WASHING MACHINE AND HEATED WATER GENERATION DEVICE

DESCRIPTION

TECHNICAL FIELD

The present invention relates to a washing machine that washes clothes and the like using hot water, and a heated water generation device.

BACKGROUND ART

Conventionally, as this type of washing machine, there has been proposed a washing machine that increases a temperature of a washing liquid to easily remove dirt (for example, see PTL 1).

FIG. 15 is a sectional view of a conventional washing machine. In FIG. 15, provided are water supply port 62 that supplies water to water tub 63 and switching valve 66 that branches a water supply path from water supply port 62 to water tub 63 into main water path 64 and bypass path 65. Heating unit 67 is provided in the middle of bypass path 65.

Unfortunately, this configuration complicates a channel for supplying the heated washing liquid to water tub 63.

In order to solve this problem, it is conceivable to provide heater 72 at a bottom of water tub 71 as shown in FIG. 16.

FIG. 16 is a perspective view of a conventional water tub. In water tub 71, recess 73 is disposed at the bottom, and heater 72 is provided so as to be located in recess 73. Fixing portion 74 that fixes heater 72 in recess 73 is disposed on an outer peripheral side of the bottom of water tub 71.

Citation List

Patent Literature

PTL 1: Unexamined Japanese Patent Publication No. 2006-43100

SUMMARY OF THE INVENTION

However, in the conventional configuration, the washing tub (not shown) is rotatably provided in water tub 71, and rotates in a direction of the arrows in FIG. 16 during a spin-drying operation. This rotation of the washing tub causes a flow of the washing liquid in the direction of the arrows in FIG. 16.

Since a support portion of heater 72 of fixing portion 74 is disposed in a direction orthogonal to the flow of the washing liquid, the washing liquid collides with the support portion of heater 72. This causes turbulence, prevents a favorable rotation of the washing tub, and causes vibration. Otherwise, spin-drying failure occurs due to an increase in rotational resistance because of abnormal occurrence of foam.

The present invention provides a washing machine capable of suppressing vibration and abnormal occurrence of foam during a spin-drying operation.

The washing machine of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a driving device that drives the washing tub to rotate, and a heating device that is provided in the water tub and heats a washing liquid. The heating device is attached to an attachment portion disposed in the water tub, and the attachment portion is disposed such that a first side surface substantially orthogonal to a rotation direction of the washing tub during spin-drying is inclined toward the rotation direction of the washing tub.

This configuration can provide a washing machine capable of suppressing vibration and abnormal occurrence of foam during the spin-drying operation.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an exploded perspective view of a washing machine according to a first exemplary embodiment of the present invention with a door removed, as viewed from a rear surface.

FIG. 2 is a sectional view of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 3 is a sectional view showing a state of circulation of a washing liquid in the washing machine according to the first exemplary embodiment of the present invention.

FIG. 4 is a plan view of a water tub of the washing machine according to the first exemplary embodiment of the present invention, as viewed from above.

FIG. 5 is an enlarged view of a main portion of the water tub of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 6 is a plan view of the water tub of the washing machine according to the first exemplary embodiment of the present invention with a heating plate removed, as viewed from above.

FIG. 7 is a sectional view taken along line 7-7 of FIG. 6.

FIG. 8 is an enlarged plan view of a main portion of the water tub of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 9 is an enlarged sectional view of a main portion of the water tub of the washing machine according to the first exemplary embodiment of the present invention.

FIG. 10 is a perspective view of the water tub of the washing machine according to the first exemplary embodiment of the present invention, as viewed

from below.

FIG. 11 is a perspective view of the water tub of the washing machine according to the first exemplary embodiment of the present invention, as viewed from above.

FIG. 12 is an enlarged plan view of a main portion of the water tub of the washing machine according to the first exemplary embodiment of the present invention, as viewed from above.

FIG. 13 is an enlarged plan view of a main portion of a water tub of a washing machine according to a second exemplary embodiment of the present invention, as viewed from above.

FIG. 14 is an enlarged sectional view of a main portion of the water tub of the washing machine according to the second exemplary embodiment of the present invention.

FIG. 15 is a sectional view of a conventional washing machine.

FIG. 16 is a perspective view of a water tub of the conventional washing machine.

DESCRIPTION OF EMBODIMENTS

(First exemplary embodiment)

Hereinafter, a first exemplary embodiment of the present invention will be described with reference to the drawings. Note that the present invention is not limited by the present exemplary embodiment.

FIG. 1 is an exploded perspective view of a washing machine according to the present exemplary embodiment as viewed from a rear surface of the washing machine. FIG. 2 is a longitudinal sectional view of the washing machine according to the present exemplary embodiment.

Housing 1 is formed in a square shape having a front surface, both side

surfaces, and a rear surface, has opening 2 disposed on the rear surface, and has door 3 closing opening 2 openably. By removing door 3, a user can view inside or within housing 1 from opening 2.

In the present exemplary embodiment, since opening 2 is disposed on the rear surface of housing 1, on an occasion of maintenance, housing 1 is rotated to a position where the inside of housing 1 can be maintained through opening 2, and the inside of housing 1 is maintained. Door 3, which is disposed on the rear surface, does not come into sight of the user and does not impair the appearance when the washing machine is installed.

In the present exemplary embodiment, opening 2 is disposed on the rear surface of housing 1, but may be disposed on a side surface. Forming opening 2 on a side surface can reduce an amount of movement of housing 1 during maintenance and improve inspection workability.

Upper case 4 is attached to an upper side of housing 1. In a space surrounded by housing 1 and upper case 4, water tub 5 having a bottomed cylindrical shape formed of a flame-retardant synthetic resin is supported, and rotating shaft 6 is provided at a central axis of water tub 5. Washing tub 7 connected to rotating shaft 6 is provided in water tub 5. Pulsator 8 connected to rotating shaft 6 is provided at the bottom of washing tub 7. Motor 9 as a driving device is provided in a lower part of water tub 5. Rotating shaft 6 is connected to motor 9, and washing tub 7 and pulsator 8 are driven to rotate by motor 9.

Loading port 10 from which laundry is loaded into washing tub 7 is disposed on a top surface of water tub 5. Loading port 10 is openably closed by lid 11. An external loading port (not shown) from which laundry is loaded into washing tub 7 is disposed in upper case 4, and the external loading port is openably closed by outer lid 12.

Washing tub 7 includes cylindrical side wall 7a made of a metal having corrosion resistance, in the present exemplary embodiment, a stainless steel, and bottom wall 7b made of a flame-retardant synthetic resin, and washing tub 7 is configured by integrally fixing side wall 7a and bottom wall 7b. Washing tub 7 is provided with multiple spin-drying holes 13 on side wall 7a, and annular fluid balancer 14 for reducing spin-drying vibration attached to an upper part of washing tub 7.

Washing tub 7 is provided with circulation channel covers 15 at opposing positions on side wall 7a, and circulation channels (not shown) are disposed between a side surface of washing tub 7 and circulation channel covers 15. Two circulation channels opposing to each other are disposed by attaching a pair of circulation channel covers 15 to washing tub 7. Circulation channel covers 15 and the circulation channels are preferably disposed in an identical shape in order to suppress occurrence of imbalance during a rotation of washing tub 7, but may be disposed in a different shape as needed.

Discharge ports 16 are disposed in circulation channel covers 15 at positions corresponding to an upper part and a middle part of washing tub 7. Discharge port 16 may be disposed only at one of the positions corresponding to the upper part and the middle part of washing tub 7.

Blade 8a is integrally disposed on a lower surface of pulsator 8. The rotation of pulsator 8 by motor 9 pushes the washing liquid to an outer peripheral side by centrifugal force of blade 8a. The washing liquid circulates in the circulation channels, and a washing liquid is discharged and sprinkled from discharge port 16 of the circulation channels into washing tub 7.

Recess 17 is disposed in a substantially arc shape around rotating shaft 6 at the bottom of water tub 5. The bottom of water tub 5 is disposed obliquely so as to be gradually lower toward recess 17. Drain port 18 is disposed at one

end of recess 17. A bottom surface of recess 17 is disposed obliquely so as to be gradually lower toward drain port 18. Drain port 18 is disposed at a leading position in a rotation direction during spin-drying of washing tub 7 in recess 17. In the present exemplary embodiment, the rotation direction of washing tub 7 during spin-drying is clockwise when washing tub 7 is viewed from above, and is a direction of arrow A shown in FIG. 11.

In recess 17 disposed at the bottom of water tub 5, attachment portion 20 to which heating device 19 is attached is integrally disposed so as to bulge upward from the bottom of recess 17. Heating device 19 is for heating the washing liquid supplied into water tub 5, and is configured by a heater.

Attachment portion 20 of heating device 19 is disposed from a side surface of water tub 5 to recess 17, and disposed so as to bulge upward from the bottom surface of recess 17. Attachment portion 20 is disposed such that a top surface is substantially the same height as a bottom surface of water tub 5 or slightly higher than the bottom surface of water tub 5. Attachment portion 20 has first side surface 20a substantially orthogonal to arrow A as the rotation direction of washing tub 7, and second side surface 20b substantially orthogonal to first side surface 20a. First side surface 20a is configured to be inclined toward the rotation direction of washing tub 7 as going upward from the bottom surface of recess 17. Second side surface 20b is disposed in a substantially vertical plane shape, and attachment opening 21 through which heating device 19 is inserted from outside water tub 5 is disposed on second side surface 20b (see FIGS. 7 and 8).

In heating device 19, a heater wire is disposed in a meandering shape, and both ends of the heater wire are fixed to attachment plate 22 having an insulating and heat insulating function. Temperature sensor 23 configured by a thermistor is attached to attachment plate 22, and temperature sensor 23

detects a temperature of heating device 19. Temperature sensor 23 is provided at a substantially center of both ends of the heater wire such that the temperature of the heating device 19 can be accurately detected. A sealing material (not shown) is provided on an outer peripheral portion of attachment plate 22, and attachment plate 22 is water-tightly attached to a peripheral edge of attachment opening 21 of second side surface 20b of attachment portion 20 by the sealing material.

Water tub 5 is attached to housing 1 such that attachment opening 21 of attachment portion 20 is located at a position facing door 3 that openably closes opening 2 of housing 1 outside water tub 5. When door 3 is opened, attachment opening 21 of attachment portion 20 faces opening 2 of housing 1, and heating device 19 attached to attachment opening 21 can be maintained.

Heat shield plate 24 disposed of metal, in the present exemplary embodiment, stainless steel, is provided below heating device 19. Heat shield plate 24 is fixed while spaced apart from the bottom surface of recess 17. Heat shield plate 24, which is provided between heating device 19 and the bottom surface of recess 17, can prevent transmission of heat generated by heating device 19 directly to recess 17, and prevent the bottom of water tub 5 having recess 17 from being deteriorated by heat.

Heat shield plate 24, having corrosion resistance, is disposed of stainless steel in the present exemplary embodiment, but may be disposed of other metal materials. As long as the material can suppress transmission of heat generated by heating device 19 to water tub 5, and is flame-retardant or noncombustible, a material other than metal, for example, ceramic may be used.

Heating plate 25 formed of metal, in the present exemplary embodiment, stainless steel, is provided at a position above heating device 19, and heating plate 25 is disposed between the bottom surface of washing tub 7 and heating

device 19. Through-hole 25a is disposed on heating plate 25, on a central side of water tub 5. Through-hole 25a is disposed at a position deviated from a position above heating device 19, and heating device 19 is configured to be covered with heating plate 25. Heating device 19 is covered with heating plate 25, and heating plate 25 is disposed between the bottom surface of washing tub 7 and heating device 19. This can prevent heat generated from heating device 19 from being directly transmitted to washing tub 7 and prevent the bottom of washing tub 7 from being deteriorated by heat.

Heating plate 25 is fixed apart from heating device 19 by a plurality of ribs 26 (see FIG. 8) erected upward from the bottom surface of recess 17. Heating plate 25 is attached at substantially the same height as the bottom surface of water tub 5 and the top surface of attachment portion 20 of heating device 19. Further, heating plate 25 is attached to be inclined so as to be gradually higher toward through-hole 25a, and the washing liquid heated by heating device 19 is efficiently guided to through-hole 25a by the inclination of heating plate 25.

An inclination angle of heating plate 25 is set to 3 degrees with respect to the horizon in the present exemplary embodiment. In the washing machine according to the present exemplary embodiment, the inclination allowed for installation is set to 2 degrees with respect to the horizon. Heating plate 25 is set to be inclined with respect to a contact surface when the washing machine is installed with an inclination of 2 degrees.

Heating plate 25 is disposed in a substantially rectangular shape. Side 25b of heating plate 25 located closer to second side surface 20b of attachment portion 20 is installed so as to be in contact with or adjacent to second side surface 20b of attachment portion 20. Side 25c of heating plate 25 located on the outer peripheral side of recess 17 is installed so as to be in contact with or

adjacent to the outer peripheral side surface of recess 17. Side 25d of heating plate 25 located on a central side of recess 17 is installed so as to be in contact with or adjacent to a central side surface of recess 17. Side 25e of heating plate 25 located on the rotation direction side of washing tub 7 is spaced apart from the side surface of recess 17. Side 25f of heating plate 25 located between the central side surface of recess 17 and second side surface 20b of attachment portion 20 is formed in an arc shape, and is spaced apart from the central side surface of recess 17 and from second side surface 20b of attachment portion 20.

Passage hole 25g is disposed at a position above temperature sensor 23 on heating plate 25. The washing liquid heated by heating device 19 passes upward from passage hole 25g, and thus the heated washing liquid does not stay around temperature sensor 23. Temperature sensor 23 can therefore detect the temperature of the washing liquid accurately.

Circulation water port 32 is disposed between heat shield plate 24 and a side wall of recess 17 near heating device 19 in recess 17 (see FIGS. 3, 8, and 9). Circulation pump 27 is connected to circulation water port 32, and one end of circulation path 28 is connected to circulation pump 27 (see FIG. 3). Circulation path 28 is provided outside water tub 5, and the other end of circulation path 28 is connected to water inlet port 29 disposed near loading port 10. The washing liquid in water tub 5 sucked from circulation water port 32 flows through circulation path 28 by circulation pump 27, and is supplied from above to the laundry in washing tub 7 from water inlet port 29.

Water inlet port 29 is disposed above discharge ports 16 of the circulation channels disposed by side wall 7a of washing tub 7 and circulation channel covers 15. A circulation amount of the washing liquid by circulation pump 27 is set to be larger than the circulation amount of the washing liquid in the circulation channels. As a result, the amount of the washing liquid supplied

from water inlet port 29 is large, and the washing liquid is thus supplied from a high position. The supplied washing liquid splashes against the laundry and the washing liquid in washing tub 7 to produce foam. A large amount of foam wraps the laundry and acts on dirt, thereby improving washing performance.

Operation display device 30 is provided at a rear part of a top surface of upper case 4. Operation display device 30 is operated to set various operation courses and to display the set operation courses and the like. Control device 33 is provided at a position facing opening 2 disposed in housing 1 (see FIG. 1), and control device 33 executes the operation course selected by operation display device 30.

In the present exemplary embodiment, the operation courses executed by control device 33 include a course for laundry by heating the washing liquid and a course for laundry without heating the washing liquid.

Hereinafter, operations and actions of the washing machine configured as described above will be described.

Outer lid 12 and lid 11 are opened, laundry is loaded into washing tub 7 from loading port 10, outer lid 12 and lid 11 are closed, and a power switch (not shown) of operation display device 30 is operated to apply a power supply. An operation course or the like is selected by operation display device 30, and a start switch (not shown) is operated to start the operation.

When the operation is started, after the amount of the loaded laundry is detected, the water supply device (not shown) is operated to start water supply. Then, the washing liquid is supplied into water tub 5 together with the detergent put in a detergent case (not shown).

When a predetermined amount of washing liquid is stored in water tub 5, circulation pump 27 is operated and the washing liquid is poured from water inlet port 29 (see FIG. 3). The washing liquid from water inlet port 29, which

is supplied from a high position, splashes against the laundry in washing tub 7 to produce foam, and the foam permeates deep into the fibers of the laundry, and wraps, floats, and removes the dirt.

The amount of water supplied to water tub 5 is set in accordance with the amount of the laundry loaded into washing tub 7. When a predetermined water level is detected by a water level sensor (not shown), the water supply is stopped, and motor 9 is driven to rotate pulsator 8 forward and reverse alternately. The rotation of pulsator 8 agitates the laundry in washing tub 7 together with the washing liquid to wash the laundry.

Circulation pump 27 is continued to operate in a washing step. By circulating the foamed washing liquid, the foam acts on the dirt, and the dirt can be efficiently removed.

The washing step is continued for a predetermined time, and a drain valve (not shown) is opened to drain water upon completion of the washing step. Upon completion of drainage, spin-drying is performed. Spin-drying is performed by rotating washing tub 7 in one direction, and in the present exemplary embodiment, by rapidly rotating washing tub 7 in a clockwise direction as viewed from above (direction of arrow A in FIG. 11).

After spin-drying, the water supply device is operated to supply a predetermined amount of water to washing tub 7, a rinsing step is performed, and then a spin-drying step is performed, thereby ending the steps of laundry.

When a course for laundry by heating the washing liquid is selected as the operation course, a heating step of heating the washing liquid is performed in the washing step. When the operation is started, the amount of the loaded laundry is detected, and water is supplied into water tub 5 in accordance with the amount of the loaded laundry. Electricity is supplied to heating device 19 together with the water supply to heat the washing liquid in water tub 5.

The washing liquid heated by heating device 19 moves upward. Since heating plate 25 located above heating device 19 is obliquely provided so as to be gradually higher toward through-hole 25a, the heated washing liquid is guided along the inclination of heating plate 25 to through-hole 25a and moves from through-hole 25a to above heating plate 25.

The washing liquid below heating plate 25 moves above heating plate 25, and thus the low-temperature washing liquid flows from around heating plate 25 to below heating plate 25. Side 25e of heating plate 25 on the rotation direction side of washing tub 7 and side 25f of heating plate 25 located between the central side surface of recess 17 and second side surface 20b are spaced apart from the side surface of recess 17. As a result, the washing liquid flows below heating plate 25 from two substantially opposing sides of heating plate 25. Since the washing liquid flows below heating plate 25 from the two substantially opposing sides of heating plate 25, the washing liquid efficiently convects and can be efficiently heated. Heating device 19 also heats heating plate 25, and heating plate 25 also heats the washing liquid. This improves heating efficiency of the washing liquid.

Through-hole 25a is disposed on the inclined upper side of heating plate 25, and thus the heated washing liquid can be efficiently guided upward. Through-hole 25a is disposed at a position laterally deviated from the position above heating device 19, and an upper side of heating device 19 is covered with heating plate 25. Heating plate 25 can therefore prevent foreign matters from being in contact with heating device 19.

In the heating step, the washing liquid is heated by heating device 19 to a predetermined temperature suitable for washing, in the present exemplary embodiment, about 15°C.

When the washing liquid reaches a certain temperature slightly lower

than the predetermined temperature, circulation pump 27 is operated to circulate the washing liquid and supply the washing liquid from water inlet port 29 to the laundry. Circulation of the heated washing liquid can dissolve powdery detergent efficiently, suppress undissolved portion of the powder detergent, and improve the washing efficiency.

The washing liquid supplied from water inlet port 29, which is supplied to the laundry from a high position, splashes against the laundry to produce foam. The foam permeates the laundry, and washes away dirt stuck deep into the fibers. The heated washing liquid activates enzymes of the detergent and improves the washing power.

When the washing liquid reaches the predetermined temperature, pulsator 8 is rotated alternately forward and reverse. The rotation of pulsator 8 agitates the laundry in washing tub 7 together with the washing liquid to wash the laundry. Since the washing liquid is heated and agitated, the undissolved powdery detergent can be suppressed. In this state, circulation pump 27 is continued to operate, thereby improving the cleaning efficiency.

The rotation of pulsator 8 pushes the washing liquid to the outer peripheral side by the centrifugal force due to the rotation of blade 8a disposed on the lower surface of pulsator 8. The washing liquid rises through the circulation channel disposed by side wall 7a of washing tub 7 and circulation channel covers 15, and is sprinkled from discharge port 16 toward the laundry in washing tub 7.

The washing liquid sprinkled on the laundry from discharge port 16 is heated to the predetermined temperature, and thus the enzymes in the detergent are activated to efficiently wash the dirt permeating the fibers of the laundry.

As described above, the heating step of heating the washing liquid is

performed in the washing step when the course for laundry by heating the washing liquid is selected as the operation course. Here, heating device 19, circulation pump 27, and pulsator 8 operate as follows depending on various conditions.

The washing liquid heated by heating device 19 moves upward. Accordingly, the washing liquid having a low temperature moves downward in washing tub 7. At this time, heating device 19 and circulation pump 27 are simultaneously operated, and the washing liquid having a low temperature at the bottom of washing tub 7 is circulated by circulation pump 27 and supplied into washing tub 7 from water inlet port 29. As a result, the upper part and the lower part of the washing liquid in washing tub 7 are mixed, and the temperature can be increased uniformly.

When the amount of clothes in washing tub 7 is larger than a predetermined amount, a temperature difference between the washing liquid included in the clothes in the upper part and the lower part in washing tub 7 increases. In contrast, when the amount of the clothes in washing tub 7 is smaller than the predetermined amount, the temperature difference between the washing liquid included in the clothes in the upper part and the lower part in washing tub 7 is relatively small.

Thus, when the amount of the clothes in washing tub 7 is larger than the predetermined amount, heating device 19 and circulation pump 27 are simultaneously operated. This can achieve the uniform temperature of the washing liquid included in the clothes in the upper part and the lower part in washing tub 7. On the other hand, when the amount of the clothes in washing tub 7 is smaller than the predetermined amount, only heating device 19 is operated. This can uniformly increase the temperature of the washing liquid included in the clothes without consuming wasteful power.

As a result of various experiments, the predetermined amount of the clothes is set to be about 1/5 of a weight of the laundry having washing and spin-drying capacity in the present exemplary embodiment. More specifically, the experiments have been conducted using washing machines having weights of washing and spin-drying capacity of 10 kg and 12 kg, and as a result, the predetermined amount of the clothes is set to 2 kg.

When the amount of the washing liquid in washing tub 7 is larger than the predetermined amount, a temperature difference between the upper part and the lower part of the washing liquid in washing tub 7 is even larger. In contrast, when the amount of the washing liquid in washing tub 7 is smaller than the predetermined amount, the temperature difference between the upper part and the lower part of the washing liquid in washing tub 7 is relatively small.

Thus, when the amount of the washing liquid in washing tub 7 is larger than the predetermined amount, heating device 19 and circulation pump 27 are simultaneously operated. As a result, the upper part and lower part of the washing liquid in washing tub 7 are mixed, and the temperature can be increased uniformly. On the other hand, when the amount of the washing liquid in washing tub 7 is smaller than the predetermined amount, only heating device 19 is operated. This can uniformly increase the temperature without consuming wasteful power.

As a result of various experiments, the predetermined amount of the washing liquid is set to be about 1/4 of the washing liquid required for washing the laundry having washing and spin-drying capacity in the present exemplary embodiment. More specifically, the experiments have been conducted using washing machines having weights of washing and spin-drying capacity of 10 kg and 12 kg, and as a result, the predetermined amount of the clothes is set to 30 L.

When the amount of the clothes to be washed is small and the amount of the washing liquid necessary for laundry is small, a height of the clothes in the washing liquid in washing tub 7 is sufficiently lower than a height of discharge port 16 located in the middle part of washing tub 7. By operating pulsator 8, the washing liquid is discharged and sprinkled into washing tub 7 from discharge port 16 located in the middle part of washing tub 7.

In contrast, when the amount of the clothes to be washed is large and the amount of the washing liquid required for laundry is large, the height of the clothes in the washing liquid in washing tub 7 is sufficiently higher than the height of discharge port 16 located in the middle part of washing tub 7. By operating circulation pump 27, the washing liquid is sprinkled into washing tub 7 from water inlet port 29.

Thus, when the amount of the clothes in washing tub 7 is small, only pulsator 8 is operated after operation of heating device 19. This can uniformly increase the temperature without consuming wasteful power. Further, when the amount of the clothes in washing tub 7 is large, heating device 19 and circulation pump 27 are simultaneously operated. This can mix the washing liquid in the upper part and lower part in washing tub 7 and uniformly increase the temperature. Upon completion of the washing step using hot water, the drain valve (not shown) is opened to drain water. Upon completion of drainage, spin-drying is performed. Spin-drying is performed by rotating washing tub 7 in one direction, and in the present exemplary embodiment, by rapidly rotating washing tub 7 in a clockwise direction as viewed from above.

After spin-drying, the water supply device is operated to supply the predetermined amount of water to washing tub 7, the rinsing step is performed, and then the spin-drying step is performed, thereby ending the steps of laundry.

In the spin-drying step, washing tub 7 is rotated rapidly in a clockwise

direction as viewed from above. The rotation of washing tub 7 generates an airflow in water tub 5 in the direction of arrow A shown in FIG. 11, and the spin-dried washing liquid flows together with the airflow.

First side surface 20a of attachment portion 20 is inclined toward the rotation direction of washing tub 7 as going upward, and thus the flow generated by the rotation of washing tub 7 is guided along the inclination of first side surface 20a. Thus, first side surface 20a that is inclined in the rotation direction side of washing tub 7 can suppress the obstruction of the flow caused by the rotation of washing tub 7, and suppress the occurrence of turbulence and the generation of vibration.

Second side surface 20b is disposed substantially vertically for attaching heating device 19, but is located downstream the flow generated by the rotation of washing tub 7 with respect to first side surface 20a. This causes no obstruction of the flow or no turbulence.

The upper side of heating device 19 is covered with heating plate 25. Further, heating plate 25 is provided at substantially the same height as the bottom surface of water tub 5 and the top surface of attachment portion 20, and thus do not obstruct the flow of the washing liquid flowing in water tub 5 and can suppress the occurrence of turbulence.

The bottom surface of water tub 5 is inclined toward recess 17, and the bottom surface of recess 17 is inclined toward drain port 18. The washing liquid in water tub 5 flows toward drain port 18 in a draining step. Since heating device 19 is provided at a position apart from drain port 18, the washing liquid at a position facing heating device 19 across rotating shaft 6 in water tub 5 flows out of drain port 18 without passing through heating device 19. A decrease in the amount of the washing liquid passing through heating device 19 can suppress adhesion of lint included in the washing liquid to heating device

19.

When maintenance of heating device 19 is needed, for example, for a trouble caused in heating device 19, first, the washing machine is rotated to a position where door 3 faces, and door 3 is removed from housing 1. Heating device 19, which is provided at a position facing opening 2 from which door 3 is removed, can be visually recognized by removing door 3.

Heating device 19 can be removed from water tub 5 by removing wiring from terminals at both ends of heating device 19 and removing fixing screws (not shown). Heating device 19 can be pulled out of water tub 5 to be maintained. When heating device 19 is replaced with new heating device 19, new heating device 19 is inserted into attachment opening 21 of attachment portion 20 of water tub 5, the fixing screws are screwed to fix heating device 19 to water tub 5, and the wiring is attached to the terminals of heating device 19. Finally, the maintenance is completed by attaching door 3 to housing 1 and returning the washing machine to the original position.

The bottom surface of water tub 5 is inclined to be gradually lower toward drain port 18, and the bottom surface of water tub 5 is disposed such that both the bottom surface of water tub 5 and the bottom surface of recess 17 are the highest on the outer peripheral side. Reinforcing ribs 31 are disposed on both an outer side of the bottom surface of water tub 5 and an outer surface of recess 17. By increasing a height of the outer peripheral side of the outer surface of recess 17, a height of reinforcing ribs 31 located on the outer surface of recess 17 can be increased, and recess 17 can be enforced.

Heating device 19 is attached substantially parallel to the bottom surface of recess 17, and is disposed so as to be inclined such that a side, of heating device 19, closer to drain port 18 is lower than a horizontal plane. Heating device 19 is disposed substantially parallel to the bottom surface of

recess 17, and is thus unlikely to become resistance to drain water flowing toward drain port 18. This can prevent the lint included in the drain water from being entangled with heating device 19.

Opening 2 is disposed on the rear surface of housing 1 in the present exemplary embodiment, but may be disposed on the side surface of housing 1, and heating device 19 may face opening 2 on the side surface of housing 1. Alternatively, opening 2 may be disposed on the front surface of housing 1 and heating device 19 may face opening 2 on the front surface of housing 1.

Opening 2, which is provided on the side surface or the front surface of housing 1, can reduce the amount of movement of the washing machine during maintenance and improve workability.

(Second exemplary embodiment)

FIG. 13 is an enlarged plan view of a main portion of a washing tub of a washing machine according to a second exemplary embodiment of the present invention, as viewed from above. FIG. 14 is a sectional view of a main portion of the washing tub of the washing machine according to the second exemplary embodiment of the present invention.

The present exemplary embodiment uses heating plate 35 having a different shape from a shape of heating plate 25 according to the first exemplary embodiment, and is the same as the first exemplary embodiment except that the position of drain port 18 is different. Thus, the same components as those in the first exemplary embodiment are given the same reference numerals, and descriptions thereof are not repeated.

Heating plate 35 made of metal, in the present exemplary embodiment, stainless steel, is provided above heating device 19, and heating device 19 is configured to be covered with heating plate 35. Since heating device 19 is covered with heating plate 35, heat generated from heating device 19 can be

prevented from being directly transmitted to washing tub 7, and deterioration of the bottom of washing tub 7 due to heat can be suppressed.

Heating plate 35 is disposed in a substantially rectangular shape. Side 35b of heating plate 35 located closer to second side surface 20b of attachment portion 20 is installed so as to be in contact with or adjacent to second side surface 20b of attachment portion 20. Side 35c of heating plate 35 located closer to the outer peripheral side of recess 17 is installed so as to be in contact with or adjacent to the outer peripheral side surface of recess 17. Side 35d of heating plate 35 located on the central side of recess 17 is installed so as to be in contact with or adjacent to the central side surface of recess 17. Arc-shaped notches 35h are disposed on sides 35c and 35d of heating plate 35 such that the washing liquid convects through notches 35h. Side 35e of heating plate 35 on the rotation direction side of washing tub 7 is positioned so as to be spaced apart from the side surface of recess 17.

Heating plate 35 is attached to be inclined to be gradually higher toward side 35e, and the washing liquid heated by heating device 19 is efficiently guided to side 35e by the inclination of heating plate 35.

Heating plate 35 has an inclination angle of 3 degrees with respect to the horizon in the present exemplary embodiment. In the washing machine according to the present exemplary embodiment, the inclination allowed for installation is set to 2 degrees with respect to the horizon. Heating plate 35 is set to be inclined with respect to a contact surface when the washing machine is installed with an inclination of 2 degrees.

Passage hole 35g is disposed at a position above temperature sensor 23 on heating plate 35. The washing liquid heated by heating device 19 passes upward from passage hole 35g, and thus the heated washing liquid does not stay around temperature sensor 23. Temperature sensor 23 can therefore detect the

temperature of the washing liquid accurately.

When a course for laundry by heating the washing liquid is selected as the operation course, heating device 19 is energized together with water supply to heat the washing liquid in water tub 5.

The washing liquid heated by heating device 19 moves upward. Since heating plate 35 located above heating device 19 is obliquely provided so as to gradually higher toward side 35e, the heated washing liquid is guided to side 35e along heating plate 35 and moves from side 35e to above heating plate 35.

The washing liquid below heating plate 35 moves above heating plate 35, and thus the low-temperature washing liquid flows from around heating plate 35 to below heating plate 35. Since heating plate 35 has notches 35h disposed on sides 35c and 35d, the washing liquid flows below heating plate 35 through notches 35h from sides 35c and 35d, which are two substantially opposing sides of heating plate 35. Since the washing liquid flows below heating plate 35 from sides 35c and 35d, which are two substantially opposing sides of heating plate 35, the washing liquid efficiently convects and can be efficiently heated. Heating device 19 also heats heating plate 35, and heating plate 35 also heats the washing liquid. This improves heating efficiency of the washing liquid.

Heating plate 35 is obliquely provided, and thus the washing liquid heated by heating plate 35 can be efficiently guided upward. The upper side of heating device 19 is covered with heating plate 35. Heating plate 35 can therefore prevent foreign matters from being in contact with heating device 19.

Drain port 18 is provided at a position apart from side 35e of heating plate 35 as viewed from above water tub 5, the drain water is guided to drain port 18 by heating plate 35. This can prevent the lint included in the drain water from being entangled with heating device 19.

As described above, a washing machine according to a first aspect of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a driving device that drives the washing tub to rotate, and a heating device that is provided in the water tub and heats a washing liquid. The heating device is attached to an attachment portion disposed in the water tub, and the attachment portion is disposed such that a first side surface substantially orthogonal to a rotation direction of the washing tub during spin-drying is inclined toward the rotation direction of the washing tub.

With this configuration, when the washing tub is rotated in a spin-drying step, an airflow is generated in the water tub due to the rotation of the washing tub, and the spin-dried washing liquid flows together with the airflow. Since the first side surface of the attachment portion of the heating device is inclined in the rotation direction side of the washing tub, the flow caused by the rotation of the washing tub is guided along the inclination of the first side surface. This can suppress the obstruction of the flow, the occurrence of turbulence, and the generation of vibration.

In a washing machine according to a second aspect of the present invention, according to the first aspect of the present invention, the attachment opening through which the heating device is inserted may be disposed on a second side surface substantially orthogonal to the first side surface of the attachment portion.

With this configuration, the second side surface is disposed substantially vertically for attaching the heating device, but is located downstream the flow generated by the rotation of the washing tub with respect to the first side surface. This causes no obstruction of the flow or no turbulence.

In a washing machine according to a third aspect of the present

invention, according to the first or second aspect of the present invention, a drain port may be disposed in the water tub, and a bottom surface of the water tub may be disposed to be gradually lower toward the drain port, and the heating device may be provided substantially parallel to the bottom surface of the water tub.

With this configuration, since the heating device is disposed substantially parallel to the bottom surface of the water tub, the heating device is unlikely to become resistance to drain water flowing toward the drain port. This can prevent the lint included in the drain water from being entangled with the heating device.

In a washing machine according to a fourth aspect of the present invention, according to any one of the first to third aspects of the present invention, a heat shield plate that shields transmission of heat generated by the heating device to the bottom surface of the water tub may be provided between the bottom of the water tub and the heating device.

This configuration can prevent transmission of heat generated by the heating device directly to the bottom surface of the water tub and prevent deterioration of a bottom of the water tub due to heat.

In a washing machine of a fifth aspect of the present invention, according to any one of the first to fourth inventions, a heating plate that covers an upper side of the heating device is provided between the bottom surface of the washing tub and the heating device.

This configuration can prevent transmission of heat generated by the heating device directly to the bottom surface of the washing tub and prevent deterioration of the bottom of the washing tub due to heat.

Further, since the upper side of the heating device is covered with the heating plate, the heating device does not obstruct the flow of the washing liquid

flowing in the water tub, and the occurrence of turbulence can be suppressed.

A washing machine of a sixth aspect of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a driving device that drives the washing tub to rotate, and a drain port that is disposed on the bottom surface of the water tub and drains a washing liquid in the water tub, and a heating device that is provided at the bottom of the water tub and heats the washing liquid. The drain port and a heating means are provided apart from each other.

With this configuration, the washing liquid at a position apart from the heating device flows out of the drain port without passing through the heating device. A decrease in the amount of the washing liquid passing through the heating device suppresses adhesion of lint included in the washing liquid to the heating device.

In a washing machine according to a seventh aspect of the present invention, particularly according to the sixth aspect of the present invention, a heat shield plate that shields transmission of heat generated by the heating device to the bottom surface of the water tub may be provided between the bottom surface of the water tub and the heating device.

This configuration can prevent transmission of heat generated by the heating device directly to the bottom surface of the water tub and prevent deterioration of the bottom of the water tub due to heat.

In a washing machine according to an eighth aspect of the present invention, particularly according to the sixth or seventh aspect of the present invention, a heating plate that covers an upper side of the heating device is provided between the bottom surface of the washing tub and the heating device.

With this configuration, since the upper side of the heating device is covered with the heating plate, the heating device does not obstruct the flow of

the washing liquid flowing in the water tub, and the occurrence of turbulence can be suppressed.

A washing machine according to a ninth aspect of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a driving device that drives the washing tub to rotate, and a heating device that is provided in the water tub and heats a washing liquid. The housing has an opening openably closed by a door, the water tub is provided with an attachment portion to which the heating device is attached, and the attachment portion is provided with the attachment opening through which the heating device is inserted into the water tub from outside of the water tub at a position facing the opening.

With this configuration, when maintenance of the heating device is needed, for example, for a trouble caused in the heating device, the washing machine is rotated to a position where the door faces, and the door is removed from the housing. The heating device is provided at a position facing the opening from which the door is removed, and thus maintenance of the heating device can be performed by removing the door.

In a washing machine according to a tenth aspect of the present invention, particularly according to the ninth aspect of the present invention, the opening may be disposed on a rear surface of the housing.

With this configuration, the door does not come into sight and does not impair the appearance when the washing machine is installed.

In a washing machine according to an eleventh aspect of the present invention, particularly according to the ninth aspect of the present invention, the opening may be disposed on a side surface of the housing.

This configuration can reduce the amount of movement of the washing machine during maintenance and improve workability.

In a washing machine according to a twelfth aspect of the present invention, particularly according to any one of the ninth to eleventh aspects of the present invention, a heat shield plate that shields transmission of heat generated by the heating device to a bottom surface of the water tub may be provided between the bottom surface of the water tub and the heating device.

This configuration can prevent transmission of heat generated by the heating device directly to the bottom surface of the water tub and prevent deterioration of a bottom of the water tub due to heat.

In a washing machine according to a thirteenth aspect of the present invention, particularly according to any one of the ninth to twelfth aspects of the present invention, a heating plate that covers an upper side of the heating device is provided between the bottom surface of the washing tub and the heating device.

With this configuration, since the upper side of the heating device is covered with the heating plate, the heating device does not obstruct the flow of the washing liquid flowing in the water tub, and the occurrence of turbulence can be suppressed.

A heated water generation device according to a fourteenth aspect of the present invention includes a water tub, a heating device disposed at a bottom of the water tub and heating a liquid in the water tub, a temperature sensor provided in the heating device, and a heating plate provided above the heating device to cover the heating device. The passage hole is disposed at a position substantially above the temperature sensor on the heating plate.

With this configuration, the hot water heated by the heating device is thermally transmitted to the entire water tub through the heating plate, and deterioration of other materials due to direct thermal damage can be suppressed.

Further, the passage hole allows the hot water heated by the heating

device to flow upward without being obstructed by the heating plate at a position above the temperature sensor. Thus, a temperature can be detected stably.

A washing machine according to a fifteenth aspect of the present invention is provided with the heated water generation device according to the fourteenth aspect of the present invention.

With this configuration, the hot water heated by the heating device is thermally transmitted to the entire water tub through the heating plate, and deterioration of other materials due to direct thermal damage can be suppressed.

Further, the passage hole allows the hot water heated by the heating device to flow upward without being obstructed by the heating plate at a position above the temperature sensor. Thus, a temperature can be detected stably.

A washing machine according to a sixteenth aspect of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a pulsator rotatably provided at an inner bottom of the water tub, a driving device that drives the washing tub and the pulsator to rotate, a circulation path connected to the washing tub to circulate water in the washing tub, and a circulation pump that forms a flow of water in the circulation path. The washing machine includes a heating device that is provided in the water tub and heats a washing liquid, and a control device that controls the driving device, the circulation pump, and the heating device. The control device operates the circulation pump and the heating device simultaneously.

With this configuration, the low-temperature washing liquid at the bottom of the washing tub is circulated by the circulation pump and supplied into the washing tub from a water inlet port. This operation mixes an upper portion and a lower portion of the washing liquid in the washing tub and increases the temperature uniformly.

In a washing machine according to a seventeenth aspect of the present invention, according to the sixteenth aspect of the present invention, the control device may operate the circulation pump and the heating device simultaneously when an amount of water in the washing tub is larger than a predetermined amount, and the control device may operate only the heating device when the amount of water in the washing tub is smaller than the predetermined amount.

With this configuration, when the amount of the washing liquid in the washing tub is larger than a predetermined amount, the heating device and the circulation pump are simultaneously operated. This can mix the washing liquid in the upper part and the lower part in the washing tub and uniformly increase the temperature. Further, when the amount of the washing liquid in the washing tub is smaller than the predetermined amount, only the heating device is operated. This can uniformly increase the temperature of the washing liquid without consuming wasteful power.

In a washing machine according to an eighteenth aspect of the present invention, according to the sixteenth or seventeenth aspect of the present invention, the control device may simultaneously operate the circulation pump and the heating device when an amount of clothes in the washing tub is larger than a predetermined amount, and the control device may operate only the heating device when the amount of the clothes in the washing tub is smaller than the predetermined amount.

With this configuration, when the amount of the clothes in the washing tub is larger than the predetermined amount, the heating device and the circulation pump are simultaneously operated. This can achieve the uniform temperature of the washing liquid included in the clothes in the upper part and the lower part in the washing tub. Further, when the amount of the clothes in the washing tub is smaller than the predetermined amount, only the heating

device is operated. This can uniformly increase the temperature of the washing liquid included in the clothes without consuming wasteful power.

A washing machine according to a nineteenth aspect of the present invention has a discharge port located at a middle part in the washing tub, and in any one of the sixteenth to eighteenth aspects of the present invention, the control device may operate only the pulsator after the heating device is energized when the amount of water in the washing tub is smaller than the predetermined amount, and the control device may operate the circulation pump simultaneously with energization of the heating device when the amount of water in the washing tub is larger than the predetermined amount.

With this configuration, when the amount of the washing liquid in the washing tub is smaller than the predetermined amount, only the pulsator is operated after operation of the heating device. This can uniformly increase the temperature without consuming wasteful power. Further, when the amount of the washing liquid in the washing tub is larger than the predetermined amount, the heating device and the circulation pump are simultaneously operated. This can mix the washing liquid in the upper part and the lower part in the washing tub and uniformly increase the temperature.

In a washing machine according to a twentieth aspect of the present invention, according to any one of the sixteenth to nineteenth aspects of the present invention, the control device operates the pulsator after the heating device is energized when the amount of clothes in the washing tub is smaller than a predetermined amount, and the control device operates the circulation pump simultaneously with energization of the heating device when the amount of clothes in the washing tub is larger than the predetermined amount.

With this configuration, when the amount of the clothes in the washing tub is smaller than the predetermined amount, only the pulsator is operated

after operation of the heating device. This can uniformly increase the temperature without consuming wasteful power. Further, when the amount of the clothes in the washing tub is larger than the predetermined amount, the heating device and the circulation pump are simultaneously operated. This can mix the washing liquid in the upper part and the lower part in the washing tub and uniformly increase the temperature.

A washing machine according to a twenty-first aspect of the present invention includes a housing, a water tub provided in the housing, a washing tub rotatably provided in the water tub, a driving means that drives the washing tub to rotate, a heating device that is provided in the water tub and heats the washing liquid in the water tub, and a circulation path that circulates the washing liquid in the water tub from above into the washing tub. A circulation water port to the circulation path is disposed at a bottom of the water tub.

With this configuration, the washing liquid heated by the heating device at the bottom of the water tub can be circulated upward in the water tub. This can reduce uneven washing and easily remove dirt.

In a washing machine according to a twenty-second aspect of the present invention, particularly according to the twenty-first aspect of the present invention, the circulation water port may be disposed near the heating device.

This configuration can efficiently guide the washing liquid heated by the heating device to the circulation path.

In a washing machine according to a twenty-third aspect of the present invention, according to the twenty-first or twenty-second aspect of the present invention, the circulation water port may be disposed to protrude upward from a bottom surface of the water tub toward the heating device.

As the washing liquid heated by the heating device moves upward, the washing liquid having a relatively low temperature flows in from around. With

this configuration, the circulation water port is disposed to protrude upward from the bottom surface of the water tub toward the heating device. This can efficiently guide the heated washing liquid heated by the heating device to the circulation path.

INDUSTRIAL APPLICABILITY

As described above, the washing machine of the present invention can suppress the occurrence of vibration during the spin-drying operation, and thus can be applied to uses such as a washing and spin-drying machine and a commercial washing machine.

REFERENCE MARKS IN THE DRAWINGS

1	housing
2	opening
3	door
5	water tub
7	washing tub
8	pulsator
9	motor (driving device)
17	recess
19	heating device
20	attachment portion
20a	first side surface
20b	second side surface
21	attachment opening
23	temperature sensor
24	heat shield plate

	25	heating plate
	25a	through-hole
	27	circulation pump
	28	circulation path
	29	water inlet port
	35	heating plate

CLAIMS

1. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a driving device that drives the washing tub to rotate; and

a heating device that is provided in the water tub and heats a washing liquid, wherein

the heating device is attached to an attachment portion disposed in the water tub, and

the attachment portion has a first side surface disposed to be inclined toward a rotation direction side of the washing tub, the first side surface being substantially orthogonal to the rotation direction of the washing tub during spin-drying.

2. The washing machine according to claim 1, wherein the attachment portion is disposed with an attachment opening of the heating device, on a second side surface substantially orthogonal to the first side surface.

3. The washing machine according to claim 1 or 2, wherein

the wawer tub includes a drain port and a bottom surface that is gradually lower toward the drain port, and

the heating device is provided substantially parallel to the bottom surface of the water tub.

4. The washing machine according to any one of claims 1 to 3, further

comprising a heat shield plate that shields transmission of heat generated by the heating device to the bottom surface of the water tub is provided between the bottom surface of the water tub and the heating device.

5. The washing machine according to any one of claims 1 to 4, further comprising a heating plate that covers an upper side of the heating device is provided between the bottom surface of the washing tub and the heating device.

6. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a driving device that drives the washing tub to rotate;

a drain port that is provided on a bottom surface of the water tub and drains a washing liquid in the water tub, and

a heating device that is provided at a bottom of the water tub and heats the washing liquid, wherein the drain port and the heating device are provided apart from each other.

7. The washing machine according to claim 6, further comprising a heat shield plate that shields transmission of heat generated by the heating device to the bottom surface of the water tub is provided between the bottom surface of the water tub and the heating device.

8. The washing machine according to claim 6 or 7, further comprising a heating plate that covers an upper side of the heating device is provided between the bottom surface of the washing tub and the heating device.

9. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a driving device that drives the washing tub to rotate; and

a heating device that is provided in the washing tub and heats the washing liquid, wherein

the housing has an opening that is openably closed by a door,

the water tub is provided with an attachment portion to which the heating device is attached, and

the attachment portion is disposed with an attachment opening through which the heating device is inserted into the water tub from outside of the water tub at a position facing the opening.

10. The washing machine according to claim 9, wherein the opening is disposed on a rear surface of the housing.

11. The washing machine according to claim 9, wherein the opening is disposed on a side surface of the housing.

12. A washing machine according to any one of claims 9 to 11, further comprising a heat shield plate that shields transmission of heat generated by the heating device to a bottom surface of the water tub is provided between the bottom surface of the water tub and the heating device.

13. The washing machine according to any one of claims 9 to 12,

further comprising a heating plate that covers an upper side of the heating device is provided between a bottom surface of the washing tub and the heating device.

14. A heated water generation device comprising:

a water tub;

a heating device that is provided at a bottom of the water tub and heats a liquid in the water tub;

a temperature sensor provided in the heating device; and

a heating plate provided above the heating device to cover the heating device, wherein the heating plate has a passage hole disposed substantially above the temperature sensor.

15. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a driving device that drives the washing tub to rotate;

a water supply device that supplies a washing liquid into the water tub;

a heating device that is provided at a bottom of the washing tub and heats the washing liquid;

a temperature sensor provided in the heating device; and

a heating plate provided above the heating device to cover the heating device, wherein the heating plate has a passage hole disposed substantially above the temperature sensor.

16. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a pulsator rotatably provided at an inner bottom of the washing tub;

a driving device that drives the washing tub and the pulsator to rotate;

a circulation path that circulates the washing liquid in the washing tub;

a circulation pump that forms a flow of the washing liquid in the circulation path;

a heating device that is provided in the water tub and heats the washing liquid; and

a control device that controls the driving device, the circulation pump, and the heating device, wherein the control device operates the circulation pump and the heating device simultaneously.

17. The washing machine according to claim 16, wherein

the control device operates the circulation pump and the heating device simultaneously when an amount of water in the washing tub is larger than a predetermined amount, and

the control device operates only the heating device when the amount of water in the washing tub is smaller than the predetermined amount.

18. The washing machine according to claim 16 or 17, wherein

the control device operates the circulation pump and the heating device simultaneously when an amount of clothes in the washing tub is larger than a predetermined amount, and

the control device operates only the heating device when the amount of clothes in the washing tub is smaller than the predetermined amount.

19. The washing machine according to any one of claims 16 to 18, wherein

the washing machine has a discharge port located in a middle of the washing tub,

the control device operates only the pulsator after energizing the heating device when the amount of water in the washing tub is smaller than the predetermined amount, and

the control device operates the circulation pump simultaneously with energization of the heating device when the amount of water in the washing tub is larger than the predetermined amount.

20. The washing machine according to any one of claims 16 to 19, wherein

the control device operates the pulsator after energizing the heating device when the amount of clothes in the washing tub is smaller than the predetermined amount, and

the control device operates the circulation pump simultaneously with energization of the heating device when the amount of clothes in the washing tub is larger than the predetermined amount.

21. A washing machine comprising:

a housing;

a water tub provided in the housing;

a washing tub rotatably provided in the water tub;

a driving device that drives the washing tub to rotate;

a heating device that is provided in the water tub and heats a washing

liquid; and

a circulation path that circulates the washing liquid in the water tub from above into the washing tub, wherein a circulation water port to the circulation path is disposed at a bottom of the water tub.

22. The washing machine according to claim 21, wherein the circulation water port is disposed near the heating device.

23. The washing machine according to claim 21 or 22, wherein the circulation water port is disposed to project upward from a bottom surface of the water tub toward the heating device.