

DRUM TYPE WASHING MACHINE

Field of the Invention

5 The present invention relates to a drum type washing machine for performing 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

Fig. 6 shows a conventional drum type washing machine. Hereinafter, a configuration thereof will be described.

As shown in Fig. 6, rotary drum 1 provided with a
15 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 shaft 4 is fixed to a central axis of rotation of rotary drum 1 in an approximately horizontal direction. Further,
20 the other end thereof is fixed to idler pulley 5. Rotary drum 1 is driven to rotate by first motor 6 at 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 at a second rotational speed N_2 (e.g., 1000 rpm)
25 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 to thereby rotate 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 to thereby rotate 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 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
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 at same
vertical plane as 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
15 is 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 a start switch (not shown) provided at 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
5 detector (not shown) reaches a preset water level and, then, first motor 6 is driven. During the wash cycle, water gets absorbed into the laundry articles. For this reason, while water is replenished, rotary drum 1 is driven to rotate at a low speed by first motor 6 at the first rotational speed N1 and, accordingly, the laundry articles inside rotary drum 1
10 are lifted up and then dropped onto a surface of water.

Such a drum type washing machine generally has a function of heating washing water to a high temperature in order to increase a cleaning effect of the laundry articles or destroy bacteria adhered to the laundry articles.
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To do so, heater 14 is powered on, and the washing water in water tub 3 is heated to be maintained at a regular temperature while detecting the temperature with temperature detector 18. Meanwhile, the heating to a high temperature
20 requires safety measures. For example, if heater 14 is powered on while there is no water in water tub 3 due to a breakdown of controller 23, an inner temperature of water tub 3 abnormally increases. Since, however, the power supply to heater 14 is disconnected by anti-overheating
25 device 19, it is possible to prevent damages from being inflicted on devices or a fire caused by an 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 wash cycle are carried out.

5 During the water-extraction cycle, rotary drum 1 is driven to rotate by second motor 7 at the 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
10 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 an anti-vibration unit prevents the vibration from being transferred to washing machine main body 10
15 during the normal water-extraction cycle.

However, in such a conventional configuration, in case washing water is heated to a high temperature (e.g., higher than 80 °C), a temperature of the rotary drum also increases to a high temperature. Thus, if a door is designed to be
20 opened during or after the wash cycle, a user may get burned by having a contact with the rotary drum. Meanwhile, in order to protect the user from getting burned, if the door is controlled to be closed until the wash, the rinse and the water-extraction cycles are completed, the user may complain
25 that the door is unopenable once the operation is started. Moreover, in case a large volume of hot water is drained

after the wash cycle, it is required to enhance a heat resistance of a water drain conduit of a washing machine main body. In addition, a water draining operation needs to be performed while protecting the user from the hot water.

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Summary of the Invention

It is, therefore, an object of the present invention to provide a more convenient drum type washing machine in which a cooling operation including repeated performances of water supply operation and drain operation thereof is performed until heated washing water is cooled to a predetermined temperature during a water draining operation following a high temperature washing cycle, to thereby improve safety in a water drain conduit and allow a user to open a door without having to concern about safety any time after the high temperature washing cycle.

In accordance with the present invention, there is provided a drum type washing machine including: a cylindrical rotary drum having a bottom portion, a horizontal or a slanted rotational axis and a first opening at its front portion; a cylindrical water tub having a bottom portion and a second opening corresponding to the first opening, the cylindrical water tub incorporating therein the rotary drum rotatably; a washing machine main body having a third opening corresponding to the first and

the second opening, for supporting the water tub so that the water tub is rockable in left/right and to-and-fro directions; a door provided at the washing machine main body, for opening/closing the third opening to load/unload laundry articles into/from the rotary drum; 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 provided at a water drain conduit communicating with the bottom portion of the water tub, for controlling a drain of the washing water in the water tub; and a control unit 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 based on data received from the temperature detector and the water level detector, wherein the control unit performs a cooling cycle of repeating a water supply and drain by controlling the water supply unit and the water draining unit until the heated washing water is cooled to a predetermined temperature during a water draining operation following a high temperature washing cycle for performing a washing with the washing water heated to a temperature above another predetermined temperature by

controlling the heating unit.

Brief Description of the Drawings

5 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:

10 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;

15 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;

20 Fig. 5 illustrates a graph setting forth a cooling cycle of the drum type washing machine; and

 Fig. 6 is a vertical 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 with reference to the accompanying drawings. However, the present invention is not limited to those preferred embodiments.

(First preferred embodiment)

5 Fig. 1 shows a longitudinal sectional view of a drum type washing machine in accordance with a first preferred embodiment of the present invention, and Fig. 2 describes a partial control circuit block diagram of the drum type washing machine shown in Fig. 1.

10 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
15 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. By connecting motor 28 installed on a rear surface of water tub 26 to rotating
20 shaft 27, rotating drum 24 is driven to rotate in forward and reverse directions. Several agitation blades 29 provided on an inner surface of rotary drum 24 facilitate an agitating operation of laundry articles.

25 An opening formed on an upward slant surface of a front portion of water tub 26 can be opened/closed by door 30. By opening door 30, laundry articles can be loaded into

rotary drum 24 and unloaded therefrom through laundry loading/unloading opening 31. Since door 30 is provided on the upward slant surface, a user can load and unload the laundry articles without bending down. Further, to ensure
5 safety of the user, door 30 is configured to be closed by actuating door locking unit 40 during the operation of the washing machine.

Water tub 26 is suspended in washing machine main body 32 such that it can rock in left/right and to-and-fro
10 directions by spring 33 and is supported by damper 34 so that its vibration is reduced. Further, by connecting one end portion of water drain conduit 35a to a lower portion of water tub 26 and the other end portion thereof to water drain valve (water draining unit) 36, washing water in water
15 tub 26 can be drained therethrough. Water supply valve (first water supply unit) 37 supplies water into water tub 26 via detergent dispenser 37a and first water supply conduit 38a. Moreover, water supply valve 37 communicates with second water supply unit 38b capable of supplying water
20 into water drum 24 from top thereof via second water supply conduit 38c.

Water level detector 39 detects a water level in water tub 26. Further, by providing heater (heating unit) 41 including a sheath heater or the like for heating washing
25 water and temperature detector 42 for detecting a temperature of the washing water, laundry articles in rotary

drum 24 can be effectively cleaned with hot water.

By providing water overflow opening 49 on a sidewall of water tub 26, it is designed such that water overflows when the height of the water exceeds the vertical position of water overflow opening 49. One end of water overflow conduit is connected to water overflow opening 49, whereas the other end thereof is connected to water drain conduit 35b installed at a place located below water drain valve 36.

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 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 water drain valve 36, water supply valve 37, heater 41 or the like via load driving unit 47, thereby performing the wash cycle.

Fig. 3 provides an enlarged front view of the input setting unit and the display unit of the drum type washing machine in accordance with a first preferred embodiment of the present invention.

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 and water temperature changing input switch 45i.

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, water level display unit 46e, water temperature display unit 46f, residual operating time display unit 46g, door lock indicating unit 46h or the like.

Fig. 4 presents an operation flowchart of principal

parts of the drum type washing machine in accordance with the first preferred embodiment.

Hereinafter, the operation thereof will be described with reference to Fig. 4. A user loads laundry articles
5 into rotary drum 24 after opening door 30 and then closes door 30. Next, the user starts the operation by turning on power-on switch 45f in step 101. Thereafter, a course is set by manipulating course setting switch 45d in step 102. In step 103, it is checked whether or not the settings of
10 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,
15 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 step 104. On the contrary, if the settings need not be changed, it is allowed
20 to proceed to step 105. If the operation is initiated by manipulating start/pause switch 45e in step 105, door locking unit 40 or the like is actuated by control unit 44 in step 106. Thereafter, water is supplied by operating water supply valve 37 in step 107, and, then, water level
25 detector 39 checks whether or not the water has reached a predetermined water level in step 108.

If the water has reached the predetermined water level, it is allowed to proceed to the wash cycle. In step 109, an agitating rotation of rotary drum 24 is initiated by driving motor 28. On the other hand, if the water has not reached the predetermined water level, the process is returned to step 107. During the wash cycle, water gets absorbed into the laundry articles and, thus, the water level is lowered. For this reason, while water is replenished, rotary drum 24 is driven to rotate by motor 28 at a rotational speed N. Accordingly, the laundry articles inside rotary drum 24 are lifted up and then dropped onto a surface of water, the other laundry articles or bottom of rotary drum 24.

In step 110, it is checked whether or not a set water temperature requires heating. In case the set water temperature requires heating, the washing water is heated by controlling controller 43 to operate heater 41 via control unit 44 and load driving unit 47 in step 111. On the other hand, in case the set water temperature does not require heating in step 110, it is allowed to proceed to step 114.

In step 112, temperature detector 42 checks whether or not a temperature T of heated washing water is higher than a first predetermined temperature T1 (e.g., 90 °C). If it is higher than that, the control of heater 41 is completed.

In step 114, it is checked whether or not a predetermined washing time has elapsed. If it has elapsed, an agitating rotation of rotary drum 24 is stopped by

stopping a driving of motor 28 in step 115, thereby completing the wash cycle.

In step 116, temperature detector 42 checks whether or not the temperature T of washing water is higher than a second predetermined temperature T2 (e.g., 55 °C). If it is higher than T2, it is allowed to proceed to a cooling cycle of steps 117 to 120. On the contrary, if it is equal to or lower than T2, it is allowed to proceed to step 121. The following is a description of the cooling cycle. The water is supplied by operating water supply valve 37 in step 117. Some of the supplied water is drained by operating water drain valve 36 in step 118. Then, the water is replenished by operating water supply valve 37 in step 119. In step 120, it is checked whether or not the temperature T of the washing water is equal to or lower than the second predetermined temperature T2. If the temperature is equal to or lower than T2, it is allowed to proceed to step 121 in which control unit 44 drains washing water in water tub 26 completely by operating water drain valve 36. Meanwhile, if it is higher than T2, it is returned to step 118, so that the water drain in step 118 and the water supply in step 119 are repeated.

In step 122, control unit 44 releases door locking unit 40 so that door 30 can be opened and further displays the release on door lock indicating unit 45h. Thereafter, a next cycle is executed in step 123.

Moreover, in case the user selects to open the door by temporarily stopping the operation on purpose, if it is detected that the temperature of washing water is higher than the second predetermined temperature T2 (e.g., 55 °C),
5 the cooling cycle is performed. If otherwise, the water is drained and, then, door locking unit 40 is released.

As described above, the temperature of the water to be drained can be decreased by performing the cooling cycle of repeating the water supply and drain until heated washing
10 water is cooled to the predetermined temperature during the water drain operation following the high temperature washing cycle. Accordingly, it is possible to improve safety in the water drain conduit and allow the user to conveniently open the door without having to concern about safety any time
15 after the high temperature washing.

(Second preferred embodiment)

Fig. 5 illustrates a graph of a cooling process of the drum type washing machine in accordance with a second preferred embodiment. A vertical sectional view and a
20 control circuit block diagram of the second preferred embodiment will be described with reference to Figs. 1 and 2 of the first preferred embodiment.

As illustrated in Fig. 5, control unit 44 sets a water level S1 for the hot temperature washing cycle to be lower
25 than a water level S2 for a general wash cycle in which the heating unit does not operate. Other configurations are

same as those of the first preferred embodiment.

The following is a description of an operation of the
aforementioned configuration. In case the user selects a
high water temperature (e.g., 90 °C) by using water
5 temperature change input switch 45i, a water level is
automatically set to be the predetermined water level S1
(e.g., 60 mm) lower than the water level S2 (e.g., 85 mm)
for the general wash cycle using, e.g., tap water, in which
the heating unit does not operate. Accordingly, the volume
10 of the high-temperature washing water for the case of the
water level S1 is smaller than that for the case of the
water level S2. Further, when the water draining operation
follows the hot temperature washing cycle performed as in
the first preferred embodiment, an initial volume of water
15 which is supplied up to a predetermined maximum water level
S3 (e.g., 130 mm) set to be lower than a vertical position
of the water overflow opening 49 is greater for the case of
the water level S1 than for the case of the water level S2.
After water is supplied, the temperature of the water to be
20 drained is calculated based on a following Eq. 1. Based on
Eq. 1, the temperature of the water to be drained for the
case of the water level S2 and that for the case of the
water level S1 are calculated. Referring to the calculation
result to be shown in Eq. 2, the temperature of the water to
25 be drained is lower for the case of the low water level S1
for the hot water washing cycle than that for the case of

the high water level S2 for the general wash cycle having no heating operation.

[Eq. 1]

5 [(temperature of hot water) × (water volume in hot water level) + (temperature of cooling water) × (volume of supplied cooling water)] / total volume of hot water = temperature of water to be drained

[Eq. 2]

10 Temperature of water to be drained after being supplied in water level S2 : $(90\text{ }^{\circ}\text{C} \times 15\text{ L} + 20\text{ }^{\circ}\text{C} \times 5\text{ L}) / 20\text{ L} = 73\text{ }^{\circ}\text{C}$

Temperature of water to be drained after being supplied in water level S1 : $(90\text{ }^{\circ}\text{C} \times 12\text{ L} + 20\text{ }^{\circ}\text{C} \times 8\text{ L}) / 20\text{ L} = 62\text{ }^{\circ}\text{C}$

15 As described above, by supplying more cooling water before water drain operation performed after the high temperature washing cycle, a temperature of initially drained water can be lowered. Consequently, the safety in the water drain conduit and the cooling effect can be
20 improved. Further, since the temperature of the washing water can be quickly lowered, it is possible to shorten a period of time required for the cooling cycle.

Hereinafter, preferred embodiments 3 to 8 will be described with reference to Figs. 1, 2 and 5 of the second
25 preferred embodiment.

(Third preferred embodiment)

As shown in Figs. 1, 2 and 5, water tub 26 has water overflow opening 49 where water overflows when the water level of washing water in water tub 26 is higher than a predetermined water level S4. Further, control unit 44 sets
5 a maximum water level for the cooling cycle to a third predetermined water level S3 lower than the predetermined water level S4 in which water overflows. Other configurations are same as those of the first and the second preferred embodiment.

10 The following is a description of an operation of the aforementioned configuration. In performing a cooling cycle, first of all, water is supplied up to the third predetermined water level S3(e.g., 130 mm) lower than the predetermined water level S4(e.g., 200 mm) corresponding to
15 the vertical position of the water overflow opening by operating water supply valve 37. Next, water is drained by operating water drain valve 36. Thereafter, water is supplied again up to the predetermined water level S3. In this manner, the water supply and the water draining are
20 repeated until the temperature of washing water in rotary drum 24 becomes equal to or lower than the second predetermined temperature T2 (e.g., 55 °C).

As described above, by setting the maximum water level S3 in supplying water to be lower than the water level S4
25 corresponding to the vertical position of water overflow opening 49, hot water can be prevented from overflowing in

the water drain conduit directly from the water overflow opening 49. Accordingly, the safety in the water drain conduit can be further improved.

(Fourth preferred embodiment)

5 As shown in Figs. 1, 2 and 5, control unit 44 controls motor 28 to rotate rotary drum 24 for a first predetermined time t_1 at the third predetermined water level S3. Other configurations are same as those of the first to the third preferred embodiment.

10 The following is a description of an operation of the aforementioned configuration. In performing a cooling cycle, first of all, water is supplied up to the third predetermined water level S3 (e.g., 130 mm) by operating water supply valve 37 serving as a water supply unit. Then,
15 rotary drum 24 is driven to rotate alternately between in a forward and in a reverse direction by driving motor 28 with the use of control unit 44 for the first predetermined time (e.g., 1 minute), thereby stirring laundry articles and washing water in rotary drum 24. Next, the water is drained
20 to a fourth predetermined water level S5 (e.g., 40 mm) by operating water drain valve 36. Thereafter, water is supplied again up to the predetermined third water level S3 to repeat the stirring operation. In this manner, the water supply, the stirring and the water drain are repeated until
25 the temperature of the washing water in rotary drum 24 becomes equal to or lower than the second predetermined

temperature T2 (e.g., 55 °C).

As described above, since the laundry articles are stirred with a large amount of washing water for a predetermined time, it is possible to reduce nonuniformity between temperatures of laundry articles and the washing water in the rotary drum and a peripheral temperature of the temperature detector. Consequently, the temperature can be quickly and uniformly lowered, thereby enabling the user to open the door safely after the high temperature washing cycle.

(Fifth preferred embodiment)

As shown in Figs. 1, 2 and 5, control unit 44 controls motor 28 to rotate rotary drum 24 for the first predetermined time t1 at the third predetermined water level S3 and also controls temperature detector 42 to detect a temperature of washing water. Other configurations are same as those of the first to the fourth preferred embodiment.

The following is a description of an operation of the aforementioned configuration. In performing the cooling cycle, first of all, water is supplied up to the third predetermined water level S3 (e.g., 130 mm) by operating water supply valve 37. Then, rotary drum 24 is driven to rotate alternately between in a forward and in a reverse direction by driving motor 28 with the use of control unit 44 for the first predetermined time (e.g., 1 minute), thereby stirring laundry articles and washing water in

rotary drum 24. Further, temperature detector 42 detects a temperature of the washing water within the first predetermined time t1. Next, the water is drained to the fourth predetermined water level S5 (e.g., 40 mm) by
5 operating water drain valve 36. Thereafter, water is supplied again up to the predetermined third water level S3 to repeat the stirring operation and detect the temperature of the washing water. In this manner, the water supply, the stirring, the temperature detection and the water drain are
10 repeated until the temperature of the washing water in rotary drum 24 becomes equal to or lower than the second predetermined temperature T2 (e.g., 55 °C).

As described above, since the laundry articles are stirred with a large amount of washing water for a
15 predetermined time, the temperature can be detected in a state where the nonuniformity between temperatures of laundry articles and the washing water in the rotary drum and a peripheral temperature of the temperature detector is reduced. Consequently, it is possible to reduce a
20 possibility of misdetection and also allows a user to open the door safely after the high temperature washing cycle.

(Sixth preferred embodiment)

As shown in Figs. 1, 2 and 5, control unit 44 controls motor 28 to rotate rotary drum 24 for the first
25 predetermined time t1 at the third predetermined water level S3. And also, in case a washing water temperature detected

by the temperature detector is higher than the second predetermined temperature T2, the water is drained to the fourth predetermined water level S5 (e.g., 40 mm) near the first predetermined water level and, then, supplied again up to the third predetermined level. Other configurations are same as those of the first to the fourth preferred embodiment.

The following is a description of an operation of the aforementioned configuration. In performing the cooling cycle, first of all, water is supplied up to the third predetermined water level S3 (e.g., 130 mm) by operating water supply valve 37. Then, rotary drum 24 is driven to rotate alternately between in a forward and in a reverse direction by driving motor 28 with the use of control unit 44 for the first predetermined time (e.g., 1 minute), thereby stirring laundry articles and the washing water in rotary drum 24. Further, temperature detector 42 detects the temperature of the washing water within the first predetermined time t1. At this time, if the detected temperature is higher than the second predetermined temperature T2 (e.g., 55 °C), the water is drained to the fourth predetermined water level S5 near the first predetermined water level S1 (e.g., 60 mm) during a next water draining operation so that the washing water is not completely drained. Thereafter, by supplying water again up to the predetermined third water level S3, the stirring

operation is repeated and, also, the temperature of the washing water is detected again. In this manner, the water supply, the stirring, the temperature detection and the water drain are repeated until the temperature of the washing water in rotary drum 24 becomes equal to or lower than the second predetermined temperature T2 (e.g., 55 °C).

In case the washing water is completely drained, no water exists near the temperature detector. Thus, the temperature is imprecisely detected and, also, a user may open the door at a high temperature. However, by controlling the washing water to be incompletely drained during the cooling cycle until the temperature becomes equal to or lower than the second predetermined temperature, the user can open the door under a safer condition.

(Seventh preferred embodiment)

As shown in Figs. 1, 2 and 5, control unit 44 controls motor 28 to rotate rotary drum 24 for the first predetermined time t1 under the condition of the third predetermined water level S3. And also, in case a washing water temperature detected by the temperature detector 42 is equal to or lower than the second predetermined temperature T2, water in the water tub is completely drained and then it is allowed to proceed to a next cycle. Other configurations are same as those of the first to the fourth preferred embodiment.

The following is a description of an operation of the

aforementioned configuration. In performing the cooling cycle, first of all, water is supplied up to the third predetermined water level S3 (e.g., 130 mm) by operating water supply valve 37. Then, rotary drum 24 is driven to rotate alternately between in a forward and in a reverse direction by driving motor 28 with the use of control unit 44 for the first predetermined time (e.g., 1 minute), thereby stirring laundry articles and washing water in rotary drum 24. Further, temperature detector 42 detects a temperature of the washing water within the first predetermined time t1. At this time, if the detected temperature is equal to or lower than the second predetermined temperature T2 (e.g., 55 °C), the water in water tub 26 is completely drained. Thereafter, a next cycle is performed.

As described above, by controlling the washing water to be incompletely drained during the cooling cycle until the temperature becomes equal to or lower than the second predetermined temperature, the temperature detector can operate until the temperatures of laundry articles and the washing water in the rotary drum and that of the door decrease to a safe temperature. As a result, the user can open the door under a safer condition.

(Eighth preferred embodiment)

As shown in Figs. 1, 2 and 5, water supply unit 38 includes first water supply unit 38a for supplying water

into water tub 26 while communicating therewith and second water supply unit 38b for supplying water into rotary drum 24 through a hole of rotary drum 24. At least a part of or an entire volume of the water is supplied by second water supply unit 38b right after the high temperature washing cycle. Other configurations are same as those of the first to the seventh preferred embodiment.

The following is a description of an operation of the aforementioned configuration. When the cooling cycle is performed right after the high temperature washing cycle, a part of or an entire volume of the water is supplied to the third predetermined water level S3 (e.g., 130 mm) by operating second water supply unit 38b provided at top of rotary drum 24 and water tub 26. Then, the supplied water directly flows toward the laundry articles in rotary drum 24 and the door, thereby decreasing the water temperature.

As described above, by directly supplying water into rotary drum 24, it is possible to quickly decrease the temperatures of laundry articles and the washing water in rotary drum 24 and that of the door. Accordingly, the user can safely open the door and, also, a period of time required for the cooling cycle can be reduced.

As described above, in the drum type washing machine in accordance with the present invention, the cooling operation of repeating the water supply and drain is performed until heated washing water is cooled to a specific

temperature during the water drain operation following the high temperature washing cycle, to thereby decrease a temperature of the washing water to be drained. Accordingly, the safety in the water drain conduit can be improved.

5 Further, the user can open the door without having to concern about safety any time after the high temperature washing cycle. Consequently, the present invention can be applied to a drum type washing machine having a drying function.

10 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.

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What is claimed is:

1. A drum type washing machine comprising:

5 a cylindrical rotary drum having a bottom portion, a horizontal or a slanted rotational axis and a first opening at its front portion;

10 a cylindrical water tub having a bottom portion and a second opening corresponding to the first opening, the cylindrical water tub incorporating therein the rotary drum rotatably;

a washing machine main body having a third opening corresponding to the first and the second opening, for supporting the water tub so that the water tub is rockable in left/right and to-and-fro directions;

15 a door provided at the washing machine main body, for opening/closing the third opening to load/unload laundry articles into/from the rotary drum;

a motor for rotating the rotary drum;

20 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;

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

a water draining unit provided at a water drain conduit communicating with the bottom portion of the water tub, for controlling a drain of the washing water in the water tub; and

5 a control unit 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 based on data received from the temperature detector and the water level detector, wherein
10 the control unit performs a cooling cycle of repeating a water supply and drain by controlling the water supply unit and the water draining unit until the heated washing water is cooled to a predetermined temperature during a water draining operation following a high temperature washing
15 cycle for performing a washing with the washing water heated to a temperature above another predetermined temperature by controlling the heating unit.

2. The drum type washing machine of claim 1, wherein the
20 control unit sets a water level for the high temperature washing cycle to be same as a first predetermined water level that is lower than a water level for a general wash cycle.

25 3. The drum type washing machine of claim 1 or 2, wherein the water tub has a water overflow opening through which

water overflows into the water drain conduit when a water level of the washing water in the water tub is higher than a second predetermined water level, and the control unit sets a maximum water level in performing the cooling cycle same
5 as a third predetermined water level that is lower than the second predetermined water level.

4. The drum type washing machine of claim 3, wherein the control unit controls the motor to rotate the rotary drum
10 for a first predetermined time when the water level of the washing water is set at the third predetermined water level during the cooling cycle, thereby stirring washing water and laundry articles in the rotary drum.

15 5. The drum type washing machine of claim 4, wherein the control unit controls the motor to rotate the rotary drum for the first predetermined time under a condition where the water level of the washing water is set at the third predetermined water level during the cooling cycle and also
20 controls the temperature detector to detect a temperature of washing water.

6. The drum type washing machine of claim 5, wherein in case the temperature detected by the temperature detector is
25 higher than the predetermined temperature, the control unit supplies water to the third predetermined water level after

draining water to a fourth predetermined water level near the first predetermined water level and then drains a part of the supplied water.

- 5 7. The drum type washing machine of claim 5 or 6, wherein in case a temperature detected by the temperature detector is equal to or lower than the predetermined temperature, the control unit completely drains water in the water tub and then executes a next cycle.

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8. The drum type washing machine of any one of claims 1 to 7, wherein the water supply unit includes a first water supply unit for supplying water into the water tub while communicating therewith and a second water supply unit for
15 supplying water into the rotary drum through the first opening of the rotary drum, wherein the second water supply unit supplies a part of or an entire volume of water at least right after the high temperature washing cycle.