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(54) **WET-BULB-SENSOR-DEVICE FOR DOMESTIC OVEN**

(57) The invention relates to a wet-bulb-sensor-device (1) for a domestic oven (2), comprising at least the following components:
- a in operation upwardly opened basin (3) for water (4), of which a water-level (5) is formed in operation;
- a inlet-port (6) for water (4) for filling the basin (3);
- a temperature-sensor (7) which in operation is partially immersed in the water (4) in the basin (3);
- a controller (8) with a regulating-means (9) for setting in operation a predetermined height of a water-level (5).

The wet-bulb-sensor-device (1) is particularly characterized in that, in operation, the inlet-port (6) is arranged in the earth-gravity-field (10) below the predetermined water-level (5).

With the wet-bulb-sensor-device proposed herein a pressure-controlled constant water-level is achievable.

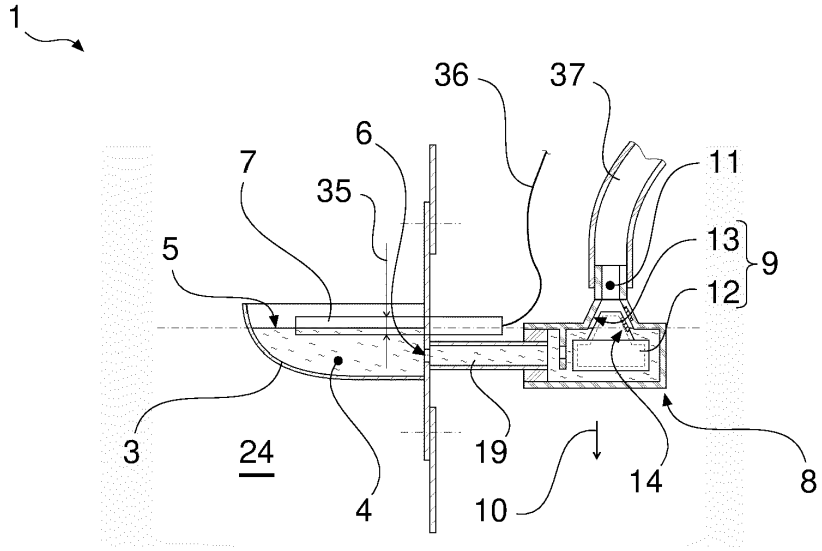

Fig. 1

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Description

[0001] The invention relates to a wet-bulb-sensor-device for a domestic oven, a steam-generating-device comprising such a wet-bulb-sensor-device for a domestic oven, a domestic oven comprising such a steam-generating-device for heating comestible goods, a method for operating such a wet-bulb-sensor-device, and a computer-program and a computer-program-product each for carrying out such a method.

[0002] For many domestic ovens, it is desirable to record the wet-bulb temperature, which is the lowest temperature that can be achieved by direct evaporative cooling. This is particularly advantageous in the context of a steam oven. In one embodiment, that is an furnace, and in another embodiment, that is a microwave oven of the type popularly used in the home by non-professionals.

[0003] To detect the wet-bulb temperature, it is necessary to provide a (small) amount of water inside the domestic oven and a temperature-sensor to detect the water temperature and/or the temperature in the immediate environment above a water-level of the water. For this purpose, a basin is provided and a temperature-sensor preferably partially immersed in the water. For this purpose, it is necessary to keep the water-level constant in a narrow range.

[0004] Currently, it is common to provide an electrical controller for this purpose, which receives its input value via the temperature-sensor, for example, the temperature-sensor detects a temperature above the boiling point of water. Then clearly the water or too much of the water in the basin has evaporated. Water must therefore be added. Overflowing of the basin is often accepted because the amount is sufficiently small not to significantly affect the cooking result and that would not result in damage to the oven.

[0005] On this basis, the present invention is based on the task of at least partially overcoming the back-draws from the prior art. The features according to the invention result from the independent claim(s), for which advantageous embodiments are shown in the dependent claim(s). The features of the claims can be combined in any technically sensible manner, whereby the explanations from the following description as well as features from the figures, which comprise supplementary embodiments of the invention, can also be consulted for this purpose.

[0006] The invention relates to a wet-bulb-sensor-device for a domestic oven, comprising at least the following components:

- a in operation upwardly opened basin for water, of which a water-level is formed in operation;
- a inlet-port for water for filling the basin;
- a temperature-sensor which in operation is partially immersed in the water in the basin;
- a controller with a regulating-means for setting in operation a predetermined height of a water-level.

[0007] The wet-bulb-sensor-device is characterized in particular by that in operation, the inlet-port is arranged in the earth-gravity-field below the predetermined water-level.

[0008] The spatial directions used herein refer to the intended use in operation, with the orientation to the earth-gravity-field, if of anything being referred to as the top, and a user side, i.e., a side to which the user has intended access (for example, via a door to a domestic oven), if of anything being referred to as the front, with the rear side being the most inaccessible side (often intended for at least one connection and/or oriented toward a wall). In some applications, such as stovetops or domestic ovens with a stovetop, one (or possibly more) user side(s) is the top side. The sides or lateral elements are arranged between front and rear and extending along the earth-gravity-field, often referred to as left or right, but thus not arranged below or above between front and rear. It should be noted that often a connection is not or not solely provided at the rear, but also alternatively or additionally at the sides, bottom and/or top.

[0009] Unless explicitly stated to the contrary, ordinal numbers used in the preceding and following descriptions are merely for the purpose of unambiguous distinguishability and do not reflect any order or ranking of the predetermined components. An ordinal number greater than one does not imply that another such component must necessarily be present.

[0010] The wet-bulb-sensor-device proposed here has a basin which is open at the top and can be filled with water during operation. Furthermore, a temperature-sensor is provided, which is partially immersed in the water, wherein the temperature-sensor is preferably fixed, and thus has a constant orientation with respect to a water-level. Preferably, the temperature-sensor is not only arranged for detecting a temperature in the water in the basin, but moreover for detecting the temperature immediately above the water-level of the water in the basin. In order to be able to adjust this water-level, a inlet-port is provided for filling i.e., in operation primarily for refilling, water. Furthermore, so that the water-level can be maintained exactly (i.e., within a small fluctuation range), a controller is provided. By means of its regulating-means, during operation the water can be adjusted to a predetermined level, which is thus designed to the spatial relation to the temperature-sensor described above.

[0011] It should be noted that the term temperature-sensor is used here to refer only to that particular part of a sensor device which is actually set-up to measure a variable. This means a sensor in this context is a sensor in the control-engineering-sense and not a sensor device (as commercially available) with stiffening elements, cable, connection and

possibly insulation. However, the temperature sensor preferably is part of such (temperature) sensor device. In one embodiment, the temperature-sensor comprises two or more separate sensing elements, where quite preferably in operation each of the sensing elements is fully immersed in the water (i.e., under the water-level) or fully above the water-level.

[0012] While in the prior art it is considered uncritical whether the temperature-sensor is completely submerged or merely wetted with water, it has been recognized on this side that such an operating mode leads to unfavorable behavior of the control or even to a less than satisfactory cooking result and/or cooking experience of the user. For example, up to now considerable fluctuations have been allowed between a measurement under water and a measurement until completion of an evaporation of a wetting, as just after the event that the entire water is evaporated a temperature above the boiling point of water is reached and, thus the controller can react not before that point of time. Because the boiling point shifts with the current air pressure, in addition this temperature is not exactly determined.

[0013] It is therefore proposed here that the inlet-port for water is arranged below the predetermined water-level. This means that there is a predetermined pressure at the inlet-port, which can be detected and thus it is possible to determine very precisely whether the water-level has changed. The pressure is thus structurally determined and can be permanently implemented in a controller or its regulating-means. In one embodiment, the water level in the basin can be transferred to a controller chamber located in a service compartment of the oven. According to the principle of communicating vessels, the water-level in the basin and the water-level in the controller chamber is the same. In such arrangement, the controller can measure and/or adjust the water level in the controller chamber, and such level will be identical in the basin. Such controller chamber can be adapted to host a controller in an service compartment that is thermally separated from the oven cavity in which there is the basin. This advantageously allows to place the controller in an environment that will have lower temperature than the cavity furnace, enabling the use of inexpensive (e.g., plastic) material for the controller.

[0014] If different modes of operation of the wet-bulb-sensor-device are desired e.g., a measurement without partial immersion (herein referred to as dry measurement) or, on the contrary, a measurement with fully immersed temperature-sensor (herein referred to as immersion measurement), this can also be adjusted by detecting the pressure by means of the regulating-means (or indirectly via a further (pressure) sensor communicating the sensed values to the regulating-means as an input value) the corresponding lower or higher water-level.

[0015] When reference is made herein to in operation or an operational situation, this does not mean dry measurement and not immersion measurement, but rather precisely the partially immersed and thus very accurate measurement of the wet-bulb-temperature. Nevertheless, at least in one embodiment, these two or at least one of these non-operational measurements (dry and fully immersed) can be performed.

[0016] It is further proposed in an advantageous embodiment of the wet-bulb-sensor-device that the controller comprises a supply-port and the regulating-means is formed by a floating-body and a corresponding sealing-seat closable by means of the floating-body, wherein the supply-port and the inlet-port are connected to each other in a communicating manner and the sealing-seat is arranged at the predetermined height of the water-level.

[0017] In this embodiment, a particularly simple, mechanical pressure measurement for simultaneous detection and adjustment of the water-level is proposed. For this purpose, the controller comprises a floating-body from which, together with a corresponding sealing-seat, a valve for water is formed for the inlet-port. The supply-port is communicatively connected to a water-source, for example a water-tank (for example as part of a domestic oven) or a so-called wall-port of a household. Further, the supply-port is communicatively connected to the inlet-port.

[0018] A communicating connection is created via one or more corresponding lines, which is concealed against the environment (technically i.e., with sufficiently low leakage) and thus suitable for conducting water. Often, ports (i.e., here the inlet-port and the supply-port) represent a technical element which can be connected to a separate technical element in a (water-) conducting tight manner. Alternatively, such a connection is integrated into another component and is merely a theoretically considered passage at a position in the water-supply-system.

[0019] In this embodiment, the physical relationship explained below applies, which is also shown in Fig. 3. First, the water pressure must be determined, for example using a water-tank via the water column:

$$(1.1)\quad p_r = \rho_w \cdot g \cdot h_r,$$

where p_r is the water pressure provided by means of the water-tank, ρ_w the density of water, g the acceleration-constant due to gravity and h_r the height of the water (i.e., the water column) measured at a current fill level of the water-tank. Alternatively, the water pressure p_r is determined by a wall-port or via a throttle by means of a pipe connection of, for example, a domestic oven.

[0020] The resulting supply force F_r on the floating-body is dependent on the area exposed to this water pressure p_r (e.g., diameter of the sphere section of a sphere) the vector component transverse to the orientation of the earth-gravity-field. It results thus:

$$(1.2)\quad F_r = A_O \cdot p_r,$$

where F_r is the supply force acting on the floating-body, and A_O is the area of the opening perpendicular to earth-gravity-field. For example, if the area of the opening is circular:

$$(1.3)\quad A_O = \frac{\pi}{4} d_O^2,$$

where d_O is the diameter of the circular area of the opening.

[0021] At a set water-level, the regulating-means must close the corresponding sealing-seat by pressing the floating-body (by buoyancy) from below against the water column i.e., against the supply force F_r. A correspondingly large counterforce must therefore be generated.

[0022] This buoyancy force F_b is determined as follows:

$$(1.4)\quad F_b = V_b \cdot \rho_w \cdot K_b,$$

where K_b is the percentage of the submerged part of the floating-body in the water and V_b its volume, which for a spherical floating-body is determined as follows:

$$(1.5)\quad V_b = \frac{\pi}{6} d_b^3,$$

where d_b is the diameter of the spherical floating-body.

[0023] In addition, the mass of the floating-body must be considered, which is known or can be easily calculated from its volume and density or sum of variety of densities according to each respective partial volume with constant density. The mass of the floating-body is to be multiplied by the acceleration due to gravity and results in the weight force F_w which is to be subtracted from the buoyancy force F_b or to add it to the supply force F_r so that the following applies for a closed state of the regulating-means:

$$(1.6)\quad (F_r + F_w) < F_b.$$

[0024] The volume V_b or the diameter d_b of the floating-body is preferably to be increased compared to an mathematical equilibrium in order to absorb dynamic effects, such as turbulences, deformations of the floating-body and/or the corresponding sealing-seat, surface tension of the wetting water, which can counteract or effectively prevent the closing. Here it must be taken into account that between the predetermined water-level and the height of the corresponding sealing-seat a height difference (h_{diff}) and/or a changed height (h_r) of the water column might be affected and, in that case, has to be recalculated. It should be noted that a floating-body has an almost arbitrary geometry and is not necessarily designed to float freely, but is preferably guided, for example pivotable, and/or supported.

[0025] For example, a diameter d_O of the corresponding sealing-seat is 2 mm [two millimeters], a height h_r of the water column is 200 mm [two hundred millimeters], a spherical hollow plastic floating-body is used with a diameter d_b of 16 mm [sixteen millimeters] with a shell thickness of 0.7 mm [seven-tenths of a millimeter] and filled with air, the floating-body being 60% [sixty percent] submerged in the controller's pool-side. Suitable diameters d_b of the spherical floating-body in such an embodiment are between five and twenty millimeters. Suitable diameters d_O of the corresponding sealing-seat are between one and five millimeters in such an embodiment.

[0026] It is further proposed in an advantageous embodiment of the wet-bulb-sensor-device that a position-sensor is integrated into the regulating-means, wherein a movement of the floating-body out of the closed position can be detected by means of the position-sensor.

[0027] A position-sensor is, for example, an angle sensor in a bearing of a tiltable floating-body, whereby in one embodiment only one of the extreme positions can be detected. Alternatively or additionally, the position-sensor comprises, for example, an electrical, magnetic and/or capacitive contact sensor or a distance sensor, whereby in one embodiment only one stop position i.e., one extreme position, can be detected.

[0028] If the movement of the floating-body can be detected, feedback on error conditions is possible, for example.

[0029] According to a further aspect, a steam-generating-device for a domestic oven is proposed, comprising at least

the following components:

- a steam-generator having an oven-side steam-inlet;
- a wet-bulb-sensor-device according to any one of previous claims; and
- a water-supply-system for the steam-generator and for the basin of the wet-bulb-sensor-device,

wherein, in operation, the controller of the wet-bulb-sensor-device is at the same time arranged for setting a predetermined height of a water-level of the steam-generator using the same regulating-means.

[0030] In this embodiment, the wet-bulb-sensor-device can be controlled together with a steam-generator or a water-level of the steam-generator via a common controller. The controller is a structural unit and/or comprises a single regulating-means. In one embodiment, a floating-body and the corresponding sealing-seat is the only regulating-means for the steam-generator and the wet-bulb-sensor-device.

[0031] For example, the steam-generator is equipped with an evaporator and a parallel branch line, with the same water-level to be set in both. Because of the evaporation, the water-level must be continuously re-adjusted. The steam-inlet is an opening to the furnace chamber of a domestic oven or can be connected to such an opening or to such a socket which is connected to such an opening.

[0032] It is further proposed in an advantageous embodiment of the steam-generating-device that the predetermined water-level of the basin of the wet-bulb-sensor-device and the steam-generator is identical.

[0033] In this advantageous embodiment, a particularly simple controller can be used, for example with a floating-body as the regulating-means without further throttling elements or cascade sections.

[0034] It is further proposed in an advantageous embodiment of the steam-generating-device that the water-supply-system comprises a first supply-line towards the inlet-port of the basin of the wet-bulb-sensor-device and a second supply-line towards the steam-generator, wherein the first supply-line has a greater flow resistance than the second supply-line.

[0035] Here it is proposed that the flow resistance (for example by means of different diameters of the lines) is smaller towards the steam-generator (e.g., the diameter correspondingly larger) and larger towards the wet-bulb-sensor-device (e.g., the diameter correspondingly smaller). This is to achieve that in a dynamic condition, due to the usually significantly larger or more frequent water demand in the steam-generator, more of the water supplied is directed to the steam-generator than to the wet-bulb-sensor-device when the controller is opened. In one embodiment, a throttle, preferably a pinch throttle, is provided in the first supply-line (to the wet-bulb-sensor-device), which is expertly set during assembly or initial start-up at the factory.

[0036] It should be noted that in a reversed mode of operation, where the demand on the wet-bulb sensing device is greater, the flow resistance of these lines is then correspondingly reversed.

[0037] It is further proposed in an advantageous embodiment of the steam-generating-device that said steam-generating-device is lockably connected to an overflow-port in communication via a drain-valve.

[0038] To avoid a failure case with an overfilling of the steam-generating-device and/or for an operationally necessary draining of the water in the steam-generating-device, a drain-valve is proposed. In the former case, this is for example pressure controlled, preferably passively via a corresponding floating-body. In the latter case, the drain-valve can additionally or alternatively be opened or closed, manually or electronically.

[0039] Preferably, the overflow-port is connected in a communicating manner to an overflow tank or a house-port, for example a wastewater pipe or a siphon, or to a pipe conveying the fluid in a tray positioned in the oven cavity bottom.

[0040] It is further proposed in an advantageous embodiment of the steam-generating-device that the controller is formed according to an embodiment as described above.

[0041] Particularly advantageous here is a controller with a floating-body and a corresponding sealing-seat as described above, whereby quite preferably the water-level of both the steam-generator and the wet-bulb-sensor-device or its basin is identical.

[0042] According to another aspect, a domestic oven for heating comestible goods is proposed, comprising at least the following components:

- a cavity closable with a user-side door for holding comestible goods to be heated;
- a temperature-control-device, for adjusting a temperature within the cavity;
- a wet-bulb-sensor-device according to an embodiment as described above or a steam-generating-device according to an embodiment as described above, wherein a temperature detected by means of the temperature-sensor thereof is usable as an input value for the temperature-control-device; and
- a water-source for supplying, in operation, water to the wet-bulb-sensor-device,

wherein preferably a control unit or a component of a control unit of the domestic oven is arranged to communicate with an external computer.

[0043] The domestic oven is, for example, a steam oven, a baking oven and/or a microwave oven, whereby preferably a steam cooking function is integrated into both of the latter by means of the steam-generating-device according to an embodiment according to the above description. In operation, a door to a cavity, which is accessible for and openable by a user, is provided at the front and/or at the top, wherein a climate condition can be set within the cavity i.e., usually an increased temperature and/or increased humidity compared to the environment. For this purpose, the cavity and/or the door is preferably thermally insulated with respect to the environment. It should be noted that the domestic oven proposed here is designed with an integrated or without i.e., separate, door.

[0044] The wet-bulb-sensor-device is set up to detect the wet-bulb-temperature as indicated above, with the basin or its opening (oriented upwards during operation) and the temperature-sensor being arranged in the cavity for this purpose.

[0045] A temperature detected by means of the wet-bulb-sensor-device can be used as an input value, preferably in addition to a dry temperature detection, for the temperature-control-device, or integrated into a corresponding control loop. The temperature and/or the relative humidity as a setpoint is specified by a user directly or indirectly (for example via a program). Furthermore, the domestic oven comprises a water-source, whereby in one embodiment this is formed as a water-tank or alternatively by a connection (for example together with a pipe) for a usual house-port. Preferably, the setting of a predetermined water-level is set solely by means of the controller, whereby the water-source is then communicatively connected to the basin or its inlet-port solely via the controller, for example connected to a supply-port of the controller. This means that when the controller is closed, a communicating connection is interrupted.

[0046] It should be noted that the water-source is preferably further arranged to supply water to the steam-generator.

[0047] It is further proposed in an advantageous embodiment of the domestic oven that the water-source is formed by a water-tank which, in operation, is arranged in the earth-gravity-field above the controller and is communicatively connected to the inlet-port via the controller.

[0048] With the water-tank, a flexible arrangement in a household kitchen is possible. By arranging the water-tank above the controller, a water column can be easily set up as described above. In addition, such a top-mounted water-tank is easily accessible to a user for refilling.

[0049] It is further proposed, in an advantageous embodiment of the domestic oven, that the regulating-means comprises a vent-port communicatively connected to the water-tank by means of a vent-line connected to the water-tank above a predetermined maximum fill level.

[0050] This vent-line prevents the creation of air bubble cushions inside the controller chamber itself, that could damage the correct behaviour of the floater. In one embodiment, the predetermined maximum fill level of the water-tank is set by means of an instruction to a user, for example via a marker or a floating-body.

[0051] In an advantageous embodiment, the domestic oven is capable of communicating with an external entity e.g., by way of the so-called Internet of Things [IoT]. This is helpful e.g., for assisting the user in front of the domestic oven when cooking or in an error case. This is also helpful e.g., for assisting a user being a service provider knowing from remote that an error case occurred and/or replacement of a part is needed soon. The external computer is preferably part of the so-called cloud and/or a local device of a service provider.

[0052] It is further proposed in an advantageous embodiment of the domestic oven that the water-tank is connected to an overflow-line at a predetermined maximum filling-level,
wherein preferably the overflow-line is connected to an overflow-port for a steam-generating-device, preferably on the connection-sided downstream of a drain-valve according to an embodiment as described above.

[0053] Here, it is suggested that, for example, a skimmer-type overflow orifice or an overflow valve is provided so that the overfilled water drains out of the water-tank via the overflow-line so that the water-tank can be filled (at least not permanently) beyond and above the maximum fill level.

[0054] In an advantageous embodiment, a drain-valve as described above is provided for the steam-generating-device. The overflow-line of the water-tank is preferably connected in the discharge direction downstream of the drain-valve to a common line or a common overflow-port. Preferably, the overflow-port is connected in a communicating manner to an overflow-tank or a house-port, for example a waste water line or a siphon or the inner side of the cavity, discharging the liquid above a oven tray.

[0055] According to a further aspect, a method for operating a wet-bulb-sensor-device according to an embodiment as described above is proposed, wherein upon a predetermined movement of the floating-body away from the sealing position detected by means of the position-sensor, which movement continues beyond a predetermined refilling period, a communication signal is output by the position-sensor and/or a processor,
wherein in response to the communication signal a user receives at least one of the following indications via a user-machine-interface:

- a water-source communicatively connected to the inlet-port is to be filled or connected, respectively, or a corresponding source valve is to be opened;
- the temperature detected by means of the temperature-sensor is faulty; and
- a steam-generator of a steam-generating-device, preferably according to an embodiment according to the above

description, is insufficiently supplied.

[0056] This method can be used to notify a user of an error in the wet-bulb-sensor-device or its water supply. Alternatively or additionally, in the manner of the Internet of Things [IoT], a service provider can be notified of an error and it is evaluated what needs to be done or (for example, as part of a closed service contract) an appointment is made to rectify the error. The service provider then has the status of a user of the wet-bulb-sensor-device or of a domestic oven, whereby in the latter case additional errors can preferably be determined remotely.

[0057] The processor is preferably a general purpose processor (e.g., a central processing unit, CPU) or microprocessor, RISC processor, GPU and/or DSP. Preferably, the processor is integrated into a control unit of an associated domestic oven, or is its sole processor. The communication signal is an analog or digital signal, which can be read out by the processor, unambiguously assigned and/or processed in a confusion-proof manner by means of corresponding electronic architecture. In one embodiment, the communication signal is a short-time voltage change, for example as a so-called beacon. In one embodiment, the communication signal is implemented with more extensive information, for example with a header and an information part.

[0058] Preferably, the processor has access to an internal and/or an external data memory. A (data) memory is, for example, a hard disk drive (HDD, SSD, HHD) or a solid state (non-volatile) memory, for example, a ROM memory or flash memory [flash EEPROM]. The storage often comprises a plurality of individual physical units or is distributed across a large number of separate devices, so that access to it takes place via (data) communication, for example package data service. The latter is a decentralized solution, whereby the memory and processors of a large number of separate computing units are used instead of or in addition to a (single unitary) central on-board computer.

[0059] In one embodiment, the user-machine-interface is a screen on (i.e., integrated into or at) a domestic oven or an external, preferably mobile, terminal device, such as a smartphone.

[0060] If a water-tank is provided or a connected house-port (for example by means of a source valve, for example a safety tap in the household kitchen or in the house in question) is closed or not supplied with water (for example due to construction work) or also in the domestic oven itself a pipe is damaged (for example having a leak and/or being clogged), the user is output that a water-source communicating with the inlet-port is to be filled or connected or a corresponding source valve is to be opened.

[0061] Preferably, the error case listed here also indicates that a (preferably present) steam-generator of a steam-generating-device is insufficiently supplied.

[0062] It is further proposed in an advantageous embodiment of the method that the wet-bulb-sensor-device is used in a domestic oven according to an embodiment as described above,
wherein furthermore a filling sensor is integrated in the water-tank, by means of which a predetermined minimum filling-level of the water-tank can be detected during operation, wherein, when the water-tank is filled above the predetermined minimum filling-level and when the communication signal is output by means of the position-sensor of the regulating-means of the wet-bulb-sensor-device or a processor to a user via a user-machine-interface, the indication is output that an error is present in the controller of the wet-bulb-sensor-device.

[0063] This method can be used to notify a user of an error in the water-tank in connection with the wet-bulb-sensor-device or its water supply. Alternatively or additionally, as explained above, a service provider can be notified of an error according to the Internet of Things [IoT].

[0064] In this embodiment, it can be automatically determined whether there is an error in the water supply within the system consisting of the water-tank and the wet-bulb-sensor-device, and preferably the steam-generator. Namely, if the filling sensor detects sufficient filling i.e., above the minimum filling-level, and at the same time the above-mentioned position-sensor emits a communication signal, a connection to the controller is impaired. Thus, refilling the water-tank will not provide any remedy for the error case according to the communication signal of the position-sensor. This is a service case and, for example, a service provider is informed or instructed immediately by means according to the IoT, possibly without the knowledge or perception of an owner of the impaired domestic oven in question.

[0065] According to a further aspect, a computer-program or computer-program-product is proposed comprising a computer-program-code, the computer-program-code being executable on at least one computer such that the at least one computer is caused to execute a method, preferably according to an embodiment as described above, wherein at least one of the computers is:

- integrated in a domestic oven, preferably as a control unit or a component of a control unit; and/or
- arranged to communicate with a control unit of a domestic oven.

[0066] A computer comprises one or more processors, for example a general purpose processor (e.g., a central processing unit, CPU) or microprocessor, RISC processor, GPU and/or DSP. The computer has, for example, additional elements such as memory interfaces. Optionally or additionally, the terms denote such a device capable of executing a provided or embedded computer-program, preferably using standardized programming language, such as C++, Java-

Script or Python, and/or controlling and/or accessing data storage devices and/or other devices such as input interfaces and output interfaces. The term computer also refers to a plurality of processors or a plurality of (sub-) computers that are interconnected and/or otherwise communicating and may share one or more other resources, such as (data) storage.

[0067] In one embodiment, the computer-program is partially or fully executable on a server or server unit of a cloud system, a mobile terminal device (for example, a smartphone), and/or on at least one unit of the computing device. The term server or server unit is used herein to refer to such a computer that provides data and/or operational services or services to one or more other computing devices or computers, thereby forming the cloud system.

[0068] It should be noted that in one embodiment the method is variable by means of an algorithm based on so-called DeepLearning or Machine-Learning, preferably as an alternative or supplementary filter for a Kalman filter. Such a machine-learning algorithm or deep-learning algorithm is already known, for example, from the fields of speech recognition or speech processing and face recognition, which are characterized by the fact that they are based on data sets that cannot be adequately controlled by humans and/or on rules that are only insufficiently known or not known at all. Comparable to a finite element algorithm, such an algorithm is trivial in the smallest sense, but due to the the tasks are unsolvable for a human or only solvable under an unjustifiable expenditure of time. Known algorithms or applicable program libraries are, for example, TensorFlow®, Keras and Microsoft® Cognitive Toolkit.

[0069] For example, the method learns how a wet-bulb-sensor-device, a water-tank a steam-generating-device and/or a domestic oven behaves, preferably under the influence of a user behavior, and outputs correspondingly modified control variables.

[0070] According to a further aspect, a computer-program-product is proposed on which computer-program-code is stored. The computer-program-code is executable, for example as explained above, on a computer, for example as part of a computer-program. A computer-program-product on which computer-program-code is stored is, for example, a medium such as, for example, RAM, ROM, an SD card, a memory card, a flash memory card, or a disc. Alternatively, a computer-program-product is stored on a server and is downloadable. Once the computer-program is made readable via a readout unit (for example, a drive and/or installation), the computer-program-code contained therein and the method contained therein is executable by a computer or in communication with a plurality of computer-based devices, for example, as described above.

[0071] The invention described above is explained in detail below against the relevant technical background with reference to the accompanying drawings, which show preferred embodiments. The invention is in no way limited by the purely schematic drawings, it being noted that the drawings are not dimensionally accurate and are not suitable for defining dimensional relationships. It is illustrated in

- Fig. 1: a schematic sectional view of a possible embodiment of a wet-bulb-sensor-device having a controller with a floating-body as part of the regulating-means;
- Fig. 2: a domestic oven in a rear view with a steam-generating-device;
- Fig. 3: a schematic illustration of a control of the water-level in the basin of a wet-bulb-sensor-device by means of a floating-body;
- Fig. 4: an advantageous controller with a pivoting floating-body;
- Fig. 5: a system-depiction of a steam-generating-device with wet-bulb sensing device and common controller with floating-body; and
- Fig. 6: a rear side of a domestic oven with a steam-generating-device according to Fig. 5.

[0072] Fig. 1 schematically shows in section a possible embodiment of a wet-bulb-sensor-device 1 having a controller 8 with a floating-body 12 as part of the regulating-means 9. In operation, the basin 3 is open at the top in the earth-gravity-field 10 and is arranged within a cavity 24 of a domestic oven 2. The basin 3 is filled to a predetermined water-level 5. A temperature-sensor 7 is oriented parallel to the water-level 5, that is, transverse to the orientation of the earth-gravity-field 10. In one embodiment, the water-level 5 is allowed to fluctuate by the dimensions of the temperature-sensor 7 i.e., the predetermined maximum deviation 35. The temperature-sensor 7 is communicatively connected to a processor 33 (not shown here) via a cable 36. The basin 3 is supplied with water 4 via a inlet-port 6 , wherein the inlet-port 6 is arranged below the (minimum) water-level 5 and is communicatively connected to the controller 8 via a (first) supply-line 19.

[0073] A controller 8 is provided between the inlet-port 6 and a supply-port 11, by means of which the water-level 5 in the basin 3 is (completely) passively regulated i.e., without energy supply from outside. For this purpose, the controller 8 comprises a regulating-means 9, which in turn is composed of a floating-body 12 and a corresponding sealing-seat 13. The floating-body 12 is shown here in a detached position, so that water 4 can flow out of the supply-port 11 from a source-line 37 towards the inlet-port 6. This has been explained previously. Further provided here (purely optionally) is a position-sensor 14 on the regulating-means 9, which is arranged to output a communication signal when the floating-body 12 is out of the sealing-position. For example, the position-sensor 14 is formed here by a magnet on the floating-body 12 and a magnetic field sensor at or near the sealing-seat 13. It should be noted that the controller 8 is preferably

arranged outside the cavity 24 and is particularly preferably thermally insulated from heat radiation from the cavity 24 or its wall.

[0074] In Fig. 2, a domestic oven 2 is shown in a spatial rear view with a steam-generating-device 15 whose water-supply-system 18 comprises a water-tank 27. The cavity 24 is enveloped by its side, rear, top and bottom walls and is closable at the front by means of a front-mounted door 23 (indicated by dashed lines). The domestic oven 2 is, for example, an oven with a steam cooking function.

[0075] Above the cavity 24, the water-tank 27 is arranged as the water-source 26. By means of a source-line 37, the controller 8 of the wet-bulb-sensor-device 1 (concealed here, for example as shown in Fig. 3) and, via a (separate) second supply-line 20, a steam-generator 16 are supplied directly from the water-source 26. The steam-generator 16 is arranged for generating and discharging steam via the steam-inlet 17 into the cavity 24. In this embodiment, (purely optionally) the second supply-line 20 is separate and at the same time designed as a source-line 37, with a supply valve 38 being provided here (purely optionally electronically controlled).

[0076] Purely optionally, a processor 33 is indicated here, which is connected in a communicating manner to the controller 8 (for example a position-sensor 14 according to Fig. 1) and is set up to issue a warning. The processor 33 is, for example, part of a controller of the domestic oven 2 and preferably also comprises a temperature-control-device (here within an oven-control-unit 25) for the temperature in the cavity 24. In this particular embodiment, a mobile-device 39 is

connected (wirelessly) to the processor 33 in a communicating manner and displays the warning on its user-machine-interface 34 (here then the touch display) in a manner understandable to a user, for example a service provider.

[0077] Fig. 3 shows a schematic illustration of a control of the water-level 5 in the basin 3 of a wet-bulb-sensor-device 1 by means of a floating-body 12. For components and interrelationships not explicitly described here, reference is made without exclusion of generality to the description regarding Fig. 1. Here, in contrast to Fig. 1, a differently shaped (here spherical) floating-body 12 is shown, as well as a vent-port 28 with vent-line 29 to a water-tank 27. The source-line 37 is connected below the water-tank 27. Between a minimum filling height 30 and a maximum filling height 31 there is an actual tank-water-level, over which the water column 40 (i.e. its height) is determined. From the body diameter 41 of the floating-body 12 and the opening diameter 42 of the corresponding sealing-seat 13 or supply-port 11, the equilibrium is set at the water-level 5 shown. Due to the buoyancy of the floating-body 12 and the relative alignment to the corresponding sealing-seat 13, there is a height difference 43 between the water-level 5 of the basin 3 and the lower end of the water column 40. The minimum filling-level 30 is ensured, for example, via a filling sensor (not shown here), which is connected in a communicating manner, for example, to a processor 33 as shown in Fig. 2 and via the latter the filling sensor issues a warning to a user-machine-interface 34. The maximum filling height 31 is ensured here via an overflow-line 32 at the water-tank 27. Alternatively, the maximum filling height 31 is controlled via a maximum water filling sensor. Preferably, the same sensor that measures a minimum filling height 30 in the tank, is able to measure also the maximum filling height 31. When the maximum filling height 31 is reached, in one embodiment, the oven will make a sound and/or visual indication, in order to alert the user to stop pouring water. In the case of electronically controlling the filling heights 30, 31, the overflow line 32 is an emergency measure only if the user ignores the "tank full" alarms and keeps on pouring water. In such case, preferably the surplus water will be guided to the drain outlet inside the caivity.

[0078] Fig. 4 shows an advantageous controller 8 with a pivoting floating-body 12. The floating-body 12 is supported by a pivoting bearing and can be pivoted out of the position shown when it afloats in such a way that the lateral connection piece 44 (i.e. the supply-port 11) is closed in cooperation with the corresponding sealing-seat 13. A line can be connected via a lower connection piece 45, for example for a first supply-line 19 and/or a second supply-line 20 (compare Fig. 2, Fig. 5 and/or Fig. 6). A vent-line 29 can be connected via an upper connection piece 46, the vent-port 28.

[0079] Fig. 5 shows a system-depiction of a steam generation device 15 with wet-bulb-sensor-device 1 and common controller 8 with floating-body 12. Purely for clarity without excluding generality, the wet-bulb-sensor-device 1 is schematically designed as shown, for example, in Fig. 1 and Fig. 3 with a controller 8 as shown in Fig. 4. A parallel return line 47 is associated here with the steam-generator 16, which opens into a common a droplet separation chamber 48. The steam is going up into the cavity, the water drops will return back to the water circuit by means of return line 47. The generated steam is introduced via the steam-inlet 17 into the cavity 24 (not shown here) of a domestic oven 2.

[0080] The wet-bulb-sensor-device 1 and the steam-generator 16 are supplied with water 4 via a common water-supply-system 18 with a single (common) controller 8. Again, purely for clarity and without exclusion of generality, a water-tank 27 is shown as a water-source 26 for generating a predetermined supply pressure via a water column 40, the water-source 26 and pressure being alternatively or additionally formed with water pressure form a wall connection. For details thereof, reference is made to the preceding description and Fig. 3. The controller 8 is supplied with water 4 by means of the source-line 37 via a supply-port 11. The floating-body 12 floats up when a water-level 5 (here purely optionally identical) of the wet-bulb-sensor-device 1 and the steam-generator 16 is reached, and then closes the supply-port 11. The water 4 float up the floating-body 12 is in communicative connection with the wet-bulb-sensor-device 1 by means of the first supply-line 19 and with the steam-generator 16 via the second supply-line 20. The desired water-level 5 is thus set in the basin 3 of the wet-bulb-sensor-device 1 and in the steam-generator 16. Here also in the purely optional

return line 47, which branches off from or more precise as (droplet-fluid is coming from above) branches into the second supply-line 20.

[0081] The second supply-line 20 is also connected to an overflow-port 22, with a drain-valve 21 being interposed, which can be opened and closed (manually or electronically), or even throttled i.e., allowing a determinable (controllable) flow. For example, a safety sensor is integrated in the steam-generator 16 for this purpose (not shown here).

[0082] Fig. 6 shows a rear side of a domestic oven 2 with a steam-generating-device 15 as shown in Fig. 5 in a real application. This embodiment corresponds to the system illustration in Fig. 5. However, additionally a vent-line 29 from the controller 8 and an overflow-line 32 from the water-tank 27 are also provided here, for example as in the schematic illustration in Fig. 3. From the illustration can be derived that the water-supply-system 18 of the steam-generating-device 15 can be compactly integrated into an provided installation space for a domestic oven 2.

[0083] With the wet-bulb-sensor-device proposed herein a pressure-controlled constant water-level is achievable.

List of reference numerals

1	Wet-bulb-sensor-device	36	Cables
2	Domestic oven	37	Source-line
3	Basin	38	Supply-valve
4	Water	39	mobile-device
5	Water-level	40	Water column
6	Inlet-port	41	Body diameter
7	Temperature-sensor	42	Opening diameter
8	Controller	43	Height difference
9	Regulating-means	44	side socket
10	Earth-gravity-field	45	lower socket
11	Supply-port	46	upper socket
12	Floating-body	47	Return-line
13	Sealing-seat	48	Droplet separation chamber
14	Position-sensor		
15	Steam-generating-device		
16	Steam-generator		
17	Steam-inlet		
18	Water-supply-system		
19	first supply-line		
20	second supply-line		
21	Drain-valve		
22	Overflow-port		
23	Door		
24	Cavity		
25	Control unit		
26	Water-source		
27	Water-tank		
28	Vent-port		
29	Vent-line		
30	minimum filling height		
31	maximum filling height		
32	Overflow-line		
33	Processor		
34	User-machine-interface		
35	maximum deviation		

Claims

1. A wet-bulb-sensor-device (1) for a domestic oven (2), comprising at least the following components:

- a in operation upwardly opened basin (3) for water (4), of which a water-level (5) is formed in operation;
- a inlet-port (6) for water (4) for filling the basin (3);
- a temperature-sensor (7) which in operation is partially immersed in the water (4) in the basin (3);
- a controller (8) with a regulating-means (9) for setting in operation a predetermined height of a water-level (5),

characterized in that
in operation, the inlet-port (6) is arranged in the earth-gravity-field (10) below the predetermined water-level (5).

2. The wet-bulb-sensor-device (1) according to claim 1, wherein

the controller (8) comprises a supply-port (11) and the regulating-means (9) is formed by a floating-body (12) and a corresponding sealing-seat (13) closable by means of the floating-body (12),
wherein the supply-port (11) and the inlet-port (6) are connected to each other in a communicating manner and the sealing-seat (13) is arranged at the predetermined height of the water-level (5).

3. The wet-bulb-sensor-device (1) according to claim 2, wherein
a position-sensor (14) is integrated into the regulating-means (9), wherein a movement of the floating-body (12) out of the closed position can be detected by means of the position-sensor (14).

4. A steam-generating-device (15) for a domestic oven (2), comprising at least the following components:

- a steam-generator (16) having an oven-side steam-inlet (17);
- a wet-bulb-sensor-device (1) according to any one of previous claims; and
- a water-supply-system (18) for the steam-generator (16) and for the basin (3) of the wet-bulb-sensor-device (1), wherein, in operation, the controller (8) of the wet-bulb-sensor-device (1) is at the same time arranged for setting a predetermined height of a water-level (5) of the steam-generator (16) using the same regulating-means (9).

5. The steam-generating-device (15) according to claim 4, wherein
the predetermined water-level (5) of the basin (3) of the wet-bulb-sensor-device (1) and of the steam-generator (16) is identical.

6. The steam-generating-device (15) according to claim 4 or claim 5, wherein

the water-supply-system (18) comprises a first supply-line (19) towards the inlet-port (6) of the basin (3) of the wet-bulb-sensor-device (1) and a second supply-line (20) towards the steam-generator (16),
wherein the first supply-line (19) has a greater flow resistance than the second supply-line (20).

7. The steam-generating-device (15) according to any one of claim 4 to claim 6, wherein
said steam-generating-device (15) is lockably connected to an overflow-port (22) in communication via a drain-valve (21).

8. The steam-generating-device (15) according to any one of claim 4 to claim 7, wherein the controller (8) is formed according to claim 2.

9. A domestic oven (2) for heating comestible goods, comprising at least the following components:

- a cavity (24) closable with a user-side door (23) for holding comestible goods to be heated;
- a temperature-control-device (25), for adjusting a temperature within the cavity (24);
- a wet-bulb-sensor-device (1) according to any one of claim 1 to claim 3 or a steam-generating-device (15) according to any one of claim 4 to claim 8, wherein a temperature detected by means of the temperature-sensor (7) thereof is usable as an input value for the temperature-control-device (25) in order to determine environmental data inside the cooking cavity such as humidity; and
- a water-source (26) for supplying, in operation, water (4) to the wet-bulb-sensor-device (1),

wherein preferably a control unit (25) or a component of a control unit (25) of the domestic oven (2) is arranged to communicate with an external computer.

10. The domestic oven (2) according to claim 9, wherein
the water-source (26) is formed by a water-tank (27) which, in operation, is arranged in the earth-gravity-field (10) above the controller (8) and is communicatively connected to the inlet-port (6) via the controller (8).

11. The domestic oven (2) according to claim 10, wherein
the regulating-means (9) comprises a vent-port (28) communicatively connected with the water-tank (27) by means of a vent-line (29) connected to the water-tank (27) above a predetermined maximum filling-level (31).

12. The domestic oven (2) according to claim 10 or claim 11, wherein

the water-tank (27) is connected to an overflow-line (32) at a predetermined maximum filling-level (31),
wherein preferably the overflow-line (32) is connected to an overflow-port (22) for a steam-generating-device (15), preferably on connection-sided downstream of a drain-valve (21) according to claim 7.

13. A method for operating a wet-bulb-sensor-device (1) according to claim 3, wherein upon a predetermined movement of the floating-body (12) from the sealing position detected by means of the position-sensor (14), which movement continues beyond a predetermined refilling period, a communication signal is output by the position-sensor (14) and/or a processor (33),
wherein in response to the communication signal a user receives at least one of the following indications via a user-machine-interface (34):

- a water-source (26) communicatively connected to the inlet-port (6) is to be filled or connected, respectively, or a corresponding source valve is to be opened;
- the temperature detected by means of the temperature-sensor (7) is faulty; and
- a steam-generator (16) of a steam-generating-device (15), preferably according to any one of claim 4 to claim 8, is insufficiently supplied.

14. The method according to claim 13, wherein the wet-bulb-sensor-device (1) is used in a domestic oven (2) according to one of claims 10 to 12,

wherein furthermore a filling sensor is integrated in the water-tank (27), by means of which a predetermined minimum filling-level (30) of the water-tank (27) can be detected during operation,
wherein, when the water-tank (27) is filled above the predetermined minimum filling-level (30) and when the communication signal of the floating body (12) being in the detached position is output by means of the position-sensor (14) of the regulating-means (9) of the wet-bulb-sensor-device (1) or a processor (33) to a user via a user-machine-interface (34), the indication is output that a error is present.

15. A computer-program or computer-program-product comprising a computer-program-code, the computer-program-code being executable on at least one computer in such a way that the at least one computer is caused to execute a method, preferably according to claim 13 or claim 14, wherein at least one of the computers is:

- integrated in a domestic oven (2), preferably as a control unit (25) or a component of a control unit (25); and/or
- arranged to communicate with a control unit (25) of a domestic oven (2).

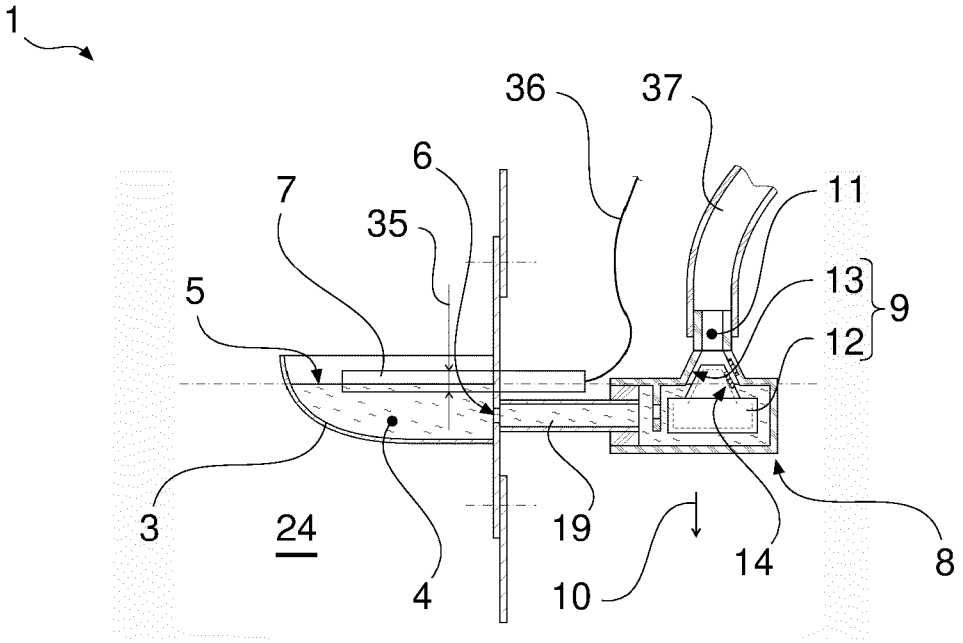
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Fig. 1

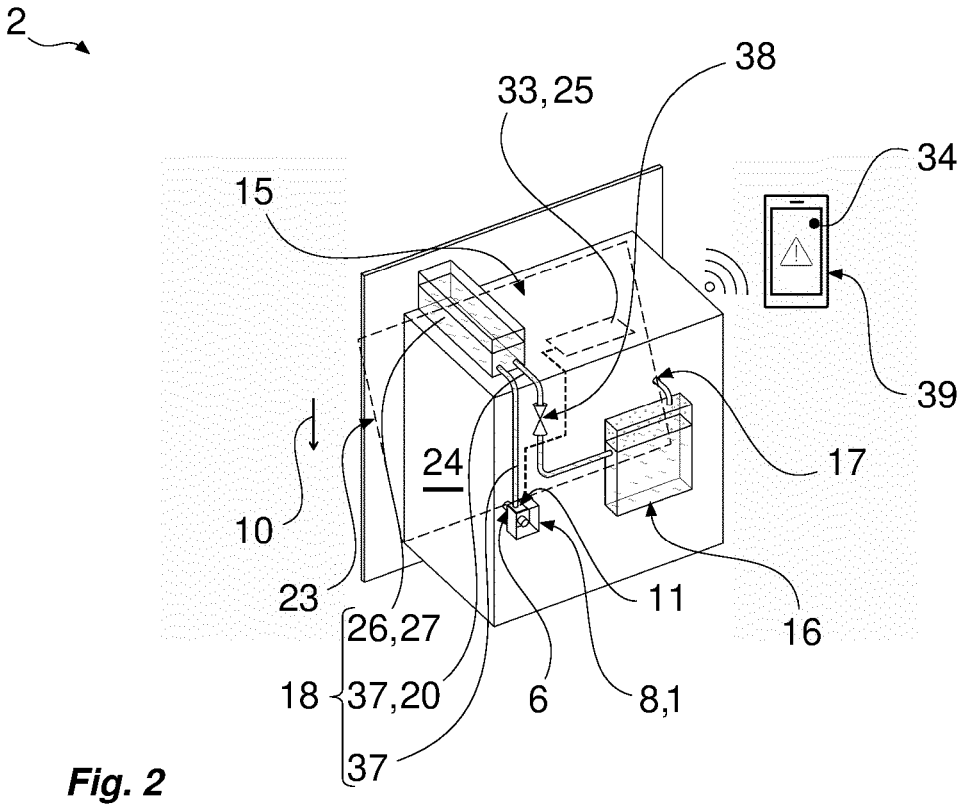
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Fig. 2

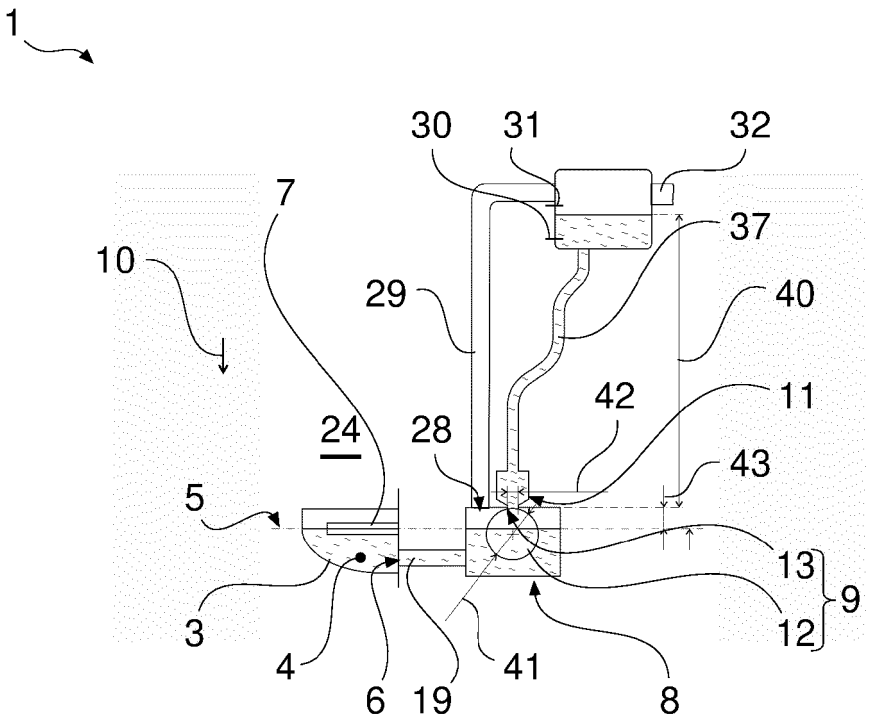
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Fig. 3

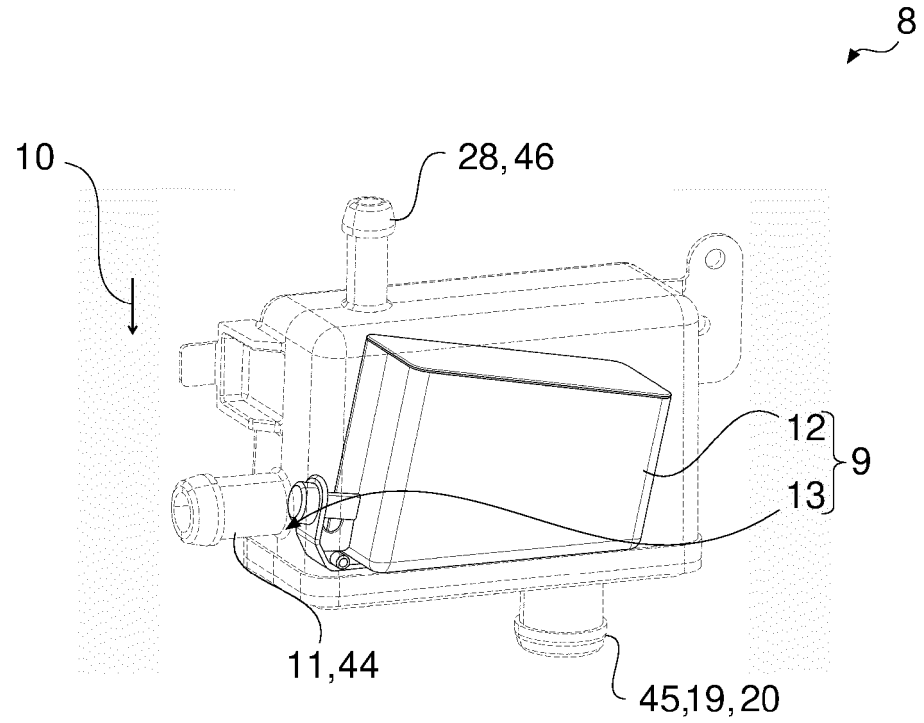
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Fig. 4

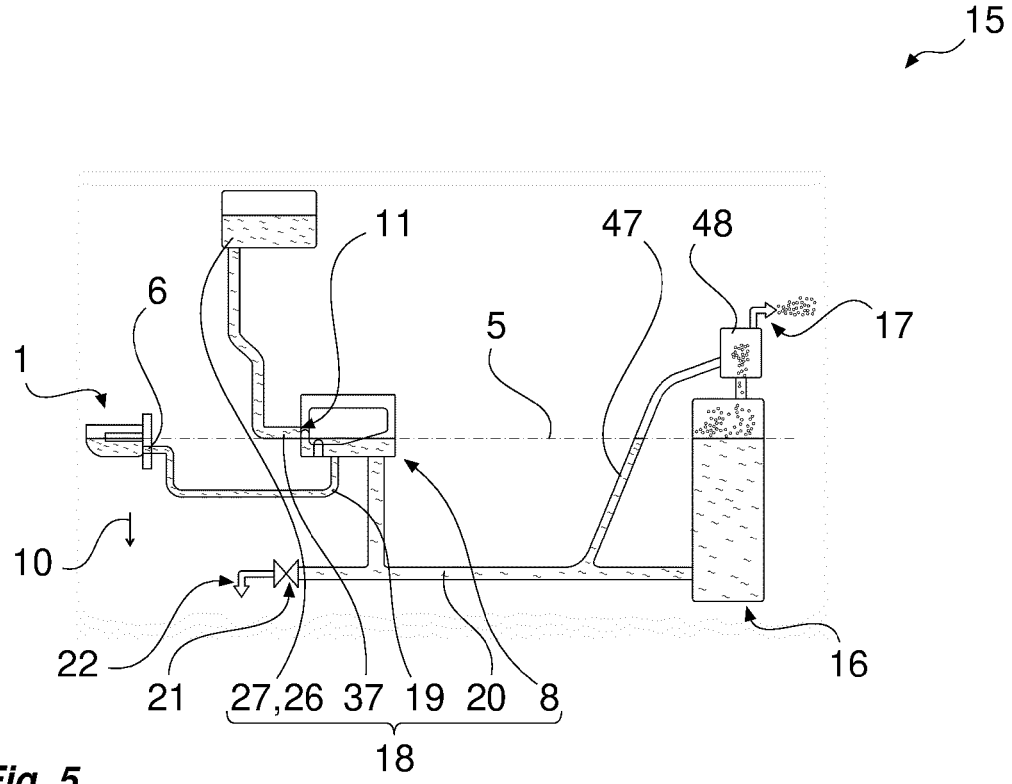
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Fig. 5

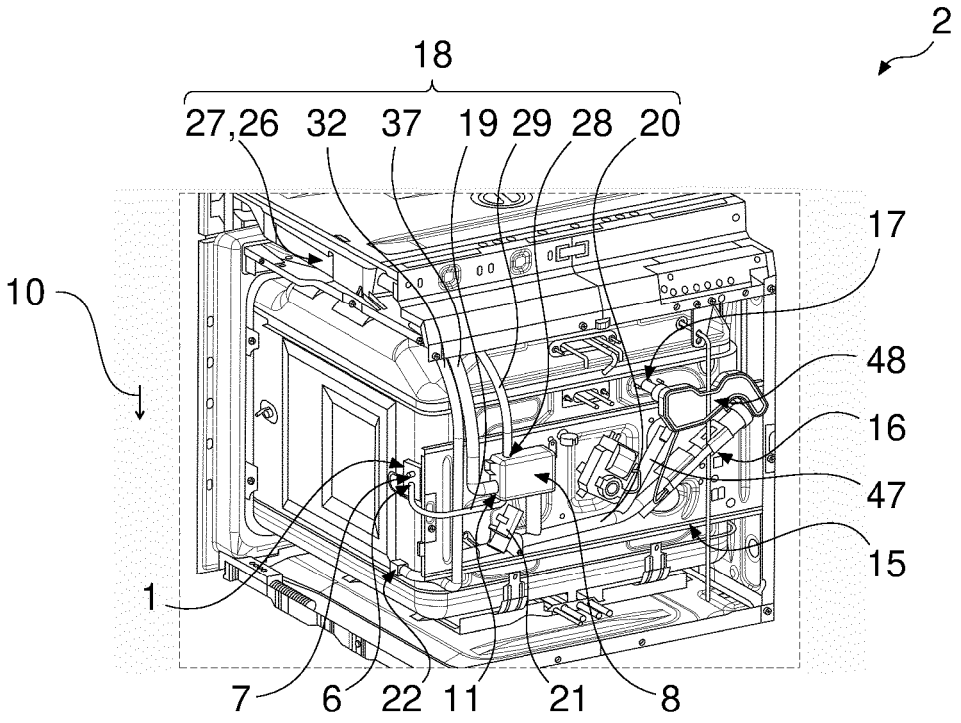
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Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 1135

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2021/088388 A1 (LEES HARRISON JOHN [US] ET AL) 25 March 2021 (2021-03-25) * figures 1-5 * * paragraphs [0007], [0047], [0048], [0064], [0065] *	1,2, 4-12,15	INV. F24C15/32
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TECHNICAL FIELDS SEARCHED (IPC)

F24C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 March 2023	Moreno Rey, Marcos

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