

DRUM TYPE WASHING MACHINE

Field of the Invention

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

10 Background of the Invention

 In general, conventional drum type washing machine has a function of heating washing water to a high temperature in order to enhance a cleaning effect of laundry articles or
15 destroy germs clinging to the laundry articles (see, e.g., Japanese Patent Laid-open Application No. H10-263285).

 Fig. 9 shows a conventional drum type washing machine disclosed in Japanese Patent Laid-open Application No. H10-263285. Hereinafter, a configuration thereof will be
20 described.

 As shown in Fig. 9, rotary drum 1 provided with a number of drum perforations 2 on its entire cylindrical wall is incorporated in water tub 3 in such a way that rotary drum 1 is allowed to rotate therein. One end of rotating
25 shaft 4 is fixed to a central axis of rotation of rotary drum 1 in an approximately horizontal direction. Further,

the other end thereof is fixed to idler pulley 5. Rotary drum 1 is driven to rotate by first motor 6 with a first rotational speed N1 (e.g., 53 rpm) during wash or rinse cycle. Further, rotary drum 1 is driven to rotate by second motor 7 with a second rotational speed N2 (e.g., 1000 rpm) during a water-extraction cycle.

First and second motor 6 and 7 are connected to idler pulley 4 via belts 8 and 9, respectively. Idler pulley 5 is provided with two types of reduction ratios. To be more specific, first motor 6 is connected to first idler pulley 5a having a large reduction ratio via belt 8 and thus rotates the rotary drum 1 at a low rotational speed, whereas second motor 7 is connected to second idler pulley 5b having a small reduction ratio via belt 9 and thus rotates the rotary drum 1 at a high rotational speed.

Water tub 3 including water tub main body 3a having an approximately circular cross section about rotating shaft 4 and approximately circular water tub front plate 3b for covering an opening of water tub main body 3a incorporates therein rotary drum 1. Rotary drum 1 and water tub 3 are configured to have approximately concentric circular shapes about rotating shaft 4 in a direction perpendicular to rotating shaft 4. Approximately recessed heater chamber 15 is provided at a bottom portion of the water tub 3 to accommodate therein heater 14.

Water tub 3 is suspended in washing machine main body

10 so that it can move in left/right and to-and-fro
directions by springs 11 and its vibration generated during
the water-extraction cycle is reduced by vibration damper 12.
Further water tub 3 is supported by anti-vibration weight 13
5 for preventing its vibration generated during a normal
water-extraction cycle from being transferred to washing
machine main body 10 and also for reducing a vibration
generated during the water-extraction cycle. Furthermore,
by connecting one end portion of water drain hose 16 to a
10 bottom portion of water tub 3 and the other end portion
thereof to water drain pump 17, washing water in water tub 3
can be drained out. In a lower vicinity of heater 14,
temperature detector 18 and anti-overheating device 19 are
fixed to a bottom portion of water tub main body 3a.

15 Approximately cylindrical packing member 20 is formed
of a flexible material such as rubber or the like and
connects an opening portion of water tub 3 provided at same
vertical plane as a front opening of rotary drum 1 and a
front opening portion of washing machine main body 10, one
20 end thereof located at the water tub side being fixed to
outer front plate 3b. Furthermore, opening/closing door 21
is provided at the front opening portion of washing machine
main body 10. Water supply valve 22 supplies water into
water tub 3.

25 Controller 23 controls operations of first and second
motor 6 and 7, heater 14, water drain pump 17, water supply

valve 22 or the like. Further, controller 23 includes a control unit for controlling a series of cycles including wash, rinse, water-extraction or the like in sequence, an input unit, a display unit and the like.

5 An operation of the washing machine having the
aforementioned configuration will now be described. After
opening door 21, laundry articles are loaded into rotary
drum 1. After the operation is initiated by turning on a
power switch (not shown) and a start switch (not shown)
10 provided at the controller 23 is manipulated, water is
supplied by operating water supply valve 22. The supply of
water is stopped when the water level detected by a water
level detector (not shown) reaches in a preset water level
and, then, first motor 6 is driven. During the washing
15 cycle, water gets absorbed into the laundry articles. For
this reason, water is replenished, rotary drum 1 is driven
to rotate at a low speed by first motor 6 with a first
rotational speed N1, and the laundry articles inside rotary
drum 1 undergo so-called pounding motions by being lifted up
20 and then dropped onto a surface of water.

At this time, heater 14 is powered on to heat the
washing water in water tub 3 to a target temperature and
controls temperature of washing water with an aid of
temperature detector 18.

25 After completion of the wash cycle, washing water is
drained from water tub 3 by operating water drain pump 17.

In the rinse cycle, the same operations as the washing cycle are carried out.

During the water-extraction cycle, rotary drum 1 is driven to rotate at a high speed by second motor 7 with a second rotational speed N_2 so that water on the laundry articles is squeezed out by a centrifugal force. At this time, if the laundry articles are not arranged in a balanced manner inside rotary drum 1, although vibrating members such as rotary drum 1, water tub 3 or the like vibrate, vibration damper 12 dampens the vibration therefrom during the water-extraction cycle and also anti-vibration unit prevents the vibration from being transferred to washing machine main body 10 during the normal water-extraction cycle.

However, in such conventional configuration, washing water temperature control and maintaining of uniformity in the washing water temperature are attained by mixing of washing water resulting from rotation of rotating drum.

In case the washing water is required to be heated to a high temperature (e.g., above 80 °C), without setting a washing time, a certain amount of time will be spent in heating washing water to that temperature, increasing the total washing time, and this increase in washing time may result in increase in number of forward and backward rotations of the rotary drum, translating into increase in motor load, which, in turn, may lead to operational failures of the motor caused by increase in motor temperature caused

by increase in motor load. On the other hand, in case the washing time is set, if the amount of laundry articles is large or the temperature of water fed into the drum is not high enough, the water temperature may not reach the preset level. In such case, desired effects of high temperature washing cycle, i.e., cleaning and sterilizing, may not be realized. In addition, if the amount of laundry articles is small, a stirring time may become unnecessarily long, resulting in fabric damage or shrinkage.

Further, since the operation failures may occur in a heating unit or a temperature detector for the washing water, countermeasures against those problems should also be implemented.

Summary of the Invention

Embodiments of the present invention seek to provide a drum type washing machine capable of reducing fabric damages and a load to a motor without affecting effects of a high temperature washing regardless of the amount of laundry articles or a temperature of supplied washing water in a high temperature washing cycle for performing a washing with washing water heated above a predetermined temperature.

In accordance with a first aspect of the present invention, there is provided a drum type washing machine equipped with a washing

machine main body having an opening whose front portion is provided with an opening/closing door, comprising: a cylindrical rotary drum having a bottom portion and a horizontal or a slanted rotational axis; a cylindrical water tub having a bottom portion, the rotary cylindrical water tub incorporating therein the rotary drum in such a way to allow the rotary drum to rotate therein; a motor for rotating the rotary drum; a heating unit for heating washing water in the water tub; a temperature detector for detecting a temperature of the washing water in the water tub; a water supply unit for controlling a supply of the washing water into the water tub; a water level detector for detecting a level of the washing water in the water tub; a water draining unit for controlling a drain of the washing water in the water tub; and a controller for controlling a series of cycles including wash, rinse and water-extraction by controlling the motor, the heating unit, the water supply unit and the water draining unit with data inputted from the temperature detector and the water level detector, wherein in a high temperature washing cycle for performing a washing with washing water heated above a first predetermined temperature by controlling the heating unit, the controller sets a rate of an agitating time in a first agitating operation to be lower than a rate of an agitating time in a second agitating operation, the first agitating operation for rotating the rotary drum until a temperature of the

heated washing water reaches a second predetermined temperature lower than the first predetermined temperature and the second agitating operation for rotating the rotary drum until the temperature of the washing water increases from the second predetermined temperature to the first predetermined temperature.

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 vertical 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 block diagram of the drum type washing machine;

Fig. 3 provides an enlarged front view of an input setting unit and a display unit of the drum type washing machine;

Fig. 4 presents an operation flowchart of principal parts of the drum type washing machine;

Fig. 5 offers a view for setting forth high temperature washing cycle of the drum type washing machine;

Fig. 6 represents an operation flowchart of principal

parts of a drum type washing machine in accordance with a second preferred embodiment of the present invention;

Fig. 7 depicts an operation flowchart of principal parts of a drum type washing machine in accordance with a third preferred embodiment of the present invention;

Fig. 8 illustrates an operation flowchart of principal parts of a drum type washing machine in accordance with a fourth preferred embodiment of the present invention; and

Fig. 9 is a vertical sectional view of a conventional drum type washing machine.

Detailed Description of the Preferred Embodiment

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

(First preferred embodiment)

Fig. 1 shows a longitudinal sectional view of a drum type washing machine in accordance with a first preferred embodiment of the present invention; Fig. 2 describes a partial control circuit block diagram of the drum type washing machine shown in Fig. 1; Fig. 3 provides an enlarged front view of an input setting unit and a display unit of the drum type washing machine shown in Fig. 1; Fig. 4 presents an operation flowchart of principal parts of the

drum type washing machine; and Fig. 5 offers a view for setting forth a high temperature washing cycle of the drum type washing machine shown in Fig. 1.

As illustrated in Fig. 1, cylindrical rotary drum 24
5 having a bottom surface is provided with a number of drum perforations 25 on its entire cylindrical wall and also is installed inside water tub 26 in such a way that it is allowed to rotate therein. Further, rotary drum 24 has a rotating shaft(central axis of rotation) 27 provided at the
10 center of rotation thereof such that a direction of the central axis of rotation thereof is declined toward a rear portion of the washing machine. A rotational force of motor 28 installed at an outer bottom surface of water tub 26 is transferred to rotating shaft 27 via V belt 52 tightly hung
15 between driving pulley 50 fixed to a rotational axis of motor 28 and idler pulley 51 installed around an end portion of rotating shaft 27 to drive rotating drum 24 to rotate in forward and reverse directions. By providing several agitation blades 29 on an inner surface of rotary drum 24,
20 an agitating operation in which laundry articles are lifted up and dropped onto a surface of water to undergo so-called pounding motions.

Opening 30b formed on upward slant surface 30a of a front portion of washing machine main body 30 can be
25 opened/closed by door 31. By opening door 31, laundry articles can be loaded into and unloaded from rotary drum 24

through water tub laundry loading/unloading opening 26a of
water tub 26 and rotary drum laundry loading/unloading
opening 24a. Further, to ensure safety to a user, door 31
is configured to be closed by actuating door locking unit 40
5 during the operation of the washing machine.

Water tub 26 is suspended in washing machine main body
30 so that it can rock in left/right and to-and-fro
directions by spring 33 and is supported by damper 34 so
that its vibration is reduced. Further, by connecting one
10 end portion of water drain conduit 32 to a lower portion of
water tub 26 and the other end portion thereof to water
drain valve 36, washing water in water tub 26 can be drained
therethrough. Water supply valve (water supply unit) 37
supplies water into water tub 26 via detergent dispenser 35
15 and water supply conduit 38. Water level detector 39
detects a water level in water tub 26. Further, by
providing heater(heating unit) 14 for heating washing water
and temperature detector 42 for detecting a temperature of
the washing water at an inner lower portion of water tub 26,
20 laundry articles in rotary drum 24 can be cleaned with hot
water.

In this preferred embodiment, though rotary drum 24
has rotating shaft 27 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
25 washing machine, rotary drum 24 with rotating shaft 27 may

be placed such that the direction of the central axis of rotation thereof is approximately horizontal to the washing machine.

Controller 43 is configured as shown in the control circuit diagram of Fig. 2 and includes control unit 44. Further, control unit 44 having a microcomputer or the like controls operations of motor 28, water drain valve 36, water supply valve 37, heater 41 or the like thereby controlling a series of cycles including wash, rinse and water-extraction in sequence. Control unit 44 receives information for setting an operation course or the like from input setting unit 45 and then displays it on display unit 46 to inform the user of the information. At the same time, once the operation is commenced by input setting unit 45, control unit 44 receives data from water level detector 39 for detecting a water level in water tub 26 or the like and then controls operations of motor 28, water drain valve 36, water supply valve 37, heater 41 or the like via load driving unit 47, thereby performing a predetermined operation.

As shown in Fig. 3, input setting unit 45 includes washing time setting switch 45a for setting a washing time, rinsing number setting switch 45b for setting a rinsing number, water-extracting time setting switch 45c for setting a water-extracting time, start/pause switch 45e, power-on switch 45f, power-off switch 45g, water level changing input setting switch 45h, water temperature changing input switch

45i, course setting switch 45d for selecting various washing courses or the like.

Also, as shown in Fig. 3, display unit 46 includes washing time display unit 46a, rinsing number display unit 46b, water-extracting time display unit 46c, course setting display unit 46d for displaying a course set by course setting switch 45d, e.g., a "sterilizing course" for performing a washing with hot water, water level display unit 46e, water temperature display unit 46f, residual operating time display unit 46g or the like.

Hereinafter, an operation of the drum type washing machine configured as described above will be explained with reference to the flowchart of Fig. 4 and the operation flowchart of Fig. 5.

After opening door 31, laundry articles are loaded into rotary drum 24. The operation is started by turning on power-on switch 45f in a step 101. Next, course setting switch 45d is manipulated in a step 102, thereby setting a high temperature course (e.g., sterilizing course) for performing a washing with water heated above a first predetermined temperature T1. In a step 103, it is checked whether or not the settings of the water level, the water temperature, the washing time, the rinsing number and the water-extracting time are needed to be changed. If the settings are to be changed, the changed settings are executed by manipulating washing time setting switch 45a,

rinsing number setting switch 45b, water-extracting time setting switch 45c, water level changing input setting switch 45h and water temperature changing input switch 45i. Next, information on the changes is displayed on display unit 46 in a step 104. On the contrary, if the settings are not to be changed, it is allowed to proceed to a step 105. If the operation is initiated by manipulating start/pause switch 45e in the step 105, door locking unit 40 or the like is actuated by control unit 44 in a step 106. Thereafter, water is supplied by operating water supply valve 37 in a step 107, and, then, whether or not the water has reached a predetermined water level is checked by water level detector 39 in a step 108. If it has reached the predetermined water level, it is allowed to proceed to a wash cycle. In a step 109, an agitating rotation of rotary drum 24 is initiated by driving motor 28, thereby executing a first agitating operation of the wash cycle. Meanwhile, if it has not reached the predetermined water level, it is returned to the step 107. During the wash cycle, rotary drum 24 is driven to rotate by motor 28 with a rotational speed N so that laundry articles therein can be lifted up and dropped onto a surface of water to undergo so-called pounding motions.

In a step 110, the washing water is heated by heater 14 under the control of control unit 44. In a step 111, whether or not a temperature T of the washing water is heated above a second predetermined temperature T_2 (e.g., 50

°C, see notation "I" of Fig. 5) is checked by temperature detector 42. If it is higher than or equal to the second predetermined temperature T2, it is allowed to proceed to a second agitating operation of a step 112. On the other hand, if it is lower than the second predetermined temperature T2, it is returned to the step 110. Likewise, the high temperature washing cycle is divided into the first half agitating operation of the step 109 and the second half agitating operation of the step 112.

In this case, as will be shown in a following Eq.(1), an operating rate X1% (agitating time/(stopped time + agitating time)) of a drum in the first half agitating operation is set to be smaller than an operating rate of an operating rate X2% of the drum in the second half agitating operation.

[Eq. 1]

In case the agitating time of 7 seconds and the stopped time of 23 seconds are repeated in the first agitating operation, an operating rate of the drum in the first agitating operation =

operating rate of drum X1 % = $7 \text{ sec} / (7 \text{ sec} + 23 \text{ sec}) \times 100 = 23 \%$, and

in case the agitating time of 15 seconds and the stopped time of 8 seconds are repeated in the second agitating operation, an operating rate of the drum in the second agitating operation =

operating rate of drum X2 % = $15 \text{ sec} / (15 \text{ sec} + 8 \text{ sec})$
× 100 = 65 %, wherein X1 % is smaller than X2 %.

Moreover, in comparison with a case where the amount of laundry articles is small (e.g., 1 kg) or a feed water temperature is high (e.g., 30 °C), if the amount of laundry
5 articles is large (e.g., 6 kg) or a feed water temperature is low (e.g., 1 °C), a period of time required for increasing washing water temperature to the second predetermined temperature T2 becomes longer. Thus, a time
10 for the first half agitating operation becomes longer, whereas an actual agitating time of the laundry articles, i.e., an actual driving time of the motor, becomes shortened.

In a step 113, whether or not a temperature T of the washing water has reached the first predetermined
15 temperature T1 (e.g., 90 °C, see notation "I" of Fig. 5) is checked by temperature detector 42. If it is higher than or equal to the first predetermined temperature T1, it is allowed to proceed to a step 114 to turn off heater 41 by means of control unit 44. On the contrary, if it is lower
20 than the first predetermined temperature T1, the high temperature washing is considered to be incomplete and, thus, it is returned to the step 112.

In a step 115, an agitating rotation of rotary drum 24 is stopped by stopping a driving of motor 28 with the use of
25 control unit 44, thereby completing the wash cycle. In a step 116, it goes to a next cycle, e.g., a rinse cycle or

the like.

As described above, in the high temperature washing cycle in accordance with this preferred embodiment, the small amount of agitation is executed during the first half
5 agitating operation until the second predetermined temperature T2 (e.g., 50 °C) is achieved. Accordingly, a load to motor 29 for rotating rotary drum 24 decreases and, thus, operation failures caused by the temperature increase can be prevented. And, also, even in case the washing time
10 is extended, the operation can be normally continued until the completion of the cycle. Moreover, by extending the stopped time between the agitations, effects of a hot water washing are achieved, resulting in an enhanced cleaning effect.

15 Meanwhile, in the second half agitating operation, the large amount agitation is executed in a state of high temperature ranging from the second predetermined temperature T2 (e.g., 50 °C) to the first predetermined temperature T1 (e.g., 90 °C). Accordingly, the washing
20 water of a high temperature is sufficiently applied to the laundry articles, thereby enabling to improve the cleaning efficiency and the sterilizing efficiency.

Consequently, in case the amount of laundry articles is large (e.g., 6 kg) or a feed water temperature is low
25 (e.g., 15 °C), since a period of time required for increasing washing water temperature to the second

predetermined temperature T2 becomes longer, a time for the first half agitating operation becomes longer. However, the actual agitating time decreases and, thus, a load to motor 28 gets reduced. Further, the washing time can be extended until the first predetermined temperature T1 of a desired high temperature is achieved. On the other hand, in case the amount of laundry articles is small or a feed water temperature is high, a period of time for increasing the washing water temperature to a predetermined temperature becomes shortened. Accordingly, the washing time becomes short and the agitation number of the laundry articles is reduced, preventing the fabrics of the laundry articles from being damaged and shrunken from the high temperature agitation.

(Second preferred embodiment)

Fig. 6 shows an operation flowchart of principal parts of a drum type washing machine in accordance with a second preferred embodiment of the present invention.

In the first agitating operation of the high temperature washing cycle, control unit 44 repeats an agitating of a cycle, i.e., a combination of a low agitation having a low rate of the agitating time (e.g., 7 sec agitation and 23 sec stop) and a high agitation having a high rate of the agitating time (e.g., 20 sec agitation and 4 sec stop) compared to the low agitation. This is for preventing a water temperature detecting accuracy from being

deteriorated due to the low operating rate of the rotary drum in the first half agitating operation caused by an insufficient washing agitation. Since other parts are equal to those of the first preferred embodiment, the same reference numerals are used to represent them and the detailed description thereof will be omitted.

Hereinafter, an operation of the aforementioned configuration will be described. Steps 201 to 208 of Fig. 6 are equal to the steps 101 to 108 of the first preferred embodiment, so that a description thereof will be omitted.

In the first agitating operation, washing water is heated by heater 41 being controlled by control unit 44.

Next, in a step 210, an agitating rotation of rotary drum 24 is initiated by driving motor 28 to perform a low agitation (agitation 1a, 7 sec agitation and 23 sec stop, for example, see "II" of Fig. 5),.

In a step 211, it is checked whether or not an agitating time S of the low agitation has reached a predetermined time S1a (e.g., 5 min). If it has reached the predetermined time S1a, it is allowed to proceed to a step 211 to execute a high agitation (agitation 1b, 20 sec agitation and 4 sec stop, for example, see "II" of Fig. 5). Meanwhile, if it has not reached the predetermined time S1a, it is returned to the step 210.

In a step 213, it is checked whether or not an agitating time S of the high agitation has reached a

predetermined time S1b (e.g., 1 min). If it has reached the predetermined time S1b, it is allowed to proceed to a step 214. Meanwhile, if it has not reached the predetermined time S1b, it is returned to the step 212.

5 In a step 214, it is checked whether or not a washing water temperature T has reached a second predetermined temperature T2 (e.g., 50 °C). If it has reached the second predetermined temperature T2, it is allowed to proceed to a second agitating operation of a step 215. Meanwhile, if it
10 has not reached the second predetermined temperature T2, it is returned to the step 210.

 Likewise, when the agitating cycle i.e., a combination of a low agitation having a low rate of the agitating time and a high agitation having a high rate of the agitating
15 time compared to the low agitation, is repeated in the first agitating operation, although a temperature is non-uniform during the low agitation in which the laundry articles in the rotary drum are not properly stirred due to a small number of agitations, a uniform temperature can be achieved
20 by stirring the entire laundry articles during the high agitation. Thus, it is possible to more precisely detect a temperature of the washing water and that of the laundry articles in the rotary drum.

 Accordingly, in case a load to the motor increases due
25 to the extended washing time depending on the amount of laundry articles or the feed water temperature, e.g., in

case the amount of laundry articles is large or a feed water temperature is low, a mechanical power of the first half agitation is suppressed, thereby reducing the possibility of motor's operation failures caused by the temperature increase and ensuring the washing time until a temperature of the washing water reaches the first predetermined temperature T1. On the contrary, in case the amount of laundry articles is small or the feed water temperature is high, since a temperature of the washing water quickly increases, the washing time becomes short. As a result, the fabrics can be less damaged and less shrunken from the high temperature washing.

(Third preferred embodiment)

Fig. 7 offers an operation flowchart of principal parts of a drum type washing machine in accordance with a third preferred embodiment of the present invention.

Control unit 44 in accordance with a third preferred embodiment of the present invention controls the operation of the washing machine when failure of the heating unit or the temperature detector occurs. This control is achieved by allowing the operation of the washing machine to proceed to a next cycle in case the first and the second predetermined time are respectively detected in the first and the second agitating operation of the high temperature washing cycle. Since other parts are equal to those of the first to the second embodiment, the same reference numerals

are used to represent them and the detailed description thereof will be omitted.

Hereinafter, an operation of the aforementioned configuration will be described. Steps 301 to 308 of Fig. 7
5 are equal to the steps 101 to 108 of the first preferred embodiment, so that a description thereof will be omitted.

In a step 309, control unit 44 initiates an agitating rotation of rotary drum 24 by driving motor 28, thereby executing a first agitating operation. Next, in a step 310,
10 washing water is heated by controlling heater 41. In a step 311, it is checked whether or not an agitating time of the first agitating operation is shorter than a first predetermined time S1 (e.g., 40 min, see "III" of Fig. 5). If it is shorter than the first predetermined time S1, it is
15 allowed to proceed to a step 312. However, if it is longer than the first predetermined time S1, it is allowed to proceed to a step 313.

In the step 312, it is checked whether or not a washing water temperature T has reached a second
20 predetermined temperature T2 (e.g., 50 °C). If it has reached the second predetermined temperature T2, it is allowed to proceed to a second agitating operation of the step 313.

In other words, in the first agitating operation, if
25 the agitating time has reached the first predetermined time S1 despite that the washing water temperature has not

reached the second predetermined temperature T2, the heating unit or the temperature detector is considered to be abnormal, and, then, it goes to the second agitating operation of the next step.

5 In a step 314, it is checked whether or not an agitating time of the second agitating operation is shorter than a second predetermined time S2 (e.g., 60 min, see "III" of Fig. 5). If it is shorter than the second predetermined time S2, it is allowed to proceed to a step 315. However,
10 if it is equal to or longer than the second predetermined time S2, it is allowed to proceed to a step 316.

 In the step 315, it is checked whether or not the washing water temperature T has reached a first predetermined temperature T1 (e.g., 90 °C). If it has
15 reached the second predetermined temperature T2, it is allowed to proceed to the step 316 to turn off heater 41 with control unit 44.

 In other words, in the second agitating operation as well as in the first one, if the agitating time has reached
20 the second predetermined time S2 despite that the washing water temperature has not reached the first predetermined temperature T1, the heating unit or the temperature detector is considered to be abnormal and, it proceeds to a next cycle.

25 Likewise, by limiting maximum agitating time, i.e., the first and the second predetermined time S1 and S2, in

the first and the second agitating operation, when heater 41 or temperature detector 42 is not able to detect the first water temperature T1 due to their failures or the like, the agitating operation can be completed after the predetermined time and, then, the next cycle can be carried out. Accordingly, it is possible to restrict the load to the motor and prevent the motor's operation failures caused by the temperature increase or the fabric damage from an unnecessary agitation.

(Fourth preferred embodiment)

Fig. 8 provides an operation flowchart of principal parts of a drum type washing machine in accordance with a fourth preferred embodiment of the present invention.

Control unit 44 in accordance with the fourth preferred embodiment is configured to execute the high temperature washing cycle for a third predetermined time S3 (e.g., 60 min). The third predetermined time S3 indicates a minimum agitating time for ensuring the cleaning efficiency or the sterilizing efficiency required in the high temperature washing cycle. Since other parts are equal to those of the first to the third preferred embodiment, the same reference numerals are used to represent them and the detailed description thereof will be omitted.

Hereinafter, an operation of the aforementioned configuration will be described. Steps 401 to 414 of Fig. 8 are equal to the steps 101 to 114 of the first preferred

embodiment, so that a description thereof will be omitted.

In a step 415, it is checked whether or not the high temperature washing time is longer than the third predetermined time S3 (e.g., 60 min, see "IV" of Fig. 5).

5 If it is longer than the third predetermined time S3, it is allowed to proceed to a step 416.

In the step 416, the agitating rotation of rotary drum 24 is stopped by stopping a driving of motor 28 with the use of control unit 44, thereby completing the wash cycle.
10 Thereafter, it goes to a step 418 in which a next cycle is executed.

Meanwhile, if the high temperature washing time is equal to and shorter than the predetermined time S (e.g., 60 min) in the step 415, it goes to a step 417 where a rotation
15 of rotary drum 24 is controlled as in the second agitating operation of the step 412 until it reaches the third predetermined time S3.

As described above, in accordance with this preferred embodiment, the high temperature washing cycle is performed
20 for more than a minimum predetermined time, i.e., the third predetermined time S3, capable of at least ensuring the efficiency thereof. Accordingly, even if the amount of laundry articles is small or the feed water temperature is high, it can be ensured that the operation is executed for a
25 predetermined time until a predetermined water temperature is achieved, thereby preventing the cleaning efficiency or

the sterilizing efficiency from being deteriorated due to an early completion of the agitating operation. As a result, it is possible to improve and optimize the cleaning efficiency and the sterilizing efficiency in the high temperature water washing.

Although heater 41 is turned off in the step 417, heater 41 may be on-off controlled to thereby maintain the washing water temperature T at the second predetermined temperature, which, in turn, will enhance the cleaning efficiency or the sterilizing efficiency.

As described above, in the drum type washing machine in accordance with the present invention, in case a load to the motor increases due to the extended washing time depending on the amount of laundry articles or the feed water temperature, e.g., in case the amount of laundry articles is large or a feed water temperature is low, a mechanical power of the first half agitation is suppressed, thereby reducing the possibility of the motor's operation failures caused by the temperature increase of the motor and ensuring the washing time until a temperature of the washing water reaches a predetermined temperature. On the contrary, in case the amount of laundry articles is small or the feed water temperature is high, since a temperature of the washing water quickly increases, the washing time is controlled to become short. Consequently, the fabrics can be less damaged and less shrunken from the high temperature

washing. For this reason, the present invention is applicable to a drum type washing machine having a drying function.

5 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 equipped with a washing machine main body having an opening whose front portion is provided with an opening/closing door, comprising:

a cylindrical rotary drum having a bottom portion and a horizontal or a slanted rotational axis;

a cylindrical water tub having a bottom portion, the cylindrical water tub incorporating therein the rotary drum in such a way to allow the rotary drum to rotate therein;

a motor for rotating the rotary drum;

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

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

a water supply unit for controlling a supply of the washing water into the water tub;

a water level detector for detecting a level of the washing water in the water tub;

a water draining unit for controlling a drain of the washing water in the water tub; and

a controller for controlling a series of cycles including wash, rinse and water-extraction by controlling the motor, the heating unit, the water supply unit and the water draining unit with data inputted from the temperature detector and the water level detector, wherein in a high

temperature washing cycle for performing a washing with washing water heated above a first predetermined temperature by controlling the heating unit, the controller sets a rate of an agitating time in a first agitating operation to be
5 lower than a rate of an agitating time in a second agitating operation, the first agitating operation for rotating the rotary drum until a temperature of the heated washing water reaches a second predetermined temperature lower than the first predetermined temperature and the second agitating
10 operation for rotating the rotary drum until the temperature of the washing water increases from the second predetermined temperature to the first predetermined temperature.

2. The drum type washing machine of claim 1, wherein the
15 control unit repeats a low agitation having a low rate of an agitating time and a high agitation having a high rate of the agitating time compared to the low agitation in the first agitating operation of the high temperature washing cycle.

20 3. The drum type washing machine of claim 1 or 2, wherein in case a first and a second predetermined maximum time of preset maximum times are respectively detected in the first and the second agitating operation of a high temperature
25 washing cycle, the control unit completes a cycle being executed and carries out a next cycle.

4. The drum type washing machine of any one of claims 1 to 3, wherein the control unit executes a high temperature washing cycle for a third minimum agitating time required for an agitation.