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(54) **DISHWASHING MACHINE AND METHOD**

(57) There is disclosed a dishwashing machine (100). The dishwashing machine (100) comprises a controller (234) and one or more sensors (276) arranged to obtain temperature information in a washing compartment (204) of the dishwashing machine (100). The con-

troller (234) is configured to use the temperature information to detect one or more regions of accumulated liquid (272, 276), so as to determine an orientation of one or more items (260, 262, 264, 266) in the washing compartment.

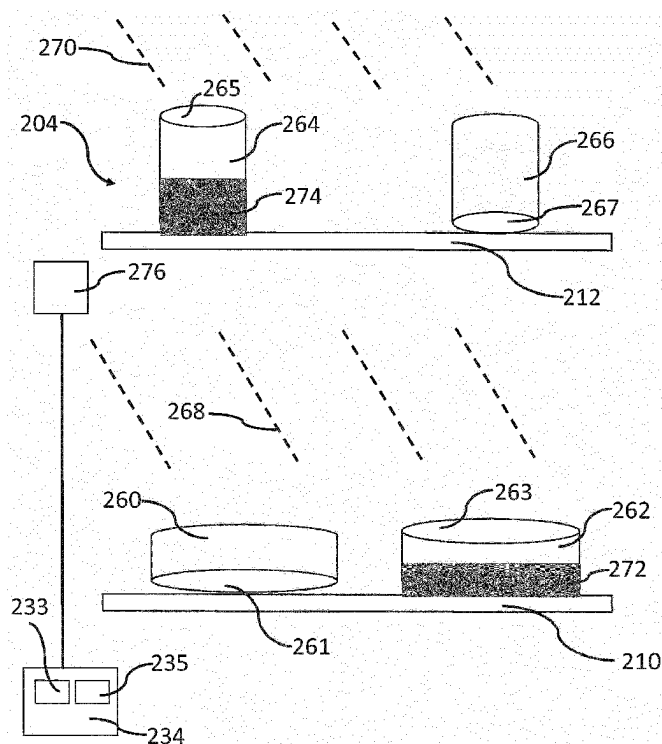


Fig. 2

Description

Technical Field

[0001] The present disclosure relates to a dishwashing machine and a method of operation of such a dishwashing machine.

Background

[0002] Dishwashing machines (also referred to as dishwashers) are used for washing items such as crockery and cutlery. A known dishwashing machine comprises a washing compartment for holding one or more items to be washed, and a washing mechanism for washing those items. Typically a user can select from a plurality of pre-defined washing cycles via a user interface on a front face of the dishwashing machine.

Summary

[0003] According to a first aspect disclosed herein, there is provided a dishwashing machine comprising: a controller; one or more sensors arranged to obtain temperature information in a washing compartment of the dishwashing machine; the controller configured to use the temperature information to detect one or more regions of accumulated liquid, so as to determine an orientation of one or more items in the washing compartment.

[0004] According to an example, the controller is configured to detect a region of accumulated liquid by detecting a temperature difference between one or more regions of the washing compartment and an ambient temperature of the washing compartment.

[0005] According to an example, the temperature difference comprises a threshold temperature difference.

[0006] According to an example, the threshold temperature difference comprises a difference of 10°C or more.

[0007] According to an example, the one or more sensors comprises one or more thermal imaging cameras.

[0008] According to an example, the controller is configured to cause an output to be generated for a user of the dishwashing machine, the output comprising an indication of one or more items oriented incorrectly in the dishwashing machine.

[0009] According to an example, the output comprises location information of the one or more items oriented incorrectly in the dishwashing machine.

[0010] According to an example, the output comprises a heat map.

[0011] According to an example, the controller is configured to determine a volume of each of the one or more regions of accumulated liquid, and the controller configured to provide the output only when one or more of the determined volumes is at or above a threshold value.

[0012] According to a second aspect there is provided a method of operating a dishwashing machine comprising:

ing: using temperature information obtained from one or more sensors in a washing compartment of the dishwashing machine to determine one or more regions of accumulated liquid, so as to determine an orientation of one or more items in the washing compartment.

[0013] According to an example, the method comprises detecting a region of accumulated liquid by detecting a temperature difference between one or more regions of the washing compartment and an ambient temperature of the washing compartment.

[0014] According to an example, the method comprises causing an output to be generated for a user of the dishwashing machine, the output comprising an indication of one or more items oriented incorrectly in the dishwashing machine.

[0015] According to an example, the output comprises location information of the one or more items oriented incorrectly in the dishwashing machine.

[0016] According to an example, the method comprises determining a volume of each of the one or more regions of accumulated liquid, and providing the output only when one or more of the determined volumes is at or above a threshold value.

Brief Description of the Drawings

[0017] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a dishwashing machine according to an example.

Figure 2 shows schematically a part of a dishwashing machine according to an example.

Figure 3 shows schematically a flow chart of a method according to an example.

Detailed Description

[0018] The present disclosure has applicability to dishwashing machines (also referred to as dishwashers). Dishwashing machines are used to automate the washing of items associated with food preparation and/or cooking and/or eating. Such items include crockery such as plates, bowls, cups, mugs etc. Such items may also include cutlery such as knives, forks, spoons, or indeed any other cooking or eating utensil. Other items that may be washed include glassware, food containers, saucepans etc.

[0019] Figure 1 schematically shows an example of a dishwashing machine 100. The dishwashing machine 100 comprises a main body 102, within which there is a washing compartment or chamber 104. In this example the washing compartment 104 comprises a lower portion 106 and an upper portion 108. The lower portion 106

comprises a tray or rack 110 for holding items to be washed, and the upper portion 108 comprises a tray or rack 112 for holding items to be washed. The racks 110 and 112 can be moved in and out of the washing compartment 104 on roller assemblies.

[0020] Items to be washed are schematically shown at 114. In this case the items to be washed are schematically represented by plates 116 and 118 on rack 112, and plates 120 and 122 on rack 120. Of course there may alternatively be any other type of item to be washed or combination of items to be washed. In the example of Figure 1 a washing mechanism 123 comprises spray arm 124 in lower portion 106, and spray arm 126 in upper portion 108. In other examples the upper spray arm 126 is omitted. Each spray arm comprises a series of holes or nozzles which can spray water upwardly towards the items to be washed 114, while the spray arms 124 and 126 rotate. These are commonly referred to as spray holes. Rotation of the spray arms 124 and 126, whilst ejecting water therefrom, helps to clean the items in a washing load.

[0021] A problem which has been recognised by the present inventors is that incorrectly placed and/or oriented items in the machine may accumulate or collect water during a washing cycle. For example a receptacle such as a drinking glass should be placed upside-down when loaded in the dishwashing machine i.e. with a base of the glass facing a top of the dishwashing machine, and an open end of the glass facing downwards towards a base or bottom of the dishwashing machine. This may be considered or termed a correct orientation. If however the receptacle is placed the other way round i.e. with its open end facing upwards, then liquid may accumulate in the receptacle. This may be considered or termed an incorrect orientation. The accumulated liquid (e.g. water) in the receptacle may be dirty and/or contain detergent, and therefore such incorrectly placed items may not be properly washed. This is also true for other types of receptacles such as cups, mugs, bowls, saucepans etc. Receptacles may also be placed in the dishwashing machine by a user in a correct orientation, but then move to an incorrect orientation. This may happen, for example, when a rack holding the receptacle is pushed in to the dishwashing machine, or during a washing cycle (e.g. due to pressure of water from the spray arms acting on the receptacle).

[0022] In the example of Figure 1 the spray arm 124 is connected to shaft 125. The shaft 125 enables rotation of spray arm 124 about a central axis of the shaft 125. The shaft 125 and spray arm 124 may be considered to be comprised in a spray arm assembly 121. In the example of Figure 1 the spray arm 126 is connected to shaft 127. The shaft 127 enables rotation of spray arm 126 about a central axis of the shaft 127.

[0023] The dishwashing machine 100 further comprises water inlet schematically shown at 128 and water outlet schematically shown at 130, for enabling water to be fed to and taken away from the dishwashing machine

respectively. In some examples a heater element (not shown) is provided for heating water as necessary. In other examples hot and cold water is drawn from a building's supply as required. A power connection is schematically shown at 132, which enables the dishwashing machine to be connected to mains electrical power for powering the dishwashing machine.

[0024] A water pump is schematically shown at 150. The water pump 150 is constructed and arranged to distribute water around the dishwashing machine 100. For example, the water pump 150 can pump water to spray arms 124 and 126. Water that has been sprayed falls back down to a base or sump 152 of the dishwashing machine 100, from where that water can be recycled (after filtering, in some examples) by the pump 150.

[0025] In some examples rotation of the spray arms 124 and 126 is effected by the force of water being ejected from spray holes of the spray arms. In such examples the spray holes may be arranged and/or oriented so as to facilitate such rotation. Additionally or alternatively one or more motors, shown schematically at 148 may be provided for powering rotation of the spray arms 124 and 126.

[0026] A controller is schematically shown at 134 for controlling operations of the dishwashing machine. The controller may comprise at least one memory and at least one processor. The controller 134 can, for example, cause the dishwashing machine to operate according to one or more pre-determined washing cycles selected via a user interface 136. The available washing cycles may differ from each other by temperature and/or duration, for example. Via the user interface 136 a user may also be able to select whether the washing cycle is for a full or half load. A display 138 is also provided which can display information to the user. This may include information such as confirming a user's washing cycle selection, as well as information such as time remaining of a washing cycle that is in progress. The display 138 may also display one or more alarm states to a user, for example by use of a flashing light. A speaker may also be provided in some examples, so that an audible alarm can be provided to a user (for example a buzzer). An alarm state may, for example, indicate an end of a wash or detection of an incorrectly oriented receptacle.

[0027] A door of the dishwashing machine 100 is schematically shown at 140. The door 140 is connected to main body 120 via hinges 142 and 144. In Figure 1 the door is in an open position enabling access to washing compartment 104. The door 140 may be moved to a closed position so that the washing compartment 104 is then substantially enclosed. The door 140 may also include a receptacle for holding dishwashing detergent (e.g. a detergent cube) which can be released in to the dishwashing machine during a wash. The receptacle for holding washing detergent may of course also be positioned elsewhere within the dishwashing machine. The dishwashing machine may also include one or more further receptacles for containing dishwashing machine salt

and/or rinse aid, for example.

[0028] A washing cycle generally comprises three main stages: (i) wetting; (ii) injection of detergent, (iii) rinsing. In some examples one or more of these steps may be omitted. For example a rinse wash may include just a rinsing cycle. Whichever steps are included or not included, the washing of the washing load may be generally termed a washing cycle.

[0029] Figure 2 is a schematic side view showing certain parts of a washing compartment 204 of a dishwashing machine according to an example. The washing compartment 204 comprises a first rack 210 for holding one or more items to be washed. In the example of Figure 2 the first rack 210 is holding a first bowl 260 and a second bowl 262. The first bowl is oriented correctly with its open end 261 facing downwardly towards a base of the washing compartment 204. The second bowl 262 is oriented incorrectly, with its open end 263 facing upwardly towards a top of the washing compartment 204. In the example of Figure 2 the second rack 212 is holding a first glass 264 and a second glass 266. The first glass 264 is oriented incorrectly, with its open end 265 facing upwardly towards a top of the washing compartment 204. The second glass 266 is oriented correctly with its open end 267 facing downwardly towards a base of the washing compartment 204.

[0030] Liquid (e.g. water, which may include detergent) that has been sprayed by the spray arms of the dishwashing machine is schematically shown by the dashed lines e.g. lines 268 and 270. As a result of its incorrect orientation liquid (e.g. water, which may include detergent) has accumulated in bowl 262, as schematically shown at 272. Likewise, as a result of its incorrect orientation liquid (e.g. water, which may include detergent) has accumulated in glass 264, as schematically shown at 274.

[0031] A sensor is schematically shown at 276. The sensor 276 is arranged to obtain temperature information in the washing compartment 204. In the example of Figure 2 one sensor 276 is shown. In other examples two or more sensors 276 may be provided. The two or more sensors may be distributed at different locations about the washing compartment 204. Therefore generally speaking there may be one or more of sensors 276. The sensor 276 may be located, for example, on an internal surface of the washing compartment 204 e.g. on a side surface or top or bottom surface of the washing compartment 204. According to some examples the sensor 276 may be considered a temperature sensor.

[0032] A controller is schematically shown at 234. The controller 234 comprises a memory 233 and a processor 234. The controller 234 is in communication with sensor 276, and is arranged to receive signals therefrom. The controller 234 can thereby receive temperature information of the washing compartment 204. The controller 234 may be considered equivalent to controller 134 of Figure 1.

[0033] According to some examples, the controller 234

is configured to use temperature information received from sensor 276 to detect one or more regions of accumulated or collected liquid (e.g. accumulated liquid 272 and 274), so as to determine an orientation of one or more items in the washing compartment. By detecting regions of accumulated liquid the controller can determine one or more incorrectly oriented items or receptacles, for example bowl 262 and glass 264 in the example of Figure 2.

[0034] According to an example, the controller 234 is configured to receive information of temperatures at various locations in the washing compartment 204 (which may, for example, be achieved by using two or more sensors). Using this information the controller 234 can determine temperature differences between different regions of the washing compartment 204. For example regions of accumulated liquid may be at a higher temperature compared to regions of non-accumulated liquid.

[0035] By way of example, prior to a washing cycle an ambient or surrounding temperature in the washing compartment 204 may be 30°C. A washing cycle is then begun, and water at a temperature of 60°C (for example) is sprayed in the washing compartment 204. By way of example, this raises the ambient or surrounding temperature in the dishwashing machine to 40°C. A temperature of any items being washed in the washing compartment will be raised by the heated water that has been sprayed. For example, a correctly stacked dish or bowl will be raised to about 43 to 45°C e.g. about 3 to 5°C above the ambient temperature of 40°C. On the other hand, accumulated water holds its temperature for longer and may therefore be at about 10 to 12°C above the ambient temperature. Therefore accumulated water may be at about 50 to 52°C for example. Accordingly in some examples the controller is configured to detect a region of accumulated liquid by detecting a temperature difference between one or more regions of the washing compartment. In some examples this may comprise a comparison with an ambient temperature of the washing compartment. In some examples the temperature difference comprises a threshold temperature difference with the ambient temperature. In some examples the threshold temperature difference comprises a difference of 5°C, or a difference of 10°C, or a difference of 15°C. In some examples the "ambient" temperature is a predetermined or expected temperature, and is not directly measured. For example the ambient temperature may be predetermined at 40°C, and any regions at or above 50°C will be considered to constitute regions of accumulated water.

[0036] In an example, the sensor 276 comprises a thermal imaging camera. That is the one or more sensors may comprises one or more thermal imaging cameras. Where thermal imaging cameras are used a heat-map of the washing compartment 204 may be generated.

[0037] According to some examples, the controller 234 is configured to cause an output to be generated for a user of the dishwashing machine, the output comprising an indication of one or more items oriented incorrectly in

the dishwashing machine. The output may be in the form of an alarm e.g. a flashing light or a beeping noise. The alarm prompts the user to open the dishwashing machine and correctly place any incorrectly oriented items. According to some examples the output comprises location information of one or more items oriented incorrectly in the dishwashing machine. That is in some examples the output indicates to the user where in the dishwashing machine any incorrectly oriented items are. This could be by way of a textual output e.g. any combination of words such as "upper rack", "lower rack", "front", "back", "left", "right" etc. Additionally or alternatively a diagrammatic or pictorial representation of the washing compartment 204 may be provided (e.g. on display 138), on which a position of one or more incorrectly oriented receptacles or items is shown or highlighted. In examples where the one or more sensors comprises one or more thermal imaging cameras, then the output may comprise a heat map image obtained by the thermal imaging camera(s). The heat map may be displayed on a display of the dishwashing apparatus e.g. display 138. The heat map may, for example, show relatively hot areas (e.g. areas of accumulated liquid) in red, and relatively cool areas in blue.

[0038] According to some examples, where it is determined that there is accumulated liquid at a region then the controller 234 is arranged to determine or estimate an amount or volume of the accumulated liquid at that region. According to some examples, an output indicative of one or more incorrectly oriented items is provided only when a determined volume at a region is at or above a threshold value e.g. 5 cm³. This allows the controller to differentiate between accumulated liquid associated with an incorrectly oriented item and other amounts of accumulated liquid which may not be associated with incorrectly oriented items. For example where a glass or bowl has a concave base, then even when correctly oriented in the dishwashing machine a small amount of water may collect in the concave base.

[0039] Figure 3 is a flow chart schematically showing a method according to an example, which is described in relation to Figure 1 and Figure 2.

[0040] At S1, heated water is sprayed in washing compartment 204. The heated water may be sprayed, for example, by spray arms 124 and 126.

[0041] At S2 a temperature is detected at one or more regions in the washing compartment 204, using one or more sensors 276.

[0042] At S3, the detected temperatures are compared with ambient temperature in the washing compartment. The ambient temperature may be an actual measured temperature, or a predetermined or expected temperature e.g. 40°C.

[0043] At S4, it is determined whether one or more of the detected temperatures is at or above a threshold. The threshold may be an absolute temperature e.g. 50°C. Alternatively the threshold may be a relative temperature or temperature difference e.g. 10°C above the ambient temperature.

[0044] If the determination at S4 is "no", then the process loops back to S3. It may therefore be considered that in some examples the temperature(s) in the washing compartment are continuously monitored during a washing cycle e.g. so as to detect items which fall in to an incorrect orientation during the washing cycle.

[0045] If the determination at S4 is "yes", then the process proceeds to S5 where it is determined that one or more items are incorrectly oriented in the washing compartment 204.

[0046] Then, at S6 an output is provided to a user indicative of the one or more incorrectly oriented items. The output may indicate a location of the one or more incorrectly oriented items in the washing compartment 204.

[0047] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0048] Reference is made herein to data storage for storing data, such as memory. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0049] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0050] The examples described herein are to be un-

derstood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A dishwashing machine comprising:

a controller;
one or more sensors arranged to obtain temperature information in a washing compartment of the dishwashing machine;
the controller configured to use the temperature information to detect one or more regions of accumulated liquid, so as to determine an orientation of one or more items in the washing compartment.

2. A dishwashing machine according to claim 1, the controller configured to detect a region of accumulated liquid by detecting a temperature difference between one or more regions of the washing compartment and an ambient temperature of the washing compartment.

3. A dishwashing machine according to claim 2, the temperature difference comprising a threshold temperature difference.

4. A dishwashing machine according to claim 3, the threshold temperature difference comprising a difference of 10°C or more.

5. A dishwashing machine according to any of claims 1 to 4, the one or more sensors comprising one or more thermal imaging cameras.

6. A dishwashing machine according to any of claims 1 to 5, the controller configured to cause an output to be generated for a user of the dishwashing machine, the output comprising an indication of one or more items oriented incorrectly in the dishwashing machine.

7. A dishwashing machine according to claim 6, the output comprising location information of the one or more items oriented incorrectly in the dishwashing machine.

8. A dishwashing machine according to claim 6 or claim 7, the output comprising a heat map.

9. A dishwashing machine according to any of claims 6 to 8, the controller configured to determine a volume of each of the one or more regions of accumulated liquid, and the controller configured to provide the output only when one or more of the determined volumes is at or above a threshold value.

10. A method of operating a dishwashing machine comprising:

using temperature information obtained from one or more sensors in a washing compartment of the dishwashing machine to determine one or more regions of accumulated liquid, so as to determine an orientation of one or more items in the washing compartment.

11. A method according to claim 10, the method comprising detecting a region of accumulated liquid by detecting a temperature difference between one or more regions of the washing compartment and an ambient temperature of the washing compartment.

12. A method according to claim 10 or claim 11, the method comprising causing an output to be generated for a user of the dishwashing machine, the output comprising an indication of one or more items oriented incorrectly in the dishwashing machine.

13. A method according to claim 12, the output comprising location information of the one or more items oriented incorrectly in the dishwashing machine.

14. A method according to claim 12 or claim 13, the method comprising determining a volume of each of the one or more regions of accumulated liquid, and providing the output only when one or more of the determined volumes is at or above a threshold value.

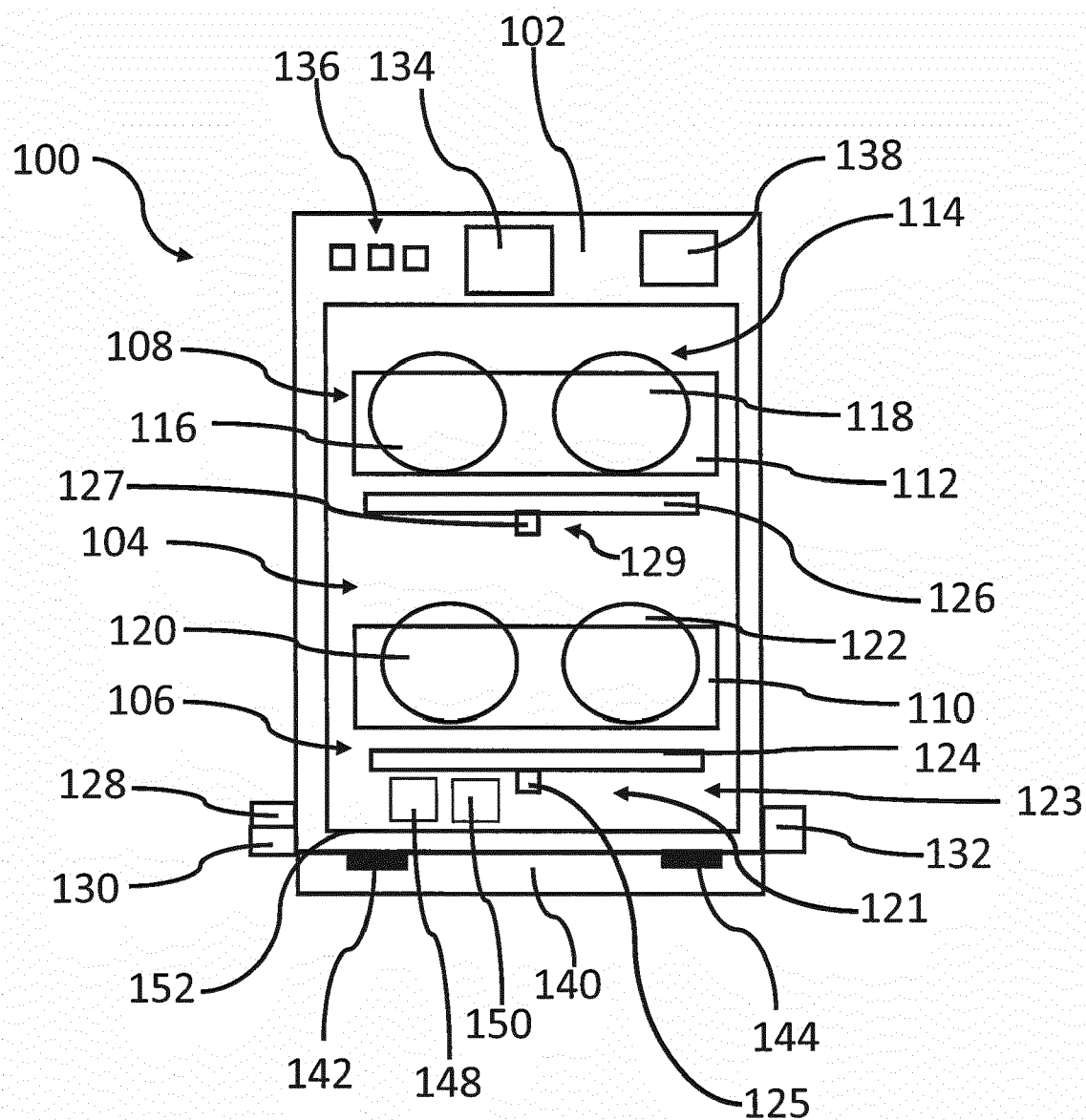


Fig. 1

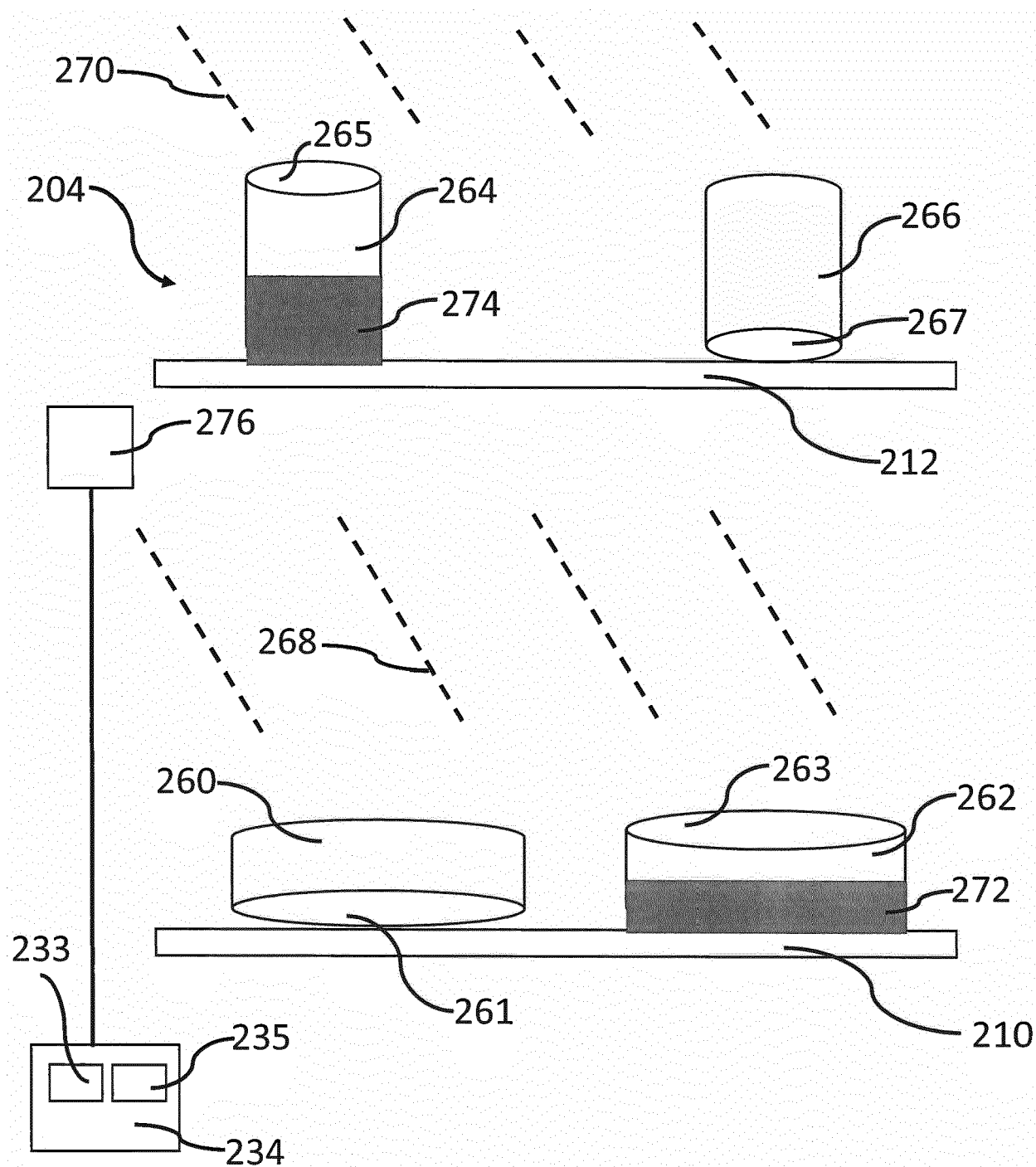


Fig. 2

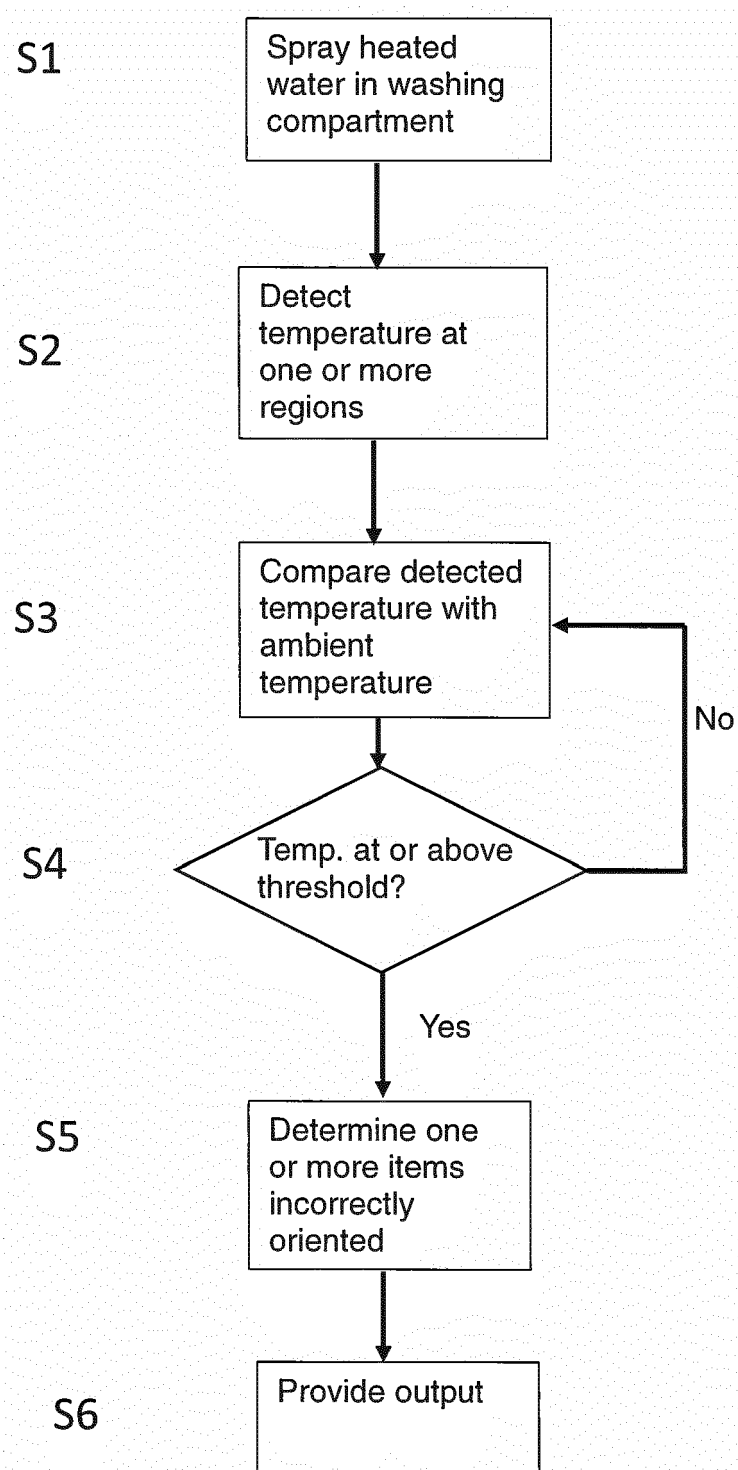


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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