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(54) METHOD FOR REMOVING STAINS DURING A CLEANING CYCLE OF A HOUSEHOLD APPLIANCE

(57) A method for removing stains, in particular tea stains, during a cleaning cycle of a household appliance, such as a dishwashing machine. The cleaning cycle comprises at least a main wash cycle. A cleaning agent is released during the main wash cycle when the temperature inside the household appliance during the main wash cycle exceeds a predetermined temperature threshold, the threshold being higher than 40°C, for example higher than 55°C.

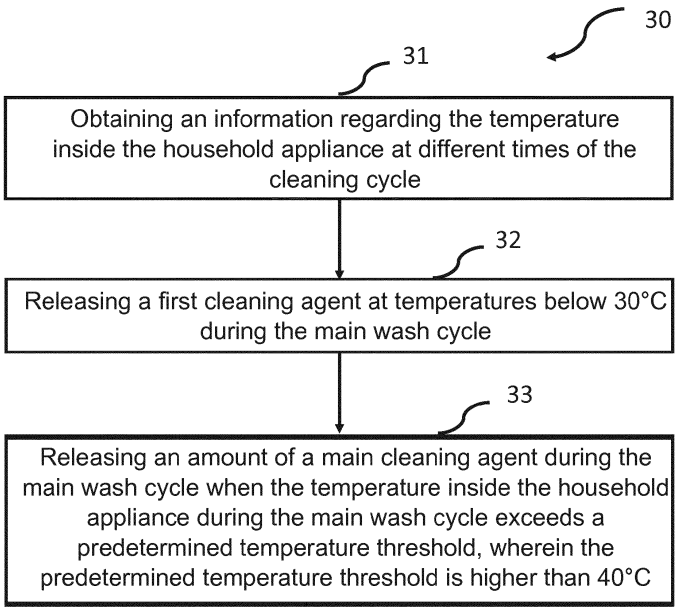


Fig.3

EP 3 656 272 A1

Description

TECHNICAL FIELD

[0001] The invention relates to the field of cleaning programs and more particularly to methods enabling an optimized removal of stains on objects such as cups arranged inside a household appliance such as a dishwasher. The method of the invention is particularly suitable for removing tea stains on cups without requiring the use of bleach.

TECHNOLOGICAL BACKGROUND

[0002] Household appliances are used to clean stains on textiles, typically cleaned in a washing machine, or objects such as dishes, cups or other utensils typically cleaned using a dishwashing machine. Washing machines and dish-washing machines are very convenient devices that allow users to save time while achieving a satisfactory level of cleanliness in a more environmentally friendly way than manual wash.

[0003] When cleaning textiles in a washing machine or utensils in a dishwashing machine, users expect all stains to be eliminated. Typically, it is possible to select an appropriate program on the machine depending on the level of dirtiness of the objects to be cleaned or the total load inside the machine.

[0004] In a dishwashing machine, it is typically possible to select between an intensive wash program or a more economical program, each program generally differing by its maximum temperature, duration, amount and type of cleaning agent used.

[0005] Typical cleaning cycles in a dishwashing machine include a first "main wash" cycle, during which cleaning agents are released in the first minutes after filling of the dishwashing machine with water. The temperature is typically increased beyond 40°C. This main wash cycle is followed by one or more rinse cycles until the end of the cleaning cycle which leaves the objects inside the dishwashing machine dry.

[0006] Generally, dishwashing involves the use of cleaning agents such as dishwashing liquids, tablets or pouches. The cleaning agents can be either dispensed from a dispensing unit that is an integral part of the household appliance, or from a removable device independent from the household appliance and that is placed inside a chamber of the household appliance. During the cleaning cycle, it is customary to dispense a first enzyme phase in the first minutes of the main wash cycle, followed by the dispensing of an alkaline agent a few minutes later. These cleaning agents are typically administered at temperatures below 35 °C in the early stages of the cleaning cycle, so that they may act longer on removing dirt and stains throughout the cleaning cycle. A third cleaning agent (generally called finisher) is sometimes further administered during the last rinse cycle.

[0007] Although cleaning programs are generally well set and can eliminate most stains by adjusting temperature, dosage of cleaning agents and cleaning cycle duration, some stains are much harder to remove without reverting to very high temperatures or cleaning agent doses. This is the case for example with tea stains on ceramic cups, for which best results are obtained when using bleach. However, bleach is not always compatible with other items loaded inside the household appliance. Furthermore, liquid bleach-containing cleaning agents are generally not stable and not suitable for use in a household appliance, in particular with they are to be stored in cartridge of a removable or non-removable dosing system or in pouches.

[0008] For the above reasons, a method for more efficiently removing stains during the cleaning cycle of a household appliance is needed.

SUMMARY OF THE INVENTION

[0009] To address the above need, the invention provides a method for removing stains during a cleaning cycle of a household appliance, the cleaning cycle comprising at least a main wash cycle, the method comprising:

- Releasing an amount of a main cleaning agent during the main wash cycle when a temperature inside the household appliance during the main wash cycle exceeds a predetermined temperature threshold, wherein the predetermined temperature threshold is higher than 40 °C.

[0010] The method of the invention is particularly suitable for dishwashing machines and is efficient in removing persistent stains such as tea stains that typically form on ceramic utensils. The invention successfully removes such stains without requiring the use of bleach, nor the need to necessarily use large amounts of cleaning agents or very high temperatures (above 70°C) during the cleaning cycle.

[0011] Surprisingly, it has been observed that hard to remove stains, such as tea stains, can be efficiently removed by dispensing the alkali phase at higher temperatures during the main wash cycle. In methods of the state of the art, cleaning agents are dispensed during the main wash cycle very early at the start of the main wash, when the temperature

inside the machine barely goes above 30 °C. However, when the cleaning agent is administered only at higher temperatures, above 40°C, the combined effect of the temperature and the cleaning action of the active components comprised in the main cleaning agent enhances the cleanliness of the objects to be cleaned.

[0012] The "main wash" cycle refers to the cycle during which active cleaning agents are released. Other cleaning agents, in particular finishers, can further be released during subsequent rinse cycles.

[0013] According to an embodiment, the predetermined temperature threshold may be chosen among one of the following values: 50 °C, 55°C, 58°C, 60°C, a maximum temperature reached during the main wash cycle before a decrease in temperature, 95% of the maximum temperature reached during the cleaning cycle.

[0014] It has been observed that the effect described above is particularly enhanced for the above-mentioned temperature thresholds. Should the program run by the machine not reach temperatures above 50°C, it is possible to dispense the main cleaning agent when the temperature inside the machines reaches its maximum before decreasing again. The determination of this temperature can for example be done by means of a temperature sensor, located on a dosing device or somewhere inside the machine. It is also possible to estimate the time at which these temperatures will be reached based on a database describing the program run by the machine. Such a database can be provided by manufacturers, be determined based on previously run programs or found via external sources, for example online.

[0015] According to an embodiment, the main cleaning agent may comprise an alkali.

[0016] The term "alkali" encompasses cleaning agents with a pH value above 7. More particularly, it targets cleaning agents with a pH above 8, and preferably cleaning agents having a strong alkalinity with a pH above 10.

[0017] According to an embodiment, the method may further comprise:

- releasing a first cleaning agent at temperatures below 40 °C during the main wash cycle;
- releasing the main cleaning agent at least 5 minutes after starting the release of the first cleaning agent.

[0018] The main cleaning agent may further benefit from the dispensing of a first cleaning agent at the earlier stages of the main wash at lower temperatures. This first cleaning agent typically comprises an enzyme phase. By postponing the release of the alkali phase, the efficiency of the cleaning cycle can be further improved. The timing of the release of the main cleaning agent can be correlated with the heating rate inside the household appliance. It is also possible to start dispensing the main cleaning agent at least 2 minutes after the end of the release of the last portion of the first cleaning agent.

[0019] According to an embodiment, the method may further comprise:

- releasing a first cleaning agent at temperatures below 40 °C during the main wash cycle, the first cleaning agent comprising an enzyme;
- releasing a second cleaning agent after starting the release of the first cleaning agent.

[0020] In such a case, the main cleaning agent is released at higher temperatures in addition to the release of another cleaning agent or a similar released at the earlier stages of the main wash cycle. This mode can be implemented when the household appliance, in particular a dishwashing machine runs a pre-stored cleaning program and only adds an additional step consisting in the supplementary release of an amount of main cleaning agent at higher temperatures, in addition to the standard operation of the selected pre-stored cleaning program. Alternatively, the first cleaning agent and the second cleaning agent can both be enzymes, for example the same type of enzyme, released at different times of the cleaning cycle. For example, the first cleaning agent can be released during a pre-wash of the cleaning cycle whereas the second cleaning agent can be released during a main wash of the cleaning cycle.

[0021] According to an embodiment, the first cleaning agent can be dosed relative to the second cleaning in a ratio comprised between 0,1 times and 10 times an amount of the second cleaning agent.

[0022] For example, the first cleaning agent and the second cleaning agent can both be enzymes, typically but not necessarily the same type of enzyme. The first cleaning agent can be dosed at 3/5 of the total amount of enzymes released whereas the second cleaning agent can be dosed at 2/5 of the total amount of enzymes released. By dispensing enzymes at two different times of the cleaning cycle, a better total cleanliness result is observed at the end of the cleaning cycle in a household appliance. Alternatively, the first cleaning agent may be an enzyme whereas the second cleaning agent is an alkali. Care would be taken to adjust the alkalinity inside the household appliance upon dispensing the main cleaning agent.

[0023] According to an embodiment, the method may further comprise:

- determining the amount of main cleaning agent to be released based on a value of the predetermined temperature threshold, the amount of main cleaning agent being higher when the predetermined temperature threshold is lower.

[0024] A correlation has been observed between the amount of main cleaning agent released and the cleanliness of

the objects cleaned during the cleaning cycle of the household appliance. For predetermined temperature thresholds set above 55°C, the dosage of main cleaning agent can be set to a lower value, for example between 15 grams and 25 grams. For predetermined temperature thresholds at 40°C, the dosage of main cleaning agent can advantageously be set to a higher value, for example between 25 grams and 40 grams.

[0025] According to an embodiment the amount of main cleaning agent to be released may be between 3 grams and 40 grams.

[0026] According to an embodiment the method may further comprise:

- Obtaining an information regarding the temperature inside the household appliance at different times of the cleaning cycle.

[0027] The temperature inside the household appliance can be measured at regular time intervals with a sensor or based on estimations of the temperature variations for the cleaning program that the machine is running. This information is not necessarily a temperature as such, but could be a related parameter that makes it possible to determine the temperature inside the machine. It could be, for example, a setting of a heating unit inside the machine, a tension or current measured at such a heating unit, an information provided by an external sensor or an information provided manually by a user or obtained from a distant source, for example online. The household appliance, dishwasher, can also transfer a temperature measurement made inside the appliance to a dosing device via an "API" (for "Applications Programming Interface) for example.

[0028] According to an embodiment the information regarding the temperature inside the household appliance at different times of the cleaning cycle may be provided by a temperature sensor.

[0029] According to an embodiment the information regarding the temperature inside the household appliance at different times of the cleaning cycle may be provided by a database of programs run by the household appliance.

[0030] The sample rate of this querying of information relating to the temperature (or mere reception thereof) can be occurring at frequencies ranging from 0,01 Hz to 1kHz for example.

[0031] According to an embodiment the method may further comprise:

- releasing the amount of the main cleaning agent from a removable dosing device positioned inside the household appliance.

[0032] A removable dosing device can be for example an automated unit comprising cartridges filled with different cleaning agents and a dispensing unit capable of releasing a controlled amount of cleaning agent at controlled times. Different types of hardware might be part of the dosing device for controlling the dispensing of the cleaning agents, or for communicating with external devices such as data processing units, the household appliance or a mobile device or server that a user can operate.

[0033] According to an embodiment the method may further comprise:

- releasing the amount of the main cleaning agent from a compartment configured to receive cleaning agents in the household appliance.

[0034] According to an embodiment the method may further comprise:

- obtaining an information relating to the presence of tea stains among objects arranged inside the household appliance.

[0035] For example, the presence of mugs or cups inside the machine might be assessed based on a specific vibration signature during the loading process inside the machine. Turbidity of water during the cleaning cycle or specific markers identifiable by biosensors could also be used to determine the presence of tea stains. Otherwise, a user might select a special program or an option within a program that parameterizes the household appliance to implement the method of the invention. Such a selection can also be viewed as an "information relating to the presence of tea stains" or an assumption thereof. This program can be selected by pressing a button on the machine or can be chosen within a menu selectable on the machine or on a man-machine interface capable of setting a program on the household appliance. A user might set a "tea stains" cleaning option for a currently selected program form the household appliance or via a mobile device or server, in an "app" for example.

[0036] The invention also pertains to a system for removing stains during a cleaning cycle of a household appliance, the cleaning cycle comprising at least a main wash cycle, the system comprising:

- a non-transitory data processing unit configured to obtain an information regarding a temperature inside the house-

hold appliance at different times of the cleaning cycle;

- a dosing device containing a main cleaning agent and capable of receiving information from the non-transitory data processing unit, the dosing device being configured to release an amount of the main cleaning agent during the main wash cycle at a time provided by the non-transitory data processing unit, the time being associated with temperature inside the household appliance during the main wash cycle exceeding a predetermined temperature threshold, wherein the predetermined temperature threshold is higher than 40 °C.

[0037] Such a system may be implemented in different forms. The non-transitory data processing unit may be a piece of dedicated hardware placed on the dosing device (for example in the case when the dosing device is a removable automatic dosing device to be placed inside the household appliance). It may also be a separate device incorporated into the household appliance or placed removably inside the household appliance or outside of it. The non-transitory data processing device may also be part of another device such as a mobile device, smartphone, tablet, computer, server for example.

[0038] According to an embodiment the dosing device may be a removable dosing device configured to be positioned inside the household appliance.

[0039] The invention also pertains to a non-transitory computer readable storage medium having stored thereon a computer program comprising instructions for execution of a method as described above for removing stains during a cleaning cycle of a household appliance.

[0040] In other words, the invention also pertains to a computer program product comprising instructions for execution of a method as described above for removing stains during a cleaning cycle of a household appliance.

BRIEF DESRIPTION OF THE DRAWINGS

[0041] The present disclosure will hereinafter be described in conjunction with the following drawing figures, wherein like numerals denote like elements, and:

Fig. 1 shows a set of devices that can be used to implement the method according to an exemplary embodiment;
Fig. 2 shows a schematic representation of the components that can be part of a system according to an embodiment;
Fig. 3 shows a simplified workflow of a method according to an exemplary embodiment;
Figs 4-8 show 5 examples of graphs of the evolution of temperature inside dishwashing machines as a function of time during a cleaning program.

DETAILED DESCRIPTION

[0042] The invention pertains to a method that provides a more efficient and economical means of removing persistent stains such as tea stains that can typically be found on ceramics (cups) without using bleach.

[0043] To do so, the invention postpones the dispensing of a cleaning agent during the main wash cycle of a household appliance until the temperature reaches a predetermined temperature threshold.

[0044] This method can be applied to all sorts of household appliances but is particularly efficient for removing stains during the cleaning cycle of dishwashing machines.

[0045] Figure 1 represents an environment 1 in which a household appliance 300 can receive cleaning agents dispensed from a dosing device 200 configured to dispense cleaning agents during the cleaning cycles of the household appliance. A mobile device 400 such as a mobile phone, a tablet, or any other computer or assimilated device can further interact with the dosing device 200 and/or the household appliance 300. The mobile device 400 can for example be used to set parameters for the dispensing of the cleaning agents or to select a cleaning program from programs runnable on the household appliance 300. The mobile device 400 can further either receive information from or send information to the dosing device 200 and/or the household appliance 300. For example, the mobile device can provide the household appliance 300 and/or the dosing device 200 with information relating to the state of the objects inserted inside the household appliance 300 such as the nature of these objects, the presence of stains, for example tea stains, the type of the stains and the level of dirtiness of the inserted objects.

[0046] The dosing device 200 can be a separate device as shown on figure 1 comprising several cartridges with different cleaning agents (for example an enzyme containing liquid, an alkali containing liquid and a finisher) and a dispensing unit coupled with the cartridges. The dosing device may also be an integral part of the household appliance 300, for example a dosing compartment thereof.

[0047] Figure 2 schematically shows a system 22 that can be used to implement the method of the invention. This system comprises the dosing device 200, already described in connection with figure 1, and a non-transitory data processing unit 20. The non-transitory data processing unit 20 processes an information relating to the temperature inside the household appliance 300 and communicates with the dosing device 200 to instruct when an amount of main

cleaning agent or any other cleaning agent is to be dispensed. The non-transitory data processing unit 20 may further instruct the amount of cleaning agent that is to be released by the dosing device 200. The non-transitory data processing unit 20 can be either an integral part of the dosing device 200 or a separate element. The non-transitory data processing unit 20 can for example also be part of the household appliance 300, inside the mobile device 400 or part of another element capable of communicating with the dosing device 200.

[0048] The non-transitory data processing unit 20 can typically comprise at least one processor 212, a storage element 211 (for example a hard drive or a volatile memory such as a random access memory), an interface 213 capable of displaying information to a user and/or to receive inputs from a user and optionally a sensor 214. The storage element 211 can for example be used to download information from a network, to store information sent for example by the mobile device 400 or information received via the interface 213. It can also comprise pre-stored information for example regarding programs run by household appliance 300, in particular the evolution of the temperature inside household appliance 300 as a function of time. The information received or already stored can be kept in the storage element 211. The sensor 214 may be a device such a temperature sensor capable of determining a temperature inside the household appliance 300 during a cleaning cycle. The non-transitory data processing unit 20 may further comprise other sensors (in replacement of the temperature sensor or in addition thereto) for example a timer, an accelerometer, a spectrometer, a pH-meter, a conductivity measuring sensor, a turbidity measuring sensor.

[0049] Information regarding the temperature inside the household appliance 300 may be communicated to the non-transitory data processing unit 20 via an external source, such as an external sensor located in the household appliance 300, or via an access to a database comprising information regarding the temperature inside the household appliance 300 at different times of the cleaning cycle.

[0050] Information may be transferred between the non-transitory data processing unit 20 and the dosing device 200 and/or the household appliance 300 and/or the mobile device 400 via a wired or wireless connection. Wireless communication can be implemented using for example Radio Frequency identification (RFID), Near Field Communication (NFC), Bluetooth, Wireless Local Area Network (WLAN), Thread, Zigbee.

[0051] The system 20 described above can typically be used to implement the improved stain removal method of the invention. This stain removal method consists in postponing the time at which a main cleaning agent, typically comprising an alkali liquid, is dispensed during the main wash cycle of the cleaning cycle of a household appliance 300. Maximum efficiency has been observed when the main cleaning agent is dispensed not at the beginning of the main wash cycle, but rather when a predetermined temperature threshold is exceeded, for example a temperature threshold higher than 40°C.

[0052] Figure 3 shows an example of a method 30 for removing stains during a cleaning cycle of a household appliance consisting in obtaining an information 31 relating to the temperature inside the household appliance 300 at different times of the cleaning cycle. This information can either be provided by a sensor 214 or read in a database that comprises recordings or estimations of the temperature evolution inside the household appliance 300 as a function of time.

[0053] The method proceeds by releasing 32 a first cleaning agent, typically comprising an enzyme, at the early stages of the main wash cycle at temperatures inside the household appliance 300 typically lower than 30°C.

[0054] Then, the method proceeds by releasing an amount 33 of main cleaning agent, typically a cleaning agent comprising an alkali, when the temperature inside the household appliance 300 exceeds 40°C. The moment when such a condition is met can be determined either using a measured temperature, or via estimations based on the knowledge of the evolution of temperature inside the household appliance as a function of time.

[0055] It is to be noted that the amount released can be increased when the predetermined temperature threshold is closer to 40°C and decreased if the predetermined temperature threshold is closer to 55°C, advantageously above 58°C.

[0056] The predetermined temperature threshold can be set at a fixed value (for example 40°C, 50°C, 55°C, 58°C or 60°C), or be dynamically associated with an event observed during the cleaning cycle. For example, it is possible to start dispensing the main cleaning agent once the temperature inside the household appliance 300 reaches a maximum value and starts decreasing. Should a database contain the expected or predicted temperature evolution inside the household appliance 300 as a function of time, it is possible to set the condition for dispensing the main cleaning agent as exceeding a temperature corresponding to a certain percentage of the maximum temperature during the main wash cycle, for example 80% or 90% or 95% of that maximum temperature value, or at a predicted time when such temperatures are expected. In that case, a timer can be used to trigger the dispensing of the main cleaning agent. Another possibility is to further set a time separating the beginning of the main cycle from the release of the main cleaning agent. For example, it could be possible to wait 5 or 10 minutes after the start of the main wash cycle or 5 or 10 minutes after the start of the dispensing of a first cleaning agent during the main wash cycle, before releasing the main cleaning agent. Typically, the amount of main cleaning agent released during a main wash cycle can be comprised between 3 grams and 40 grams, the amount depending on the level of dirtiness and load of objects inside the household appliance 300, as well as on the predetermined temperature threshold that is selected.

[0057] According to another embodiment, the dispensing of an amount of main cleaning agent when the temperature inside the household appliance 300 exceeds a predetermined temperature threshold can also be implemented on top

of a normal cleaning cycle. In such a case, a first cleaning agent typically comprising an enzyme phase can be dispensed in the first minutes of the main wash cycle, followed within the next ten minutes by the release of a second cleaning agent typically comprising an alkali, when the temperature is still lower than 40°C. Then, an amount of main cleaning agent that can be substantially smaller than in the examples described above can be dispensed at higher temperatures above 40°C inside the household appliance.

[0058] The method described above can be stored within a cleaning program of the household appliance 300, and ready to be selected by a user. It may also be available as an option to be added to any program of the household appliance, for example as a stain removal option, particularly suitable for removing tea stains, in particular in dishwashing machines. The decision to run a cleaning program that comprises the above-described method can be taken by a user. The user selects such a special program or option either on the household appliance 300, or via any other interface, for example on a mobile device 400. Alternatively, the decision to implement the method of the invention can be taken by the dosing device 200 or the non-transitory data processing unit 22, based for example on information regarding the presence of hard to remove stains such as tea stains.

[0059] It is further possible to adapt the cleaning strategy upon determination of the presence of such harder to remove stains or upon indication by an external source such as the user that such stains might be present. If the preselected program does not reach temperatures above 40°C, it is possible to adapt the main wash cycle to include a short time frame during which the temperature exceeds 40°C, advantageously 55°C or higher, to dispense the main cleaning agent at such higher temperatures.

[0060] The control of the household appliance using the method described above can be provided in the form of an app on a mobile phone for example, or a computer program loadable into any electronic device capable of communicating with household appliances and updating their programming.

[0061] Figures 4 to 8 provide 5 examples of cleaning cycles inside different dishwashing machines which benefited from the method for cleaning stains described above. In the examples provided below, 102 objects were placed inside the dishwashing machine, comprising all sorts of items and dirt types.

[0062] The objects include knives, tea spoons, large spoons, salad bowls, pans, cups, mugs, saucers, plates, sieves, spatulas, soup ladle, cans, glass bowls, a chopping board, forks and pots. These objects provide a good example of the type of surfaces that can be found in items cleaned by dishwashing machines. The type of stains found on these 102 items were the following: egg yolk, spinach, tea stains, milk stains, minced meat, oat flakes, egg, burnt lasagna.

[0063] The distribution of items and dirt is consistent with European norm EN 50242 established to test the efficiency of cleaning programs. In addition to the limits set by this norm, different types of materials such as glass, ceramic or plastic items such as plastic cans were loaded in the dishwashing machines.

[0064] To test the efficiency of the cleaning strategy that was adopted, the cleanliness of cups comprising tea stains was graded from 0 to 10, 10 being associated with a perfectly clean result. In the following examples, the grade provided for tea stains is an average value obtained over 6 cups that were inserted into the dishwashing machine. The total cleanliness of all items was rated from 0 to 5, 5 being associated with a perfectly cleaned set of items. The presence of droplets was also rated using a method consisting in counting the presence of droplets on the cleaned items. The grades go from 0 (no droplets found) to 6 (6 or more droplets found).

[0065] Figure 4 shows the evolution of temperature as a function of time throughout a cleaning cycle of a MIELE G6730SC dishwashing machine. The selected program that is represented on figure 4 is labelled "quick power wash 60°C". the diagram of figure 4 comprises a vertical temperature axis 408 and a horizontal time axis 409. The cleaning program can be decomposed into 6 cycles: filling 401 of the dishwasher with water, a main wash cycle 402, a first water exchange cycle 403, a first rinse cycle 404, a second water exchange cycle 405 and a final rinse cycle 406.

[0066] The temperature inside the dishwashing machine rises to almost 65 °C during the main wash cycle. The dispensing of cleaning agents comprises: releasing a first cleaning agent 410 at the beginning of the main wash cycle, releasing a finisher 430 in the final rinse cycle, and releasing a main cleaning agent 420 during the main wash cycle.

[0067] Figure 4 illustrates 4 different timings for the release of the main cleaning agent 420, referred to under the reference numbers 2a-2d. This dispensing of main cleaning agent 420 occurs after a delay of more than 10 minutes after the dispensing of the first cleaning agent 410. Theoretically, a delay 440 of about 7 minutes could have also led to satisfactory results.

[0068] A fist test was performed using the classical "quick power wash 60°C" cycle of the dishwashing machine. This normal cycle consists in releasing the main cleaning agent 2 minutes after dispensing the first cleaning agent 410. Table 1 shown below summarizes the results observed after this normal cleaning cycle. It was repeated twice with a different dosage of the first cleaning agent (enzyme phase), the main cleaning agent (alkali phase) and the finisher.

Table 1

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	Tea stains grade
1st test	3,54	21,5	3,36	4,8	0,9	6,6

(continued)

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	Tea stains grade
2nd test	5,9	35,8	5,6	4,8	0,8	8,3

[0069] As can be seen on table 1, the normal cleaning cycle of the dishwashing machine does not allow to reach a satisfactory level of tea stain removal. At high dosage of cleaning agent, the result remains below 9 (9 being considered as a satisfactory grade above which the user does not notice any tea stains on cups).

[0070] Table 2 shown below provides the results observed when the main cleaning agent 420 is dispensed at higher temperatures, more than 10 minutes after dispensing of the first cleaning agent 410. Tests 4 and 5 were both done with a dispensing of the main cleaning agent at a temperature T above 60°C. Test 4 was done with a normal dosage of the main cleaning agent whereas test 5 was done with a higher dosage of cleaning agent than test 4.

Table 2

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	T (°C)	Tea stains grade
Test 1(2a)	3,54	21,5	3,36	4,8	0,9	50	7,2
Test 2 (2b)	3,54	21,5	3,36	4,8	0,7	55	8,7
Test 3 (2c)	3,54	21,5	3,36	4,7	0,9	58	9,3
Test 4 (2d)	3,54	21,5	3,36	4,6	0,5	60	9,1
Test 5 (2d)	5,9	35,8	5,6	4,8	0,5	60	9,2

[0071] Table 2 demonstrates that dispensing the main cleaning agent 420 at temperatures above 55 °C with a normal dosing enables a perfect removal of teas stains. It further shows that the dosage does not play any significant role in the cleanliness result if the temperature threshold for dispensing the main cleaning agent is above 55°C.

[0072] Further tests tend to confirm these observations.

[0073] Figure 5 shows the evolution of temperature as a function of time throughout a cleaning cycle of a AEG FS56302WO dishwashing machine running a 60 minutes program. The diagram of figure 5 comprises a vertical temperature axis 408 and a horizontal time axis 409. The cleaning program can be decomposed into 4 cycles: filling 501 of the dishwasher with water, a main wash cycle 502, a first water exchange cycle 503 and a final rinse cycle 504.

[0074] The dispensing of cleaning agents comprises: releasing a first cleaning agent 510 at the beginning of the main wash cycle, releasing a finisher 530 in the final rinse cycle, and releasing a main cleaning agent 520 during the main wash cycle.

[0075] Figure 5 illustrates 4 different timings for the release of the main cleaning agent 520, referred to under the reference numbers 2, 2a-2c. The "classical" or "normal" timing for dispensing the main cleaning agent corresponds to reference number 2 and is referred to under numeral 550.

[0076] The dispensing of main cleaning agent 520 occurs after a delay of more than 10 minutes after the dispensing of the first cleaning agent 510. Theoretically, a delay 540 of about 7 minutes could also lead to satisfactory results.

[0077] Table 3 shown below provides the result observed when the main cleaning agent 520 is released at the different times 2, 2a-2c represented on figure 5. For release times 2 and 2c, normal and higher dosage of cleaning agents were tested.

Table 3

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	T (°C)	Tea stains grade
Test 1 (2)	3,54	21,5	3,36	4,7	0,8	25-30	6,3
Test 2 (2a)	3,54	21,5	3,36	4,6	0,5	50	6
Test 3 (2b)	3,54	21,5	3,36	4,7	0,8	55	9,3
Test 4 (2c)	3,54	21,5	3,36	4,8	0,7	58	8,8
Test 5 (2)	5,9	35,8	5,6	4,8	0,8	30	6,5
Test 6 (2c)	5,9	35,8	5,6	4,8	0,6	58	9

[0078] This table confirms the observation made in connection with figure 4. Furthermore, although this is not represented on table 3, it has been seen that an increase of the amount of main cleaning agent dispensed even at lower temperatures, below 55°C but above 40°C can also lead to very satisfactory removal of tea stains with high cleanliness grades.

[0079] Figure 6 shows the evolution of temperature as a function of time throughout a cleaning cycle of a Bosch SMS68TW06E dishwashing machine running a short one-hour program with a 1 hour drying cycle. The diagram of figure 6 comprises a vertical temperature axis 408 and a horizontal time axis 409. The cleaning program can be decomposed into 6 cycles: filling 601 of the dishwasher with water, a main wash cycle 602, a first rinse cycle 603, a final rinse cycle 604, a zeolite drying cycle 605 and a drying cycle 606.

[0080] The dispensing of cleaning agents comprises: releasing a first cleaning agent 610 at the beginning of the main wash cycle and releasing a main cleaning agent 620 during the main wash cycle.

[0081] Figure 6 illustrates 3 different timings for the release of the main cleaning agent 620, referred to under the reference numbers 2, 2a and 2b. The "classical" or "normal" timing for dispensing the main cleaning agent corresponds to reference number 2 and is referred to under numeral 650.

[0082] Table 4 shown below provides the result observed when the main cleaning agent 620 is released at the different times 2, 2a-2b represented on figure 6.

Table 4

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	T (°C)	Tea stains grade
Test 1 (2)	3,54	21,5	3,36	4,7	0,8	25-30	6,3
Test 2 (2a)	3,54	21,5	3,36	4,6	0,5	40	6,0
Test 3 (2b)	3,54	21,5	3,36	4,7	0,8	58	9,0

[0083] This table confirms the observation made in connection with figures 4 and 5. Furthermore, although this is not represented on table 4, it has been seen that an increase of the amount of main cleaning agent dispensed at 40°C can also lead to very satisfactory removal of tea stains with high cleanliness grades.

[0084] Figure 7 shows the evolution of temperature as a function of time throughout a cleaning cycle of a Bosch SMS68TW06E dishwashing machine running a long two-hour program with a 1 hour drying cycle. The diagram of figure 7 comprises a vertical temperature axis 408 and a horizontal time axis 409. The cleaning program can be decomposed into 5 cycles: filling 701 of the dishwasher with water, a main wash cycle 702, a first rinse cycle 703, a final rinse cycle 704 and a drying cycle 706.

[0085] The dispensing of cleaning agents comprises: releasing a first cleaning agent 710 at the beginning of the main wash cycle and releasing a main cleaning agent 720 during the main wash cycle.

[0086] Figure 7 illustrates 2 different timings for the release of the main cleaning agent 720, referred to under the reference numbers 2 and 2a. The "classical" or "normal" timing for dispensing the main cleaning agent corresponds to reference number 2 and is referred to under numeral 750.

[0087] Table 5 shown below provides the result observed when the main cleaning agent 720 is released at the different times 2 and 2a represented on figure 7. Tests 1 and 2 are conducted with a normal dosage of cleaning agents whereas tests 3 and 4 were done with a higher dosage of cleaning agent than tests 1 and 2.

Table5

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	T (°C)	Tea stains grade
Test 1 (2)	3,54	21,5	3,36	4,8	0,3	25-30	6
Test 2 (2a)	3,54	21,5	3,36	4,7	0,2	50-52	6
Test 3 (2)	5,9	35,8	5,6	4,9	0,2	25-30	6,8
Test 4 (2a)	5,9	35,8	5,6	5	0,3	50-52	8

[0088] This table confirms the observation made in connection with figures 4, 5 and 6. Furthermore, it can be seen that dosage of the cleaning agents is a second means of acting on the removal of tea stains, with results that are synergistically combined with the temperature at which the alkali main cleaning agent 720 is dispensed.

[0089] A further observation that was made, but not represented on figure 7, is that the total cleanliness can be further improved by splitting the dispensing of the enzyme phase into two separate phases. A first portion of the enzyme phase, for example 3/5 of the total of the enzyme phase, can be dispensed at the beginning of the cleaning cycle, either during

a pre-wash cycle or during the first minutes of the main wash cycle. A second amount of the enzyme phase, for example 2/5 of the total amount of the enzyme phase, can be dispensed at a later stage of the cleaning cycle, for example about 10 minutes after dispensing the first amount.

[0090] Figure 8 shows the evolution of temperature as a function of time throughout a cleaning cycle of a Bauknecht BFE 2B19 dishwashing machine running a short intensive program with a drying cycle. The diagram of figure 8 comprises a vertical temperature axis 408 and a horizontal time axis 409. The cleaning program can be decomposed into 6 cycles: filling 801 of the dishwasher with water, a main wash cycle 802, a first rinse cycle 803, a second rinse cycle 804, a final rinse cycle 805 and a drying cycle 806.

[0091] The dispensing of cleaning agents comprises: releasing a first cleaning agent 810 at the beginning of the main wash cycle and releasing a main cleaning agent 820 during the main wash cycle.

[0092] Figure 8 illustrates 2 different timings for the release of the main cleaning agent 820, referred to under the reference numbers 2 and 2a. The "classical" or "normal" timing for dispensing the main cleaning agent corresponds to reference number 2 and is referred to under numeral 850.

[0093] Table 6 shown below provides the result observed when the main cleaning agent 820 is released at the different times 2 and 2a represented on figure 8.

Table 6

	Enzyme (g)	Alkali (g)	Finisher (g)	Total cleanliness	Droplets count	T (°C)	Tea stains grade
Test 1 (2)	5.9	35.8	5.6	4.9	0.4	25-30	7.7
Test 2 (2a)	5.9	35.8	5.6	4.9	0.3	60	9.3

[0094] This table confirms the observation made in connection with figures 4-7. It further proves that dosage alone is not enough to achieve a perfect removal of tea stains, but can be achieved with the synergistical effect of the timing of the dispensing of the main cleaning agent 820 and the dosage of the cleaning agent.

[0095] Although not represented in the above examples, it is also possible to dispense the main cleaning agent in calculated amounts twice, once at the beginning of the main wash cycle according to a "normal" release of the cleaning agents, followed by a second dispensing of the main cleaning agent at higher temperatures.

[0096] The steps of the examples and embodiments described above can be implemented by a processor such as a computer. A computer program product comprising steps of the above-described method can be used to implement the method on a computer.

[0097] It is possible to store a computer program comprising instructions to implement the method of the invention on different non-transitory computer readable storage mediums. These could for example comprise a processor or chip, FPGA (field programable gate array), an electronic circuit comprising several processors or chips, a hard drive, a flash or SD card, a USB stick, a CD-ROM or DVD-ROM or Blue-Ray disc, or a diskette 216.

[0098] While at least one exemplary embodiment has been presented in the foregoing detailed description, it should be appreciated that a vast number of variations exist. It should also be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration of the various embodiments in any way. Rather, the foregoing detailed description will provide those skilled in the art with a convenient road map for implementing an exemplary embodiment as contemplated herein. It being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope of the various embodiments as set forth in the appended claims.

Claims

1. A method (30) for removing stains during a cleaning cycle of a household appliance (300), the cleaning cycle comprising at least a main wash cycle (402,502.602.702.802), the method comprising:

   - Releasing an amount of a main cleaning agent (420, 520, 620, 720, 820) during the main wash cycle when a temperature inside the household appliance during the main wash cycle exceeds a predetermined temperature threshold, wherein the predetermined temperature threshold is higher than 40 °C.

2. The method according to claim 1, wherein the predetermined temperature threshold is chosen among one of the following values: 50 °C, 55°C, 58°C, 60°C, a maximum temperature reached during the main wash cycle before a decrease in temperature, 95% of the maximum temperature reached during the cleaning cycle.

3. The method according to any one of the preceding claims, wherein the main cleaning agent comprises an alkali.

4. The method according to any one of the preceding claims, further comprising:

- releasing a first cleaning agent (410, 510, 610, 710, 810) at temperatures below 40 °C during the main wash cycle;
- releasing the main cleaning agent at least 5 minutes after starting the release of the first cleaning agent.

5. The method according to any one of the preceding claims, further comprising:

- releasing a first cleaning agent at temperatures below 40 °C during the main wash cycle, the first cleaning agent comprising an enzyme;
- releasing a second cleaning agent (450, 550, 650, 750, 850) after starting the release of the first cleaning agent.

6. The method according to claim 5, wherein the first cleaning agent is dosed relative to the second cleaning in a ratio comprised between 0,1 times and 10 times an amount of the second cleaning agent.

7. The method according to any one of the preceding claims, further comprising:

- determining the amount of main cleaning agent to be released based on a value of the predetermined temperature threshold, the amount of main cleaning agent being higher when the predetermined temperature threshold is lower.

8. The method according to any one of the preceding claims, wherein the amount of main cleaning agent to be released is between 3 grams and 40 grams.

9. The method according to any one of the preceding claims, further comprising:

- Obtaining an information regarding the temperature inside the household appliance at different times of the cleaning cycle.

10. The method according to claim 9, where the information regarding the temperature inside the household appliance at different times of the cleaning cycle is provided by a database of programs runnable by the household appliance.

11. The method according to any one of the preceding claims, further comprising:

- releasing the amount of the main cleaning agent from a removable dosing device (200) positioned inside the household appliance.

12. The method according to any one of the preceding claims, further comprising:

- obtaining an information relating to the presence of tea stains among objects arranged inside the household appliance.

13. System (22) for removing stains during a cleaning cycle of a household appliance (300), the cleaning cycle comprising at least a main wash cycle (402,502.602.702.802), the system comprising:

- a non-transitory data processing unit (20), configured to obtain an information regarding a temperature inside the household appliance at different times of the cleaning cycle;
- a dosing device (200) containing a main cleaning agent (420, 520, 620, 720, 820) and capable of receiving information from the non-transitory data processing unit, the dosing device being configured to release an amount of the main cleaning agent during the main wash cycle at a time provided by the non-transitory data processing unit, the time being associated with temperature inside the household appliance during the main wash cycle exceeding a predetermined temperature threshold, wherein the predetermined temperature threshold is higher than 40 °C.

14. The system according to claim 11, wherein the dosing device is a removable dosing device configured to be positioned inside the household appliance.

15. A non-transitory computer readable storage medium having stored thereon a computer program comprising instructions for execution of a method according to any one of claims 1 to 12 for removing stains during a cleaning cycle of a household appliance.

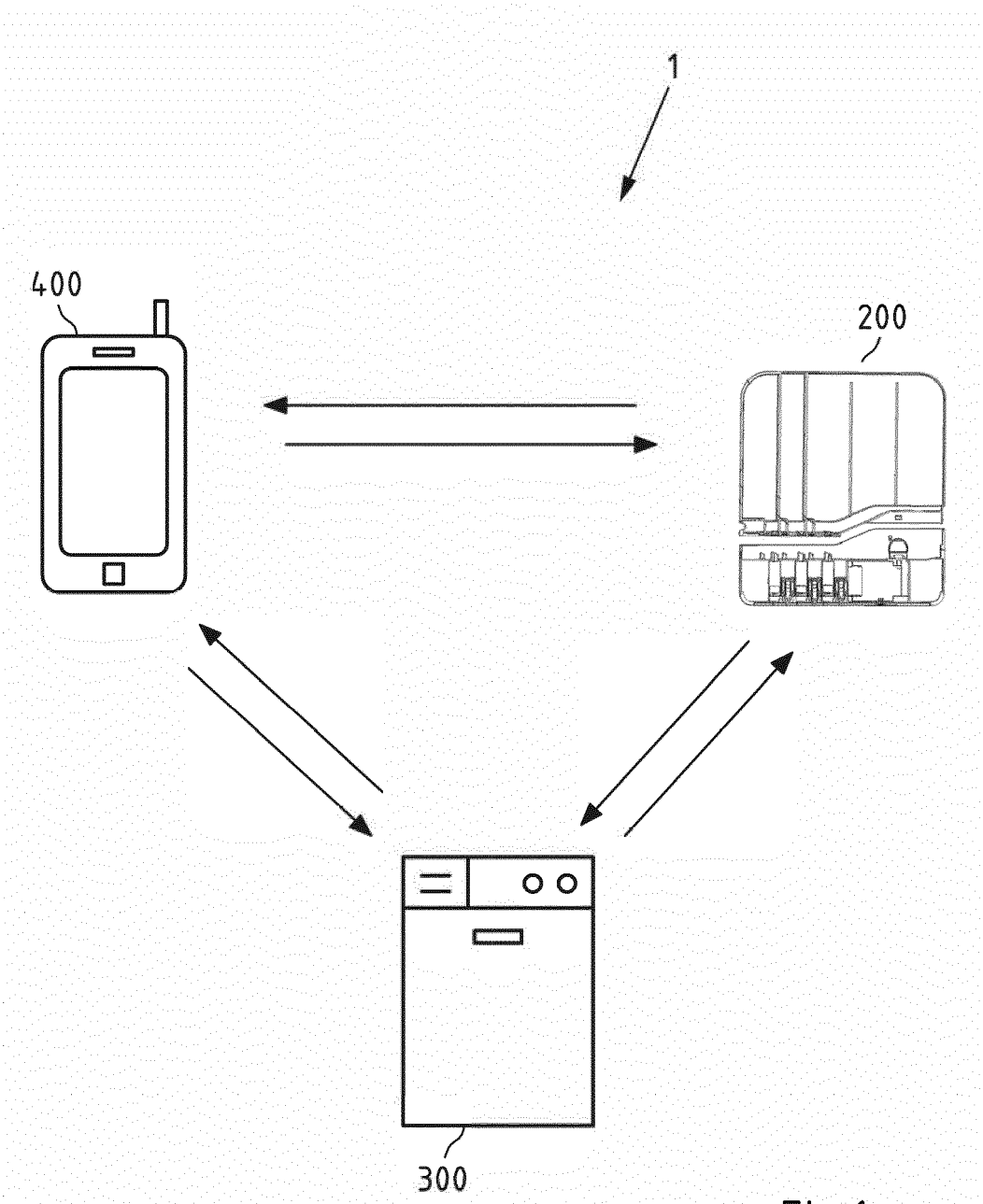
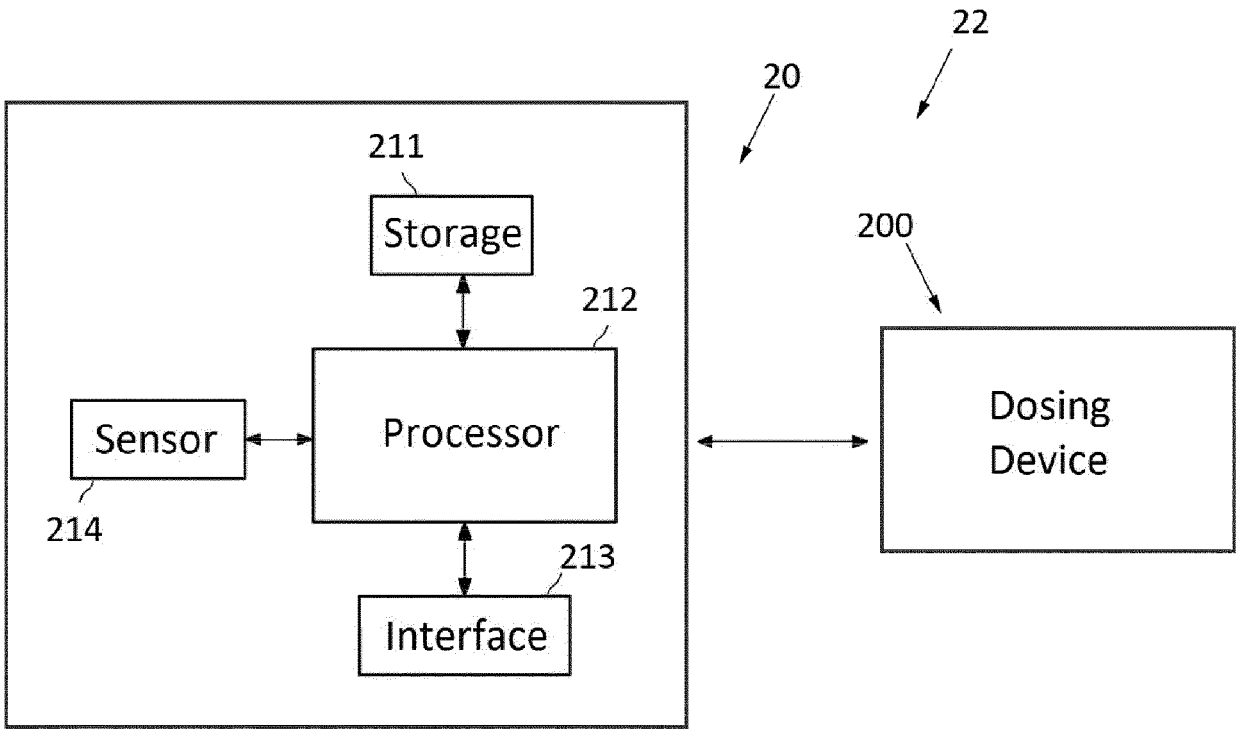


Fig.1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20
211
Storage
200
212
Processor
Dosing
Device
Sensor
214
213
Interface

Fig.2

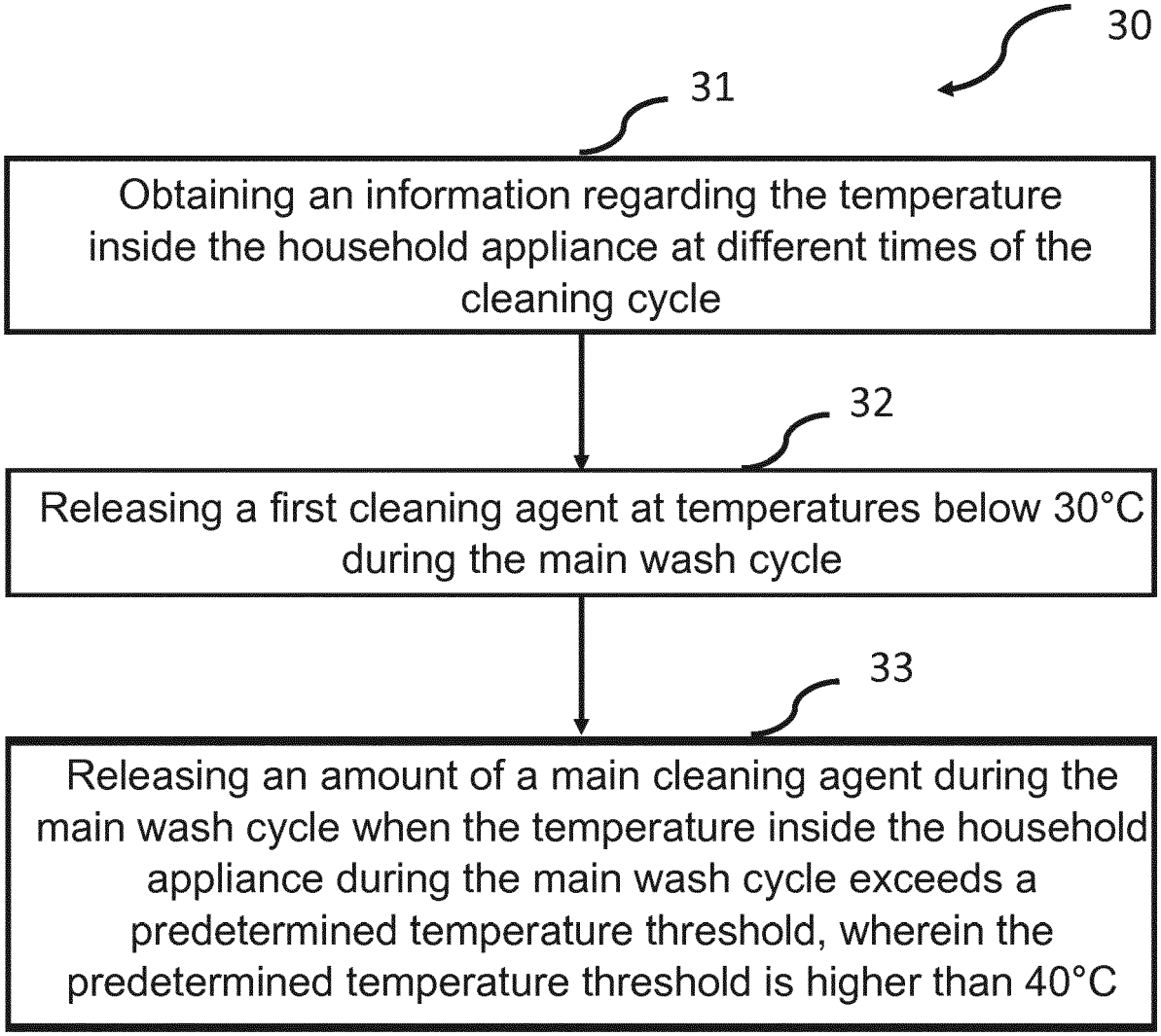

30
31
Obtaining an information regarding the temperature inside the household appliance at different times of the cleaning cycle
32
Releasing a first cleaning agent at temperatures below 30°C during the main wash cycle
33
Releasing an amount of a main cleaning agent during the main wash cycle when the temperature inside the household appliance during the main wash cycle exceeds a predetermined temperature threshold, wherein the predetermined temperature threshold is higher than 40°C

Fig.3

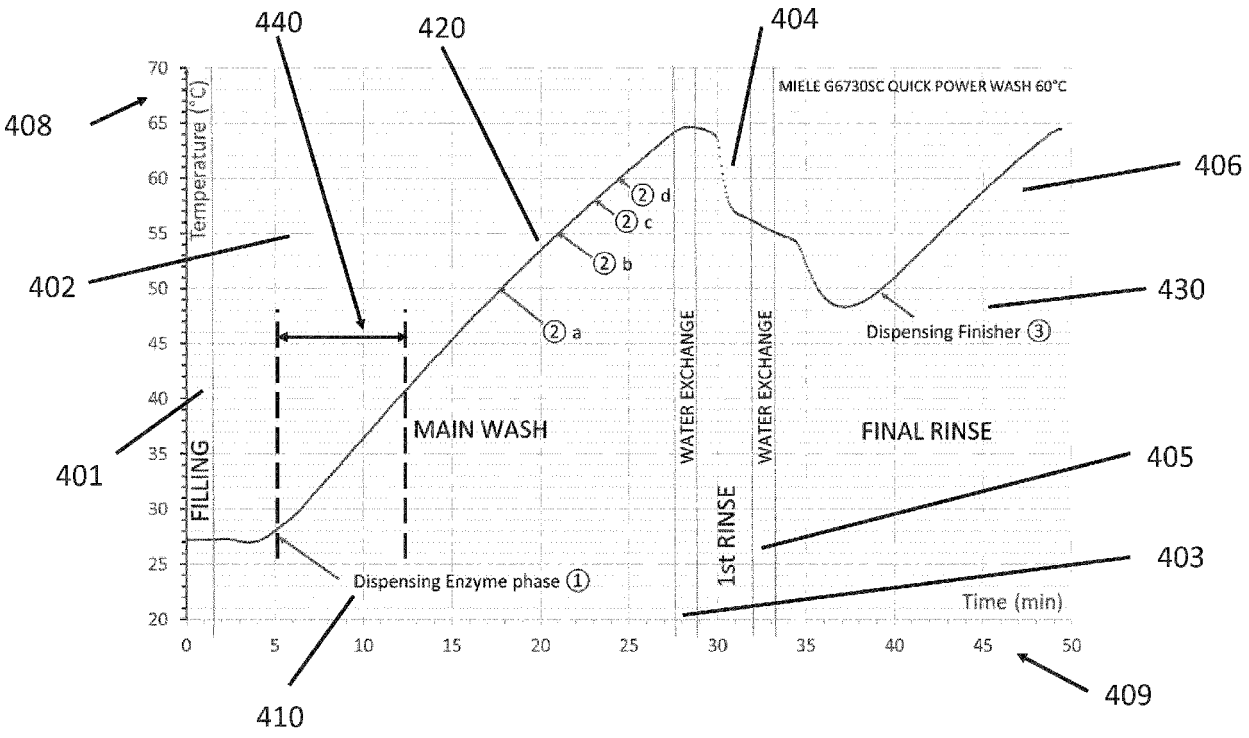

440
420
404
408
406
402
430
401
405
403
410
409
MIELE G6730SC QUICK POWER WASH 60°C
Temperature (°C)
Time (min)
FILLING
MAIN WASH
WATER EXCHANGE
1st RINSE
WATER EXCHANGE
FINAL RINSE
Dispensing Enzyme phase ①
Dispensing Finisher ③
② a
② b
② c
② d
70
65
60
55
50
45
40
35
30
25
20
0
5
10
15
20
25
30
35
40
45
50

Fig.4

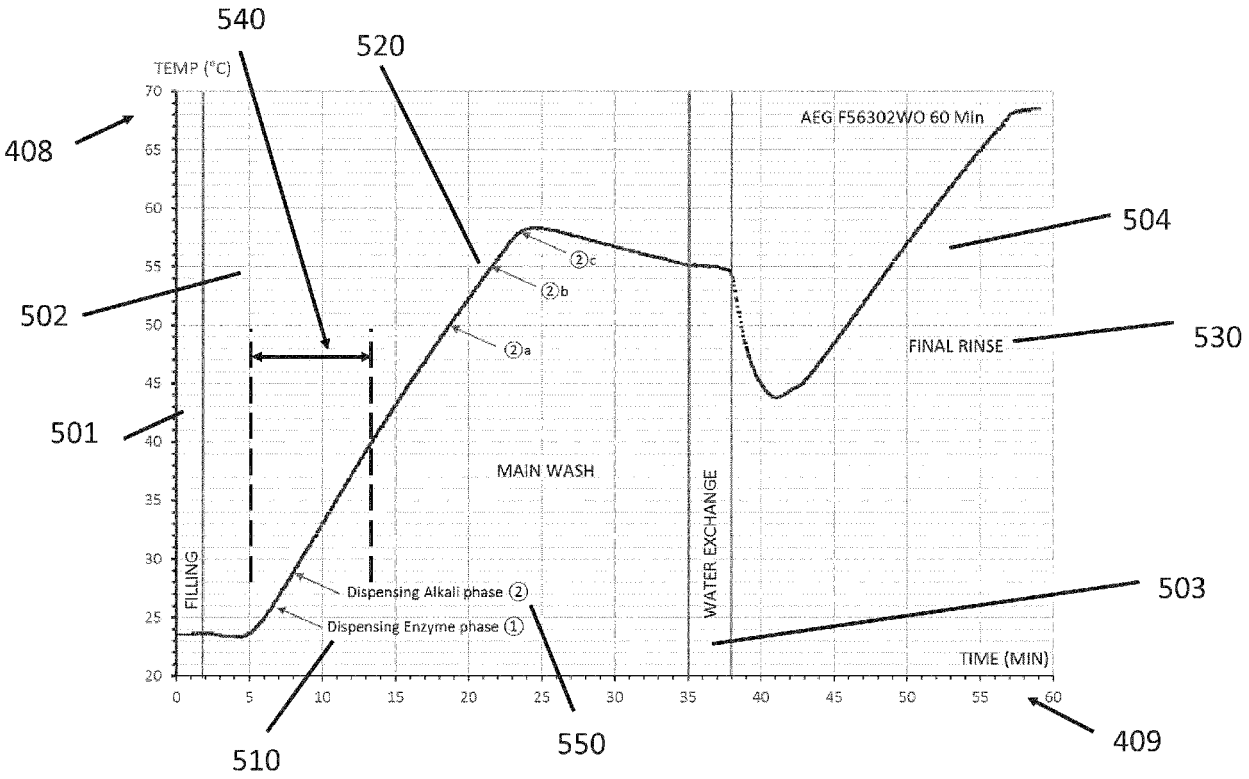
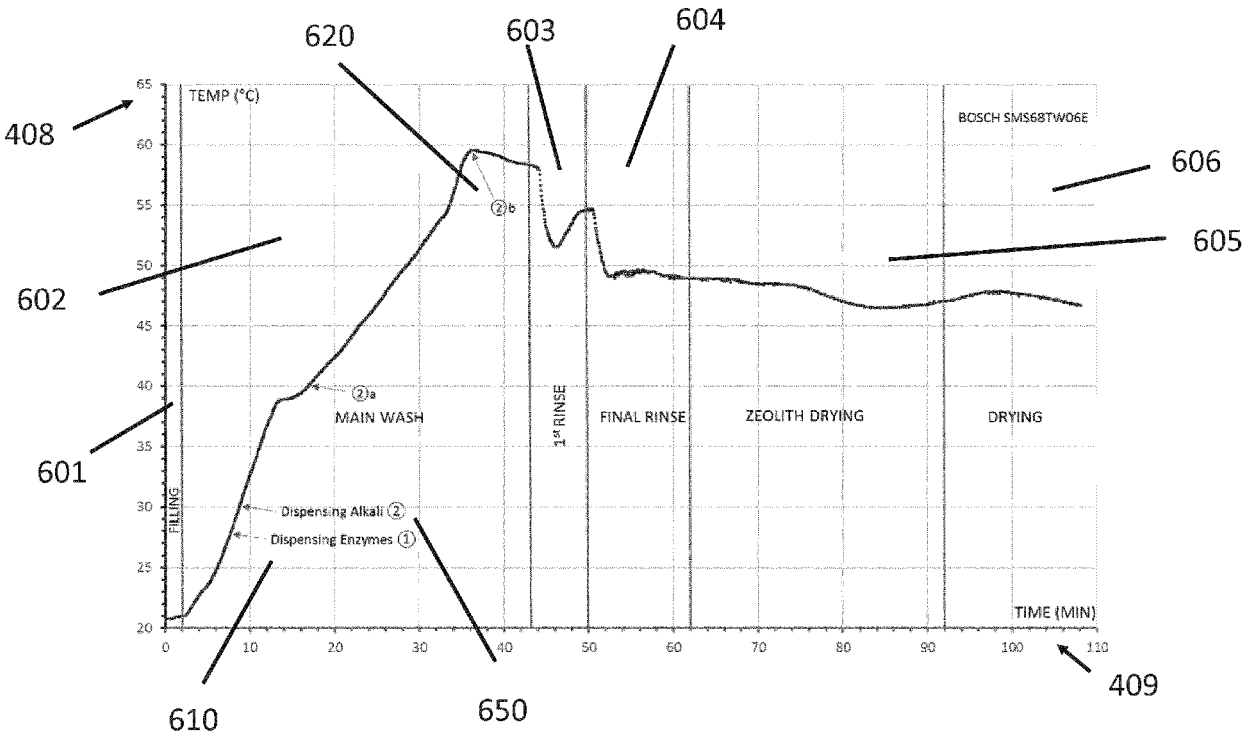

540
520
TEMP (°C)
408
AEG F56302WO 60 Min
504
502
②c
②b
②a
FINAL RINSE
530
501
MAIN WASH
WATER EXCHANGE
FILLING
Dispensing Alkali phase ②
Dispensing Enzyme phase ①
503
TIME (MIN)
510
550
409

Fig.5


620
603
604
408
606
605
602
601
610
650
409
TEMP (°C)
BOSCH SMS68TW06E
②b
②a
MAIN WASH
1st RINSE
FINAL RINSE
ZEOLITH DRYING
DRYING
FILLING
Dispensing Alkali ②
Dispensing Enzymes ①
TIME (MIN)
65
60
55
50
45
40
35
30
25
20
0
10
20
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40
50
60
70
80
90
100
110

Fig.6

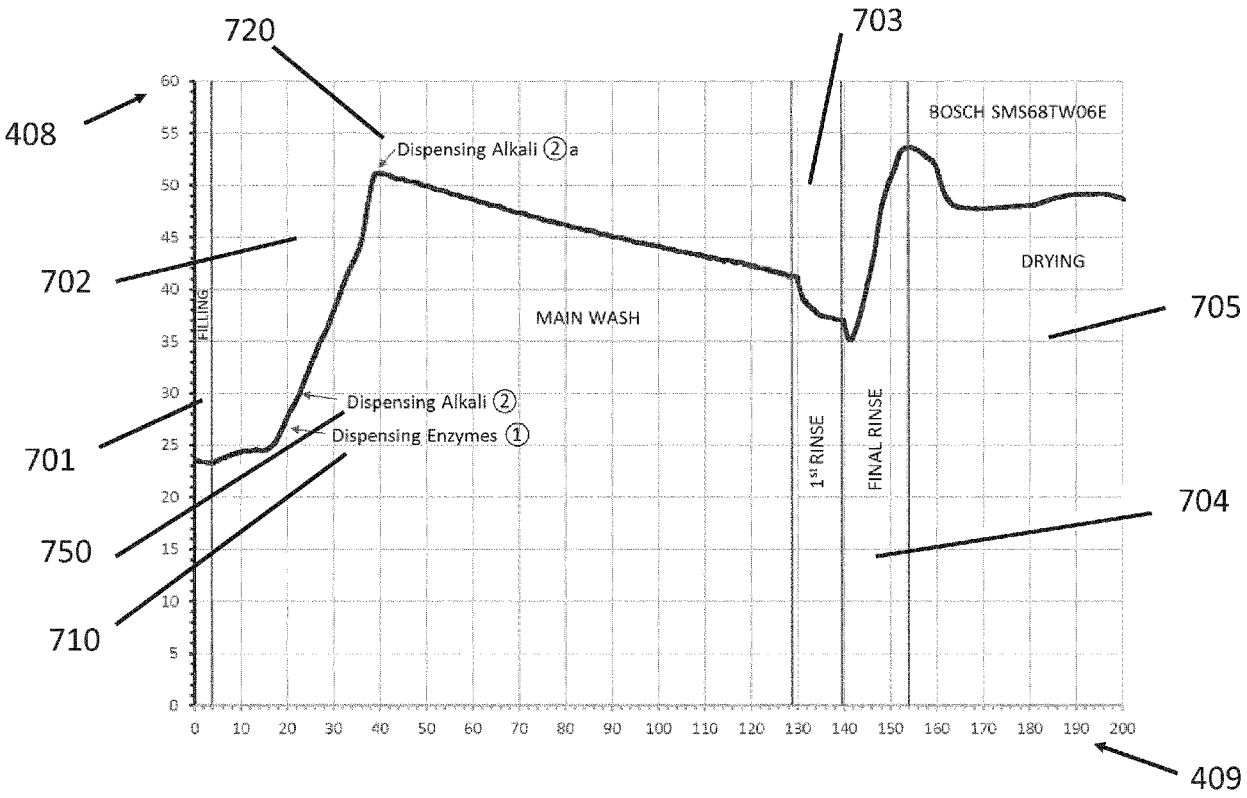
720
703
408
BOSCH SMS68TW06E
Dispensing Alkali ②a
DRYING
702
705
FILLING
MAIN WASH
Dispensing Alkali ②
Dispensing Enzymes ①
1st RINSE
FINAL RINSE
701
704
750
710
409

Fig.7

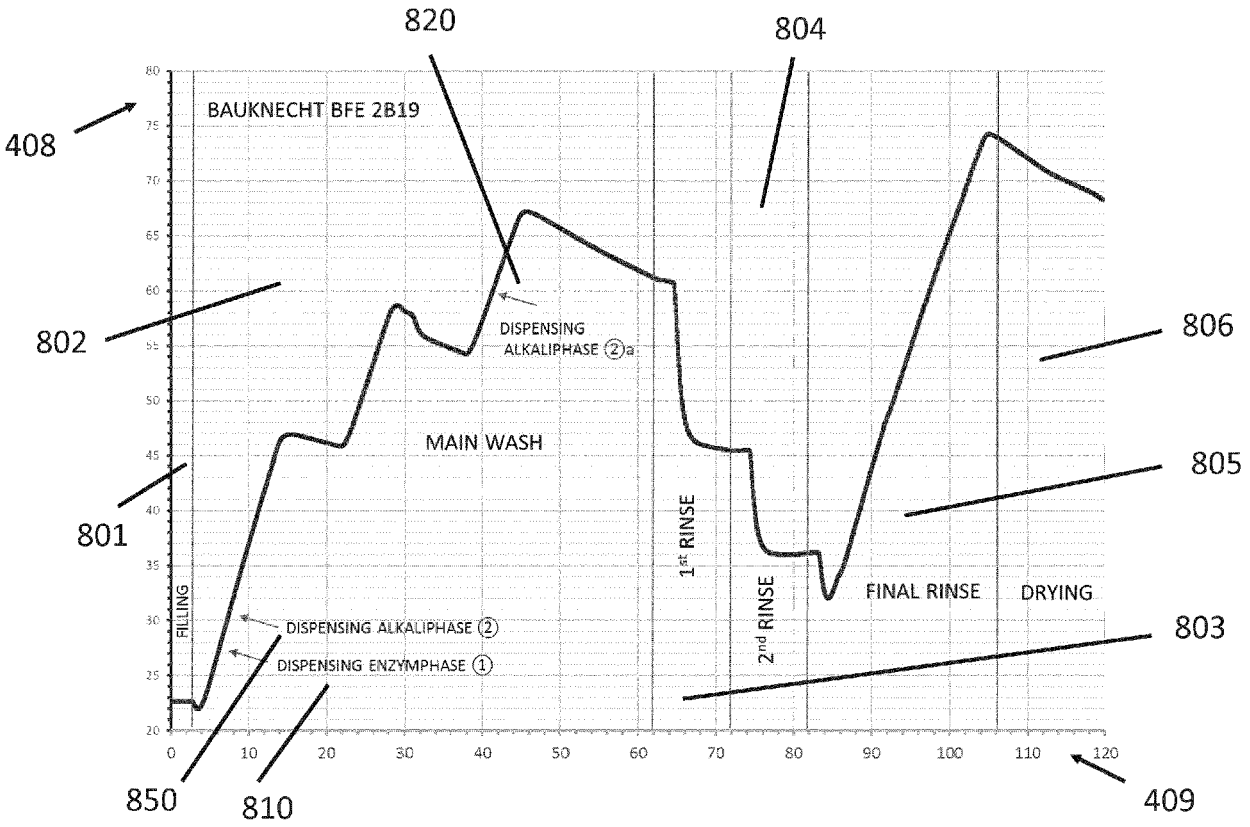
820
804
408
BAUKNECHT BFE 2B19
802
DISPENSING
ALKALIPHASE (2)a
806
MAIN WASH
805
801
1st RINSE
2nd RINSE
FINAL RINSE
DRYING
FILLING
DISPENSING ALKALIPHASE (2)
DISPENSING ENZYMPHASE (1)
803
850
810
409

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 8126

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 June 2019	Lodato, Alessandra

CATEGORY OF CITED DOCUMENTS

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11-06-2019

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		WO 2013076491 A1	30-05-2013
CN 106758010 A	31-05-2017	NONE	

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