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(54) **METHOD FOR CONTROLLING A WATER SUPPLY AND TREATMENT SYSTEM OF A HOUSEHOLD APPLIANCE, RELATED WATER TREATMENT SYSTEM AND DISHWASHER MACHINE**

(57) Method for controlling a water supply and treatment system (2) for a household appliance (1), comprising the following phases:

- receiving a command for activating the water supply and treatment system (2);
- activating the valve system (21) in order to permit the transit of a water flow;
- monitoring at least one supplied water sensing device (22);
- determining the flow rate of the water flowing through the water supply and treatment system (2);
- executing a decision-making step, wherein it is evaluated if the determined water flow rate exceeds a predefined threshold;

o if the determined flow rate value is greater than or equal to said threshold, then continuing to supply water into the household appliance (1) until the desired quantity is reached, by controlling said valve system (21) in a first mode;

o if the determined flow rate value is smaller than said threshold, then continuing to supply water into the household appliance (1) until the desired quantity is reached, by controlling said valve system (21) in a second mode, different from said first mode;

- deactivating the valve system (21) in order to prevent the transit of a water flow through the water supply and treatment system (2).

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Description

[0001] The present invention relates to a novel method for controlling a water supply and treatment system for a household appliance.

[0002] The present invention also relates to a water supply and treatment system of a household appliance, adapted to be controlled by a method according to the present invention.

[0003] The present invention further relates to a dishwasher machine having a water supply and treatment system according to the present invention.

[0004] It is known that dishwasher machines comprise, in their water supply and treatment system, a safety air-gap system with a backflow prevention function. In the solutions currently known in the art, such air gap allows the transit of a continuous water flow, at a substantially constant rate, towards the portion downstream of the air gap.

[0005] In order to comply with amended safety regulations, the mechanical structure and the circuit of the air gap have been considerably modified.

[0006] Figure 1 schematically shows the structure and the hydraulic operation of air gap 3 according to the regulations in force. In Figure 1 it can be seen that water inlet 31 of air gap 3 is controlled by the valve system 21 of the water supply and treatment system, while the water outflow towards decalcification system 4, through outlet 32, depends on the load losses occurring downstream. In particular, it has been observed that all load losses downstream of air gap 3 are essentially caused by decalcification system 4, whereas the other features and/or devices of the household appliance, in particular those of the hydraulic circuit comprised therein, are substantially irrelevant.

[0007] Although they can be changed, the structural and hydraulic characteristics of decalcification system 4 do not permit a significant reduction of such load losses to avoid that, when the water supply and treatment system is in the supply configuration, i.e. when large amounts of water are required and/or when the water mains to which the water supply and treatment system is connected is delivering a very high flow rate, such water might exit through safety aperture 33 of air gap 3 and overflow into a chamber 12 of the household appliance, e.g. the wash chamber of the dishwasher machine, because it did not succeed in flowing completely towards decalcification system 4.

[0008] Construction solutions are also known wherein the water supply and treatment system can be programmed to deal with variable quantities of water entering the decalcification system, in particular for regenerating the decalcifying substances.

[0009] Such programming is done through an initial setting of the dishwasher machine and is dependent on the hardness level of the inflowing water. Such setting is normally made by the user when the household appliance is used for the first time or in case of changes in the hardness of the inflowing water. Such programming allows setting a predefined opening time for the water intake valve during a water supply phase of the dishwasher machine.

[0010] It is also known that, depending on the hardness of the water, the time of interaction between the water and the decalcifying substances should be conveniently varied, for the purpose of maximizing the effect of the treatment upon the water; therefore, the flow through the decalcification system must be neither too fast nor too slow.

[0011] Moreover, it is known that the water flow rate at the inlet of the water supply and treatment system is not constant in time and space; for example, it depends on the type of water source or system supplying water to the household appliance.

[0012] In light of the above, it appears that it is not sufficient to work on the mechanical structure of the hydraulic circuit of the water supply and treatment system to be certain to avoid any undesired overflow of water into a chamber of the household appliance, e.g. the wash chamber of the dishwasher machine, in all operating conditions of the household appliance.

[0013] Therefore, the need is increasingly felt for a water supply and treatment system which can work in any operating condition in compliance with all law requirements without upsetting the hydraulic circuits and structural characteristics of the components already included in the household appliances being currently manufactured.

[0014] In general, the present invention aims at solving these and other technical problems by providing a method for controlling a water supply and treatment system that ensures the prevention of any undesired overflow of water into a chamber of the household appliance.

[0015] One aspect of the present invention relates to a method for controlling the water supply and treatment system having the features set out in the appended claim 1.

[0016] A further aspect of the present invention relates to a water supply and treatment system having the features set out in the appended claim 10.

[0017] Another further aspect of the present invention relates to a dishwasher machine having the features set out in the appended claim 13.

[0018] Yet another aspect of the present invention relates to a computer program having the features set out in the appended claim 14.

[0019] Auxiliary features are set out in respective dependent claims appended hereto.

[0020] The features and advantages of the method, system, dishwasher machine and program will become apparent

in the light of the following description of several possible illustrative embodiments of the method, water supply and treatment system, dishwasher machine and program, as well as from the annexed drawings, wherein:

- Figure 1 schematically shows one possible embodiment, provided herein by way of non-limiting example, of an air gap capable of complying with the EN 61770 Air gap AB specifications;
- Figure 2 is a flow chart showing a preferred embodiment, provided herein by way of non-limiting example, of the method according to the present invention;
- Figure 3 schematically shows one possible embodiment of a hydraulic circuit of the water supply and treatment system according to the present invention;
- Figure 4 shows a dishwasher machine according to the present invention.

[0021] With reference to the above-listed figures, reference numeral 2 designates as a whole a water supply and treatment system; whereas reference numeral 1 designates as a whole a household appliance.

[0022] The control method according to the present invention is particularly suitable for controlling water supply and treatment systems 2 like those included in household appliances 1, e.g. dishwasher machines.

[0023] The control method according to the present invention is adapted to control a water supply and treatment system 2 comprising: a valve system 21, adapted to selectively adjust the transit of a water flow through said water supply and treatment system 2; at least one supplied water sensing device 22, adapted to sense the flow rate of the water flowing through the water supply and treatment system 2; an air gap 3; and a water decalcification system 4. Some possible embodiments of the water supply and treatment system 2 will be described in detail later on in this specification.

[0024] The control method according to the present invention comprises a sequence of phases, preferably carried out in succession, in particular the following phases:

- receiving a command for activating water supply and treatment system 2 in order to supply a desired quantity of water into said household appliance 1;
- activating valve system 21 in order to permit the transit of a water flow through water supply and treatment system 2;
- monitoring at least one supplied water sensing device 22;
- determining the flow rate of the water flowing through water supply and treatment system 2;
- executing a decision-making step, wherein it is evaluated if the determined water flow rate exceeds a predefined threshold;
 - o if the determined flow rate value is greater than or equal to said threshold, then continuing to supply water into household appliance 1 until the desired quantity is reached, by controlling said valve system 21 in a first mode;
 - o if the determined flow rate value is smaller than said threshold, then continuing to supply water into household appliance 1 until the desired quantity is reached, by controlling said valve system 21 in a second mode, different from said first mode;
- deactivating valve system 21 in order to prevent the transit of a water flow through water supply and treatment system 2 upon reaching the desired water quantity in said household appliance 1.

[0025] The control method according to the present invention is designed in a manner such that said first control mode of valve system 21 is adapted to control said valve system 21 in such a way as to adjust the water flow through water supply and treatment system 2 by varying, in particular reducing, the flow rate of the water flowing through water supply and treatment system 2 downstream of valve system 21, so as to permit an outflow towards water decalcification system 4 as defined by the structural characteristics of said water decalcification system 4, e.g. as a function of a volume of a decalcifying substance in relation to a volume of a first tank 5 comprised in water decalcification system 4, said first tank 5 being adapted to contain said decalcifying substance.

[0026] The control method according to the present invention is also designed in a manner such that said second control mode of valve system 21 is adapted to control said valve system 21 in such a way as to keep substantially unchanged the flow rate of the water flowing through water supply and treatment system 2 downstream of valve system 21. Preferably, said second control mode is such as to avoid making any intentional changes to the water flow rate. Therefore, said valve system 21 will not alter the flow rate in case of flow rate variations, e.g. flow rate reductions and/or increases, caused by external actions, in a water mains to which water supply and treatment system 2 is connected for receiving water. Preferably, such flow rate variations are just small oscillations.

[0027] The control method according to the present invention makes it possible to avoid any undesired overflow of water into a chamber 12 of household appliance 1, thus allowing the water to correctly flow towards the inlet of decalcification system 4. The present invention ensures, therefore, compliance with all the regulations currently in force without upsetting the characteristics of the hydraulic system of water supply and treatment system 2. The present invention is

applicable to solutions wherein the structural, mechanical and hydraulic characteristics of decalcification system 4 are kept substantially unchanged, as well as to solutions wherein said decalcification system 4 is designed with a known volume of decalcifying substance in relation to a volume of said first tank 5, preferably below a certain threshold.

[0028] Furthermore, the present invention makes it possible to obtain a water supply and treatment system 2 which can control the supplied water, e.g. a water supply and treatment system 2 with a variable flow rate downstream of valve system 21.

[0029] In a first possible embodiment of the control method according to the present invention, said first control mode of valve system 21 envisages the following sub-phase:

- deactivating valve system 21, thus preventing the transit of the water flow, for at least a first interval "T1".

[0030] Such time period "T1" is dependent on the flow rate value determined during the phase of determining the flow rate, and is dependent on the characteristics of decalcification system 4, in particular on the load losses generated by such decalcification system 4.

[0031] By selectively interrupting the water flow, the present implementation of the method ensures that the water will correctly flow towards the inlet of decalcification system 4, while preventing any water from undesirably overflowing into chamber 12 of household appliance 1.

[0032] Such an implementation permits obtaining a water supply and treatment system 2 which can control the supplied water, e.g. a water supply and treatment system 2 with a time-variable flow rate downstream of valve system 21, by controlling the water outflow towards said decalcification system 4.

[0033] In an even more preferable embodiment of the control method according to the present invention, said first mode comprises a plurality of sub-phases of deactivating valve system 21 for a first interval "T1": such sub-phases alternate with sub-phases of activating valve system 21, allowing the transit of the water flow for a second interval "T2". The present implementation of the method permits supplying the necessary amount of water to household appliance 1 in intervals or impulses, thus preventing any undesired overflow of water into a chamber 12 of household appliance 1 while allowing the water to correctly flow towards the inlet of decalcification system 4.

[0034] More in general, said valve system 21 receives a power signal, preferably an electric/electronic one. In a previously described embodiment of the control method, said first control mode controls said valve system 21 by means of a power signal with a predetermined duty cycle dependent on the flow rate value determined in the phase of determining the flow rate, and dependent on the characteristics of decalcification system 4. Said power signal is, for example, a pulsed signal.

[0035] For the purposes of the present description, the power signal with a duty-cycle is meant to be the time fraction, e.g. "T2", in which the signal is in the high logic state, which in the case considered herein can activate said valve system 21.

[0036] In an illustrative and non-limiting alternative embodiment of the control method according to the present invention, said first mode envisages the subsequent sub-phase of controlling valve system 21 in such a way as to vary, preferably reduce, the flow rate and control a water outflow through water supply and treatment system 2 below said threshold, thus ensuring a continuous water flow.

[0037] In the present embodiment, instead of selectively interrupting the transit of water through water supply and treatment system 2, the flow rate is selectively reduced without interrupting the transit of the water flow, thus still preventing any undesired overflow of water into chamber 12 of household appliance 1 and ensuring a correct water outflow towards the inlet of decalcification system 4, in particular such outflow being defined by the ratio between the volume of decalcifying substance and the volume of said first tank 5.

[0038] The present solution also reduces the problems caused by vibrations generated when interrupting and restarting the water flow, thereby reducing the risk of failures and/or leaks in the hydraulic circuit.

[0039] In the present embodiment of the method, the flow rate value controlled by valve system 21 below said flow rate threshold is determined as a function of the flow rate value determined in the phase of determining the flow rate and is dependent on the characteristics of decalcification system 4.

[0040] More in general, said flow rate threshold is determined by taking into account a first volume of a first tank 5, comprised in water decalcification system 4, and a second volume of a decalcifying substance contained in said first tank 5.

[0041] By way of non-limiting example, said flow rate threshold is in the range of 2 l/min to 3 l/min, preferably approximately 2.5 l/min.

[0042] In a preferred embodiment of the method according to the present invention, in said second control mode of valve system 21 valve system 21 is activated in such a way as to allow the transit of the maximum possible quantity of water.

[0043] Describing now more in detail the construction of one possible embodiment of water supply and treatment system 2 according to the present invention, which is adapted to be included in a household appliance 1, preferably a dishwasher machine, said water supply and treatment system 2 is adapted to be controlled by the control method according to the present invention.

[0044] Water supply and treatment system 2 according to the present invention comprises: an inlet duct 20 adapted

to be connected to a water mains; a valve system 21, adapted to selectively adjust the transit through said water supply and treatment system 2 of a water flow coming from said water mains. Preferably, said valve system 21 is at least capable of selectively interrupting the transit of the water flow, coming from said water mains, through said water supply and treatment system 2.

[0045] Said water supply and treatment system 2 further comprises at least one supplied water sensing device 22, adapted to sense the flow rate of the water flowing through the water supply and treatment system 2.

[0046] In a preferred, though illustrative and non-limiting, embodiment, said supplied water sensing device 22, which is monitored during the phase of monitoring of the control method according to the present invention, is a flowmeter, preferably a turbine flowmeter. Such a flowmeter is arranged in series in water supply and treatment system 2, in particular downstream of valve system 21, and is adapted to determine the flow rate of the water flowing through water supply and treatment system 2 upstream of air gap 3. The data obtained from such flowmeter permit determining the water flow rate.

[0047] Alternative embodiments of supplied water sensing device 22 may consist of flow-rate sensing devices or pressure sensors. Said flow-rate sensing devices may be of the velocity-measuring type, e.g. static or dynamic ones, or devices directly measuring the flow rate, e.g. volumetric devices, etc., all of which can provide data useful to determine the flow rate of the water flowing in water supply and treatment system 2 upstream of air gap 3, in particular to allow the execution of the phase of determining the water flow rate of the control method according to the present invention. Said pressure sensors may be pressure switches, e.g. positioned in wash chamber 12 of household appliance 1. The data obtained from such pressure sensor, in particular the pressure variations that have occurred, allow determining the amount of water supplied to water supply and treatment system 2.

[0048] Said water supply and treatment system 2 further comprises an air gap 3. Said air gap 3 is positioned downstream of said valve system 21. Figure 1 schematically shows the features of one illustrative and non-limiting possible embodiment of an air gap 3 compliant with the EN 61770 Air gap AB specification. Any alternative embodiments of said air gap not described in detail herein, particularly any embodiments complying with the EN 61770 Air gap AB specification, should also be considered to fall within the present description.

[0049] More in general, downstream of the backflow prevention device or air gap water supply and treatment system 2 may comprise an element, a part of which is adapted to receive the water exiting the backflow prevention device, preferably at atmospheric pressure. Said element has such a hydraulic head with respect to an outlet of the first tank 5 towards a wash chamber 12 of household appliance 1 that allows the transit of a water flow in said first tank 5. Preferably, said element has a hydraulic head with respect to an outlet of the first tank 5 towards a wash chamber 12 of less than 600 mm.

[0050] Said water supply and treatment system 2 further comprises a water decalcification system 4.

[0051] Said water decalcification system 4 in turn comprises: a first tank 5, a second tank 6, and a regeneration circuit 7.

[0052] More in general, water supply and treatment system 2 permits, by means of air gap 3, separating decalcification system 4 from the pressure of the water system, e.g. a water distribution network.

[0053] Said first tank 5 is adapted to contain a decalcifying substance, e.g. epoxy resins. More in general, said first tank 5 is, essentially, that components which is responsible for the above-mentioned load losses. By appropriately designing its shape, particularly its volume, according to the volume of the decalcifying substance contained therein, it is possible to reduce such load losses significantly. Preferably, the ratio between the volume of the decalcifying substance and the volume of the first tank 5 is smaller than or equal to 0.87. By designing a first tank 5 with a volume greater than the volume of the decalcifying substance contained therein, load losses can be reduced. In fact, such a volume ratio ensures that the decalcifying substance, which is typically in granular form, will be able to move freely in all the different operating configurations of water supply and treatment system 2 and/or phases of the control method. Furthermore, such a volume ratio will prevent such granules from getting compacted, thus ensuring a constant a long-lasting load-loss reduction.

[0054] For the purposes of the present description, said volume of the decalcifying substance is determined by pouring such decalcifying substance into a graduated container containing water, leaving such decalcifying substance to settle for some time, e.g. two hours, and then measuring the level of such decalcifying substance in such graduated container. Furthermore, the volume value determined in this way is smaller by approximately 8% than obtainable by means of the international method of measurement.

[0055] Said second tank 6 is adapted to contain a substance for regenerating said decalcifying substance. In the embodiment wherein said decalcifying substance consists of resins, such regenerating substance is sodium chloride or salt dissolved in water, e.g. brine. Said second tank 6 comprises a neck for suitably refilling said second tank 6 with substance for regenerating said decalcifying substance. Such neck is advantageously situated inside wash chamber 12 of household appliance 1, in particular a dishwasher machine. Said neck can be suitably closed by means of a cap 63.

[0056] Said regeneration circuit 7 is adapted to allow for selective transit of a regenerating substance from the second tank 6 towards the first tank 5. In particular, said regeneration circuit 7 is selectively capable of supplying a known quantity of substance for regenerating said decalcifying substance. In particular, such regeneration phase occurs after a known

period of time and/or a known number of wash cycles, depending on the hardness of the water supplied to water supply and treatment system 2. As is known to those skilled in the art, this procedure allows the decalcifying substance to regain its decalcifying properties. In one illustrative and non-limiting possible embodiment of said regeneration circuit 7, it comprises a pump capable of delivering a known quantity of regenerating substance per time unit. One illustrative and non-limiting possible embodiment of regeneration circuit 7 is described in patent application EP2564752A1 and/or in patent application WO2016203443A1.

[0057] Alternative embodiments of regeneration circuit 7, comprising switching valves and circuits, should be considered as other possible embodiments of regeneration circuit 7 of water supply and treatment system 2 according to the present invention.

[0058] In a preferred, though illustrative and non-limiting, embodiment, said valve system 21 is a supply valve adapted to selectively either fully open, to allow a fluid to flow through it, or fully close, to prevent the fluid from flowing through it. Said supply valve is, for example, a safety system of household appliance 1, to which said water supply and treatment system 2 is connected. In a preferred embodiment of valve system 21, the activation of valve system 21 results in valve system 21 being fully opened; whereas the deactivation of valve system 21 results in valve system 21 being fully closed.

[0059] In an illustrative and non-limiting alternative embodiment, said valve system 21 is a proportional valve adapted to selectively open to adjust the water flow rate. The opening extent of the proportional valve can be controlled by means of a supply and/or control signal. Said proportional valve is also adapted to close to prevent the transit of fluid through it when said valve is off. Said proportional valve is, for example, a safety system of household appliance 1 to which said water supply and treatment system 2 is connected, e.g. acting as a supply valve.

[0060] In an illustrative and non-limiting alternative embodiment, said valve system 21 comprises both a supply valve, as previously described, and a proportional valve, as previously described, the latter being preferably situated downstream of the supply valve. Said valve system 21 ensures a high degree of safety, since a specific supply valve can be implemented, while also allowing the execution of the control method according to the present invention, wherein mode 1 and mode 2 are executed by controlling said proportional valve. In one possible embodiment of valve system 21, said supply valve and said proportional valve are included in a single valve body, wherein respective shutters work in series along the duct portion formed between the inlet and the outlet of the common valve body.

[0061] Any alternative embodiments of valve system 21 which have not been described in detail herein, but which will be apparent to a person skilled in the art in light of the contents of the present patent application, shall be considered to fall within the protection scope of the present invention.

[0062] Figure 3 schematically shows one illustrative and non-limiting possible embodiment of the hydraulic circuit of water supply and treatment system 2 according to the present invention. In Figure 3 one can see inlet duct 20 adapted to be hydraulically connected to a water mains. Downstream of inlet duct 20 there is valve system 21. Downstream of the valve system 21 there is supplied water sensing device 22, e.g. a flowmeter. In the illustrated embodiment, said valve system 21 and said supplied water sensing device 22 are controlled by a control system 13, the latter being comprised in water supply and treatment system 2 or being the control system comprised in household appliance 1, e.g. a dishwasher machine. In the illustrated embodiment, said control system 13 comprises a control unit 131 and a memory means 132. Said memory means 132 stores a computer program comprising the phases of the control method according to the present invention. Said computer program is executed by control unit 131, which can send control signals to the devices and systems included in water supply and treatment system 2 according to the present invention.

[0063] Downstream of supplied water sensing device 22 there is air gap 3, which is preferably adapted to fulfil all the requirements of the EN 61770 Air gap AB specification.

[0064] The water flow out of air gap 3 can reach, by gravity, both decalcification system 4 and wash chamber 12 of a dishwasher machine 1 according to modes that will be described below by way of example.

[0065] In the embodiment illustrated in Figure 3, the water flow falling by gravity into decalcification system 4 enters said first tank 5 containing decalcifying substances. Said first tank 5 is in fluidic communication with wash chamber 12, thus allowing the water flowing through the first tank 5 to arrive decalcified at wash chamber 12. The same first tank 5 is in fluidic communication with both the second tank 6 and said regeneration circuit 7 to allow, whenever necessary, a quantity of regenerating substance to be supplied to said first tank 5 from said second tank 6 in order to regenerate the decalcifying substances, as previously specified, through said regeneration circuit 7.

[0066] In one illustrative and non-limiting possible embodiment of the hydraulic circuit of water supply and treatment system 2, the water coming from the first tank 5 enters wash chamber 12 through the neck of cap 63 associated with the second tank 6, e.g. as described in patent application EP1844694A1.

[0067] In a preferred embodiment of regeneration circuit 7, the regeneration phase occurs in a closed loop by means of a pump comprised in regeneration circuit 7.

[0068] Referring back to the control method according to the present invention, Figure 2 shows a flow chart representing a preferred implementation of the control method according to the present invention.

[0069] The following is the sequence of phases shown in Figure 2:

a) receiving a command for activating water supply and treatment system 2 in order to supply a desired quantity of water into said household appliance 1;
 b) activating valve system 21 in order to permit the transit of a water flow through water supply and treatment system 2;
 c) monitoring at least one supplied water sensing device 22;
 d) determining the flow rate of the water flowing through water supply and treatment system 2;
 e) executing a decision-making step, wherein it is evaluated if the determined water flow rate exceeds a predefined threshold;

- if the determined flow rate value is greater than or equal to said threshold, following the path "YES" to get to phase e1) of continuing to supply water into household appliance 1 until the desired quantity is reached, by controlling said valve system 21 in a first mode;
- if the determined flow rate value is smaller than said threshold, then following the path "NO" to get to phase e2) of continuing to supply water into household appliance 1 until the desired quantity is reached, by controlling said valve system 21 in a second mode, different from said first mode;

f) deactivating valve system 21 in order to prevent the transit of a water flow through water supply and treatment system 2 upon reaching the desired water quantity in said household appliance 1.

[0070] In another possible embodiment of the control method according to the present invention, the phase of executing a decision-making step, e.g. the above-mentioned step e), is preceded by a decision-making sub-phase g). In said decision-making phase g) it is evaluated if, in the phase of receiving a command for activating water supply and treatment system 2, decalcified water should be mixed with non-decalcified water to be supplied into wash chamber 12. If the result of such decision-making phase is yes, then said valve system 21 will be controlled in a third mode, different from said first mode and said second mode, until the desired quantity of water is reached.

[0071] In said third mode, as water continues to be supplied into household appliance 1 until the desired quantity is reached, said valve system 21 is controlled in such a way as to reduce below said threshold the flow rate of the water flowing through water supply and treatment system 2 downstream of valve system 21, and then selectively equal or exceed said water flow rate threshold for at least a predetermined time period "T3". Such time period "T3" is dependent on the flow rate value determined in the phase of determining the flow rate, and is dependent on the characteristics of decalcification system 4, and in particular on the load losses generated by such decalcification system 4 and the structural characteristics of air gap 3. Said time period "T3" is such as to allow water to naturally exit through aperture 33 of air gap 3 and flow towards wash chamber 12.

[0072] More in general, in a preferred, though illustrative and non-limiting, embodiment of the control method according to the present invention, said phase e2) of the method comprises the following sub-phases:

- continuing to monitor said supplied water sensing device 22;
- determining the flow rate of the water flowing through water supply and treatment system 2;
- executing a decision-making step, wherein it is still evaluated if the determined water flow rate exceeds a predefined threshold;

- o if the determined flow rate value is greater than or equal to said threshold, switching to phase e1) ;
- o if the determined flow rate value is smaller than said threshold, staying in phase e2).

[0073] The present embodiment continues to monitor supplied water sensing device 22 in order to avoid that any uncontrolled increase in the supplied quantity of water, due to unexpected variations in the flow rate of the water mains to which water supply and treatment system 2 is connected, might cause water to undesirably overflow into wash chamber 12.

[0074] As aforementioned, the control method according to the present invention is well suited to be implemented as a computer program. Said computer program is adapted to be stored in a memory means 132 comprised in a control system 13. Said control system 13 may either be comprised in water supply and treatment system 2 or be comprised in household appliance 1. Said program is adapted to be executed by a control unit 131. Said computer program envisages, and comprises, the phases of the control method for controlling a water supply and treatment system 2 for a household appliance 1 according to the present invention, preferably in accordance with the preferred embodiment shown in Figure 2.

[0075] As aforementioned, water supply and treatment system 2 is adapted to be comprised in a dishwasher machine 1, and water supply and treatment system 2 is adapted to be controlled by the control method according to the present invention.

[0076] In a preferred, though illustrative and non-limiting, embodiment of dishwasher machine 1, it comprises a wash

chamber 12 and a door 10. Said door 10 is adapted to allow access to said wash chamber 12. Dishwasher chamber 1 further comprises a control system 13. Said control system 13 is adapted to allow the execution of the operations and wash programs of dishwasher machine 1, e.g. for sending the activation commands of water supply and treatment system 2.

[0077] Said dishwasher machine 1 comprises a water supply and treatment system 2 according to the present invention.

[0078] Said control system 13 is adapted to execute the method for controlling the supply and decalcification system 2 according to the present invention.

[0079] Figure 4 shows one possible embodiment of dishwasher machine 1 according to the present invention. Dishwasher machine 1 comprises a wash chamber 12, in which one or more baskets can be positioned which are adapted to contain crockery; a door 10, adapted to sealingly close said wash chamber 12; and a sump 11 for recovering the water, as is known to those skilled in the art. In Figure 4 it is also possible to see cap 63 of the second tank comprised in the decalcification system of water supply and treatment system 2 according to the present invention.

[0080] The control method according to the present invention also allows water supply and treatment system 2 to manage variable flow rates, thus ensuring proper control of valve system 21, in particular by permitting the controlled opening and closing of valve system 21, also when variable flow rates are defined according to the hardness of the inflowing water.

[0081] The control method according to the present invention also allows mixing decalcified water with non-decalcified water, e.g. coming directly from the water mains to which water supply and treatment system 2 is connected. Such mixing, e.g. occurring in accordance with phase g) of the method, is accomplished in a simple and quick manner, without requiring the use of any other valve devices, such as solenoid valves, in addition to said valve system 21. In fact, the control method according to the present invention makes it possible to suitably control said valve system 21, e.g. by opening and closing said valve system 21. Water supply and decalcification system 2 requires no further valve devices, e.g. solenoid valves, to allow mixing decalcified water with non-decalcified water to be supplied into wash chamber 12.

[0082] The control method according to the present invention allows supply and treatment system 2 to supply water into decalcification system 4 by gravity, without it overflowing from air gap 3 and reaching wash chamber 12, even when the flow rate at the inlet is high, in particular above said threshold.

[0083] Water supply and treatment system 2 according to the present invention is advantageously applicable to systems compliant with the new EN 61770 Air gap AB specification thanks to the control method according to the present invention, which makes it possible to appropriately control valve system 21 in the event that the flow rate exceeds a predetermined threshold, so as to allow the water to enter decalcification system 4, in particular by allowing it enough time to flow towards the decalcification system.

[0084] Any other embodiments of the method, water supply and treatment system 2 and household appliance which have not been specifically described or illustrated herein, but which will be apparent to a person skilled in the art in light of the technical contents and examples provided herein, shall be considered to fall within the scope of the present invention.

REFERENCE NUMERALS

[0085]

Household appliance	1
Door	10
Sump	11
Wash chamber	12
Control system	13
Control unit	131
Memory means	132
Water supply and treatment system	2
Inlet duct	20
Valve system	21
Supplied water sensing device	22
Air gap	3
Inlet	31
Outlet	32
Aperture	33
Decalcification system	4
First tank	5
Second tank	6

Cap	63
Regeneration circuit	7

5 Claims

1. Method for controlling a water supply and treatment system (2) for a household appliance (1), wherein said water supply and treatment system (2) comprises: a valve system (21), adapted to selectively adjust the transit of a water flow through said water supply and treatment system (2); at least one supplied water sensing device (22), adapted to sense the flow rate of the water flowing through the water supply and treatment system (2); an air gap (3), located downstream of said valve system (21); and a water decalcification system (4);

said method comprising the following phases, preferably carried out in succession:

- a) receiving a command for activating the water supply and treatment system (2) in order to supply a desired quantity of water into said household appliance (1);
- b) activating the valve system (21) in order to permit the transit of a water flow through the water supply and treatment system (2);
- c) monitoring at least one supplied water sensing device (22) ;
- d) determining the flow rate of the water flowing through the water supply and treatment system (2) upstream of the air gap (3);
- e) executing a decision-making step, wherein it is evaluated if the determined water flow rate exceeds a predefined threshold;

- if the determined flow rate value is greater than or equal to said threshold, then e1) continuing to supply water into the household appliance (1) until the desired quantity is reached, by controlling said valve system (21) in a first mode;

- if the determined flow rate value is smaller than said threshold, then e2) continuing to supply water into the household appliance (1) until the desired quantity is reached, by controlling said valve system (21) in a second mode, different from said first mode;

f) deactivating the valve system (21) in order to prevent the transit of a water flow through the water supply and treatment system (2) upon reaching the desired water quantity in said household appliance (1);

wherein said first control mode is adapted to control said valve system (21) so as to adjust the water flowing through the water supply and treatment system (2) by changing the flow rate of the water flowing through the water supply and treatment system (2) downstream of the valve system (21); and wherein said second control mode is adapted to control said valve system (21) so as to keep the flow rate of the water flowing through the water supply and treatment system (2) substantially unchanged downstream of the valve system (21) .

2. Method according to claim 1, wherein said first mode envisages the following sub-phase:

- deactivating the valve system (21), thus preventing the transit of the water flow, for at least a first interval (T1).

3. Method according to claim 2, comprising a plurality of sub-phases of deactivating the valve system (21) for a first interval (T1); such sub-phases of deactivating being alternated with sub-phases of activating the valve system (21), wherein water is allowed to flow, for a second interval (T2).

4. Method according to one of the preceding claims, wherein said first mode provides for controlling said valve system (21) by means of a power signal with a duty cycle.

5. Method according to claim 1, wherein said first mode envisages the following sub-phase:

- controlling the valve system (21) so as to reduce the flow rate of the water flowing through the supply and treatment system (2) below said threshold, while allowing a continuous transit of the water flow.

6. Method according to claim 1, wherein said flow rate threshold is determined as a function of a first volume of a first

tank (5), comprised in the water decalcification system (4), and a second volume of a decalcifying substance contained in said first tank (5).

7. Method according to claim 1, wherein said supplied water sensing device (22) monitored during the monitoring phase is a flowmeter arranged in series in the water supply and treatment system (2); the data obtained from such flowmeter permit determining the water flow rate.

8. Method according to claim 1, wherein the phase of executing a decision-making step is preceded by a decision-making sub-phase g);

in said decision-making sub-phase g) it is evaluated if in the phase of receiving a command for activating the water supply and treatment system (2) it is necessary to mix decalcified water with non-decalcified water to be supplied into the wash chamber (12); if so, said valve system (21) will be controlled in a third mode, different from said first mode and said second mode;

in said third mode, as water continues to be supplied into the household appliance (1) until the desired quantity is reached, said valve system (21) is controlled in such a way as to reduce below said threshold the flow rate of the water flowing through the water supply and treatment system (2) downstream of the valve system (21), and then selectively equal or exceed said water flow rate threshold for at least a predetermined time period (T3).

9. Method according to claim 8, wherein during said phase g) the mixing is carried out without using any further valve devices in addition to said valve system (21).

10. Water supply and treatment system (2) for a household appliance (1), comprising:

- an inlet duct (20) adapted to be connected to a water mains;
- a valve system (21), adapted to selectively adjust the transit through said water supply and treatment system (2) of a water flow coming from said water mains;
- at least one supplied water sensing device (22), adapted to sense the flow rate of the water flowing through the water supply and treatment system (2);
- an air gap (3), located downstream of said valve system (21) ;
- a water decalcification system (4), in turn comprising a first tank (5), adapted to contain a decalcifying substance; a second tank (6), adapted to contain a substance for regenerating said decalcifying substance; and a regeneration circuit (7) adapted to allow a regenerating substance to selectively flow from the second tank (6) to the first tank (5) ;
- said water supply and treatment system (2) being adapted to be controlled by a control method according to claim 1.

11. Water supply and treatment system (2) according to claim 10, wherein such water supply and treatment system (2) has no additional valve devices to allow decalcified water to be mixed with non-decalcified water to be supplied into a wash chamber (12) of the household appliance (1).

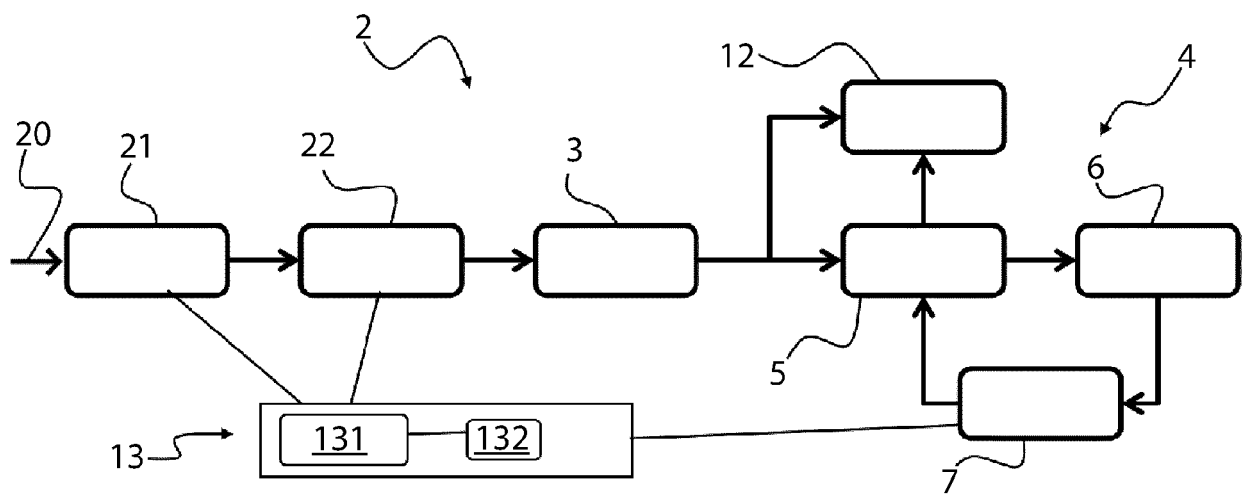
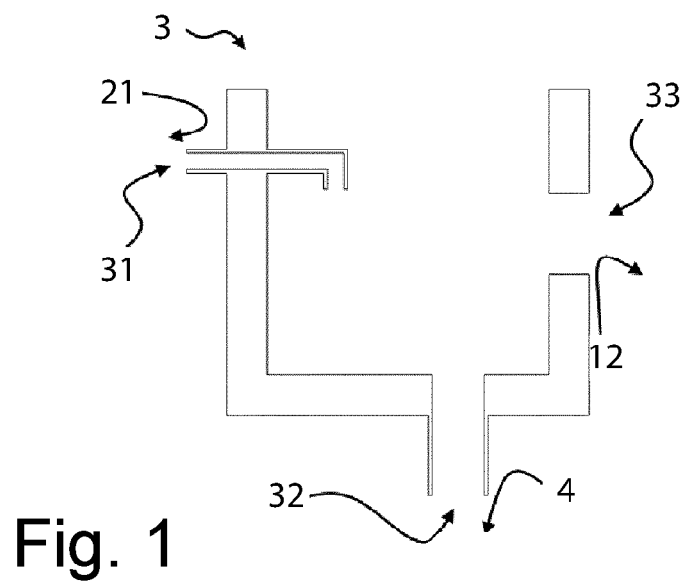
12. Water supply and treatment system (2) according to claim 10, wherein said regeneration circuit (7) comprises a pump capable of delivering a known quantity of regenerating substance per time unit.

13. Dishwasher machine comprising a wash chamber (12) and a door (10) adapted to allow access to said wash chamber (12) and a control system (13);

said dishwasher machine comprising a water supply and treatment system according to claim 10; said control system (13) being adapted to execute the method for controlling the supply and decalcification system according to claim 1.

14. Computer program adapted to be stored in a memory means (132) comprised in a control system (13) for a household appliance (1);

said computer program being adapted to be executed by a control unit (131); said computer program envisaging the phases comprised in the method for controlling a water supply and treatment system (2) for a household appliance (1) according to claim 1.



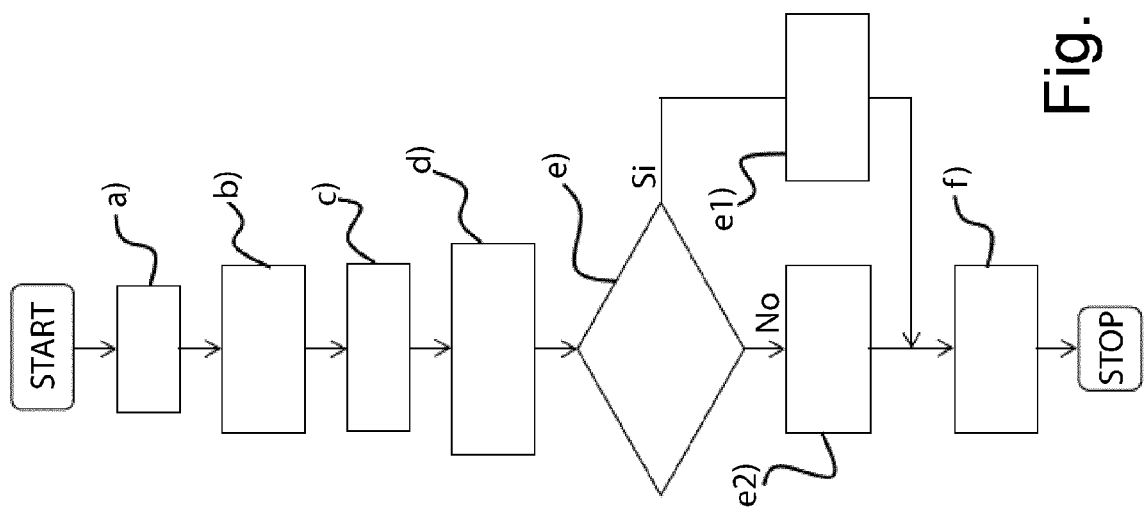


Fig. 2

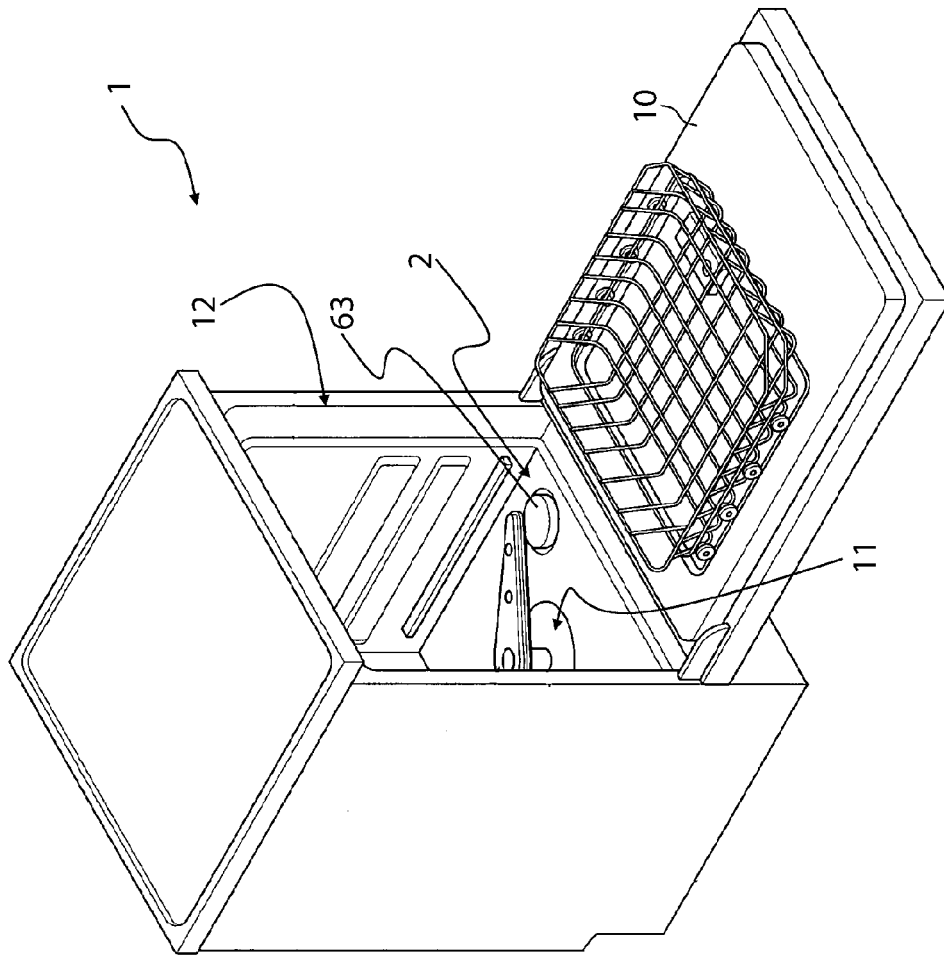


Fig. 4



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Application Number

EP 22 15 6705

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Y	* paragraphs [0038], [0039] *	7, 12, 13	
A	* paragraphs [0049], [0069] * * claims; figures *	6, 8, 9, 11	ADD. A47L15/00
Y, D	EP 2 564 752 A1 (BITRON SPA [IT]) 6 March 2013 (2013-03-06) * paragraph [0017] - paragraph [0019] * * claims; figures *	7, 12, 13	
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Place of search Munich		Date of completion of the search 4 July 2022	Examiner Popara, Velimir
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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