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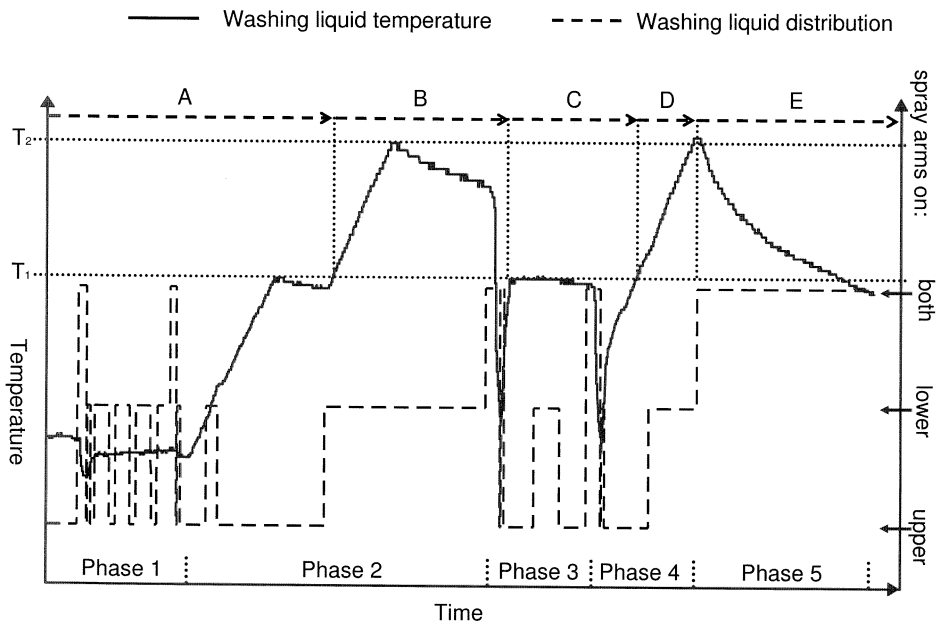
(54) **Dishwasher and method for operating a dishwasher**

(57) Dishwasher, comprising a washing chamber in which at least one upper basket and at least one lower basket for receiving the washing load are or can be arranged, wherein the upper basket can receive more delicate washing load and the lower basket can receive more stable washing load, further comprising a washing liquid circulation system distributing washing liquid within the washing chamber by means of an upper spray arm and a lower spray arm and having at least one pump for supplying washing liquid to both spray arms and further comprising liquid heating means for heating the washing liquid, such that the washing liquid can be heated up at least to a first temperature T_1 and to a second temperature T_2, wherein the first temperature T_1 is lower than the second temperature T_2, and wherein the washing liquid circulation system stops the supply of the washing liquid to the upper spray arm when the washing liquid temperature exceeds the first temperature T_1.

Fig. 1



EP 2 425 758 A1

Description

[0001] The present invention relates to a dishwasher and a method for operating a dishwasher.

[0002] EP 1 132 038 B1 describes a household dishwashing machine comprising a control system, a washing chamber, wherein at least a first and a second basket are housed, for containing the crockery to be washed, a hydraulic circuit, comprising at least a first and a second liquid sprayer, a pump, a first supply branch for said first sprayer and a second supply branch for said second sprayer, where in order to wash the crockery said pump provides for forcing liquid from the bottom of said tub into said supply branches, for causing a respective liquid flow to exit from each of said sprayers, detergent spraying means, liquid heating means, adjusting means of the amount of liquid forced by said pump into said supply branches, a manually operable selecting means, for selecting the type of crockery contained in said first basket and in said second basket, said selecting means being connected with said control system with information being indicative of the type of crockery contained in said first basket and in said second basket, the control means which, at least during a phase of an operating cycle of the machine, controls the liquid flow exiting each sprayer, in particular for changing one or more characteristics of said flow, in function of said information supplied through said selecting means, said selecting means and said control means being provided for performing, during a same operating cycle of the machine, a treatment of the crockery contained in the first basket which is different from the treatment to which the crockery contained in said second basket are subjected to.

[0003] From dishwashers described in the prior art it is known to provide manually selecting means for the user to determine which kind of washing load is loaded to which basket which is inconvenient and complicated for a user. Further dishwashers are known in the prior art wherein the user has to decide to charge the dishwasher with heavy duty dishes or delicate dishes.

[0004] An object of the present invention is to provide a dishwasher and a method for operating a dishwasher which can be charged with heavy duty dishes and delicate dishes at the same washing cycle and which provides an acceptable cleaning result as well as convenient operation by a user.

[0005] A solution of this object according to the invention is defined and characterized by independent claims 1 and 6. The dependent claims refer to further embodiments of the present invention.

[0006] A dishwasher according to the present invention comprises a washing chamber in which at least one upper basket and at least one lower basket for receiving the washing load are or can be arranged, wherein the upper basket can receive more delicate washing load and the lower basket can receive more stable washing load, further comprising a washing liquid circulation system distributing washing liquid within the washing chamber by means of an upper spray arm and a lower spray arm and having at least one pump for supplying washing liquid to both spray arms and further comprising liquid heating means for heating the washing liquid, such that the washing liquid can be heated up at least to a first temperature T_1 and to a second temperature T_2, wherein the first temperature T_1 is lower than the second temperature T_2, and wherein the washing liquid circulation system stops the supply of the washing liquid to the upper spray arm when the washing liquid temperature exceeds the first temperature T_1.

[0007] In such a dishwasher delicate washing load such as glasses which can be arranged in the upper basket and is treated carefully or softly regarding higher temperatures of the washing liquid.

[0008] According to a further embodiment of the invention in the washing chamber at least one upper spray arm and at least one lower spray arm each of that being substantially related to one of the respective baskets are provided.

[0009] Such an arrangement allows to treat washing load differently depending whether it is arranged in the upper basket or in the lower basket.

[0010] According to a further embodiment of the invention the washing liquid is heated up to at least a first temperature T_1 in a main washing phase and to a second temperature T_2 in a rinse phase and/or the main washing phase comprises the steps

- heating up the washing liquid comprising a detergent to a first temperature T_1 which is adapted to the detergent, in particular to an enzyme component of the detergent;
- keeping the first temperature T_1 for a defined period;
- heating up the washing liquid to a second temperature T_2, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

and/or the rinse phase comprises the steps

- adding rinse aid to the washing liquid;
- heating up the washing liquid to the second temperature T_2 or beyond, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

and/or the main wash phase and/or the rinse phase comprises that the liquid circulation system drains at least a part of the washing liquid and substitutes it by fresh liquid as soon as the washing liquid temperature exceeds the second temperature T_2 and/or the washing liquid circulation system stops the supply of washing liquid to the upper spray arm until the washing liquid temperature is equal or below the first temperature T_1 and/or the first temperature T_1 is in the range of 45°C to 50°C and wherein the second temperature T_2 is 65°C or higher.

[0011] Thus, it is allowed to wash washing load in the upper basket more softly than in the lower basket. Surprisingly it was found, that the temperature of the washing load in the upper basket increases similarly as in the lower basket when the supply of the washing liquid to the upper spray arm is stopped. Thus, the temperature of the washing liquid is reduced by substituting hot washing liquid with fresh liquid which allows to treat the delicate washing load more softly. The temperatures of the washing liquid are adapted to the respective detergent. The wash load in the upper basket is treated carefully with regards to the high temperature of the washing liquid and to the aggressive combination of detergent and hot washing liquid. Direct contact of washing liquid and delicate washing load is prevented in the case that the washing liquid comprises very high temperatures or temperatures effecting aggressive to the surfaces of the delicate washing load. The temperature range of 45°C to 50°C is adapted to the activity of the enzyme component of the detergent. The second temperature of 65°C or higher is adapted for cleaning heavy duty dishes which are arranged in the lower basket.

[0012] According to a further embodiment of the invention the dishwasher comprises a pump for circulating the washing liquid and wherein the pump speed is increased after the supply of the washing liquid to the upper spray arm was stopped and/or that the pressure with which the washing liquid is distributed by the spray arms is low when the washing liquid temperature is below the first temperature T_1 and that it is high in the main wash phase when the washing liquid temperature exceeds the first temperature T_1 and that it is low in the rinse phase even though the washing liquid temperature exceeds the first temperature T_1.

[0013] The increase of the pump speed allows to treat the heavy duty dishes more powerful e.g. mechanically while the more delicate washing load is not treated aggressive. Further the pressure with which the washing liquid is distributed by the spray arms is adapted and/or adjusted to the washing liquid temperature. Therefore delicate washing load and in particular the surface of the delicate washing load is treated very softly.

[0014] In a further embodiment of the invention a measuring system measures the liquid temperature within the sump and transfers the measured value to a control system of the dishwasher.

[0015] Thus, an easy and secure way of measuring the liquid temperature is received.

[0016] Further the object of the invention can be solved by a method for operating a dishwasher according to the present invention wherein the dishwasher comprises a washing chamber in which at least one upper basket and at least one lower basket for receiving the washing load are or can be arranged, wherein the upper basket can receive more delicate washing load and the lower basket can receive more stable washing load, wherein the washing liquid is distributed within the washing chamber by means of an upper spray arm and a lower spray arm and wherein the washing liquid is supplied to both spray arms by means of at least one pump, wherein the washing liquid is heated up at least to a first temperature T_1 and to a second temperature T_2, wherein the first temperature T_1 is lower than the second temperature T_2, and wherein the supply of the washing liquid to the upper spray arm is stopped when the washing liquid temperature exceeds the first temperature T_1.

[0017] By means of the inventive method the delicate washing load in the upper basket is treated carefully with regards to the high temperature of the washing liquid and to the aggressive combination of detergent and hot washing liquid.

[0018] According to a further embodiment of the invention in the washing chamber at least one upper spray arm and at least one lower spray arm each of that being substantially related to one of the respective baskets are provided. Such an arrangement allows to treat washing load differently depending whether it is arranged in the upper basket or in the lower basket.

[0019] According to a further embodiment of the invention the washing liquid is heated up to at least a first temperature T_1 in a first phase which is a main washing phase and to a second temperature T_2 in a second phase which is a rinse phase wherein the main washing phase comprises the steps

- heating up the washing liquid comprising a detergent to a first temperature T_1 which is adapted to the detergent, in particular to an enzyme component of the detergent;
- keeping the first temperature T_1 for a defined period;
- heating up the washing liquid to a second temperature T_2, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;and/or the rinse phase comprises the steps
- adding rinse aid to the washing liquid;
- heating up the washing liquid to the second temperature T_2 or beyond, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

and/or the main wash phase and/or the rinse phase comprises that at least a part of the washing liquid is drained by liquid circulation system drains substitutes by fresh liquid as soon as the washing liquid temperature exceeds the second temperature T_2 and/or the washing liquid circulation system stops the supply of washing liquid to the upper spray arm until the washing liquid temperature is equal or below the first temperature T_1 and/or the first temperature T_1 is in the range of 45°C to 50°C and wherein the second temperature T_2 is 65°C or higher.

[0020] Thus, it is allowed to wash washing load in the upper basket more softly than in the lower basket. Surprisingly it was found, that the temperature of the washing load in the upper basket increases similarly as in the low-

er basket when the supply of the washing liquid to the upper spray arm is stopped. Thus, the temperature of the washing liquid is reduced by substituting hot washing liquid with fresh liquid which allows to treat the delicate washing load more softly. The temperatures of the washing liquid are adapted to the respective detergent. The wash load in the upper basket is treated carefully with regards to the high temperature of the washing liquid and to the aggressive combination of detergent and hot washing liquid. Direct contact of washing liquid and delicate washing load is prevented in the case that the washing liquid comprises very high temperatures or temperatures effecting aggressive to the surfaces of the delicate washing load. The temperature range of 45°C to 50°C is adapted to the activity of the enzyme component of the detergent. The second temperature of 65°C or higher is adapted for cleaning heavy duty dishes which are arranged in the lower basket.

[0021] In a further embodiment of the invention the dishwasher comprises a pump for circulating the washing liquid and wherein the pump speed is increased after the supply of the washing liquid to the upper spray arm was stopped and/or that the pressure with which the washing liquid is distributed by the spray arms is low when the washing liquid temperature is below the first temperature T_1 and that it is high in the main wash phase when the washing liquid temperature exceeds the first temperature T_1 and that it is low in the rinse phase even though the washing liquid temperature exceeds the first temperature T_1.

[0022] The increase of the pump speed allows to treat the heavy duty dishes more powerful e.g. mechanically while the more delicate washing load is not treated aggressive. Further the pressure with which the washing liquid is distributed by the spray arms is adapted and/or adjusted to the washing liquid temperature. Therefore delicate washing load and in particular the surface of the delicate washing load is treated very softly.

[0023] In a further embodiment of the invention a measuring system measures the liquid temperature within the sump and transfers the measured value to a control system of the dishwasher.

[0024] Thus, an easy and secure way of measuring the liquid temperature is received.

FIG 1 is a diagram of an operating method according to the invention illustrating the distribution of the washing liquid temperature and the washing liquid quantity;

[0025] A dishwasher comprises a washing chamber wherein usually an upper basket and a lower basket for receiving the washing load are arranged and an upper spray arm and a lower spray arm are provided each one being related to one of the respective baskets, wherein washing liquid circulates within the dishwasher and wherein the washing liquid is distributed within the washing chamber by means of the spray arms and wherein the washing liquid is supplied to both spray arms by means of at least one pump and wherein liquid heating means are provided for heating the washing liquid. In general the upper basket is provided for being loaded with more delicate washing load, e.g. glasses, wherein the lower basket is provided for more stable washing load, e.g. pots or plates. Delicate means in particular the vulnerability of the surface of the dishes. Further the circulation of the washing liquid usually comprises a sump in a bottom region of the dishwasher, wherein the washing liquid is collected coming from the washing chamber. A pump is arranged in or adjacent to the sump for circulating the washing liquid within the dishwasher or, more precisely, within the circulation system of the dishwasher. Further means for discharging washing liquid from the circulation system and means for feeding the circulation system with fresh liquid are provided. The temperature of the washing liquid might be measured within the sump or on alternative applicable positions, e.g. the spray arms or within the pump. Further the distribution of the washing liquid can be controlled in such a way, that both spray arms can be supplied with washing liquid at the same time, or only one of the spray arm. The liquid heating means and the circulation system of the dishwasher as well as the means for discharging, the means for feeding and distributing the washing liquid can be controlled by a control system. Commands to the control system can be given by a software implemented to a microcontroller connected to the control system or also from a hardware adapted to control the control system or by a user or a maintenance technician.

[0026] The control system can control the dishwasher in such way that it is able to perform a method according to Fig. 1.

[0027] The diagram shows the characteristics "washing liquid temperature" and "washing liquid distribution" over a time line and how the two characteristics correlate with each other. In other words, the diagram shows the temperature of the washing liquid as measured within the sump and the periods when both spray arms or only one of the spray arms is supplied with washing liquid. The time line is subdivided in several washing phases. Phase 1 is a pre-wash phase, phase 2 is a main wash phase, phase 3 is a cold rinse phase, phase 4 is a hot rinse phase and phase 5 is a drying phase. In phase 2 which is the main wash phase, the washing liquid is provided with a detergent, wherein the detergent comprises an enzyme component. The washing liquid is heated up to a temperature that is adapted for the use of the detergent, in particular to a first temperature T_1 which enables the enzyme component to be active without being destroyed by a higher temperature. Usually the first temperature T_1 is between 45°C and 50°C, preferedly close to or exactly 50°C. Subsequently the washing liquid is kept on the first temperature T_1 without further heating up to allow sufficient duration of the enzyme component being active. During this treatment it is possible to supply washing liquid to both spray arms or only to the upper

spray arm to ensure that the washing load in the upper basket is washed sufficiently during phase 2.

[0028] Further subsequently the washing liquid is heated up to a second temperature T_2 which can be 65°C or higher. As soon as the washing liquid temperature exceeds 50°C, the supply of washing liquid to the upper spray arm is stopped and is not continued before the washing liquid temperature falls upon or below the first temperature T_1. The lower spray arm is still continued being supplied with washing liquid.

[0029] When the washing liquid temperature reaches the second temperature T_2, a part of the washing liquid is drained from the circulation system and substituted with fresh liquid. Thus, the washing liquid temperature is reduced. Phase 2 is continued and terminated with the washing liquid of reduced temperature, wherein the supply of the washing liquid to the upper spray arm remains stopped. Alternatively or in addition to the drain and substitution of the washing liquid, the pump speed can be reduced during heating up the washing liquid from the first temperature T_1 to the second temperature T_2.

[0030] Also during phase 3 and/or phase 4 which form together a rinse phase, the washing liquid temperature is heated up from a first temperature T_1 to a second temperature T_2, in particular during phase 4 which is a hot rinse phase. Also herein the supply of washing liquid to the upper spray arm is stopped when the washing liquid temperature exceeds the first temperature T_1.At the beginning of phase 3 rinse aid is added to the washing liquid and during phase 3 a part of the washing liquid is substituted with fresh liquid. The washing liquid temperature during phase 3 does not exceed the first temperature T_1 and therefore the washing liquid is supplied to upper spray arm and the lower spray arm. At the end of phase 3, the washing liquid is drained and replaced with fresh liquid.

[0031] During phase 4 the washing liquid is heated up, wherein the first temperature T_1 is exceeded and therefore the supply of washing liquid to the upper spray arm is stopped. The washing liquid is heated up to the second temperature T_2. After that phase 5, which is a drying phase, is started.

[0032] According to Fig. 1 the diagram illustrates a division of the characteristics "washing liquid temperature" and "washing liquid distribution" in sections A to E. In section A, washing liquid is supplied to the upper spray arm and the lower spray arm, the distribution of the washing liquid is to both at the same time or only one at a time changing after a certain time, wherein the washing liquid temperature is low and the pressure with which the washing liquid is distributed by the spray arms is also low. In section B, the supply of washing liquid to the upper spray arm is stopped. Only the lower spray arm receives washing liquid. The washing liquid temperature is high and the washing liquid pressure is also high. In section C, as in section A, the washing liquid is supplied to the upper spray arm and the lower spray arm, wherein the washing liquid temperature is low and the pressure with which the washing liquid is distributed by the spray arms is also low. In section D, the supply of washing liquid to the upper spray arm is stopped, wherein the washing liquid temperature is high and the washing liquid pressure is low. In section E the circulation of the washing liquid is stopped completely. A preferred ratio of pressures to be provided in the upper and the lower spray arm is shown in the following table.

Section	Sprayarm pressure	
	Upper	Lower
A	< 70	200
B	0	200
C	< 70	< 140
D	0	110

Claims

1. Dishwasher, comprising a washing chamber in which at least one upper basket and at least one lower basket for receiving the washing load are or can be arranged, wherein the upper basket can receive more delicate washing load and the lower basket can receive more stable washing load, further comprising a washing liquid circulation system distributing washing liquid within the washing chamber by means of an upper spray arm and a lower spray arm and having at least one pump for supplying washing liquid to both spray arms and further comprising liquid heating means for heating the washing liquid, such that the washing liquid can be heated up at least to a first temperature T_1 and to a second temperature T_2, wherein the first temperature T_1 is lower than the second temperature T_2, and wherein the washing liquid circulation system stops the supply of the washing liquid to the upper spray arm when the washing liquid temperature exceeds the first temperature T_1.

2. Dishwasher according to claim 1 **characterized in that** in the washing chamber at least one upper spray arm and at least one lower spray arm each of that being substantially related to one of the respective baskets are provided.

3. Dishwasher according to one of the preceding claims and having at least one or an arbitrary combination of the following features:

   a.) the washing liquid is heated up to at least a first temperature T_1 in a main washing phase and to a second temperature T_2 in a a rinse phase.
   b.) the main washing phase comprises the steps

- heating up the washing liquid comprising a detergent to a first temperature T_1 which is adapted to the detergent, in particular to an enzyme component of the detergent;
- keeping the first temperature T_1 for a defined period;
- heating up the washing liquid to a second temperature T_2, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

and/or the rinse phase comprises the steps

- adding rinse aid to the washing liquid;
- heating up the washing liquid to the second temperature T_2 or beyond, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

d.) the main wash phase and/or the rinse phase comprises that the liquid circulation system drains at least a part of the washing liquid and substitutes it by fresh liquid as soon as the washing liquid temperature exceeds the second temperature T_2.
e.) the washing liquid circulation system stops the supply of washing liquid to the upper spray arm until the washing liquid temperature is equal or below the first temperature T_1.
f.) the first temperature T_1 is in the range of 45°C to 50°C and wherein the second temperature T_2 is 65°C or higher.

4. Dishwasher according to one of the preceding claims **characterized in that** the dishwasher comprises a pump for circulating the washing liquid and wherein the pump speed is increased after the supply of the washing liquid to the upper spray arm was stopped and/or that the pressure with which the washing liquid is distributed by the spray arms is low when the washing liquid temperature is below the first temperature T_1 and that it is high in the main wash phase when the washing liquid temperature exceeds the first temperature T_1 and that it is low in the rinse phase even though the washing liquid temperature exceeds the first temperature T_1.

5. Dishwasher according to one of the preceding claims **characterized in that** a measuring system measures the liquid temperature within the sump and transfers the measured value to a control system of the dishwasher.

6. Method for operating a dishwasher, wherein the dishwasher comprises a washing chamber in which at least one upper basket and at least one lower basket for receiving the washing load are or can be arranged, wherein the upper basket can receive more delicate washing load and the lower basket can receive more stable washing load, wherein the washing liquid is distributed within the washing chamber by means of an upper spray arm and a lower spray arm and wherein the washing liquid is supplied to both spray arms by means of at least one pump, wherein
the washing liquid is heated up at least to a first temperature T_1 and to a second temperature T_2, wherein the first temperature T_1 is lower than the second temperature T_2, and wherein the supply of the washing liquid to the upper spray arm is stopped when the washing liquid temperature exceeds the first temperature T_1.

7. Method for operating a dishwasher according to claim 6, **characterized in that** in the washing chamber at least one upper spray arm and at least one lower spray arm each of that being substantially related to one of the respective baskets are provided.

8. Method for operating a dishwasher according to one of the claim 6 or 7 and having at least one or an arbitrary combination of the following features such that

a.) the washing liquid is heated up to at least a first temperature T_1 in a first phase which is a main washing phase and to a second temperature T_2 in a second phase which is a rinse phase.
b.) the main washing phase comprises the steps

- heating up the washing liquid comprising a detergent to a first temperature T_1 which is adapted to the detergent, in particular to an enzyme component of the detergent;
- keeping the first temperature T_1 for a defined period;
- heating up the washing liquid to a second temperature T_2, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

and/or the rinse phase comprises the steps

- adding rinse aid to the washing liquid;
- heating up the washing liquid to the second temperature T_2 or beyond, wherein supply of the washing liquid to the upper spray arm is stopped as soon as the washing liquid temperature exceeds the first temperature T_1;

c.) the main wash phase and/or the rinse phase

comprises that at least a part of the washing liquid is drained by liquid circulation system drains substitutes by fresh liquid as soon as the washing liquid temperature exceeds the second temperature T_2.

d.) the washing liquid circulation system stops the supply of washing liquid to the upper spray arm until the washing liquid temperature is equal or below the first temperature T_1.

e.) the first temperature T_1 is in the range of 45°C to 50°C and wherein the second temperature T_2 is 65°C or higher.

9. Method for operating a dishwasher according to one of the claim 6, 7 or 8 **characterized in that** the dishwasher comprises a pump for circulating the washing liquid and wherein the pump speed is increased after the supply of the washing liquid to the upper spray arm was stopped and/or that the pressure with which the washing liquid is distributed by the spray arms is low when the washing liquid temperature is below the first temperature T_1 and that it is high in the main wash phase when the washing liquid temperature exceeds the first temperature T_1 and that it is low in the rinse phase even though the washing liquid temperature exceeds the first temperature T_1.

10. Method for operating a dishwasher according to one of the claim 6, 7, 8 or 9 **characterized in that** the liquid temperature is measured by a measuring system within the sump and transfers the measured value to a control system of the dishwasher.

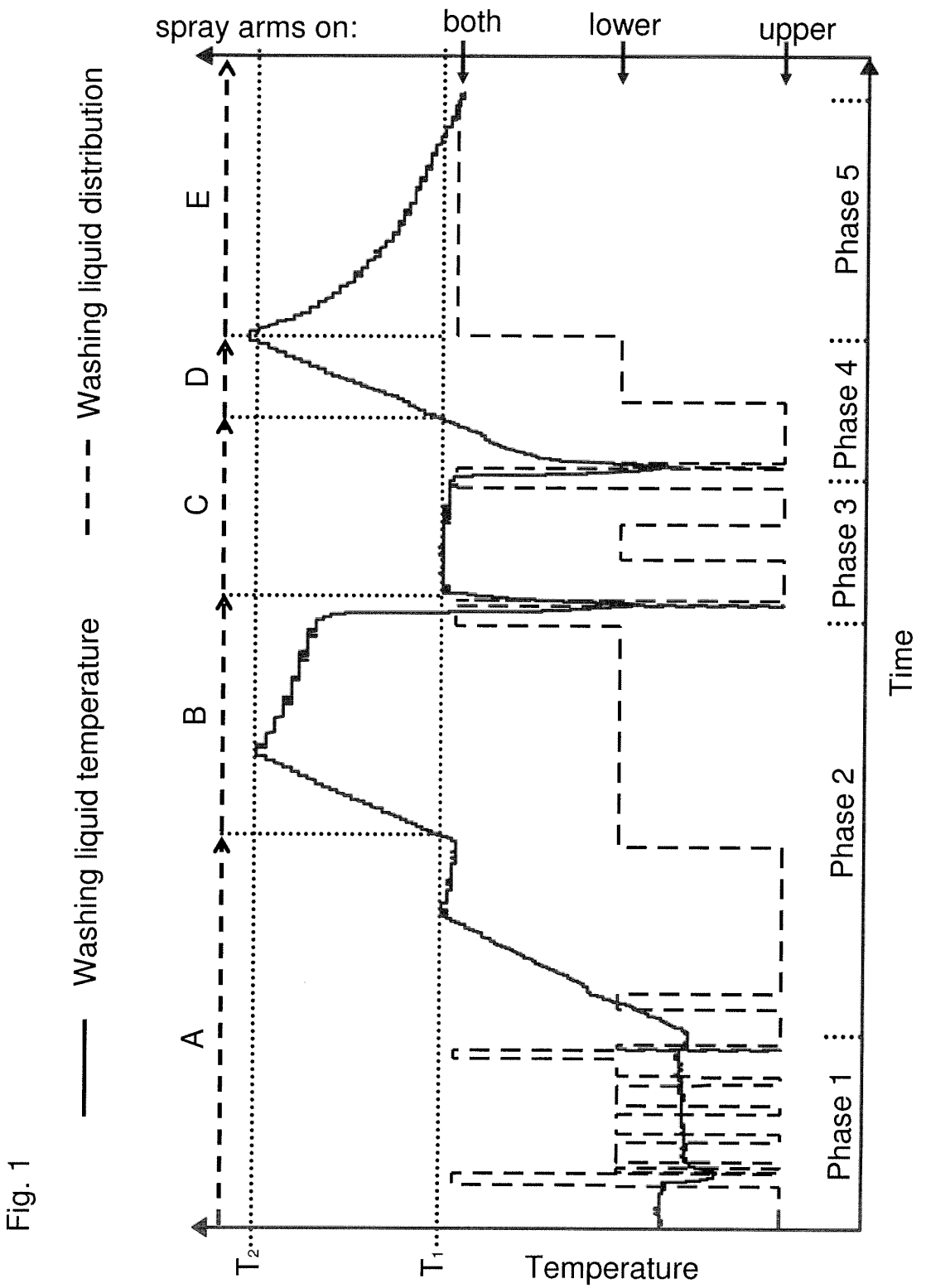

spray arms on:
both
lower
upper
Washing liquid distribution
Washing liquid temperature
A
B
C
D
E
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Time
T2
T1
Temperature

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 5310

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Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 17 5310

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