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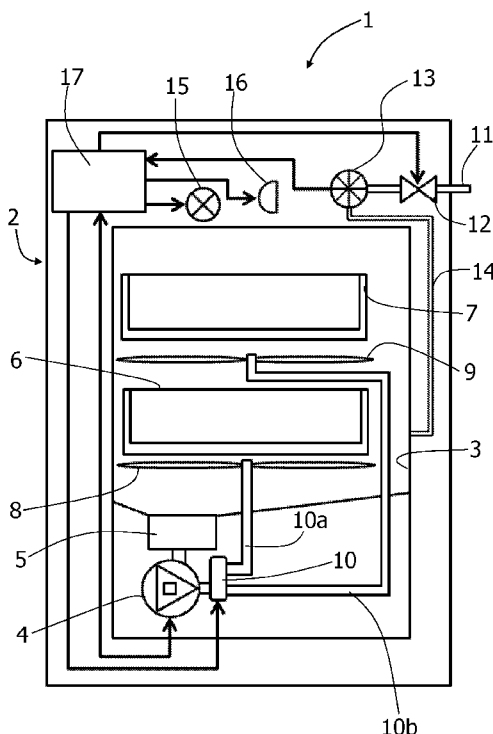
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(54) Title: METHOD FOR CONTROLLING FILLING WITH WATER OF A WATER-CONDUCTING ELECTRIC HOUSE-
HOLD APPLIANCE

Fig. 1



(57) Abstract: It is described a method for controlling filling with water of a water-conducting electric household appliance (1) having a control system (17), such as a dishwashing machine or a laundry washing machine. After the start of a treatment program of the electric household appliance (1): the control system (17) controls opening of a loading valve (12) set on a line (11, 14) for conveying water to a treatment container (3) of the electric household appliance (1); the control system (17) monitors a sensor (13) prearranged for detecting conveyance of water to the treatment container (3); in presence of a signal from the sensor (13), the control system evaluates if such signal is usable for the purposes of water dosage, or compatible with a predetermined value or range of values, and, in the negative case, the control system (17) provides for carrying out corrective actions.



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"Method for controlling filling with water of a water-conducting electric household appliance"

Field of the invention

5 The present invention refers to the water-conducting electric household appliances in general, such as dishwashers and laundry washing machines, and has been developed with particular reference to the methods for the loading of water in such appliances.

Background art

10 Water-conducting electric appliances such as dishwashers and laundry washing machines have a treatment container, designed to receive items to be washed. In general, a treatment program of such household appliance comprises a plurality of operating steps, at least some of which performed with water, such as steps of pre-washing, washing, rinsing, soaking. Each of these steps involves the
15 loading of water into the treatment container, the execution of a respective part of the treatment and then the drain of the used liquid. In some cases, after an initial filling of water into the treatment container, the control system controls the execution of one or more re-fillings, during a same program step.

 The water is usually drawn from the domestic water supply and its
20 volume is dosed with a filling sensor, typically a sensor of a pneumatic type (such as a pressure switch), a sensor of a volumetric type (such as a flow meter with impeller) or a sensor of an optical (such as a device including a light emitter and a light receiver).

 It might be possible that the filling sensor, for several reasons, does not
25 operate correctly and/or does not provide the machine control system with a respective signal. EP 2276388 A discloses a method to control the filling up of a water-conducting electric appliance, according to which the possible condition of a total failure of a filling sensor is detected by using a washing pump and evaluating the flow-rate characteristic curve of the pump.

30 Aim and summary of the invention

 The present invention aims to obtain a method which allows controlling the filling with water of a water-conducting household electric appliance even in presence of anomalous signals from a sensor of the aforementioned type.

 One auxiliary aim of the invention is to provide a method alternative to
35 the one known from EP 2276388 A, to be used in case of absence of signal from a

filling sensor, which is however simpler and more quick to intervene.

One or more of these aims is obtained, according to the present invention, by a method to control the filling with water of a water-conducting household electric appliance having the characteristics indicated in claim 1.

5 Preferred features of the invention are indicated in the sub-claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

Further aims, features and advantages of the present invention will
10 become apparent from the following description, with reference to the appended drawings, provided for purely illustrative and not limiting purposes, in which:

- Figure 1 is a schematic representation in section of a dishwasher which implements the method according to the present invention.

Description of preferred embodiments of the invention

15 The reference to "one embodiment " in the context of this description is intended to indicate that a particular configuration, structure or characteristic described in relation to the embodiment is included in at least one embodiment. Hence, the terms "in one embodiment" and the like, that are present in different points of this description, do not necessarily refer to the same embodiment.
20 Furthermore, particular conformations, structures, or characteristics may be combined in any adequate way in one or more embodiments. The references used herein are for convenience only and do not define the scope of protection of the embodiments.

It is also pointed out that in the following description there will be
25 described only the elements useful for the understanding of the invention, taking for granted that the appliance according to the invention comprises all the elements in itself known for its operation, such a possible external cabinet thereof, a user interface, a resistance for water heating, a dispenser of washing agents, and so on.

30 In figure 1 is schematically represented a water-conducting household electric appliance according to a possible embodiment of the present invention, here represented by a domestic dishwasher, illustrated limited to the parts of immediate interest for the understanding of the present invention.

The machine 1 has a structure 2 that comprises a treatment container 3,
35 here represented by a wash tub, having below a housing space in which various

functional components of the machine 1 are positioned, among which a pump 4 and a sump 5 for water collection, as well as other components not shown in the figure for reasons of greater clarity of the drawing. The wash tub 3, of a conception known as a whole, comprises an upper wall, a lower wall and four side walls one of which - the front wall - consists of the inner shell of the door of the machine, not shown here (the so-called "counter door "). In the inside of the wash tub 3 at least one crockery basket is provided: in the depicted example, the machine 1 has a lower basket 6 and an upper basket 7, designed to contain respective loads of crockery.

The machine 1 has a spraying system, which includes at least one sprinkler member to sprinkle with water the crockery contained in a basket. In the shown case, since the machine has two baskets, the spraying system includes two sprinkler members 8 and 9, to sprinkle with water the crockery contained in the baskets 6 and 7, respectively. The spraying system is fed through the wash pump 4 and through a known device 10 for the alternating supply of the sprinklers 8 and 9; the device 10 has at least one inlet, connected to the delivery of the pump 4, and at least two outlets, connected via ducts 10a and 10b to the sprinklers 8 and 9, respectively.

The machine 1 has a supply duct 11, for connection to a domestic water supply mains, on which is a controllable loading valve 12, for example a solenoid valve, preferably of a normally-closed type. The machine also comprises a sensor device, also defined in the following, as filling sensor, prearranged for detecting conveying of water, from the water supply mains, in the tub 3, i.e., for generating signals representative of a level of the supplied water level or of its volume. In a preferred embodiment, such as the represented one, the aforesaid sensor device is a volumetric sensor with an impeller, designated by 13. Sensors of this type are well known in the field. Reference can be made, for example, to EP 0599341 for the description of a flow meter of this type, suitable for the purposes of use on the machine 1.

In general terms, such a sensor includes an impeller set in rotation by the fluid, such impeller integrating or having associated one or more excitation elements; a stationary part of the sensor then includes a detector, suitable to be excited by the excitation elements movable with the impeller. The excitation element or elements can be of a magnetic type, in which case the detector is a magnetic field detector; alternatively, the detection of the rotation of the impeller

can be performed via an optical detector, in which case a part of the same impeller obtains the excitation means.

Very briefly, a fluid entering the sensor device causes a rotation of the, and the number of revolutions of the latter - which is proportional to the volume
5 on inlet - is detected by means of the aforesaid sensor. In the example, the impeller-type filling sensor 13 is operatively arranged between the duct 11 and a duct 14 for feeding water into the tub 3.

Still in the figure, reference 15 designates a visual signalling device, such as a light or a display set on a control panel of the machine. 16 indicates an
10 acoustical signal device, such as a buzzer. With 17 is indicated the control system of the machine, preferably including a microprocessor control unit associated to which are memory means containing program information and data for the execution of a plurality of possible treatment programs of the machine 1. The control system 17 also includes means for the selection and the start of the
15 aforesaid programs, not represented.

In the usual operation, a user - after having loaded the crockery in the tub 3 of the machine 1 - selects a desired treatment program and causes the start thereof, for example by pushing a suitable button. At the start of each treatment step implying use of water provided by the program, the system 17 controls
20 opening of the valve 12, which is kept open as long as the system itself does not detect, by means of the filling sensor 13, the loading in the wash tub 3 of a determined volume of liquid. In the meantime, or thereafter, the control system 17 - after any possible required switching of the device 10 - controls the start of operation of the wash pump 4. The water loaded in the washtub reaches one or
25 both of the sprinkler members 8, 9 and is sprinkled on the content of the baskets 6, 7. The water then falls on the bottom of the tub, to flow off into the sump 5, from which it is again set in circulation via the pump 4. At the end of the treatment step, the control system stops the operation of the wash pump 4 and starts the operation of a drain pump, not shown. Once draining off of the previously used
30 water, the drain pump is stopped and the system 17 controls a new opening of the valve 12, to load the volume of water required for the execution of a subsequent step of the program treatment.

As seen, after the selection and the start of a treatment program, during the loading of water from the water supply mains, the control system 17 monitors
35 a return signal from the filling sensor 13 and uses such signal in order to control

closing of the valve 12.

It is possible that the filling sensor 13 generates a signal, but this signal is not readable or usable in an effective way by the control system 17 for the purposes of the dosage of the volume of water necessary for the operation of the machine.

For example, in a customary impeller-type sensor 13 the number of output signal pulses is substantially proportional to the volume of water that passes through the sensor itself. Given that the domestic water mains are at substantially constant flow rate, the number of pulses generated by the sensor in a unit of time is comprised on average in a range or determined range of values, which can be stored in the control system 17 (note that often the electrovalves for water loading used in the household electric appliances or the same impeller meter include a flow or pressure regulator, also having the function to make the water flow-rate stable; see for example EP 1456576 A). It is however possible that, due to a failure of the sensor, the number of pulses in the time unit does not fall within the aforesaid range: think, for example, to a sensor 13 whose impeller - due to a damage of rotation pin or of the supports of the latter - rotates slowly and in a jerky way or on the contrary rotates too quickly, or to a fault of the detector of the rotation of the impeller.

In accordance with the invention, in presence of one such "anomalous" signal from the sensor 13 - i.e., a signal which is not compatible with a stored reference value or range of values, or anyway incomprehensible or not effectively usable by the system 17 to determine the volume of water that is being loaded in the tub - the control system 17 keeps the loading valve 12 open until elapsing of a predetermined time interval, hereinafter referred to also as third time interval for simplicity, for example comprised between 40 and 80 seconds, preferably about 60 seconds.

After elapsing of such time interval, the control system 17 controls the closing of the loading valve 12 and drives the motor of a treatment pump 4 to a first predetermined speed, preferably a speed lower than the normal washing speed. The fact that the sensor 13 generates a signal, even if an anomalous one, should be indicative of the circumstance that water is anyway entering the appliance: the activation of the pump is essentially aimed at verifying the actual presence of water in the tub 3.

The control system 17 monitors a signal characteristic of the operation of

the motor of the pump 4 and evaluates this signal, by comparing it with a first threshold value. If the characteristic signal does not reach and/or does not exceed the first threshold value, the control system 17 controls a new opening of the valve 12 and then evaluates again the signal characteristic of the operation of the motor of the pump 4: when this characteristic signal reaches the first threshold value, the control system 17 control closing of the valve 12.

The aforesaid characteristic signal can be for example the amount of current absorbed by the motor of the pump 4, which is representative of its characteristic curve, and hence of its load. Of course, nothing prevents to monitor other controllable quantities of the motor, representative of the characteristic curve or of the load of the pump. In one embodiment, the motor of the pump 4 is a brushless motor, electronically controlled, i.e., a permanent magnet motor whose speed is controllable.

It will be appreciated that, being known the characteristics of the hydraulic circuit of the machine 1, by experimental tests it is possible to determine, for various speeds of the motor of the pump 4 and for corresponding values of current absorption, corresponding volumes or range of volumes or water levels in the tub. This information is encoded in a suitable way in the memory means of the control system 17 and is usable for the purposes of the implementation of the process described herein. The step of activation of the pump at the above mentioned first speed is essentially aimed at verifying, by the control system 17, the actual loading in the tub of a water volume or level, even if a minimal one, without yet driving the pump itself to its normal washing speed.

In one embodiment it is provided that, if after the aforesaid new opening of the valve 12, the current absorption by the motor of the pump 4 (or other monitored characteristic signal) does not reach and/or does not exceed the aforesaid first threshold value within a further predetermined time interval, the control system 17 stops the treatment program (and so causes closing of the valve 12), after possible generation of at least one signalling for the user, through the device 15 and/or the device 16, and/or after generation of an error code, to be highlighted on occasion of a subsequent use of the machine. One such circumstance may be considered indicative of the fact that the flow rate of water entering the machine 1 from the water supply mains is very low and implies excessively long times for the achievement of the volume of water required for execution of a treatment step. The aforesaid further predetermined time interval

can be for example comprised between 60 and 120 seconds, preferably between 40 and 80 seconds, and more preferably be of about 60 seconds.

After closing of the valve 12 that occurs after the above time interval, or anyway after the achievement of the said first threshold value, the control system
5 17 drives the motor of the pump 4 to a second speed, preferably greater than the first speed, very preferably at the washing speed. Thereafter, the system 17 evaluates again the current absorption (or other characteristic signal) of the motor of the pump 4: if this signal reaches and/or exceeds a second threshold value, the system 17 controls prosecution of the treatment program in the usual way.
10 Otherwise, the control system 17 controls a new opening of the valve 12, evaluates again the absorption (or other characteristic signal) and when this signal reaches the second threshold value - indicative of the achievement of at least a volume or level of water in the tub appropriate for the execution of the treatment - the control system 17 controls closing of the valve 12 and controls continuation
15 of the treatment program, in the usual way. It will be appreciated that, based on the experimental data stored in the control system 17, the latter is capable to know which value or range of values of current absorption that - at the washing speed of the motor of the pump 4 - corresponds to a water level in the tub which is deemed to be sufficient for the execution of an efficient treatment.

20 In a preferred embodiment of the invention, in the absence of any signal from the filling sensor 13 until the end of a first time interval after the opening of the loading valve 12, the control system 17 activates a signalling, by means of at least one of the visual signalling device 15 and the acoustic signalling device 16. In a preferred embodiment, the visual signalling and the acoustic signalling are
25 both activated. In this way, the user is immediately warned of a possible breakdown of the machine 1 due to a failure of its filling sensor 13 or to an anomalous condition of the water mains, such as the closing of a tap of the water fitting for connecting the machine or the absence of water in the mains.

The aforesaid first time interval has preferably a relatively short
30 predetermined duration, indicatively not greater than one minute and preferably comprised between 10 and 30 seconds, more preferably of about 15 seconds. Note that the first load of water in a treatment program typically happens a few seconds after the start of the program itself: therefore, in accordance with a preferred embodiment of the invention, the warning concerning the anomalous condition
35 occurs in any case after a relatively short time after the start of the program, when

the user is presumably still nearby the machine 1.

In the absence of signal from the filling sensor 13 also until the end of a second time interval, subsequent to aforesaid first time interval, the control system 17 controls ending of the treatment program. Preferably, during the second time
5 interval the control system 17, in addition to monitor the filling sensor 13, keeps the visual signalling and/or the acoustic signalling generated via the device 15 and/or the device 16.

In a preferred embodiment the second time interval has a predetermined duration which is greater than the first time interval, indicatively not greater than
10 five minutes, preferably comprised between 200 and 250 seconds, most preferably about 220 seconds. In this way, after having warned the user in a sure manner concerning the presence of an anomaly in the course of the loading of water, a sufficiently long time (preferably at least 2 - 3 minutes) is offered to the same user for performing a possible corrective action. In other words, even after having
15 started the signalling of the anomaly, the control system 17 remains in a waiting condition for a given period, and continues to monitor the condition of the filling sensor 13: if during this period - the aforesaid second time interval - there occurs the signal from the sensor 13, the treatment program can continue in the usual way; one such case may happen, for example, if the tap of the connection fitting
20 of the machine 1, which was initially, closed, is opened by the user after the start of the visual and /or acoustic signalling.

Conversely, in the case of a prolonged absence of the signal from the sensor 13 for the whole duration of the second time interval, the program is stopped by the control system 17, which sets itself in a state of quiescence. Of
25 course, stopping of the program involves the closing of the loading valve 12. Preferably, but not necessarily, the stopping of the program also implies deactivation of the signalling means 15, 16: in a preferred embodiment, however, before stopping the program, the control system 17 generates an error code that is in any case visually and/or acoustically highlighted on occasion of a subsequent
30 use of the machine.

From the above it is clear that, after a relatively short time from the opening of the loading valve 12 (between 210 and 270 seconds after the opening of the valve 12, in the given example), the program is anyway stopped, if the absence of signal from the sensor 13 persists. As said, the absence of the signal
35 from the sensor 13 may be possibly remedied during the second time interval. For

example this can be the case - already mentioned - of an initially closed tap of the fitting for connection to the water mains, or the case of a momentary jamming of the impeller of the sensor, due to any reasons. The absence of signal that persists throughout the whole second time interval is instead indicative of circumstances
5 such as a total absence of water in the water mains, or else of a failure of the sensor 13 so serious that emission of any signal is impeded, or still the accidental disconnection of the sensor 13 from a connector thereof.

From the above description, are clear the characteristics of present invention, as well as its advantages, mainly represented by the possibility to
10 manage in a simple and quick way the case of generation by a filling sensor of the household appliance, of signals being anomalous with respect usual values, and possibly to manage also the case of absence of any signals from one such filling sensor.

It is clear that many variants are possible for the man skilled in the art to
15 the method described by way of example, without thereby departing from the scope of the invention as defined in the appended claims.

The invention has been exemplified in relation to a water conducting household electric appliance using an impeller-type volumetric meter, but the invention is susceptible of use also in the case of other types of filling sensors,
20 such as pneumatic-type sensors or optical-type sensors.

It is then well-known that some machines for washing are equipped with an internal reservoir, designed for enabling re-use of at least a part of the washing liquid already used for a treatment: the filling sensor provided in accordance with the invention may be a sensor arranged on a supplying line that extends from one
25 such internal reservoir internal of the household electric appliance to the treatment container thereof.

CLAIMS

1. A method for controlling filling with water of a water-conducting electric household appliance (1) having a control system (17), such as a dishwashing machine or a laundry washing machine, wherein, after start of a treatment program of the electric household appliance (1):

a) the control system (17) controls opening of a loading valve (12) set on a line (11, 14) for conveying water to a treatment container (3) of the electric household appliance (1);

b) the control system (17) monitors a sensor (13) prearranged for detecting conveyance of water to the treatment container (3);

c) in presence of a signal from the sensor (13), the control system evaluates if such signal is usable for the purposes of water dosage, or compatible with a predetermined value or range of values, and, in the negative case, the control system (17) keeps the loading valve (12) open until elapsing of a predetermined time interval;

d) after elapsing of the predetermined time interval, the control system (17) controls closing of the loading valve (12) and drives the motor of a treatment pump (4) to a first speed;

e) the control system evaluates (17) a signal characteristic of the operation of the motor of the pump (4) and

e1) if the signal characteristic of the operation of the motor of the pump (4) reaches or exceeds a first threshold value, the control system (17) drives the motor of the pump (4) to a second speed, preferably greater than the first speed, or else

e2) if the signal characteristic of the operation of the motor of the pump (4) does not reach the first threshold value, the control system (17) controls a new opening of the loading valve (12), evaluates the signal characteristic of the operation of the motor of the pump (4) and once the signal characteristic of the operation of the motor of the pump (4) has reached the first threshold value, the control system (17) controls closing of the loading valve (12) and drives the motor of the pump (4) to said second speed;

f) with the motor of the pump (4) at said second speed, the control system (17) evaluates the signal characteristic of the operation of the motor of the pump (4), and

f1) if the signal characteristic of the operation of the motor of the pump (4) reaches or exceeds a second threshold value, the control system (17) controls prosecution of the treatment program, or else

5 f2) if the signal characteristic of the operation of the motor of the pump (4) does not reach the second threshold value, the control system (17) controls a further opening of the loading valve (12), evaluates the signal characteristic of the operation of the motor of the pump (4) and once the signal characteristic of the operation of the motor of the pump (4) has reached the second threshold value, the control system (17) controls
10 closing of the loading valve (12) and controls prosecution of the treatment program.

2. The method according to claim 1, wherein, after steps a) and b), and in the presence of a signal from the sensor (13) usable by the control system (17) for the purposes of water dosage, or compatible with a predetermined value or range
15 of values and, in the positive case, the control system (17) controls prosecution of the treatment program.

3. The method according to claim 1 or claim 2, wherein the predetermined time interval is comprised between 40 and 80 seconds.

4. The method according to claim 1, wherein the second speed is a
20 treatment speed.

5. The method according to claim 1, wherein, if after said new opening of the loading valve (12), the signal characteristic of the operation of the motor of the pump (4) does not reach said first threshold value within a further predetermined time interval, the control system (17) controls ending of the
25 treatment program.

6. The method according to claim 1, wherein

- after steps a) and b), and in the absence of a signal from the sensor (13) until the end of a first time interval after the opening of the loading valve (12), the control system (17) controls activation of a signalling (15, 16); and
30 - in the absence of a signal from the sensor (13) also until the end of a second time interval that follows the first time interval, the control system (17) controls ending of the treatment program.

7. The method according to claim 6, wherein the first time interval is not greater than one minute and is preferably comprised between 10 and 30 seconds.

35 8. The method according to claim 6 or claim 7, wherein the second time

interval is not greater than five minutes and is preferably comprised between 200 and 250 seconds.

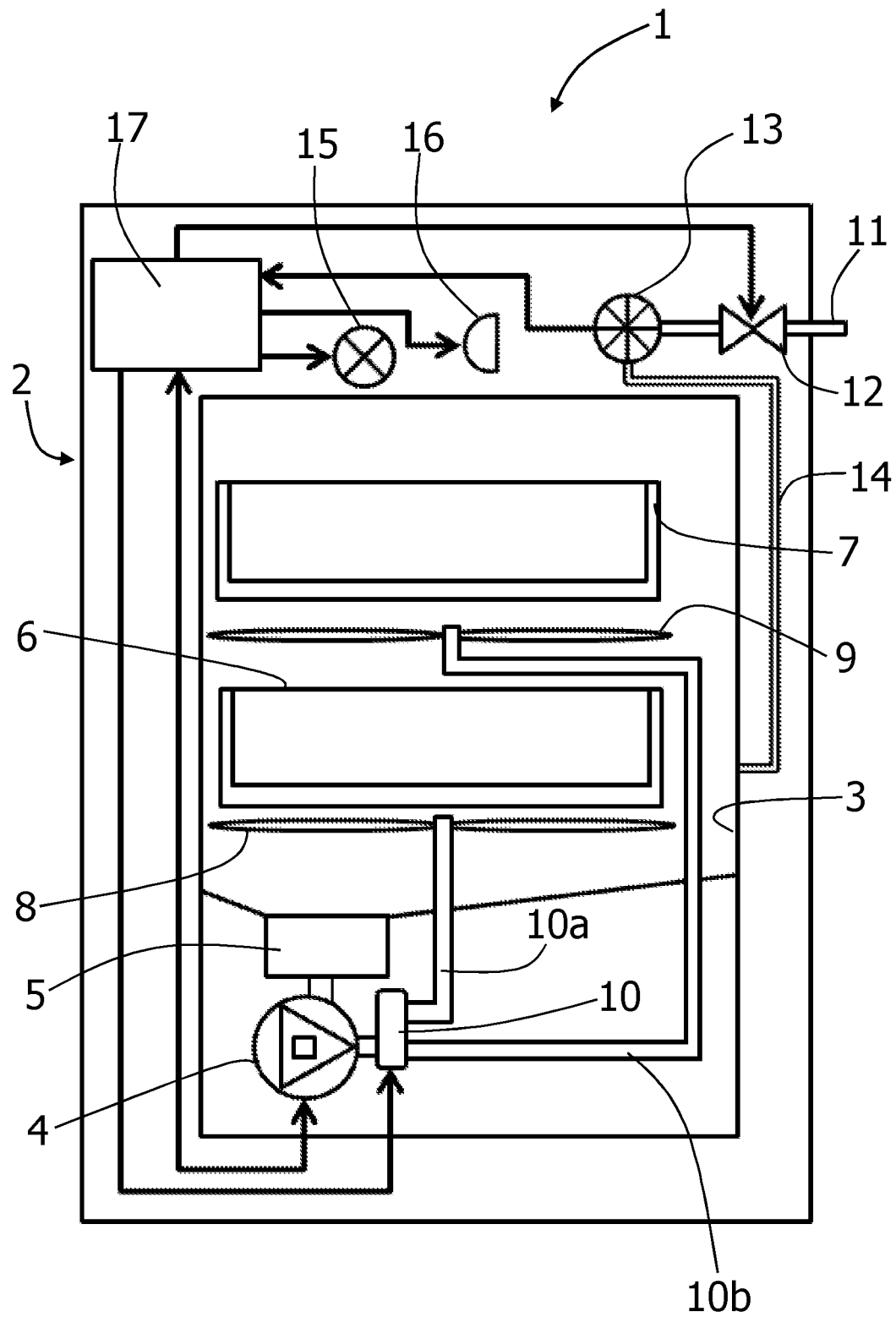
9. The method according to any of claims 6-8, wherein ending of the treatment program is controlled between 210 and 270 seconds after opening of the loading valve (12).

10. The method according to any of the preceding claims, wherein the sensor is an impeller-meter.

11. The method according to any of the preceding claims, wherein the sensor (13) is set on a line for supplying water from an external water main to which the electric household appliance (1) is connected.

12. The method according to any of claims 1-10, wherein the sensor is set on a line for supplying water that extends from a reservoir internal to the electric household appliance to the treatment container (3) thereof.

13. A water-conducting electric household appliance, that implements the method according to one or more of claims 1-12, comprising a treatment container (3), a loading valve (12) set on a line (11, 14) for conveying water to the treatment container (3), a sensor (13) prearranged for detecting conveyance of water to the treatment container (3), a control system (17).

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L15/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/038736 A1 (HESTERBERG BERND [DE] ET AL) 17 February 2011 (2011-02-17) claims; figures -----	1

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

9 April 2014

Date of mailing of the international search report

23/04/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

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