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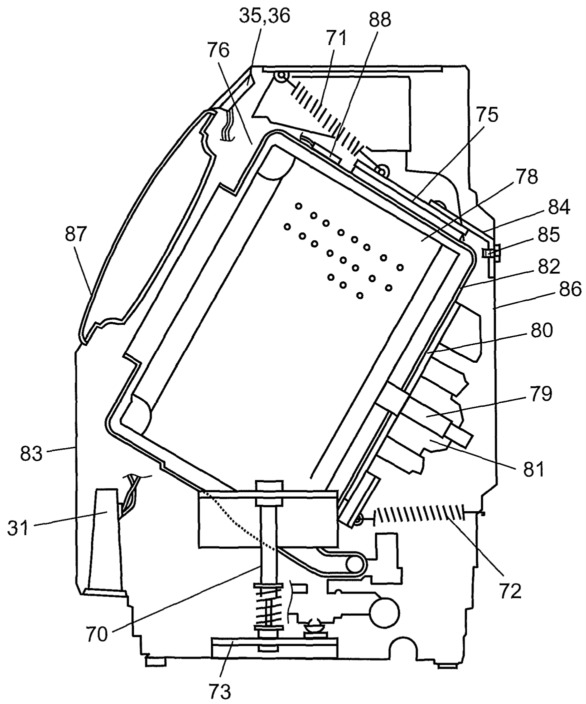
(54) **Washing machine**

(57) A controller of a washing machine first makes a motor generate a predetermined acceleration torque in the step of detecting quantity of laundry. Then, the controller increases the drum rotation to a predetermined rotating speed. The controller retains the rotation at this predetermined rotating speed for a predetermined time. While the rotation is retained, the controller compares a calculation result output from a displacement calculator with a preset reference value. If the calculation result is smaller than the reference value, the controller detects a state that the washing tub is anchored with respect to the casing.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to washing machines in which a drum holding laundry and a washing tub are oscillatably and resiliently supported by a casing.

BACKGROUND OF THE INVENTION

[0002] Fig. 6 illustrates the internal structure of a conventional washing machine. This washing machine has a vibration-proofing structure for preventing transmission of vibration associated with drum rotation to casing 1. More specifically, suspension 3 in casing 1 has the vibration-proofing structure so as to support washing tub 2 and absorb its vibration by suspending washing tub 2 from above. In addition, damper 4 supports washing tub 2 from beneath so as to damp vibrations.

[0003] Cylindrical drum 5 with a bottom is rotatably supported in washing tub 2. Motor 7 is provided on an external bottom of washing tub 2, and rotation of motor 7 is transmitted to drum 5 through motor pulley 8, belt 9, driving pulley 6, and so on. A series of steps including washing, rinsing, and spin-drying (dehydrating) are executed by rotating drum 5.

[0004] Acceleration sensor 10 is fixed to washing tub 2. When washing tub 2 vibrates and acceleration is applied to acceleration sensor 10, an oscillator inside acceleration sensor 10 oscillates and converts this displacement to an electrical signal. This electrical signal is transmitted to a controller (not illustrated), and is used to control the vibration. Lead switch 14 is also mounted on washing tub 2. Lead switch 14 turns on and off by magnet 15 attached to driving pulley 6. These ON and OFF signals are transmitted to the controller, and are also used for typically controlling the rotation.

[0005] In this setup, the vibration-proofing structure oscillatably supports washing tub 2 and absorbs unbalanced vibrations caused by laundry in drum 5 becoming unevenly distributed during the spin-drying step. Transmission of vibration to casing 1 is thus preventable. However, if the laundry becomes more than usually piled on one side, washing tub 2 may generate abnormal vibration.

[0006] If washing tub 2 vibrates abnormally, significant noise will be generated from the washing machine, or the washing machine may be damaged. To solve this problem, the controller reduces the rotating speed of drum 5 or stops the spin-drying operation and supplies more water to rebalance the laundry, in response to vibration of washing tub 2 detected by acceleration sensor 10.

[0007] On the other hand, washing tub 2 may be excessively shaken when transporting or delivering the washing machine because washing tub 2 is oscillatably supported inside casing 1. In this case, washing tub 2 or components attached to washing tub 2 may collide with the inner wall of casing 1 or other components attached inside casing 1, causing damage.

[0008] To remove this risk during transportation, transport fixture 16 is attached between casing 1 and washing tub 2 by fixing bolt 17 before transportation. Washing tub 2 is therefore anchored to avoid movement during transportation. On installing the washing machine, fixing bolt 17 and transport fixture 16 are removed to release washing tub 2.

[0009] However, with this structure, removal of transport fixture 16 after transporting the washing machine may be forgotten, and washing and spin-drying may be carried out with it still in place. In this case, the vibration-proofing effect of suspension 3 and damper 4, intended to reduce vibration while drum 5 rotates, does not function. Moreover, abnormal sound or abnormal vibration may be generated from casing 1. This may lead to damage of the components. In addition, this type of abnormality often occurs during the spin-drying. Since the washing machine is generally used under automated operation, the user is normally away from the washing machine at the time of spin-drying. Therefore, it is difficult to readily notify the user of abnormality.

SUMMARY OF THE INVENTION

[0010] The present invention offers a washing machine that prevents failure due to abnormal vibration during washing and spin-dry by detecting whether or not a washing tub is anchored with respect to a casing early on in the washing step.

[0011] The washing machine of the present invention includes a casing, a washing tub, a drum, an acceleration sensor, an acceleration detector, a displacement calculator, a motor, a rotating speed detector, and a controller. The washing tub is oscillatably and resiliently supported inside the casing. The cylindrical drum with a bottom has an axis of rotation, and is disposed inside the washing tub to hold laundry. The acceleration sensor attached to the washing tub can detect acceleration of vibration of the washing tub. The acceleration detector detects an acceleration output from the acceleration sensor. The displacement calculator calculates the acceleration output of the washing tub output from the acceleration detector to output a displacement. The motor rotates (drives) the drum. The rotating speed detector detects a rotation speed of the motor. The controller controls the rotation of the motor based on the detected output from the rotating speed detector, and controls a washing step and a step of detecting the quantity of laundry before the washing step. The controller also detects a state that the washing tub is anchored with respect to the casing. More specifically, the controller makes the motor generate a predetermined acceleration torque during a step of detecting the laundry quantity. The drum rotation is then increased to a predetermined rotating speed. Rotation at this predetermined rotating speed is retained for a predetermined time. While the rotation continues, a calculation result output from the displacement calculator is compared with a preset reference value. If the calculation result is smaller than the reference value, a state that the washing tub is anchored with respect to the casing is detected.

[0012] This prevents failure due to abnormal vibration during washing and spin-drying even if the installation contractor forgets to remove the transport fixture in the washing machine, leaving the washing tub anchored to the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a sectional view of a structure of a drum-type washing machine during transportation in an exemplary embodiment of the present invention.

Fig. 2 is a block diagram of a control circuit in the drum-type washing machine shown in Fig. 1.

Figs. 3 and 4 illustrate the operation for detecting laundry quantity in the drum-type washing machine shown in Fig. 1.

Fig. 5 is a flow chart illustrating how to detect a transport fixture in the drum-type washing machine shown in Fig. 1.

Fig. 6 illustrates the internal structure of a conventional washing machine.

DETAILED DESCRIPTION OF THE INVENTION

[0014] An exemplary embodiment of the present invention is described below with reference to drawings. It is apparent, however, the present invention is not limited to the exemplary embodiment.

[0015] Fig. 1 is a sectional view illustrating a structure of a drum-type washing machine during transportation in the exemplary embodiment of the present invention. Fig. 2 is a block diagram of a control circuit of the drum-type washing machine. This washing machine includes casing 83, washing tub 82, drum 78, acceleration sensor 88, acceleration detector 39, displacement calculator 40, motor 81, rotating speed detector 33, and controller 31. Washing tub 82 is oscillatably and resiliently supported inside casing 83. Cylindrical drum 78 with a bottom has rotation axis 79 that extends horizontally or obliquely, and is disposed inside washing tub 82 so as to hold laundry.

[0016] Acceleration sensor 88 is fixed to washing tub 82, and detects a vibration component in multiple directions. In other words, acceleration sensor 88 can detect acceleration of vibration of washing tub 82. Acceleration detector 39 detects an acceleration output from acceleration sensor 88. Displacement calculator 40 calculates the acceleration output in a front-back direction or top-bottom direction of washing tub 82, and outputs a displacement in the front-back direction or top-bottom direction.

[0017] Motor 81 rotates drum 78. Rotating speed detector 33 detects the speed of rotation (number of revolutions per unit time) of motor 81. Controller 31 controls the rotation of motor 81 based on a detection output of rotating speed detector 33. In other words, controller 31 controls a washing step, a rinsing step, a spin-drying step, and a step of detecting laundry quantity (fabric quantity) before the washing step. Controller 31 also detects whether or not washing tub 82 is anchored with respect to casing 83. In Fig. 2, controller 31 includes acceleration detector 39, displacement calculator 40, and rotating speed detector 33. However, they may be provided separately.

[0018] Next, the washing machine is detailed with reference to a specific example. In Fig. 1, washing tub unit 76 includes washing tub 82, drum 78, bearing 80, and motor 81. Drum 78 is rotatably housed inside washing tub 82. Rotation axis 79 of drum 78 is supported by bearing 80 provided on a rear face of washing tub 82. Rotation axis 79 is connected to motor 81 for driving drum 78.

[0019] Washing tub unit 76 is disposed inside casing 83 with its axis center tilted. Vibration-proofing damper 70 attached to bottom 73 of casing 83 supports the weight of washing tub unit 76. First vibration-proofing spring 71 is provided between upper support clasp 75, which is fixed to a top part of washing tub 82, and the top face of casing 83. Second vibration-proofing spring 72 is provided between a bottom part of washing tub 82 and rear face 86 of casing 83. Vibration-proofing damper 70, first vibration-proofing spring 71, and second vibration-proofing spring 72 oscillatably and resiliently support washing tub 82 and absorb its vibration. Cover 87 is openably disposed on a left tilted face of casing 83. The user opens this cover 87 to load laundry into drum 78.

[0020] Input setting part 35 and display panel 36 are provided above cover 87. Acceleration sensor 88 is fixed to an upper outer wall of washing tub 82. Controller 31 configured typically with a microcomputer establishes signal transmission with input setting part 35, display panel 36, and acceleration sensor 88; and also controls the rotation of motor 81. Input setting part 35 receives operation input by the user, and sends an input signal to controller 31. Display panel 36 displays a content of input from input setting part 35 and a detection result of controller 31.

[0021] Acceleration sensor 88 is typically configured with a semiconductor acceleration sensor. Acceleration sensor 88 is preferably configured with a sensor for multiple axes (two or three axes) typically in front-back, left-right, and top-bottom directions, instead of that for acceleration in a single direction. Vibration of washing tub unit 76 is not always limited to one direction. Therefore, movement of washing tub 82 is more accurately detectable by employing an acceleration sensor for multiple axes.

[0022] Transport fixture 84 for preventing shaking of washing tub unit 76 during transportation of the washing machine is attached to upper support clasp 75 and rear face 86 of casing 83 by fixing bolt 85. In other words, upper support clasp 75 provided on the outer wall of washing tub 82 is a portion for attaching transport fixture 84 in order to anchor washing tub 82 to casing 83. Transport fixture 84 is needed only during transportation, and is removed together with fixing bolt 85 when the washing machine is installed.

[0023] In Fig. 2, rectifier 21 rectifies AC electric power of commercial power 20. A smoothing circuit, configured with choke coil 22 and smoothing capacitor 23, smoothes rectified power and supplies DC electric power to inverter circuit 24. Inverter circuit 24 rotates motor 81 using this DC power as driving electric power.

[0024] Controller 31 controls the rotation of motor 81 based on an operating instruction input from input setting part 35 and information on operation status detected by a range of detectors, including rotating speed detector 33 and acceleration sensor 88. Controller 31 also controls the operation of feed valve 27, drain valve 28, air blower 12, and heater 29 by using load driver 26. In addition, controller 31 sends a signal to display panel 36 for displaying the operation status and control state so that the user becomes informed.

[0025] Motor 81 includes a stator having three-phase coils 7a, 7b, and 7c; a rotor (not illustrated) having dipole permanent magnet; and position detecting elements 30a, 30b, and 30c. In other words, motor 81 is, for example, configured with a DC brushless motor, and is rotated and controlled by PWM(Pulse Width Modulation)-controlled inverter circuit 24 configured with switching elements 24a to 24f. Accordingly, the rotating speed of motor 81 is variable.

[0026] Rotor position detection signals detected by position detecting elements 30a, 30b, and 30c are input to controller 31. Based on these rotor position detection signals, controller 31 controls ON and OFF states of switching elements 24a to 24f by PWM control, using driving circuit 32. Through this control, controller 31 controls a current flow to three-phase coils 7a, 7b, and 7c of the stator so as to rotate motor 81 at a predetermined rotating speed.

[0027] Detection outputs of position detecting elements 30a, 30b and 30c are input to rotating speed detector 33. Rotating speed detector 33 detects a time cycle of one of signals of position detecting elements 30a, 30b, and 30c corresponding to the change the one of signals, and calculates a rotating speed of motor 81 from this time cycle.

[0028] Corresponding to the quantity of laundry loaded to drum 78, a load applied to motor 81 via drum 78 changes. Accordingly, laundry-quantity detector 34 can detect the quantity of laundry (fabric quantity) loaded to drum 78 based on a detected rotating speed by supplying the detection output of rotating speed detector 33 to laundry-quantity detector 34. More specifically, laundry-quantity detector 34 detects the laundry quantity loaded to drum 78 by using power (load generated in motor 81 when the rotating speed increases) applied to motor 81, the detection output of rotating speed detector 33, and the time needed for changing rotating speed. Further details are described later.

[0029] Since the detection output from rotating speed detector 33 corresponds to the rotating speed of drum 78, the rotating speed of drum 78 in the following description refers to that obtained based on the detection output from rotating speed detector 33.

[0030] Acceleration sensor 88 fixed to washing tub 82 detects acceleration of washing tub 82 in multiple directions of top-bottom and front-back. Acceleration detector 39 detects a digital signal or an analog signal from acceleration sensor 88. For example, acceleration detector 39 samples acceleration at 160 Hz in a period of the laundry-quantity detection step. Displacement calculator 40 calculates this acceleration data, and figures out displacement in the top-bottom and front-back directions. Controller 31 detects presence of abnormal vibration based on displacement data of washing tub 82 calculated in this way, so as to detect whether or not transport fixture 84 is in place.

[0031] Next, how the laundry quantity is detected is described with reference to Figs. 3 and 4. Fig. 3 and 4 illustrate the operation for detecting laundry quantity in the drum-type washing machine in Fig. 1. A horizontal axis indicates an elapse of time, and a vertical axis indicates the rotating speed of drum 78.

[0032] When controller 31 gives an instruction for starting the laundry-quantity detection step before starting the washing operation, motor 81 starts to rotate. As shown in Figs. 3 and 4, controller 31 makes motor 81 generate acceleration torque T1 after a predetermined time passes or after reaching predetermined rotating speed N1. Then, the rotating speed is increased by ΔN1 in time t1 to reach predetermined rotating speed N2 (first detection step).

[0033] Predetermined rotating speed N1 is a low rotating speed immediately after motor 81 starts. Predetermined rotating speed N2 is a rotating speed not greater than a primary resonance frequency of washing tub unit 72, which is a vibrating system in Fig. 1. A reason for setting maximum rotating speed N2 of the drum to a rotating speed not greater than the primary resonance frequency of washing tub unit 76 is described later.

[0034] After the rotating speed reaches N2, controller 31 controls motor 81 to retain rotating speed N2 for ts seconds without reducing the rotating speed. Then, while the rotating speed is stably retained at N2, acceleration sensor 88 executes the step of detecting presence of transport fixture 84.

[0035] An inertia moment in the vibrating system, such as drum 78, changes corresponding to the quantity of laundry loaded in drum 78. This may cause variation in period of time until the rotating speed reaches N2, or unstable rotating speed. Controller 31 retains rotating speed at N2 for ts seconds so as to reduce such variations. Detection variations in acceleration detected by acceleration sensor 88 thus becomes small.

[0036] As shown in Fig. 3, the rotating speed can be ideally retained at N2 when the inertia moment of the vibrating system, such as drum 78, is small. On the other hand, if the inertia moment of the vibrating system, such as drum 78, is large, the rotating speed overshoots after reaching N2, and thus the rotating speed may become slightly higher than N2. This overshooting differs by the quantity and texture of laundry.

[0037] In other words, as shown in Fig. 4, the rotating speed overshoots for ΔNs after reaching rotating speed N2. In this case, controller 31 immediately corrects the rotating speed to N2 by the rotating speed correction control. Then, in the next ts seconds, acceleration sensor 88 executes the step of detecting presence of transport fixture 84. In practical products, a setting of 1 to 3 seconds for ts seconds is normally sufficient for ensuring correct detection, although it also depends on a capacity of each washing machine.

[0038] After completing the step of detecting presence of transport fixture 84, controller 31 reduces the rotating speed of drum 78. Then, decelerating torque T2 is generated by motor 81 in the inertia rotation so as to reduce the rotating speed for ΔN2 from predetermined rotating speed N3 in time t2 so that the rotating speed of motor 81 reaches predetermined N4 (second detection step). Here, since the rotating speed is accurately reduced from N2, time t2 for reducing the rotating speed can be accurately detected.

[0039] In laundry-quantity detection, t1 is calculated based on a load applied to motor 81 in increasing the rotating speed in the first detection step, and t2 is calculated based on reduction of the rotating speed in the second detection step. Laundry-quantity detector 34 calculates the quantity of loaded laundry based on a predetermined table using t1 and t2.

[0040] In general, after detecting the laundry quantity, a water level appropriate for the laundry quantity is set, water is supplied, and detergent is added to start the washing step. In the laundry-quantity detection step before starting this washing operation, controller 31 detects acceleration caused by shaking of washing tub 82 so as to detect presence of transport fixture 84.

[0041] Next, how the presence of transport fixture 84 is detected is described with reference to Fig. 5, which is a flow chart illustrating a transport fixture detection method for the drum-type washing machine shown in Fig. 1.

[0042] When a signal for starting the washing operation is input using input setting part 35 (S31), motor 81 starts (S32), and acceleration sensor 88 begins to detect acceleration (S33).

[0043] Acceleration sensor 88 outputs an acceleration signal in at least the top-bottom and front-back directions of washing tub unit 76, and acceleration detector 39 detects this output. After acceleration detector 39 starts sampling digital signals or analog signals from acceleration sensor 88 at 160 Hz, controller 31 starts the laundry-quantity detection step (S34). In other words, controller 31 drives motor 81 to increase the rotating speed of drum 78 from N1 by using predetermined torque T1 such that the rotating speed reaches predetermined rotating speed N2, which is faster by ΔN1 (S35).

[0044] When the rotating speed of drum 78 reaches N2, controller 31 immediately controls the operation to retain the rotating speed of drum 78 at N2 (S37). When the rotating speed of drum 78 becomes stable at N2, acceleration detector 39 measures the acceleration signal in the front-back direction (X-axis) and the top-bottom direction (Z-axis) (S38). The acceleration signal at rotating speed N2 is measured for ts seconds (S39).

[0045] Based on the acceleration signals in the X-axis direction and Z-axis direction obtained in S38, displacement calculator 40 calculates the acceleration signal in the X-axis direction and Z-axis direction, using four arithmetical operations, so as to figure out amount of displacement in the X-axis direction and Z-axis direction per rotation of drum 78 (S40).

[0046] Controller 31 compares the displacement of washing tub 82 in the X-axis direction with a preset reference value (S41). If the displacement in the X-axis direction is smaller than the reference value, controller 31 next compares displacement of washing tub 82 in the Z-axis direction with a preset reference value (S42). If the displacement in the Z-axis direction is also smaller than the reference value, controller 31 determines that washing tub 82 is anchored with respect to casing 83. In other words, controller 31 determines that the presence of transport fixture 84 is holding back vibration that should be generated under normal conditions (S43), and stops any further operations (S44). Controller 31 may also display the information that washing tub 82 is anchored with respect to casing 83 on display panel 36 (S45).

[0047] On the other hand, if the displacement is greater than the reference value in S41 and S42, controller 31 determines that washing tub 82 is movable in an oscillatable manner. In other words, controller 31 determines that there is no transport fixture 84 (S46), and proceeds to the next washing step (S47).

[0048] In this way, controller 31 makes motor 81 generate predetermined acceleration torque T1 early on in detecting the laundry quantity. This torque T1 increases the rotation of drum 78 to rotating speed N2 that is not greater than the primary resonance frequency of washing tub unit 76, which is the vibrating system including washing tub 82. Further, controller 31 retains the rotation at rotating speed N2 for time ts. During this time ts, an acceleration signal is detected so as to calculate displacement in the front-back direction and top-bottom direction by displacement calculator 40. Then, calculated displacement (arithmetical result) is compared with the reference value. If the arithmetical result is smaller than the reference value, a state that washing tub 82 is anchored with respect to casing 83 is detected. In this way, controller 31 detects whether or not washing tub 82 is anchored with respect to casing 83. The presence of transport fixture 84 is thus accurately detectable by directly detecting amplitude of vibration of washing tub 82 with the above structure.

[0049] As described above, the presence of transport fixture 84 is determined early on in the operation of the washing machine at the step of detecting laundry quantity. This prevents occurrence of abnormal vibrations during the washing and spin-drying steps. In addition, display of an abnormal state readily notifies the user of the situation. Instead of display panel 36, a buzzer or voice guidance may also be provided. In other words, any notifier for notifying a detection result of controller 31 may be provided.

[0050] The setup for this detection process does not require any special structure. A conventional vibration sensor or laundry-quantity detection structure already in practical use can be applied. Accordingly, the setup for this detection process can be put into practical use at low cost.

[0051] Maximum rotating speed N2 of drum 78 on detecting laundry quantity or the presence of transport fixture 84 is set to not greater than the primary resonance frequency of washing tub 82. This avoids the generation of a high amount of energy, although washing tub 82 shakes during detection. Therefore, the laundry quantity or the presence of transport fixture 84 is detectable without abnormal vibration or noise being generated, even if transport fixture 84 is not detached.

[0052] As seen in Fig. 5, displacement in the X-axis direction and Z-axis direction is calculated and then compared with the reference values. However, vibration in the left-right direction (Y-axis direction) may be detected to calculate displacement in the Y-axis direction and used for determination. Alternatively, one or two displacements in the X-axis direction, Y-axis direction, or Z-axis direction may be used for determination.

[0053] In the above description, the quantity of laundry in drum 78 is detected at both increasing and decreasing the rotating speed. However, the laundry quantity may also be detected only at either one.

[0054] The above description refers to cases in which the axis of rotation of drum 78 is horizontal or tilted. However, the present invention is not limited to this structure. Even if the axis of rotation of drum 78 is vertical, the present invention is applicable if washing tub 82 housing drum 78 is anchored dulling transportation.

[0055] In the above description, washing tub 82 is anchored to casing 83 using transport fixture 84. However, the present invention is not limited to this structure. The present invention is also applicable to other structures for anchoring washing tub 82, including a structure in which packing material is inserted inside casing 83.

[0056] As described above, according to the present invention, the erroneous leaving in place of transport fixture 84 used during transport and delivery of the washing machine can be accurately detected, and thus failure caused by abnormal vibration during washing or spin-drying steps can be prevented. The present invention is thus effectively applicable to washing machines for both household and industrial use.

Claims

1. A washing machine comprising:

    a casing;
    a washing tub oscillatably and resiliently supported inside the casing;
    a cylindrical drum with a bottom for holding laundry, the drum having an axis of rotation and being provided in the washing tub;
    an acceleration sensor capable of detecting acceleration of vibration of the washing tub, the acceleration sensor being fixed to the washing tub;
    an acceleration detector configured to detect an acceleration output from the acceleration sensor;
    a displacement calculator configured to calculate the acceleration output of the washing tub output from the acceleration detector, and output a displacement;
    a motor configured to rotate the drum;
    a rotating speed detector configured to detect a speed of rotation of the motor; and
    a controller configured to control rotation of the motor based on a detection output from the rotating speed detector, control a washing step and a step of detecting quantity of laundry before the washing step, and detect whether or not the washing tub is anchored with respect to the casing;
    wherein the controller is configured in the step of detecting quantity of laundry
    to make the motor generate a predetermined acceleration torque;
    to increase rotation of the drum to a predetermined rotating speed;
    to retain the rotation at the predetermined rotating speed for a predetermined period of time; and
    to compare a calculation result output from the displacement calculator while the rotation is retained at the predetermined rotating speed for the predetermined period of time with a preset reference value, thereby detecting a state of the washing tub anchored with respect to the casing when the calculation result is smaller than the reference value.

2. The washing machine according to claim 1, wherein the washing tub has a fixing portion on an external wall thereof, the fixing portion being provided so as to attach a transport fixture for anchoring the washing tub to the casing.

3. The washing machine according to claim 1 or 2, further comprising a notifier configured to notify a detection result of the controller;

wherein the notifier notifies that the washing tub is anchored with respect to the casing when the controller detects that the washing tub is anchored with respect to the casing.

4. The washing machine according to any one of claims 1 to 3, wherein the predetermined rotating speed to which the controller increases the rotation of the drum is not greater than a primary resonance frequency of a vibration system including the washing tub.

FIG. 1

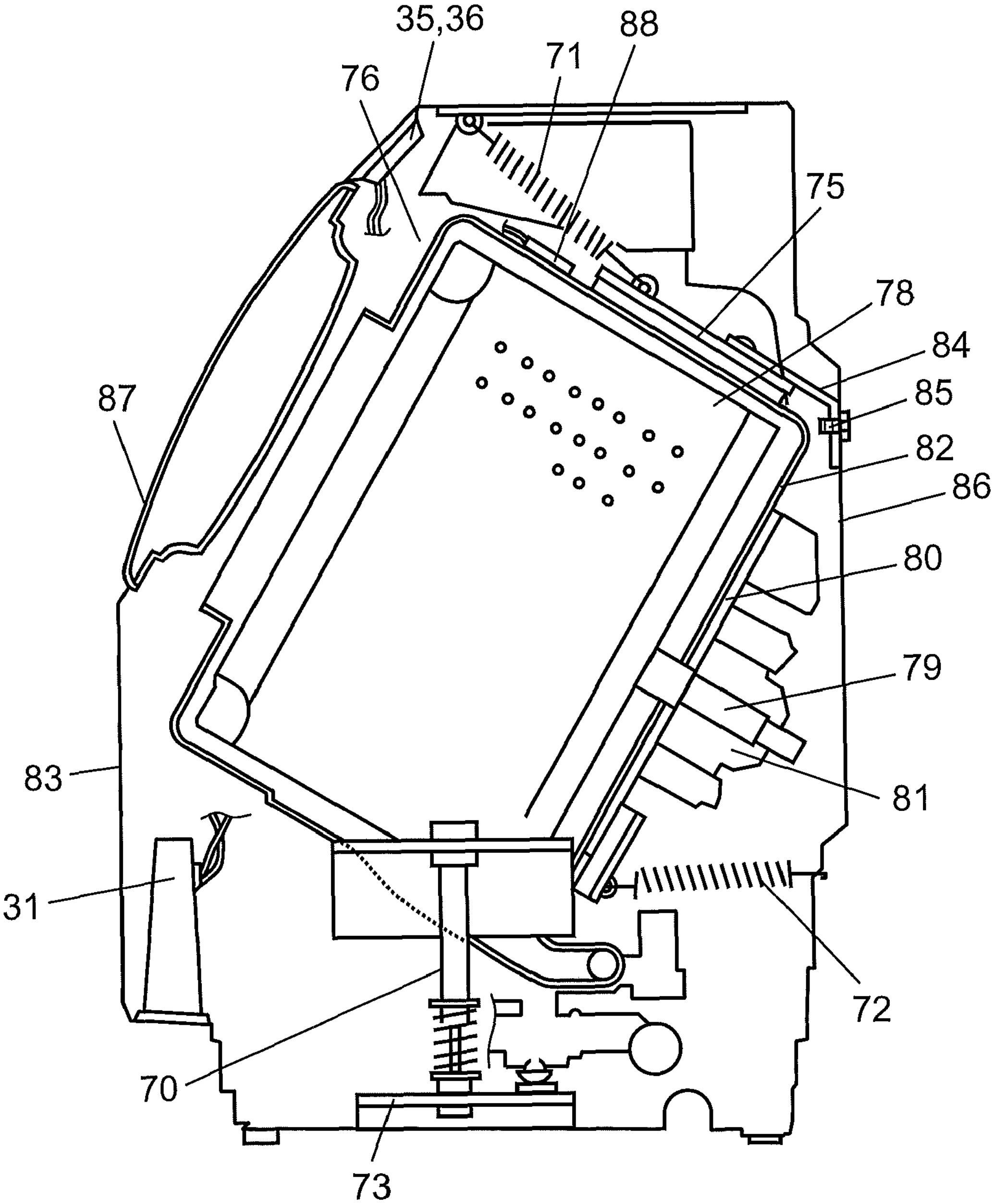
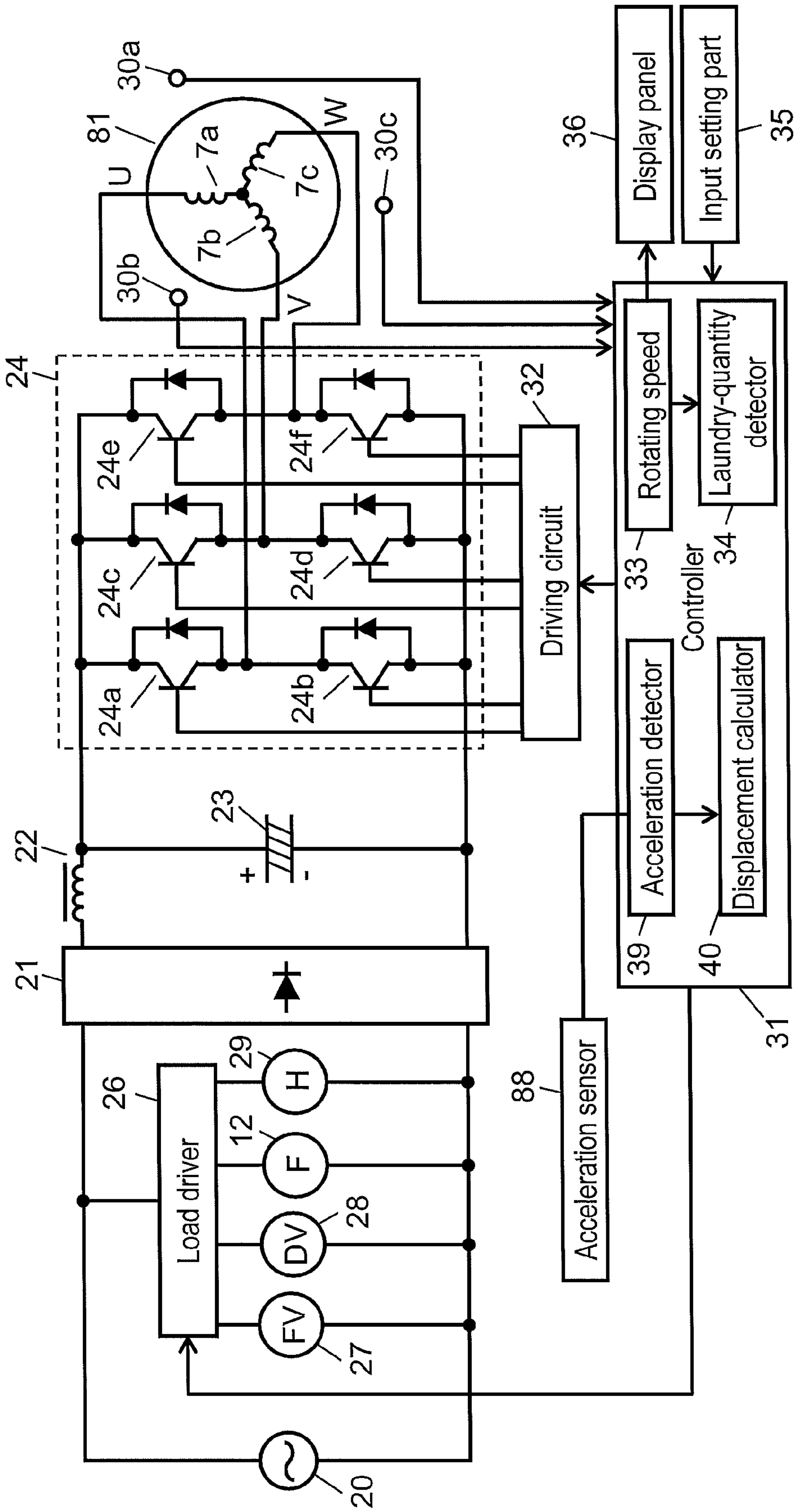


FIG. 2



30a
81
U
W
7a
7c
7b
30b
V
30c
36
Display panel
Input setting part
35
24
32
24e
24f
24c
24d
24a
24b
Driving circuit
Rotating speed
Laundry-quantity detector
33
34
Controller
Acceleration detector
Displacement calculator
39
40
31
22
23
+
-
21
26
Load driver
29
H
12
F
DV
28
FV
27
88
Acceleration sensor
20

FIG. 3

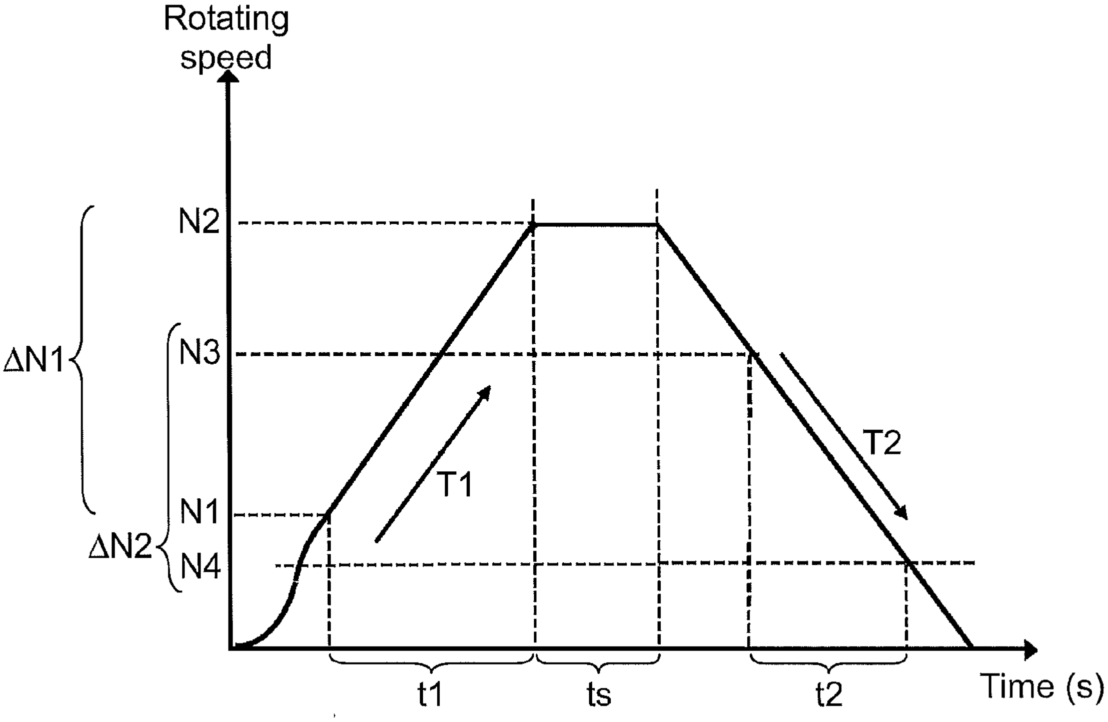

Rotating speed
N2
ΔN1
N3
N1
ΔN2
N4
T1
T2
t1
ts
t2
Time (s)

FIG. 4

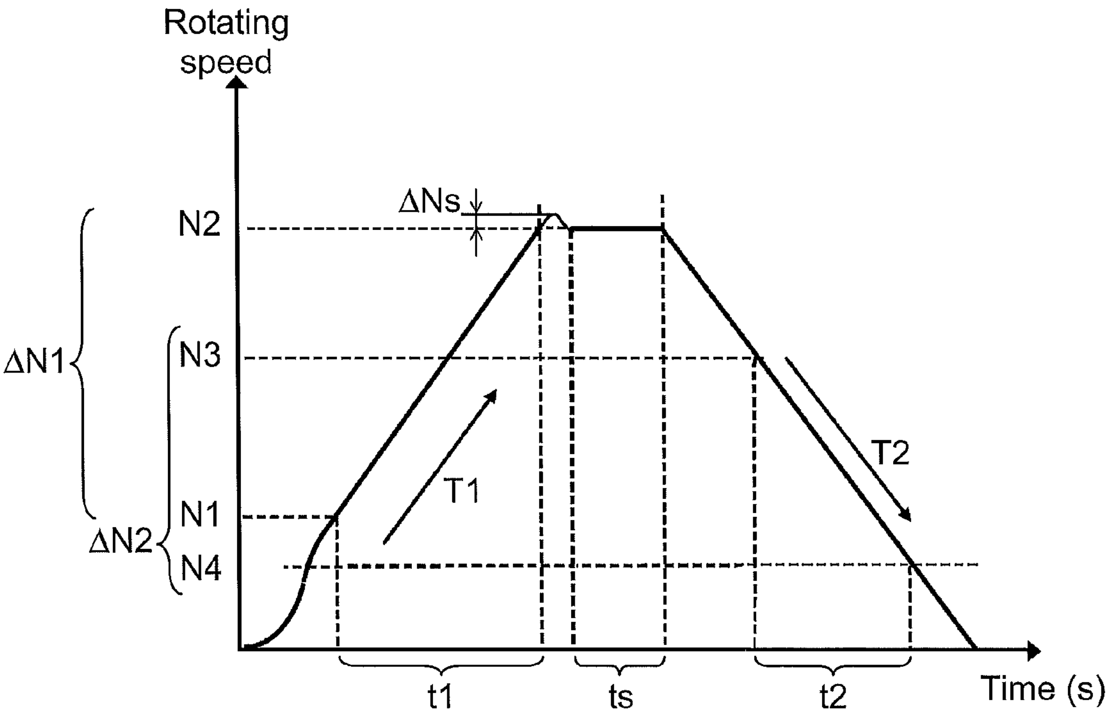

Rotating speed
ΔNs
N2
ΔN1
N3
N1
ΔN2
N4
T1
T2
t1
ts
t2
Time (s)

FIG. 5

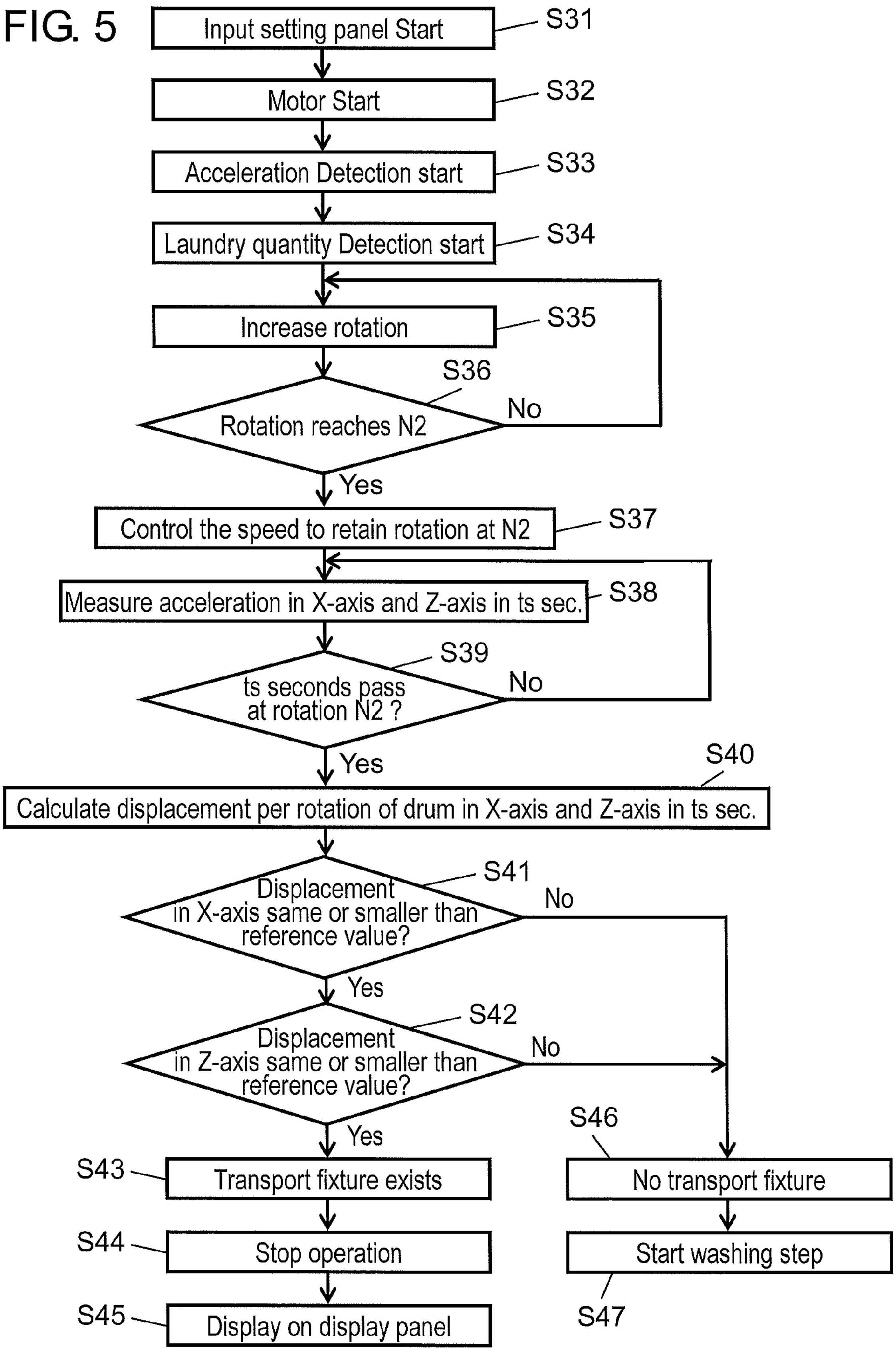
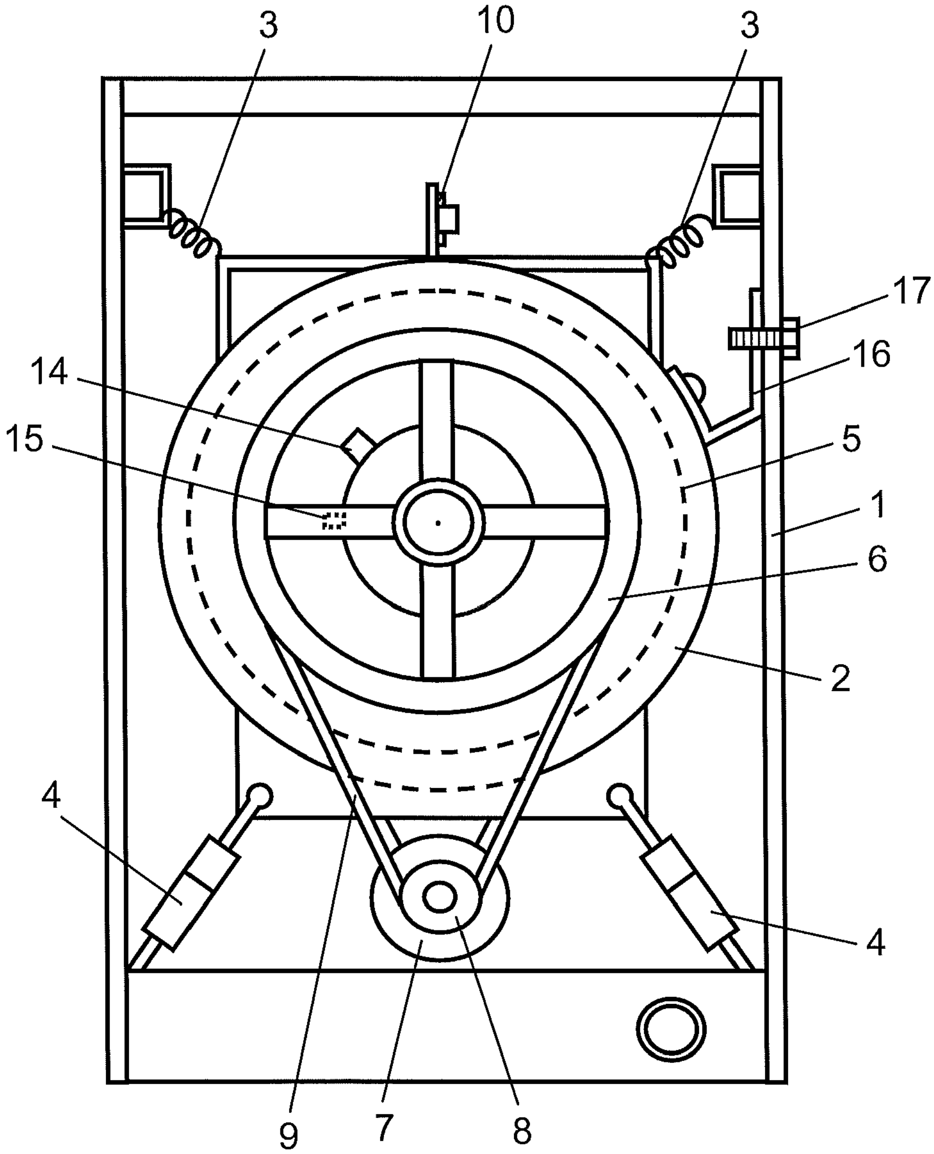

Input setting panel Start
S31
Motor Start
S32
Acceleration Detection start
S33
Laundry quantity Detection start
S34
Increase rotation
S35
S36
Rotation reaches N2
No
Yes
Control the speed to retain rotation at N2
S37
Measure acceleration in X-axis and Z-axis in ts sec.
S38
S39
ts seconds pass at rotation N2 ?
No
Yes
S40
Calculate displacement per rotation of drum in X-axis and Z-axis in ts sec.
S41
Displacement in X-axis same or smaller than reference value?
No
Yes
S42
Displacement in Z-axis same or smaller than reference value?
No
Yes
S43
Transport fixture exists
S44
Stop operation
S45
Display on display panel
S46
No transport fixture
Start washing step
S47

FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 6974

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 032 494 A (TANIGAWA MASANOBU [JP] ET AL) 7 March 2000 (2000-03-07) * column 17, line 23 - column 20, line 28; figures 1,21,22,24,26 * -----	1,4	INV. D06F
A	DE 69 50 556 U (SIEMENS ELEKTROGERAETE GMBH [DE]) 27 May 1971 (1971-05-27) * page 1, paragraph 4 - page 2, paragraph 2; figures 1,2 * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 July 2009	Kising, Axel

CATEGORY OF CITED DOCUMENTS

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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

2

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 15 6974

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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24-07-2009

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