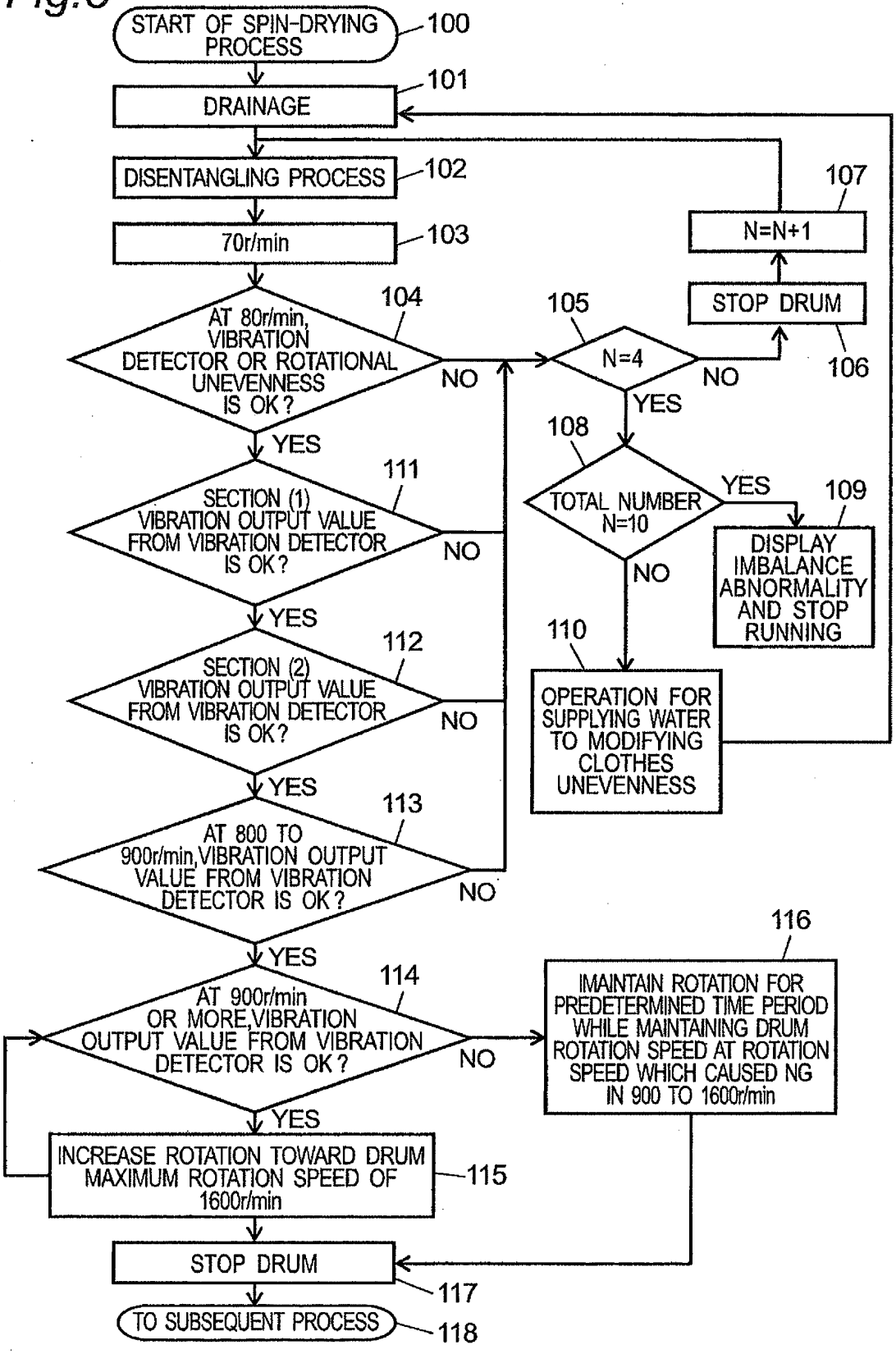

1
S21
DISENTANGLING PROCESS (FORWARD AND REVERSE ROTATIONS AT ABOUT 50 r/min)
S22
INCREASE ROTATION SPEED (CLOCKWISE ROTATION)
S23
VIBRATION VALUE AT 85 TO 90r/min<a ?
NO
YES
S24
INCREASE ROTATION SPEED (CLOCKWISE ROTATION)
S25
VIBRATION VALUE AT 90 TO 200r/min<b ?
NO
YES
S26
INCREASE ROTATION SPEED (CLOCKWISE ROTATION)
S27
VIBRATION VALUE AT 200 TO 300r/min<c ?
NO
YES
S28
INCREASE ROTATION SPEED (CLOCKWISE ROTATION)
S29
VIBRATION VALUE AT 300 TO 320r/min<d ?
NO
YES
S30
INCREASE ROTATION SPEED TO 400r/min (CLOCKWISE ROTATION)
S31
INCREASE ROTATION SPEED TO 420r/min (CLOCKWISE ROTATION)
S32
VIBRATION VALUE AT 410 TO 420r/min<e ?
NO
YES
S33
BRAKE (STOP ROTATION)
2
STOP ROTATION OF DRUM
S34
S35
NUMBER OF TIMES DRUM ROTATION HAS BEEN STOPPED IS LESS THAN 30 ?
YES
NO
S36
INTERRUPT SPIN-DRYING AND GENERATE NOTIFICATION OF ABNORMALITY

Fig.5


START OF SPIN-DRYING PROCESS
100
DRAINAGE
101
DISENTANGLING PROCESS
102
70r/min
103
AT 80r/min, VIBRATION DETECTOR OR ROTATIONAL UNEVENNESS IS OK?
104
NO
YES
N=4
105
NO
YES
STOP DRUM
106
N=N+1
107
TOTAL NUMBER N=10
108
YES
NO
DISPLAY IMBALANCE ABNORMALITY AND STOP RUNNING
109
OPERATION FOR SUPPLYING WATER TO MODIFYING CLOTHES UNEVENNESS
110
SECTION (1) VIBRATION OUTPUT VALUE FROM VIBRATION DETECTOR IS OK?
111
NO
YES
SECTION (2) VIBRATION OUTPUT VALUE FROM VIBRATION DETECTOR IS OK?
112
NO
YES
AT 800 TO 900r/min, VIBRATION OUTPUT VALUE FROM VIBRATION DETECTOR IS OK?
113
NO
YES
AT 900r/min OR MORE, VIBRATION OUTPUT VALUE FROM VIBRATION DETECTOR IS OK?
114
NO
YES
IMAINTAIN ROTATION FOR PREDETERMINED TIME PERIOD WHILE MAINTAINING DRUM ROTATION SPEED AT ROTATION SPEED WHICH CAUSED NG IN 900 TO 1600r/min
116
INCREASE ROTATION TOWARD DRUM MAXIMUM ROTATION SPEED OF 1600r/min
115
STOP DRUM
117
TO SUBSEQUENT PROCESS
118

REFERENCES CITED IN THE DESCRIPTION

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