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(72) Inventors:
 • **GUIDA, Nicola**
47100 Forli (IT)
 • **GATTEI, Lorenzo**
47100 Forli (IT)
 • **HESSENAUER, Evi**
91541 Rothenburg ob der Tauber (DE)
 • **FARALDI, Paolo**
47100 Forli (IT)

(71) Applicant: **ELECTROLUX APPLIANCES AKTIEBOLAG**
105 45 Stockholm (SE)

(74) Representative: **Electrolux Group Patents AB Electrolux Group Patents**
105 45 Stockholm (SE)

(54) **WATER MANAGEMENT SYSTEM**

(57) The invention relates to a water management system (1) for a steam oven (2), comprising
 - a water softening system (20) comprising a water inlet (22) and a water outlet (23),
 - wherein the water inlet (22) is connected to a water supply (61),
 - wherein the water outlet (23) is connected to a steam generation system (70) of the steam oven (2),
 - wherein the water softening system (20) comprises water-hardness reduction means to reduce a water hard-

ness of a water stream (11, 12), and
 - further comprising sensor means (80) for providing sensor values of the water stream (11, 12) to an estimation unit (31) and
 - further comprising an estimation unit (31) to estimate based on the sensor values whether the water hardness of the water stream (11, 12) is within a predefined range, a corresponding steam oven and a corresponding method for operating a water management system and/or a steam oven.

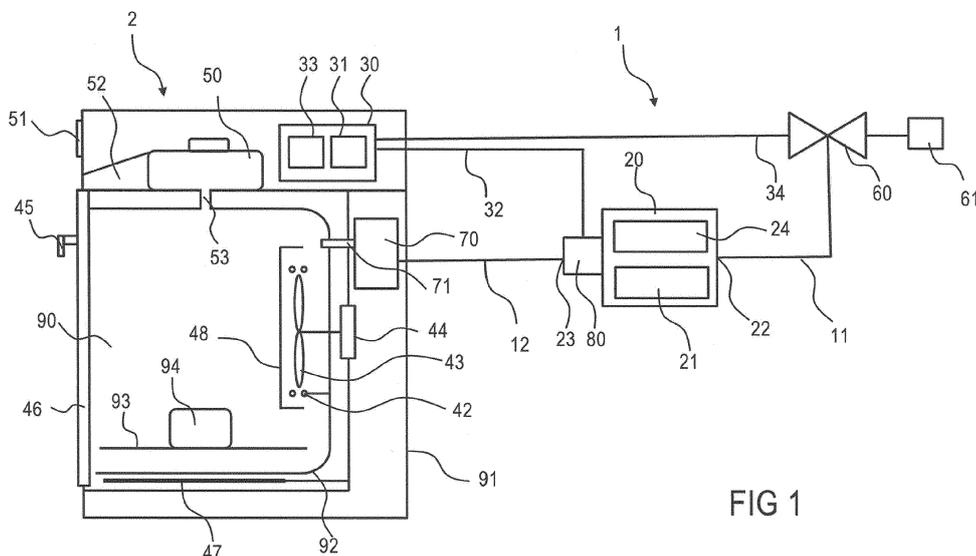


FIG 1

Description

[0001] The present invention relates to a water management system for a steam oven, a steam oven, and a method for operating a water management system and/or a steam oven.

[0002] Steam ovens are a well-known category of appliances, dedicated to cooking purposes. Steam ovens are existing, in a first variant, as solo steam appliances. In solo steam appliances, exclusively pure steam cooking functions are available, as no heating systems beside a steam generator are available. In a second variant, steam ovens are existing as combi steam appliances. In combi steam appliances, steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with the one of hot air.

[0003] To create steam there needs to be available a water supply of a water feeding system which leads the water into the steam generation system.

[0004] When using steam ovens as available on the market, the users are asked to regularly descale the steam generation system in order to remove the lime stone which is collected in the steam generation system.

[0005] A descaling operation removes scale from the steam generation system. It removes, for example, limescale, limestone, calcium and/or layers of oxides formed on the surfaces of the steam generation system.

[0006] Some steam ovens are asking the user in the set-up process of the appliance to give an indication on the water hardness level in order to define the right interval of performing such a descaling procedure.

[0007] The majority of steam ovens as available on the market are equipped with a dedicated descaling function of the steam generation system. The indication when such a descaling process needs to be done is either defined in the user manual and it depends on the user to perform it in time, or steam ovens are available which have an internal counter in the software depending on the water hardness level which is defined by the user, which tells the user when to perform such a descaling process.

[0008] In ovens as available on the market there is no feedback about the real water hardness level and no feedback from the steam generator about the real quantity of lime stone and thus the right time to perform such a descaling process can be just estimated. This can result in a decreased steam generation performance and thus decreased food quality or even in an accumulation of lime stone particles which could harm the steam generation system including tubes and valves.

[0009] This invention is especially meant to provide an enhanced approach to the water management in steam ovens. It is an object of the present invention to overcome the above drawbacks and problems.

[0010] These problems are solved by the subject matter of the attached independent claims. Preferred embodiments may be taken from the dependent claims.

[0011] The above described problems are advantageously solved by a water management system for a steam oven according to claim 1, a steam oven according to claim 13, and a method for operating a steam oven and/or a water management system according to claim 15.

[0012] According to claim 1, the invention relates to a water management system for a steam oven, comprising

- a water softening system comprising a water inlet and a water outlet,
- wherein the water inlet is connected (or: connectable) to a water supply,
- wherein the water outlet is connected (or: connectable) to a steam generation system of the steam oven,
- wherein the water softening system comprises water-hardness reduction means to reduce a water hardness of a water stream,
- further comprising a or at least one sensor means for providing sensor values of the water stream to an estimation unit and
- further comprising an estimation unit to estimate based on the sensor values whether the water hardness of the water stream is within a predefined range.

[0013] In an embodiment, a first water stream, especially hard water or inlet water, from the water supply flows or can flow through the water inlet and a second water stream, especially soft water or softened water, for the steam generation system flows or can flow through the water outlet. Preferably, the second water stream comprises softened water compared to the first water stream.

[0014] Preferably, the water softening system comprises water-hardness reduction means to reduce a first water hardness of a or the first water stream at the water inlet to a second water hardness of a or the second water stream at the water outlet.

[0015] The sensor means can preferably be arranged at or near the water outlet and/or at or near the water inlet for providing sensor values of the first water stream and/or of the second water stream to the estimation unit.

[0016] Preferably, the estimation unit is configured to estimate based on the sensor values whether the water hardness of the water stream, especially of the second water stream, is within a predefined range and/or whether the water softening system shall be restored.

[0017] A water management system according to the invention therefore is especially a water hardness management system, whereas also a sanitizing unit and a flood prevention unit can preferably be included in the water management system.

[0018] Preferably, the water-hardness reduction means comprises or uses at least one or more of ion exchange resins, phosphates dispensers and reverse osmosis systems, preferably contained in at least one cartridge.

[0019] In an embodiment, the water-hardness reduction means and/or the at least one cartridge can interact and/or deal with a total fixed amount of ions, especially of Ca and/or Mg, corresponding to a total amount of water. Dealing with a total fixed amount of Ca and/or Mg can especially mean exchanging the ions, for example the Ca-ions (Ca^{++} ; Calcium-ions) and/or the Mg-ions (Mg^{++} ; Magnesium-ions) against Na-ions (Na^{+} ; Natrium-ions) and/or dispensing phosphates and/or pressing the water through a membrane.

[0020] Dealing with a total fixed amount of water preferably means that for this fixed amount of water, the water hardness of the water stream is within the predefined range. The total amount of water can preferably be variable depending on the hardness of the water stream from the water supply.

[0021] Ion exchange resins can preferably be regenerated, for example by the use of Natrium Chloride (NaCl) to recover their water-hardness reduction functionality. This proceeding can be also used in water softening systems (water softeners) for dishwashers.

[0022] The estimation unit preferably estimates based on the sensor values whether the water hardness of the, especially second, water stream is within a predefined range, wherein the estimation unit preferably estimates based on the sensor values whether the water hardness of the, especially second, water stream is below a predefined level, for example below 3°F or below 7°F . Alternatively or in addition, a water hardness of the, especially second, water stream within a predefined range can preferably mean that the water hardness is above a predefined lower threshold and below a predefined upper threshold.

[0023] Preferably, when the sensor means and/or the estimation unit estimates based on the sensor values that the water hardness of the water stream, especially of the second water stream, is not within the predefined range and/or that the water softening system shall be restored, an expiration of the softening cartridge is identified and/or a service operation is triggered, wherein the service operation is preferably either a regeneration or a replacement of the at least one cartridge. In some embodiments, a replacement of the at least one cartridge is or can be privileged.

[0024] Preferably, the at least one cartridge is dimensioned to expire at around 2 years, after 2 years or after more than 2 years. Preferably, for oven applications, a relatively low amount of water is needed for the water stream.

[0025] The first water stream preferably corresponds to hard water or inlet water of the water softening system. The second water stream preferably corresponds to soft water or outlet water of the water softening system. Therefore, preferably, water of the first water stream enters the water softening system at the water inlet, is softened within the water softening system and then leaves the water softening system at the water outlet as second water stream. Water softening is preferably achieved using softening active matter, especially lime softening and/or ionexchange resins.

[0026] The water hardness (or: water hardness level) is preferably determined by the concentration of mineral content in the water, especially by the concentration of ions and/or of multivalent cations. More preferably, the water hardness is determined by the sum of the molar concentrations of Ca^{2+} and Mg^{2+} . The sum can be expressed in mol/L or mmol/L units. Various alternative units preferably represent an equivalent mass of calcium oxide (CaO) or calcium carbonate (CaCO_3) that, when dissolved in a unit volume of pure water, would result in the same total molar concentration of Mg^{2+} and Ca^{2+} .

[0027] Water hardness is often not expressed as a molar concentration, but rather in various units, such as degrees of general hardness (dGH or $^{\circ}\text{dH}$), parts per million (ppm, mg/L or American degrees) or French degrees ($^{\circ}\text{fH}$, $^{\circ}\text{f}$ or $^{\circ}\text{F}$). Parts per million (ppm) is usually defined as 1 mg/L CaCO_3 . It is equivalent to mg/L without chemical compound specified. A degree of General Hardness (dGH, $^{\circ}\text{dH}$ or deutsche Härte) is defined as 10 mg/L CaO or 17.848 ppm. A French degree ($^{\circ}\text{fH}$ or $^{\circ}\text{f}$ or $^{\circ}\text{F}$) is defined as 10 mg/L CaCO_3 , equivalent to 10 ppm. The abbreviation "L" (or: "l") preferably corresponds to "liter". The unit mg /L (or: mg/l) preferably corresponds to mg/L CaCO_3 or to mg/L CaO .

[0028] Hard water is preferably water with a high concentration of mineral content and/or water which comes from the water tap or a water feeding system. More preferably, hard water can be water which contains more than 120 ppm or 6.75 dGH or 6.75°dH or 67.5 mg/L CaO .

[0029] Preferably, hard water can be at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water. Possible, especially predetermined, ranges for the water hardness of especially hard water can be between 7°F and more than 32°F , between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L especially of CaCO_3 , respectively. Possible ranges for moderately hard water are between 4°dH and 8°dH or between 70 and 140 mg/L CaCO_3 , respectively. Possible ranges for hard water can also be between 8°dH and 13°dH or between 140 and 220 mg/L CaCO_3 , respectively. Possible ranges for very hard water are between 13°dH and 18°dH or between 220 and 320 mg/L CaCO_3 , respectively. Possible ranges for extremely hard water are above 18°dH or above 320 mg/L CaCO_3 , respectively.

[0030] Soft water is preferably water with a low concentration of mineral content and/or water after a treatment by the

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water softening system. More preferably, soft water can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO. Possible ranges for soft water are between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L especially of CaCO₃, respectively.

5 **[0031]** The following table shows the classifications, thresholds, ranges and/or hardness levels for soft water, moderately hard water, hard water, very hard water and extremely hard water. A predefined range of the water hardness of the water stream can preferably be at least one of the following ranges and/or a combination thereof.

| Classification | Water Hardness in mg/L | Water Hardness in °dH | Water Hardness in °F |
|-----------------|------------------------|-----------------------|----------------------|
| Soft | 0-70 | 0-4 | 0-7 |
| Moderately hard | 70-140 | 4-8 | 7-14 |
| Hard | 140-220 | 8-13 | 14-22 |
| Very hard | 220-320 | 13-18 | 22-32 |
| Extremely hard | >320 | >18 | >32 |

10 **[0032]** Preferably, a predefined range of the water hardness of the water stream is one of or a combination of the above defined ranges. A predefined range of the water hardness of the water stream therefore may be for example, a range between 0°F and 7°F and/or 0°dH and 4°dH and/or between 0 and 70 mg/L especially of CaCO₃.

[0033] Preferably, the water management system avoids a descaling operation of the steam generation system of the steam oven. Preferably, the water management system integrates a self-diagnosing, regeneration free, water softening system into the steam oven.

25 **[0034]** The water management system can also prevent the need to deal with chemicals to perform the descaling operation of the steam generation system. Preferably, the water management system eliminates downtime of the steam oven due to a descaling operation.

[0035] Furthermore, the water management system can improve the efficiency of the steam generation system by eliminating the steady process of limestone accumulation and subsequent removal.

30 **[0036]** The water softening system can be integrated into the steam oven or can be externally to the steam oven. In an embodiment, the water softening system is adapted and/or connected to the water supply. The water supply can be a water tap and/or a water tank and/or a fixed water connection and/or a water pipe and/or a fixed or removable drawer and/or a water feeding system.

35 **[0037]** The water supply for the steam oven and/or the water softening system can preferably be set up as a fixed water tank of the oven which needs to be filled using an additional water jar. Furthermore or as an alternative, the water supply for the steam oven can preferably be set up as an extractable water tank which can be extracted from the oven and filled directly on a water tap. Furthermore, the water supply for the steam oven can preferably be set up as a fixed water connection to the water supply system of the house, for example to a water tap.

[0038] The water management system is preferably dimensioned to keep the, especially second, water stream below a water hardness target for a defined amount of supplied water, in order to cover a predefined steam oven usage time, more preferably the whole lifetime of the oven.

40 **[0039]** In addition, the water management system can provide long term duration of the steam oven, preferably life long duration without service and/or descaling.

[0040] In an advantageous embodiment, the water management system is intended to treat a predefined amount of water in the, especially first, water stream, wherein the steam generation system is able to handle a predefined amount of minerals as residual hardness of the second water stream, so that the oven is able to run a predefined number of steam cycles.

45 **[0041]** In a specific embodiment, the water management system can be intended to treat a predefined amount of 500 to 800 l, especially 750 l, of water in the, especially first, water stream, wherein the steam generation system is able to handle a predefined amount of approximately 15 g to 21 g minerals as residual hardness of the, especially second, water stream, so that the steam oven is able to run a predefined number of 400 to 600 steam cycles, preferably with a maximum water consumption of each cycle of 11 and/or applying a safety factor of 1 to 1,5.

50 **[0042]** Preferably, the residual hardness shall be dimensioned to leave behind an concentration of mineral content in the water that the system and/or the oven can handle without impairment and/or damage. In the above mentioned or in another embodiment, the water management system can be intended to provide the, especially second, water stream, preferably softened water, with a water hardness below 3° F or below 7° F and/or 3 mg/l or 7 mg/l of Ca-CO₃ to the steam generation system.

55 **[0043]** Preferably, the water management system is capable to handle different levels of water hardness of the first water stream, preferably automatically or by a calibration process performed during the installation of the steam oven.

[0044] In an advantageous embodiment, the sensor means comprises a water hardness sensor means and/or a volume counter and/or a flow measurement unit. The sensor means can further include, in an embodiment, a flow rate sensor and/or a water detection means and/or a water volume counter. The sensor means or a part of it is preferably placed in an area where water could flow in case of failures or uncontrolled water supply. Therefore, preferably uncontrolled water supply can be avoided.

[0045] In an embodiment, preferably for a first class of sensor means, the sensor means perform and/or can perform a direct measurement of the water hardness. Such a sensor means can preferably directly measure the water hardness, preferably at the water outlet, immediately identify when the water softening system ceases or reduces its performance, and preferably indicate the need for restoration or regeneration of the water softening system. Examples for such sensor means are conductivity sensor means, optical sensor means or capacitive sensor means. An advantage of such sensor means may be the direct feedback on the final outflow water hardness at the water outlet, regardless of possible contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the system.

[0046] In a further embodiment, preferably for a second class of sensor means, the sensor means perform and/or can perform a total cumulative water amount calculation of the water stream, for example by volumetric counters or flow meters. Based on the second class of sensor means, the estimation unit can preferably determine and/or indicate softening system expiration by assuming the hardness of the water at the water inlet constant, while the maximum amount of water the water softening system can treat is preferably predetermined. Even though the second class of sensors can be blind to contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the system, the second class of sensors is normally easier to integrate and can be more economical.

[0047] The first and second classes of sensors, for the purpose of the invention, can work alone, or can be combined as a sensor means to ensure or enable double check of the water hardness, for example.

[0048] In an embodiment, preferably for a third class of sensor means, the sensor means measures and/or can measure water spillage and/or perform leakage detection via threshold conductivity sensors or floater based sensors. Also this third class of sensors, for the purpose of the invention, can work alone, or can be also be combined in a sensor means with one or more of the first and second class to ensure or enable double check.

[0049] The first category of sensors is preferably put downstream the water softening system, for example at or near the water outlet. The first category of sensors preferably monitors the supposedly softened water. The second category can preferably be placed before or after the water softening system, for example at or near the water inlet and/or at or near the water outlet, as the water flow is at least essentially the same.

[0050] The water management system can comprise a flood prevention system, especially an integrated anti-flooding system. Flood prevention means can be common practice, for example, for built-in ovens, and can be even mandatory for high-end ovens.

[0051] Preferably, the flood prevention system is intended to stop the first water steam after a continuous flow of a determined amount of litres of water.

[0052] In an embodiment, the flood prevention system comprises a valve for blocking the water supply.

[0053] The flood prevention system can be connected to the sensor means, wherein the sensor means especially comprises a water detection means and/or a volume counter, so that the valve can be closed upon water detection and/or uncontrolled water supply.

[0054] Preferably, the flood prevention system comprises at least two means: a first means, preferably a or the sensor means, to detect anomalies related to the water supply, and a second means, preferably a valve, more preferably an electric valve, to stop water flow from the water inlet in case of such anomalies.

[0055] The second class of sensor means can preferably be used to replace the third class of sensor means. Preferably, the, especially second class of, sensor means is integrating at least two functions, for example a flood prevention system as well as a water hardness determination or estimation.

[0056] Preferably, the water softening system upon reach of a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness can or shall be restored. Preferably, the water softening system contains a disposable cartridge containing the softening material, especially the softening active matter. The disposable cartridge is a preferred means to reduce a first water hardness of the first water stream at the water inlet to a second water hardness of the second water stream at the water outlet.

[0057] The water softening system can be restored preferably by changing or renewing the disposable cartridge containing the softening material, especially the softening active matter. The softening material, especially the softening active matter, preferably converts hard water into soft water.

[0058] The water softening system can be intended to provide an indication to the user that the softening system must be restored and/or to prevent the steam oven to generate steam until the softening function has been restored, to avoid processing water with excess of hardness and resulting limestone layer creation.

[0059] Preferably, the water softening system is providing an automatic system to detect and to preferably communicate to the user when the softening effectiveness is over or falls below a predefined level.

[0060] In an advantageous embodiment, the water softening system comprises a means to understand when the

target or predefined overall amount of water has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system.

[0061] Preferably, the water softening system and/or the water management system provides a direct measurement of the water hardness. More preferably, the sensor means comprises a water hardness sensor in order to perform a direct measurement of the water hardness, which can be installed downstream the softening system.

[0062] As an alternative or in addition, the water softening system and/or the water management system can provide an indirect measurement or estimation of the remaining autonomy of the water softening system, especially whether the second water stream is within a predefined range of water hardness and/or whether the water softening system shall be restored.

[0063] For the indirect measurement or estimation of the remaining autonomy of the softening system and/or the water hardness of the, especially second, water stream, the sensor means preferably comprises a volumetric counter buffering the total amount of water treated by the water softening system and provided to the steam generation system.

[0064] The water softening system can also comprise a sanitizing unit, which can be integrated into the water softening system and/or into the oven. Preferably, the sanitizing unit comprises means to prevent microbial proliferation over the life span of the oven.

[0065] The sanitizing unit can comprise antimicrobial additives in the materials constituting the components in contact with the water and/or sanitizing agent dispensers.

[0066] According to claim 13, the invention relates to a steam oven with a water management system according to the invention.

[0067] In an embodiment, the steam oven can be a solo steam appliance, wherein exclusively pure steam cooking functions are available, as no heating systems beside the steam generation system are available. As an alternative, the steam oven can also be a combi steam appliance, wherein steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with other heating systems. Heating systems can be convection heating and/or hot air and/or upper heat and/or lower heat.

[0068] The steam oven can preferably be an electric and/or domestic oven and/or a household oven.

[0069] The steam oven can preferably be a built-in oven, a stand-alone-oven, a high-end oven, a low class oven or a mid-range oven.

[0070] The steam oven can preferably comprise one or more of the following: a housing, an oven cavity, an oven door with a handle or grip, a convection heating unit in combination with a convection fan and/or an air baffle, an upper heating unit, a lower heating unit and a fan for sucking air out of the cavity through a suction hole.

[0071] Preferably, the steam oven comprises one or more of the following: a steam generation system with a pipe to submit steam into the oven cavity, an oven control unit with an estimation unit and a flood prevention unit, an operating panel for operating the oven as well as items to be cooked arranged on a baking tray.

[0072] According to claim 15, the invention also relates to a method for operating a water management system and/or a steam oven, especially according to one of the preceding claims, comprising

- a water softening system comprising a water inlet and a water outlet,
- wherein the water inlet is connected or connectable to a water supply,
- wherein the water outlet is connected or connectable to a steam generation system of the steam oven,

wherein the method comprises the following steps:

- reducing, by means of the water softening system, a water hardness of the water stream,
- providing, by sensor means sensor values of the water stream to an estimation unit and
- estimating by means of the estimation unit, based on the sensor values, whether the water hardness is within a predefined range.

[0073] In an embodiment, a first water stream, especially hard water or inlet water, flows or can flow from the water supply through the water inlet and a second water stream, especially softened water, for the steam generation system flows or can flow through the water outlet.

[0074] Preferably, the method further comprises the following step: reducing, by means of the water softening system, a first water hardness of the first water stream at the water inlet to a second water hardness of the second water stream at the water outlet,

[0075] The method can further comprise preferably the following step: providing, by sensor means at the water outlet and/or at the water inlet, sensor values of the first water stream and/or of the second water stream to an estimation unit.

[0076] Preferably, the method further comprises the following step: estimating by means of the estimation unit, based on the sensor values, whether the water hardness is within a predefined range and/or whether the water softening system shall be restored.

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[0077] The present invention will be described in further detail with reference to the drawing from which further features, embodiments and advantages may be taken, and in which:

FIG 1 shows a system for a water management system and a steam oven according to an embodiment of the invention.

[0078] FIG 1 shows an embodiment of the invention which is further described in the following. FIG. 1 shows a steam oven 2 as an electric domestic oven. The oven 2 comprises an oven cavity 90 which is arranged within a housing 91. At the front side, the oven cavity 90 is delimited by an oven door 46 with a handle or grip 45.

[0079] The oven 2 further comprises, at the back side of the cavity 90, a convection heating unit 42 in combination with a convection fan 44 and an air baffle 48.

[0080] The oven 2 further comprises a not shown upper heating unit, a lower heating unit 47 and a fan 50 for sucking air out of the cavity 90 through a suction hole 53 as input and an output channel 52 as an output.

[0081] The oven 2 further comprises a steam generation system 70 with a pipe 71 to submit steam into the oven cavity 90. An oven control unit 30 provides control functions for the oven. The oven control unit 30 comprises an estimation unit 31 and a flood prevention unit 33. The oven 2 further comprises an operating panel 51 at its front side above the door for operating the oven 2. Within the cavity 90, items to be cooked 94 are arranged on a baking tray 93.

[0082] FIG 1 further shows a water management system 1 for the steam oven 2. The water management system 1 comprises a water softening system 20. The water softening system 20 comprises a water inlet 22 and a water outlet 23. The water inlet 22 is connected or connectable to a water supply 61.

[0083] The water outlet 23 is connected or connectable to the steam generation system 70 of the steam oven 2. A first water stream 11, especially hard water or inlet water, from the water supply 61 flows or can flow through the water inlet 22. A second water stream 12, especially soft water or softened water, for the steam generation system 70 flows or can flow through the water outlet 23.

[0084] The following table shows the classifications, thresholds, ranges and hardness levels for soft water, moderately hard water, hard water, very hard water and extremely hard water. A predefined range of the water hardness of the water stream 11, 12 can be at least one of the following ranges and/or a combination thereof.

| Classification | Hardness in mg/L | Hardness in °dH | Hardness in °F |
|-----------------|------------------|-----------------|----------------|
| Soft | 0-70 | 0-4 | 0-7 |
| Moderately hard | 70-140 | 4-8 | 7-14 |
| Hard | 140-220 | 8-13 | 14-22 |
| Very hard | 220-320 | 13-18 | 22-32 |
| Extremely hard | >320 | >18 | >32 |

[0085] A predefined range of the water hardness of the water stream 11, 12 can be one of or a combination of the above defined ranges. A predefined range of the water hardness of the water stream 11, 12 therefore may be for example, a range between 0°F and 7°F and/or 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃ (calcium carbonate).

[0086] Hard water can be at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water. Possible ranges for hard water can be between 7°F and more than 32°F, between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L CaCO₃, respectively. Possible ranges for moderately hard water are between 4°dH and 8°dH or between 70 and 140 mg/L CaCO₃, respectively. Possible ranges for hard water can also be between 8°dH and 13°dH or between 140 and 220 mg/L CaCO₃, respectively. Possible ranges for very hard water are between 13°dH and 18°dH or between 220 and 320 mg/L CaCO₃, respectively. Possible ranges for extremely hard water are above 18°dH or above 320 mg/L CaCO₃, respectively.

[0087] Soft water is preferably water with a low concentration of mineral content and/or water after a treatment by the water softening system 20. More preferably, soft water can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO. Possible ranges for soft water are between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃, respectively.

[0088] The water softening system 20 comprises means to reduce a first water hardness of the first water stream 11 at the water inlet 22 to a second water hardness of the second water stream 12 at the water outlet 23.

[0089] An advantageous way to reduce a first water hardness of the first water stream 11 at the water inlet 22 to a second water hardness of the second water stream 12 at the water outlet 23 is the use of ion exchange resins, phosphates dispensers and/or reverse osmosis systems as water-hardness reduction means, preferably contained in one or more cartridges 24.

[0090] Such cartridges 24 can deal or interact with a total fixed amount of ions, especially Ca and Mg, corresponding

to a total amount of water.

[0091] Dealing or interacting with the water stream, especially with a total fixed amount of Ca and/or Mg, can especially comprise exchanging the ions by an ion exchanger. For example, the Ca-ions (Ca^{++} ; Calcium-ions) and/or the Mg-ions (Mg^{++} ; Magnesium-ions) can be exchanged against Na-ions (Na^{+} ; Natrium-ions). As an alternative or in addition, dealing or interacting can comprise dispensing phosphates in a phosphates dispenser and/or pressing the water through a membrane in a reverse osmosis system.

[0092] Dealing with a total fixed amount of water preferably means that for this fixed amount of water, the water hardness of the water stream is within the predefined range. The total amount of water can preferably be variable depending on the hardness of the water stream from the water supply at the water inlet 22.

[0093] The ion exchange resins can be regenerated, as also used in dishwasher water softeners, which are regenerated by Natrium Chloride (NaCl) to recover the water softening functionality.

[0094] When the sensor means 80 and/or the estimation unit 31 identifies an expiration of the softening cartridge 24, a service operation is triggered, which can be either a regeneration or a replacement of the cartridge 24 or its content. For oven applications, due to relatively low amount of water needed, the replacement of the cartridge 24 can be privileged, especially when the cartridge 24 is dimensioned in such a way that the water softening capabilities last for around 2 years or longer.

[0095] FIG 1 further shows sensor means 80 at the water outlet 23 for providing sensor values of the second water stream 12 to the estimation unit 31, for example by means of a first transmission line 32 or a radio transmission. As an alternative or in addition, but not shown, the sensor means 80 can also be arranged partly or entirely at the water inlet 22 for providing sensor values of the first water stream 11 to the estimation unit 31.

[0096] The sensor means 80 can comprise at least or more sensors of the following three classes, which will be described in the following.

[0097] The water softening system 20 can provide a direct measurement, preferably a water hardness sensor, installed downstream the softening system at the second water stream 12 within the sensor means 80. In addition or as an alternative, the water softening system 20 can also provide an indirect measurement or determination, for example a volumetric counter buffering the total amount of water treated by the softening system 20 and provided to the steam generation system 70.

[0098] The sensor means 80 can comprise a first class of sensors. In this case, the sensor means can perform a direct measurement of the water hardness. Such sensor means can directly measure the water hardness, preferably at the water outlet 23, immediately identify when the water softening system 20 ceases or reduces its performance, and preferably indicate the need for restoration or regeneration. Examples for such sensor means 80 are conductivity sensor means, optical sensor means or capacitive sensor means. An advantage of such sensor means 80 is or may be the direct feedback on the final outflow water hardness at the water outlet 23, regardless of possible contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the water softening system 20.

[0099] Furthermore, the sensor means 80 can comprise a second class of sensors. In this case, the sensor means 80 can perform a total cumulative water amount calculation of the water stream 11,12, for example by volumetric counters or flow meters. Based on the second class of sensor means 80, the estimation unit 31 can preferably determine and/or indicate an expiration of the softening system 20 by assuming the hardness of the water at the water inlet 22 constant, while the maximum amount of water the water softening system 20 can treat is predetermined. Even though the second class of sensors can be blind to contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the water softening system 20, the second class of sensors is normally easier to integrate and can be more economical.

[0100] The first and second classes of sensors, for the purpose of the invention, can work alone, or can be combined as a sensor means 80 to ensure double check of the water hardness, for example.

[0101] The sensor means 80 can further comprise a third class of sensors. In this case, the sensor means 80 can measure water spillage and perform leakage detection via threshold conductivity sensors or floater based sensors. Also this third class of sensors can work alone as a sensor means 80, or can be also be combined with one or more of the first and second class to ensure double check of the water hardness, for example.

[0102] The first class of sensors can be put downstream the water softening system 20, for example at or near the water outlet 23. The first class of sensors can monitor the supposedly softened water. The second class can be placed before or after the water softening system 20, for example at or near the water inlet 22 or at or near the water outlet 23, as the water flow is at least essentially the same.

[0103] FIG 1 also shows the estimation unit 31 which estimates based on the sensor values whether the water hardness is within a predefined range or below a predefined level. In addition, the estimation unit 31 can also estimate based on the sensor values whether the water softening system 20 shall be restored.

[0104] The water management system 1 avoids a descaling operation of the steam generation system 70 of the steam oven 2. It is possible to integrate the water softening system 20 as a self-diagnosing and regeneration free means into the steam oven 2.

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[0105] Therefore, the water management system 1 prevents the need to deal with chemicals to perform the descaling operation of the steam generation system 70. In addition, the water management system eliminates downtime of the steam oven 2 due to a descaling operation, as no descaling operation is necessary.

[0106] The water management system 1 also improves the efficiency of the steam generation system 70 by eliminating the steady process of limestone accumulation and subsequent removal.

[0107] The water softening system 20 is in FIG 1 externally to the steam oven 2. Alternatively and not shown, the water softening system 20 can be also integrated into the steam oven 2.

[0108] The water softening system 20 is adapted and connected to the water supply 61. The water supply 61 can be a water tap and/or a fixed or removable drawer and/or a fixed water connection.

[0109] The water supply 61 for the steam oven 2 can be set up as a fixed water tank which needs to be filled using an additional water jar. As a first alternative, the water supply 61 for the steam oven 2 can also be set up as an extractable water tank which can be extracted from the oven and filled directly on the water tap. As a second alternative, the water supply 61 for the steam oven 2 can also be set up as a fixed water connection to the water supply system of the house, for example to a water tap.

[0110] The water management system 1 is dimensioned to keep the second water stream 12 below a water hardness target for a defined amount of supplied water, in order to cover a certain and/or predefined steam oven usage time, preferably the whole lifetime of the oven 2. The water management system 1 can provide long term duration of the steam generation system 70, preferably life long duration without service.

[0111] The water management system 1 is intended to treat a predefined amount of water in the first water stream 11, wherein the steam generation system 70 is able to handle a predefined amount of minerals as residual hardness of the second water stream 12, so that the oven is able to run a predefined number of steam cycles.

[0112] As a non-limiting example, the water management system can be intended to treat a predefined amount of 500 l to 800 l of water in the first water stream 11. The steam generation system 70 can be able to handle a predefined amount of approximately 15 g to 21 g of minerals as residual hardness of the second water stream 12. Therefore, in the example, the steam oven 2 is able to run a predefined number of 400 to 600 steam cycles with a maximum water consumption of each cycle of 11 and applying a safety factor of 1,5.

[0113] The water management system 1, in an embodiment, is intended to provide the second water stream 12, preferably softened water, with a water hardness below 3° F or below 7° F and/or corresponding to 3 mg/l or 7 mg/l of CaCO₃ to the steam generation system.

[0114] The water management system 1 is also capable to handle different levels of water hardness of the first water stream 11. This handling can be performed automatically or by a calibration process performed during the installation of the steam oven 2.

[0115] The sensor means 80 as part of the water management system 1 comprises or can comprise a water hardness sensor means and/or a volume counter and/or a flow measurement unit. The sensor means can be placed in an area where water could flow in case of failures or uncontrolled water supply.

[0116] The water management system 1 comprises a flood prevention unit 33, especially an integrated anti-flooding system. The flood prevention unit is intended to stop the first water stream 11 after a continuous flow of a determined amount of litres of water. The flood prevention unit 33 controls a valve 60 for blocking the water supply 61 by means of a second transmission line 34 or a radio transmission.

[0117] The flood prevention unit 33 is connected to the sensor means 80. The sensor means can comprise a water detection means and/or a volume counter, so that the valve 60 can be closed upon water detection and/or uncontrolled water supply.

[0118] Upon reach of a predefined overall amount of water, the water softening system 20 can be restored. The water softening system 20 can be restored by changing or renewing the disposable cartridge 24 containing the softening material, especially the softening active matter. Restoring can be performed by changing the disposable cartridge 24 which contains the softening active matter.

[0119] The water softening system 20 can provide an indication to the user that the softening system 20 must be restored and/or to prevent the steam oven to generate steam until the softening function has been restored, to avoid processing water with excess of hardness and resulting limestone layer creation. Examples of such an indication to the user are an optical and/or acoustical signalling.

[0120] The water softening system 20 is providing an estimation unit 31 to detect and to preferably communicate to the user when the softening effectiveness is over or falls below a predefined level.

[0121] The estimation unit 31 estimates when the target or predefined overall amount of water of the water softening system 20 has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system 70.

[0122] The water softening system 20 can also comprise a sanitizing unit 21, which can be integrated into the water softening system 20. The sanitizing unit 21 comprises means to prevent microbial proliferation over the life span of the system and antimicrobial additives in the materials constituting the components in contact with the water and/or sanitizing

agent dispensers.

[0123] The features of the present invention disclosed in the description, the claims, and/or the figure may both separately and in any combination thereof be material for realizing the invention in various forms thereof.

5 **List of reference numerals**

[0124]

- 1 water management system
- 10 2 steam oven
- 11 first water stream
- 12 second water stream
- 20 water softening system
- 21 sanitizing unit
- 15 22 water inlet
- 23 water outlet
- 24 cartridge
- 30 oven control unit
- 31 estimation unit
- 20 32 first transmission line
- 33 flood prevention unit
- 34 second transmission line
- 42 convection heating unit
- 44 convection fan
- 25 45 handle or grip
- 46 oven door
- 47 lower heating unit
- 48 air baffle
- 50 fan
- 30 51 operating panel
- 52 output channel
- 53 suction hole
- 60 valve
- 61 water supply
- 35 70 steam generation system
- 71 pipe
- 80 sensor means
- 90 oven cavity
- 91 housing
- 40 92 items to be cooked
- 93 baking tray

Claims

- 45
1. Water management system (1) for a steam oven (2), comprising
 - a water softening system (20) comprising a water inlet (22) and a water outlet (23),
 - wherein the water inlet (22) is connected to a water supply (61),
 - 50 - wherein the water outlet (23) is connected to a steam generation system (70) of the steam oven (2),
 - wherein the water softening system (20) comprises water-hardness reduction means (24) to reduce a water hardness of a water stream (11, 12),
 - further comprising sensor means (80) for providing sensor values of the water stream (11, 12) to an estimation unit (31) and
 - 55 - further comprising an estimation unit (31) to estimate based on the sensor values whether the water hardness of the water stream (11, 12) is within a predefined range.

 2. Water management system (1) according to claim 1,

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- wherein a first water stream (11), especially hard water or inlet water, from the water supply (61) can flow through the water inlet (22) and a second water stream (12), especially soft or softened water, for the steam generation system (70) can flow through the water outlet (23) and/or

- wherein the estimation unit (31) is configured to estimate based on the sensor values whether the water hardness of the water stream (12), especially of the second water stream (12), is within a predefined range and/or whether the water softening system (20) shall be restored and/or

- wherein hard water is preferably at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water, wherein a predefined range of the water hardness, especially for hard water, is or can be between 7°F and more than 32°F, between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L CaCO₃, respectively and/or

- wherein soft water or softened water is preferably water with a low concentration of mineral content and/or water after a treatment by the water softening system (20), wherein more preferably, soft water is or can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO, wherein a predefined range is or can be, especially for soft water, between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃, respectively.

3. Water management system (1) according to claim 1 or 2,

- wherein the water softening system (20) comprises water-hardness reduction means (24) to reduce a first water hardness of the first water stream (11) at the water inlet (22) to a second water hardness of the second water stream (12) at the water outlet (23) and/or

- wherein the water-hardness reduction means (24) comprise or use at least one of ion exchange resins, phosphates dispensers and reverse osmosis systems, preferably contained in at least one cartridge and/or

- wherein the water-hardness reduction means (24) and/or the at least one cartridge can deal or interact with, especially absorb and/or exchange, a total fixed amount of ions, especially Ca and/or Mg, corresponding to a total or predetermined amount of water.

4. Water management system (1) according to claim 1, wherein the water management system

a) avoids a descaling operation of the steam generation system (70) and/or integrates the water softening system (20) as a self-diagnosing and regeneration free means into the steam oven (2) and/or

b) prevents the need to deal with chemicals to perform a descaling operation of the steam generation system (70) and/or

c) eliminates downtime of the steam oven (2) due to a descaling operation and/or

d) improves the efficiency of the steam generation system (70) by eliminating the steady process of limestone accumulation and subsequent removal.

5. Water management system (1) according to claim 1 or 2, wherein

a) the water softening system (20) is integrated into the steam oven (2) or externally to the steam oven (2) and/or

b) the water softening system (20) is adapted and/or connected to the water supply (61) and/or

c) the water supply (61) is a water tap and/or a water pipe and/or a fixed water connection and/or a water tank and/or a fixed or removable drawer, wherein the water supply (61) is preferably

c1) a fixed water tank within the steam oven (2) which needs to be filled using an additional water jar and/or

c2) an extractable water tank which can be extracted from the steam oven (2) and filled directly on a water tap and/or

c3) a fixed water connection to the water supply system of the house, for example to a water tap.

6. Water management system (1) according to one of the preceding claims, wherein the water management system is

a) dimensioned to keep the, especially second, water stream (12) below a water hardness target for a defined amount of supplied water, in order to cover a predefined steam oven usage time, preferably the whole lifetime of the steam oven (2), and/or

b) providing long term duration of the steam oven, preferably life long duration without service and/or

c) intended to treat a predefined amount, preferably 500 l to 800 l, of water in the water stream (11), wherein the steam generation system (70) is able to handle a predefined amount of minerals, preferably approximately

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15 g to 21 g, as residual hardness of the, especially second, water stream (12), so that the steam oven is able to run a predefined number, preferably 400 to 600, of steam cycles, preferably with a maximum water consumption of each cycle of 11 and/or applying a safety factor of 1 to 1.5, and/or

c) intended to provide the, especially second, water stream (12), preferably softened water, within a predefined range of water hardness or with a predefined water hardness, preferably below 3° F or 7° F or between 0°F and 7°F and/or corresponding to 3 mg/l or 7 mg/l of CaCO₃ to the steam generation system (70) and/or

d) capable to handle different levels of water hardness of the, especially first, water stream (11), preferably automatically or by a calibration process performed during the installation of the steam oven (2).

7. Water management system (1) according to one of the preceding claims,

- wherein the sensor means (80) are at the water outlet (23) and/or at the water inlet (22) for providing sensor values of the, especially first, water stream (11) and/or of the, especially second, water stream (12) to an estimation unit (31) and/or

- wherein the sensor means (80) comprises a water hardness sensor means and/or a volume counter and/or a flow measurement unit, wherein the sensor means is preferably placed in an area where water could flow in case of failures or uncontrolled water supply and/or

- wherein the sensor means (80) preferably comprises a first class of sensor means, wherein the sensor means is preferably configured to perform a direct measurement of the water hardness, more preferably conductivity sensor means, optical sensor means and/or capacitive sensor means and/or

- wherein the sensor means (80) preferably comprises a second class of sensor means, wherein the sensor means is preferably configured to perform a total cumulative water amount calculation of the water stream, for example by volumetric counters or flow meters and/or

- wherein the sensor means (80) preferably comprises a third class of sensor means, wherein the sensor means is preferably configured to measure water spillage and/or perform leakage detection, especially via threshold conductivity sensors or floater based sensors.

8. Water management system (1) according to one of the preceding claims, wherein the water management system comprises a flood prevention unit (33), especially an integrated anti-flooding system, wherein preferably the flood prevention unit

a) is intended to stop the, especially first, water steam (11) after a continuous flow of a determined amount of litres of water and/or

b) controls a valve (60) for blocking the water supply (61) and/or

c) is connected to the sensor means (80), wherein the sensor means especially comprises a water detection means and/or a volume counter, so that the valve can be closed upon water detection and/or uncontrolled water supply.

9. Water management system (1) according to one of the preceding claims, wherein the water softening system

a) upon reach of a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness can be restored, preferably by changing a disposable cartridge (24) containing softening material, especially softening active matter, and/or

b) is intended to provide an indication to the user that the softening system (20) must be restored and/or to prevent the steam generation system to generate steam until the softening function has been restored, to avoid processing water with an excess of hardness and resulting limestone layer creation.

10. Water management system (1) according to one of the preceding claims, wherein the estimation unit (31)

a) detects and preferably communicates to the user when the softening effectiveness of the water softening system is over or falls below a predefined level and/or

b) estimates when the target or predefined overall amount of water for the water softening system has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system (70).

11. Water management system (1) according to one of the preceding claims, wherein the softening system provides

a) a direct measurement of the water hardness, preferably a water hardness sensor, installed downstream the water softening system (20) and/or

b) an indirect measurement or determination of the water hardness, preferably a volumetric counter buffering the total amount of water treated by the water softening system (20) and provided to the steam generation system (70).

5 12. Water management system (1) according to one of the preceding claims, wherein the water softening system comprises an especially integrated sanitizing unit (21), wherein preferably the sanitizing unit comprises

- 10 a) means to prevent microbial proliferation over the life span of the steam oven and/or
b) antimicrobial additives in the materials constituting the components in contact with the water and/or
c) sanitizing agent dispensers.

13. Steam oven with a water management system according to one of the preceding claims, wherein preferably

- 15 a) the steam oven is a solo steam appliance, wherein only pure steam cooking functions are available, as no heating systems beside the steam generation system are available or
b) wherein the steam oven is a combi steam appliance, wherein steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with other heating systems, especially with hot air and/or upper heat and/or lower heat.

20 14. Steam oven (2) according to claim 13, wherein the steam oven is an electric domestic oven comprising one or more of the following: a housing (91), an oven cavity (90), an oven door (46) with a handle or grip (45), a convection heating unit (42) in combination with a convection fan (44) and/or an air baffle (48), an upper heating unit, a lower heating unit (47), a fan (50) for sucking air out of the cavity (90) through a suction hole (53), a steam generation system (70) with a pipe (71) to submit steam into the oven cavity (90), an oven control unit (30) with the estimation unit (31) and a flood prevention unit (33), an operating panel (51) for operating the oven as well as items to be
25 cooked (92) arranged on a baking tray (93).

15. Method for operating a water management system and/or a steam oven, especially according to one of the preceding claims, comprising

- 30 - a water softening system (20) comprising a water inlet (22) and a water outlet (23),
- wherein the water inlet (22) is connected or connectable to a water supply (61),
- wherein the water outlet (23) is connected or connectable to a steam generation system (70) of the steam oven (2), wherein the method comprises the following steps:
35 - reducing, by means of the water softening system (20), a water hardness of the water stream (11, 12),
- providing, by sensor means (80), sensor values of the water stream (11, 12) to an estimation unit (31) and
- estimating, by means of the estimation unit (31), based on the sensor values whether the water hardness is within a predefined range.

40 16. Method for operating a water management system and/or a steam oven according to claim 15,

- wherein a first water stream (11), especially hard water or inlet water, can flow from the water supply (61) through the water inlet (22) and a second water stream (12), especially softened water, for the steam generation system (70) can flow through the water outlet (23) and/or
45 - wherein the method further comprises the following step: reducing, by means of the water softening system (20), a first water hardness of the first water stream (11) at the water inlet (22) to a second water hardness of the second water stream (12) at the water outlet (23).

50 17. Method for operating a water management system and/or a steam oven according to claim 15 or 16, wherein the method further comprises the following step or steps:

- providing, by sensor means (80) at the water outlet (23) and/or at the water inlet (22), sensor values of the first water stream (11) and/or of the second water stream (12) to an estimation unit (31) and
55 - estimating by means of the estimation unit (31), based on the sensor values whether the water hardness is within a predefined range and/or whether the water softening system (20) shall be restored.

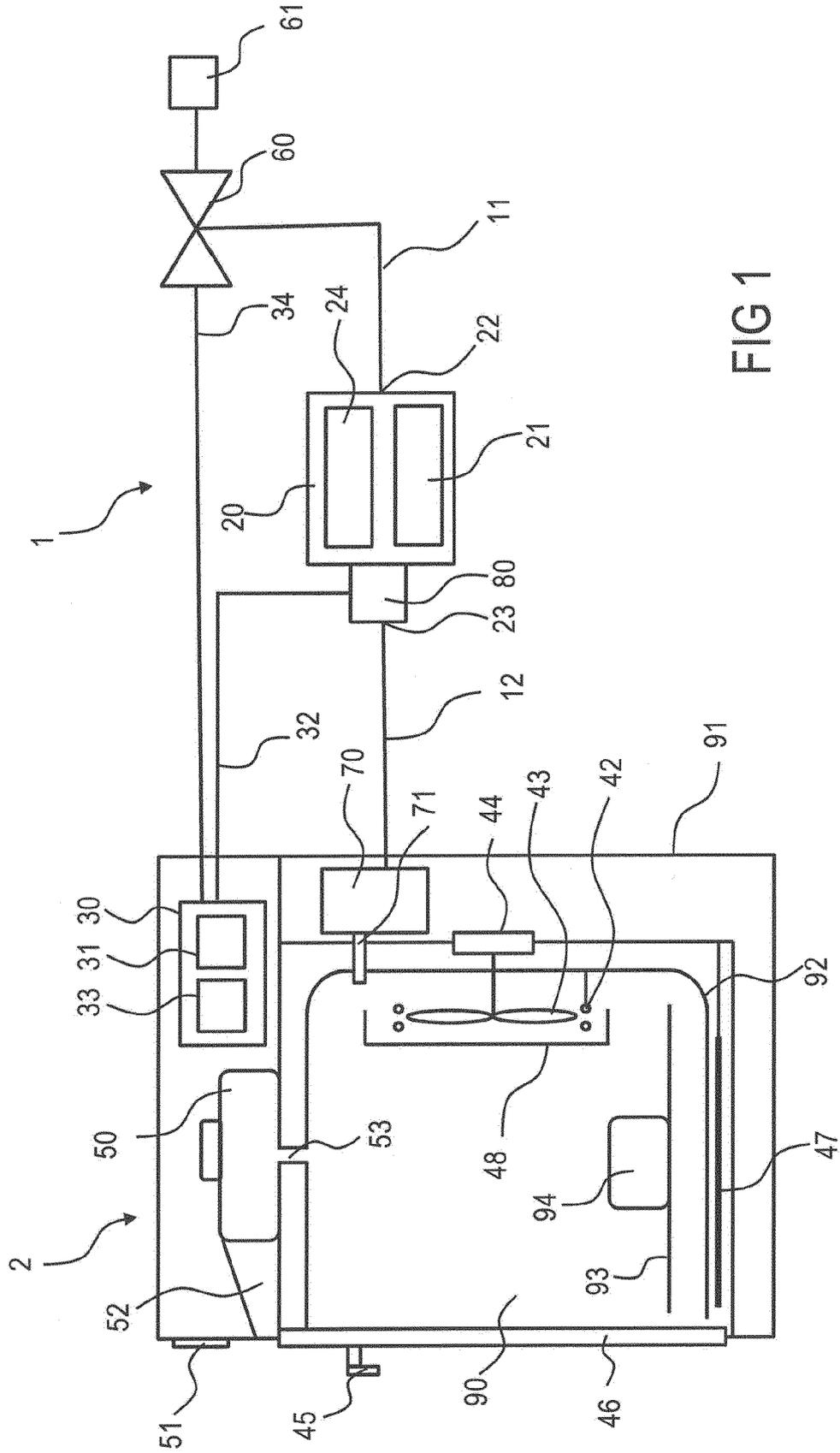


FIG 1



PARTIAL EUROPEAN SEARCH REPORT

Application Number

under Rule 62a and/or 63 of the European Patent Convention.
This report shall be considered, for the purposes of subsequent proceedings, as the European search report

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| DOCUMENTS CONSIDERED TO BE RELEVANT | | | |
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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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| X | JP 2010 190475 A (CHUBU ELECTRIC POWER; NICHIIWA DENKI KK) 2 September 2010 (2010-09-02) * figures 1-5 * * paragraphs [0027] - [0029] * | 13,14 | |
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| | | | TECHNICAL FIELDS SEARCHED (IPC) |
| | | | F24C |
| INCOMPLETE SEARCH | | | |
| The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out. | | | |
| Claims searched completely : | | | |
| Claims searched incompletely : | | | |
| Claims not searched : | | | |
| Reason for the limitation of the search: see sheet C | | | |
| Place of search | Date of completion of the search | Examiner | |
| The Hague | 29 March 2018 | Moreno Rey, Marcos | |
| CATEGORY OF CITED DOCUMENTS | | T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons | |
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EPO FORM 1503 03.82 (P04E07)



**INCOMPLETE SEARCH
SHEET C**

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Claim(s) searched incompletely:
13, 14

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Claim(s) not searched:
1-12, 15-17

Reason for the limitation of the search:

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The application does not meet the requirements of Article 84 EPC, because claims 1-17 are not clear.

Claim 1 merely relates to a water management system for a steam oven, wherein the steam oven itself does not form part of the subject-matter of claim 1. Hence, claim 1 merely defines a water management system suitable for a steam oven .

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However, the intended scope of protection of claim 1 is not clear, as it is not apparent what technical features a water management system must imply in order to be suitable to be used in combination with a steam oven, especially as it appears that a vast majority of known water management systems can be used in combination with a steam oven. Further, as the steam oven does not form part of the subject-matter of claim 1, any definition in reference to the steam oven does not result in a valid limitation of the subject-matter of claim 1. This applies to the definition of the water outlet (23) and the estimation unit (31), as these features form part of a non-claimed entity, namely the steam oven itself.

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Additionally, the problem to be solved by the present invention is presented as improving a descaling process of a steam oven (see page 2 of the description). However, claim 1 referring to a water management system alone is not capable of solving said problem posed, thereby claim 1 does not appear to contain all the technical features essential to the definition of the invention, as the device according to claim 1 is not capable of solving the problem posed. As a consequence, the steam oven itself is considered as being essential to the definition of the invention in order to solve the problem posed.

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Moreover, the term " sensor means (80)" described in claim 1 is vague and renders the subject-matter of claim 1 unclear, as claim 1 fails to further define said sensor means. Hence, it is not apparent how said sensor means operate, how they interrelate with the water management system and how these sensor means are capable of performing the operation of providing sensor values of the water stream to the estimation unit.

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For instance, well known test strips that change colour depending on the water hardness would fall within the scope of protection of claim 1. However, such well known test strips do not appear to form part of the intended scope of protection as they find no support in the description. Finally, the term "estimation unit (31)" is equally vague and renders the subject-matter of claim 1 unclear. It is not clear to the reader what can be understood as being an estimation unit, as the estimation unit is not further defined and the entity (steam oven) comprising the estimation unit does not form part of the subject-matter of the claim.

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It is not clear from the wording of claim 1 how said estimation is realised and if said estimation is performed by the estimation unit itself. Claim 1 equally allows a user to perform said estimation himself and the estimation unit merely assists him in doing said estimation.

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For instance, when using well known test strips , the user most compare

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the colour change of the test strip with a colour chart . Such a colour chart can be seen as the estimation unit as it serves to estimate the water hardness based on the colour change.

The vague definition of the subject-matter of claim 1 resulted in that the initial phase of the search a very large number of documents relevant to the issue of novelty were revealed. So many documents were retrieved that it was impossible to determine which parts of the claims 2-17 may be said to define subject-matter for which protection might legitimately be sought (Article 84 EPC). For these reasons, a meaningful search of the whole claimed subject-matter of claims 1-17 as present can not be carried out (Rule 63 EPC).

Moreover, a meaningful search is not possible on the basis of the dependent claims 2-12, as these claims include such a vast number of optional features introduced with the wording "and/or" that the intended scope of protection of claims 2-12 is equally not apparent to the reader (Article 84 EPC), thereby equally rendering a meaningful search of claims 1-12 not possible (Rule 63 EPC).

The same reasoning as for claims 1-12 also applies to claims 15-17, if referring to a method for operating a water management system.

Claims 13 and 14 define a steam oven, thereby overcoming some of the objections raised above.

However, claims 13 and 14 are merely partially searchable, as these claims are equally unclear (Article 84 EPC), as the operation of the sensor means and the estimation unit is not clearly defined, as well as it is not apparent how these features interact with the steam oven itself and especially, how said features are capable of solving the problem posed in the description.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-03-2018

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| JP 2004138381 A | 13-05-2004 | NONE | |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82