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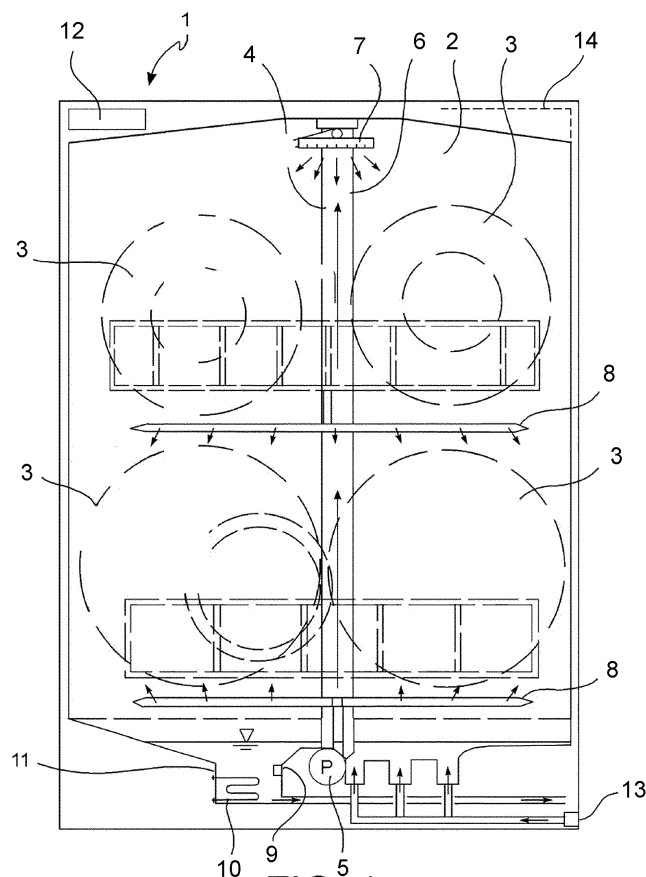
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(54) DISHWASHER AND TREATMENT METHOD

(57) A dishwasher (1) comprises a washing container closable by means of a door (14), a spraying device (4), a washing liquid heating device (10), as well as an electronic control device (12) which controls the heating

device (10) during a hot washing step depending on a thermal gradient of the washing liquid measured by a temperature sensor (9).

**FIG. 1****EP 3 375 344 A1**

Description

[0001] The present invention relates to a method for treating/washing dishes by means of a dishwasher, and to a dishwasher implementing the treatment/washing method.

[0002] Dishwashers are known, having a washing container for receiving dishes to be washed, a spraying device adapted to spray a washing liquid on the dishes arranged in the washing container, and a heating device adapted to heat the washing liquid.

[0003] Known dishwashers allow the selection of one or more dish washing programs characterized, for example, by a selectable washing temperature which allows the washing program to adapt to the type of dirt to be removed, or by a selectable "ecological" mode which provides for an electricity and/or water saving use.

[0004] At present, the user is therefore in charge of carrying out targeted selections of specific parameters, such as the washing temperature for example, without providing definite indications on the most suitable temperature for a determined type of dirt, e.g. encrustations, greasy residues and so on. Furthermore, the dishwashers of the prior art do not allow for a targeted selection of treatment parameters based on the quantity of dishes loaded in the washing container and the material and/or surface properties thereof which, however, influence the result of the washing, both for the overall surface area to be cleaned and for the thermal capacity and thermal conduction properties of the dishes, which determines the temperature and stay time of washing liquid in contact with the dirt, as well as the washing liquid evaporation and/or rinsing time. The only possibility of influencing the washing based on the quantity of dishes to be washed is that of (the user) dosing more or less detergent, but also in this case without any guidance or automatic execution.

[0005] Therefore, it is the object of the present invention to improve the known dishwashers and dish washing methods, so as to adapt the washing program in a manner which is more targeted to the number and/or material and/or mass of dishes to be washed.

[0006] It is a further object of the invention to improve the known dishwashers and dish washing methods, so as to automate the setting of dish treatment parameters also based on the number and/or material and/or mass of the dishes to be washed.

[0007] It is a further object of the invention to improve the known dishwashers and dish washing methods, so as to better reconcile the needs to reduce energy, water and time consumption and improve washing performance.

[0008] These and other objects are achieved by a dishwasher according to claim 1 and by means of a method for washing dishes in a dishwasher.

[0009] Advantageous embodiments are the subject of the dependent claims.

[0010] According to an aspect of the invention, a dish-

washer comprises:

- a washing container for receiving dishes to be washed,
- a spraying device adapted to spray a washing liquid into the washing container to wet the dishes,
- a washing liquid heating device,
- an electronic control device configured to execute a dish treatment program with at least one hot washing step having an initial step of heating the washing liquid and of simultaneously distributing the heated washing liquid on the dishes in the washing container,
- a temperature sensor connected to the electronic control device and put in thermal contact with the washing liquid,

characterized in that:

- during the initial heating step, the temperature sensor measures the temperature of the washing liquid,
- depending on the temperatures measured by the temperature sensor, the electronic control device calculates a thermal gradient parameter indicative of the washing liquid heating speed (and therefore of the dishes wet by the washing liquid) in said initial heating step,
- the electronic control device controls the heating device during the hot washing step depending on the thermal gradient parameter.

[0011] The thermal gradient of the washing liquid (and therefore of the dishes wet thereby) varies depending on the quantity of dishes loaded, mass, surface area exposed, and material of the dishes, and is therefore a universal or generic indicator of the quantity of dishes to be washed, wetted and heated.

[0012] The adjustment of the operating time and of the switching off timing of the heating device and/or the adjustment of the total time of the hot washing step (which also includes a possible hot washing step once the heating device has been switched off, but by means of the same washing liquid previously heated) depending on the calculated thermal gradient parameter, allows for a targeted adaptation of the dish treatment/washing program to the quantity of dishes loaded in the washing container. This allows to automate the adjustment of dish treatment parameters based on the number and/or material and/or mass of dishes to be washed, so as to better reconcile the needs to reduce energy, water and time consumption and improve washing performance.

[0013] To better understand the invention and appreciate the advantages thereof, some embodiments will be described below by way of non-limiting example, with reference to Figure 1 which shows a dishwasher according to an embodiment of the invention, with the door removed to better see the internal components.

[0014] With reference to the Figure, a dishwasher is

generally indicated by reference numeral 1. The dishwasher 1 comprises at least one washing container 2 adapted to receive dishes 3 to be washed and closable by means of a door 4 (only diagrammatically indicated). Inside the dishwasher 1, a spraying device 4 is provided, such as a pump 5 with a supply pipe 6 and one or more spraying nozzles 7 and/or spraying rotors 8. The spraying device 4 is configured to spray a washing liquid on the dishes 3 arranged in the washing container 2. The dishwasher 1 further comprises a heating device adapted to heat the washing liquid, such as an electrical resistor 10 which may be arranged, for example, but not necessarily, in a washing liquid collection tank 11. The collection tank 11, preferably formed in a lower area of the washing container 2 or below the washing container 2, is connected with the spraying device 4 to allow it to draw the cold or heated washing liquid required for the dish treatment.

[0015] The dishwasher 1 further comprises control means, for example an electronic control unit or device 12, configured to execute a dish treatment program, preferably selectable from a plurality of treatment programs.

[0016] The plurality of treatment programs comprises at least one dish treatment/washing program with at least one hot washing step having an initial washing liquid heating step in which the heating device 10 is actuated to heat the washing liquid and in which the spraying device 4 is actuated so as to distribute and spray the heated washing liquid on the dishes 3 arranged in the washing container 2.

[0017] The dishwasher 1 further comprises a temperature sensor 9 connected with the electronic control device 12 and put in thermal contact with the washing liquid, preferably inside the collection tank 11, but at a distance from the heating device 10 so as to measure the temperature of the washing liquid and not that of the heating device 10.

[0018] In accordance with an aspect of the invention, during the initial heating step, the temperature sensor 9 measures the temperature of the washing liquid. Depending on the temperature values measured by the temperature sensor 9 and communicated to the control device 12, the electronic control device 12 calculates a thermal gradient parameter I indicative of the washing liquid heating speed (and therefore of the dishes wet by the washing liquid) during said initial heating step. The electronic control device 12 determines the switching off of the heating device 10 during the hot washing step and/or the duration of the hot washing step depending on the thermal gradient parameter.

[0019] The thermal gradient of the washing liquid (and therefore of the dishes 3 wet thereby) varies depending on the quantity of dishes 3 loaded, on the mass, on the surface area exposed and on the material of the dishes 3, and is therefore a universal indicator of the quantity of dishes 3 to be washed, wet and heated.

[0020] The adjustment of the operating time and of the switching off timing of the heating device 10 and/or the adjustment of the total time of the hot washing step (which

also includes a possible hot washing step once the heating device 10 has been switched off, but by means of the same washing liquid previously heated) depending on the calculated thermal gradient parameter I, allows a targeted adaptation of the treatment/washing program to the quantity of dishes 3 loaded in the washing container 2. This allows to automate the adjustment of dish 3 treatment parameters based on the number and/or material and/or mass of dishes 3 to be washed, so as to better reconcile the needs to reduce energy, water and time consumption and improve washing performance.

Detection and/or determination of the thermal gradient parameter I

[0021] According to an embodiment, the thermal gradient parameter I may be the increase (i.e. the difference) in temperature detected by the temperature sensor 9 in a reference time interval (for example, constant and predetermined) during the initial heating step, and therefore a temperature difference. The greater this temperature difference is, the greater is the heating speed of the washing liquid and of the dishes 3 and, therefore, this would be indicative of a smaller number or mass of dishes 3 to be washed. The lower said temperature difference is, the lower is the heating speed of the washing liquid and of the dishes 3 and, therefore, this would be indicative of a greater number or mass of dishes 3 to be washed.

[0022] According to a further embodiment, the thermal gradient parameter I may be the quotient between the increase (i.e. the difference) in temperature detected by the temperature sensor 9 in a reference time interval (for example, constant and predetermined, or variable) during the initial heating step and the duration of the reference time interval, and therefore a temperature gradient. The greater this temperature gradient is, the greater is the heating speed of the washing liquid and of the dishes 3 and, therefore, this would be indicative of a smaller number or mass of dishes 3 to be washed. The lower said temperature gradient is, the lower is the heating speed of the washing liquid and of the dishes 3 and, therefore, this would be indicative of a greater number or mass of dishes 3 to be washed.

[0023] According to an embodiment, the thermal gradient parameter I is equal or proportional to the quotient $(T_{\text{target_min}} - T_2)/t_1$ between the difference (increase) in washing liquid temperature $(T_{\text{target_min}} - T_2)$ measured in a time interval and the duration t_1 of said time interval during the initial heating step.

[0024] More precisely, in an exemplifying manner, the washing liquid temperature difference $(T_{\text{target_min}} - T_2)$ measured may be the difference between a predetermined or presettable minimum nominal washing liquid heating temperature $T_{\text{target_min}}$, for example 55°C, and an initial temperature T_2 of the washing liquid not yet heated (therefore measured before the activation of the heating device 10). In this case, the duration t_1 is the time elapsed between the switching-on of the heating

means 10 and the reaching of the minimum nominal temperature $T_{\text{target_min}}$. The time duration t_1 is not constant (since it depends on the mass and on the overall thermal capacity of the dishes) and the reaching of the minimum nominal temperature $T_{\text{target_min}}$ is verified by the control device 12 by means of the comparison of the temperature detected by the temperature sensor 9 with the reference value $T_{\text{target_min}}$.

Adjustment of the parameters of the hot washing step - temperature

[0025] According to an embodiment, the control device 12 adjusts the duration of the switching-on of the heating device 10 or the heating power of the heating device 10 during the hot washing step depending on the thermal gradient parameter I . In particular, the control device 12 increases the duration of the switching-on phase of the heating device 10 and/or the heating power of the heating device 10 as the thermal gradient (parameter) I lowers with respect to preset reference values of time and/or power and of thermal gradient. Therefore, as the mass or quantity of dishes 3 to be treated increases, the duration of the switching-on phase and/or the heating power of the heating device 10 increases.

[0026] According to an embodiment, the control device 12 adjusts a maximum nominal temperature value $T_{\text{target_max}}$ of the washing liquid depending on the thermal gradient (parameter) I and carries out and verifies the reaching of the maximum nominal temperature value $T_{\text{target_max}}$ by means of the heating device 10 and the temperature sensor 9.

[0027] In particular, the maximum nominal temperature value $T_{\text{target_max}}$ of the washing liquid increases as the thermal gradient (parameter) I decreases, indicative of a greater thermal inertia and therefore of a greater number and mass of dishes 3 loaded in the washing container 2.

[0028] Thereby, as the mass and/or quantity of dishes 3 to be treated increases, the maximum temperature at which the washing liquid is heated, and therefore the total amount of thermal energy transmitted to the dishes and to the washing liquid, is automatically increased.

[0029] Similarly, as the mass and/or quantity of dishes 3 to be treated lowers, the maximum temperature at which the washing liquid is heated, and therefore the total amount of thermal energy transmitted to the dishes and to the washing liquid, is automatically lowered.

[0030] According to an embodiment, the control device 12 adjusts the maximum nominal temperature $T_{\text{target_max}}$ within a fixed temperature interval, for example, between 55°C and 65°C, with a fixed lower value (for example, greater than 45°) which ensures a temperature sufficiently hot for activating the chemical and physical dirt removal mechanisms, and a fixed greater value (for example, lower than 75°) which prevents thermal damage to the dishes 3 and to the dishwasher 1, irrespective of the quantity of dishes 3 loaded, detected by

means of the aforesaid temperature gradient.

Adjustment of the parameters of the hot washing step - duration

[0031] According to an embodiment, during the hot washing step, the electronic control device 12 keeps the heating device 10 switched-on until reaching the maximum nominal temperature $T_{\text{target_max}}$ of the washing liquid and switches-off the heating device 10 upon reaching the maximum nominal temperature $T_{\text{target_max}}$ of the washing liquid (detected by the temperature sensor 9), but continues to actuate the spraying device 4 to wash the dishes 3 by means of the previously heated washing liquid and with the heating device 10 switched-off, for a residual hot washing duration t_2 .

[0032] By means of the aforesaid adjustment of the maximum nominal temperature $T_{\text{target_max}}$ depending on the thermal gradient (parameter) I , as the detected thermal gradient decreases (indicative of a greater mass and/or quantity of dishes 3 to be treated), the duration of the initial heating step and also the maximum temperature reached, and therefore the total amount of thermal energy transmitted to the dishes and to the washing liquid, is automatically increased.

[0033] Similarly, as the detected thermal gradient increases (indicative of a smaller mass and/or quantity of dishes 3 to be treated), the duration of the initial heating step and also the maximum temperature reached, and therefore the total amount of thermal energy transmitted to the dishes and to the washing liquid, is automatically decreased.

[0034] With further advantage, the control device 12 determines or calculates the residual hot washing duration value t_2 depending on the thermal gradient (parameter) I . In particular, the residual hot washing duration value t_2 increases as the thermal gradient (parameter) I decreases, i.e. as the thermal inertia and therefore the number and mass of dishes 3 loaded in the washing container 2 increases.

[0035] Thereby, as the mass and/or quantity of dishes 3 to be treated increases, the duration t_2 of the hot washing step with the heating device 10 switched-off is automatically increased, therefore utilizing for a longer time the heat transmitted to the dishes and to the washing liquid and washing the dishes 3 for a longer time.

[0036] Similarly, as the thermal gradient (parameter) I increases (indicative of a smaller mass and/or quantity of dishes 3 to be treated), the duration of the hot washing step with the heating off is automatically decreased, saving time and electricity.

[0037] According to an embodiment, the control device 12 adjusts the duration t_2 of the residual hot washing step with the heating device 10 switched-off within a fixed time interval, for example, between 300 seconds and 1200 seconds, with a fixed lower value (for example, greater than 240 seconds) which ensures the utilization of the washing liquid and of the heat already introduced

in the system, and a fixed greater value (for example, lower than 1300 seconds) which prevents an unnecessary and repeated treatment of the dishes already cleaned with the now already dirty washing liquid, irrespective of the quantity of dishes 3 loaded, detected by means of the aforesaid temperature gradient.

Adjustment of the parameters of a subsequent cold rinsing step - duration

[0038] According to an embodiment, upon conclusion of the hot washing step, the electronic control device 12 actuates the draining of the washing liquid and the loading, for example by means of one or more inlet valves 13, of a cold rinsing liquid, in particular of cold mains water, to carry out a cold rinsing step with the heating device 10 switched-off and with the spraying device 4 switched-on, to rinse previously washed dishes 3 for a cold rinsing duration t3.

[0039] According to an embodiment, the control device 12 adjusts the cold rinsing duration t3 depending on the thermal gradient (parameter) I.

[0040] In particular, the cold rinsing duration t3 increases as the thermal gradient (parameter) I lowers, indicative of a greater thermal inertia and therefore of a greater number and mass of dishes 3 loaded in the washing container 2.

[0041] Thereby, as the mass and/or quantity of dishes 3 to be treated increases, the duration t3 of the cold rinsing, and therefore the stay of the rinsing liquid on the dishes, is automatically increased, providing more time for rinsing the greater quantity of dishes and also utilizing in a more complete manner the residual thermal energy stored in the dishes.

[0042] Similarly, as the mass and/or quantity of dishes 3 to be treated lowers, the cold rinsing duration t3, and therefore the stay of the cold rinsing liquid on the dishes, is automatically lowered, saving electricity and time.

[0043] According to an embodiment, the control device 12 adjusts the duration t3 of the cold rinsing step within a fixed time interval, for example, between 120 seconds and 240 seconds, with a fixed lower value (for example, greater than 100 seconds) which ensures a minimum rinse, and a fixed greater value (for example, lower than 300 seconds) which prevents an unnecessary lengthening of the rinsing step and the relevant energy consumption, irrespective of the quantity of dishes 3 loaded, detected by means of the aforesaid temperature gradient.

[0044] According to an embodiment, the control device 12 compares the thermal gradient (parameter) I with a predetermined threshold value and, if the thermal gradient (parameter) I is lower than the predetermined threshold value, it does not carry out any cold rinse and immediately switches, after the hot washing step, to a hot rinsing step and then to a drying step of the dishes 3, for example by means of condensation of the moisture evaporated from the dishes 3.

[0045] The complete exclusion of the cold rinse, in

case the thermal gradient parameter I is lower than the predetermined threshold value, leads to a reduction in the consumption of water and electricity for pumping.

Adjustment based on the detected ambient temperature T1

[0046] According to an embodiment, upon the switching-on of the dishwasher 1 or at the beginning of the treatment or washing program, even before loading mains water (washing liquid) into the washing container 2, the temperature sensor 9 detects an ambient temperature value T1 and the control device 12 stores the detected ambient temperature value T1 and:

- controls the heating device 10 and/or
- adjusts the temperature and/or duration of the hot washing step, and/or
- adjusts the duration of the cold rinsing step,

also as a function of the detected ambient temperature T1.

[0047] Taking into account the influence of the ambient temperature on the energy balance of the washing, in an embodiment, the control device 12 increases the duration of the switching-on of the heating device 10 and/or the heating power of the heating device 10 as the detected ambient temperature T1 lowers, for example, with respect to preset reference values of time and/or power and of temperature.

[0048] In addition or alternatively, the control device 12 may increase the maximum nominal temperature value T_target_max of the washing liquid as the detected ambient temperature T1 decreases.

[0049] According to an embodiment, the control device 12 increases the duration of the initial heating step (for example at constant heating power) as the detected ambient temperature T1 decreases.

[0050] Similarly, as the detected ambient temperature T1 increases, the duration of the initial heating step, and also the maximum temperature of the washing liquid, is automatically decreased.

[0051] In addition or alternatively, the control device 12 determines or calculates the residual hot washing duration value t2 also depending on the detected ambient temperature T1.

[0052] In particular, the residual hot washing duration t2 increases as the detected ambient temperature T1 lowers. Similarly, as the detected ambient temperature T1 increases, the duration of the hot washing step t2 with the heating switched-off is automatically decreased.

[0053] The influence of the detected ambient temperature T1 on the estimate of the dishes quantity as a function of the detected thermal gradient depends on the thermal capacity of the washing container 2 and on the thermal insulation of the washing container 2 from the environment external to the dishwasher 1. By way of example, with a constant detected thermal gradient, the change of

the maximum nominal temperature $T_{\text{target_max}}$ based on the detected ambient temperature T_1 is lower than 1.5%, preferably lower than 1%, of the $T_{\text{target_max}}$ value expressed in °C. For example, keeping the thermal gradient parameter I fixed, with a detected ambient temperature T_1 of 16°C, the $T_{\text{target_max}}$ value is 62.9°C, whereas with a detected ambient temperature T_1 of 30°C the $T_{\text{target_max}}$ value is 62.2°C.

[0054] According to an embodiment, the control device 12 adjusts the cold rinsing duration t_3 depending on the detected ambient temperature T_1 . In particular, the cold rinsing duration t_3 increases as the detected ambient temperature T_1 lowers and vice versa.

[0055] Like the thermal gradient (parameter) I , also the ambient temperature T_1 (if considered in the control method) is a constant value, determined on the basis of the detection carried out by the temperature sensor 9, and the changes thereof, e.g. "increase" and "lowering", as well as the resulting changes, e.g. "increase" or "lowering", in temperature and duration of the treatment program steps, are to be considered with reference to preset or preselectable reference values.

Adjustment based on the initial temperature T_2 of the water or washing liquid

[0056] In case the water or washing liquid loaded in the dishwasher has an already very high initial temperature, for example greater than 35°C, it is not easy to determine a significant thermal gradient, since a part of the thermal energy of the washing liquid is already absorbed by the dishes 3 during the loading of the washing liquid which usually occurs with the simultaneous spraying on the dishes, and because the time required for reaching the minimum nominal washing liquid heating temperature $T_{\text{target_min}}$, for example 55°C, is very limited.

[0057] For this reason and due to the little electricity required for the further heating of the washing liquid, the control device may compare the initial temperature T_2 of the washing liquid not yet heated (measured before the activation of the heating device 10) with a predetermined threshold value, for example 35°C, and if the initial temperature T_2 is greater than the predetermined threshold value, set the $T_{\text{target_max}}$ and/or t_2 and/or t_3 values directly at their preset maximum values, irrespective of the washing liquid heating speed and therefore irrespective of the quantity of dishes 3 loaded into the washing container 2.

[0058] In an embodiment, the treatment/washing program may comprise:

- an initial switching-on step, in which the temperature sensor 9 detects and the control device 12 stores the ambient temperature T_1 .
- a subsequent pre-washing step, in which the control device 12 actuates the supply valve 13 to load mains water into the washing container 2 and in which the

water is sprayed on the dishes 3, without the actuation of the heating device 10,

the subsequent hot washing step with the initial heating step and the residual hot washing step described above,

- the subsequent cold rinsing step, and, if provided, a subsequent hot rinsing step and a final drying step.

[0059] By means of the dishwasher 1 described so far, it is possible to carry out a dish treatment method aimed at saving water, electricity and detergent with the same quantity of dishes washed and at improving the washing result, intended as a more complete removal of food residues from the dishes.

[0060] In particular, the method includes the steps and operations previously described and carried out automatically by means of the control device 12. Alternatively, the same steps and operations may be carried out by equivalent, alternative or different means with respect to the control device 12, or by an operator.

[0061] In fact, the method of controlling and operating the dishwasher may also be carried out without being implemented by the control device 12 and also in a non-automatic manner.

[0062] Obviously, further changes and variations to the dishwasher 1 and to the dish treatment method described so far may be made by those skilled in the art in order to meet contingent and specific needs, all falling within the scope of protection of the invention as defined by the following claims.

Claims

1. A dishwasher (1), comprising:

- a washing container (2) adapted to receive dishes (3) to be washed and closable by means of a door (14),
- a spraying device (4) adapted to spray a washing liquid on the dishes (3) arranged in the washing container (2),
- a heating device (10) adapted to heat the washing liquid,
- a control device (12) configured to execute a dish treatment program with at least one hot washing step having an initial step of heating the washing liquid and of simultaneously distributing the heated washing liquid on the dishes (3) in the washing container (2),
- a temperature sensor (9) connected to the electronic control device (12) and put in thermal contact with the washing liquid,

characterized in that:

- during the initial heating step, the temperature

sensor (9) measures the temperature of the washing liquid,

- depending on the measured temperature, the electronic control device (12) calculates a thermal gradient parameter (I) indicative of the washing liquid heating speed in said initial heating step,

- the electronic control device (12) controls the heating device (10) during the hot washing step depending on the thermal gradient parameter (I).

2. A dishwasher (1) according to claim 1, wherein:

- the thermal gradient parameter (I) is selected from the group consisting of:

- the increase in temperature detected by the temperature sensor (9) in a reference time interval,

- the quotient between the increase in temperature detected by the temperature sensor (9) in a reference time interval and the duration of the reference time interval,

and/or

- the thermal gradient parameter (I) is equal or proportional to the quotient $((T_{\text{target_min}} - T_2)/t_1)$ between the difference in washing liquid temperature ($T_{\text{target_min}} - T_2$) measured in a time interval and the duration (t_1) of said time interval during the initial heating step, wherein:

- the temperature difference ($T_{\text{target_min}} - T_2$) is the difference between a predetermined or presettable minimum nominal washing liquid heating temperature ($T_{\text{target_min}}$) and an initial temperature (T_2) of the washing liquid not yet heated, measured before the activation of the heating device (10),

- the duration (t_1) is the time elapsed between the switching-on of the heating means (10) and the reaching of the minimum nominal temperature ($T_{\text{target_min}}$), wherein the reaching of the minimum nominal temperature ($T_{\text{target_min}}$) is verified by the control device (12) by means of the temperature sensor (9),

and/or

- the control device (12) adjusts the duration of the switching-on of the heating device (10) or the heating power of the heating device (10) during the hot washing step depending on the thermal gradient parameter (I),

and/or

- wherein the control device (12) increases the duration of the operation of the heating device (10) and/or the heating power of the heating device (10) as the thermal gradient parameter (I) lowers with respect to preset reference values.

3. A dishwasher (1) according to one of the preceding claims, wherein the control device (12) determines the maximum nominal temperature value ($T_{\text{target_max}}$) of the washing liquid depending on the thermal gradient parameter (I) and verifies the reaching of the maximum nominal temperature value ($T_{\text{target_max}}$) by means of the temperature sensor (9), wherein the maximum nominal temperature value ($T_{\text{target_max}}$) of the washing liquid increases as the thermal gradient parameter (I) decreases.

4. A dishwasher (1) according to claim 3, wherein the control device (12) adjusts the maximum nominal temperature ($T_{\text{target_max}}$) within a fixed temperature interval, or within a temperature interval of between 55°C and 65°C.

5. A dishwasher (1) according to one of claims 3 or 4, wherein, during the hot washing step, the electronic control device (12):

- keeps the heating device (10) switched-on until reaching the maximum nominal temperature ($T_{\text{target_max}}$) of the washing liquid, and
- switches-off the heating device (10) upon reaching the maximum nominal temperature ($T_{\text{target_max}}$) of the washing liquid, and
- once the heating device (10) has been switched-off, continues to actuate the spraying device (4) for a residual hot washing duration (t_2),

wherein, as the thermal gradient parameter decreases with respect to a predetermined reference value (I), the duration of the initial heating step, and also the maximum nominal temperature ($T_{\text{target_max}}$) of the washing liquid, is automatically increased, wherein, as the thermal gradient parameter increases with respect to the predetermined reference value, the duration of the initial heating step, and also the maximum nominal temperature ($T_{\text{target_max}}$) of the washing liquid, is automatically decreased.

6. A dishwasher (1) according to claim 5, wherein the control device (12) adjusts the residual hot washing duration (t_2) depending on the thermal gradient parameter (I).

7. A dishwasher (1) according to claim 5, wherein the

residual hot washing duration value (t2) increases as the thermal gradient parameter (I) decreases and lowers as the thermal gradient parameter (I) increases.

8. A dishwasher (1) according to one of claims 5 to 7, wherein the control device (12) adjusts the duration (t2) of the residual hot washing step within a fixed time interval, or within a time interval of between 300 seconds and 1200 seconds.

9. A dishwasher (1) according to one of the preceding claims, wherein, upon conclusion of the hot washing step, the electronic control device (12) actuates the draining of the washing liquid and the loading of a cold rinsing liquid to carry out a cold rinsing step with the heating device (10) switched-off and with the spraying device (4) actuated for a cold rinsing duration (t3), wherein the control device (12) adjusts the cold rinsing duration (t3) depending on the thermal gradient parameter (I).

10. A dishwasher (1) according to claim 9, wherein the cold rinsing duration (t3) increases as the thermal gradient parameter (I) decreases and lowers as the thermal gradient parameter (I) increases with respect to preset reference values.

11. A dishwasher (1) according to claim 9 or 10, wherein the control device (12) adjusts the duration (t3) of the cold rinsing step within a fixed time interval, or within a time interval of between 120 seconds and 240 seconds.

12. A dishwasher (1) according to claim 9, 10 or 11, wherein the control device (12) compares the thermal gradient parameter (I) with a predetermined threshold value and, if the thermal gradient parameter (I) is lower than the predetermined threshold value, it does not carry out any cold rinse and immediately switches, after the hot washing step, to a hot rinsing step and subsequently to a drying step of the dishes (3).

13. A dishwasher (1) according to one of the preceding claims, wherein, at the beginning of the treatment or washing program, before loading the washing liquid into the washing container (2), the temperature sensor (9) detects an ambient temperature value (T1) and the control device (12):

- controls the heating device (10) and/or
- adjusts the temperature and/or the duration of the hot washing step, and/or
- adjusts the duration of the cold rinsing step,

also based on the detected ambient temperature

(T1).

14. A dishwasher (1) according to claim 13, wherein the control device (12):

- increases the duration of the switching-on of the heating device (10) as the detected ambient temperature (T1) decreases,
- increases the maximum nominal temperature (T_target_max) of the washing liquid as the detected ambient temperature (T1) lowers,
- increases the duration of the initial heating step as the detected ambient temperature (T1) lowers,

and wherein, as the detected ambient temperature (T1) increases, the duration of the initial heating step, and also the maximum temperature of the washing liquid, is decreased.

15. A dishwasher (1) according to claim 13 or 14, wherein the control device (12) adjusts the residual hot washing duration (t2) also depending on the detected ambient temperature (T1), wherein the residual hot washing duration (t2) increases as the detected ambient temperature (T1) lowers, and/or

wherein the control device (12) adjusts the cold rinsing duration (t3) depending on the detected ambient temperature (T1), wherein the cold rinsing duration (t3) increases as the detected ambient temperature (T1) lowers and vice versa, and/or

wherein the control device (12) compares an initial temperature (T2) of the washing liquid, measured before the activation of the heating device (10), with a predetermined threshold value and, if the initial temperature (T2) is greater than the predetermined threshold value, it sets the values of the maximum nominal washing liquid temperature (T_target_max), the residual hot washing duration (t2) and the cold rinsing duration (t3) directly to the preset maximum values thereof.

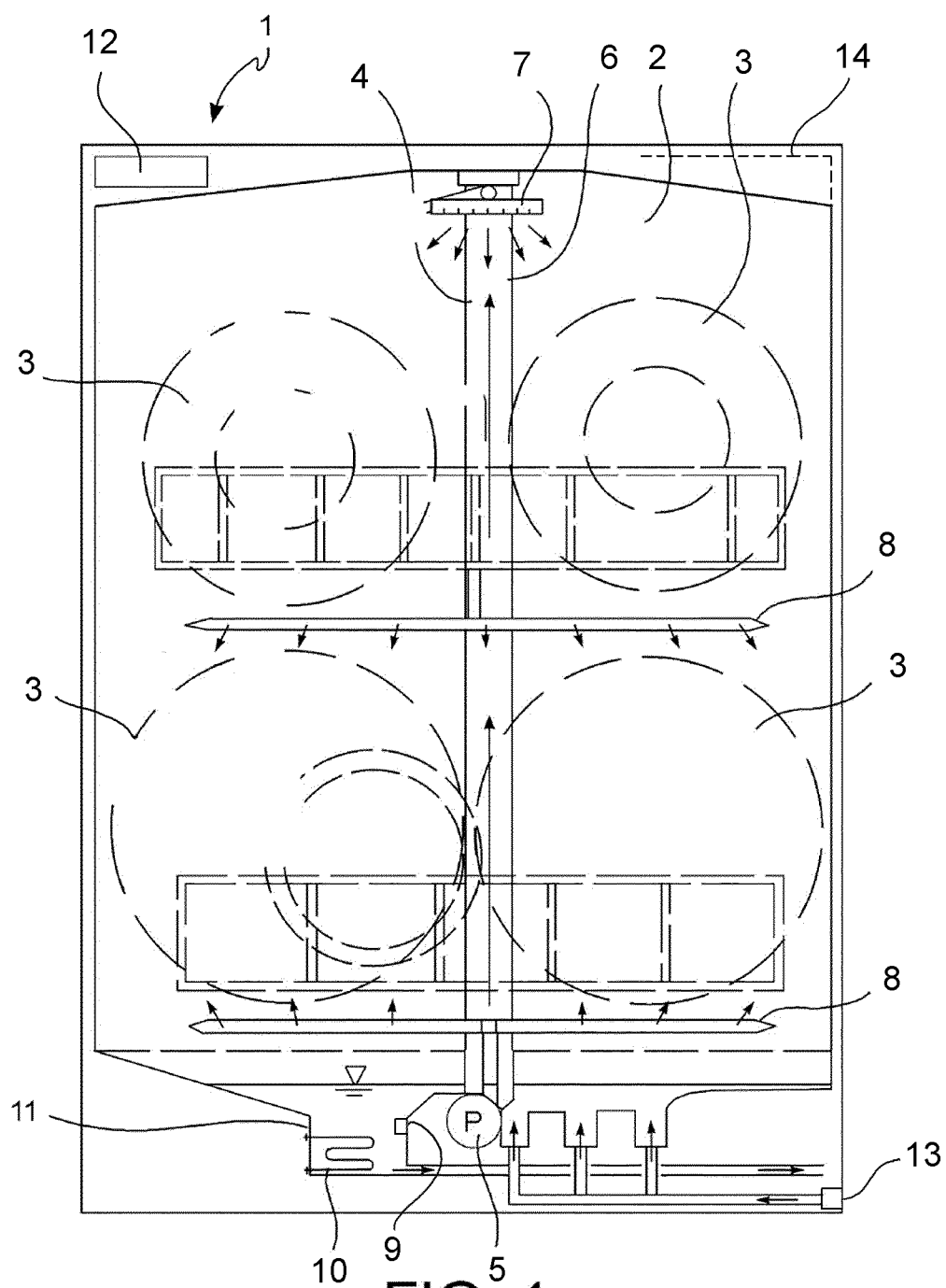


FIG. 1



EUROPEAN SEARCH REPORT

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