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(54) **Method for detecting a rinse agent in a rinsing liquid of a household washing machine, in particular a dishwasher and washing machine thereof**

(57) The present invention relates to a method for detecting a rinse aid agent in a rinse liquid of a washing machine (1) for household use, in particular a dishwasher, said washing machine (1) comprising:
- a control system (SC), in particular of the electric or electronic type, for handling and controlling the operation of the washing machine (1), said control system (SC) being adapted to implement at least one rinse program;
- a tub (2) in which dishes are treated by means of a rinse liquid, in particular water, added with a rinse aid agent during said at least one rinse program;
- sensing means (5a, 5b, 5c) associated with said tub (2) and connected to said control system (SC) for detecting the degree of turbidity of the rinse liquid in the tub (2).

The invention is **characterized in that** said method is executed by said control system (SC) and comprises the steps of:

- a) taking a first measurement (M1) of the degree of turbidity of the rinse liquid in the tub (2);
- b) executing a step of releasing (R) the rinse aid agent into the tub (2);
- c) taking a second measurement (M2) of the degree of turbidity of the rinse liquid in the tub (2);
- d) comparing said first measurement (M1) with said second measurement (M2);
- e) verifying the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub (2) for the purpose of detecting the presence of the rinse aid agent

in said tub (2).

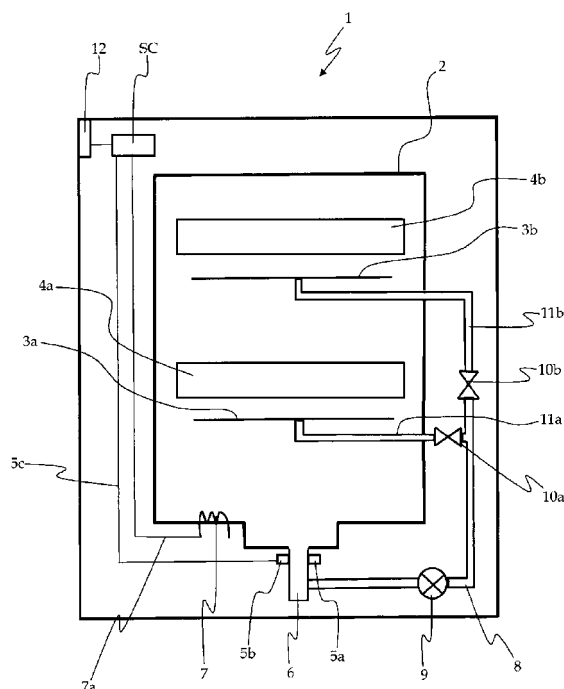


Fig. 1

Description

[0001] The present invention relates to a method for detecting a rinse aid agent in a rinse liquid of a washing machine for household use, in particular a dishwasher, according to the preamble of claim 1.

[0002] The present invention also relates to a washing machine for household use, in particular a dishwasher.

[0003] Household washing machines, in particular dishwashers, known in the art comprise a wash tub in which crockery is cleaned through washing means comprising wash liquid and a wash agent; typically said wash liquid and wash agent are sprayed onto the crockery to be washed by at least one sprayer.

[0004] Said household washing machines comprise means for handling and controlling the operation of the washing machine, which generally comprise an electric or electronic control system capable to implement a number of wash programs.

[0005] It is known that the control systems of modern household dishwashers are designed to execute a plurality of wash programs, which typically vary depending on load, crockery typology, dirtiness degree or rinsing performance required by the crockery to be washed.

[0006] Said wash programs (also called "wash cycles" in the art) are predefined programs differentiated from one another by parameters such as wash temperature, water quantity and duration.

[0007] Each wash program of said plurality of wash programs usually comprises:

- at least one first dish wash step, wherein a washing agent, in particular detergent adapted to remove dirt from crockery, is added to water supplied from the water main;
- at least one second dish rinse step (said step constituting a rinse program), during which an additive agent, in particular rinse aid, may be added to water from the main, said water added with rinse aid constituting the rinse liquid.

[0008] Each wash program of said plurality of wash programs may also comprise:

- at least one dish prewash step, which precedes the first wash step and allows softening the dirt and removing the greasiest residues from the crockery;
- at least one intermediate rinse step between the first wash step and the second rinse aid step, which allows the circulating rinse liquid supplied from the water main to eliminate the last residues of dirt still present on the crockery as well as the chemical residues produced during the wash step;
- at least one dish drying step carried out at the end of the rinse cycle.

[0009] Document No. US 5,797,409A discloses a household washing machine, in particular a dishwasher,

which comprises a sensor for measuring the turbidity of the rinse liquid and detecting the presence of said additive or rinse aid agent in the rinse liquid.

[0010] In particular, the sensor of document no. US 5,797,409A comprises a pair of optical sensors located in the wash tub on diametrically opposed sides. Said pair comprises a luminous signal transmitter and a luminous signal receiver. As is known, a luminous ray crossing a fluid undergoes effects due to interaction between the ray itself and the substances dissolved in the fluid, and said interaction essentially translates into deviation and/or absorption of the luminous ray; as a consequence, the greater the degree of turbidity of a fluid, the weaker the luminous signal received by the receiver.

[0011] As concerns the sensor described in document no. US 5,797,409A, it performs an optical measurement of the degree of turbidity of the rinse liquid following the release of the rinse aid agent, and the control system of the washing machine compares the degree of turbidity detected through said measurement with a predefined fixed value.

[0012] If the value obtained by measuring the degree of turbidity of the rinse liquid following the release of the rinse aid agent is greater than said predefined fixed value beyond a certain threshold, the control system of the washing machine detects the presence of rinse aid agent in the rinse liquid.

[0013] On the contrary, if the difference between the two values (i.e. between a first value obtained by measuring the degree of turbidity and a second predefined fixed value) is null or anyway smaller than said predefined threshold, the control system of the washing machine detects the absence of rinse aid agent in the rinse liquid. Once the absence of rinse aid agent in the rinse liquid has been ascertained, the control system of the washing machine increases the duration of the dish drying step.

[0014] The above-described household dishwasher has many drawbacks.

[0015] In particular, an important drawback of the above-described solution and of the other solutions known in the art is that they do not allow for a reliable and constant measurement of the degree of turbidity of the rinse liquid, and therefore of the presence of the rinse aid agent in the rinse liquid.

[0016] In fact, the use of a predefined fixed value for detecting the presence of rinse aid agent in the rinse liquid inevitably implies the risk that the level of limpidity of the rinse liquid is measured incorrectly after the release of the rinse aid agent, in that said measurement may be affected by and may be dependent on a number of possible system variables. For example, some of these variables may consist of different degrees of dirtiness of the crockery treated in a specific program and/or changes (especially due to time and/or food pollutants) in the optical characteristics of the materials where the measurement is taken and/or degradation of the optoelectronic components of the sensors employed, and so on.

[0017] A further drawback of the above-described so-

lution is that, even if the detection of the rinse aid agent were made correctly, the choice of increasing the duration of the dish drying step would not allow to obtain an adequate energy saving.

[0018] In this frame, it is the main object of the present invention to provide a method for detecting a rinse aid agent in a rinse liquid of a washing machine for household use, in particular a dishwasher, which allows taking a reliable and constant measurement of the degree of turbidity of the rinse liquid and, as a result, of the presence of rinse aid agent in the rinse liquid.

[0019] It is another object of the present invention to provide a method for detecting a rinse aid agent in a rinse liquid of a washing machine for household use, in particular a dishwasher, which allows to correctly detect the presence of rinse aid agent in the rinse liquid and to take measurements aimed at attaining an adequate energy saving as a consequence of the detection of the presence of the rinse aid agent.

[0020] Since the presence of rinse aid is generally a regulatory performance requirement, it is a further object of the present invention to optimize the drying performance in the event of absence of rinse aid, resulting in greater user satisfaction.

[0021] It is yet another object of the present invention to reduce the technologic complexity and the cost of a washing machine for household use, in particular a dishwasher, thanks to the elimination of those electromechanical sensors frequently used in the prior art for detecting the presence of rinse aid agent in a washing machine.

[0022] Said objects are achieved by the present invention through a method for detecting a rinse aid agent in a rinse liquid of a washing machine for household use, in particular a dishwasher, and a washing machine thereof, incorporating the features set out in the appended claims, which are intended as an integral part of the present description.

[0023] Further objects, features and advantages of the present invention will become apparent from the following detailed description and from the annexed drawings, which are supplied by way of non-limiting explanatory example, wherein:

- Fig. 1 is a schematic view of a washing machine for household use, in particular a dishwasher, which incorporates the features of the present invention.
- Fig. 2 is a basic diagram of a method for detecting a rinse aid agent in a rinse liquid of the washing machine of Fig. 1.

[0024] Referring now to the annexed drawings, in Fig. 1 reference numeral 1 designates as a whole a washing machine for household use, in particular a dishwasher, according to the present invention.

[0025] The washing machine 1 comprises an electric or electronic control system SC for handling and control-

ling the operation of the washing machine 1, said control system SC being adapted to implement at least one rinse program.

[0026] The washing machine 1 further comprises a tub 2, within which crockery is cleaned by washing means including a wash liquid, in particular water, possibly added with a detergent. During said at least one rinse program, a rinse liquid is delivered to the crockery, in particular water added with a rinse aid agent.

[0027] The annexed drawings do not show the crockery, the rinse liquid and the rinse aid agent.

[0028] Said wash liquid (water possibly added with detergent) and said rinse liquid (water possibly added with rinse aid agent) are sprayed onto the crockery to be washed by means of at least one sprayer 3a, 3b; in particular, Fig. 1 shows a first sprayer 3a associated with a lower rack 4a and a second sprayer 3b associated with an upper rack 4b, said racks 4a, 4b being adapted to receive the crockery to be washed and rinsed.

[0029] The washing machine 1 also comprises sensing means 5a, 5b, 5c associated with said tub 2 and connected to said control system SC for detecting the degree of turbidity of the wash liquid and of the rinse liquid in the tub 2.

[0030] Preferably, said sensing means comprise a pair of optical devices 5a, 5b associated with the tub 2. In particular, the pair of optical devices 5a, 5b are positioned on the wall of a pit 6 obtained in a bottom portion of said tub 2 for collecting the wash liquid and the rinse liquid; said optical devices 5a, 5b are arranged in diametrically opposed positions, adjacent to the walls of the pit 6, and comprise a luminous signal emitter 5a and a luminous signal receiver 5b, said receiver 5b facing said emitter 5a. In addition, said sensing means comprise a wiring 5c adapted to connect said pair of optical devices 5a, 5b to the control system SC of the washing machine 1.

[0031] As an alternative to the embodiment of the invention shown in Fig. 1, the optical devices may be comprised in an integrated detector, with the emitter and the receiver arranged at different ends of said detector (see for example patent EP1335060).

[0032] Fig. 2 shows a basic diagram of the progress of a method for detecting a rinse aid agent in the rinse liquid of the washing machine for household use, in particular a dishwasher, incorporating the features of the present invention; the axis of abscissas shows, not in scale, the duration t of the wash cycle, in particular in the rinse program, whereas the axis of ordinates shows, in scale, the values of a parameter M inversely proportional to the turbidity index and the values of a logic parameter R pertaining to the active or inactive state of a rinse aid dispenser device (not shown in the annexed drawings), and the temperatures T of said wash cycle, in particular in the rinse program.

[0033] In accordance with the present invention, said method for detecting a rinse aid agent in a rinse liquid is executed by the control system SC of the washing machine 1 and comprises the steps of:

- a) taking a first measurement (indicated in Fig. 2 by reference M1) of the degree of turbidity of the rinse liquid in the tub 2;
- b) executing a step of releasing (R) the rinse aid agent into the tub 2;
- c) taking a second measurement M2 of the degree of turbidity of the rinse liquid in the tub 2;
- d) comparing said first measurement M1 with said second measurement M2;
- e) verifying the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub 2 for the purpose of detecting the presence of the rinse aid agent in said tub 2.

[0034] The method according to the present invention allows to provide a washing machine 1 for household use, in particular a dishwasher, which allows taking a reliable and constant measurement of the degree of turbidity of the rinse liquid, and therefore of the presence of rinse aid agent in the rinse liquid.

[0035] It must be pointed out that, also as concerns the measurements M1, M2 taken in accordance with the present invention, the greater the measured degree of turbidity of the rinse liquid, the weaker the luminous signal received by the receiver 5b. In fact, Fig. 2 shows that the luminous signal received by the receiver 5b during the second measurement M2 is weaker than the luminous signal received by the receiver 5b during the first measurement M1; this means that the degree of turbidity of the rinse liquid detected in the second measurement M2 is higher than the degree of turbidity detected in the first measurement M1 (and, as a consequence, the degree of transparency of the rinse liquid is lower in the second measurement M2 than in the first measurement M1).

[0036] As far as said step e) is concerned, it may additionally comprise a step of verifying that said predefined increase of the degree of turbidity of the rinse liquid (i.e. the decrease of the parameter M, which, it must be reminded, is inversely proportional to the turbidity index) between said first measurement M1 and said second measurement M2 is greater (in percentage) than a predetermined upper threshold value X%.

[0037] Said upper threshold value X% is strongly affected by the characteristics of the sensing means 5a, 5b, 5c in use; by way of example, it may be 3% or 7% or 10%. If such a condition occurs, there is certainty that there is rinse aid agent in the tub 2.

[0038] Still with reference to said step e), it may further comprise a step of verifying that the difference in the values of the parameter M of the rinse liquid between said first measurement M1 and said second measurement M2 is smaller (in percentage) than a predetermined lower threshold value Y%, where $Y% < X%$. Said lower threshold value Y% is also strongly affected by the characteristics of the sensing means 5a, 5b, 5c in use; by way of example, it may be 5% or 2% or 1%. If such a condition occurs, there is certainty that there is little or no rinse aid agent in the tub 2.

[0039] Still with reference to said step e), it may additionally comprise the detection of a condition in which the variation of the parameter M of the rinse liquid between said first measurement M1 and said second measurement M2 is comprised between Y% and X%, i.e. is within an intermediate range.

[0040] If such a condition occurs, it is assumed that there is presence, absence or insufficiency of rinse aid by taking as reliable the detection made during the previous cycle (that is to say, if presence/absence of rinse aid was detected during a certain rinse cycle carried out by the washing machine 1, that detection will also apply to the next rinse cycle, if during said next rinse cycle the detection falls within said intermediate range).

[0041] Alternatively, the detection of presence, absence or insufficiency of rinse aid may take place if the conditions of step e) occur for a finite and consecutive number of times.

[0042] According to the present invention, the washing machine 1 also comprises heating means 7 adapted to warm up the wash liquid and the rinse liquid in said tub 2. In the representation of Fig. 1, said heating means comprise a resistor 7 associated with the tub 2 of the washing machine 1 and connected to the control system SC of the washing machine 1 through a second wiring 7a.

[0043] It is however clear that said heating means 7 may consist of other elements known in the art, and may be associated with different elements of the washing machine 1. For example, the heating means 7 may be associated with a circuit for distributing the wash liquid and the rinse liquid in the washing machine 1; in particular, said distribution circuit may comprise a delivery duct 8 associated with a pump 9, a first valve 10a for supplying wash liquid and rinse liquid to a first pipe 11a associated with the first sprayer 3a, and a second valve 10b for supplying wash liquid and rinse liquid to a second pipe 11b associated with the second sprayer 3b.

[0044] Preferably, said step e) is followed by a step f) of activating said heating means 7 in order to warm up said rinse liquid to a first temperature T1, lower than a reference temperature TR, in the event that said step e) has verified the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub 2.

[0045] The step f) of activating the heating means 7 to a first temperature T1 lower than a reference temperature TR allows to attain an adequate energy saving, while at the same time not altering the crockery drying performance of the washing machine 1 according to the present invention, since the rinse aid agents known in the art also have the function of facilitating the drying of the crockery.

[0046] Consequently, the detection of rinse aid agents in the tub 2 according to the method of the present invention allows activating the heating means 7 to a first temperature T1 lower than a reference temperature TR, in particular during a possible step of drying and/or rinsing the crockery following a wash cycle. Conversely, the heating means 7 will be activated to a temperature higher than said reference temperature TR in the event that said

step e) verifies that the increase of the degree of turbidity of the rinse liquid between said first measurement M1 and said second measurement M2 is smaller than said predetermined lower threshold value Y%. In such a case, one may alternatively choose to keep the heating means 7 at the reference temperature TR and to protract the rinsing and/or drying treatments by an additional time period. Said step e) is followed by a step g) of activating signalling means 12 in the event that said step e) has not verified the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub 2. The activation of the signalling means 12 allows warning a user about the fact that the rinse aid agent was not actually released into the tub 2 during the release step R.

[0047] Furthermore, the step a) of taking a first measurement M1 of the degree of turbidity of the rinse liquid in the tub 2 may be carried out at the end of a first dish wash step. As is known, during said first dish wash step a wash agent, such as a detergent adapted to remove dirt from crockery, is typically added to the wash liquid supplied from the water main.

[0048] In particular, said step a) of taking a first measurement M1 of the degree of turbidity of the rinse liquid in the tub 2 may be carried out during an intermediate rinse step to be executed between said first wash step and a second rinse aid step; said rinse aid step substantially begins with the rinse aid release step R.

[0049] Preferably, the method for detecting a rinse aid agent according to the present invention is implemented by keeping the revolution speed of a pump 9 substantially constant; in particular, said method is implemented with a revolution speed of the pump 9 of approximately 2500 revolutions per minute (rpm). Said method is preferably executed when the rinse liquid is at a temperature between 40°C and 50°C, preferably between 45°C and 48°C, more preferably at a temperature of 47°C.

[0050] In addition, said step of releasing R the rinse aid agent into the tub 2 may be carried out by opening a distributor device (not shown in the drawings) filled with said rinse aid agent, said distributor device being usually positioned in a door (not shown in the drawings since it is known in the art) allowing access to the tub 2.

[0051] Said release step R may also be carried out by using a so-called "multiphase preparation", which typically comprises an active principle adapted to aid the rinsing of the dishes, coated with a layer of protective material, usually wax, which melts optimally when a certain temperature is reached inside the tub 2. The features of the present invention, as well as the advantages thereof, are apparent from the above description.

[0052] In particular, the method for detecting a rinse aid agent in a rinse liquid of a washing machine 1 for household use, in particular a dishwasher, according to the present invention allows taking a reliable and constant measurement of both the degree of turbidity of the rinse liquid and of the presence of rinse aid agent in the rinse liquid.

[0053] In fact, the method according to the present in-

vention allows making a detection which is not affected by or dependent on a number of possible system variables, such as the degree of dirtiness of the crockery treated in a specific program and/or changes in the optical characteristics of the materials where the measurement is taken and/or degradation of the optoelectronic components of the sensing means in use.

[0054] A further advantage of the method according to the present invention is that the activation of the heating means 7 to a first temperature T1 lower than a reference temperature TR allows to attain an adequate energy saving, while at the same time not altering the performance, in particular the dish drying performance, of the washing machine 1.

[0055] Another advantage of the method according to the present invention is that the detection of the presence of rinse aid agents in the tub 2 allows to eliminate those mechanical, electromechanical or electronic devices known in the art for detecting the rinse aid agent in the distributor device into which said rinse aid agent can be placed. This elimination inevitably implies a reduction in the costs incurred when manufacturing the washing machine 1.

[0056] The method and the washing machine for household use described herein by way of example may be subject to many possible variations without departing from the novelty spirit of the inventive idea; it is also clear that in the practical implementation of the invention the illustrated details may have different shapes or be replaced with other technically equivalent elements.

[0057] Among such variants, it is worth pointing out the possibility that the dishwashing machine comprises a method alternative to condensation for drying the crockery. For example, patent application WO2009/008828 describes a dishwashing machine equipped with a dedicated evaporation-type drying circuit. Also when using such an alternative method, the drying processes (and in particular the parameters thereof, such as, for example: times, temperatures, etc.) are controlled by taking into account the presence, absence or insufficiency of rinse aid agent following a detection made by means of a turbidity sensor. One may even perform a full calibration of the drying system in use (e.g. a system comprising: fan, electric resistor, hygroscopic material, etc.) as a function of the presence, absence or insufficiency of rinse aid agent.

[0058] It can therefore be easily understood that the present invention is not limited to the above-described method and washing machine, but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

Claims

1. A method for detecting a rinse aid agent in a rinse liquid of a washing machine (1) for household use,

in particular a dishwasher, said washing machine (1) comprising:

- a control system (SC), in particular of the electric or electronic type, for handling and controlling the operation of the washing machine (1), said control system (SC) being adapted to implement at least one rinse program;
- a tub (2) in which dishes are treated by means of a rinse liquid, in particular water, added with a rinse aid agent during said at least one rinse program;
- sensing means (5a, 5b, 5c) associated with said tub (2) and connected to said control system (SC) for detecting the degree of turbidity of the rinse liquid in the tub (2),

said method being **characterized in that** it is executed by said control system (SC) and comprises the steps of:

- a) taking a first measurement (M1) of the degree of turbidity of the rinse liquid in the tub (2);
 - b) executing a step of releasing (R) the rinse aid agent into the tub (2);
 - c) taking a second measurement (M2) of the degree of turbidity of the rinse liquid in the tub (2);
 - d) comparing said first measurement (M1) with said second measurement (M2);
 - e) verifying the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub (2) for the purpose of detecting the presence of the rinse aid agent in said tub (2).
2. A method according to claim 1, **characterized in that** said step e) comprises the step of verifying that said predefined increase of the degree of turbidity of the rinse liquid between said first measurement (M1) and said second measurement (M2) is greater than a predetermined upper threshold value (X%), in particular equal to 3% or 7% or 10%.
 3. A method according to any one of the preceding claims, **characterized in that** said step e) verifies that the increase of the degree of turbidity of the rinse liquid between said first measurement (M1) and said second measurement (M2) is smaller than a predetermined lower threshold value (Y%), in particular equal to 5% or 2% or 1%.
 4. A method according to claims 2 and 3, wherein said upper threshold value (X%) is greater than said lower threshold value (Y%), **characterized in that** said step e) is implemented in a manner such as to verify that the detected increase of the degree of turbidity of the rinse liquid is within a predetermined intermediate range.

5. A method according to one or more of the preceding claims, **characterized in that** said step e) is followed by a step f) of activating heating means (7) in order to warm up said rinse liquid to a first temperature (T1) lower than a reference temperature (TR) in the event that said step e) has verified the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub (2).
6. A method according to claims 3 and 5, **characterized in that** said heating means (7) are activated to a temperature higher than said reference temperature (TR) in the event that said step e) has verified that the increase of the degree of turbidity of the rinse liquid between said first measurement (M1) and said second measurement (M2) is smaller than said predetermined lower threshold value (Y%).
7. A method according to one or more of the preceding claims, **characterized in that** said step e) is followed by a step g) of activating signalling means (12) in the event that said step e) has not verified the existence of a predefined increase of the degree of turbidity of the rinse liquid in the tub (2).
8. A method according to claim 1, **characterized in that** said step a) of taking a first measurement (M1) of the degree of turbidity of the rinse liquid in the tub (2) is executed at the end of a first dish wash step, said step a) being in particular executed during an intermediate rinse step between said first wash step and a second rinse aid step.
9. A method according to one or more of the preceding claims, **characterized in that** it is implemented by keeping the revolution speed of a pump (9) substantially constant, said revolution speed being preferably of approx. 2500 rpm.
10. A washing machine (1) for household use, in particular a dishwasher, implementing a method for detecting a rinse aid agent in a rinse liquid according to one or more of the preceding claims from 1 to 9.

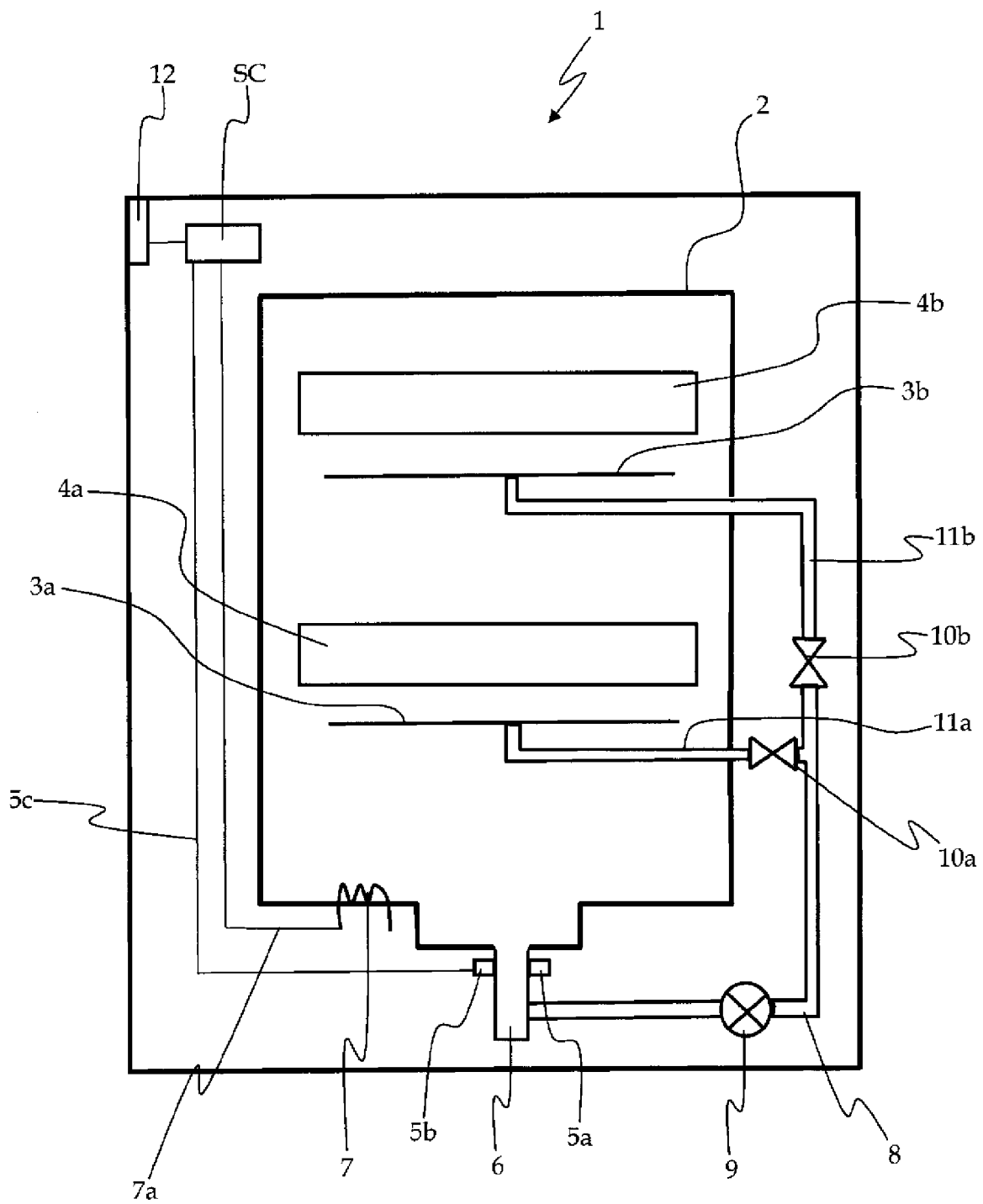


Fig. 1

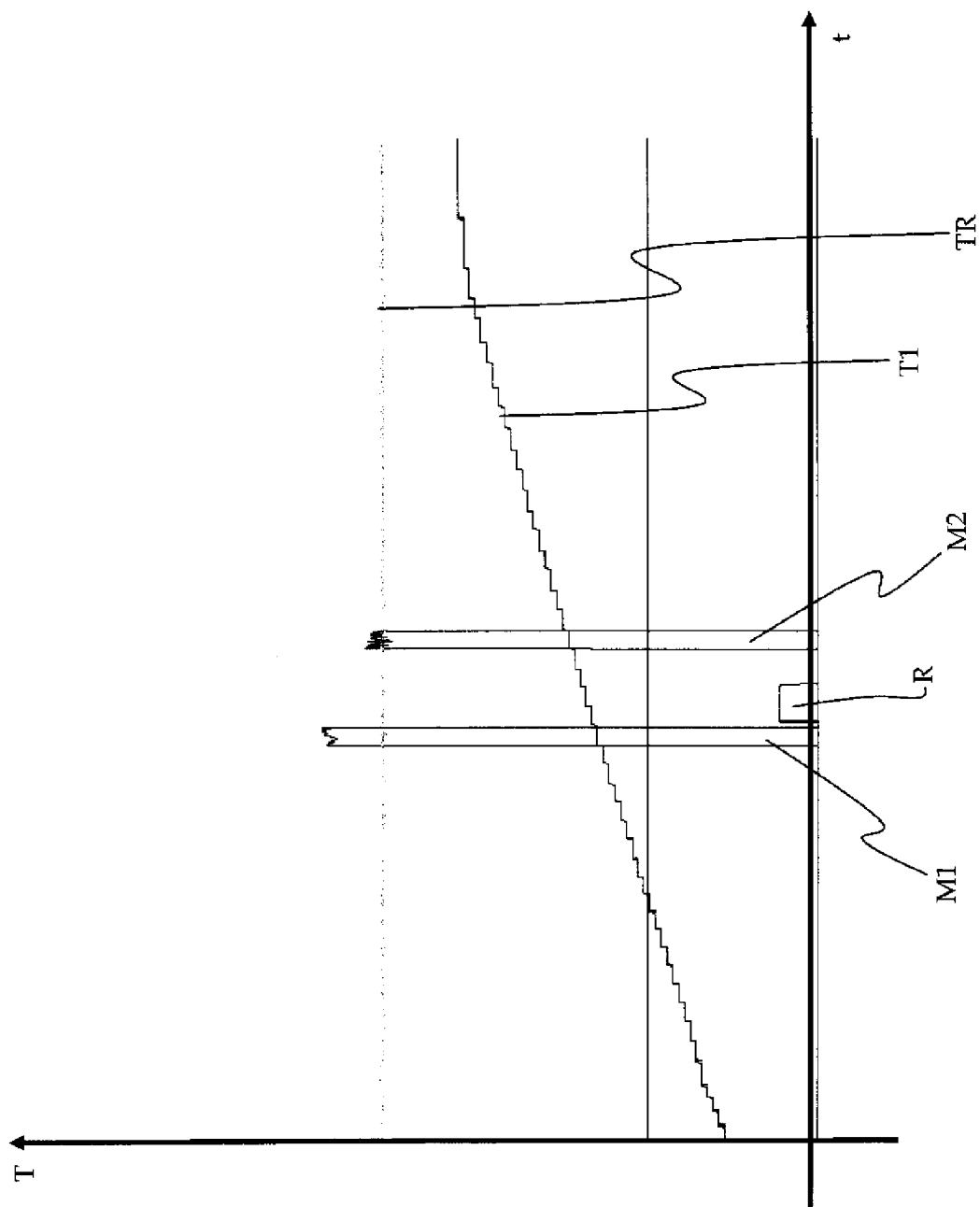


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5797409 A [0009] [0010] [0011]
- EP 1335060 A [0031]
- WO 2009008828 A [0057]