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(54) CONTROL METHOD FOR A DISHWASHER

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(57) **ABSTRACT**

A control method for a dishwasher is provided. The control method may include heating air in a tub after a main washing process of washing dishes in the tub, and discharging the air containing moisture in the tub to an outside, during the air-heating or at the same time as the air-heating, such that energy efficiency may be increased and a time required for a dish drying process may be shorten.

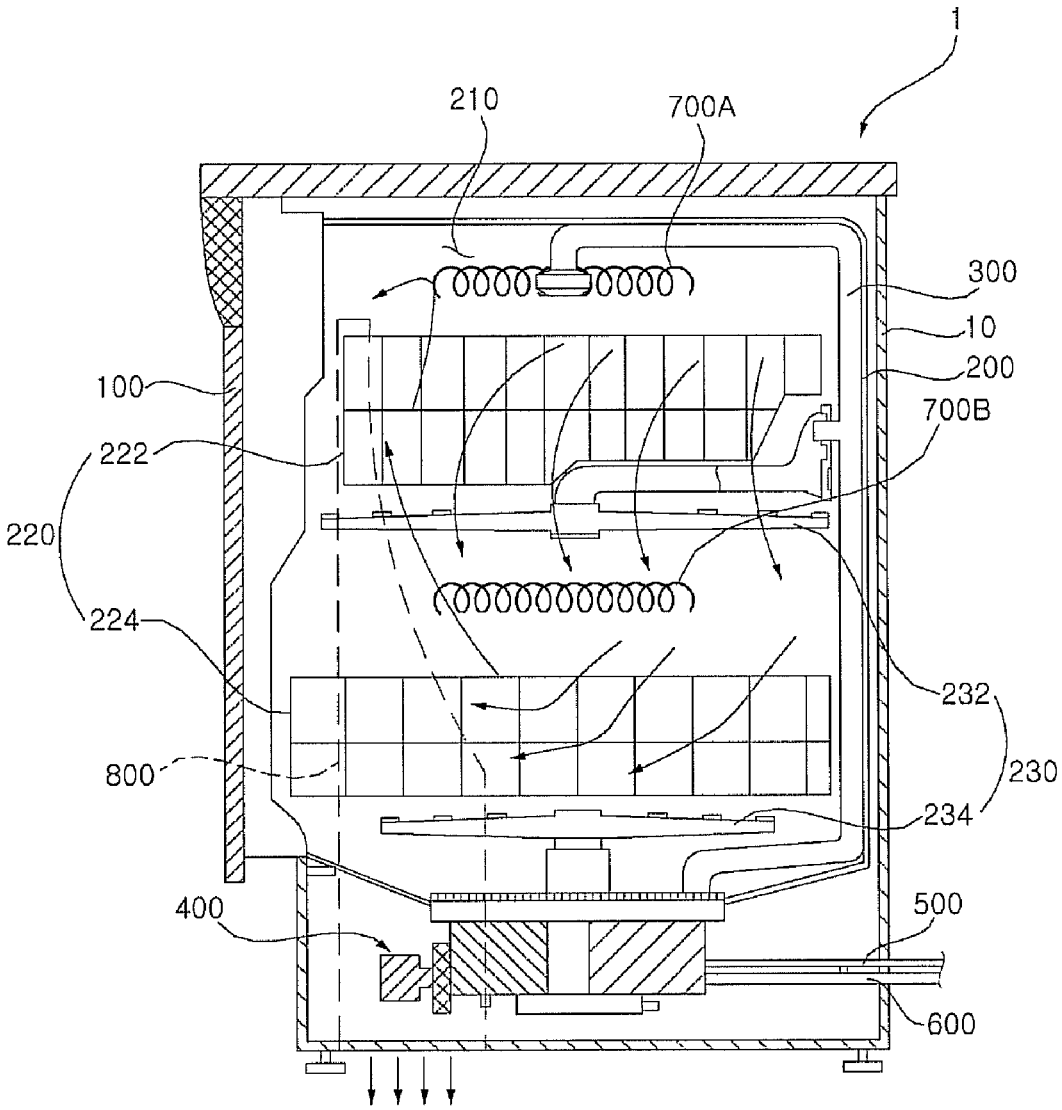


FIG. 1

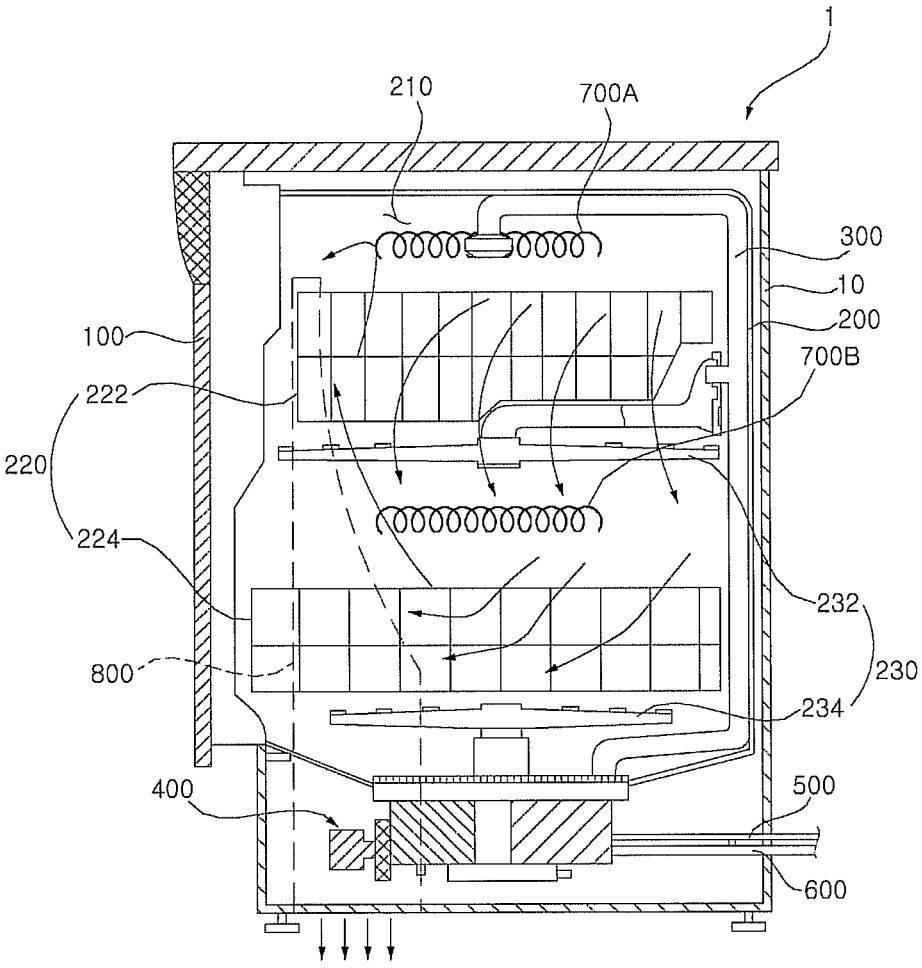

1
210
700A
300
10
200
100
700B
222
220
224
232
230
800
234
400
500
600

FIG. 2

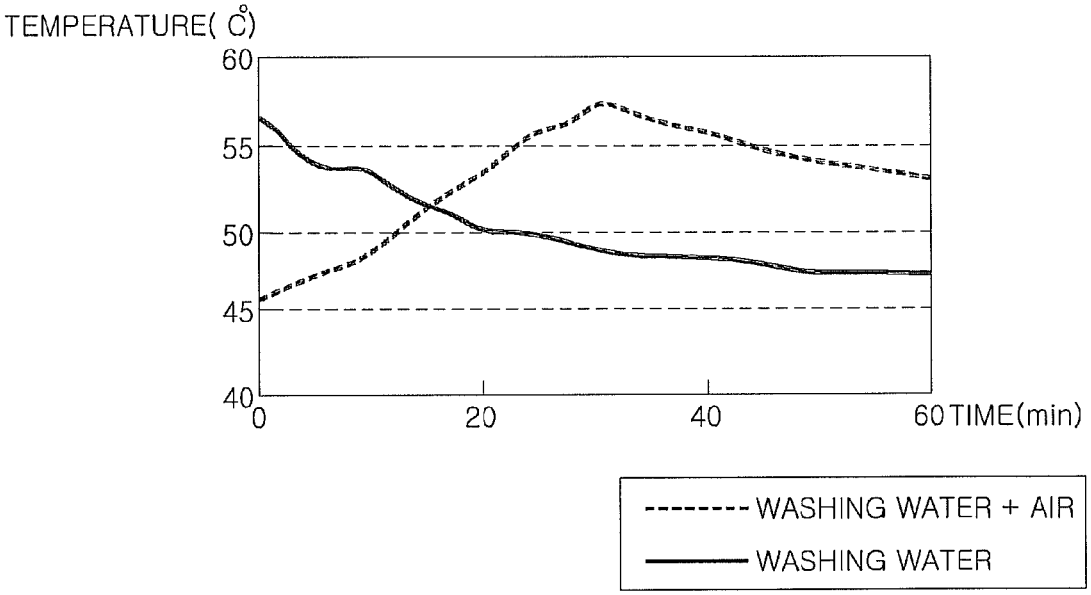
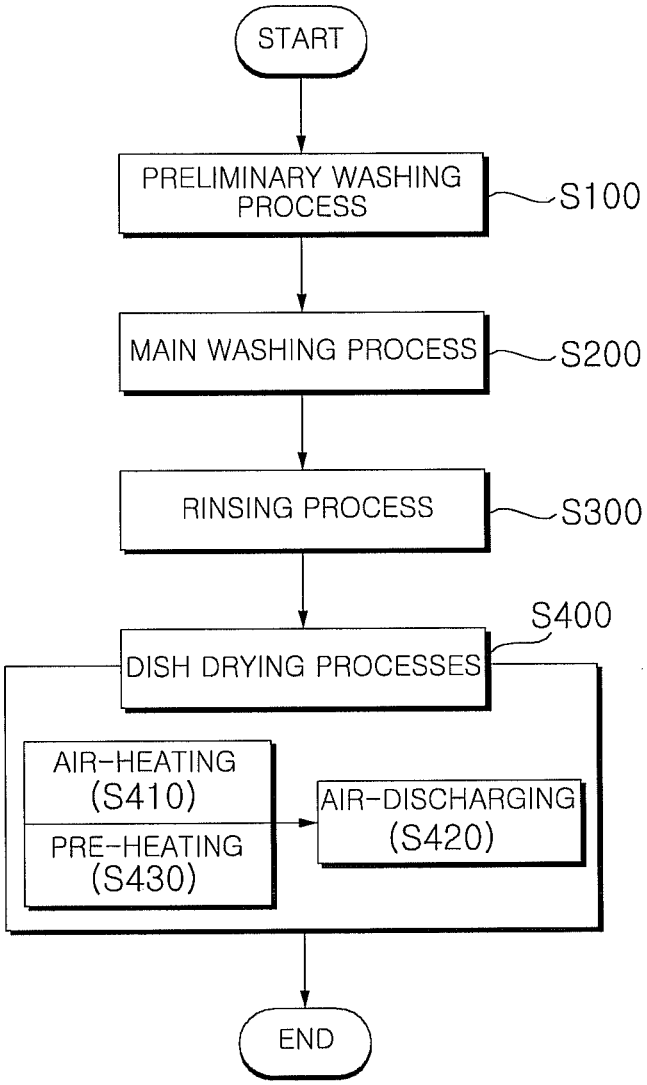

TEMPERATURE(C°)
60
55
50
45
40
0
20
40
60 TIME(min)
WASHING WATER + AIR
WASHING WATER

FIG. 3


START
PRELIMINARY WASHING PROCESS
S100
MAIN WASHING PROCESS
S200
RINSING PROCESS
S300
S400
DISH DRYING PROCESSES
AIR-HEATING (S410)
PRE-HEATING (S430)
AIR-DISCHARGING (S420)
END

CONTROL METHOD FOR A DISHWASHER

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims priority to Korean Patent Application No. 10-2011-0137518, filed in Korea on Dec. 19, 2011, the entire disclosure of which is incorporated by reference herein for all purposes.

BACKGROUND

[0002] 1. Field

[0003] A control method for a dishwasher is disclosed herein.

[0004] 2. Background

[0005] Control methods for dishwashers are known. However, they suffer from various disadvantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements, and wherein:

[0007] FIG. **1** is a side cross-sectional view of a dishwasher to which a control method for a dishwasher according to an embodiment may be applied;

[0008] FIG. **2** is a graph illustrating an operation effect of a control method for a dishwasher according to an embodiment; and

[0009] FIG. **3** is a flow chart illustrating a control method for a dishwasher according to an embodiment.

DETAILED DESCRIPTION

[0010] Embodiments will be described hereinafter with reference to the accompanying drawings. Embodiments may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Where possible, like reference numerals have been used to indicate like elements, and repetitive disclosure has been omitted.

[0011] In general, a dishwasher is an apparatus that washes off foreign material, such as slop, attached to items, such as dishes, by spraying washing water into an inside of a tub at high pressure. In order to increase a washing efficiency, such a dishwasher may be configured to perform heating of the washing water to dissolve detergent in the water more easily. In addition, the dishwasher may be configured to wash items, such as dishes, by soaking the slop attached to the dishes for a long time using washing water at a high temperature.

[0012] In a method of operating a dishwasher, a washing cycle may be separated into, for example, a preliminary washing process, a main washing process, and a dish drying process. In the preliminary washing process, the dish washing may be performed more reliably by soaking the slop attached to dishes. In recent years, a sterilization process that irradiates ultraviolet light to suppress growth of bacteria has been added.

[0013] In the dish drying process, two methods may be employed. One of the two methods may be a circulating drying method, in which dishes in the tub may be heated, moisture vaporized by evaporating the moisture from the dishes, vaporized air in the tub condensed by circulating it in the dishwasher, and then the condensed water may be discharged to the outside to dry the dishes. The other method may be a discharge drying method, in which dry air may be introduced into the tub from outside of the dishwasher, steam vaporized from the heated dishes such as in the circulating drying method may be included in the dry air, and then, humid air containing the moisture discharged to the outside to dry the dishes.

[0014] However, in such control methods described above, the circulating drying method has a lower efficiency than the discharge drying method. On the other hand, in such control methods, the discharge drying method may be configured such that the washing water within the sump is heated to a predetermined temperature in a rinsing process to rinse the washed dishes after the main washing process and the dish temperature in the tub increased, in order to induce the evaporation of water. However, as the dish drying process is longer by a predetermined heating time of the washing water, and in heating at least the washing water, the washing water is heated to a temperature suitable to wash the dishes and improve the dryness performance as described above, there is a severe problem of energy consumption.

[0015] Hereinafter, a control method for a dishwasher in accordance with an embodiment will be described in detail with reference to the accompanying drawings.

[0016] FIG. **1** is a side cross-sectional view of a dishwasher to which a control method for a dishwasher according to an embodiment may be is applied. The dishwasher **1** of FIG. **1** may include a cabinet **10** that forms an external appearance of the dishwasher, a door **100** that opens and closes an opening formed in the cabinet **10**, a tub **200** disposed inside of the cabinet **10** to store dishes or other items to be washed and forming a receiving space in which to wash the dishes in a washing process, and a sump assembly **400** including various parts coupled to a lower side of the tub **200** to store washing water, to spray the washing water onto the dishes, and to dry the dishes.

[0017] A washing chamber **210** that accommodates the dishes may be provided inside of the tub **200**, and the washing chamber **210** may be provided with a plurality of racks **220** on which to place the dishes. The rack **220** may include an upper rack **222** installed at an upper side of the washing chamber **210** and a lower rack **224** installed at a lower side of the washing chamber **210**. The dishes or other items may be washed by spraying the washing water through a spray arm **230** in a state in which the dishes or other items are positioned in the rack **220**.

[0018] The spray arm **230** may include an upper arm **232** disposed, for example, at a lower side of the upper rack **222**, and a lower arm **234** disposed, for example, at a lower side of the lower rack **224**. Each of the upper arm **232** and the lower arm **234** may be rotatably installed, and the spray arm **230** may be provided with a plurality of spray nozzles that spray the washing water onto the dishes or other items.

[0019] The sump assembly **400** may be connected to the upper arm **232** and the lower arm **234** by a connection pipe **300**. The sump assembly **400** may store the washing water and supply the washing water selectively or simultaneously to the upper arm **232** and the lower arm **234** through the connection pipe **300**.

[0020] The sump assembly **400** may include a sump that stores the washing water supplied through a water supply pipe **500** connected to an external water source (not shown), a drain chamber (not shown) inserted with a drain filter (not shown) that filters foreign materials from the washing water drained after washing the dishes, and a drain pump **600** that drains the washing water. When washing of the dishes is

finished, the washing water may be pumped by the drain pump and drained to an outside of the dishwasher through the drain pipe **600**.

[0021] Further, the sump assembly **400**, though not shown in the drawing, may further include a sump heater to increase a temperature of the washing water by directly applying heat to the washing water, in order to increase an efficiency of washing of the dishes or other items. The sump heater may increase the temperature of the washing water in the sump assembly **400** up to a temperature suitable to wash the dishes. More particularly, as the temperature of the washing water increases, it becomes more suitable for soaking slop, which has been attached to the dishes for a long time and has become difficult to remove. A high temperature of the washing water is not necessary; however, the temperature needs to be increased to an appropriate level, considering a durability of parts with respect to heat that make up the sump assembly **400**.

[0022] One side of the cabinet **10** may be provided with an internal air discharge (not numbered) to discharge air from the tub **200** to the outside, such that the outside of the dishwasher **1** and the inside of the washing chamber **210** may communicate with each other. The internal air discharge may be provided such that the air is discharged to the outside of the cabinet **10** by driving an exhaust fan (not shown).

[0023] The dishwasher **1** may further include air heaters **700**A and **700**B disposed inside of the washing chamber **210** to heat the internal air of the washing chamber **210**, as shown in FIG. **1**. The air heaters **700**A and **700**B may be disposed, for example, at a middle part of any one side wall at left or right sides of the washing chamber **210**, as shown in FIG. **1**, in order to provide heat for heat radiation of the dishes or other items received in the upper rack **222** and the lower rack **224**. However, although with the embodiment of FIG. **1**, the air heaters **700**A and **700**B are shown disposed at a middle part of any one side wall at left or right sides of the washing chamber **210**; embodiments are not so limited. That is, the air heaters **700**A and **700**B may be disposed in any location suitable to provide heat at a predetermined temperature to increase the temperature of the dishes by convection in the washing chamber **210**, taking into consideration caloric values of the air heaters **700**A and **700**B and air flow provided by driving an exhaust fan in the tub **200**.

[0024] In the embodiment of FIG. **1**, an upper air heater **700***a* may be provided, for example, at a location corresponding to an upper side of the upper rack **222**, and a lower air heater **700**B may be provided, for example, at a middle portion between the upper rack **222** and the lower rack **224**, that is, a location corresponding to an upper side of the lower rack **224**.

[0025] An operation process of the dishwasher constructed as described above according to an embodiment will be described herein below.

[0026] First, after a user places dishes or other items to be washed onto the upper rack **222** and/or the lower rack **224** and the dishwasher **1** is activated by an operation button (not shown), the sump heater may heat the washing water to a temperature suitable to wash the dishes or other items, and then the washing water at the high temperature may be sprayed onto the dishes or other items through the upper arm **232** and/or the lower arm **234**. The washing water sprayed through the upper arm **232** and/or the lower arm **234** may be sprayed onto the dishes at a high pressure. Hereinafter, a process of spraying washing water at the high pressure using the upper arm **232** and/or the lower arm **234** may be referred to as a 'main washing process', step S**200**.

[0027] However, before the main washing process, step S**200**, a preliminary washing process, step S**100**, may be performed, by spraying the washing water at the high temperature onto the dishes at a low pressure, in order to appropriately soak slop, which has been attached to the dishes or other items for a long time and has become difficult to remove. When the main washing process, step S**200**, has been terminated, after performing a rinsing process, step S**300**, that removes foreign material, such as slop attached to the dishes, a dish drying process may be performed to remove any remaining moisture from the dishes, step S**400**. Then, operation of the dishwasher **1** may be completed.

[0028] Hereinafter, a control method for a dishwasher constructed as described above according to an embodiment will be described in detail.

[0029] FIG. **2** is a graph illustrating an operation effect of a control method for a dishwasher according to an embodiment. FIG. **3** is a flow chart illustrating a control method for a dishwasher according to an embodiment.

[0030] As shown in FIG. **3**, after performing the main washing process, step S**200**, to wash the dishes in the tub, the control method may include in step S**400**, a step of air-heating in the tub, step S**410**, and discharging the air containing moisture in the tub to the outside, step S**420**.

[0031] The main washing process, step S**200**, may be referred to as a process of spraying the washing water onto the dishes at the high pressure using the upper arm **232** and/or the lower arm **234**, and before the main washing process, step S**200**, after the washing water accommodated in the sump is heated by the sump heater, a preliminary washing process, step S**100**, may be performed that sprays the heated washing water onto the dishes or other items in the tub **200** and soaks slop attached to the dishes, as described above. In addition, after the main washing process, step S**200**, the rinsing process, step S**300**, may be performed as described above.

[0032] The above-discussed air-heating, step S**410**, and air-discharging, step S**420**, performed after the main washing process, step S**200**, may be processes that dry the dishes or other items. Accordingly, hereinafter, they are collectively referred to as "dish drying processes", step S**400**.

[0033] The air-heating, step S**410**, in the dish drying processes, step S**400**, may heat air in a tub, such as tub **200** of FIG. **1**, using air heaters, such as air heaters **700**A and **700**B of FIG. **1**, disposed in a washing chamber, such as washing chamber **210** of FIG. **1**, of the tub. Heating the air in the washing chamber means instantaneously increase a dryness of the air, such that the air contains more moisture than the air at the high temperature, as is well-known. Heating the air in the washing chamber through the air-heating, step S**410**, may increase the temperature of the dishes or other items and to vaporize any remaining moisture in the dishes by directly heating the air and increase the content of moisture that may be contained in the air by indirectly increasing the dryness of the air.

[0034] However, a method of increasing the temperature of the dishes is not limited to the above-mentioned air-heating, step S**410**. That is, it is possible to increase an entire internal temperature of the washing chamber by heating the washing water accommodated in the sump using the sump heater before the air-heating, step S**410**, or at the same time as the air-heating, step S**410**. For the convenience of description, this may be referred to as "pre-heating", step S**430**.

[0035] The temperature of washing water heated by the pre-heating, step S**430**, may be set to at least a proper temperature for washing the dishes or other items (that is, the main washing process, step S**200**).

[0036] In prior art methods, a temperature of dishes may be increased under a discharge type drying in the tub, which may dry the dishes by discharging air containing moisture in the tub to the outside. Accordingly, the temperature of the dishes or other items has been increased through only the above-mentioned pre-heating, step S**430**. However, in the prior art dish temperature increasing method, energy consumption is extreme, as water that has a relatively large specific heat has to be heated, to a temperature sufficient to satisfy conditions for improving drying performance of the dishes, rather than to a temperature for heating the washing water or a least optimum temperature for washing the dishes. Accordingly, there is a problem in that an execution time of the overall dish drying process is long, as the heating time of the washing water is long and the heating temperature of the washing water is increased.

[0037] In order to overcome this problem, in the control method according to embodiments disclosed herein, air in the washing chamber that has a specific heat, which is relatively small and may be heated in a short time, may be directly heated by the air-heating, step S**410**.

[0038] More particularly, a temperature of the dishes may be quickly increased by use of the air heaters, moisture may be vaporized, and air containing moisture may be discharged to the outside in the discharge type drying way, by setting locations of the air heaters, such that the air may be heated and the dishes heated for heat radiation.

[0039] The dishes heated by the air-heating, step S**410**, may increase in temperature up to at least a first set temperature, which is increased by a predetermined temperature from an increased temperature (a second set temperature) by heating the washing water using the sump heater. In other words, this means that the first set temperature of the dishes increased by the air heated in the air-heating, step S**410**, may be higher than the second set temperature of the dishes increased in the pre-heating, step S**430**. This is because, if the air in the washing chamber is heated using the air heaters, by convection of the heated air within the washing chamber, the temperature of the dishes received in the upper and lower racks, such as upper and lower racks **222**, **224** of FIG. **1**, may be increased by convection of the heated air, or the temperature may be directly increased by the higher temperature due to the heating of the radiation through the air heaters.

[0040] FIG. **2** is a graph illustrating an operation effect of a control method for a dishwasher according to an embodiment. FIG. **2** will be described in detail herein below.

[0041] Referring to FIG. **2**, when the same energy is consumed, in a case that heating of the washing water of the sump heater is used, it is known that the temperature of the dishes may be maintained at the higher temperature in the dish drying process when the washing water and the air are simultaneously heated using both the temperature changes of the dishes and the sump heater and the air heaters. The water may be easily vaporized as the moisture in the dishes is evaporated.

[0042] The air-discharging, step S**420**, may include discharging the air in the tub containing water vapor to the outside by driving an exhaust fan.

[0043] Thus, in the control method of a dishwasher according to embodiments disclosed herein, the discharging drying process having higher drying performance is adopted, rather than the circulating drying process of prior art dish drying methods. Thus, there is an advantage in that a time required for the dish drying process may be greatly reduced, as moisture contained in the dishes may be vaporized while increasing a temperature of the dishes in a shorter time period, and dryness of the air may be increased.

[0044] Therefore, the control method for a dishwasher according to embodiments disclosed herein has the effect of reduced energy consumption, compared to increasing a temperature of the dishes using the washing water, by quickly increasing the temperature of the dishes by heating air in the tub during the dish drying process. In addition, control method for a dishwasher according to embodiments disclosed herein has the effect in that a time required for the dish drying process may be reduced and the dish drying quickly achieved, as the air in the tub is heated and the temperature of dishes quickly increased.

[0045] Embodiments disclosed herein provide a control method for a dishwasher capable of increasing energy efficiency during a dish drying process, while shortening a dish drying time and improving an entire drying performance.

[0046] Embodiments disclosed herein provide a control method for a dishwasher that may include air-heating for heating air in a tub after a main washing process of washing dishes in the tub, and air-discharging for discharging the air containing a moisture in the tub into an outside, during the air-heating or at the same time as the air-heating. The control method may include further pre-heating for heating washing water accommodated in a sump to increase a temperature of the dishes, after the main washing process and before the air-heating. In addition, a temperature (a first set temperature) of the dishes increased through the air heated in the air-heating may be higher than that (a second set temperature) of the dishes increased in the pre-heating.

[0047] Embodiments disclosed herein further provide control method for a dishwasher that may include a preliminary washing process, after heating washing water accommodated in a sump by a washing water heater, for soaking slops attached to dishes by spraying heated washing water onto the dishes in a tub, a main washing process for spraying the washing water onto the dishes having soaked slops using a high pressure after the preliminary washing process, and a dish drying process for drying the dishes in the tub after the main washing process. The dish drying process may include air-heating for heating air in the tub, and air-discharging for discharging the air containing moisture in the tub into an outside, after the air-heating. The air-heating may increase a temperature of the dishes using an air heater installed in the tub. In addition, the air-heating may heat the air such that the temperature of the dishes may be increased up to a first set temperature.

[0048] The dish drying process may further include pre-heating for heating the washing water accommodated in the sump such that the temperature of the dishes is increased up to a second set temperature, after the main washing process and before the air-heating. The first set temperature may be higher than the second set temperature.

[0049] In addition, the air-discharging may discharge the air in the tub containing water vapor into the outside by driving an exhaust fan. Further, the air heater may be disposed on a location where the dishes in the tub can be heated for heat radiation.

[0050] As discussed above, the embodiments of the control method of a dishwasher have been described with reference to

the accompanying drawings. However, embodiments are not to be construed as limited thereby. Those skilled in the art will readily appreciate that many modifications are possible without materially departing from the novel teachings and advantages. Accordingly, all such modifications are intended to be included within the scope of this inventive concept as defined in the claims.

[0051] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0052] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A control method for a dishwasher, comprising:

heating air in a tub after a main washing process of washing dishes in the tub; and

discharging the air containing moisture in the tub to an outside, during the heating of the air.

2. The control method according to claim **1**, further comprising:

heating washing water accommodated in a sump to increase a temperature of the dishes, after the main washing process and before the heating of the air.

3. The control method according to claim **2**, wherein a first predetermined temperature of the dishes increased through the heating of the air is higher than a second predetermined temperature of the dishes increased in the heating of the washing water.

4. The control method according to claim **1**, wherein the main washing process comprises:

spraying washing water at a predetermined temperature onto the dishes at a high pressure.

5. The control method according to claim **4**, further comprising a preliminary washing process, the preliminary washing process comprising:

prior to the main washing process, spraying the washing water at the predetermined temperature dishes onto the dishes at a low pressure.

6. The control method according to claim **4**, further comprising after the main washing process, rinsing the dishes.

7. The control method according to claim **6**, wherein the heating of the air and the discharging of the air are performed after the rinsing of the dishes.

8. The control method according to claim **1**, wherein the heating of the air comprises heating the air in the tub using at least one air heater.

9. The control method according to claim **7**, wherein the at least one air heater is disposed in a location at which the dishes in the tub can be heated using heat radiation.

10. A control method for a dishwasher, comprising:

after heating washing water accommodated in a sump by a washing water heater, soaking slop attached to the dishes by spraying the heated washing water onto dishes in a tub, at a low pressure;

thereafter, spraying the washing water onto the dishes having been soaked, at a high pressure; and

thereafter, drying the dishes in the tub, wherein the drying of the dishes includes:

heating air in the tub, and

discharging the air containing moisture in the tub to an outside, after the heating of the air.

11. The control method according to claim **10**, wherein the heating of the air increases a temperature of the dishes using at least one air heater installed in the tub.

12. The control method according to claim **11**, wherein the heating of the air heats the air such that the temperature of the dishes is increased to a first predetermined temperature.

13. The control method according to claim **12**, wherein the drying of the dishes further includes heating the washing water accommodated in the sump such that the temperature of the dishes is increased to a second predetermined temperature, after the main washing process and before the heating of the air.

14. The control method according to claim **13**, wherein the first predetermined temperature is higher than the second set temperature.

15. The control method according to claim **11**, wherein the at least one air heater is disposed in a location at which the dishes in the tub can be heated using heat radiation.

16. The control method according to claim **11**, wherein a washing chamber that accommodates the dishes is provided inside of the tub, wherein an upper rack is installed on an upper side and a lower rack is installed on a lower side of the washing chamber, and wherein the at least one air heater includes:

an upper air heater provided at an upper side of the upper rack; and

a lower air heater provided at an upper side of the lower rack.

17. The control method according to claim **11**, wherein the at least one air heater is disposed in a location in which a temperature of the dishes is increased to the first predetermined temperature, taking into consideration a caloric value and an air flow created by a driving fan in the tub.

18. The control method according to claim **10**, wherein the discharging of the air discharges the air in the tub containing water vapor to the outside by driving an exhaust fan.

19. A control method for a dishwasher, comprising:

heating air in a tub after a main washing process of washing dishes in the tub using at least one air heater; and

discharging the air containing moisture in the tub to an outside, during the heating of the air.

20. The control method according to claim **18**, wherein the at least one air heater is disposed in a location at which the dishes in the tub can be heated using heat radiation.

21. The control method according to claim **19**, wherein a washing chamber that accommodates the dishes is provided

inside of the tub, wherein an upper rack is installed on an upper side and a lower rack is installed on a lower side of the washing chamber, and wherein the at least one air heater includes:

an upper air heater provided at an upper side of the upper rack; and

a lower air heater provided at an upper side of the lower rack.

* * * * *