

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 and water-extraction cycles by rotating a rotary drum accommodating therein laundry articles.

10 Background of the Invention

Fig. 7 shows a conventional drum type washing machine. Hereinafter, its configuration will be described.

As shown in Fig. 7, rotary drum 1 provided with a
15 number of drum perforations 2 on its entire cylindrical wall is incorporated in water tub 3 such a way that rotary drum 1 is allowed to rotate therein. One end of rotating shaft 4 is fixed to a central axis of rotation of rotary drum 1 in an approximately horizontal direction. Further, the other
20 end thereof is fixed to idler pulley 5. Rotary drum 1 is driven to rotate by first motor 6 with a first rotational speed N_1 (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 N_2 (e.g., 1000 rpm) during a water-
25 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
5 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
10 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
15 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
20 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 for preventing its vibration generated during a normal
25 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
bottom portion of water tub 3 and the other end portion
thereof to water drain pump 17, washing water in water tub 3
5 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.

Approximately cylindrical packing member 20 is formed
of a flexible material such as rubber or the like and
10 connects an opening portion of water tub 3 provided to
correspond to a front opening of rotary drum 1 and a front
opening portion of washing machine main body 10, one end
thereof located at the water tub side being fixed to outer
front plate 3b. Furthermore, opening/closing door 21 is
15 provided at the front opening portion of washing machine
main body 10. Water supply valve 22 supplies water into
water tub 3. 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, thereby controlling a series of
20 cycles including wash, rinse, water-extraction or the like
in sequence. (see, e.g., Japanese Patent Laid-open
Application No. H10-263285).

An operation of the washing machine having the
aforementioned configuration will now be described. After
25 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 by manipulating a start switch (not shown) provided at the controller 23, water supply valve 22 is operated to supply water thereinto. The supply of water is stopped when the water level detected by a water level detector (not shown) reaches target level and, then, first motor 6 is driven. As a consequence of water being absorbed into the laundry articles during the wash cycle, water gets 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 and then dropped onto a surface of water. Such drum type washing machine generally includes functions for heating washing water to a high temperature to enhance cleaning effect or to destroy germs clinging to the laundry articles. In such a washing machine, 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, necessitating a need for presence of safety device. For example, if heater 14 gets powered on in absence of washing water in water tub 3 due to a breakdown of controller 23, a temperature inside water tub 3 would abnormally increase. Before this happens, however, anti-overheating device 19 functions to power off heater 14 by disconnecting power supplied thereto, thereby preventing damages on the washing machine or a fire as a consequence of

washing machine overheating.

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. In the rinse cycle, the operations including the water supply, the rotation of rotary drum 1 or the like are similarly performed as in the wash cycle.

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 N2 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, the conventional washing machine only has an anti-overheating device as a safety device for powering off the heating unit during a situation in which the heating unit is operated in absence of the washing water in the water tub caused by, for example, a mal functioning of water level detector or control circuit, causing the water drain pump to inadvertently drain the washing water from the water tub.

Although the anti-overheating device is installed as a safety device, it takes several minutes before it detects an abnormality in temperature and powers off the heating unit. During those several minutes, however, the temperature of the water tub may abnormally increase, damaging the housing or causing a fire. Further, the anti-overheating device has a one-time-use-only structure, meaning that once it is used, it becomes non-usable, requiring it to be replaced for a normal operation of the washing machine, which is cumbersome and costly.

Summary of the Invention

It is, therefore, an object of the present invention to provide a drum type washing machine capable of preventing a temperature inside a water tub from being abnormally increasing in absence of the washing water in the water tub by powering off a heating unit when an increasing rate of a temperature detected by a temperature detector is greater than a predetermined value, thereby improving washing machine safety without sacrificing its ease of maintenance and cost.

In accordance with the present invention, there is provided a drum type washing machine including: a cylindrical rotary drum having a bottom surface and a rotating shaft in a horizontal or an declined direction; a

cylindrical water tub, having a bottom surface, for rotatably accommodating therein the rotary drum; a motor for rotating the rotary drum; a water supply unit for supplying washing water into the water tub; a heating unit for heating
5 the washing water in the water tub; a temperature detector for detecting a temperature of the washing water in the water tub; and a controller for performing each of wash, rinse and water-extraction cycles by controlling the motor, the heating unit, the water supply unit, the heating unit
10 being controlled by using data inputted from the temperature detector, wherein the controller performs a hot water washing cycle in which laundry articles are washed while the washing water is heated by controlling the heating unit, and wherein in the hot water washing cycle, the controller
15 powers off the heating unit in case an increasing rate of the temperature detected by the temperature detector is greater than a predetermined value.

Brief Description of the Drawings

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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:

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Fig. 1 shows a vertical cross sectional view of a drum type washing machine in accordance with a first preferred

embodiment of the present invention;

Fig. 2 describes a cross sectional view illustrating principal parts of the drum type washing machine in accordance with the first preferred embodiment;

5 Figs. 3A and 3B provide graphs showing temperature changes detected by a temperature detector of the drum type washing machine in accordance with the first preferred embodiment;

10 Fig. 4 represents a power-on/off time chart of a heater of a drum type washing machine in accordance with a second preferred embodiment of the present invention;

Fig. 5 offers a power-on/off time chart of a heater of a drum type washing machine in accordance with a third preferred embodiment of the present invention;

15 Figs. 6A to 6C illustrate power-on/off time charts of heaters of drum type washing machines in accordance with a fourth and a fifth preferred embodiment of the present invention; and

20 Fig. 7 sets forth a vertical cross sectional view of a conventional drum type washing machine.

Detailed Description of the Preferred Embodiment

25 Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. Detailed explanations of parts

identical or similar to those described in the conventional example will be omitted, and like reference numerals will be used therefor. However, the present invention is not limited to those preferred embodiments.

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(First preferred embodiment)

Fig. 1 shows a vertical cross sectional view of a drum type washing machine in accordance with a first preferred embodiment of the present invention; Fig. 2 describes a cross sectional view illustrating principal parts of the drum type washing machine; and Figs. 3A and 3B provide graphs showing temperature changes detected by a temperature detector of the drum type washing machine.

Specifically, Fig. 3A describes a situation where a water tub is filled with water, whereas Fig. 3B depicts a situation where there is no washing water present in the water tub.

As illustrated in Fig. 1, cylindrical rotary drum 24 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 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. Rotary drum 24 is driven to

rotate in forward and backward directions via rotating shaft
27 connected to motor 28 installed on an outer bottom
portion of water tub 26. Several agitation blades 29 are
provided on an inner wall of rotary drum 24, thereby
5 facilitating to agitate laundry articles.

An Opening formed on an upward slant surface of a
front portion of water tub 26 can be opened and closed by
door 30. By opening door 30, laundry articles can be loaded
into and unloaded from rotary drum 24 through water tub
10 laundry loading/unloading opening 31 of water tub 26 and
rotary drum laundry loading/unloading opening 24a. Since
door 30 is provided on an upward slant surface, a user can
load and unload the laundry articles without bending down.

Water tub 26 is suspended in washing machine main body
15 32 so that it can rock in left/right and to-and-fro
directions by spring 33 and is supported by damper 34 for
dampening its vibration. Further, by connecting one end
portion of water drain conduit 35 to a lower portion of
water tub 26 and the other end portion thereof to water
20 drain valve 36, washing water in water tub 26 can be drained
therethrough. Water supply valve 37 supplies water into
water tub 26 via water supply conduit 38. Water level
detector 39 detects a water level in water tub 26. There is
provided, at inner lower portion of water tub 26, a heater
25 (heating unit) 14 including a sheath heater for heating the
washing water or the like.

Moreover, controller 47 is provided at a lower portion of washing machine main body 32, whereas input unit and display unit 47a of controller 47 are provided at an upper portion of washing machine main body 32.

5 In the first preferred embodiment, although 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 washing machine, rotary drum 24 with rotating shaft 27
10 may be placed such that the direction of the central axis of rotation thereof is approximately horizontal to the washing machine.

 Hereinafter, configuration of the heater (heating unit) and the anti-overheating device will be described with
15 reference to Fig. 2 illustrating a cross sectional view of principal parts.

 Heater attachment plate 40 is fixed to one end portion of heater 14, and screw 44 provided with securing plate 43 as a unit is attached to heater attachment plate 40 via
20 packing member 41 by nut 45, securing plate 43 being inserted into heater insertion hole 42 formed at water tub 26. After inserting heater 14 into heater accommodation chamber 15, packing material 41 is compressed between heater attachment plate 40 and securing plate 43 by screwing nut 45.
25 Compressed packing material 41 swells outwardly, thereby fixing heater 14 to water tub 26 and making heater insertion

hole 42 watertight. The other end portion of heater 14 is engaged with heater fixture 46 provided in heater accommodation chamber 15. Heat generated by the heater is transferred from heater fixture 46 to anti-overheating device 19 configuring an anti-overheating means attached to water tub 26 via heater accommodation chamber 15 and water tub 26. Moreover, temperature detector 18 is fixed to water tub 26 such that its detecting portion faces an inner portion of heater accommodation chamber 15.

An operation of the wash cycle in the aforementioned configuration will now be described. After opening door 30 to load laundry articles into rotary drum 24 and turning on a power switch (not shown), an operation is initiated by manipulating a start switch (not shown) provided at input unit 47a and water supply valve 37 is driven to supply water thereto. When a predetermined water level is detected by water level detector 39, the water supply is stopped to drive motor 28. At this time, since water is adsorbed into the laundry articles, the water level decreases, requiring replenishing thereof. As water decreased is replenished, rotary drum 24 is driven to be rotated by motor 28 with a rotation speed N and, also, the laundry articles accommodated therein are lifted up and dropped upon a surface of water, which is so-called pounding motion.

In the wash cycle, controller 47 carries out a hot water washing cycle during which washing water is heated by

controlling heater 14 and the laundry articles get washed. In the hot water washing cycle, the washing water in water tub 26 is controlled and heated to a target temperature by detecting the temperature with temperature detector 18 by
5 powering off heater 14 when an increasing rate of a temperature detected by temperature detector 18 is greater than a predetermined value after heater 14 is powered on. Normally, heater 14 is powered on when the washing water is present in water tub 26. At this time, referring to a
10 temperature change detected by temperature detector 18, the increasing rate of the temperature is about 0.5K per ten seconds, as shown in Fig. 3A, which is much smaller than a critical value of 4K. Accordingly, controller 47 determines that it is in a normal state and continues to carry out the
15 hot water washing cycle.

Herein, for example, if heater 14 is powered on in absence of the washing water in water tub 26 due to a breakdown of controller 47, temperature inside water tub 26 rapidly increases during a period time when heater 14 is
20 powered on. At this time, the temperature change detected by temperature detector 18 becomes larger and the increasing rate of the temperature is 5K per ten seconds, as shown in Fig. 3B. Since the increasing rate of the temperature described above is larger than the critical value of 4K,
25 controller 47 determines it is in an abnormal state and powers off heater 14, thereby preventing an overheating or a

fire. In addition, by providing information of the abnormal state, a user is informed of a malfunction of the washing machine.

As described above, in the first preferred embodiment, temperature detector 18 detects the increasing rate of the temperature as the wash cycle is initiated in accordance with the first preferred embodiment. Therefore, even if heater 14 is powered on in absence of the washing water in water tub 26, heater 14 can be powered off as a consequence of temperature detector 18, instead of anti-overheating device 19, detecting the abnormal state. Accordingly, it is possible to minimize the abnormal increase of the temperature and further to avoid damages of the washing machine.

In addition, since the washing machine can be used without replacing the anti-overheating device with a new one, it is possible to enhance the safety of the washing machine without suffering from a troublesome maintenance work or a cost increase therefrom.

Further, by providing the abnormal state, the user can be informed of a malfunction of the washing machine quickly. Thus, a repairman can quickly discover a breakdown of other components (e.g., the water level detector) through an inspection.

(Second preferred embodiment)

Fig. 4 presents a power-on/off time chart of a heater (heating unit) of a drum type washing machine in accordance with a second preferred embodiment of the present invention. As shown in Fig. 4, a controller shortens at least a first power-on predetermined time of a heater (heating unit) as a number of cycles increase. Other configurations are same as those of the first preferred embodiment.

An operation of the washing machine having the aforementioned configuration will now be described. Since basic operations of the wash cycle are same as those of the first preferred embodiment, an explanation thereof will be omitted.

As shown in Fig. 4, heater 14 is cyclically powered on and off such that heater 14 is powered on for a first predetermined time (e.g., 80 seconds) and powered off for a second predetermined time (e.g., 90 seconds), and the cyclic power-on/off operation of heater 14 is performed for a predetermined number of cycles. Further, the washing water in water tub 26 is controlled and heated to a target temperature by detecting the temperature with temperature detector 18. That is, heater 14 is cyclically powered on and off such that heater 14 is powered on for the first predetermined time (e.g., 80 seconds) and powered off for the second predetermined time (e.g., 90 seconds) at a first cycle, as exemplarily illustrated in Fig. 4. At a second cycle, heater 14 is powered on for the first predetermined

time (e.g., 40 seconds) reduced to a half of the
aforementioned first predetermined time at the first cycle
and powered off for the second predetermined time (e.g., 90
seconds). Further, after a third cycle during which heater
5 14 is powered on and off as in the second cycle, heater 14
is powered on continuously.

Herein, for example, if heater 14 is powered on in
absence of the washing water in water tub 26 due to a
breakdown of controller 47, the temperature inside water tub
10 26 sharply increases during which heater 14 is powered on
for the first predetermined time (e.g., 80 seconds). Since,
however, heater 14 is powered off for the second
predetermined time (e.g., 90 seconds), the increase of the
temperature inside water tub 26 is suppressed. Herein, such
15 operation is performed for a predetermined number of cycles
(e.g., three times). While heater 14 is powered on for the
first predetermined time (e.g., 80 seconds), the temperature
change detected by temperature detector 18 is 5K per ten
seconds as shown in Fig. 3B. Since the temperature change
20 is larger than the critical value of 4K, controller 47
determines it is in an abnormal state and heater 14 is made
to be powered off, thereby preventing an overheating or a
fire.

Since the power is continuously supplied to heater 14
25 after the cyclic power-on/off operation of heater 14 is
performed for a predetermined number of cycles (e.g., three

times), time required for heating the washing water in water tub 26 is almost same as that required when heater 14 is continuously powered on from the beginning.

As described above, heater 14 is cyclically powered on in the second preferred embodiment. Accordingly, in case heater 14 is powered on in absence of the washing water in water tub 26, it is possible to minimize an abnormal increase of the temperature inside water tub 26 compared to a case where heater 14 is continuously powered on, making it possible to prevent damages to the washing machine.

Moreover, since the washing machine can be used without replacing the anti-overheating device with a new one, it is possible to enhance the safety of the washing machine without suffering from a troublesome maintenance work or an increase in cost.

Besides, since heater 14 is continuously powered on after the cyclic power-on/off operation is performed for a predetermined number of cycles (e.g., three times), time required for heating the washing water in water tub 26 is almost same as that required for a case in which heater 14 is continuously powered on from the beginning, making it possible to achieve a safety of the washing machine regardless of a time required for the wash cycle.

(Third preferred embodiment)

Fig. 5 represents a power-on/off time chart of a

heater (heating unit) of a drum type washing machine in accordance with a third preferred embodiment of the present invention. As illustrated in Fig. 5, the controller shortens at least a first power-on predetermined time of a heater (heating unit) as a number of cycles increase. Other configurations are same as those of the first preferred embodiment.

An operation of the washing machine having the aforementioned configuration will now be described. Since basic operations of the wash cycle are same as those of the first preferred embodiment, an explanation thereof will be omitted.

As shown in Fig. 5, heater 14 is cyclically powered on and off such that heater 14 is powered on for the first predetermined time (e.g., 80 seconds) and powered off for the second predetermined time (e.g., 90 seconds) at a first cycle. At a second cycle, heater 14 is cyclically powered on and off such that heater 14 is powered on for the first predetermined time (e.g., 60 seconds) which is shorter than 80 seconds of the first cycle and powered off for the second predetermined time (e.g., 90 seconds). Further, at a third cycle, heater 14 is cyclically powered on and off such that heater 14 is powered on for the first predetermined time (e.g., 40 seconds) which is shorter than 60 seconds of the second time and powered off for the second predetermined time (e.g., 90 seconds). Thereafter, heater 14 is

continuously powered on, and the washing water in water tub 26 is controlled and heated to a target temperature by detecting a temperature thereof with temperature detector 18.

Herein, for example, if heater 14 is powered on in
5 absence of the washing water in water tub 26 due to a
breakdown of controller 47, the temperature inside water tub
26 sharply increases while heater 14 is powered on for the
first predetermined time (e.g., 80 seconds). Since, however,
heater 14 is powered off for the second predetermined time
10 (e.g., 90 seconds), the increase of the temperature inside
water tub 26 is suppressed. At this time, although the
heater (heating unit) is already heated to a certain
temperature, an overheating of the heater can be prevented
by shortening the first predetermined time of the second
15 cycle compared to that (e.g., 60 seconds) of the first cycle.
Moreover, at a third cycle, heater 14 is powered on for the
first predetermined time (e.g., 40 seconds) which is
shorter than that of the second cycle, making it possible to
prevent the overheating of the heater.

20 As described above, in the third preferred embodiment,
the power-on time of the heater is set by considering the
increase in temperature of the heater. Accordingly, it is
possible to prevent the temperature of the heater from being
excessively increased in a situation where heater is powered
25 on in absence of the washing water in water tub 26, thereby
preventing the cut off of anti-overheating device 19.

Further, an abnormal increase in the temperature inside water tub 26 can be minimized, thereby preventing damages of the washing machine.

5 (Fourth preferred embodiment)

Figs. 6A to 6C illustrate power-on/off time charts of a heater (heating unit) of a drum type washing machine in accordance with a fourth preferred embodiment of the present invention.

10 Fig. 6A shows a case where an input voltage of the heater in a powered-on state is smaller than 207 V; Fig. 6B illustrates a case where the input voltage thereof is greater than or equal to 207 V and smaller than 235 V; and Fig. 6C describes a case where the input voltage thereof is
15 greater than or equal to 235 V.

In the fourth preferred embodiment, there is provided an input voltage measuring unit for measuring an input voltage value of the heating unit and, further, the controller sets at least a first power-on predetermined time
20 of the heater (heating unit) according to the input voltage value measured by the input voltage measuring unit. Other configurations are same as those of the first preferred embodiment.

An operation of the washing machine having the
25 aforementioned configuration will now be described. Since basic power-on operations of the wash cycle are same as

those of the second preferred embodiment, an explanation thereof will be omitted.

As illustrated in Fig. 6B, heater 14 is cyclically powered on and off such that heater (heating unit) 14 is
5 powered on for the first predetermined time (e.g., 80 seconds) and powered off for the second predetermined time (e.g., 90 seconds) in case, for example, the input voltage value is greater than or equal to 207 V and smaller than 235 V. Referring to Fig. 6C, heater 14 is powered on for the
10 first predetermined time (e.g., 60 seconds) and powered off for the second predetermined time (e.g., 90 seconds) in case the input voltage value is greater than or equal to 235 V as a high voltage, thereby suppressing a sharp increase in temperature. Further, as shown in Fig. 6A, in case the
15 input voltage value is smaller than 207 V as a low voltage, for example, the insufficient heat dissipation of the heater caused by the low voltage is compensated with time by applying power to heater 14 for the first predetermined time (e.g., 120 seconds).

20 As described above, by setting the power-on time of the heater according to the input voltage change, allowing the cyclic power-on/off operation to be carried out for a predetermined number of cycles and detecting the temperature by using temperature detector 18, the washing water in water
25 tub 26 is heated to a target temperature.

Herein, even when heater 14 is powered on in absence

of the washing water in water tub 26 due to a breakdown of controller 47, since at least the first predetermined time is set according to the input voltage value, an excessive temperature increase of the heater (heating unit) can be avoided by considering a different output of the heater according to the input voltage value.

As described above, the first predetermined time can be set by considering the different output of the heater according to the input voltage value in the fourth preferred embodiment. Therefore, even when heater 14 is powered on in absence of the washing water in water tub 26, it is possible to minimize an abnormal increase of the temperature inside water tub 26. As a result, damages to the washing machine can be avoided.

In addition, by quickly detecting the abnormal state regardless of the change of the input voltage value, the heater can be powered off. As a result, a user can feel safe in using the washing machine.

(Fifth preferred embodiment)

Figs. 6A to 6C offer power-on/off time charts of a heater (heating unit) of a drum type washing machine in accordance with a fifth preferred embodiment of the present invention will be described.

As shown in Figs. 6A to 6C, a controller shortens at least a first predetermined time as an input voltage value

measured by an input voltage measuring unit increases. Other configurations are same as those of the first preferred embodiment.

5 An operation of the washing machine having the aforementioned configuration will now be described. Since basic power-on operations of the wash cycle are same as those of the second preferred embodiment, an explanation thereof will be omitted.

As illustrated in Fig. 6B, heater 14 is cyclically
10 powered on and off such that heater (heating unit) 14 is powered on for the first predetermined time (e.g., 80 seconds) and powered off for the second predetermined time (e.g., 90 seconds) in case the input voltage value is 220 V, for example. Referring to Fig. 6C, heater 14 is cyclically
15 powered on and off such that heater 14 is powered on for the first predetermined time (e.g., 60 seconds) which is shorter than 80 seconds and powered off for the second predetermined time (e.g., 90 seconds), thereby suppressing a sharp temperature decrease in case the input voltage value is 240
20 V greater than 220 V, for example. By performing the cyclic power-on/off operation for a predetermined number of cycles and detecting the temperature with temperature detector 18, the washing water in water tub 26 is controlled and heated to a target temperature.

25 For example, in case heater 14 is powered on in absence of the washing water in water tub 26 due to a

breakdown of controller, since an output of the heater increases as an input voltage value increases, an increase of the temperature inside water tub 26 can be sharp. However, since time required for applying power to the heater is set to be shortened, temperature of the heater does not increase up to a level at which the heater is required to be forcibly cut off. While heater 14 is powered on for the first predetermined time (e.g., 80 seconds), the increasing rate of the temperature detected by temperature detector 18 is 5K per ten seconds, as illustrated in Fig. 3B. Since such value is greater than the critical value of 4K, controller 47 determines it is in abnormal state and powers off heater 14.

As described above, the first predetermined time can be set such that the output of the heater becomes optimum despite of a high input voltage value in the fifth preferred embodiment. Therefore, in case heater 14 is powered on in absence of the washing water in water tub 26, it is possible to avoid an abnormal increase of the temperature inside water tub 26, thereby preventing damages to the washing machine.

Moreover, since the heater can be powered off by quickly detecting the abnormal state regardless of the change of the input voltage value, a user can feel safe.

As described above, in accordance with the drum type washing machine of the present invention, if an increasing

rate of a temperature detected by a temperature detector is greater than a predetermined value at the beginning of the wash cycle, a heating unit is powered off. Therefore, in case the heater is powered on in absence of the washing
5 water in a water tub due to a breakdown of a controller, it is possible to suppress an abnormal increase in the temperature of the water tub while reducing a troublesome maintenance work and enhancing a safety of the washing machine. Accordingly, the present invention is useful for a
10 drum type washing machine for performing each of wash, rinse and water-extraction cycles.

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
15 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 cylindrical rotary drum having a bottom surface and
a rotating shaft in a horizontal or an declined direction;

a cylindrical water tub, having a bottom surface, for
rotatably accommodating therein the rotary drum;

a motor for rotating the rotary drum;

10 a water supply unit for supplying washing water into
the water tub;

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

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

15 a controller for performing each of wash, rinse and
water-extraction cycles by controlling the motor, the
heating unit, the water supply unit, the heating unit being
controlled by using data inputted from the temperature
detector,

20 wherein the controller performs a hot water washing
cycle in which laundry articles are washed while the washing
water is heated by controlling the heating unit, and wherein
in the hot water washing cycle, the controller powers off
the heating unit in case an increasing rate of the
25 temperature detected by the temperature detector is greater
than a predetermined value.

2. The drum type washing machine of claim 1, wherein the controller performs cyclic power-on/off operations that the heating unit is powered on for a first predetermined time and powered off for a second predetermined time, and the cyclic power-on/off operation is performed for a predetermined number of cycles.

3. The drum type washing machine of claim 2, wherein the controller shortens at least the first predetermined time as the number of cycles increases.

4. The drum type washing machine of claim 2 or 3, further comprising an input voltage measuring unit for measuring an input voltage value of the heating unit, wherein the controller sets at least the first predetermined time according to the input voltage value measured by the input voltage measuring unit.

5. The drum type washing machine of claim 4, wherein the controller shortens at least the first predetermined time as the input voltage value measured by the input voltage measuring unit increases.