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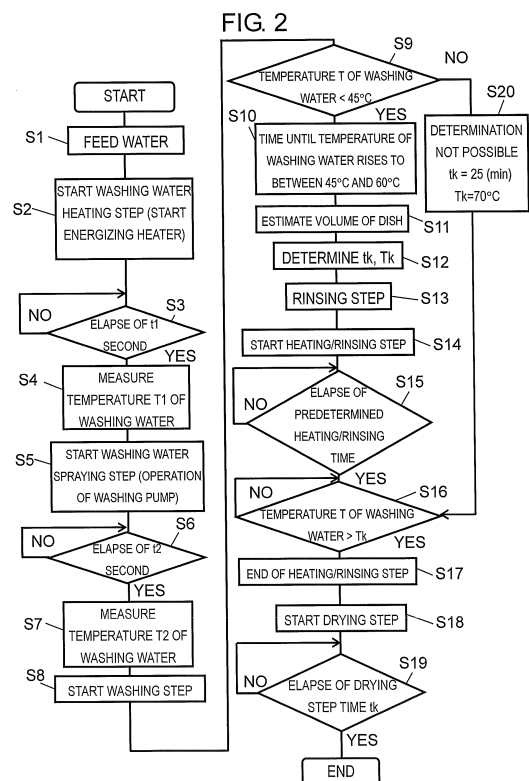
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(54) **DISHWASHER**

(57) A control unit for controlling a water feed unit, a heating unit, and a washing unit based on a detected temperature of a temperature detecting unit to execute at least a thermal capability estimating step, washing step, heating/rinsing step, and drying step compares a temperature rising-up ratio of the washing water in the thermal capability estimating step and a temperature rising-up ratio of the washing water in the washing step to detect a volume of an item to be washed and perform control. In this manner, it is possible to determine the volume of the dishes while suppressing variations of the wattage of the heater or an influence by power source voltage fluctuations in installation environment, so as to determine the volume of the dishes.



Description

TECHNICAL FIELD

[0001] The present invention relates to a dishwasher for detecting a change in temperature of washing water so as to detect the volume of dishes, thus washing the dishes.

BACKGROUND ART

[0002] In recent years, there has been proposed a dishwasher for determining the volume such as the number or weight of dishes accommodated in the dishwasher so as to finely control an operating time, thus washing the dishes (refer to PTL 1, for example).

[0003] Hereinafter, a configuration of a conventional dishwasher disclosed in PTL 1 will be described with reference to FIGS. 5 and 6.

[0004] FIG. 5 is a view illustrating a configuration of a system of the conventional dishwasher; and FIG. 6 is a graph illustrating a relationship between a power source voltage and a temperature rising-up ratio in the conventional dishwasher.

[0005] As shown in FIG. 5, the conventional dishwasher is provided with washing tub 101, washing nozzle 103, washing pump 104, water level sensor 106 serving as a water level detecting unit, heater 107 serving as a heating unit, thermistor 108 serving as a temperature detecting unit, and control unit 113. Dish 102 is accommodated in washing tub 101. Washing water is reserved in washing tub 101. Washing nozzle 103 is rotatably supported inside of washing tub 101 and sprays the washing water toward dish 102. Washing pump 104 is driven by motor 105, to then feed the washing water to washing nozzle 103. Water level sensor 106 is adapted to detect a water level inside of washing tub 101, so as to output a detection signal to control unit 113. Heater 107 is disposed at the bottom inside of the washing tub 101, for heating the washing water. Thermistor 108 is fixed outside of the bottom of washing tub 101 in tight contact, for indirectly detecting the temperature of the washing water. Air blowing fan 109 feeds and exhausts steam from the inside of washing tub 101 to the outside of the dishwasher through exhaust port 110. Inside washing tub 101 is contained dish basket 111, in which dish 102 is put. At the bottom of washing tub 101 is disposed residue filter 112 for preventing foreign matters such as residues from clogging washing pump 104 during circulation of the washing water. Control unit 113 is designed to control a series of successive operations of washing, rinsing, heating/rinsing, and drying steps for dish 102.

[0006] In the dishwasher having the above-described configuration, thermistor 108 measures the temperature of the washing water heated by heater 107 in the washing step after the start of the operation or the heating/rinsing step. And then, control unit 113 calculates the temperature rising-up ratio of the measured washing water so as

to detect the volume of dish 102. An operation time of each of the rinsing and drying steps is varied based on the detected volume of dish 102 according to the degree of the temperature rising-up ratio. In other words, if the volume of dish 102 is small when the value of the product of a current and a voltage to be input into heater 107 is constant, the total thermal capacity of dish 102 is small, and therefore, the amount of heat of the washing water dissipated by dish 102 is small, resulting in an increase in temperature rising-up ratio of the washing water (see line A in FIG. 6). To the contrary, if the volume of dish 102 is large, the total thermal capacity of dish 102 is large, and therefore, the amount of heat of the washing water dissipated by dish 102 is large, resulting in a decrease in temperature rising-up ratio of the washing water (see line B in FIG. 6). As indicated by line A in FIG. 6, the temperature of the washing water at the small volume of dish 102 rises up more rapidly by the volume of dish 102 than the case indicated by line B at the large volume of dish 102.

[0007] In the same manner in the drying step, the operation time is shortened at the small volume of dish 102, so that constant washing and drying performance can be achieved according to the volume of dish 102, and further, a dishwasher excellent in energy saving performance can be implemented.

[0008] However, variations of wattage (the amount of electricity) of heater 107, fluctuations of a power source voltage, or the like cause an error of an increase in temperature of the washing water in the conventional dishwasher (see FIG. 7). That is, although the operation can be finely controlled according to the volume of the dish for washing, it is difficult to perform an operation optimum for the variations of wattage of heater 107 or the fluctuations of the power source voltage in installation environment in every dishwasher. In view of this, it is conceived that a power source voltage detecting circuit is provided for enhancing the determination accuracy of the volume of dish 102, so that a power source voltage is corrected to stabilize the wattage of heater 107. However, the addition of a power source voltage detecting circuit complicates the configuration, and further, increases the size of a dishwasher body.

Citation List

Patent Literature

[0009] PTL 1: Unexamined Japanese Patent Publication No. 2005-052216

SUMMARY OF THE INVENTION

[0010] The dishwasher of the present invention includes a washing tub, which includes a reserving unit for reserving washing water and accommodates an item to be washed; a water feed unit for feeding water into the washing tub; a heating unit for heating the washing water

in the reserving unit; a temperature detecting unit for detecting temperature of the washing water in the reserving unit; a washing unit including at least a washing pump for pressurizing the washing water and a washing nozzle for spraying the washing water on the item to be washed; and a control unit for controlling the water feed unit, the heating unit, and the washing unit based on the detected temperature of the temperature detecting unit to execute at least thermal capability estimating step, washing step, heating/rinsing step, and drying step; wherein the thermal capability estimating step estimates the capability to heat the washing water of the heating unit; and the control unit compares a temperature rising-up ratio of the washing water in the thermal capability estimating step and a temperature rising-up ratio of the washing water in the washing step detected by the temperature detecting unit to detect a volume of the item to be washed and perform the control.

[0011] In this manner, it is possible to accurately determine the volume of a dish while suppressing variations of the wattage of the heating unit in each of dishwashers or the influence by power source voltage fluctuations in the installation environment. The drying time of the dishwasher can be reduced according to the volume of dishes, and the dishwasher excelling in energy saving performance can be realized.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a cross-sectional view schematically showing a dishwasher in a first exemplary embodiment according to the present invention.

FIG. 2 is a flowchart illustrating the operation of the dishwasher in the first exemplary embodiment according to the present invention.

FIG. 3 is a schematic table for use in estimating the volume of a dish in the dishwasher in the first exemplary embodiment according to the present invention.

FIG. 4 is a table illustrating relationships between the volume of a dish estimated in the dishwasher in the first exemplary embodiment according to the present invention and attainable temperature T_k in a heating/rinsing step and between the volume of a dish and time t_k in a drying step.

FIG. 5 is a view illustrating the configuration of a system of a conventional dishwasher.

FIG. 6 is a graph illustrating a relationship between a power source voltage and a temperature rising-up ratio in the conventional dishwasher.

DESCRIPTION OF EMBODIMENTS

[0013] An exemplary embodiment of the present invention will be hereinafter described with reference to the drawings. It should be recognized that the present

invention is not limited by the exemplary embodiment.

FIRST EXEMPLARY EMBODIMENT

[0014] FIG. 1 is a cross-sectional view schematically showing a dishwasher in a first exemplary embodiment according to the present invention.

[0015] As shown in FIG. 1, the dishwasher in the present exemplary embodiment is provided with washing tub 2, water feed unit 15, heater 11 serving as a heating unit, thermistor 13 serving as a temperature detecting unit, washing unit 18, and control unit 16.

[0016] Washing tub 2 is housed inside of main body 1. Inside of washing tub 2 is accommodated dish basket 4, in which an item to be washed such as dish 3 is put. Dish basket 4 includes upper dish basket 4a and lower dish basket 4b. Moreover, opening 5 is formed at a front surface of washing tub 2, and it is configured to be opened or closed by door 6. Dish basket 4 can be slid and drawn through opening 5 opened by door 6.

[0017] Washing unit 18 includes washing nozzle 7 disposed in the bottom portion of washing tub 2 and fixed nozzles (not shown) disposed at the upper and rear surfaces of washing tub 2. At the surfaces of the washing nozzles such as washing nozzle 7 and the fixed nozzles are formed a plurality of spraying ports 7a, through which washing water is sprayed. Washing nozzle 7 is rotatably disposed in the bottom portion of washing tub 2, thereby spraying the washing water toward dish 3 and the like. Here, the washing water is referred to as liquid for use in washing or rinsing the item to be washed such as dish 3 inside of the dishwasher.

[0018] Although the present exemplary embodiment illustrates only one washing nozzle 7 disposed in the bottom portion of washing tub 2, two washing nozzles 7 may be provided according to the shape of washing tub 2 or washing nozzle 7 may be replaced with a fixed nozzle which cannot be rotated. Additionally, washing unit 18 is provided with washing pump 8 for pressurizing the washing water and feeding the washing water to washing nozzle 7 or the like and motor 9 for driving washing pump 8 on the way of a circulation path (not shown) disposed outside of the bottom of washing tub 2.

[0019] Furthermore, reserving unit 10 for reserving the washing water therein and heater (heating unit) 11 for heating the washing water are disposed in the bottom portion inside of washing tub 2 in the vicinity of opening 5. Thermistor (temperature detecting unit) 13 for detecting the temperature of the washing water is attached onto the outer wall of the bottom of washing tub 2, so as to indirectly detect the temperature of the washing water or air staying inside of washing tub 2 via the bottom wall of washing tub 2. Water level detecting switch 14 for detecting the water level of the washing water reserved in the lower portion of washing tub 2 is mounted on the outer wall of the lower portion of washing tub 2. In addition, water feed unit 15 for feeding the water into washing tub 2 is fixed onto the outer wall of the upper portion of

washing tub 2.

[0020] Control unit 16 disposed between main body 1 and washing tub 2 and in the lower portion of main body 1 controls water feed unit 15, heater 11, and washing pump 8 so as to successively perform a series of steps of thermal capability estimating, washing, rinsing, heating/rinsing, and drying for dish 3. Moreover, control unit 16 processes signals detected by water level detecting switch 14 and thermistor 13, and further, determines the volume of a dish inside of washing tub 2 based on the temperature of the washing water detected by thermistor 13.

[0021] Operations and functions of the dishwasher in the present exemplary embodiment such configured as described above will be described below with reference to FIGS. 2 to 4 in addition to FIG. 1. FIG. 2 is a flowchart illustrating the operation of the dishwasher in the first exemplary embodiment according to the present invention. FIG. 3 is a schematic table for use in estimating the volume of a dish in the dishwasher in the first exemplary embodiment according to the present invention. FIG. 4 is a table illustrating relationships between the volume of a dish estimated in the dishwasher in the first exemplary embodiment according to the present invention and attainable temperature T_k in a heating/rinsing step and between the volume of a dish and time t_k in a drying step.

[0022] First of all, as illustrated in FIG. 2, the item to be washed such as dish 3 is put in dish basket 4, and then, is accommodated inside of washing tub 2. A user puts a detergent and closes opening 5 of washing tub 2 by door 6, and thus, starts operation.

[0023] Next, control unit 16 actuates water feed unit 15 to feed the water to washing tub 2 until water level detecting switch 14 detects the water level, and then, feeds running water or the like to reserving unit 10 (step S1).

[0024] Thereafter, the thermal capability estimating step (step S2 to step S7) including the washing water heating step (step S2 to step S4) and the washing water spraying step (step S5 to step S7) is executed. The thermal capability estimating step is a step of estimating the capability of heater 11 for heating the washing water carried out prior to the original washing step of washing dishes 3 by spraying the washing water thereto.

[0025] In the washing water heating step, heater 11 is energized without operating washing pump 8 to heat the washing water, and temperature T_1 of the washing water after elapse of predetermined time t_1 (first predetermined time) is detected. In the washing water spraying step, heater 11 is energized to heat the washing water, washing pump 8 is operated to spray the washing water onto dishes 3, and temperature T_2 of the washing water after elapse of a predetermined time t_2 (second predetermined time) is detected.

[0026] A control method of the thermal capability estimating step described above will be specifically described below.

[0027] First, control unit 16 heats the washing water to

energize to heater 11 (step S2). In this case, control unit 16 heats the washing water without spraying from the washing nozzle such as washing nozzle 7. Thus, the heat of heater 11 is used to raise the temperature of the washing water, and is barely used to raise the temperature of dishes 3.

[0028] Next, when time t_1 (first predetermined time) elapses after the start of the energization to heater 11 (YES in step S3), thermistor 13 detects temperature T_1 of the washing water (step S4). The time t_1 is provided to measure the temperature of the washing water after the water is fed from water feed unit 15 to reserving unit 10 up to a predetermined water amount detected by water level detecting switch 14 because there is delay in time when indirectly detecting the temperature of the washing water with thermistor 13. Thus, it is waited for the change in which the temperature of the lower portion of washing tub 2 (attaching portion of thermistor 13) rises to follow the change in which the temperature of the washing water rises by heater 11. That is, when time t_1 (first predetermined time) has not elapsed (NO in step S3) after the start of the energization to heater 11, the washing water heating step is continued until time t_1 (first predetermined time) elapses.

[0029] Then, the washing water spraying step of operating washing pump 8 is started while continuing the energization to heater 11 (step S5). Then, when time t_2 (second predetermined time) elapses after the start of the energization to heater 11 (YES in step S6), thermistor 13 detects temperature T_2 of the washing water again (step S7). In this case, if time t_2 (second predetermined time) has not elapsed after the start of the energization to heater 11 (NO in step S6), elapse of time t_2 (second predetermined time) is waited.

[0030] The functions and effects of operating washing pump 8 when detecting temperature T_2 of the washing water will now be described.

[0031] First, if washing pump 8 is not operated, the temperature is transmitted from high temperature to low temperature in reserving unit 10 only with the convection flow caused by the heating of the washing water. This is effective in not supplying heat to dishes 3. However, if detergent is put in to the vicinity of the region where thermistor 13 is arranged inside washing tub 2, the convection flow changes by the diffusion effect of the detergent. Therefore, error occurs in the temperature of the washing water to be originally detected by thermistor 13. In the present exemplary embodiment, washing pump 8 is operated to stir the washing water, thus making the temperature of the washing water even. The detection accuracy when measuring the temperature rising-up ratio of the washing water with thermistor 13 thus stabilizes. In this case, when operating washing pump 8 and detecting the temperature of the washing water, the amount of heat of the washing water is drawn by dishes 3 since the washing water gets on dishes 3. However, it takes time until the amount of heat of the washing water is drawn by dishes 3. The time in which washing pump 8 is operated

is thus set short (e.g., about one minute) so that there is no influence when the amount of heat of the washing water is drawn by dishes 3.

[0032] In this case, the amount of heat generated from heater 11 in time ($t_2 - t_1$) of heating the washing water in the washing water spraying step is used to heat the washing water of a predetermined water amount detected by water level detecting switch 14 and an object of known thermal capacity such as the wall of reserving unit 10 of washing tub 2, and is not influenced by the volume of dish 3 in washing tub 2.

[0033] Therefore, rising temperature ($T_2 - T_1$) of the washing water is measured from temperature T_2 of the washing water at time t_2 and temperature T_1 of the washing water at time t_1 . Therefore, even if the power source voltage under the environment in which the dishwasher is installed fluctuates, the thermal capability corresponding to a state in which dishes 3 are not accommodated in washing tub 2 with respect to the washing water of specific heater 11 arranged for every dishwasher can be estimated.

[0034] In the washing water heating step and the washing water spraying step, heater 11 does not necessarily need to be energized in all the steps. That is, since the input heat amount can be calculated by measuring the energization time of heater 11, the thermal capability of heater 11 described above can be estimated.

[0035] Therefore, rising temperature ($T_2 - T_1$) measured in the thermal capability estimating step can be defined as the temperature rising-up ratio of the washing water at time ($t_2 - t_1$).

[0036] Thereafter, the washing step of washing dishes 3 is started with the energization to heater 11 continued (step S8). At this time, washing pump 8 is operated similar to the washing water spraying step to spray the washing water toward dishes 3.

[0037] Next, it is determined whether or not temperature T of the washing water is lower than a predetermined temperature, for example, 45°C (step S9). At this time, if temperature T of the washing water is lower than 45°C (Yes in step S9), heating by heater 11 is continued, and then, time dt until temperature T of the washing water rises to a temperature of 60°C from 45°C is measured (step S10).

[0038] In the washing step, the washing water is heated while spraying onto dishes 3, and hence the time of operating washing pump 8 is set longer than in the thermal capability estimating step previously described. Thus, the speed of the temperature rise is influenced by the volume of dish 3, different from the thermal capability estimating step. In view of time dt , at which temperature T of the washing water measured in step S10 rises from 45°C to 60°C , and the thermal capability of heater 11 estimated in the thermal capability estimating step, the temperature rising-up ratio of the washing water in the thermal capability estimating step and the temperature rising-up ratio of the washing water in the washing step are compared. In this manner, the heat amount required

for increasing the temperature of dish 3, that is, the volume of dish 3, can be estimated (step S11).

[0039] The method of estimating the volume of dish 3 will be specifically described with reference to Fig. 3.

[0040] Fig. 3 shows the relationship with the volume of dish 3 estimated from rising temperature ($T_2 - T_1$) in the thermal capability estimating step and time dt in the washing step as "large", "medium", and "small" of the volume. The volume of dish 3 is "large" for a case in which the proportion of the actually accommodated volume of dish 3 to the volume that can be accommodated in washing tub 2 is greater than $2/3$, "medium" for a case in which the proportion is between $1/3$ and $2/3$, and "small" for a case in which the proportion is smaller than $1/3$.

[0041] At this time, as the temperature rising-up ratio of the washing water in the thermal capability estimating step is higher, the thermal capacity of heater 11 becomes higher. Thus, as shown in Fig. 3, determination is made that the volume of dish 3 is large even when the time in which the washing water rises from 45°C to 60°C is short (e.g., dt (second) shown in Fig. 3 is 1000 to 1100) in the washing step.

[0042] Subsequently, heating/rinsing attainable temperature T_k as a highest temperature to be attained until the completion of heating/rinsing step and drying step time t_k in the drying step are determined based on values illustrated in FIG. 4 according to the volume of dish 3 estimated in step S11 (step S12). FIG. 4 exemplifies the relationship between the volume of dish 3 estimated in step S11 and heating/rinsing attainable temperature T_k and between the volume of dish 3 and drying step time t_k . As illustrated in FIG. 4, when the result of the volume of dish 3 is determined as being, for example, "large", heating/rinsing attainable temperature T_k is set to be 70°C whereas time t_k in the drying step is set to be 25 minutes. In the same manner, when the result of the volume of dish 3 is determined as being, for example, "middle", heating/rinsing attainable temperature T_k is set to be 68°C whereas time t_k in the drying step is set to be 20 minutes. Similarly, when the result of the volume of dish 3 is determined as being, for example, "small", heating/rinsing attainable temperature T_k is set to be 66°C whereas time t_k in the drying step is set to be 15 minutes.

[0043] In step S9 of Fig. 2, if temperature T of the washing water at the start of the washing step is higher than or equal to a predetermined temperature of 45°C (NO in step S9) when used in connection to a water heating facility for example, heating/rinsing attainable temperature T_k and drying step time t_k are set to the same control conditions as when determined that the volume of dishes is "large" (see Fig. 3) assuming the estimation of the volume of dish 3 is not possible (determination not possible) (step S20). This is so that dishes 3 can be sufficiently washed and dried regardless of whether the volume of dish 3 is "small", "medium", or "large" when determined that the determination is not possible. In this manner, even if the dishwasher is used in connection to a water heating facility, washing or drying dish 3 can be satisfac-

torily carried out.

[0044] Then, the washing water is once drained, and the rinsing step of dishes 3 is executed using running water newly fed to washing tube 2 through water feed unit 15 of Fig. 1 (step S13). Thereafter, control unit 16 energizes heater 11 to heat the washing water, and executes the heating/rinsing step of heating/rinsing dishes 3 (step S14).

[0045] At this time, whether or not a predetermined heating/rinsing time has elapsed is determined (step S15). If the predetermined heating/rinsing time has elapsed (YES in step S15), whether or not determined heating/rinsing attainable temperature T_k exceeds the temperature of the washing water is determined (step S16). If heating/rinsing attainable temperature T_k exceeds the temperature of the washing water (YES in step S16), the heating/rinsing step is terminated (step S17). If the predetermined heating/rinsing time has not elapsed (NO in step S15), the heating/rinsing step is continued until elapse of the predetermined heating/rinsing time. Similarly, if the temperature of the washing water has not reached heating/rinsing attainable temperature T_k (NO in step S16), the heating/rinsing step is continued until heating/ rinsing attainable temperature T_k exceeds the temperature of the washing water.

[0046] After the heating/rinsing step is terminated (step S17), the drying step is started (step S18). Thereafter, it is determined whether or not the drying step time t_k determined according to the volume of dish 3 elapses (step S19). If the drying step time t_k elapses (YES in step S19), the drying step and the operation of the dishwasher come to an end. If drying step time t_k has not elapsed (NO in step S19), the drying step is continued until elapse of drying step time t_k .

[0047] The temperature of the washing water for measuring time dt , and the threshold value are specifically shown in the above exemplary embodiment, but are not limited thereto. They do not limit the means for calculating heating/rinsing attainable temperature T_k and drying step time t_k , in particular, and the temperature of the washing water and the threshold value may be set in a different range. An arbitrary control thus can be made according to the application, so that a very efficient dishwasher can be realized.

[0048] In the above exemplary embodiment, the example in which the temperature rise of the washing water is measured and the volume of dish 3 is estimated in the washing step has been described, but this is not the sole case. For example, the temperature rise of the washing water may be measured, and heating/rinsing attainable temperature T_k and drying step time t_k may be set in the heating/rinsing step.

[0049] In addition, the heating/rinsing step and the drying step are carried out based on the control condition according to the estimated volume of dish 3, that is, heating/rinsing attainable temperature T_k and drying step time t_k in the above-described exemplary embodiment. However, they are not limited to this. For example, the

condition of at least one of the attainable temperature of the heating/rinsing step or the drying step time of the drying step may be changed according to the volume of dish 3. Thus, the heating/rinsing and the drying can be performed without excess or deficiency according to the volume of dish 3, so that the energy can be saved and the time for the heating/rinsing step, the drying step, and the like can be shortened without lowering the performance.

[0050] As described above, the dishwasher according to the present invention can suppress the inherent variations of the wattage (heating value) of the heating unit such as heater 11 in each of the devices and the influence by the power source voltage fluctuations so as to securely determine the volume of the dish and the like. As a consequence, the heating/rinsing attainable temperature or the drying step time optimum for the volume of the dish can be determined, and thus, the heating/rinsing step or the drying step can be performed based on the optimum temperature or time. Consequently, it is possible to achieve the dishwasher capable of saving the energy or time.

[0051] Moreover, only the existing thermistor for detecting the temperature of the washing water can determine the volume of the dish or the like due to the variations of the wattage (heating value). Consequently, it is unnecessary to additionally provide a power source voltage detecting circuit for detecting fluctuations of a power source voltage so as to control a heating unit such as a heater, thereby making it possible to achieve the dishwasher having the simple configuration and a small size.

[0052] In the present exemplary embodiment, the volume of dish 3 is indicated as "large" when the proportion of the actually accommodated volume of dish 3 to the volume that can be accommodated in washing tube 2 is greater than $2/3$, as "medium" when the proportion is between $1/3$ and $2/3$, and "small" when the proportion is smaller than $1/3$, but this is not the sole case. The proportion of the volume of dish 3 may vary depending on the variation of the setting range of rising temperature ($T_2 - T_1$) in the thermal capability estimating step and time dt in the washing step.

INDUSTRIAL APPLICABILITY

[0053] The dishwasher according to the present invention can determine the volume of the dish while suppressing the variations of the wattage of the heating unit in each of the dishwashers or the influence by the power source voltage fluctuations in the installation environment, thus saving energy or time. Consequently, the present invention is usable in the technical fields of not only a tabletop dishwasher but also a built-in dishwasher or a business-grade dishwasher.

REFERENCE MARKS IN THE DRAWINGS

[0054]

- 1 main body
- 2 washing tub
- 3 dish (item to be washed)
- 4 dish basket
- 4a upper dish basket
- 4b lower dish basket
- 5 opening
- 6 door
- 7 washing nozzle
- 8 washing pump
- 9 motor
- 10 reserving unit
- 11 heater (heating unit)
- 13 thermistor (temperature detecting unit)
- 14 water level detecting switch
- 15 water feed unit
- 16 control unit

Claims

1. A dishwasher comprising:

a washing tub, which includes a reserving unit for reserving washing water and accommodates an item to be washed;
 a water feed unit for feeding water into the washing tub;
 a heating unit for heating the washing water in the reserving unit;
 a temperature detecting unit for detecting temperature of the washing water in the reserving unit;
 a washing unit including at least a washing pump for pressurizing the washing water and a washing nozzle for spraying the washing water on the item to be washed; and
 a control unit for controlling the water feed unit, the heating unit, and the washing unit based on the temperature detected by the temperature detecting unit to execute at least a thermal capability estimating step, a washing step, a heating/rinsing step, and a drying step; wherein the thermal capability estimating step estimates a capability to heat the washing water of the heating unit; and
 the control unit compares a temperature rising-up ratio of the washing water in the thermal capability estimating step and a temperature rising-up ratio of the washing water in the washing step detected by the temperature detecting unit to detect a volume of the item to be washed and perform the control.

2. The dishwasher according to claim 1, wherein

the thermal capability estimating step includes a washing water heating step of heating the washing water in the heating unit without operating the washing pump, and

a washing water spraying step of heating the washing water in the heating step and operating the washing pump to spray the washing water onto the item to be washed.

3. The dishwasher according to claim 2, wherein the temperature rising-up ratio of the washing water in the thermal capability estimating step is calculated by a difference between the temperature of the washing water detected after elapse of a first predetermined time in the washing water heating step and the temperature of the washing water detected after elapse of a second predetermined time in the washing water spraying step.

4. The dishwasher according to claim 1, wherein the control unit changes a condition of at least either one of an attainable temperature in the heating/rinsing step and a drying step time in the drying step according to the volume of the item to be washed so as to perform control.

5. The dishwasher according to claim 4, wherein the control unit performs control under a same control condition as that in a case of the maximum volume of the item to be washed when the temperature of the washing water at the start of the washing step is higher than a predetermined temperature.

FIG. 1

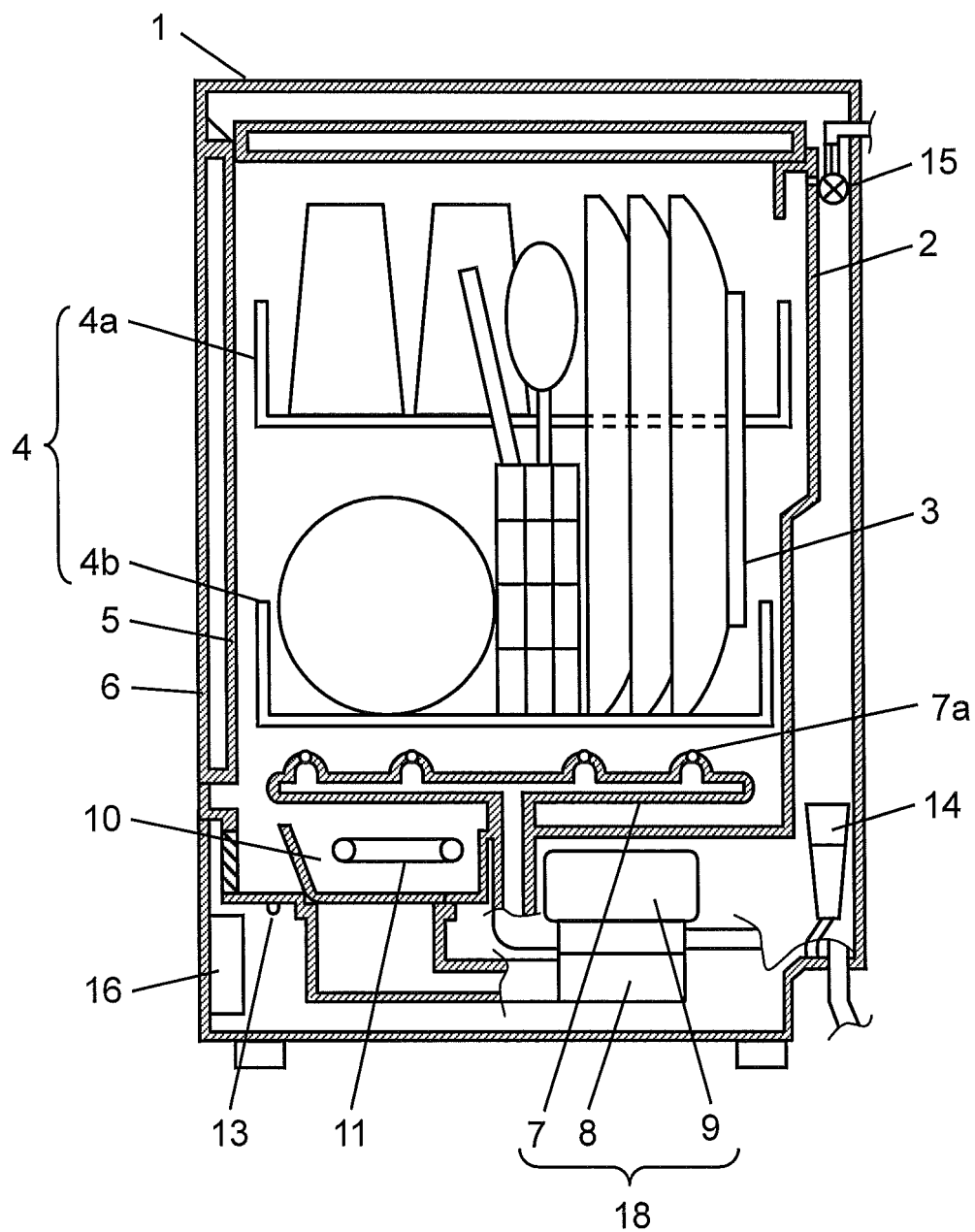


FIG. 2

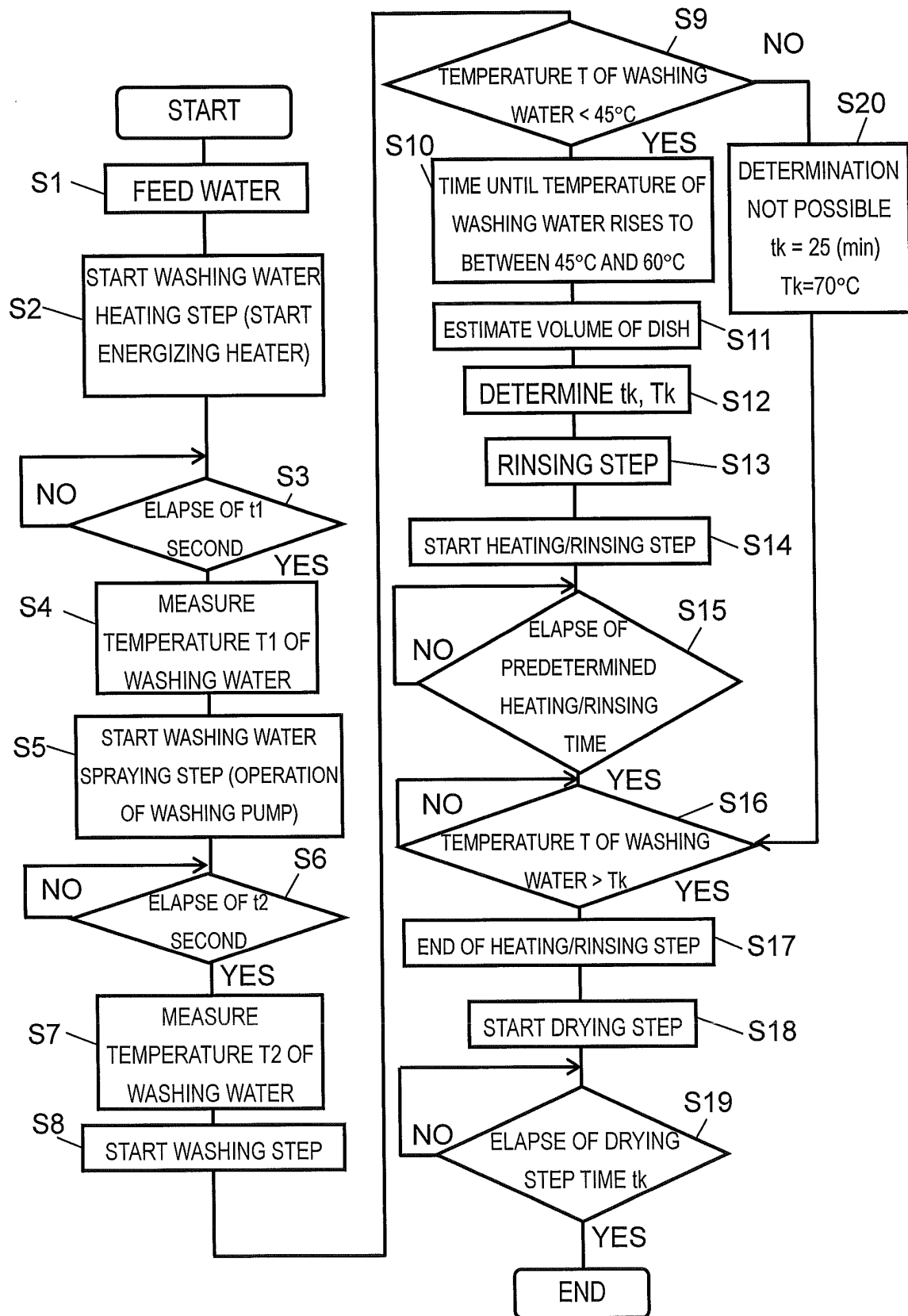


FIG. 3

		dt (SECOND)				
		~900	900~1000	1000~1100	1100~1200	1200~
T2-T1(°C)	~15	SMALL	SMALL	MEDIUM	MEDIUM	LARGE
	15~20	SMALL	SMALL	MEDIUM	MEDIUM	LARGE
	20~25	SMALL	SMALL	MEDIUM	LARGE	LARGE
	25~	SMALL	MEDIUM	MEDIUM	LARGE	LARGE

FIG. 4

	VOLUME OF DISH		
	SMALL	MEDIUM	LARGE
ATTAINABLE TEMPERATURE t_k (°C) OF HEATING/RINSING STEP	66	68	70
TIME t_k (MINUTE) OF DRYING STEP	15	20	25

FIG. 5

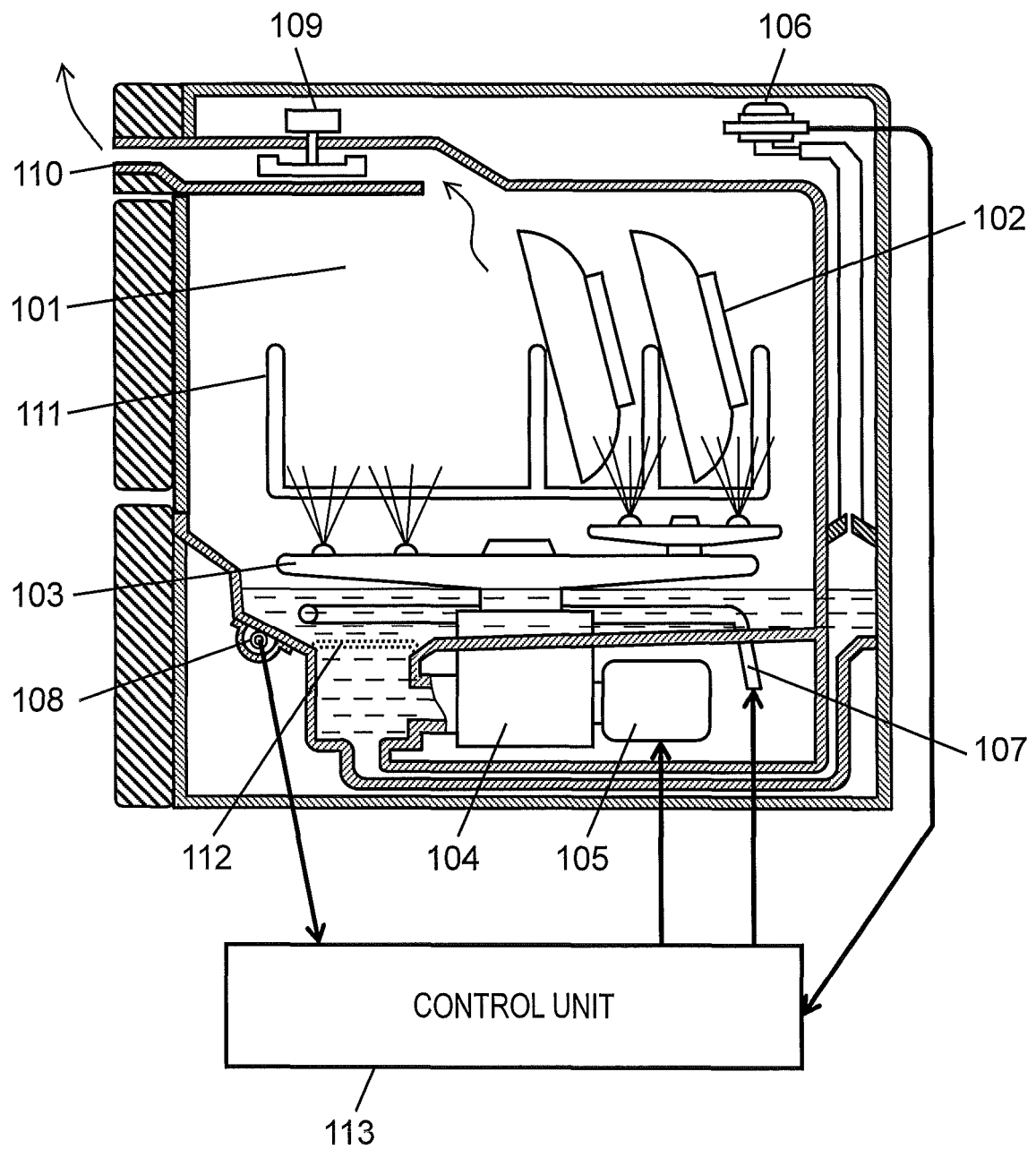
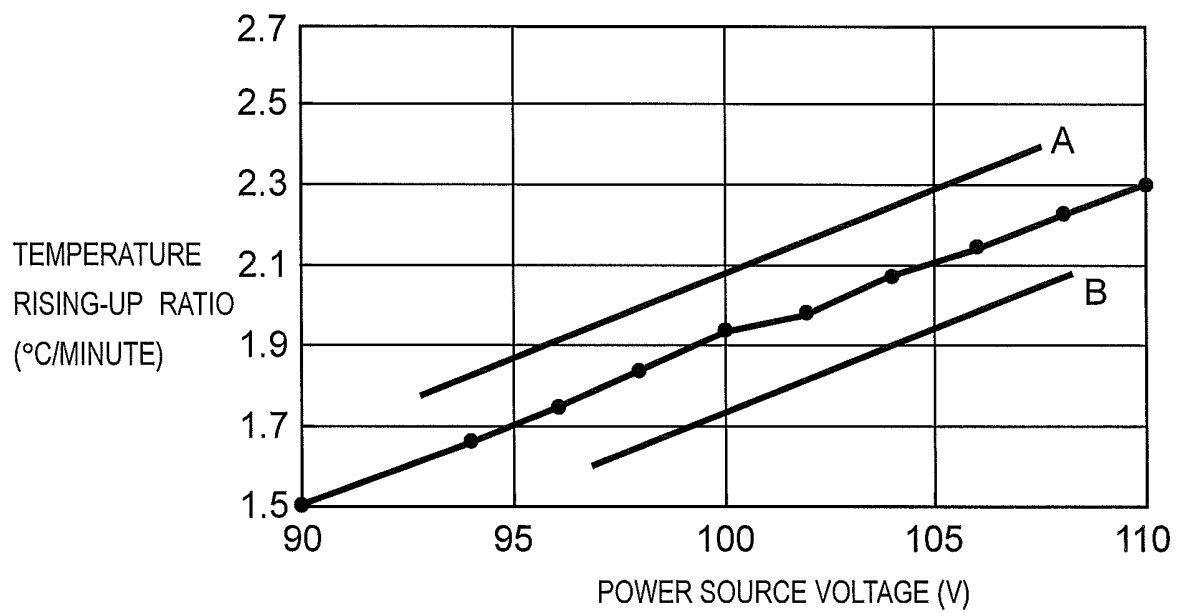


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/004190

A. CLASSIFICATION OF SUBJECT MATTER

A47L15/46(2006.01)i, A47L15/00(2006.01)i, A47L15/42(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)

A47L15/46, A47L15/00, A47L15/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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.
A	JP 5-137691 A (Matsushita Electric Industrial Co., Ltd.), 01 June 1993 (01.06.1993), entire text; all drawings (Family: none)	1-5
A	JP 2000-300499 A (Sanyo Electric Co., Ltd.), 31 October 2000 (31.10.2000), entire text; all drawings (Family: none)	1-5
A	JP 7-265251 A (Matsushita Electric Industrial Co., Ltd.), 17 October 1995 (17.10.1995), paragraphs [0009], [0026] to [0032]; fig. 1 to 3 (Family: none)	1-5

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

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"&" document member of the same patent family

Date of the actual completion of the international search
19 October, 2011 (19.10.11)Date of mailing of the international search report
01 November, 2011 (01.11.11)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 2005052216 A [0009]