

## DRUM TYPE WASHING MACHINE

### Field of the Invention

5 The present invention relates to a drum type washing machine for carrying out each of wash, rinse, water-extraction cycles and the like by driving to rotate a rotary drum having a horizontal or a slanted rotational axis.

### Background of the Invention

10 A conventional drum type washing machine can perform wash, rinse, water-extraction and dry cycles by rotating a rotary drum about a horizontal or a slanted rotational axis with water supplied up to a predetermined water level in a water tub, wherein heater 20 is provided to heat the  
15 supplied washing water (see, e.g., Japanese Patent Laid-open Application No. H10-201991).

Figs. 4 and 5 show a configuration of a conventional washing machine. Hereinafter, the configuration thereof will be described. Rotatably incorporated in water tub 3 is  
20 rotary drum 1 provided with a number of drum perforations 2 in its entire cylindrical wall. Rotary drum 1 is driven to rotate by horizontal rotating shaft 4 rotatably fixed at center of rotation of the rotary drum 1, wherein rotating shaft 4 is connected to motor 5. A plurality of agitation  
25 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 move 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, water inside water tub 3 can be drained out. Water drain hose 11 connected to water drain pump 10 is extended upwardly inside the main body and then bent downward at a height equivalent to water overflow level 26 to be extended outside of the washing machine. Water is supplied through water supply valve 12 into water tub 3, and water level detector 18 detects the water level in water tub 3. Water heater 20 such as a sheath heater or the like is provided for heating the supplied washing water for use in a hot water washing cycle with a hot water.

By operating fan 13, air is drawn into water tub 3 from air inlet 17 through warm air flow path 15 and passes by heater 14 to be heated. Thereafter, thus the heated air is discharged into water tub 3 through warm air outlet 16, thereby making it is possible to carry out a dry cycle.

With such a configuration, wash, rinse, water-extraction and dry cycles are carried out.

However, when a hot water washing cycle using hot water of an extreme temperature (e.g., 90 °C) is performed

in such a conventional washing machine for the purpose of bleaching or sterilization, the hot water used is drained as it is, which may cause the drain pipe to be deformed or a drainage hole from which the hot water is drained to be deformed. In order to overcome this problem, it is necessary to cool the hot water, before it is drained, by adding the cold water thereto. However, when there is a large amount of laundry articles to be washed, an amount of hot water required is also large, which, as well as requiring a prolonged period of time, requires a sufficient amount of cold water to cool the hot water.

Further, as a countermeasure against the above mentioned problem, an instruction may be provided in the user's manual that the maximum loading amount of laundry articles allowed in the hot water washing cycle should preferably be less than the standard washing amount. But, even in this case, if the user does not observe the instruction given in the manual, this is to no avail.

Moreover, if the amount of the laundry articles is detected using a laundry amount detector between the start of the operation of the washing machine and the water supply operation by comparing the rate of change in the rotational speed of the motor when the motor for driving the rotary drum is turned off, a detection error for the amount of the laundry articles may occur. Further, since it is impossible to determine the make-up of the laundry articles using the

detector, a precise amount of water required, which takes into consideration a difference in water amount required due to a different make-up of the laundry articles, can not be determined.

5 Further, the washing machine may be equipped with an overflow path, extending from inside of the water tub to the drain pipe, for discharging the water overflowing in the abnormal state of the washing machine, e.g., as a result of failure of the water supply valve or the water level  
10 detector or malfunction of failure of their signal transmission path and control unit. When the laundry amount is large in such a case, it is impossible to supply enough water to cool the hot washing water. This is because the hot washing water overflows through the overflow path to be  
15 discharged out without being sufficiently cooled down even with a small amount of cooling water supplied after the wash cycle has been completed.

#### Summary of the Invention

20 It is, therefore, an object of the present invention to provide a washing machine capable of saving water and time needed to cool and drain hot water and at the same time improving safety in a hot water washing cycle thereof by preventing hot water from being drained even for the case  
25 when the amount of laundry is large, requiring a corresponding large amount of washing water, wherein the hot

water washing cycle is carried out by using hot water of an extreme temperature(e.g., 90 °C) for the purpose of bleaching or sterilization.

5 It is another object of the present invention to provide a safe washing machine capable of preventing, for a large amount of laundry, the hot washing water from being drained out through an overflow path provided therein even if a sufficient amount of cooling water is not supplied thereto, the overflow path extending from inside of the  
10 water tub to the drain pipe and being used for discharging water overflowing in an abnormal state of the washing machine.

In accordance with the present invention, there is provided a drum type washing machine including: a rotary  
15 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  
20 water tub; a water drain unit for draining water from the water tub; a heating unit for heating washing water in the water tub; a temperature detector for detecting temperature of a washing water in the water tub; and a controller for controlling wash, rinse, water-extraction cycles and hot  
25 water washing cycle for heating water to perform the wash cycle by receiving data from the temperature detector to

control the heating unit, wherein the controller is operated so that a heating set temperature of the heating unit is controlled to lower temperature when the increasing temperature rate detected by the temperature detector is equal to and less than a predetermined value during the hot water washing cycle.

Even if the hot water washing cycle of the washing machine utilizes hot water of an extreme temperature (e.g., 90 °C) for the purpose of bleaching and sterilization and the amount of laundry (the amount of washing water) is large, with the washing machine in accordance with the present invention, it is possible to save water and time needed to cool and drain hot water.

Further, with the present invention, a safe washing machine is attained, the washing machine capable of preventing, for a large amount of laundry, the hot washing water from being drained out through the overflow path provided therein even if a sufficient amount of cooling water is not supplied thereto, the overflow path extending from inside of the water tub to the drain pipe and being used for discharging water overflowing in an abnormal state of the washing machine.

#### Brief Description of the Drawings

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:

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;

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

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 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 embodiment of the present invention and Fig. 2 describes a control circuit diagram of the drum type washing machine

shown in Fig. 1.

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 is installed inside water tub 33 to be freely movable. Rotary drum 31 has rotating shaft (central axis of rotation) 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 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. A plurality of agitation blades 36 is provided on an inner cylindrical surface of rotary drum 31 to easily stir laundry articles. 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 while deadening the vibration. 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 draining unit) 43 so that washing water in water tub 33 can be drained therethrough. Water supply valve (water supply unit) 44a supplies water into water tub 33 via water supply conduit 44b. Water level detector 46 is used for detecting a water level inside water tub 33. Provided on a bottom portion of water tub 33 are washing heater 45 (heating unit) for heating the supplied water and temperature detector 55 for detecting the temperature of washing water heated by washing heater 45.

In order to allow water inside water tub 33 to flow out through overflow hole 19a when the water level inside of water tub 33 is abnormally raised, overflow line 19b is set. One end of overflow path 19 communicates with overflow hole 19a and the other thereof is connected to drain conduit 42a installed at a place located below water drain valve 43.

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.

As shown in Fig. 2, controller 47 includes control

unit 48. Control unit 48 having a microcomputer or the like controls operations of motor 35, water drain valve 43, water supply valve 44a and washing heater 45 via power switching unit 49, thereby controlling a series of wash, rinse, water-extraction cycles and the like in sequence. Input setting unit 50 is used for setting operation cycles. 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.

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.

Hereinafter, operations to be performed in case that a heating set temperature is set to lower temperature when the increasing temperature rate detected by the temperature detector is lower than a predetermined value in the hot water washing cycle, will be described with reference to Fig. 3.

When a hot water washing cycle is started (step 100) and water supply operation is completed (step 101), the

heating operation for increasing the temperature of the supplied washing water up to the threshold temperature(e.g., 90 °C) is performed in the wash cycle by means of washing heater(heating unit) 45 (step 102). Once it is detected by temperature detector 55 that the temperature of the washing water reaches a predetermined temperature (e.g., 50 °C) (step 103), the time period required for the predetermined temperature to reach a prescribed temperature (e.g., 60 °C), i.e., the increasing temperature rate is measured (step 104).

10 If the measured time period is greater than a first time period, e.g., 6 minutes, it is determined that water amount is large, e.g., water amount is 30L. In this case, the heating set temperature is set to a first heating temperature (e.g., 70 °C) (step 105) lower than the threshold temperature and the wash cycle is continuously performed. In the step 104, if the measured time period is equal to or smaller than the first time period, it goes to step 106.

20 In the step 106, if the measured time period is between the first time period and a second time period (e.g., 4 minutes), it is determined that water amount is slightly smaller, e.g., water amount is 20L. In this case, the heating set temperature is set to a second heating temperature between the first heating temperature and the heating set temperature, e.g., 80 °C (step 107) and the wash cycle is continuously performed.

If the time period is less than the second time period in the step 106, it is determined that water amount is even smaller, e.g., water amount is 10L. In this case, the heating set temperature is set to, e.g., the threshold temperature (90 °C) (step 108) and the wash cycle is continuously performed.

Next, a cooling operation is performed (step 109). Specifically, water is supplied by operating water supply valve 44a to lower the temperature of the washing water to a cooling target temperature (e.g., 65 °C). Thereafter, the wash cycle is ended (step 110) and, then, a next cycle is to be followed.

Time period(h, minutes) needed to increase temperature of a predetermined water amount(V, L) by  $\Delta T$  is calculated by using equation below.

$$h = (0.2778 \times 60 \times C \times d \times V \times \Delta T \times a) / w$$

where W represents heater output; C, thermal capacity(4.18Kj/kg·deg); d, specific gravity(1kg/L); a, loss factor; V, water amount;  $\Delta T$ , raised temperature change(deg). In other words, the time period (h) is in proportion to water amount(V, L).

As described above, since an operation for controlling the heating set temperature is performed based on an increasing time of the washing water temperature, it is possible to detect an actual water amount, taking into consideration, make-up or type of laundry articles. As a

result, the mechanical deviation factors can be reduced, allowing precise decision to be reached. That is, it is possible to precisely measure washing water amount, compared with the conventional method which determines washing water amount detecting rate of change in the rotational speed of the motor when the motor for driving the rotary drum is turned off. Further, since it is possible to change washing sequence such as the number of rotation of rotary drum or stopped time and rotating time thereof or the like on the basis of the actual washing water amount obtained from the above measure result, it is more effective.

In addition, when water amount is large, a great deal of energy is required to heat washing water, but in accordance with this embodiment, water amount can be reduced when the water drain or the water cooling is performed and this saves energy. Therefore, it is very economical.

Since there is no possibility of the temperature of washing water attaining the high temperatures of washing water of the conventional washing machine in the hot water washing cycle in accordance with the present invention, the present invention is extremely effective for washing machines having a limited supply of cooling water through the overflow path for cooling the high temperature washing water.

In general, the higher temperature is, the more effective sterilization is. But, sterilization in the

general household involves removal of germ such as colon bacilli or yellow staphylococci or the like and it is known that such colon bacilli or yellow staphylococci can be effectively removed by being exposed to hot water of 50 - 60 °C or more for a predetermined period of time.

Therefore, in accordance with this embodiment, since when the amount of laundry articles are large, the first heating temperature is set to 70 °C, and this temperature should be enough to achieve desired germ removal.

Further, the higher temperature is, the more effective bleaching is. However, bleaching for general household laundry is carried out to remove yellow spots on cotton fabrics due to sebaceous matters or leftovers of food including oil and pigment or the like on fabrics. For such, bleaching can be sufficiently carried out at the temperature of 40 - 60 °C.

As described above, when the increasing temperature rate detected by the temperature detector during the hot water washing cycle is equal to and less than a predetermined value, it is determined that amount of laundry articles is large, controlling the heating temperature to decrease. Accordingly, the water draining operation after the hot water washing cycle is performed safely and economically.

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.

What is claimed is:

1. A drum type washing machine comprising:

5 a rotary 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;

10 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;

15 a heating unit for heating washing water in the water tub;

a temperature detector for detecting temperature of a washing water in the water tub; and

20 a controller for controlling wash, rinse, water-extraction cycles and hot water washing cycle for heating water to perform the wash cycle by receiving data from the temperature detector to control the heating unit,

25 wherein the controller is operated so that a heating set temperature of the heating unit is controlled to lower temperature when the increasing temperature rate detected by the temperature detector is equal to and less than a

predetermined value during the hot water washing cycle.