

DRUM TYPE WASHING MACHINE

Field of the Invention

5 The present invention relates to a drum type washing machine for carrying out each of washing, rinsing, water-extracting, drying processes and the like by driving a rotary drum having a horizontal or a slanted rotational axis.

10 Background of the Invention

 A conventional drum type washing machine can perform washing, rinsing, water-extracting and drying processes by rotating a rotary drum about a horizontal or a slanted
15 rotational axis with water supplied up to a predetermined water level in a water tub, wherein a water level detector is provided to detect a level of supplied water (see, e.g., Japanese Patent Laid-open Application No. H10-201991).

 Figs. 4 and 5 show a configuration of a conventional
20 washing machine. Hereinafter, the configuration thereof will be described. Rotatably incorporated in water tub 3 is rotary drum 1 provided with a number of drum perforations 2 in its cylindrical wall. Rotary drum 1 is driven to rotate by horizontal rotating shaft 4 rotatably fixed at center of
25 rotation of rotary drum 1, wherein rotating shaft 4 is connected to motor 5. Several agitation blades 6 are

provided on an inner cylindrical surface of rotary drum 1 to easily stir laundry articles with each other.

Water tub 3 is suspended in washing machine main body 7 by springs 8 so that it can rock in left/right and to-and-fro directions. By connecting one end of water drain connection hose 9 to a lower portion of water tub 3, the other end thereof to one end of water drain pump 10 and the other end of water drain pump 10 to water drain hose 11 respectively, washing water in water tub 3 can be drained therethrough. Water drain hose 11 connected to water drain pump 10 is extended upwardly inside the main body and then bent downward at a portion located as high as water overflow level 26. Water is supplied through water supply valve 12 into water tub 3, and water level detector 18 detects a water level in water tub 3.

By operating fan 13, air is drawn into water tub 3 from air inlet 17 through warm air flow path 15 and passes by in the meantime heater 14 to be heated thereby to become warm air. Thereafter, thus heated warm air is discharged into water tub 3 through warm air outlet 16, thereby making it possible to carry out a drying process. With such a configuration, washing, rinsing, water-extracting and drying processes are performed.

However, in such a conventional washing machine, if an abnormally excessive amount of detergent foams is generated during the washing process due to an excessive detergent

inputted, the detergent foams may intrude to fill the warm air flow path or the like and then be adhered to electrical components or the like. In general, the detergent foams are of a high electrical conductivity due to the detergent ingredient. Therefore, if the detergent foams are adhered to the electrical components such as a heater or a fan, the electrical components are corroded or electrically short-circuited, which may result in defects such as a breakdown or the like.

Further, if the amount of detergent foams keeps increasing, the detergent foams overflow from a detergent dispenser opening into inside as well as outside of the washing machine are adhered to the electrical components, e.g., a motor and the like or fall on a bottom surface, which may lead to damaging the installation place of the washing machine.

Moreover, if the washing machine is being kept continuously operated while the abnormally excessive amount of detergent foams is generated, a rotational motion of a drum faces a resistance due to the large amount of detergent foams, which causes an operation failure (abnormal rotation of drum) during a water-extracting operation. As a result, it is difficult to secure a rinsing performance or a water-extracting performance sufficiently, or the operation hour may have to be extended.

Summary of the Invention

It is, therefore, an object of the present invention to prevent a washing machine from being functionally
5 deteriorated by detergent foams generated during a washing process or from being broken due to the adhesion of the detergent foams to electrical components.

In accordance with the present invention, there is provided a drum type washing machine including: a rotary
10 drum having a horizontal or a slanted rotational axis; a water tub elastically supported at a washing machine main body, the water tub incorporating therein the rotary drum; a water supply unit for supplying water into the water tub; a water level detector for detecting a water level in the
15 water tub; a water drain unit for draining water from the water tub; and a controller for controlling washing, ordinary rinsing, water-extracting operation, wherein the controller detects a condition of detergent foams generated in the water tub based on a signal change from the water
20 level detector and then controls washing, ordinary rinsing, water-extracting processes, the water supply unit and the water drain unit on the ground of the detected result.

With such a configuration, a large amount of detergent foams generated during the washing process can be quickly
25 removed, or the generation thereof can be suppressed. Further, since the detergent foams can be prevented from

being excessively generated beyond a predetermined amount,
it is possible to avoid the functional deterioration of the
washing machine and to prevent electrical components such as
a heater, a fan motor or the like from being corroded or
5 electrically short-circuited due to the adhesion of the
detergent foams thereto.

Brief Description of the Drawings

10 The above and other objects and features of the
present invention will become apparent from the following
description of preferred embodiments, given in conjunction
with the accompanying drawings, in which:

15 Fig. 1 shows a side sectional view of a drum type
washing machine in accordance with a first preferred
embodiment of the present invention;

Fig. 2 describes a control circuit diagram of the drum
type washing machine shown in Fig. 1;

20 Fig. 3 provides a flowchart illustrating operations of
principal parts of the drum type washing machine shown in
Fig. 1;

Fig. 4 represents a side sectional view of a
conventional washing machine; and

25 Fig. 5 offers a partially cutaway perspective view the
conventional washing machine.

Detailed Description of the Preferred Embodiment

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, the present invention is
5 not limited to those preferred embodiments.

(First preferred embodiment)

Fig. 1 shows a side sectional view of a drum type washing machine in accordance with a first preferred
10 embodiment of the present invention and Fig. 2 describes a control circuit diagram of the drum type washing machine.

As shown in Figs. 1 and 2, cylindrical rotary drum 31 having a bottom surface is provided with a number of drum perforations 32 throughout its entire cylindrical wall and
15 is installed inside water tub 33 to be freely movable. Rotary drum 31 has rotating shaft (central axis of rotation) 34 installed at the center of rotation thereof such that the direction of the central axis of rotation thereof is declined toward the rear portion of the washing machine.
20 Rotary drum 31 is driven to rotate in forward and reverse directions by connecting rotating shaft 34 to motor 35 installed on a bottom portion of water tub 33. Several agitation blades 36 are provided on an inner cylindrical surface of rotary drum 31 to easily stir laundry articles.

25 An opening formed on an upwardly sloped surface at a front portion of water tub 33 can be freely opened/closed

with door 37. By opening door 37, laundry articles can be loaded into and unloaded from rotary drum 31 through laundry loading/unloading opening 38. Since door 37 is provided on the upwardly sloped surface, a user can load and unload the laundry articles without bending down.

Water tub 33 is suspended in washing machine main body 39 by spring 40 and damper 41 so that it can rock in left/right and to-and-fro directions. One end of water drain conduit 42 is configured to be connected to a lower portion of water tub 33 and the other end to water drain valve (water drain unit) 43 so that washing water in water tub 33 can be drained therethrough. Water supply valve (water supply unit) 44 supplies a part of water into water tub 33 via water supply conduit 60, detergent dispenser 61 formed on an upper front surface of washing machine main body 39 and first water supply hose 62. Further, water supply valve (water supply unit) 44 is used to supply the remaining water through the opening provided at an upper portion of water tub 33 into rotary drum 31 via second water supply hose 63 and water supply opening 64. For example, water is first supplied to water tub 33 through water supply conduit 60 up to a predetermined first desired water level and then further supplied through second water supply hose 63 up to a predetermined second desired water level.

Water level detector 46 is used for detecting a water level inside water tub 33 and also serves as a detergent

foam detector for detecting a condition of detergent foams inside water tub 33. Provided on a bottom portion of water tub 33 is washing heater 45 for heating the supplied water.

5 Here, water level detector 46 includes a pressure sensor for sensing a diaphragmatic pressure or the like. Generally, water level detector 46 has a function of detecting a specified water level inside water tub 33 by changing a coil output generated by a water pressure into a frequency. In addition, if a large amount of detergent
10 foams is generated inside water tub 33, there is no place for the detergent foams to escape to so that they remain inside of almost sealed water tub 33, thereby increasing an inner pressure of water tub 33. At this time, water level detector 46 can detect an excessive generation of detergent
15 foams by detecting a predetermined level in pressure change (e.g., 1.5 kHz) at a specified water level (pressure). That is, with a single detector, it is possible to detect a water level of washing water and an abnormal pressure, thereby making it economically very attractive.

20 Disposed at bottom portion 33a of water tub 33 is washing heater 45 including a sheath heater or the like for heating washing water for use in a hot water washing.

Controller 47 is provided at a lower inner portion of washing machine main body 39, whereas input setting unit 50
25 and display unit 51 are disposed near detergent dispenser 61 installed on the upper front surface of washing machine main

body 39.

In this embodiment, though rotary drum 31 has rotating shaft 34 installed at the center of rotation thereof such that the direction of the central axis of rotation thereof is declined toward the rear portion of the washing machine, rotary drum 31 with rotating shaft 34 may be placed such that the direction of the central axis of rotation thereof is approximately horizontal to the washing machine.

Moreover, although a drying function is not provided in this embodiment, the present invention is not limited thereto.

In general, when a temperature of water increases (about 60 °C), foams are easily generated. Therefore, the present invention is particularly effective for a washing machine with a hot water washing function.

Controller 47 has a circuit configuration as shown in Fig. 2. Specifically, control unit 48 including a microcomputer or the like controls operations of motor 35, water drain valve 43, water supply valve 44 and washing heater 45 via power switching unit 49, thereby controlling a series of operations including washing, rinsing, water-extracting and the like in sequence. Input setting unit 50 is used for setting operation courses. Control unit 48 receives information from input setting unit 50 and displays it on display unit 51 to inform a user of the information. Besides, commercial power source 52 supplies a power by

connecting power supply switch 53. In addition, control unit 48 controls a rotation of motor 35 based on information provided from rotation number detector 54 for detecting the number of revolutions of motor 35.

5 Fig. 3 provides a flowchart illustrating operations of principal parts of the drum type washing machine in accordance with a first preferred embodiment of the present invention.

10 Hereinafter, operations to be performed when the water level detector detects detergent foams during a washing process will be described with reference to Fig. 3.

When a washing process is started (step 100), water is supplied up to a specified water level by opening water supply valve 44 (step 101), wherein a reference water level (pressure) is set by water level detector 46 (step 102).
15 Next, in case a frequency change from the reference water level is equal to or greater than a first threshold value, e.g., 1.5 kHz (step 103), it is determined that an abnormally excessive amount of detergent foams is generated.
20 In this case, water is drained (step 104) and, then, a defoaming sequence is performed for about 7 minutes (step 105).

Here, the defoaming sequence is to effectively discharge detergent foams collected near water drain conduit
25 42 of water tub 33 by simultaneously or alternately operating water supply valve 44 and water drain valve 43

while a rotation of rotary drum 31 is preferably stopped completely or the rotational speed thereof is restricted to at about 20 rpm less. Moreover, if laundry articles or detergent foams inside rotary drum 31 are sprayed with water supplied through the opening provided at the upper portion of water tub 33 via second water supply hose 63 described in Fig. 1 and water supply opening 64, the defoaming function is remarkably improved.

When the defoaming sequence is completed, the washing process is completed (step 110) and, then, a next process is followed.

As described above, in case it is determined that a large amount of detergent foams is generated, the detergent foams can be quickly removed by the defoaming function. Accordingly, the failure caused by the generation of detergent foams in a conventional washing machine can also be overcome.

(Second preferred embodiment)

A second preferred embodiment of the present invention will be described with reference to the control circuit diagram shown in Fig. 3.

If the frequency change from the reference water level is smaller than 1.5 kHz in the step 103 and it is determined that the amount of detergent foams is not abnormally excessive, it goes step 106. In case the frequency change from the reference water level is equal to or greater than a

second threshold value, e.g., 1.0 kHz in the step 106, it is determined that the amount of detergent foams is slightly excessive. In this case, it is determined that the defoaming sequence for removing a large amount of detergent
5 foams is not necessarily required. Thus, a delicate sequence is carried out for 3 minutes(step 107) and, then, a typical sequence is returned(step 108).

In the delicate sequence, the washing process is performed by reducing the number of revolutions of rotary
10 drum 31, which is slower than that in the typical sequence (e.g., 40-50 rpm) by the rotational speed of 10-20 rpm, or at an operation rate[rotating time/(rotating time + stopped time)] of rotary drum 31 reduced by about 30 %, for example. Consequently, an agitation power is reduced, so that the
15 generation of detergent foams can be suppressed.

If the frequency change from the reference water level is smaller than 1.0 kHz in the step 106 and it is determined that the amount of detergent foams is small, the typical sequence is continued.

20 After repeating the aforementioned steps for a pre-specified washing hour (step 109), the washing process is completed (step 110) and, then, a next process is followed.

In this manner, it is possible to suppress the increase in the amount of detergent foams generated during
25 the washing process.

(Third preferred embodiment)

In such a drum type washing machine, after the washing process is completed, washing water containing detergent is drained for a rinsing process. In order to remove detergent solution contained in laundry articles, rotary drum 31 is
5 rotated so that a centrifugal separation by using a centrifugal force can be performed. In the third preferred embodiment, if a change in a water level detection signal is detected due to the excessive amount of detergent foams (e.g., in case the frequency change from the reference water
10 level is equal to or greater than 1.0 kHz), a water-extracting operation is not performed during the rinsing process. To be more specific, for a normal case, after washing process is completed, ordinary rinsing process is typically performed. In ordinary rinsing process, washing
15 water containing detergent is drained and the centrifugal separation (water-extracting operation) is performed. Thereafter, water supply, rinsing operation, water drain and centrifugal separation are performed for a predetermined number of times. In the third preferred embodiment, however,
20 if the large amount of detergent foams is generated and the frequency change from the reference water level is equal to or greater than 1.0 kHz in washing or rinsing process, rinsing process without water-extracting operation is carried out in addition to the above mentioned ordinary
25 rinsing process. In the rinsing process without water-extracting operation, water supply, rinsing operation and

water drain performed in the ordinary rinsing process are carried out as usual, but water-extracting operation(the centrifugal separation) is not performed. For instance, when the frequency change from the reference water level is equal to or greater than 1.0 kHz in washing process as the first and the second embodiments, the rinsing process without water-extracting operation in accordance with the third preferred embodiment is performed before the ordinary rinsing process. Further, when the frequency change from the reference water level is equal to or greater than 1.0 kHz during the ordinary rinsing process, the rinsing process without water-extracting operation in accordance with the third preferred embodiment is performed to remove the detergent foams and thereafter, the ordinary rinsing process is performed.

In this manner, the generation of detergent foams can be suppressed during the ordinary rinsing process.

The above mentioned first and second reference values can be varied depending on the type of water level detector.

By detecting a condition of detergent foams from the frequency change in a reference value of water level detector 46 and then removing the detergent foams, it is possible to prevent a breakdown or the like caused by the adhesion of the detergent foams to the electrical components. Further, since the rotation of rotary drum 31 can be prevented from being subjected to a resistance of the

detergent foams, a water-extracting failure(abnormal rotation of drum) does not occur. As a result, the drawbacks such as an insufficient performance of rinsing and water-extraction or an extended operation hour can be overcome.

As described above, the washing machine in accordance with the present invention, which has a horizontal or a slanted rotational axis, can prevent an increase of detergent foams by detecting a condition of detergent foams from a signal change of the water level detector. Therefore, the present invention can be usefully employed as a washing machine or the like having a defoaming member capable of protecting electrical components from the detergent foams.

While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modification may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A drum type washing machine comprising:
 - a rotary drum having a horizontal or a slanted rotational axis;
 - a water tub elastically supported at a washing machine main body, the water
- 5 tub incorporating therein the rotary drum;
 - a water supply unit for supplying water into the water tub;
 - a water level detector for detecting a water level in the water tub;
 - a water drain unit for draining water from the water tub; and
 - a controller for controlling washing, ordinary rinsing, and water-extracting
- 10 operations, wherein the controller detects a condition of detergent foam generated in the water tub based on a signal change from the water level detector and then controls washing, ordinary rinsing, water-extracting processes, the water supply unit and the water drain unit based on the detected result;
 - wherein the controller further controls a defoaming sequence for defoaming
- 15 detergent foam to be performed for a predetermined period when the signal change from the water level detector is detected by the controller and the detected result value is equal to or greater than a first threshold value during the washing or ordinary rinsing process, and

wherein the water level detector is a pressure sensor.

2. The drum type washing machine of claim 1, wherein the controller controls a water supply valve and a water drain valve to supply and drain water in the defoaming sequence simultaneously or alternately.
3. The drum type washing machine of claim 1, wherein the first threshold value is 1.5 kHz.
4. The drum type washing machine of claim 1, wherein the controller further controls a delicate sequence which is more delicately operated than a typical sequence; the delicate sequence being performed when the signal change from the water level detector is detected by the controller and the detected result value is smaller than a first threshold value and equal to or greater than a second threshold value during the washing or ordinary rinsing process.

5. The drum type washing machine of claim 4, wherein the water level detector is a pressure sensor and the first and the second threshold values are 1.5 kHz and 1.0 kHz respectively.

5 6. The drum type washing machine of any one of claims 1, 2, 4 and 5, wherein the controller further controls another rinsing process to be performed in which water supply, rinsing operation, and water drain are performed as the ordinary rinsing process excepting for the water-extracting operation; and wherein said another rinsing process is carried out by the controller when the signal change from the water level detector is
10 detected by the controller and the detected result value is equal to or greater than a predetermined value during washing or ordinary rinsing process.

7. The drum type washing machine of claim 6, wherein when the signal change from the water level detector is equal to or greater than the predetermined value in the
15 washing process due to detergent foams, said another rinsing process is performed by the controller before the ordinary rinsing process; and when the signal change from the water level detector is equal to or greater than the predetermined value during the

ordinary rinsing process due to detergent foam, said another rinsing process is performed first and then the ordinary rinsing process is performed thereafter.

8. The drum type washing machine claim 3, wherein the controller further
5 controls another rinsing process to be performed where water supply, rinsing operation and water drain are performed as the ordinary rinsing process excepting for water-extracting operation, and wherein said another rinsing process is carried out by the controller when the signal change from water level detector is detected by the controller and the detected result value is equal to or greater than a predetermined value during
10 washing or ordinary rinsing process.

9. The drum type washing machine claim 8, wherein when the signal change from the water level detector is equal to or greater than the predetermined value in the washing process due to detergent foam, said another rinsing process is performed by the
15 controller before the ordinary rinsing process; and when the signal change from the water level detector is equal to or greater than the predetermined value during the ordinary rinsing process due to detergent foam, said another rinsing process is performed and the ordinary rinsing process is performed thereafter.