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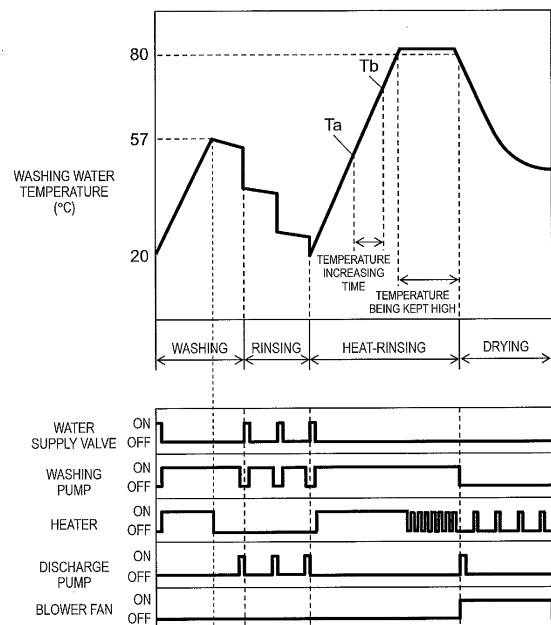
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(54) **WASHING MACHINE**

(57) A washing machine of the present invention includes: a washing tub configured to contain an object to be washed; a washing apparatus which washes the object to be washed with washing water; a heater which heats the washing water; a temperature sensor which detects a temperature of the washing water; and a controller which controls a series of washing operations including a washing step, a rinsing step, a heat-rinsing step, and a drying step. The controller has a configuration in which, when the temperature sensor detects a first predetermined temperature in at least one of the washing step and the heat-rinsing step, the controller performs, until a predetermined period of time has elapsed, a heater control in which power-on and power-off of the heater are repeated based on preset periods of time. With this arrangement, a washing machine in which high washing performance is maintained and which is excellent in energy saving performance can be realized.

FIG. 3



Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine which performs washing by spraying washing water to objects to be washed such as tableware while heating the washing water.

BACKGROUND ART

[0002] Conventionally, as a washing machine of this type, there is proposed a washing machine which performs washing by spraying washing water, from a washing nozzle, to objects to be washed such as tableware while heating the washing water (see PTL 1, for example).

[0003] In the following, a configuration of a washing machine described in PTL 1 will be described with reference to FIG. 7 and FIG. 8.

[0004] FIG. 7 is a sectional side view of a conventional washing machine. FIG. 8 is a block diagram showing a control configuration of the conventional washing machine.

[0005] As shown in FIG. 7, conventional washing machine 1 is configured by at least washing tub 2, washing pump 5, washing nozzle 6, heater 8, controller 9, thermistor 10, dish basket 11, drain pump 13, and the like. Washing tub 2 is provided inside washing machine 1. At a bottom of washing tub 2, drain outlet 3 is provided. Washing pump 5 is disposed in a pump chamber communicating with drain outlet 3 and is driven by washing motor 4.

[0006] Washing pump 5 circulates washing water inside washing tub 2.

[0007] Specifically, the washing water is suctioned through drain outlet 3 into washing pump 5. The suctioned washing water is supplied by washing pump 5 to washing nozzle 6 rotatably disposed at an inner bottom of washing tub 2. The supplied washing water is sprayed from washing nozzle 6 toward tableware 7. After the sprayed washing water is used to wash tableware 7, the washing water is circulated through a path back to drain outlet 3.

[0008] Heater 8 is disposed between washing nozzle 6 and the bottom of washing tub 2 to heat the washing water. Thermistor 10 is disposed in close contact with an outer bottom of washing tub 2 to detect the temperature of the washing water. Controller 9 detects by thermistor 10 that the temperature of the washing water reaches a predetermined temperature, and then performs a control of interrupting energization of heater 8 and the like.

[0009] Dish basket 11 is configured such that pieces of tableware 7 are orderly arranged, and is disposed above washing nozzle 6. With this arrangement, the washing water is effectively sprayed on tableware 7 arranged in dish basket 11 to efficiently wash tableware 7.

[0010] A front of washing tub 2 is opened. On a front

face part of washing tub 2, lid 12 which can be opened frontward is mounted.

[0011] Drain pump 13 suctions the washing water from drain outlet 3 of washing tub 2 and discharges the washing water outside the machine through drain hose 14.

[0012] Further, the washing water to be filled in washing tub 2 is supplied through water supply hose 15. When controller 9 detects, by water level detector 16 communicating with washing tub 2, that the washing water has been supplied to a predetermined water level, controller 9 closes water supply valve 17 to stop the supply of the washing water.

[0013] Blower fan 18 for drying blows air into washing tub 2. Thus, water vapor generated from surfaces of tableware 7 and the like is discharged outside washing tub 2 through exhaust port 19 provided in lid 12. By this process, tableware 7 is dried.

[0014] Further, as shown in FIG. 8, controller 9 is connected through a load controller to washing pump 5, heater 8, drain pump 13, water supply valve 17, and blower fan 18, and controls those components. With this arrangement, controller 9 controls a washing operation including a series of steps such as a washing step, a rinsing step, a heat-rinsing step, and a drying step.

[0015] In the following, operations and actions of a conventional washing machine will be described with reference to FIG. 9 and FIG. 10.

[0016] FIG. 9 is an explanatory diagram showing a washing-water temperature and an operation program of a conventional washing machine. FIG. 10 is a flowchart of a heat-rinsing step of the conventional washing machine.

[0017] As shown in FIG. 9, a washing operation of a general washing machine includes four steps, i.e., a washing step, a rinsing step, a heat-rinsing step, and a drying step.

[0018] First, controller 9 operates, in the washing step, water supply valve 17 to supply washing water through water supply hose 15. Thereafter, controller 9 energizes washing pump 5 and heater 8 and operates washing pump 5 and heater 8 until the washing-water temperature reaches a predetermined washing temperature (57°C, for example). Then, at the end of the washing step, controller 9 makes drain pump 13 discharge the washing water.

[0019] Next, in the rinsing step, controller 9 operates water supply valve 17 to fill new washing water in washing tub 2. Thereafter, controller 9 does not energize heater 8 but energizes only washing pump 5 and performs the operation of rinsing tableware 7 twice for a predetermined period of time. Then, at the end of the rinsing step, controller 9 makes drain pump 13 discharge the washing water.

[0020] Next, in the heat-rinsing step, controller 9 operates water supply valve 17 to fill new washing water in washing tub 2. Thereafter, controller 9 energizes washing pump 5 and heater 8 to set the temperature of the washing water to a predetermined temperature (80°C to 85°C,

for example). At this time, heater 8 is intermittently operated so that the temperature of the washing water reaches the predetermined temperature. In this state, tableware 7 is rinsed.

[0021] Note that, because consciousness of personal hygiene has been raised recently, an operation is made such that, in heat-rinsing step, the temperature is usually kept for a certain period of time (10 minutes, for example) after the temperature of the washing water reaches a predetermined maximum temperature (80°C or higher, for example).

[0022] A specific control operation will be described with reference to FIG. 10.

[0023] As shown in FIG. 10, controller 9 supplies water in washing tub 2 up to a predetermined water amount (step S1), then turns on power of washing pump 5 (step S2), and turns on power of heater 8 (step S3). By this operation, the washing water is circulated and heated.

[0024] Next, it is determined whether or not the temperature of the washing water has reached a first maximum temperature (85°C, for example) (step S4). If the temperature has reached the first maximum temperature (Yes in step S4), the energization of heater 8 is stopped (step S5).

[0025] Next, it is determined whether or not the temperature of the washing water has decreased to a second maximum temperature (80°C, for example), which is lower than the first maximum temperature (step S6). If the temperature has reached the second maximum temperature (Yes in step S6), the energization of heater 8 is started (step S7).

[0026] Next, similarly to step S4, it is determined whether or not the temperature of the washing water has reached the first maximum temperature (85°C, for example) (step S8). If the temperature has reached the first maximum temperature (Yes in step S8), the energization of heater 8 is stopped (step S9).

[0027] Next, it is determined whether or not a predetermined period of time has elapsed (step S10). If the predetermined period of time has not elapsed (No in step S10), the flow goes back to step S6. Then, the subsequent steps for repeating the energization of heater 8 are executed so that the temperature of the washing water is kept between the first maximum temperature and the second maximum temperature.

[0028] On the other hand, if the predetermined period of time has elapsed (Yes in step S10), the power of washing pump 5 and heater 8 are turned off (step S11). Further, power of drain pump 13 is turned on (step S12) to discharge the washing water from washing tub 2.

[0029] By the above-described operations, the temperature of the washing water is controlled in the heat-rinsing step.

[0030] Next, as shown in FIG. 9, in the drying step, controller 9 makes drain pump 13 discharge the washing water. Thereafter, an operation is made for a predetermined period of time such that heater 8 is intermittently energized while blower fan 18 is being energized. By this

process, tableware 7 is dried.

[0031] As described above, the operation of the conventional washing machine 1 is performed.

[0032] However, conventional washing machine 1 performs a control in such a manner that an amplitude of fluctuation of the temperature (the difference between the first maximum temperature and the second maximum temperature) is set to be a large value, for example, about 5°C when the washing water is held in a state of high temperature for a certain period of time. This control is made by taking into account delay of thermal conduction of washing tub 2 existing between thermistor 10 and the washing water. Thus, in a transition period, for example, when the temperature is increasing due to continuous energization of heater 8, there is always a temperature difference between the actual temperature of the washing water and the temperature detected by thermistor 10. Therefore, controller 9 performs a control by estimating the temperature of the washing water by adding a temperature difference to the output value of thermistor 10. For example, when the temperature of the washing water is desired to be held at 80°C or higher, the control is made, by taking into account a magnitude of the amplitude of fluctuation of the temperature of the washing water, in such a manner that the energization of heater 8 is stopped after the washing water is once heated to, for example, 85°C. For this reason, there is an issue that extra power consumption is required.

Citation List

Patent Literature

[0033] PTL 1: Unexamined Japanese Patent Publication No. 2006-288925

SUMMARY OF THE INVENTION

[0034] To solve the above problem, a washing machine of the present invention includes: a washing tub configured to contain an object to be washed; a washing apparatus which washes the object to be washed with washing water in the washing tub; a heater which heats the washing water; a temperature sensor disposed on an outer bottom surface of the washing tub, and configured to detect a temperature of the washing water; and a controller which controls a series of washing operations including a washing step, a rinsing step, a heat-rinsing step, and a drying step. The controller has a configuration in which, when the temperature sensor detects a first predetermined temperature in at least one of the washing step and the heat-rinsing step, the controller performs, until a predetermined period of time has elapsed, a heater control in which power-on and power-off of the heater are repeated based on preset periods of time.

[0035] With this arrangement, an amplitude of fluctuation of the temperature of the washing water can be kept small while the temperature is kept high, whereby it is

possible to prevent the washing water from being heated too much. As a result, it is possible to realize a washing machine in which the temperature of the washing water can be stably kept high and which has higher energy saving performance.

BRIEF DESCRIPTION OF DRAWINGS

[0036]

FIG. 1 is a sectional side view of a washing machine of an exemplary embodiment of the present invention.

FIG. 2 is a block diagram showing a control configuration of the washing machine of the exemplary embodiment.

FIG. 3 is an explanatory diagram of a washing-water temperature and an operation program of the washing machine of the exemplary embodiment.

FIG. 4 is a flowchart of a heat-rinsing step of the washing machine of the exemplary embodiment.

FIG. 5 is a flowchart showing in detail a heater control in the flowchart of FIG. 4.

FIG. 6 is a diagram showing contents of ranking for the heater control of the washing machine of the exemplary embodiment.

FIG. 7 is a sectional side view of a conventional washing machine.

FIG. 8 is a block diagram showing a control configuration of the conventional washing machine.

FIG. 9 is an explanatory diagram showing a washing-water temperature and an operation program of the conventional washing machine.

FIG. 10 is a flowchart of a heat-rinsing step of the conventional washing machine.

DESCRIPTION OF EMBODIMENT

[0037] In the following, an exemplary embodiment of the present invention will be described with reference to the drawings. Note that this exemplary embodiment does not limit the present invention.

EXEMPLARY EMBODIMENT

[0038] A washing machine of the exemplary embodiment of the present invention will be described below. Although a description will be made below by taking a configuration of a dishwasher as an example of a washing machine, the present invention is obviously not limited thereto. Components same as those in the conventional washing machine described with reference to FIG. 7 to FIG. 9 will be assigned the same reference marks and will be described briefly.

[0039] First, a configuration of the washing machine of the present exemplary embodiment will be described with reference to FIG. 1 and FIG. 2.

[0040] FIG. 1 is a sectional side view of the washing

machine of the exemplary embodiment of the present invention. FIG. 2 is a block diagram showing a control configuration of the washing machine of the exemplary embodiment.

[0041] As shown in FIG. 1 and FIG. 2, washing machine 1 of the present exemplary embodiment is configured by at least washing tub 2, washing pump 5, washing nozzle 6, heater 8, controller 9, thermistor 10, dish basket 11, drain pump 13, and the like. Dish basket 11 is provided in washing tub 2. Washing pump 5 and washing nozzle 6 are provided as a washing apparatus for washing tableware 7 stored in dish basket 11. Washing nozzle 6 is rotatably provided in washing tub 2. Washing pump 5 pressure-feeds washing water to washing nozzle 6, so that the washing water is sprayed from washing nozzle 6 toward tableware 7 stored in dish basket 11.

[0042] At this time, the washing water in washing tub 2 is heated by heater 8. The temperature of the heated washing water is measured by thermistor 10, which is mounted on an outer bottom surface of washing tub 2 and serving as a temperature sensor.

[0043] Thus, controller 9 measures the temperature of the washing water by detecting an output voltage of thermistor 10.

[0044] Further, as shown in FIG. 2, controller 9 is connected, through a load controller, to washing pump 5, heater 8, drain pump 13, water supply valve 17, and blower fan 18, and controls those components. With this arrangement, controller 9 controls and performs a washing operation including a series of steps such as a washing step, a rinsing step, a heat-rinsing step, and a drying step.

[0045] In the following, operations and actions of the washing machine of the present exemplary embodiment will be described with reference to FIG. 3 to FIG. 5.

[0046] FIG. 3 is an explanatory diagram showing a washing-water temperature and an operation program of the washing machine of the exemplary embodiment. FIG. 4 is a flowchart of a heat-rinsing step of the washing machine of the exemplary embodiment. FIG. 5 is a flowchart showing in detail a heater control in the flowchart of FIG. 4.

[0047] Basically, the operation of the washing machine, which washes tableware 7 by using loads of washing pump 5, washing nozzle 6, heater 8, and the like, is the same as the operation of the conventional washing machine.

[0048] Therefore, a detailed description will be made below on the operations and the actions of the washing machine which are features of the present exemplary embodiment and which are different from those of the conventional washing machine.

[0049] As shown in FIG. 3, the washing operation of the washing machine of the present exemplary embodiment includes four steps, i.e., a washing step, a rinsing step, a heat-rinsing step, and a drying step, similarly to the conventional washing machine.

[0050] First, in the washing step, controller 9 operates water supply valve 17 to supply washing water through

water supply hose 15. Thereafter, controller 9 energizes washing pump 5 and heater 8 to operate washing pump 5 and heater 8 until the washing-water temperature reaches a predetermined washing temperature (57°C, for example). Then, at the end of the washing step, controller 9 makes drain pump 13 discharge the washing water.

[0051] Next, in the rinsing step, controller 9 operates water supply valve 17 to fill new washing water in washing tub 2. Thereafter, controller 9 energizes only washing pump 5, without energizing heater 8, and performs the operation of rinsing tableware 7, for example, twice for a predetermined period of time. Then, at the end of the rinsing step, controller 9 makes drain pump 13 discharge the washing water. The rinsing step ends with this operation.

[0052] Next, with reference to FIG. 4 and FIG. 5, a detailed description will be made below on the operations and the actions of the heat-rinsing step, which are the features of the present exemplary embodiment.

[0053] As shown in FIG. 4 and FIG. 5, when the washing step and the rinsing step are finished, the heat-rinsing step is started (step S1).

[0054] Then, controller 9 energizes again water supply valve 17 to supply washing water to washing tub 2 up to a predetermined water amount through water supply hose 15 (step S2). Thereafter, when controller 9 detects, with water level detector 16, that the washing water has been supplied to a predetermined water level, controller 9 stops the power supply to water supply valve 17 to stop the supply of the washing water. Thereafter, washing motor 4 is energized to drive washing pump 5 (step S3) so that the washing operation is performed.

[0055] Concurrently with this operation, controller 9 continuously energizes heater 8 (step S4) to heat the washing water to increase the temperature of the washing water. At this time, controller 9 measures the time period from first increased temperature Ta (50°C, for example) to second increased temperature Tb (68°C, for example) shown in FIG. 3 as a temperature increasing time (step S5). The temperature of first increased temperature Ta and the temperature of second increased temperature Tb are measured from the output of thermistor 10 which detects the temperature of the washing water.

[0056] Next, based on the length of the measured temperature increasing time and according to a preset and stored ranking (see FIG. 6), a rank which determine the content of the control of the subsequent washing operation is determined (step S6).

[0057] Then, controller 9 determines whether or not detected temperature TS of the washing water detected by thermistor 10 is equal to or higher than the first predetermined temperature T1 (step S7). If detected temperature TS is less than first predetermined temperature T1 (No in step S7), the measurement is repeated until detected temperature TS is equal to or higher than first predetermined temperature T1.

[0058] On the other hand, if the temperature of the washing water is equal to or higher than first predetermined temperature T1 (Yes in step S7), first set periods of time based on which the heater control is performed are set, and the heater control to be described later is started (step S8). Here, the first set periods of time are time periods for which power for energizing heater 8 is turned on and off, and the first set periods of time are set based on the rank determined in step S6.

[0059] Thereafter, the heater control is finely performed in accordance with changes in the temperature of the washing water (step S9 to S16). The details will be described below with reference to FIG. 5.

[0060] Next, after the above heater control, it is determined whether or not a predetermined period of time has elapsed in the heat-rinsing step (step S17). If the predetermined period of time has not elapsed (No in step S17), the flow goes back to step S9, and the subsequent heater control is repeated until the predetermined period of time has elapsed.

[0061] On the other hand, if the predetermined period of time has elapsed (Yes in step S17), the power of heater 8 is turned off (step S18).

[0062] Next, controller 9 stops washing pump 5 (step S19).

[0063] Then, the flow goes to the drying step shown in FIG. 3 (step S20).

[0064] Here, the ranking shown in step S6 of FIG. 4 will be specifically described with reference to FIG. 6.

[0065] FIG. 6 is a diagram showing the content of the ranking for the heater control of the washing machine of the exemplary embodiment.

[0066] FIG. 6 is an example of set values which are ranked depending on the lengths of the temperature increasing times of the washing water in the heat-rinsing step. Specifically, the temperature increasing times of the washing water are classified into four ranks. In FIG. 6, the following values are set: the first predetermined temperature (a target thermistor temperature, a target washing-water temperature (estimated value)) at which the heater control is started, and the first set periods of time and second set periods of time for which the power of heater 8 is turned on and turned off.

[0067] Normally, the temperature increasing time of the washing water changes depending on a power-supply voltage, an ambient temperature, and the like. Therefore, the actual temperature of the washing water is estimated based on the temperature detected by thermistor 10 (detected temperature TS of the thermistor). For example, when the amount of heat generation of heater 8 is large because of a high power-supply voltage or when the ambient temperature is high, the temperature increasing time of the washing water is short. In this case, the difference between detected temperature TS of the thermistor and the actual temperature of the washing water is relatively large because of delay due to thermal conductivity of washing tub 2. Therefore, the temperature (first predetermined temperature T1) of the thermistor,

at which the heater control of turning on and off the power of heater 8 is started, is set to 76°C, as in rank A shown in FIG. 6, which is lower than the temperatures in other ranks B to D.

[0068] To the contrary, when the amount of heat generation of heater 8 is small because of a low power-supply voltage and when the ambient temperature is low, the temperature increasing time of the washing water is long. Therefore, when the temperature increasing time is long, the thermistor temperature (first predetermined temperature T1), at which the heater control is started, is set to 79°C, as in rank D shown in FIG. 6, which is higher than the temperatures in other ranks A to C.

[0069] By these operations, regardless of the variation of the power-supply voltage and the ambient temperature, controller 9 can start the heater control after the temperature of the washing water reaches the target washing-water temperature, for example, 82°C. That is, by controlling the temperature of the washing water on a time basis, it is possible to control the variation in temperature due to the power-supply voltage and the ambient temperature, whereby to bring the temperature closer to a certain target washing-water temperature having a small variation. As a result, the temperature of the washing water can be kept at temperatures equal to or higher than 80°C, at which high sterilization effect can be obtained.

[0070] Further, in the present exemplary embodiment, there are two types of the time periods for turning on and off the power of heater 8, which are the first set periods of time and the second set periods of time as shown in FIG. 6.

[0071] With the first set periods of time, under the condition that the power-supply voltage, the ambient temperature, and the like are normal, controller 9 can perform a control so that the temperature is almost stable at the target washing-water temperature of 82°C. In other words, normally, when the temperature of the washing water is kept high, the temperature of the washing water is determined by the balance between a rate of temperature increase (an amount of heat generation of heater 8) and a speed of heat dissipation from washing tub 2. For this reason, when the temperature increasing time is short, the time ratio of power-on to power-off is set low, as in rank A shown in FIG. 6, compared to other ranks B to D. To the contrary, when the temperature increasing time is long, the time ratio of power-on to power-off is set high, as in rank D shown in FIG. 6, compared to the other ranks A to C. With this arrangement, regardless of the variation of the power-supply voltage and the ambient temperature, controller 9 can control the temperature of the washing water to be kept in the vicinity of the target washing-water temperature as shown in FIG. 3

[0072] However, it is difficult to keep, at all times, the temperature of the washing water at a fixed temperature of, for example, 82°C. Thus, depending on conditions of varying power-supply voltage or varying ambient temperature, the temperature of the washing water may

gradually deviate from the target washing-water temperature.

[0073] Therefore, in the washing machine of the present exemplary embodiment, a more detailed heater control including step S9 to step S16 is performed as shown in FIG. 5.

[0074] In the following, operations and actions of the more detailed heater control will be described with reference to FIG. 5.

[0075] As shown in FIG. 5, after the heater control is started (step S8), controller 9 determines whether or not detected temperature TS of the thermistor detected by thermistor 10 is equal to or higher than fourth predetermined temperature T4 (step S9). Fourth predetermined temperature T4 is set higher by, for example, 2°C than first predetermined temperatures T1, each of which is set for each rank of the temperature increasing time.

[0076] At this time, if detected temperature TS of the thermistor is less than fourth predetermined temperature T4 (No in step S9), controller 9 determines whether or not detected temperature TS of the thermistor is equal to or higher than second predetermined temperature T2, which is set higher by, for example, 1°C than first predetermined temperatures T1, each of which is set for each rank of the temperature increasing time (step S11).

[0077] At this time, if detected temperature TS of the thermistor is equal to or higher than second predetermined temperature T2 (Yes in step S11), it is determined that the temperature of the washing water is in a condition to be easily increased. In this case, controller 9 operates after making changes from the power-on/off time of heater 8 defined by the first set periods of time shown in FIG. 6 to the power-on/off time of heater 8 defined by the second set periods of time shown in FIG. 6, in which the time ratio of power-on is set lower (step S12). With this arrangement, the tableware can be washed while suppressing the increase of the temperature of the washing water and keeping the temperature of the washing water stable in the vicinity of first predetermined temperature T1 (the target washing-water temperature is 82°C).

[0078] Next, when detected temperature TS of the thermistor is less than second predetermined temperature T2 (No in step S11) and after changes are made to the second set periods of time, controller 9 determines whether or not detected temperature TS of the thermistor exceeds third predetermined temperature T3, which is set lower by, for example, 1°C than first predetermined temperatures T1, each of which is set for each rank of the temperature increasing time (step S13).

[0079] At this time, when detected temperature TS of the thermistor exceeds third predetermined temperature T3 (Yes in step S13), controller 9 operates after changing the heater control to first set periods of time shown in FIG. 6 (step S14).

[0080] Next, while controller 9 is performing the heater control with the first set periods of time (step S14) and if detected temperature TS of the thermistor is equal to or lower than third predetermined temperature T3 (No in

step S13), it is determined whether or not detected temperature TS of thermistor 10 is equal to or lower than third predetermined temperature T3, which is set lower by, for example, 1°C than first predetermined temperature T1 (step S15).

[0081] At this time, if detected temperature TS of the thermistor is equal to or lower than third predetermined temperature T3 (Yes in step S15), controller 9 determines that the washing-water temperature is in a condition to be easily decreased. Then, controller 9 once makes the power of heater 8 to be continuously turned on (the power-off time is zero) and heats the washing water (step S16). This operation makes the temperature of the washing water to bring closer to first predetermined temperature T1.

[0082] Next, it is determined whether or not the heating of the washing water under the heater control has been performed for a predetermined period of time (step S17). If the predetermined period of time has elapsed (Yes in step S17), step S18 and the subsequent steps shown in FIG. 4 are executed.

[0083] If the predetermined period of time has not elapsed (No in step S17), the flow goes back to step S9 to repeatedly perform the detailed heater control.

[0084] If thermistor 10 detects fourth predetermined temperature T4 or higher temperatures which are higher than second predetermined temperature T2 (Yes in step S9) while the heater control is performed with the second set periods of time (step S12) in the period when the heater control shown in FIG. 5 is repeated for the predetermined period of time, controller 9 determines that the washing-water temperature is in a condition to be more easily increased. In that case, the power of heater 8 is once continuously turned off (the power-on time is zero) so that the temperature of the washing water is decreased (step S10). This operation makes the temperature of the washing water to bring closer to the target washing-water temperature (82°C, for example) of first predetermined temperature T1.

[0085] Thereafter, if the temperature of the washing water returns to the vicinity of first predetermined temperature T1 (step S13), step S13 is executed, and the heater control is set back to the first set periods of time, for example (step S14).

[0086] By the above-described heater control, the temperature of the washing water can be gradually returned to the target washing-water temperature (82°C, for example). As a result, the temperature of the washing water can be kept in the vicinity of first predetermined temperature T1 with the amplitude of fluctuation of the temperature kept small. As a result, a washing machine having higher energy saving performance can be realized.

[0087] Note that the target washing-water temperature for the heater control, the set temperatures of thermistor 10 (first predetermined temperature T1, second predetermined temperature T2, third predetermined temperature T3, and fourth predetermined temperature T4), and the set periods of time, which are described in the present

exemplary embodiment are not limited to the above-described set values. For example, it is obvious that those values can be set for each type of device in view of an amount of heat generation of heater 8 and a degree of heat insulation from washing tub 2 to surrounding air.

[0088] In the present exemplary embodiment, the description has been made taking as an example the four ranks and the two set periods of time, i.e., the first set periods of time and the second set periods of time; however, the present invention is not limited thereto. For example, it is obvious that the number of the ranks and the number of the set periods of time can be arbitrarily set depending on desired control accuracy.

[0089] Further, in the present exemplary embodiment, the heater control in the heat-rinsing step has been described in detail; however, it is obvious that a similar heater control can also be performed in the washing step. A similar effect can be obtained with this control.

[0090] Further, in the present exemplary embodiment, the description has been made taking a dish washer as an example of a washing machine; however, the present invention is not limited thereto. For example, the present invention can be applied to a washing apparatus for medical instruments such as forceps to be used for surgery. With this application, it is possible to wash medical instruments, for which high sterilization effect is required, with washing water equal to or higher than 80°C.

[0091] As described above, with the present exemplary embodiment, when the temperature of the washing water is kept at high temperatures for a certain period of time, it is possible to control the amplitude of fluctuation of the temperature of the washing water to be small so that it is possible to prevent the washing water from being heated too much. As a result, it is possible to realize a washing machine which is more energy-saving and in which the temperature of the washing water can be stably kept high.

[0092] In addition, in the case of the conventional washing machine in which the amplitude of fluctuation of the temperature of the washing water is large, the maximum temperature of the washing water whose temperature is kept at a high temperature of 80°C or more for washing is as high as 85°C. Thus, the materials and the components used for washing machine 1 are greatly damaged by heat. Therefore, in the present exemplary embodiment, even when the power-supply voltage or the ambient temperature varies, the maximum temperature of the washing water whose temperature is kept at high temperatures can be lowered from 85°C to 82°C by finely performing the heater control of the temperature of the washing water. As a result, damage to the materials and the components constituting washing machine 1 can be reduced, whereby a highly reliable washing machine can be realized.

[0093] As described above, a washing machine of the present invention includes: a washing tub configured to contain therein an object to be washed; a washing apparatus which washes the object to be washed with wash-

ing water in the washing tub; a heater which heats the washing water; a temperature sensor disposed on an outer bottom surface of the washing tub, and configured to detect a temperature of the washing water; and a controller which controls a series of washing operations including a washing step, a rinsing step, a heat-rinsing step, and a drying step. The controller has a configuration in which, when the temperature sensor detects a first predetermined temperature in at least one of the washing step and the heat-rinsing step, the controller performs, until a predetermined period of time has elapsed, a heater control in which power-on and power-off of the heater are repeated based on preset periods of time.

[0094] With this arrangement, an amplitude of fluctuation of the temperature of the washing water can be kept small while the temperature is kept high, whereby it is possible to prevent the washing water from being heated too much. As a result, it is possible to realize a washing machine in which the temperature of the washing water can be stably kept high and which has higher energy saving performance.

[0095] Further, according to the washing machine of the present invention, the controller may measure, during heating of the washing water, a time period from when a temperature detected by the temperature sensor reaches a predetermined first increased temperature until when the temperature reaches a predetermined second increased temperature, and the controller may start the heater control based on a measured result.

[0096] Further, according to the washing machine of the present invention, the controller may measure, during heating of the washing water, a time period from when a temperature detected by the temperature sensor reaches a predetermined first increased temperature until when the temperature reaches a predetermined second increased temperature, and the controller may change, based on the measured result, the set periods of time for the power-on and the power-off of the heater.

[0097] With these arrangements, even when the power-supply voltage, the ambient temperature, or the like varies, it is possible to control the actual temperature of the washing water whose temperature is kept high not to deviate from a desired temperature. As a result, the object to be washed can be washed with the washing water at a more constant temperature.

[0098] Further, according to the washing machine of the present invention, when the controller detects that the temperature detected by the temperature sensor deviates from the first predetermined temperature by a prescribed temperature or more while the controller is performing the heater control, the controller may change the set periods of time for the power-on and the power-off of the heater control to bring the temperature closer to the first predetermined temperature.

[0099] With this arrangement, even when the power-supply voltage, the ambient temperature, or the like varies, it is possible to more surely control the actual temperature of the washing water whose temperature is kept

high not to deviate from a desired temperature.

INDUSTRIAL APPLICABILITY

[0100] The washing machine of the present invention can control the amplitude of fluctuation of the heating temperature of the washing water to be small. Thus, the present invention is useful in the field of dish washers or other fields in which it is required to prevent the washing water from being heated too much so that tableware can be washed while the temperature of the washing water is stably kept high with less energy.

REFERENCE MARKS IN THE DRAWINGS

[0101]

- | | |
|----|---------------------------------|
| 1 | washing machine |
| 2 | washing tub |
| 3 | drain outlet |
| 4 | washing motor |
| 5 | washing pump |
| 6 | washing nozzle |
| 7 | tableware |
| 8 | heater |
| 9 | controller |
| 10 | thermistor (temperature sensor) |
| 11 | dish basket |
| 12 | lid |
| 13 | drain pump |
| 14 | drain hose |
| 15 | water supply hose |
| 16 | water level detector |
| 17 | water supply valve |
| 18 | blower fan |
| 19 | exhaust port |

Claims

1. A washing machine comprising:

- a washing tub configured to contain an object to be washed;
- a washing apparatus which washes the object to be washed with washing water in the washing tub;
- a heater which heats the washing water;
- a temperature sensor disposed on an outer bottom surface of the washing tub, and configured to detect a temperature of the washing water; and
- a controller which controls a series of washing operations including a washing step, a rinsing step, a heat-rinsing step, and a drying step, wherein, when the temperature sensor detects a first predetermined temperature in at least one of the washing step and the heat-rinsing step,

the controller performs, until a predetermined period of time has elapsed, a heater control in which power-on and power-off of the heater are repeated based on preset periods of time.

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2. The washing machine according to claim 1, wherein the controller measures, during heating of the washing water, a time period from when a temperature detected by the temperature sensor reaches a predetermined first increased temperature until when the temperature detected by the temperature sensor reaches a predetermined second increased temperature, and the controller changes, based on a measured result, a setting of the first predetermined temperature at which to start the heater control. 10 15
3. The washing machine according to claim 1, wherein the controller measures, during heating of the washing water, a time period from when a temperature detected by the temperature sensor reaches the predetermined first increased temperature until when the temperature reaches a predetermined second increased temperature, and the controller changes, based on a measured result, the set periods of time for the power-on and the power-off of the heater control. 20 25
4. The washing machine according to claim 1, wherein when the controller detects that the temperature detected by the temperature sensor deviates from the first predetermined temperature by a prescribed temperature or more while the heater control is performed, the controller changes the set periods of time for the power-on and the power-off of the heater control to bring the temperature closer to the first predetermined temperature. 30 35

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FIG. 1

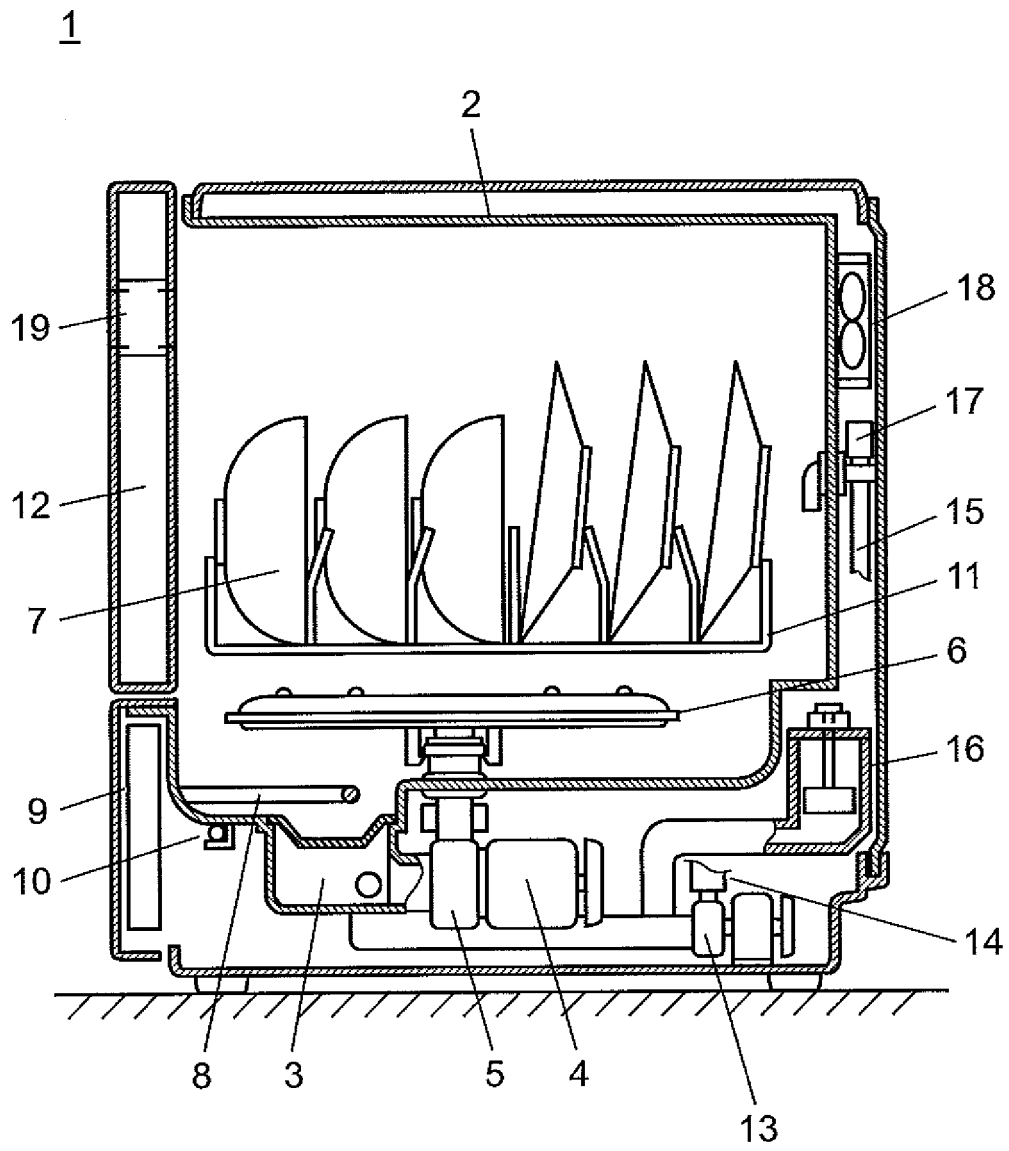


FIG. 2

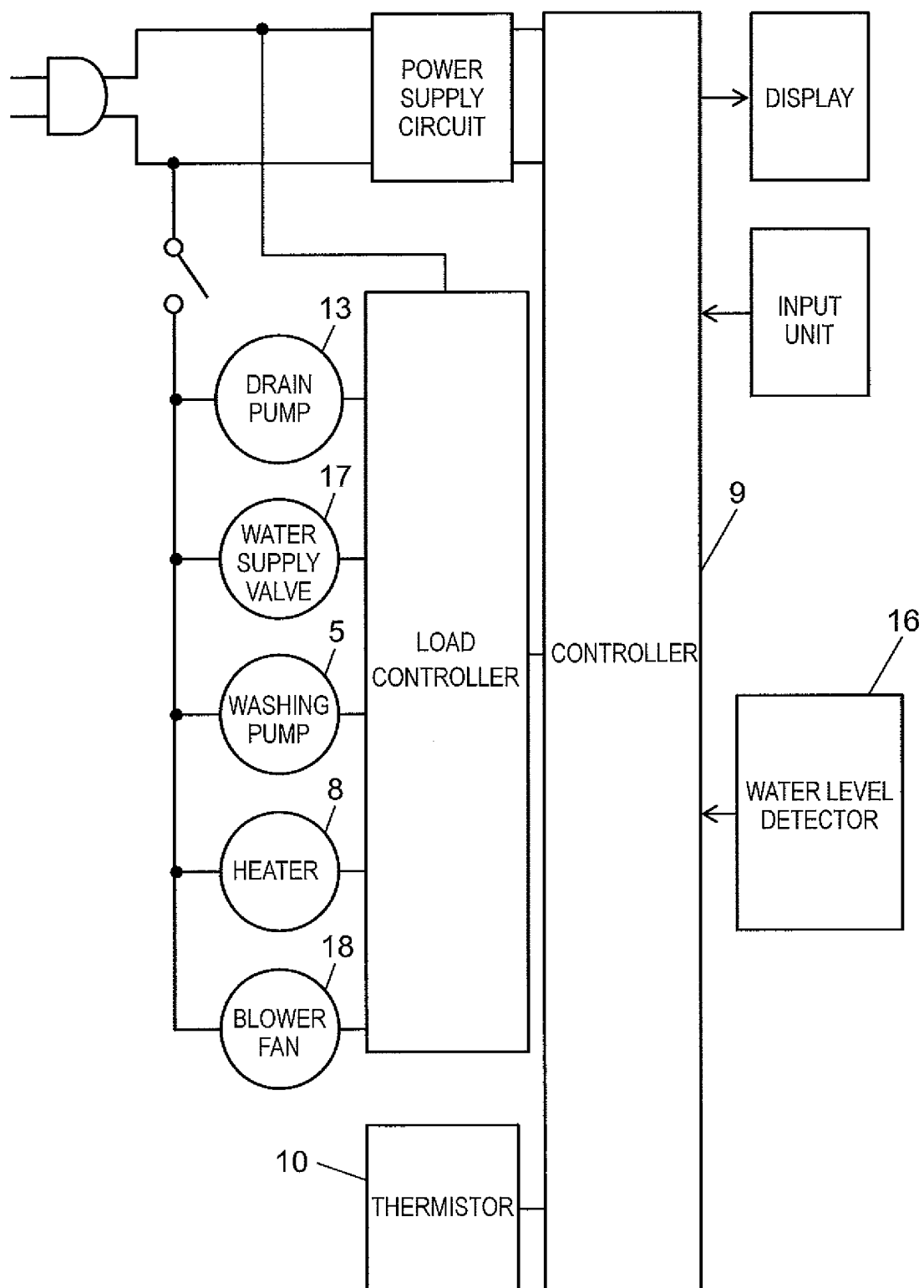


FIG. 3

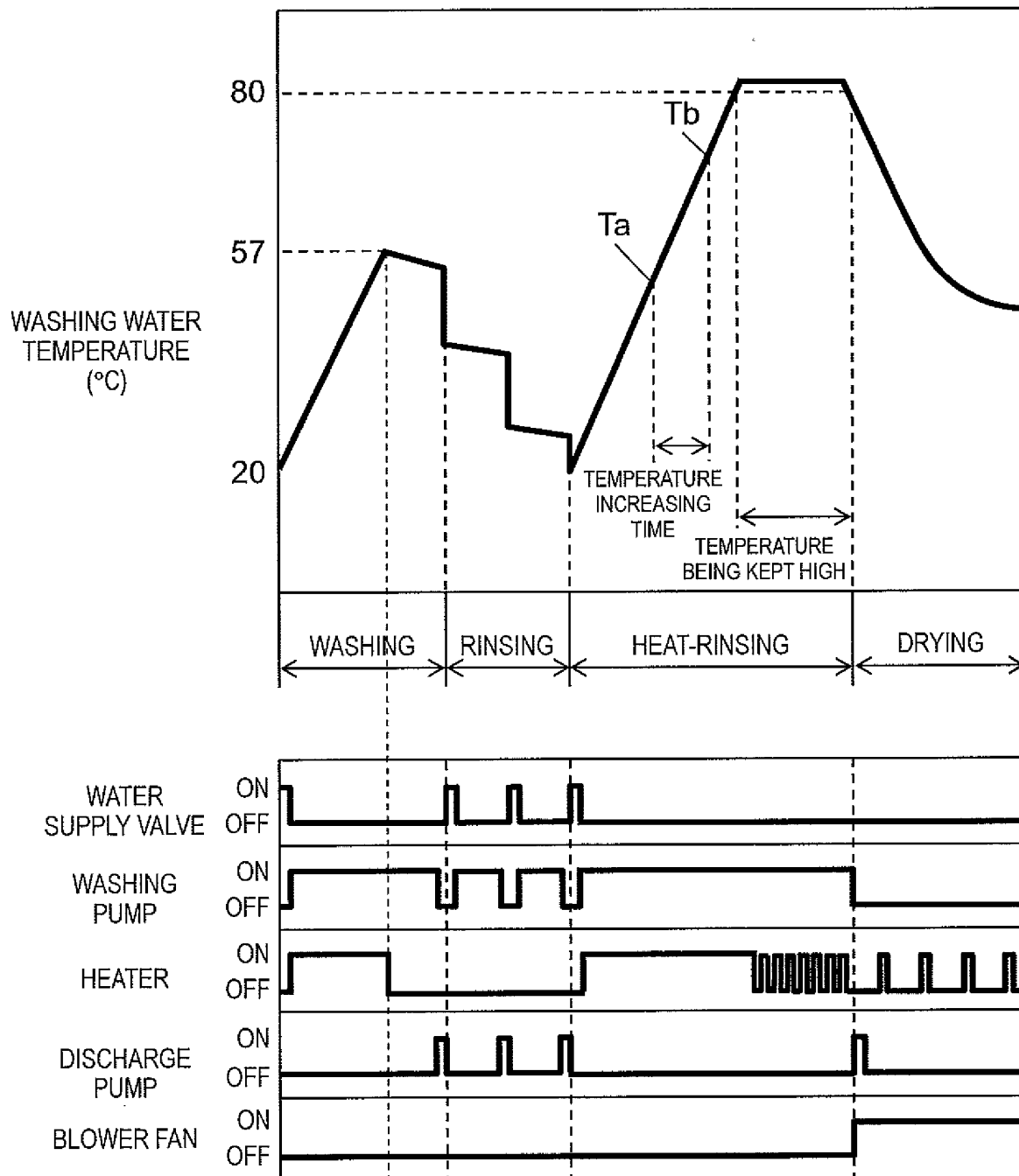


FIG. 4

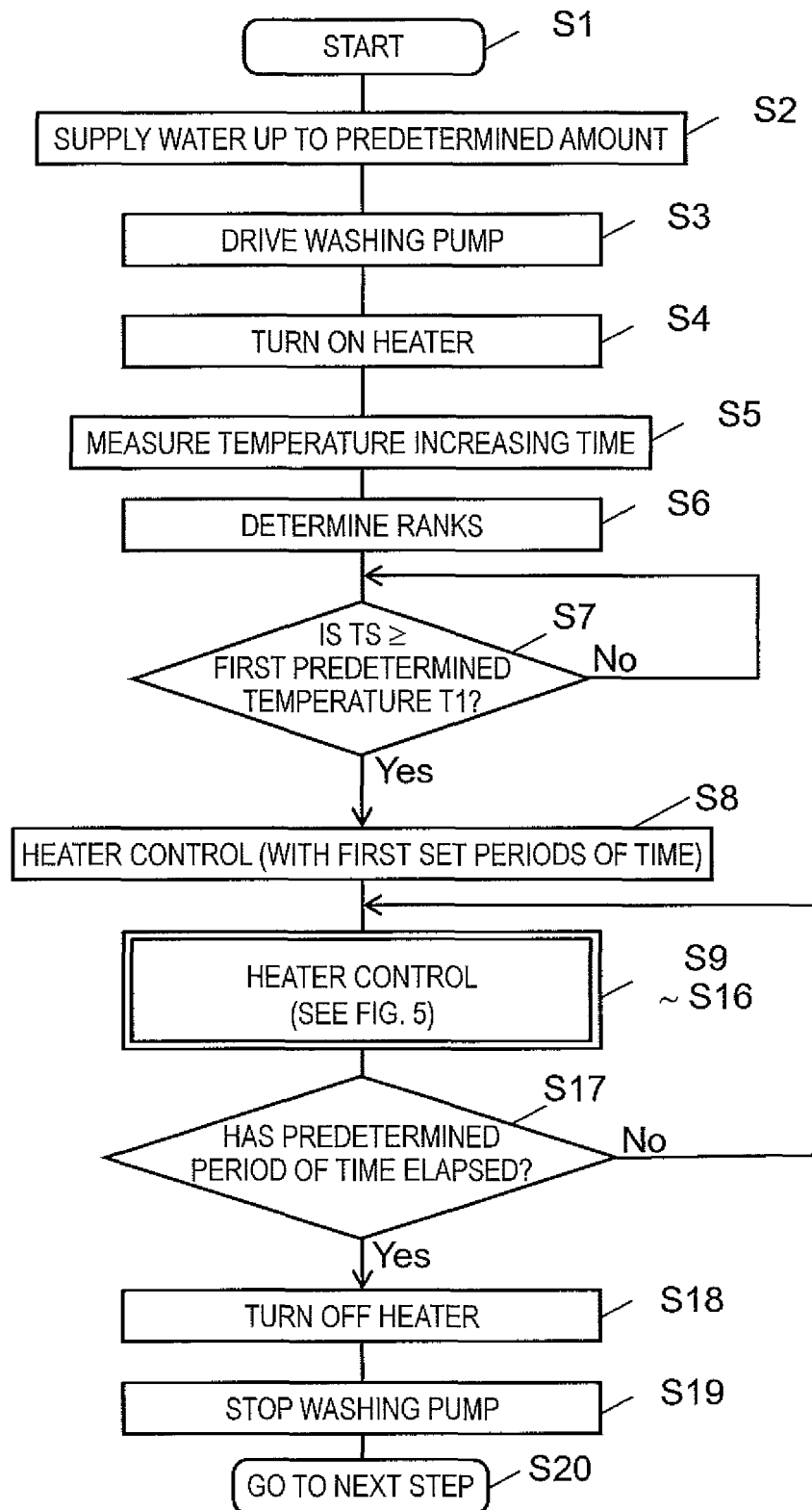


FIG. 5

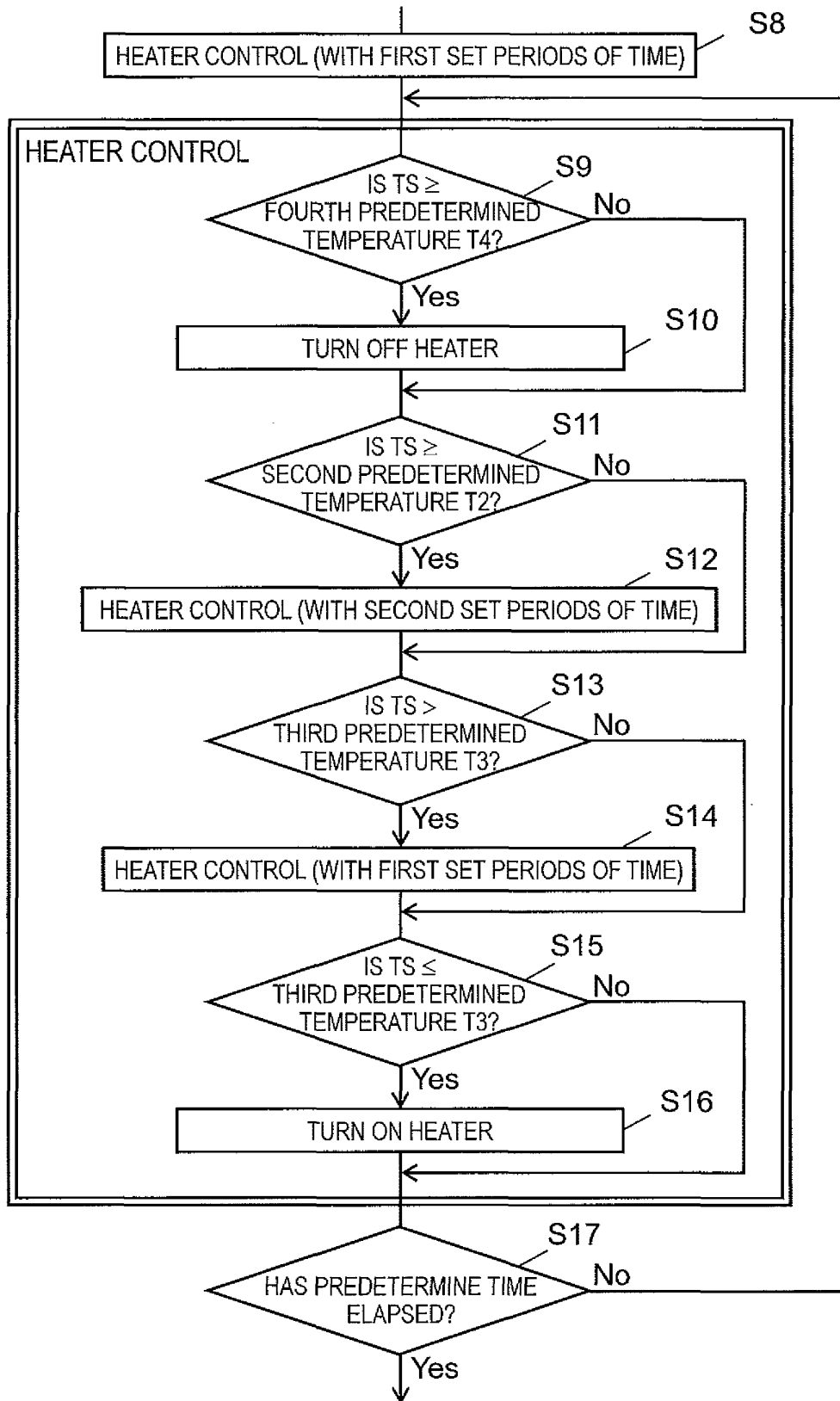


FIG. 6

RANK	TEMPERATURE INCREASING TIME	FIRST PREDETERMINED TEMPERATURE T1		FIRST SET PERIODS OF TIME: POWER ON/OFF	SECOND SET PERIODS OF TIME: POWER ON/OFF
		TARGET THERMISTOR TEMPERATURE	TARGET WASHING WATER TEMPERATURE (ESTIMATED VALUE)		
A	0 sec or more to less than 600 sec	76°C	82°C	25 sec/35 sec	12 sec/48 sec
B	600 sec or more to less than 850 sec	77°C	same as above	30 sec/30 sec	15 sec/45 sec
C	850 sec or more to less than 1200 sec	78°C	same as above	35 sec/25 sec	17 sec/43 sec
D	1,200 sec or more	79°C	same as above	40 sec/20 sec	20 sec/40 sec

FIG. 7

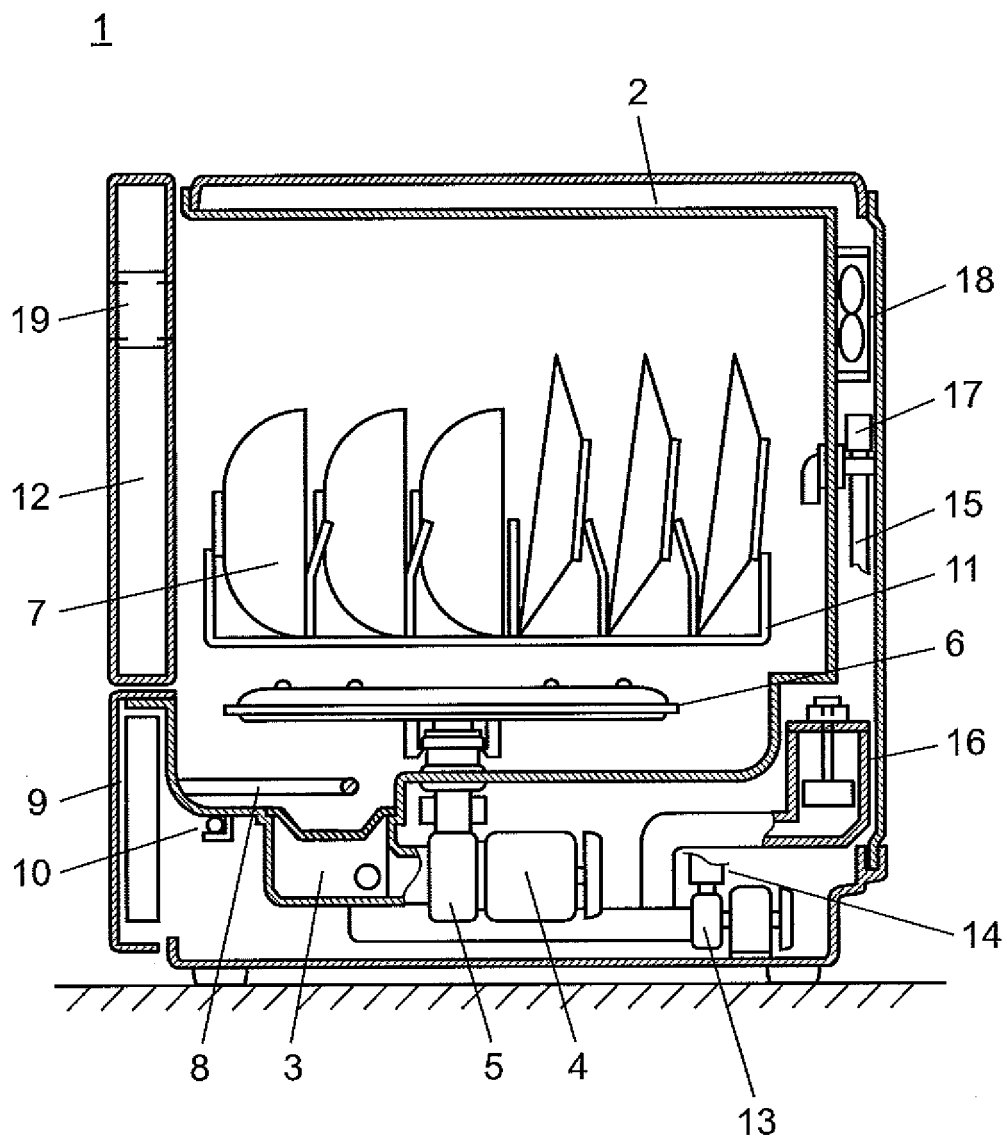


FIG. 8

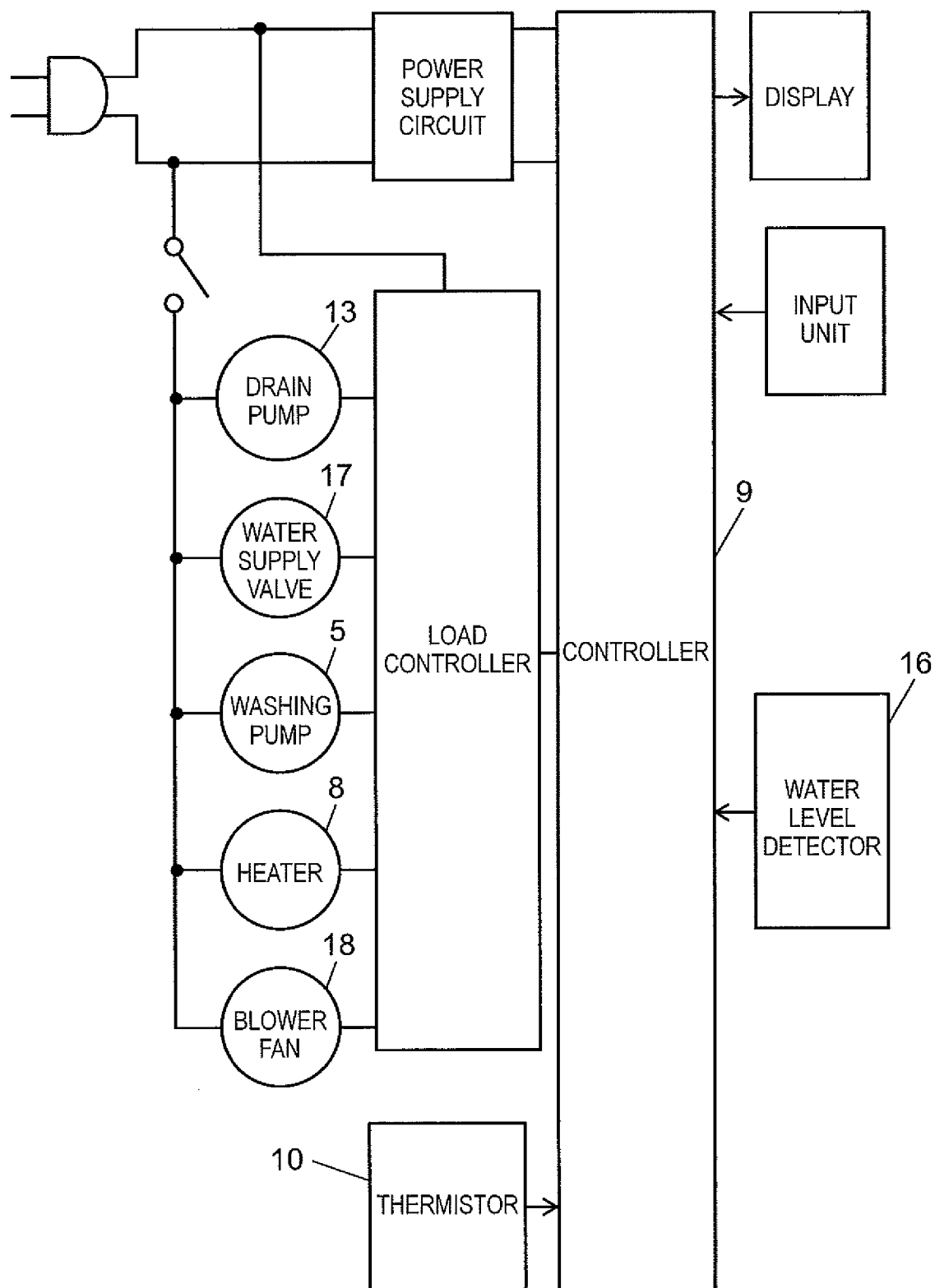


FIG. 9

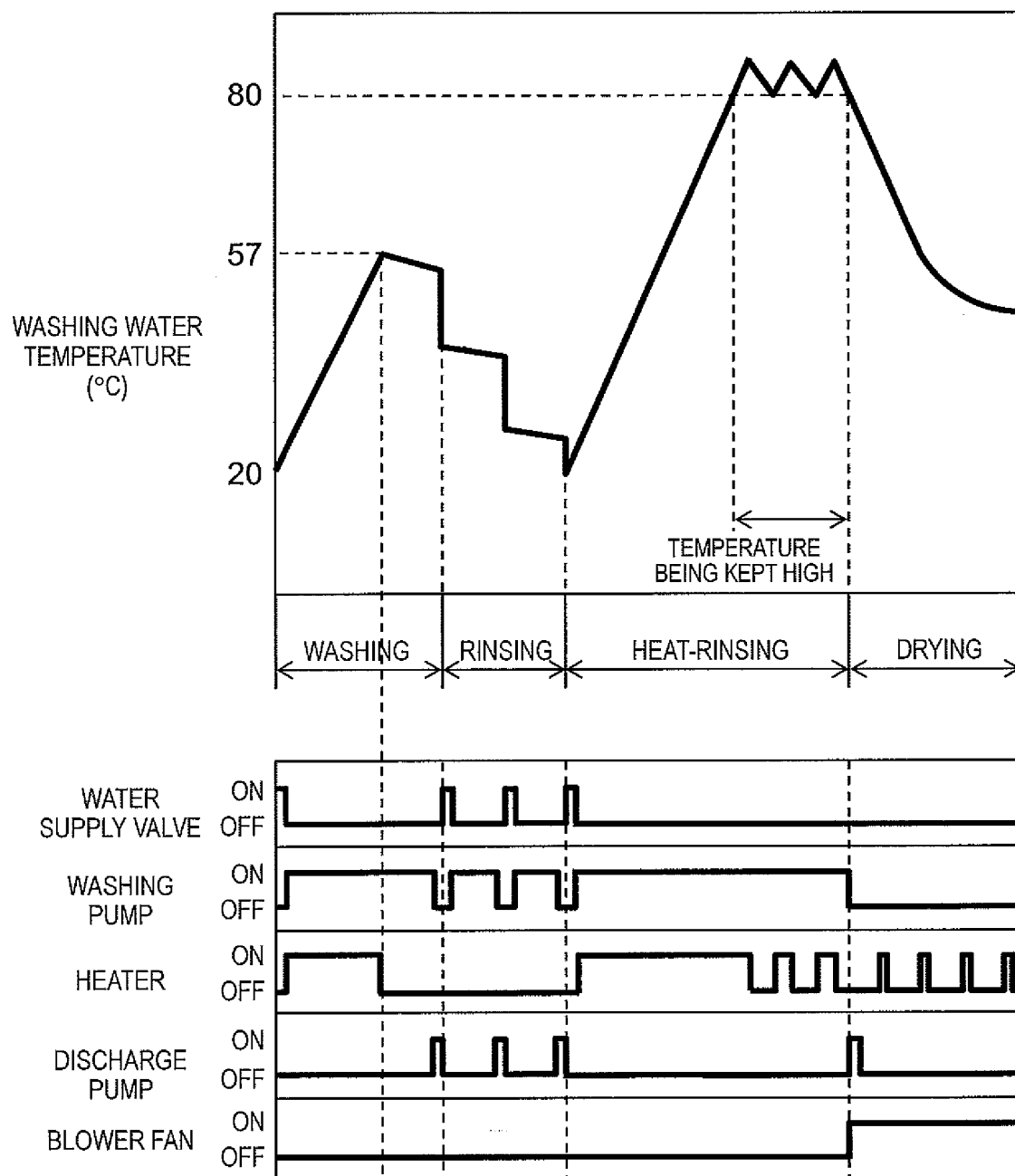
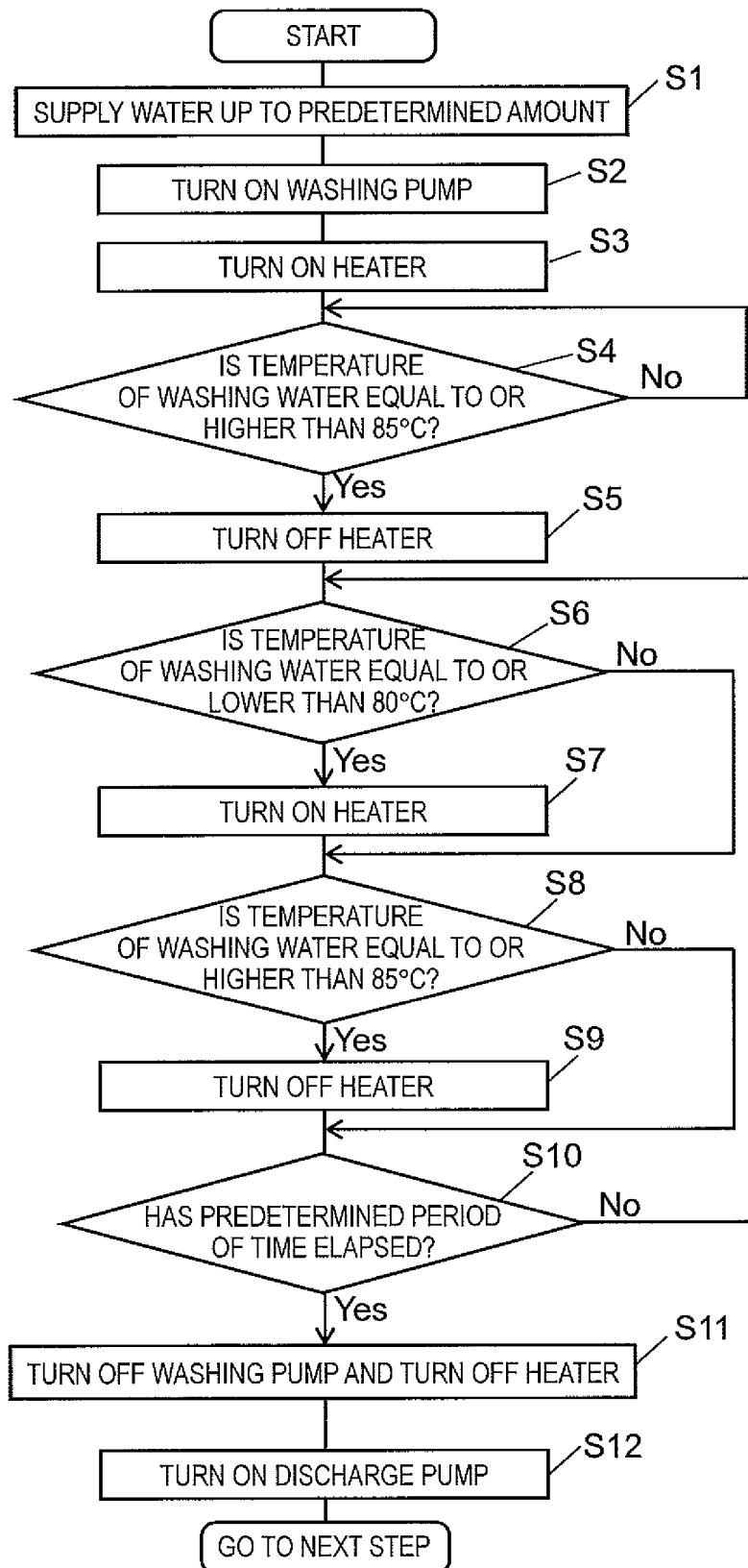


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/005524

A. CLASSIFICATION OF SUBJECT MATTER
A47L15/46(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L15/46Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2000-279360 A (Osaka Gas Co., Ltd.), 10 October 2000 (10.10.2000), paragraphs [0040], [0060] to [0067]; fig. 4, 8 to 9 (Family: none)	1, 4 2, 3
Y A	JP 2004-290505 A (Toto Ltd.), 21 October 2004 (21.10.2004), paragraphs [0021] to [0032]; fig. 6 to 10 (Family: none)	1, 4 2, 3

☐ Further documents are listed in the continuation of Box C.
☐ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
11 November, 2013 (11.11.13)Date of mailing of the international search report
26 November, 2013 (26.11.13)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006288925 A [0033]