

## DESCRIPTION

### WASHING MACHINE

#### 5 TECHNICAL FIELD

[0001]

The present disclosure relates to a washing machine.

#### BACKGROUND ART

10 [0002]

PTL 1 discloses a washing machine that executes a disturbance step of disturbing washing liquid between a washing and spin-drying tub and a water receiving tub at the end of a rinsing step.

[0003]

15 FIG. 8 is a longitudinal sectional view of a conventional washing machine described in PTL 1. FIG. 9 is a sequence diagram of the conventional washing machine described in PTL 1. FIG. 10 is a main operation time chart of a disturbance step of the conventional washing machine described in PTL 1.

[0004]

20 The configuration of the conventional washing machine will be described below with reference to the drawings.

[0005]

The conventional washing machine includes water receiving tub 101, and washing and spin-drying tub 103 rotatably disposed inside water receiving  
25 tub 101. Water receiving tub 101 is supported in an anti-vibration manner via suspension 104. Laundry 113 and detergent 114 are put into washing and spin-drying tub 103, and washing liquid is put therein up to a predetermined water

level. Balancer 110 is provided above washing and spin-drying tub 103. Pulsator 102 is rotatably provided on an inner bottom part of washing and spin-drying tub 103. Motor 106 that drives one or both of washing and spin-drying tub 103 and pulsator 102 is disposed on a bottom surface of water receiving tub 101. Motor 106 drives one or both of washing and spin-drying tub 103 and pulsator 102 via clutch mechanism 107 that switches driving. Water supply port 117 is provided above washing and spin-drying tub 103. Control device 116 controls the operation of motor 106, drain valve 108, and water supply valve 109, and sequentially controls a series of a washing step, a rinsing step, a spin-drying step, and the like.

[0006]

Next, the operation of the conventional washing machine, that is, a washing operation will be described. Laundry 113 and detergent 114 are put into washing and spin-drying tub 103, and washing liquid is put therein up to a predetermined water level. Then, control device 116 drives motor 106 to rotate, and one or both of washing and spin-drying tub 103 and pulsator 102 are rotated to perform a washing step of removing dirt adhering to laundry 113 (step S101 in FIG. 9).

[0007]

Next, in order to remove a component of detergent 114 remaining on and adhering to laundry 113, washing liquid containing components of dirt and detergent 114 is drained once, and water is supplied again from water supply port 117. Then, a rinsing step of rotating one or both of washing and spin-drying tub 103 and pulsator 102 so as to remove the component of detergent 114 from laundry 113 is started (step S102 in FIG. 9). After the rinsing step ends, control device 116 performs a spin-drying step of turning on (opening) drain valve 108 to drain the washing liquid used in the rinsing step, rotating washing

and spin-drying tub 103, and discharging the washing liquid included in laundry 113 by centrifugal force (step S104 in FIG. 9).

[0008]

Regarding this conventional washing machine, at the end of a rinsing  
5 step, control device 116 stops drainage of washing liquid at a predetermined water level, and executes a disturbance step of applying centrifugal force to the washing liquid in water receiving tub 101 again by rotation of washing and spin-drying tub 103 so as to disturb the washing liquid (step S103 in FIG. 9) as illustrated in FIG. 9. In the disturbance step, the washing liquid between  
10 washing and spin-drying tub 103 and water receiving tub 101 is disturbed, so that detergent residue 115 (see FIG. 8) adsorbed and remaining on wall surfaces of the outer surface of washing and spin-drying tub 103 and the inner surface of water receiving tub 101 is removed by the force of the disturbed water flow.

[0009]

15 In the disturbance step of disturbing the washing liquid between washing and spin-drying tub 103 and water receiving tub 101, control device 116 turns on drain valve 108 to start drainage of the washing liquid as illustrated in part (b) of FIG. 10 from the middle of rotation of washing and spin-drying tub 103 at rotation speed N as illustrated in part (a) of FIG. 10, and  
20 controls drainage during rotation of washing and spin-drying tub 103. Furthermore, as illustrated in part (c) of FIG. 10, control device 116 performs control to turn on water supply valve 109 to supply water from the middle of rotation of washing and spin-drying tub 103 at rotation speed N.

Citation List

25 Patent Literature

[0010]

PTL 1: Unexamined Japanese Patent Publication No. 2004-313232

## SUMMARY

[0011]

The above conventional washing machine executes the disturbance step  
5 in order to remove detergent residue 115 adsorbed and remaining on wall  
surfaces of the outer surface of washing and spin-drying tub 103 and the inner  
surface of water receiving tub 101. Therefore, in a case where laundry 113 in  
washing and spin-drying tub 103 has poor balance, washing and spin-drying tub  
103 is intensely shaken when control device 116 rotates washing and spin-  
10 drying tub 103. As a result, there is a possibility that the washing liquid  
applied with centrifugal force splashes out of the washing machine to cause  
water leakage or increase vibration and noise of the washing machine.

[0012]

The present disclosure prevents splashing of the washing liquid out of  
15 the washing machine in the disturbance step, and vibration and noise of the  
washing machine. Furthermore, a detergent residue adsorbed and remaining  
on wall surfaces of the outer surface of the washing and spin-drying tub and the  
inner surface of the water receiving tub is stably removed by the force of the  
disturbed water flow.

20 [0013]

In a first aspect, the present disclosure provides a washing machine  
comprising a washing and spin-drying tub, a water receiving tub including the  
washing and spin-drying tub, a driver that drives the washing and spin-drying  
tub to rotate, a water level detector that includes a pressure sensor, detects the  
25 water level of the washing and spin-drying tub by pressure and outputs the  
water level, and a controller that causes the washing machine to execute a  
washing step, a rinsing step, and a spin-drying step. The controller cause the

washing machine to execute a disturbance step of applying centrifugal force to the

washing liquid in the water receiving tub by causing the driver to rotate the washing and spin-drying tub in the rinsing step so as to disturb the washing liquid between the washing and spin-drying tub and the water receiving tub. In a case where the fluctuation of the water level of washing and spin-drying tub, which is the fluctuation of the output value of water level detector, exceeds a threshold, the controller determines that an imbalance of laundry inside the washing and spin-drying tube has occurred, and decides execution of a changing step of reducing the rotation speed of the washing and spin-drying tub in the disturbance step.

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In a second aspect, the present disclosure provides a washing machine comprising: a washing and spin-drying tub; a water receiving tub including the washing and spin-drying tub; a driver that drives the washing and spin-drying tub to rotate; a water level detector that includes a pressure sensor, detects a water level of the washing and spin-drying tub by pressure and outputs the water level; and a controller that causes the washing machine to execute a washing step, a rinsing step, and a spin-drying step, wherein the controller causes the washing machine to execute a disturbance step of applying centrifugal force to washing liquid in the water receiving tub by causing the driver to rotate the washing and spin-drying tub in the rinsing step so as to disturb washing liquid between the washing and spin-drying tub and the water receiving tub, and in a case where the fluctuation of the water level of washing and spin-drying tub, which is the fluctuation of the output value of water level detector, exceeds a threshold, the controller determines that an imbalance of laundry inside the washing and spin-drying tub has occurred, and decides execution of a correction rinsing step of correcting an imbalance state of laundry in the washing and spin-drying tub according to output from the water level

detector in the disturbance step.

[0014]

5 A washing machine according to the present disclosure prevents splashing of the washing liquid out of the washing machine in the disturbance step, and vibration and noise of the washing machine. Furthermore, a detergent residue adsorbed and remaining on wall surfaces of the outer surface of the washing and spin-drying tub and the inner surface of the water receiving tub can be stably removed by the force of the disturbed water flow.

## 10 BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a longitudinal sectional view of a washing machine according to a first exemplary embodiment of the present disclosure.

15 FIG. 2 is a block circuit diagram of the washing machine according to the first exemplary embodiment of the present disclosure.

FIG. 3 is a sequence diagram illustrating a basic operation procedure of the washing machine according to the first exemplary embodiment of the present disclosure.

20 FIG. 4 is a diagram illustrating the relationship between output from a water level detector and the water level of the washing machine according to the first exemplary embodiment of the present disclosure.

FIG. 5 is a diagram illustrating the relationship between time and the

output from the water level detector, and the relationship between time and the rotation speed of a washing and spin-drying tub of the washing machine according to the first exemplary embodiment of the present disclosure.

FIG. 6 is a sequence diagram illustrating a washing machine operation  
5 procedure according to a second exemplary embodiment of the present disclosure.

FIG. 7 is a main operation time chart of a washing machine according to the second exemplary embodiment and a third exemplary embodiment of the present disclosure.

10 FIG. 8 is a longitudinal sectional view of a conventional washing machine.

FIG. 9 is a sequence diagram of the conventional washing machine.

FIG. 10 is a main operation time chart of a disturbance step of a washing machine.

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## DESCRIPTION OF EMBODIMENTS

[0016]

Exemplary embodiments will be described below in detail with reference to the drawings. Note that the present disclosure is not limited by the  
20 accompanying drawings and the following description.

[0017]

(First exemplary embodiment)

A first exemplary embodiment will be described below with reference to FIGS. 1 to 4.

25 [0018]

(Configuration of washing machine)

FIG. 1 is a longitudinal sectional view of a washing machine according

to the first exemplary embodiment. FIG. 2 is a block circuit diagram of the washing machine according to the first exemplary embodiment.

[0019]

As illustrated in FIGS. 1 and 2, the washing machine according to the present exemplary embodiment includes water receiving tub 1, and washing and spin-drying tub 3 rotatably disposed inside water receiving tub 1. Water receiving tub 1 is supported in an anti-vibration manner via suspension 4. Laundry 13 and detergent are put into washing and spin-drying tub 3, and washing liquid is put therein up to a predetermined water level. Balancer 10 is provided above washing and spin-drying tub 3. Pulsator 2 is rotatably disposed on an inner bottom part of washing and spin-drying tub 3. Motor 6 functioning as a driver that drives one or both of washing and spin-drying tub 3 and pulsator 2 is disposed on a bottom surface of water receiving tub 1. Motor 6 drives one or both of washing and spin-drying tub 3 and pulsator 2 via clutch mechanism 7 that switches driving. Water level detector 18 detects water levels in washing and spin-drying tub 3 and water receiving tub 1. Water level detector 18 includes a pressure sensor, for example.

[0020]

Control device 16 has controller 19 including a microcomputer. Controller 19 controls the operation of motor 6, drain valve 8, water supply valve 9, and the like via power switching unit 20, and sequentially controls a series of a washing step, a rinsing step, a spin-drying step, and the like. The user sets an operation course or the like using operation display unit 21. Information from operation display unit 21 is input to controller 19. Operation display unit 21 displays the set operation course or the like to notify the user. Storage unit 22 stores data necessary for controller 19 to control the operation of motor 6, drain valve 8, water supply valve 9, and the like.

[0021]

Rotation detector 26 includes a Hall integrated circuit (IC) or the like, and is attached to motor 6 to detect the rotation of motor 6. Cloth amount detector 23 detects the amount of laundry 13 in washing and spin-drying tub 3.

5     Output from rotation detector 26 is input to cloth amount detector 23. After pulsator 2 is driven by motor 6, cloth amount detector 23 detects the amount of laundry 13 in washing and spin-drying tub 3 on the basis of a degree of decrease in rotation speed of pulsator 2 when the driving is stopped. Note that power switch 24 is configured to turn on and off power supplied from commercial power  
10     source 25 to the washing machine, and is manually operated by the user.

[0022]

Operation and actions of the washing machine configured as described above will be described below.

[0023]

15             (Washing operation)

FIG. 3 is a sequence diagram illustrating a basic operation procedure of the washing machine according to the first exemplary embodiment. FIG. 4 is a diagram illustrating the relationship between output from a water level detector and the water level of the washing machine according to the first  
20     exemplary embodiment. FIG. 5 is a diagram illustrating the relationship between time and the output from the water level detector, and the relationship between time and the rotation speed of a washing and spin-drying tub of the washing machine according to the first exemplary embodiment.

[0024]

25             Regarding the washing machine according to the present exemplary embodiment, at the end of the rinsing step, controller 19 executes a disturbance step that is a step of rotating washing and spin-drying tub 3 to apply centrifugal

force to the washing liquid in water receiving tub 1, and disturbing the washing liquid between washing and spin-drying tub 3 and water receiving tub 1 as illustrated in FIG. 3. In the disturbance step, controller 19 executes imbalance detection based on output from water level detector 18.

5 [0025]

Details of the operation of the washing machine according to the present exemplary embodiment will be described below.

[0026]

First, laundry 13 and detergent are put into washing and spin-drying  
10 tub 3, and washing liquid is put therein up to a predetermined water level. Controller 19 performs a washing step in which motor 6 is driven to rotate and one or both of washing and spin-drying tub 3 and pulsator 2 are rotated to remove dirt adhering to laundry 13 (step S1).

[0027]

15 Next, washing liquid containing dirt and the detergent component is drained once in order to remove the detergent component remaining on and adhering to laundry 13. Then, water is supplied again, and controller 19 starts a rinsing step of rotating one or both of washing and spin-drying tub 3 and pulsator 2 to remove the detergent component from laundry 13 (step S2).

20 [0028]

As described above, at the end of the rinsing step, controller 19 performs control to stop drainage of the washing liquid at a predetermined water level, and drives motor 6 such that washing and spin-drying tub 3 rotates again (step S4) so as to execute the disturbance step (step S3). As a result, centrifugal force  
25 is applied to the washing liquid in water receiving tub 1, and the washing liquid is disturbed.

[0029]

This disturbance of the washing liquid occurs due to slight unevenness of wall surfaces of washing and spin-drying tub 3 and water receiving tub 1 when centrifugal force is applied to the washing liquid such that the washing liquid rotates between washing and spin-drying tub 3 and water receiving tub

5 1.

[0030]

The water level in water receiving tub 1 rises due to the action of centrifugal force as the rotation speed of washing and spin-drying tub 3 increases. In the present exemplary embodiment, the relationship between  
10 output from water level detector 18 and the water level of water receiving tub 1 is such that the output value of water level detector 18 decreases as the water level rises as illustrated in FIG. 4.

[0031]

As illustrated in FIG. 5, the relationship between the output from water  
15 level detector 18 and the rotation speed of washing and spin-drying tub 3 is such that the output value of water level detector 18 decreases as the rotation speed of washing and spin-drying tub 3 increases.

[0032]

When the disturbance step (step S3) ends, controller 19 executes a spin-  
20 drying step of draining the washing liquid used in the rinsing step, rotating washing and spin-drying tub 3, and discharging the washing liquid included in laundry 13 by centrifugal force (step S7). In the spin-drying step (step S7), controller 19 first opens drain valve 8 to drain water. When the drainage ends, controller 19 switches clutch mechanism 7 to the spin-drying side, and transmits  
25 the power of motor 6 to washing and spin-drying tub 3 through the spin-drying shaft to rotate washing and spin-drying tub 3, thereby executing the spin-drying. Drain valve 8 maintains the open state. The operation ends when this spin-

drying step (step S7) ends.

[0033]

In the series of operations described above, controller 19 in the washing machine according to the present exemplary embodiment executes imbalance  
5 detection based on the water level fluctuation measured by water level detector 18 (step S5) in the disturbance step (step S3).

[0034]

As illustrated in FIG. 5, if laundry 13 is in a well-balanced state, the output value of water level detector 18 changes in conjunction with an increase  
10 in the rotation speed of washing and spin-drying tub 3. On the other hand, if laundry 13 is in a poor-balanced state, intense shaking occurs in water receiving tub 1 and vertical fluctuation of the washing liquid applied with centrifugal force occurs in conjunction with an increase in the rotation speed of washing and spin-drying tub 3, and therefore the output value of water level detector 18 greatly  
15 fluctuates as shown by a broken line in FIG. 5.

[0035]

Details of the imbalance detection will be described below. The output value of water level detector 18 is stored every 100 ms while motor 6 drives washing and spin-drying tub 3 to rotate. When a first output value in 1 second  
20 is represented as  $H_0$  and a maximum output value is represented as  $H_{max}$ , controller 19 determines that imbalance of laundry 13 has occurred (Yes in step S5 in FIG. 3) if the value is equal to or more than a set value (e.g.,  $H_{max} - H_0 > 800$  Hz), and executes a rotation speed changing step (step S6). That is, in a case where the fluctuation (i.e., fluctuation of the output value of water level  
25 detector 18) of the water level of washing and spin-drying tub 3 exceeds a threshold, controller 19 determines that an imbalance of laundry 13 has occurred, and executes the rotation speed changing step (step S6).

[0036]

In the rotation speed changing step (step S6), the rotation speed of washing and spin-drying tub 3 is reduced by, for example, setting the rotation speed of washing and spin-drying tub 3 to 150 rpm with respect to a goal-setting  
5 rotation speed of 200 rpm. That is, the rotation of washing and spin-drying tub 3 by motor 6 is continued while intense shaking of water receiving tub 1 is reduced. When the fluctuation of the output value of water level detector 18 is less than or equal to the threshold, controller 19 determines that no imbalance of laundry 13 has occurred (No in step S5), and performs control to continue  
10 rotation at a goal-setting rotation speed without executing the rotation speed changing step (step S6). Then, controller 19 proceeds to the spin-drying step (step S7).

[0037]

As a result, controller 19 can control the rotation of motor 6 to control  
15 the rotation of washing and spin-drying tub 3 such that the washing liquid in water receiving tub 1 applied with the centrifugal force does not exceed the upper surface of washing and spin-drying tub 3. As a result, it is possible to prevent the washing liquid from splashing out of the washing machine, and to suppress the amplitude of the washing machine. Accordingly, vibration and  
20 noise in the disturbance step (step S3) are prevented, and a detergent residue adsorbed and remaining on wall surfaces of the outer surface of the washing and spin-drying tub and the inner surface of the water receiving tub can be stably removed by the force of the disturbed water flow.

[0038]

25 As described above, controller 19 in the washing machine according to the present exemplary embodiment executes the changing step of reducing the rotation speed of washing and spin-drying tub 3 in a case where the water level

fluctuation of washing and spin-drying tub 3 detected by water level detector 18 exceeds the threshold in the disturbance step.

[0039]

(Second exemplary embodiment)

5           FIG. 6 is a sequence diagram illustrating a washing machine operation procedure according to a second exemplary embodiment. FIG. 7 is a main operation time chart of a washing machine according to the second exemplary embodiment. The same reference numerals are used to refer to the same components as those of the first exemplary embodiment, and the description  
10   thereof will be omitted.

[0040]

          In the washing machine according to the second exemplary embodiment, controller 19 interrupts the rotation operation of washing and spin-drying tub 3 in a case where controller 19 detects an imbalance abnormality and determines  
15   that the state of laundry 13 is in imbalance (Yes in step S15) in the disturbance step (step S13) as illustrated in FIG. 6. Then, controller 19 executes a correction rinsing step including a water supply step, a disturbance step, and a drainage step (step S16). After executing the correction rinsing step (step S16), controller 19 drives motor 6 functioning as a driver again such that washing and  
20   spin-drying tub 3 rotates (step S14) so as to execute the disturbance step (step S13). That is, in the imbalance detection (step S15) of the disturbance step (step S13), controller 19 executes the correction rinsing step (step S16) in a case where the water level fluctuation of washing and spin-drying tub 3 detected by water level detector 18 exceeds a threshold (Yes in step S15).

25   [0041]

          As a result, intense shaking of water receiving tub 1, which is generated when the rotation speed of washing and spin-drying tub 3 increases in the

imbalance state of laundry 13, is prevented. Moreover, since the imbalance state of laundry 13 can be eliminated, vibration and noise of the washing machine can be suppressed, and a detergent residue adsorbed and remaining on wall surfaces of the outer surface of washing and spin-drying tub 3 and the inner surface of water receiving tub 1 can be stably removed by the force of the disturbed water flow.

[0042]

(Third exemplary embodiment)

FIG. 7 is a main operation time chart of a washing machine according to a third exemplary embodiment. The same reference numerals are used to refer to the same components as those of the first and second exemplary embodiments, and the description thereof will be omitted.

[0043]

Regarding the washing machine according to the present exemplary embodiment, in the disturbance step (step S13) of disturbing the washing liquid between washing and spin-drying tub 3 and water receiving tub 1, drain valve 8 is opened to start drainage of the washing liquid before rotation of washing and spin-drying tub 3, and water is drained while washing and spin-drying tub 3 is rotated as illustrated in FIG. 7. That is, controller 19 executes drainage of the washing liquid while increasing the rotation speed of washing and spin-drying tub 3. As a result, the washing liquid is drained while a detergent residue is removed by the disturbance force, so that the washing time can be shortened. It is further possible to prevent the removed detergent residue from entering washing and spin-drying tub 3 and adhering again to laundry 13.

[0044]

(Fourth exemplary embodiment)

A washing machine according to a fourth exemplary embodiment

changes the rotation speed of washing and spin-drying tub 3 in the disturbance step according to output from cloth amount detector 23 that detects the amount of laundry 13 in washing and spin-drying tub 3 and output from water level detector 18. The same reference numerals are used to refer to the same components as those of the first to third exemplary embodiments, and the description thereof will be omitted.

[0045]

In the present exemplary embodiment, controller 19 decreases the rotation speed of washing and spin-drying tub 3 in the disturbance step when determining that the amount of laundry 13 is large on the basis of output from cloth amount detector 23. On the other hand, controller 19 increases the rotation speed of washing and spin-drying tub 3 in the disturbance step when determining that the amount of laundry 13 is small on the basis of the output from cloth amount detector 23. As a result, it is possible to prevent the water level of the disturbed water flow from greatly fluctuating depending on the amount of laundry 13, and to remove a detergent residue more stably.

[0046]

(Fifth exemplary embodiment)

A washing machine according to a fifth exemplary embodiment changes the water level of washing and spin-drying tub 3 at the start of the disturbance step according to the output from cloth amount detector 23 that detects the amount of laundry 13 in washing and spin-drying tub 3. The same reference numerals are used to refer to the same components as those of the first to fourth exemplary embodiments, and the description thereof will be omitted.

[0047]

In the present exemplary embodiment, controller 19 is configured to decide a water level to be set among a plurality of water levels stored at the start

of the disturbance step in advance, on the basis of output from cloth amount detector 23. The water level may be set to be decreased as the amount of laundry 13 increases. As a result, it is possible to prevent the washing liquid from exceeding the upper surface of washing and spin-drying tub 3 in a case  
5 where the amount of laundry 13 is large, and to remove a detergent residue more stably.

[0048]

Although the first to fifth exemplary embodiments have been described above, a part of the configuration of a certain exemplary embodiment can be  
10 replaced with the configuration of another exemplary embodiment, and the configuration of a certain exemplary embodiment can be added with the configuration of another exemplary embodiment. Moreover, it is possible to employ the configuration of an exemplary embodiment for addition, deletion, or replacement of a part of the configuration of another exemplary embodiment.

15 [0049]

(Action and the like)

As described above, a washing machine according to the present disclosure includes washing and spin-drying tub 3, water receiving tub 1 including washing and spin-drying tub 3, motor 6 functioning as a driver that  
20 drives washing and spin-drying tub 3 to rotate, water level detector 18 that detects the water level of washing and spin-drying tub 3, and controller 19 that causes the washing machine to execute a washing step, a rinsing step, and a spin-drying step. In the rinsing step, controller 19 executes a disturbance step of applying centrifugal force to the washing liquid in water receiving tub 1 by  
25 causing motor 6 functioning as a driver to rotate washing and spin-drying tub 3 so as to disturb the washing liquid between washing and spin-drying tub 3 and water receiving tub 1. In the disturbance step, controller 19 decides execution

of a changing step of reducing the rotation speed of washing and spin-drying tub 3 according to output from water level detector 18.

[0050]

With this configuration, splashing of the washing liquid out of the washing machine in the disturbance step, and vibration and noise of the washing machine are prevented. Moreover, a detergent residue adsorbed and remaining on wall surfaces of the outer surface of washing and spin-drying tub 3 and the inner surface of water receiving tub 1 can be stably removed by the force of the disturbed water flow. Moreover, a washing machine according to the present disclosure includes washing and spin-drying tub 3, water receiving tub 1 including washing and spin-drying tub 3, motor 6 functioning as a driver that drives washing and spin-drying tub 3 to rotate, water level detector 18 that detects the water level of washing and spin-drying tub 3, and controller 19 that causes the washing machine to execute a washing step, a rinsing step, and a spin-drying step. In the rinsing step, controller 19 executes a disturbance step of applying centrifugal force to the washing liquid in water receiving tub 1 by causing motor 6 functioning as a driver to rotate washing and spin-drying tub 3 so as to disturb the washing liquid between washing and spin-drying tub 3 and water receiving tub 1. In the disturbance step, controller 19 decides execution of a correction rinsing step of correcting the imbalance state of laundry 13 in washing and spin-drying tub 3 according to output from water level detector 18.

[0051]

With this configuration, intense shaking of water receiving tub 1, which is generated when the rotation speed of washing and spin-drying tub 3 is increased in a state where laundry 13 is disposed in an unbalanced manner, is prevented. Moreover, since the imbalance state of laundry 13 can be eliminated, vibration and noise of the washing machine can be suppressed, and

a detergent residue adsorbed and remaining on wall surfaces of the outer surface of washing and spin-drying tub 3 and the inner surface of water receiving tub 1 can be stably removed by the force of the disturbed water flow.

[0052]

5           Moreover, as in the above exemplary embodiments, controller 19 may perform control to execute drainage of the washing water while increasing the rotation speed of washing and spin-drying tub 3 in the disturbance step.

[0053]

10           With this configuration, the drainage operation and the step of removing a detergent residue are simultaneously performed, so that the washing time can be shortened as compared with a case where the step of removing a detergent residue is executed after a predetermined amount of water is stored in water receiving tub 1. It is further possible to prevent the removed detergent residue from entering washing and spin-drying tub 3 and adhering to laundry 13 in washing and spin-drying tub 3.

[0054]

          As in the above exemplary embodiments, cloth amount detector 23 that detects the amount of laundry 13 in washing and spin-drying tub 3 may be further provided, and controller 19 may decide changing of the rotation speed of washing and spin-drying tub 3 according to output from cloth amount detector 23 and output from water level detector 18.

[0055]

25           With this configuration, it is possible to prevent the water level of the disturbed water flow from largely fluctuating due to the amount of laundry 13, and to remove a detergent residue more stably.

[0056]

          As in the above exemplary embodiments, cloth amount detector 23 that

detects the amount of laundry 13 in washing and spin-drying tub 3 may be further provided, and controller 19 may decide execution of the correction rinsing step according to output from cloth amount detector 23 and output from water level detector 18.

5 [0057]

With this configuration, it is possible to prevent the water level of the disturbed water flow from largely fluctuating due to the amount of laundry 13, and to remove a detergent residue more stably.

[0058]

10 Moreover, as in the above exemplary embodiments, cloth amount detector 23 that detects the amount of laundry 13 in washing and spin-drying tub 3 may be further provided, and controller 19 may change the water level of washing and spin-drying tub 3 at the start of the disturbance step according to output from cloth amount detector 23.

15 [0059]

It is possible with this configuration to prevent the washing liquid from exceeding the upper surface of washing and spin-drying tub 3 in a case where the amount of laundry 13 is large, and to remove a detergent residue more stably.

[0060]

20 As in the above exemplary embodiments, the changing step may be executed in a case where fluctuation of the water level detected by water level detector 18 exceeds a threshold.

[0061]

As in the above exemplary embodiments, the correction rinsing step may  
25 be executed in a case where the fluctuation of the water level detected by water level detector 18 exceeds a threshold.

[0062]

(Other exemplary embodiment)

The first to fourth exemplary embodiments have been described above as illustrations of the technique disclosed in the present application. However, the technique in the present disclosure is not limited thereto.

5 [0063]

Thus, another exemplary embodiment will be illustrated below.

[0064]

Other configurations, the set rotation speed in the disturbance step, the changed rotation speed, the set value for the imbalance detection, and the like  
10 described in the present exemplary embodiment are merely illustrations, and may be appropriately set.

[0065]

Although it is expressed in the above description that the disturbance step is executed at the end of the rinsing step, it can also be expressed that the  
15 disturbance step is executed between the rinsing step and the spin-drying step.

## INDUSTRIAL APPLICABILITY

[0066]

As described above, a washing machine according to the present  
20 disclosure has a function of removing a detergent residue adhering to the outer surface of the washing and spin-drying tub and the inner surface of the water receiving tub. Splashing of the washing liquid out of the washing machine in the disturbance step, and vibration and noise of the washing machine are prevented. Moreover, a detergent residue adsorbed and remaining on wall  
25 surfaces of the outer surface of the washing and spin-drying tub and the inner surface of the water receiving tub can be stably removed by the force of the disturbed water flow. Accordingly, the present invention is useful as a washing

machine or the like that prevents a detergent residue from adhering again to laundry, keeps clothes clean, and improves safety.

#### REFERENCE MARKS IN THE DRAWINGS

- 5 [0067]
- 1: water receiving tub
  - 2: pulsator
  - 3: washing and spin-drying tub
  - 6: motor (driver)
- 10
- 7: clutch mechanism
  - 13: laundry
  - 16: control device
  - 18: water level detector
  - 19: controller
- 15
- 23: cloth amount detector

## CLAIMS

1. A washing machine comprising:
  - a washing and spin-drying tub;
  - 5 a water receiving tub including the washing and spin-drying tub;
  - a driver that drives the washing and spin-drying tub to rotate;
  - a water level detector that includes a pressure sensor, detects a water level of the washing and spin-drying tub by pressure and outputs the water level; and
  - 10 a controller that causes the washing machine to execute a washing step, a rinsing step, and a spin-drying step,

wherein the controller cause the washing machine to execute a disturbance step of applying centrifugal force to washing liquid in the water receiving tub by causing the driver to rotate the washing and spin-drying tub in

- 15 the rinsing step so as to disturb washing liquid between the washing and spin-drying tub and the water receiving tub, and

in a case where the fluctuation of the water level of washing and spin-drying tub, which is the fluctuation of the output value of water level detector, exceeds a threshold, the controller determines that an imbalance of laundry

- 20 inside the washing and spin-drying tube has occurred, and decides execution of a changing step of reducing a rotation speed of the washing and spin-drying tub in the disturbance step.

2. A washing machine comprising:
  - 25 a washing and spin-drying tub;
  - a water receiving tub including the washing and spin-drying tub;
  - a driver that drives the washing and spin-drying tub to rotate;

a water level detector that includes a pressure sensor, detects a water level of the washing and spin-drying tub by pressure and outputs the water level; and

a controller that causes the washing machine to execute a washing step,  
5 a rinsing step, and a spin-drying step,

wherein the controller causes the washing machine to execute a disturbance step of applying centrifugal force to washing liquid in the water receiving tub by causing the driver to rotate the washing and spin-drying tub in the rinsing step so as to disturb washing liquid between the washing and spin-  
10 drying tub and the water receiving tub, and

in a case where the fluctuation of the water level of washing and spin-drying tub, which is the fluctuation of the output value of water level detector, exceeds a threshold, the controller determines that an imbalance of laundry inside the washing and spin-drying tub has occurred, and decides execution of a  
15 correction rinsing step of correcting state of the imbalance in the disturbance step.

3. The washing machine according to claim 1 or 2, wherein the controller causes the washing machine to execute drainage of the washing liquid  
20 while increasing the rotation speed of the washing and spin-drying tub in the disturbance step.

4. The washing machine according to claim 1, further comprising a cloth amount detector that detects an amount of laundry in the washing and  
25 spin-drying tub,

wherein the controller

decreases the the rotation speed of washing and spin-drying tub in the

changing step when determining that the amount of laundry is large on the basis of output from cloth amount detector, and

increases the rotation speed of washing and spin-drying tub in the changing step when determining that the amount of laundry is small on the basis of the output from cloth amount detector.

5. The washing machine according to claim 1, further comprising a cloth amount detector that detects an amount of laundry in the washing and spin-drying tub,

wherein the controller, when determining that the amount of laundry is large on the basis of output from cloth amount detector, changes the water level of the washing and spin-drying tub at a start of the disturbance step in the way that the water level is set to be decreased as the amount of laundry increases.