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(54) **GARMENT CARE DEVICE WITH A PUMP TO PUMP WATER AFTER DETECTING A POWER-UP OF THE GARMENT CARE DEVICE**

(57) The invention relates to a garment care device (100) comprising a water tank (102) for storing water, a steam generator (104), and a pump (106) for pumping water from the water tank to the steam generator to generate steam. A water fluid transport volume (FV) is defined between the water tank and the steam generator. The pump is arranged to pump the water from the water tank through the fluid transport volume to reach the steam generator. The garment care device also comprises a steam trigger (124), and a control unit (120, 130). The control unit is adapted to i) detect a power-up of the garment care device, and ii) generate an actuation signal when the steam trigger is actuated for the first time after the power-up of the garment care device is detected. The control unit is further adapted to iii) actuate the pump with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds in response to said actuation signal.

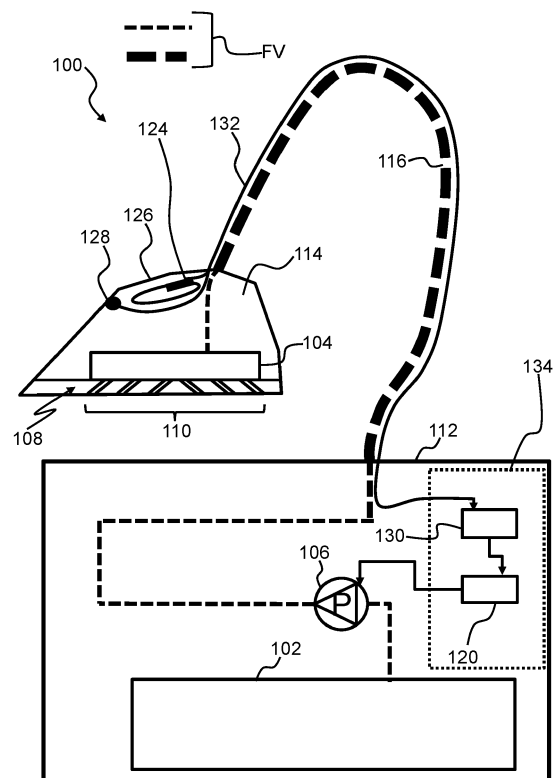


FIG.1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a garment care device having a water tank and a steam generator, and in particular to controlling a pump which pumps water from the water tank to the steam generator.

[0002] The invention may be used in the field of garment care.

BACKGROUND OF THE INVENTION

[0003] Various types of garment care device are known in which water contained in a water tank is pumped to a steam generator to generate steam for treating garments.

[0004] An example of such a garment care device is a so-called pressurized steam generator (PSG) iron having a hand unit connected to a separate base comprising the water tank. The steam generator is included in the hand unit. By pumping water from the water tank in the base to the steam generator in the hand unit, pressurized steam can be generated. This pressurized steam can assist to make ironing of garments quicker.

[0005] Including the water tank in the base can enable prolonged ironing sessions involving relatively large ironing loads. This is because the water tank can have a greater capacity than if the water tank were to be included in the hand unit. As well as requiring less frequent refilling, arranging the water tank in the base can avoid that the weight of the water in the water tank hampers handling of the hand unit.

[0006] In response to actuation of a steam trigger, a high pressure pump in the base pumps water towards the hand unit via a hose. The water is thus transported to the steam generator in the hand unit where the steam is generated nearly instantaneously. This can allow users to enjoy powerful steam delivery akin to that provided by a boiler system, but via a design which is more compact than such a boiler system.

[0007] However, enhancing the responsiveness of such types of garment care device remains a challenge. In particular, a key goal is to minimize the lag between steam trigger actuation and steam delivery.

OBJECT AND SUMMARY OF THE INVENTION

[0008] It is an object of the invention to propose a garment care device that avoids or mitigates the above-mentioned problem.

[0009] The invention is defined by the independent claims. The dependent claims define advantageous embodiments.

[0010] To this end, the garment care device according to the invention comprises

- a water tank for storing water,
- a steam generator,

- a pump for pumping water from the water tank to the steam generator to generate steam, a water fluid transport volume being defined between the water tank and the steam generator, the pump being arranged to pump the water from the water tank through the fluid transport volume to reach the steam generator,

- a steam trigger, and
- a control unit adapted to:

- i) detect a power-up of the garment care device,
- ii) generate an actuation signal when the steam trigger is actuated for the first time after the power-up of the garment care device is detected, and
- iii) actuate the pump with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds, in response to said actuation signal.

[0011] After power-up of the garment care device, pumping water with such a relatively high flow rate for such a relatively short duration can allow relatively rapid filling of the water fluid transport volume. In this manner, delay in steam generation can be shortened, thereby improving user experience and performance of garment steaming.

[0012] In some embodiments, the power-up of the garment care device corresponds to a power-up occurring for the first time in the lifetime of the garment care device.

[0013] The power-up occurring for the first time in the lifetime of the garment care device may correspond to a first power-up of the garment care device from its factory power setting.

[0014] In embodiments in which the power-up corresponds to the power-up occurring for the first time in the lifetime of the garment care device, the first predetermined flow rate is preferably in the range [150;250] g/minute and the first predetermined duration is in the range [2;5] seconds.

[0015] For example, when the power-up corresponds to the power-up occurring for the first time in the lifetime of the garment care device, the first predetermined flow rate is 200 g/minute for the first predetermined duration of 3.6 seconds.

[0016] In some embodiments, the power-up of the garment care device corresponds to a subsequent power-up occurring after a power-up having occurred for the first time in the lifetime of the garment care device.

[0017] The subsequent power-up(s) may correspond to the power-up(s) taking place after the power-up occurring for the first time in the lifetime of the garment care device and a first power-down. The subsequent power-up(s) correspond to power-up(s) the garment care device for subsequent ironing session(s) occurring hours/days/weeks after the completion of a prior ironing session.

[0018] In embodiments in which the power-up corresponds to the subsequent power-up, the first predetermined flow rate is preferably in the range [150;250] g/minute and the first predetermined duration is in the range [0.2;2] seconds.

[0019] For example, when the power-up corresponds to the subsequent power-up, the first predetermined flow rate is 200 g/minute for the first predetermined duration of 1 second.

[0020] Preferably, the first predetermined duration is a cumulated time duration when the steam trigger is actuated repeatedly.

[0021] For example, the pump is actuated with the first predetermined flow rate as a result of one or a plurality of repeated (i.e. successive) actuations of the steam trigger, with the cumulated time duration of the one or plurality of repeated actuations corresponding to the first predetermined duration.

[0022] In some embodiments, after actuating the pump with said first predetermined flow rate during said first predetermined duration, the control unit is further adapted to:

iv) actuate the pump with a second predetermined flow rate in the range [30;60] g/minute for a second duration, said second duration having a value larger than (or equal to) the difference between a predetermined duration threshold and the first predetermined duration, in response to said actuation signal.

[0023] By subsequently lowering the flow rate to the second predetermined flow rate in this manner, the risk of oversupplying water to the steam generator when the water fluid transport volume is closer to being filled with water may be lessened. This may assist to minimize undesirable "spitting" of liquid water from the garment care device.

[0024] Preferably, the second duration is a cumulated time duration when the steam trigger is actuated repeatedly.

[0025] The garment care device preferably comprises a user interface adapted to enable user selection of one or more steaming modes, wherein the control unit is further adapted to, following actuating the pump with said second predetermined flow rate for the second duration, control the pump based on said user selection.

[0026] The one or more steaming modes preferably comprise a higher steam rate mode in which the pump is controlled by the control unit to pump the water at a higher flow rate, and a lower steam rate mode in which the pump is controlled by the control unit to pump the water at a lower flow rate. The higher steam rate mode can be regarded as a "MAX" mode, and the lower steam rate mode can be regarded as an "ECO" mode.

[0027] In embodiments in which the pump is actuated with the above-mentioned second predetermined flow rate for the second duration, the control unit can be further adapted to, following actuating the pump with said first predetermined flow rate for the first predetermined duration and actuating the pump with said second predeter-

mined flow rate for the second duration, control the pump based on said user selection.

[0028] In some embodiments, the garment care device comprises:

- a base comprising the water tank,
- a hand unit comprising the steam generator, and
- a hose for carrying water from the base to the hand unit, wherein said hose is made of silicone rubber material or EPDM material.

[0029] The internal volume of the hose may account for at least a portion of the above-mentioned water fluid transport volume.

[0030] The first predetermined flow rate and the first predetermined duration, in particular when the power-up is the subsequent power-up, can be selected according to the material used to make the hose. For example, silicone rubber has been found to result in more water evaporation in the hose between uses than EPDM. For this reason, the first predetermined flow rate and the first predetermined duration when the subsequent power-up is detected may be selected such that the volume of water pumped towards the steam generator compensates for this greater evaporation in the case of the hose being made of silicone rubber.

[0031] Further provided is a method of controlling a garment care device, the garment care device comprising:

- a water tank for storing water,
- a steam generator,
- a pump for pumping water from the water tank to the steam generator to generate steam, a water fluid transport volume being defined between the water tank and the steam generator, the pump being arranged to pump the water from the water tank through the fluid transport volume to reach the steam generator, and
- a steam trigger,

the method comprising the steps of:

- i) detecting a power-up of the garment care device,
- ii) generating an actuation signal when the steam trigger is actuated for the first time after the power-up of the garment care device is detected, and
- iii) actuating the pump with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds, in response to said actuation signal.

[0032] In some embodiments, the detecting comprises:

- detecting the power-up of the garment care device corresponding to a power-up occurring for the first

time in the lifetime of the garment care device.

[0033] In embodiments in which the detecting comprises detecting the power-up corresponding to a power-up occurring for the first time in the lifetime of the garment care device, said actuating preferably comprises:

- actuating the pump with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [2;5] seconds.

[0034] In some embodiments, the detecting comprises:

- detecting the power-up of the garment care device corresponding to a subsequent power-up occurring after a power-up having occurred for the first time in the lifetime of the garment care device.

[0035] In embodiments in which the detecting comprises detecting the power-up corresponding to the subsequent power-up, said actuating preferably comprises:

- actuating the pump with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [0.2;2] seconds.

[0036] In some embodiments, the method further comprises, after actuating the pump with said first predetermined flow rate during said first predetermined duration,

- actuating the pump, in response to the actuation signal, with a second predetermined flow rate in the range [30;60] g/minute for a second duration, the second duration having a value larger than (or equal to) the difference between:
 - a predetermined duration threshold in the range [8; 25] seconds, and
 - the first predetermined duration.

[0037] In some embodiments, the garment care device further comprises a user interface adapted to enable user selection of one or more steaming modes, and the method further comprises, following actuating the pump with said second predetermined flow rate for said second duration, controlling the pump based on said user selection.

[0038] The one or more steaming modes preferably comprise a higher steam rate mode in which the pump is controlled to pump the water at a higher flow rate, and a lower steam rate mode in which the pump is controlled to pump the water at a lower flow rate.

[0039] The garment care device controlled by the method preferably comprises

- a base comprising the water tank,
- a hand unit comprising the steam generator, and
- a hose for carrying water from the base to the hand

unit, wherein said hose is made of silicone rubber material or EPDM material.

[0040] A computer program product is also provided, which computer program product comprises instructions codes which, when executed by the control unit of the garment care device defined above, cause the garment care device to implement the method as defined above.

[0041] Embodiments described herein in relation to the garment care device are applicable to the method and computer program product, and embodiments described herein in relation to the method and computer program product, for example the control logic used in such a computer program product, are applicable to the garment care device.

[0042] Detailed explanations and other aspects of the invention will be given below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] Particular aspects of the invention will now be explained with reference to the embodiments described hereinafter and considered in connection with the accompanying drawings, in which identical parts or sub-steps are designated in the same manner :

Fig.1 schematically depicts an example of a garment care device according to the invention,

Fig.2 provides a block diagram of a garment care device according to an example of the invention,

Fig.3 provides a simplified flowchart of a method of controlling a garment care device according to the invention,

Figs.4A and 4B provide a flowchart of control logic used to control a garment care device according to the invention, and

Figs.5 to 8 provide graphs of water flow rate and steam trigger actuation along the time.

DETAILED DESCRIPTION OF THE INVENTION

[0044] Fig.1 depicts a garment care device 100 according to a non-limiting example. The garment care device 100 comprises a water tank 102 for storing water, and a steam generator 104. The garment care device comprises a pump 106 for pumping water from the water tank 102 to the steam generator 104 to generate steam.

[0045] A water fluid transport volume FV is defined between the water tank 102 and the steam generator 104. The pump 106 is arranged to pump the water from the water tank 102 through the water fluid transport volume FV to reach the steam generator 102.

[0046] In the example shown in Fig.1, the garment care device 100 comprises a treatment plate 108 in which at least one steam outlet 110 is provided. In this case, the steam generated by the steam generator 104 is released from the garment care device 100 via the at least one steam outlet 110.

[0047] In some embodiments, such as the example depicted in Fig.1, the garment care device 100 comprises a base 112 comprising the water tank 102, and a hand unit 114 comprising the steam generator 104. In such embodiments, the garment care device 100 further comprises a hose 116 for carrying water from the base 112 to the hand unit 114.

[0048] The internal volume of the hose 116 may account for at least a portion of the above-mentioned water fluid transport volume FV, as shown in Fig.1.

[0049] The hose 116 is preferably made of silicone rubber material or EPDM material. The significance of the selection of the material for the hose 116 in relation to control of the pump 106 after power-up of the garment care device 100 will be discussed in more detail herein below.

[0050] The garment care device 100 comprises a control unit 120, 130, and a steam trigger 124. The steam trigger 124 is actuatable by the user in order to control the garment care device 100, and in particular to control the garment care device's 100 steam generation.

[0051] The steam trigger 124 is preferably included in the hand unit 114 of the garment care device 100 such that the user can control operation of the garment care device 100 via the steam trigger 124 while applying the steam generated by the steam generator 104 to a garment (not shown). The steam trigger 124 is, for instance, arranged under a handle 126 of the hand unit 114, as shown in Fig.1.

[0052] In some embodiments, the garment care device 100 comprises a user interface 128 adapted to enable user selection of one or more steaming modes. The user interface 128 as depicted in Fig.1 is located on the hand unit 114. Alternatively, the user interface 128 may be located on the base 112.

[0053] The one or more steaming modes preferably comprise a higher steam rate mode in which the pump 106 is controlled by the control unit 120, 130 to pump the water at a higher flow rate, and a lower steam rate mode in which the pump 106 is controlled by the control unit 120, 130 to pump the water at a lower flow rate. The higher steam rate mode can be regarded as a "MAX" mode, and the lower steam rate mode can be regarded as an "ECO" mode.

[0054] For example, the so-called "MAX" steam mode corresponds to successive steps of decreasing water flow rates when the steam trigger is continuously actuated, such as:

- 150g/mn during 1 second starting from the beginning of stage 510, then
- 138g/mn during 1 second, then
- 118g/mn during 1 second, then
- 97g/mn.

[0055] For example, the so-called "ECO" steam mode corresponds to successive steps of decreasing water flow rates, lower than water flow rates in "MAX" mode,

when the steam trigger is continuously actuated, such as:

- 118g/mn during 1 second starting from the beginning of stage 510, then
- 81g/mn during 2 seconds, then
- 62g/mn.

[0056] In the non-limiting example shown in Fig.1, the control unit 120, 130 is arranged in the base 112. In this case, electrical wiring 132 is provided between the hand unit 114 and the base 112.

[0057] In particular, the electrical wiring 132 can connect the steam trigger 124 in the hand unit 114 to the control unit 120, 130 in the base 112.

[0058] In examples in which the user interface 128 is included in the hand unit 114, the electrical wiring 132 can connect the user interface 128 to the control unit 120, 130.

[0059] In other examples (not shown), the various components of the garment care device are each included in the hand unit. Accordingly, the water tank, the steam generator, the pump, the steam trigger and the control unit are included in the hand unit, e.g. together with the treatment plate.

[0060] More generally, the control unit 120, 130 is adapted to:

- i) detect a power-up of the garment care device 100,
- ii) generate an actuation signal when the steam trigger 124 is actuated for the first time after the power-up of the garment care device 100 is detected, and
- iii) actuate the pump 106 with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds, in response to said actuation signal.

[0061] After power-up of the garment care device 100, pumping water with such a relatively high flow rate for such a relatively short duration can allow relatively rapid filling of the water fluid transport volume FV. In this manner, delay in steam generation can be shortened, thereby improving user experience and performance of garment steaming.

[0062] The above-mentioned control over the pump 106 differs from certain known garment care devices in which, after power-up, water is pumped at a relatively low flow rate to avoid flooding the steam generator, which may not have yet reached a temperature sufficient to vaporize water. In the case of the present disclosure, an opposite approach is taken in which water is pumped at a relatively high flow rate first (but for a limited duration) when the steam trigger 124 is actuated for the first time after the power-up of the garment care device 100, so that water can reach the steam generator 104 more quickly.

[0063] The water fluid transport volume FV is, for example, 10 to 30 milliliters, more preferably 10 to 25 mil-

liliters, most preferably 15 to 17 milliliters, such as about 16 milliliters.

[0064] The first predetermined flow rate being in the range [150;250] g/minute combined with the first predetermined duration not exceeding a value in the range [0.2;5] seconds can assist to provide efficient filling of such a water fluid transport volume FV, whilst minimizing the risk of flooding of the steam generator 104.

[0065] In the non-limiting example shown in Fig.1, the control unit 120, 130 comprises a controller 120, e.g. a microcontroller 120, and a pump control circuit 130. In this example, the controller 120 detects power-up of the garment care device 100, and generates the actuation signal when the steam trigger 124 is actuated for the first time after the power-up of the garment care device 100 is detected. The controller 120 in combination with the pump control circuit 130 then actuates the pump 106 with the first predetermined flow rate for the first predetermined duration in response to the actuation signal.

[0066] In the non-limiting examples shown in Figs.1 and 2, the control unit 120 and the pump control circuit 130 are included in the same printed circuit board assembly 134. In these particular examples, the printed circuit board assembly 134 is arranged in the base 112 of the garment care device 100.

[0067] The garment care device 100 preferably comprises a power switch 136, which power switch 136 is actuatable by the user of the garment care device 100 to cause said power-up of the garment care device 100. In the non-limiting example shown in Fig.2, the power switch 136 is included in the base 112, although it is also conceivable that the power switch is provided in the hand unit (not shown).

[0068] In such embodiments, detection of the power-up of the garment care device 100 can comprise detection of the power-up caused by actuation of the power switch 136. To this end, the power switch 136 is connected to the control unit 120, 130. In the particular example shown in Fig.2, the power switch 136 is connected to the controller 120 included in the control unit 120, 130.

[0069] The garment care device 100 can be powered in any suitable manner. In the non-limiting example shown in Fig.2, the garment care device 100 is connectable to a mains supply of electricity delivered via an AC power socket 138. In this case, the garment care device 100 also comprises a power supply 140 for converting the mains AC power to voltage-regulated DC power for the various components of the garment steamer 100.

[0070] In such an example, the power-up of the garment care device 100 is implemented by the user actuating the power switch 136 following connection of the garment care device 100 to the AC power socket 138.

[0071] Fig.2 also shows a heater 142 included in the steam generator 104. The heater 142 heats the steam generator 104 in order to vaporize the water pumped thereto from the water tank 102. The steam generator 104 can also include a suitable temperature sensor 144, e.g. a thermistor, for sensing the temperature of the

steam generator 104.

[0072] In the non-limiting example shown in Fig.2, the steam trigger 124 and the temperature sensor 144 are mounted on a further printed circuit board assembly 146 included in the hand unit 114, with the temperature sensor 144, e.g. thermistor, being connected to a temperature sensor control circuit 148 included in the printed circuit board assembly 134 arranged in the base 112.

[0073] More generally, the control unit 120, 130 is preferably connected to the temperature sensor 144 and the heater 142. In such embodiments, the control unit 120, 130 can control the pump 106 and/or control the heater 142 based on the temperature sensed by the temperature sensor 144.

[0074] In the non-limiting example shown in Fig.2, the controller 120 of the control unit 120, 130 is connected to a heater control circuit 150. In this case, the combination of the controller 120 and the heater control circuit 150 controls the heater 142.

[0075] Fig.3 provides a simplified flowchart of a method 200 of controlling the garment care device 100. The method 200 comprises the steps of:

- i) detecting 202 a power-up of the garment care device 100,
- ii) generating 204 an actuation signal when the steam trigger 124 is actuated for the first time after the power-up of the garment care device 100 is detected, and
- iii) actuating 206 the pump 106 with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds, in response to said actuation signal.

[0076] In some embodiments, the detecting 202 comprises:

- detecting the power-up of the garment care device 100 corresponding to a power-up occurring for the first time in the lifetime of the garment care device 100.

[0077] The power-up occurring for the first time in the lifetime of the garment care device 100 may correspond to a first power-up of the garment care device 100 from its factory power setting.

[0078] In embodiments in which the detecting 202 comprises detecting the power-up corresponding to a power-up occurring for the first time in the lifetime of the garment care device 100, said actuating 206 preferably comprises:

- actuating the pump 106 with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [2;5] seconds.

[0079] For example, when the detecting 202 compris-

es detecting the power-up corresponding to a power-up occurring for the first time in the lifetime of the garment care device 100, said actuating 206 comprises actuating the pump 106 with the first predetermined flow rate being 200 g/minute for a first predetermined duration of 3.6 seconds.

[0080] Alternatively or additionally, the detecting 202 comprises:

- detecting the power-up of the garment care device 100 corresponding to a subsequent power-up occurring after a power-up having occurred for the first time in the lifetime of the garment care device 100.

[0081] The subsequent power-up(s) may correspond to the power-up(s) taking place after the power-up occurring for the first time in the lifetime of the garment care device 100 and a first power-down. The subsequent power-up(s) correspond to power-up(s) the garment care device for subsequent ironing session(s) occurring hours/days/weeks after the completion of a prior ironing session.

[0082] In embodiments in which the detecting 202 comprises detecting the power-up corresponding to the subsequent power-up, said actuating 206 preferably comprises:

- actuating the pump 106 with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [0.2;2] seconds.

[0083] For example, when the detecting 202 comprises detecting the power-up corresponding to a subsequent power-up, said actuating 206 comprises actuating the pump 106 with the first predetermined flow rate being 200 g/minute for the first predetermined duration of 1 second.

[0084] In embodiments in which the garment care device 100 comprises the above-described hose 116 for carrying water from the base 112 to the hand unit 114, the first predetermined flow rate and the first predetermined duration following detection of the subsequent power-up are preferably set according to the material used to make the hose 116.

[0085] For example, silicone rubber has been found to result in more water evaporation in the hose 116 between uses than EPDM. Although silicone rubber and EPDM can be regarded as fluid non-permeable materials, they are actually porous at microscopic level, resulting in water inside the hose evaporating over time when the garment care device 100 is not being used, particularly over relatively long periods of non-use.

[0086] For this reason, the first predetermined flow rate and the first predetermined duration when the subsequent power-up is detected may be selected such that the volume of water pumped towards the steam generator 104 compensates for this greater evaporation in the case of a hose made of silicone rubber. The first prede-

termined flow rate may be relatively high to ensure that this greater filling required for the hose 116 made of silicone rubber takes place sufficiently quickly.

[0087] In some embodiments the method 200 further comprises, after actuating 206 the pump 106 with said first predetermined flow rate during said first predetermined duration,

- actuating 208 the pump, in response to the actuation signal, with a second predetermined flow rate in the range [30;60] g/minute for a second duration, the second duration having a value larger than (or equal to) the difference between:

- a predetermined duration threshold in the range [8; 25] seconds, and
- the first predetermined duration.

[0088] By subsequently lowering the flow rate to the second predetermined flow rate in this manner, the risk of oversupplying water to the steam generator 104 when the water fluid transport volume FV is closer to being filled with water may be lessened. This may assist to minimize undesirable "spitting" of liquid water from the garment care device 100.

[0089] It is preferred to have the second duration (with lower flow rate) longer than the first predetermined duration (with higher flow rate) for the following reasons:

- the second predetermined flow rate is lower than the first predetermined flow rate so that it fills up the remaining of the water fluid transport volume FV that is not fully filled by the first predetermined flow rate for first predetermined duration while avoiding flooding the steam generator,
- the treatment plate 108 needs to be thermally stabilized for a certain period of time by dosing water with a lower flow rate before dosing water with a larger flow rate (such as in MAX" mode or "ECO" mode).

[0090] In embodiments in which the garment care device 100 comprises the above-described user interface 128 adapted to enable user selection of one or more steaming modes, the method 200 can further comprise, following actuating the pump 106 with said second predetermined flow rate for the second duration, controlling 210 the pump 106 based on said user selection.

[0091] For example, the pump 106 may be controlled in step 210 according to the above-described higher steam rate ("MAX") mode or according to the above-described lower steam rate ("ECO") mode.

[0092] In the non-limiting example shown in Fig.2, following actuating 206 the pump 106 with said first predetermined flow rate for the first predetermined duration and actuating 208 the pump 106 with said second predetermined flow rate for the second duration, the pump 106 is controlled in step 210 based on said user selection.

[0093] Figs.4A and 4B provide a flowchart 300 of con-

trol logic used to control a garment care device 100. The start 302 of the control logic is shown in Fig.4A. The garment care device 100 is initially in a standby state, as denoted by operation box 304.

[0094] Decision box 306 questions whether or not a power-up of the garment care device 100 is detected. If such a power-up is detected, the control logic proceeds to decision box 308.

[0095] Decision box 308 questions whether or not the temperature of the steam generator 104, e.g. as determined by the above-described temperature sensor 144, is lower than 90°C.

[0096] If the temperature is not lower than 90°C, the control logic proceeds to operation box 310 in which the heater 142 is controlled to heat the steam generator 104 to 165°C. The control logic then proceeds to decision box 312.

[0097] Decision box 312 questions whether or not the steam trigger 124 is actuated. If the steam trigger 124 is actuated, the control logic proceeds to decision box 314. Decision box 314 questions whether or not the temperature of the steam generator 104 is greater than or equal to 165°C. If the temperature of the steam generator 104 is lower than 165°C, the control logic reverts to operation box 310 and the heater 142 is controlled to heat the steam generator 104 to 165°C.

[0098] If, on the other hand, the temperature of the steam generator is greater than or equal to 165°C, the control logic proceeds to (1) in Fig.4B, which will be described herein below.

[0099] Returning to decision box 308, if the temperature is lower than 90°C, the control logic proceeds to operation box 316 in which the heater 142 is controlled to heat the steam generator 104 for 2 minutes. The control logic then proceeds to decision box 318.

[0100] Decision box 318 questions whether or not the steam trigger 124 is actuated. If the answer to decision box 318 is "yes" (abbreviated in "Y" in the flow chart), the control logic proceeds to decision box 320. Decision box 320 questions whether or not the above-mentioned 2 minutes period of heating the steam generator 104 has been reached or exceeded. If the answer to decision box 320 is "no" (abbreviated in "N" in the flow chart), the control logic reverts to the operation box 316. If the answer to decision box 320 is "yes", the control logic proceeds to decision box 322.

[0101] Regarding decision box 308, it is noted that when the steam generator 104 temperature is relatively low, in this case below 90°C, the power-up detected in 306 can be regarded as a "cold start", meaning that the garment care device 100 is being powered up after a relatively long rest time. On the other hand, if the steam generator 104 temperature is higher, in this case greater than or equal to 90°C, the garment care device 100 is treated as having been powered-down, e.g. being off or in the standby state, only a relatively short while ago and subsequently restarted. The temperature of the steam generator 104 can thus indicate a relatively short "rest

time" of the garment care device 100.

[0102] More generally, the garment care device 100 preferably comprises the above-described temperature sensor 144 for sensing the temperature of the steam generator 104. In such embodiments, the control unit 120, 130 is adapted to actuate the pump 106 with the first predetermined flow rate for the first predetermined duration in response to the actuation signal and the sensed temperature of the steam generator 104 being greater than or equal to a predetermined temperature threshold.

[0103] For example, the predetermined temperature threshold is between 70°C and 95°C, preferably between 75°C and 95°C, such as about 80°C or about 90°C. The predetermined temperature threshold being set in such a range may permit the above-described "cold start" to be distinguished from the above-described "rest time".

[0104] When the steam generator 104 includes the above-described heater 142 controlled by the control unit 120, 130, 150, the control unit 120, 130, 150 is preferably adapted to control the heater 142 to heat the steam generator 104 in response to the power-up. In such embodiments, the control unit 120, 130, 150 can include the above-mentioned heater control circuit 150.

[0105] In such embodiments, the control unit 120, 130, 150 is preferably adapted to control the heater 142 to heat the steam generator 104 for a predetermined heating duration and/or to a given temperature prior to actuating the pump 106 with the first predetermined flow rate for the first predetermined duration. This may assist to lessen the risk of flooding of the steam generator 104.

[0106] For example, the control unit 120, 130, 150 is adapted to control the heater 142 to heat the steam generator 104 for the predetermined heating duration and/or to the given temperature in response to the power-up and the sensed temperature of the steam generator 104 being greater than or equal to the above-mentioned predetermined temperature threshold.

[0107] Returning to Fig.4A, decision box 322 questions whether or not a flag value is equal to a first value, for example "1". If the answer is "yes", the power-up corresponds to the above-described power-up occurring for the first time in the lifetime of the garment care device 100. In this scenario, the control logic proceeds to operation box 324 in which the pump 106 is actuated with the first predetermined for the first predetermined duration.

[0108] In this particular example, when the flag value is equal to "1", the pump 106 is actuated with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [2;5] seconds, as previously described.

[0109] Note that the first value of the flag is set during manufacturing.

[0110] The control logic then proceeds from operation box 324 to operation box 326. In operation box 326, the flag value is set to a second value, for example "0". Changing the flag value from "1" to "0" in this manner means that when the power-up corresponds to the above-described subsequent power-up, the answer to

the decision box 322 will be "no".

[0111] From operation box 326, the control logic proceeds to operation box 328 in which the pump 106 is actuated, in response to the actuation signal, with the above-described second predetermined flow rate in the range [30;60] g/minute for the second duration having a value larger than (or equal to) the difference between:

- a predetermined duration threshold in the range [8; 25] seconds, and
- the first predetermined duration.

[0112] The control logic then proceeds to (1) in Fig.4B, which will be described herein below.

[0113] In the scenario in which the answer to the decision box 322 is "no" the above-described subsequent power-up of the garment care device 100 is detected, and the control logic proceeds to operation box 330 in which the pump 106 is actuated with the first predetermined flow rate for the first predetermined duration. In this particular example, the pump 106 is actuated with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [0.2;2] seconds, as previously described.

[0114] From operation box 330, the control logic proceeds to operation box 332 in which the pump 106 is actuated, in response to the actuation signal, with the above-described second predetermined flow rate in the range [30;60] g/minute for the second duration having a value larger than (or equal to) the difference between:

- a predetermined duration threshold in the range [8; 25] seconds, and
- the first predetermined duration.

[0115] Then, the control logic proceeds to (1) in Fig.4B.

[0116] Turning to Fig.4B, in operation box 334 the pump 106 is controlled based on predefined flow control logic of a user selected steaming mode. In other words, the pump 106 is controlled by the control unit 120, 130 to pump the water according to the steam mode which has been selected by the user via the user interface 128. For example, in operation box 334 the pump 106 is controlled according to the above-described higher steam rate ("MAX") mode or the above-described lower steam rate ("ECO") mode.

[0117] Decision box 336 questions whether or not the steam trigger 124 is released. If the steam trigger 124 is not released, the control logic reverts to operation box 334. If the steam trigger 124 is released, the control logic proceeds to operation box 338. In operation box 338, the pump is in an "off state" in which the pump 106 does not pump water.

[0118] Decision box 340 questions whether or not the garment care device 100 is powered down or is idle. If the answer to decision box 340 is "no", the control logic proceeds to decision box 342.

[0119] Decision box 342 questions whether or not the

steam trigger 124 is actuated. If the answer to decision box 342 is "yes", the control logic reverts to operation box 334 in which the pump 106 is controlled based on predefined flow control logic of the user selected steaming mode. If the answer to decision box 342 is "no", the control logic reverts to decision box 340.

[0120] If the answer to decision box 340 is "yes", the control logic ends at 344.

[0121] In some embodiments, the above-mentioned second duration is based on a predetermined duration threshold in the range [8; 25] seconds.

[0122] The value of the second duration is preferably larger than (or equal to) the difference between the predetermined duration threshold and the first predetermined duration.

[0123] For example, if the first predetermined duration is 3 seconds and the predetermined duration threshold is 20 seconds, the second duration is larger than (or equal to) 20-3=17 seconds. This may apply when the water fluid transport volume FV is tubular and has an internal diameter relatively large of 3mm and a length of 1.8 meter.

[0124] For example, if the first predetermined duration is 3 seconds and the predetermined duration threshold is 8 seconds, the second duration is larger (or equal) than 8-3=5 seconds. This may apply when the water fluid transport volume FV is tubular and has an internal diameter relatively smaller of 2mm and a length of 1.8 meter.

[0125] Some examples are illustrated in the following Figs.5 to 8.

[0126] Fig.5 provides a graphical representation of a first scenario in which the steam trigger 124 is actuated continuously for 25 seconds. In this scenario, the water fluid transport volume FV is partially filled by the first predetermined flow rate (200 g/minute) for the first predetermined duration (3 seconds) during stage 500.

[0127] The remainder of the water fluid transport volume FV is filled at stage 502 and stage 504, with a relatively lower flow rate of 45 g/minute. This relatively lower flow rate corresponds to the second predetermined flow rate.

[0128] Note that at the start of stage 504, which is not a predictable time, the fluid transport volume FV could already be fully filled-in with water. In this case, this means that additional water pumped into the fluid transport volume FV would cause water to reach the inside of the steam generator. As a result, at the start of stage 504, some steam may be generated by the steam generator.

[0129] In this scenario of Fig. 5, let assume that the predetermined duration threshold is 20 seconds. The value of the second duration is preferably larger than (or equal to) the difference between the predetermined duration threshold and the first predetermined duration, so larger than (or equal to) 20-3=17 seconds.

[0130] The vertical dotted line 508 shows the time at which the cumulated duration of the first predetermined duration and the second duration have already reached

the value of the predetermined threshold duration.

[0131] The cumulated duration of the steam trigger during stage 502 and stage 504, corresponding to the second duration, is $25 - 3 = 22$ seconds. This value is larger than the above-calculated 17 seconds.

[0132] At the start of stage 506, the steam trigger 124 is released for 3 seconds, in this example from 25 seconds to 28 seconds.

[0133] When the steam trigger 124 is actuated again at time 28 seconds, since the cumulated duration of the first predetermined duration and the second duration in this example is larger than (or equal to) the predetermined duration threshold of 20 seconds, steam is generated at stage 510 by selecting a flow rate profile associated to the user selected steam mode, e.g. "MAX" or "ECO", and no more using the first predetermined flow rate nor the second predetermined flow rate.

[0134] Fig.6 provides a graphical representation of a second scenario in which the steam trigger 124 is actuated continuously for 20 seconds. In this scenario, the water fluid transport volume FV is partially filled by the first predetermined flow rate (200 g/minute) for the first predetermined duration (3 seconds) during stage 500.

[0135] The remainder of the water fluid transport volume FV is filled at stage 502 and stage 504, with a relatively lower flow rate of 45 g/minute. This relatively lower flow rate corresponds to the second predetermined flow rate.

[0136] Note that at the start of stage 504, which is not a predictable time, the fluid transport volume FV could already be fully filled-in with water. In this case, this means that additional water pumped into the fluid transport volume FV would cause water to reach the inside of the steam generator. As a result, at the start of stage 504, some steam may be generated by the steam generator.

[0137] In this scenario of Fig.6, let assume that the predetermined duration threshold is 20 seconds. The value of the second duration is preferably larger than (or equal to) the difference between the predetermined duration threshold and the first predetermined duration, so larger than (or equal to) $20 - 3 = 17$ seconds.

[0138] The vertical dotted line 508 shows the time at which the cumulated duration of the first predetermined duration and the second duration have already reached the value of the predetermined threshold duration.

[0139] The cumulated duration of the steam trigger during stage 502 and stage 504, corresponding to the second duration, is $20 - 3 = 17$ seconds. This value is equal to the above-calculated 17 seconds.

[0140] At the start of stage 506, the steam trigger 124 is released for 8 seconds, in this example from 20 seconds to 28 seconds.

[0141] When the steam trigger 124 is actuated again at time 28 seconds, since the cumulated duration of the first predetermined duration and the second duration in this example is larger than (or equal to) the predetermined duration threshold of 20 seconds, steam is gen-

erated at stage 510 by selecting a flow rate profile associated to the user selected steam mode, e.g. "MAX" or "ECO", and no more using the first predetermined flow rate nor the second predetermined flow rate.

[0142] Fig.7 provides a graphical representation of a third scenario in which the steam trigger 124 is initially actuated continuously for 6 seconds. In this scenario, the water fluid transport volume FV is partially filled by the first predetermined flow rate (200 g/minute) for the first predetermined duration (3 seconds) during stage 500.

[0143] The second predetermined flow rate (45 g/minute) is then implemented at the start of stage 502A for a duration of 3 seconds until the steam trigger 124 is released at time 6 seconds.

[0144] At the start of stage 506A, the steam trigger 124 is released for 3 seconds, in this example from time 6 seconds to 9 seconds.

[0145] The steam trigger 124 is then actuated again for another continuous 16 seconds, between time 9 seconds and 25 seconds, corresponding to stages 502B and 504.

[0146] In this scenario of Fig.7, let assume that the predetermined duration threshold is 20 seconds. The value of the second duration is preferably larger than (or equal to) the difference between the predetermined duration threshold and the first predetermined duration, so larger than (or equal to) $20 - 3 = 17$ seconds.

[0147] The vertical dotted line 508 shows the time at which the cumulated duration of the first predetermined duration and the second duration have already reached the value of the predetermined threshold duration.

[0148] At the start of stage 502B, the cumulated duration of the steam trigger during stage 502A is 3 seconds, so smaller than the above-calculated 17 seconds.

[0149] As a result, at the start of stage 502B, the pump is actuated with the second predetermined flow rate (45 g/minute), and not as per the user selected steam mode, e.g. "MAX" or "ECO".

[0150] Note that at the start of stage 504, which is not a predictable time, the fluid transport volume FV could already be fully filled-in with water. In this case, this means that additional water pumped into the fluid transport volume FV would cause water to reach the inside of the steam generator. As a result, at the start of stage 504, some steam may be generated by the steam generator.

[0151] At the start of stage 506B, the steam trigger 124 is released for 3 seconds, in this example from time 25 seconds to 28 seconds.

[0152] When the steam trigger 124 is actuated again at time 28 seconds, since the cumulated duration of the first predetermined duration and the second duration in this example is larger than (or equal to) the predetermined duration threshold of 20 seconds, steam is generated at stage 510 by selecting a flow rate profile associated to the user selected steam mode, e.g. "MAX" or "ECO", and no more using the first predetermined flow rate nor the second predetermined flow rate.

[0153] Note that in this third scenario, the cumulated duration of the steam trigger during stages 502A, 502B and 504, corresponding to the second duration, is $3 + 16 = 19$ seconds. This value is larger than the above-calculated 17 seconds.

[0154] In some embodiments, the first predetermined duration is a cumulated time duration when the steam trigger 124 is actuated repeatedly.

[0155] For example, the pump 106 is actuated with the first predetermined flow rate as a result of one or a plurality of discrete actuations of the steam trigger 124, with the cumulated time duration of the one or plurality of discrete actuations corresponding to the first predetermined duration.

[0156] Fig.8 provides a graphical representation of a fourth scenario in which the respective durations of each of a plurality of, in this case two, comprise a discrete actuations 500A (for 1 second) and 500B (for 2 seconds) of the steam trigger 124. The steam trigger is then actuated for a cumulated time duration of $1+2=3$ seconds.

[0157] In this example, since the first predetermined time duration is 3 seconds, the first predetermined flow rate is discontinued as soon as the cumulated time duration of 3 seconds is reached. This happens at time 512, 4 seconds in this example.

[0158] At time 512, since the steam trigger is continued to be pressed, the pump is then actuated with a second predetermined flow rate in the range $[30;60]$ g/minute, in the present case 45g/mn, between time 4 seconds and time 25 seconds, so for a total duration equal to $25-4=21$ seconds.

[0159] In this scenario of Fig.8, let assume that the predetermined duration threshold is 20 seconds. The value of the second duration is preferably larger than (or equal to) the difference between the predetermined duration threshold and the first predetermined duration, so larger than (or equal to) $20-3=17$ seconds.

[0160] The vertical dotted line 508 shows the time at which the cumulated duration of the first predetermined duration and the second duration have already reached the value of the predetermined threshold duration.

[0161] The cumulated duration of the steam trigger during stage 502 and stage 504, corresponding to the second duration, is $25 - 4 = 21$ seconds. This value is larger than the above-calculated 17 seconds.

[0162] At the start of stage 506, the steam trigger 124 is released for 3 seconds, in this example from 25 seconds to 28 seconds.

[0163] When the steam trigger 124 is actuated again at time 28 seconds, since the cumulated duration of the first predetermined duration and the second duration in this example is larger than (or equal to) the predetermined duration threshold of 20 seconds, steam is generated at stage 510 by selecting a flow rate profile associated to the user selected steam mode, e.g. "MAX" or "ECO", and no more using the first predetermined flow rate nor the second predetermined flow rate.

[0164] The above embodiments as described are only

illustrative, and not intended to limit the technique approaches of the present invention. Although the present invention is described in details referring to the preferable embodiments, those skilled in the art will understand that the technique approaches of the present invention can be modified or equally displaced without departing from the protective scope of the claims of the present invention. In particular, although the invention has been described based on a garment care device, it can be applied to any household device having a steam generator, a water tank, and a pump for pumping water from the water tank to the steam generator. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A garment care device (100) comprising:

- a water tank (102) for storing water,
- a steam generator (104),
- a pump (106) for pumping water from the water tank to the steam generator to generate steam, a water fluid transport volume (FV) being defined between the water tank and the steam generator, the pump being arranged to pump the water from the water tank through the fluid transport volume to reach the steam generator,
- a steam trigger (124), and
- a control unit (120, 130) adapted to:

- i) detect a power-up of the garment care device,
- ii) generate an actuation signal when the steam trigger is actuated for the first time after the power-up of the garment care device is detected, and
- iii) actuate the pump with a first predetermined flow rate in the range $[150;250]$ g/minute for a first predetermined duration not exceeding a value in the range $[0.2;5]$ seconds, in response to said actuation signal.

2. The garment care device (100) according to claim 1, wherein the power-up of the garment care device corresponds to a power-up occurring for the first time in the lifetime of the garment care device.

3. The garment care device (100) according to claim 2, wherein the first predetermined flow rate is in the range $[150;250]$ g/minute and the first predetermined duration is in the range $[2;5]$ seconds.

4. The garment care device (100) according to claim

1, wherein the power-up of the garment care device corresponds to a subsequent power-up occurring after a power-up having occurred for the first time in the lifetime of the garment care device.

5. The garment care device (100) according to claim 4, wherein the first predetermined flow rate is in the range [150;250] g/minute and the first predetermined duration is in the range [0.2;2] seconds.

6. The garment care device (100) according to any one of the preceding claims, wherein, after actuating the pump (106) with said first predetermined flow rate during said first predetermined duration, the control unit (120, 130) is further adapted to:

iv) actuate the pump, in response to said actuation signal, with a second predetermined flow rate in the range [30;60] g/minute for a second duration, said second duration having a value larger than (or equal to) the difference between:

- a predetermined duration threshold in the range [8; 25] seconds, and
- the first predetermined duration.

7. The garment care device (100) according to claim 6, wherein said second duration is a cumulated time duration when the steam trigger (124) is repeatedly actuated.

8. The garment care device (100) according to any one of the preceding claims, comprising a user interface (128) adapted to enable user selection of one or more steaming modes, wherein the control unit (120, 130) is further adapted to, following actuating the pump (106) with the second predetermined flow rate for the second duration, control the pump based on said user selection, wherein the one or more steaming modes comprise a higher steam rate mode in which the pump (106) is controlled by the control unit (120, 130) to pump the water at a higher flow rate, and a lower steam rate mode in which the pump is controlled by the control unit (120, 130) to pump the water at a lower flow rate.

9. The garment care device (100) according to any one of the preceding claims, wherein said first predetermined duration is a cumulated time duration when the steam trigger (124) is repeatedly actuated.

10. The garment care device (100) according to any one of the preceding claims, comprising:

- a base (112) comprising the water tank (102),
- a hand unit (114) comprising the steam generator (104), and
- a hose (116) for carrying water from the base to the hand unit, wherein said hose is made of

silicone rubber material or EPDM material.

11. A method of controlling a garment care device, the garment care device comprising:

- a water tank for storing water,
- a steam generator,
- a pump for pumping water from the water tank to the steam generator to generate steam, a water fluid transport volume being defined between the water tank and the steam generator, the pump being arranged to pump the water from the water tank through the fluid transport volume to reach the steam generator, and
- a steam trigger,

the method comprising the steps of:

- i) detecting (202) a power-up of the garment care device,
- ii) generating (204) an actuation signal when the steam trigger is actuated for the first time after the power-up of the garment care device is detected, and
- iii) actuating (206) the pump with a first predetermined flow rate in the range [150;250] g/minute for a first predetermined duration not exceeding a value in the range [0.2;5] seconds, in response to said actuation signal.

12. The method as claimed in claim 11, wherein said detecting (202) comprises:

- detecting the power-up of the garment care device corresponding to a power-up occurring for the first time in the lifetime of the garment care device.

13. The method as claimed in claim 12, wherein said actuating (206) comprises:

- actuating the pump with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [2;5] seconds.

14. The method as claimed in claim 11, wherein said detecting (202) comprises:

- detecting the power-up of the garment care device corresponding to a subsequent power-up occurring after a power-up having occurred for the first time in the lifetime of the garment care device.

15. The method as claimed in claim 14, wherein said actuating (206) comprises:

- actuating the pump with the first predetermined flow rate in the range [150;250] g/minute for the first predetermined duration in the range [0.2;2] seconds.

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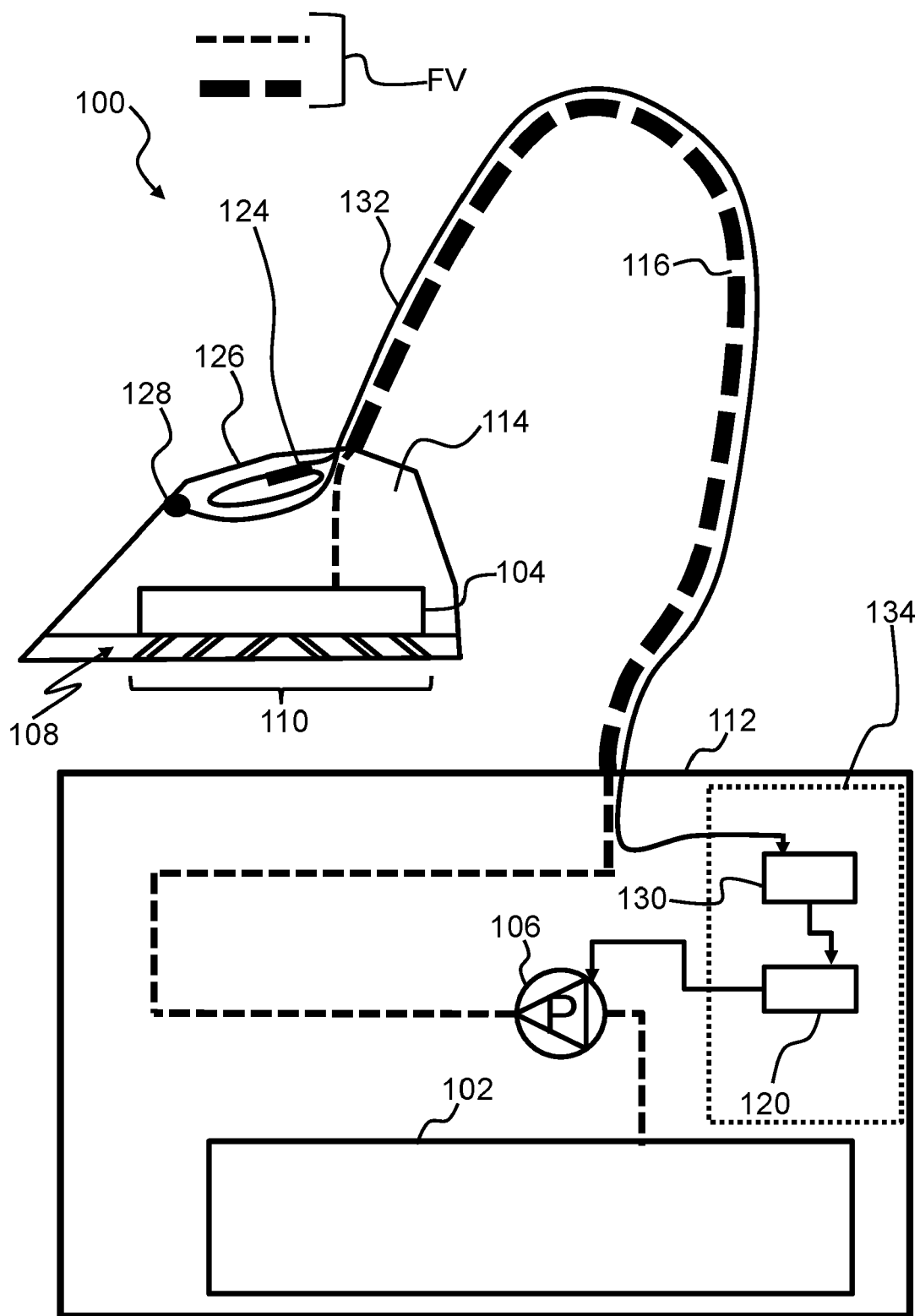


FIG.1

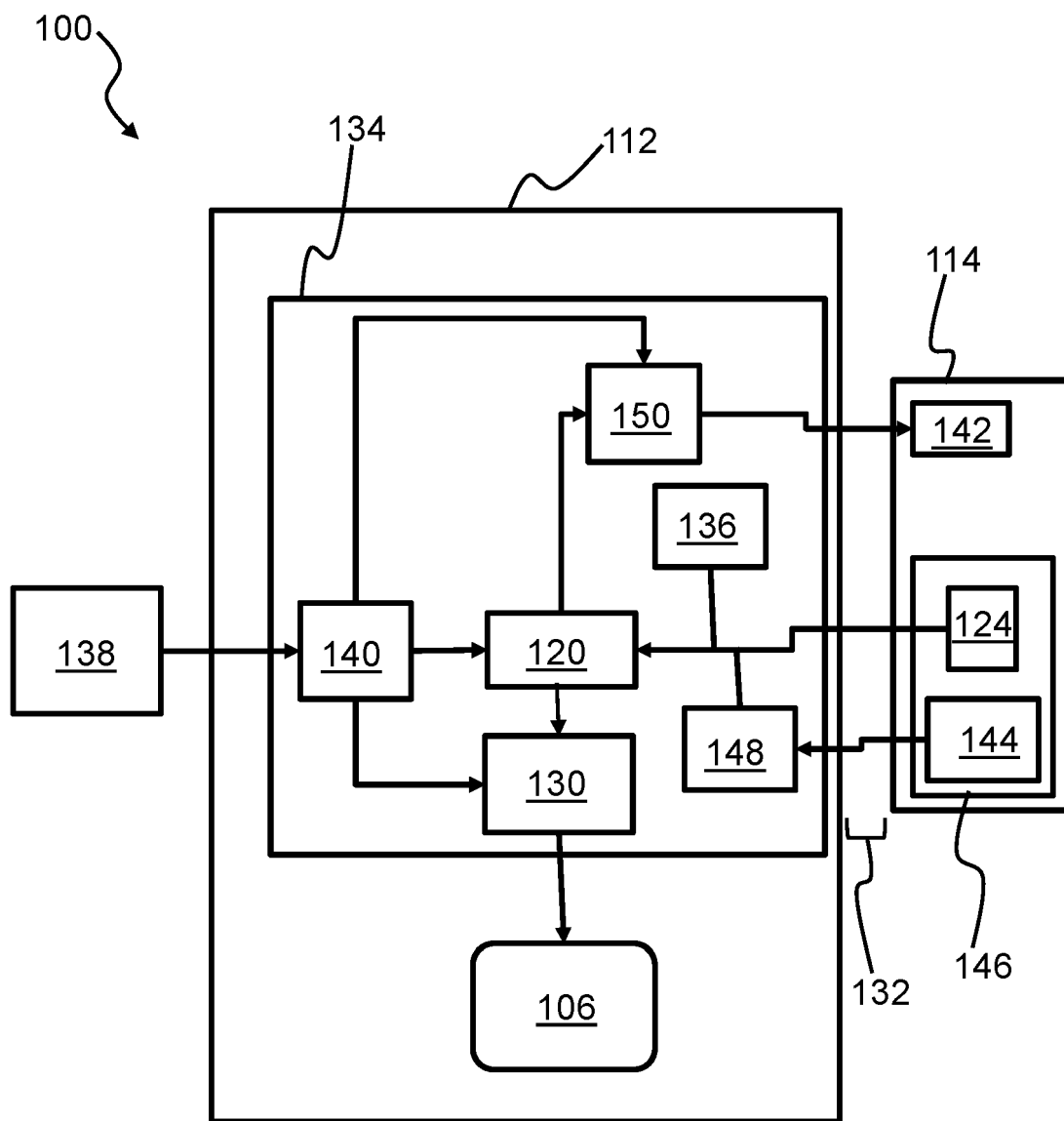


FIG.2

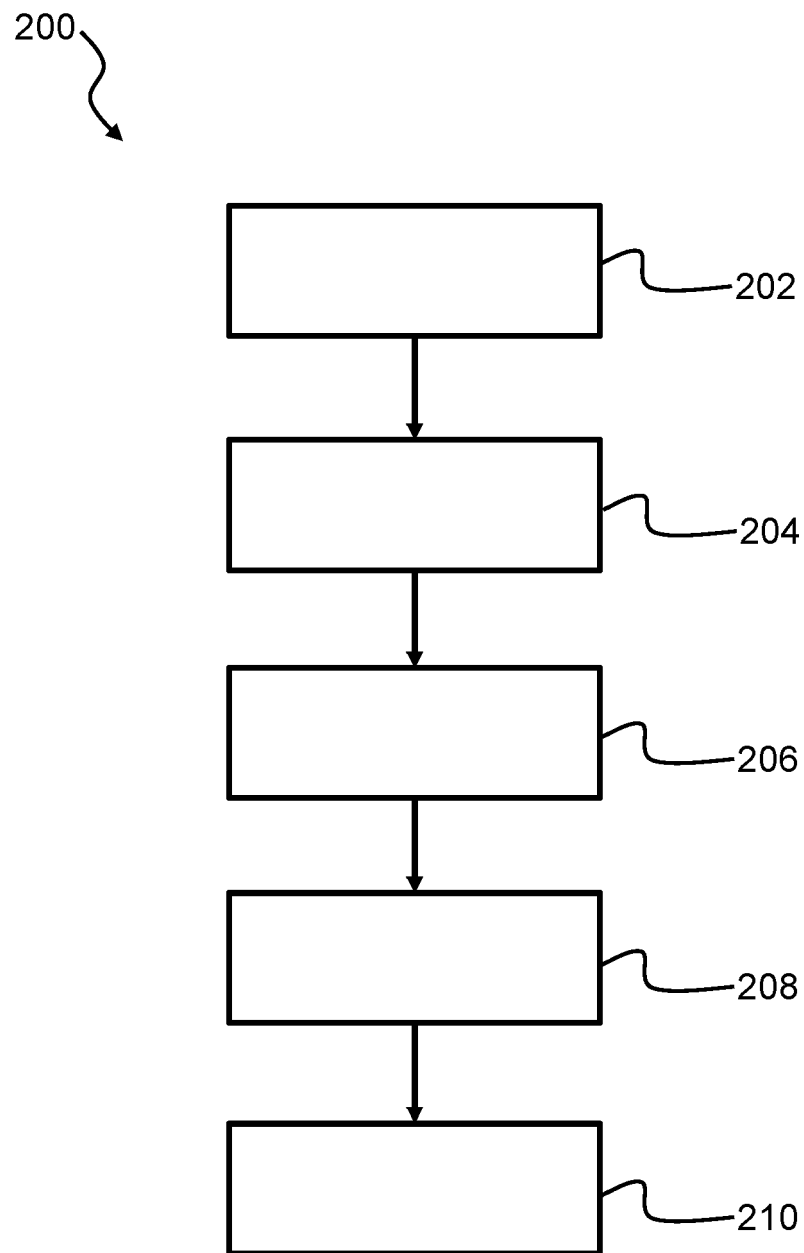
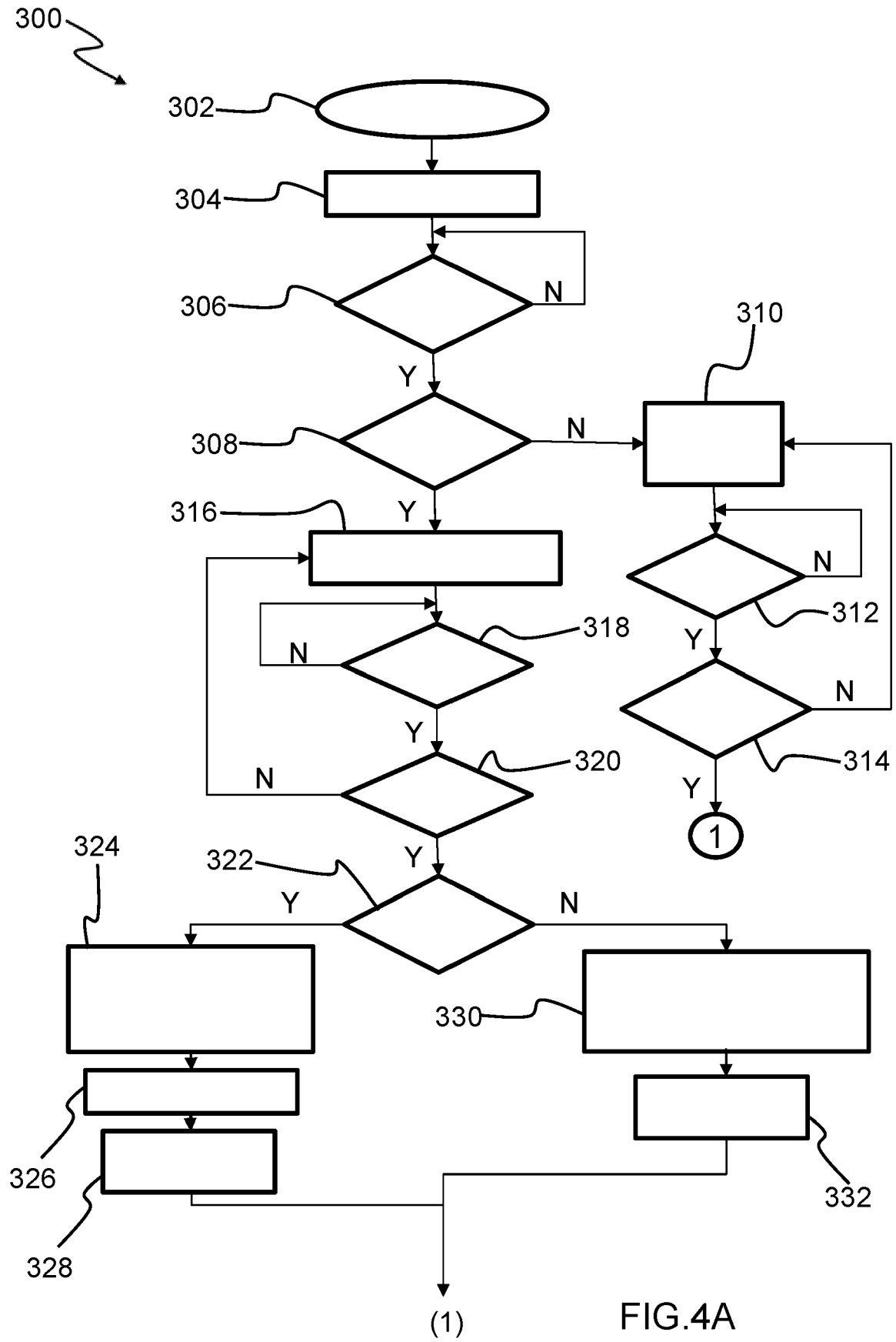


FIG.3



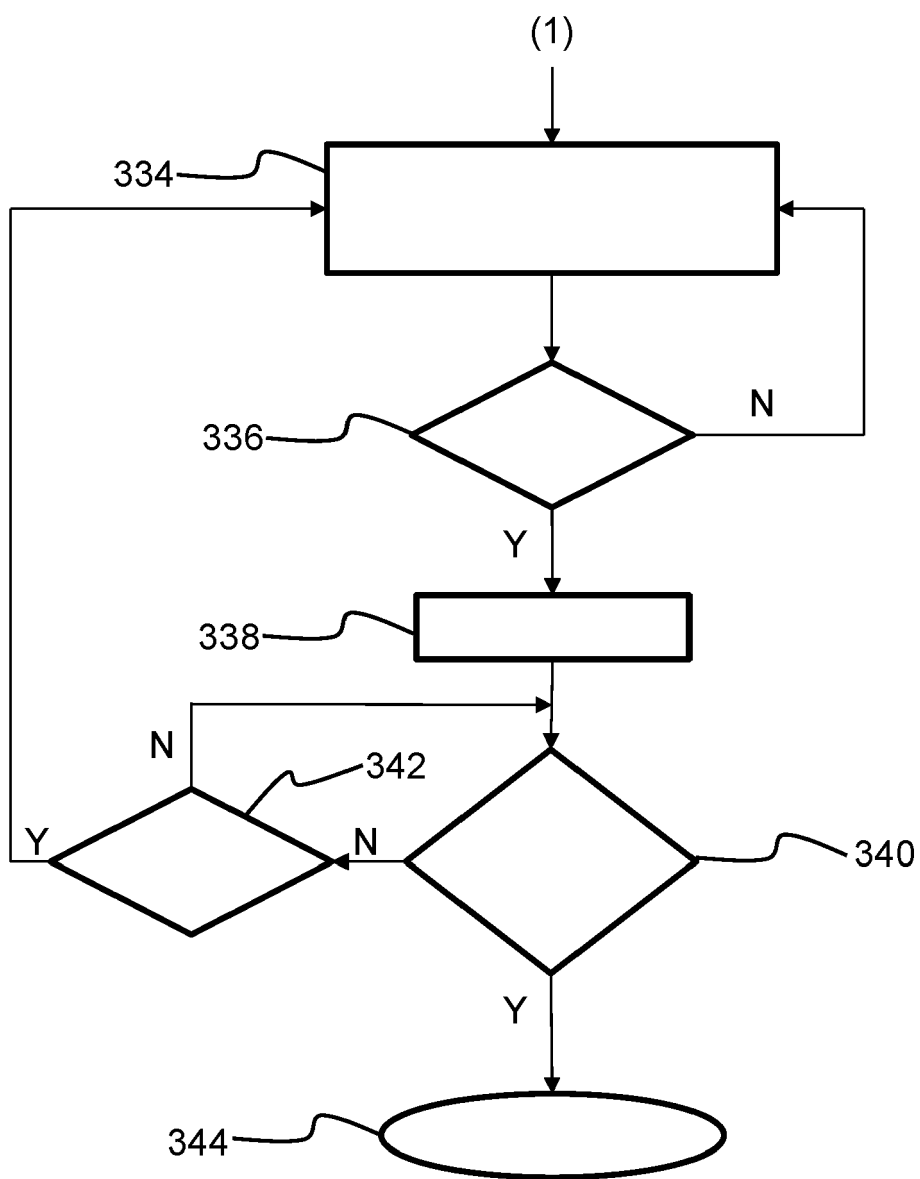


FIG.4B

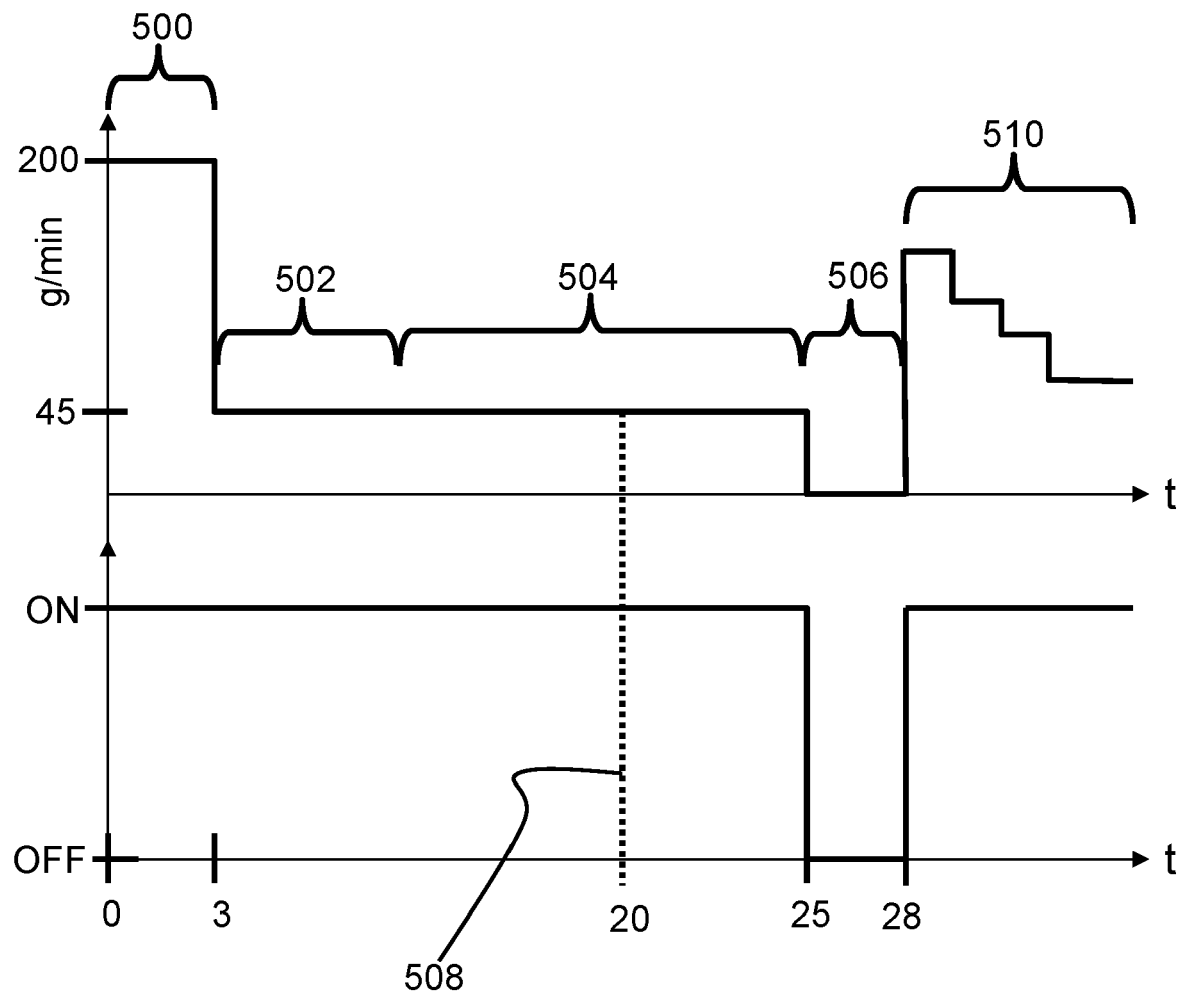


FIG.5

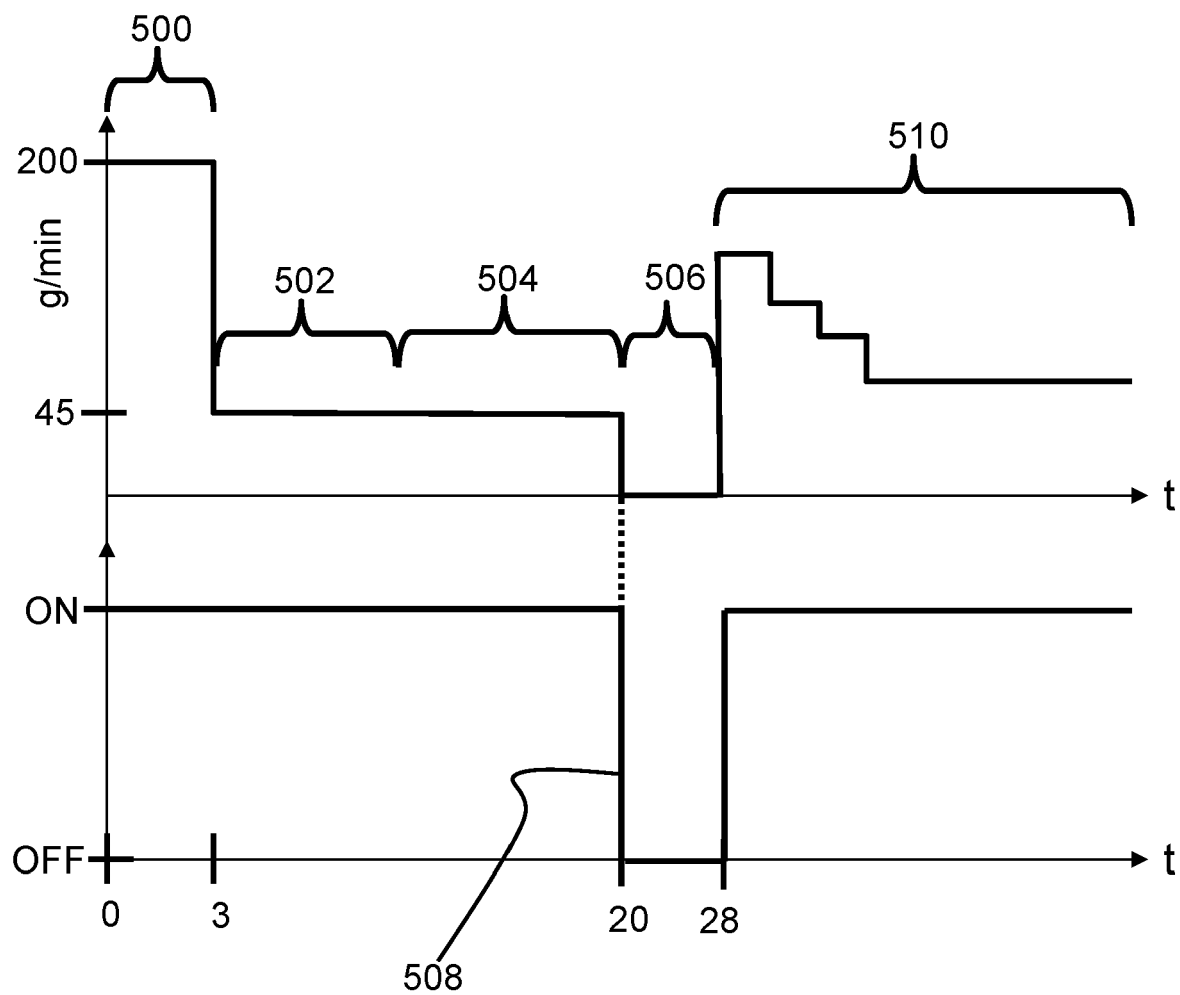


FIG.6

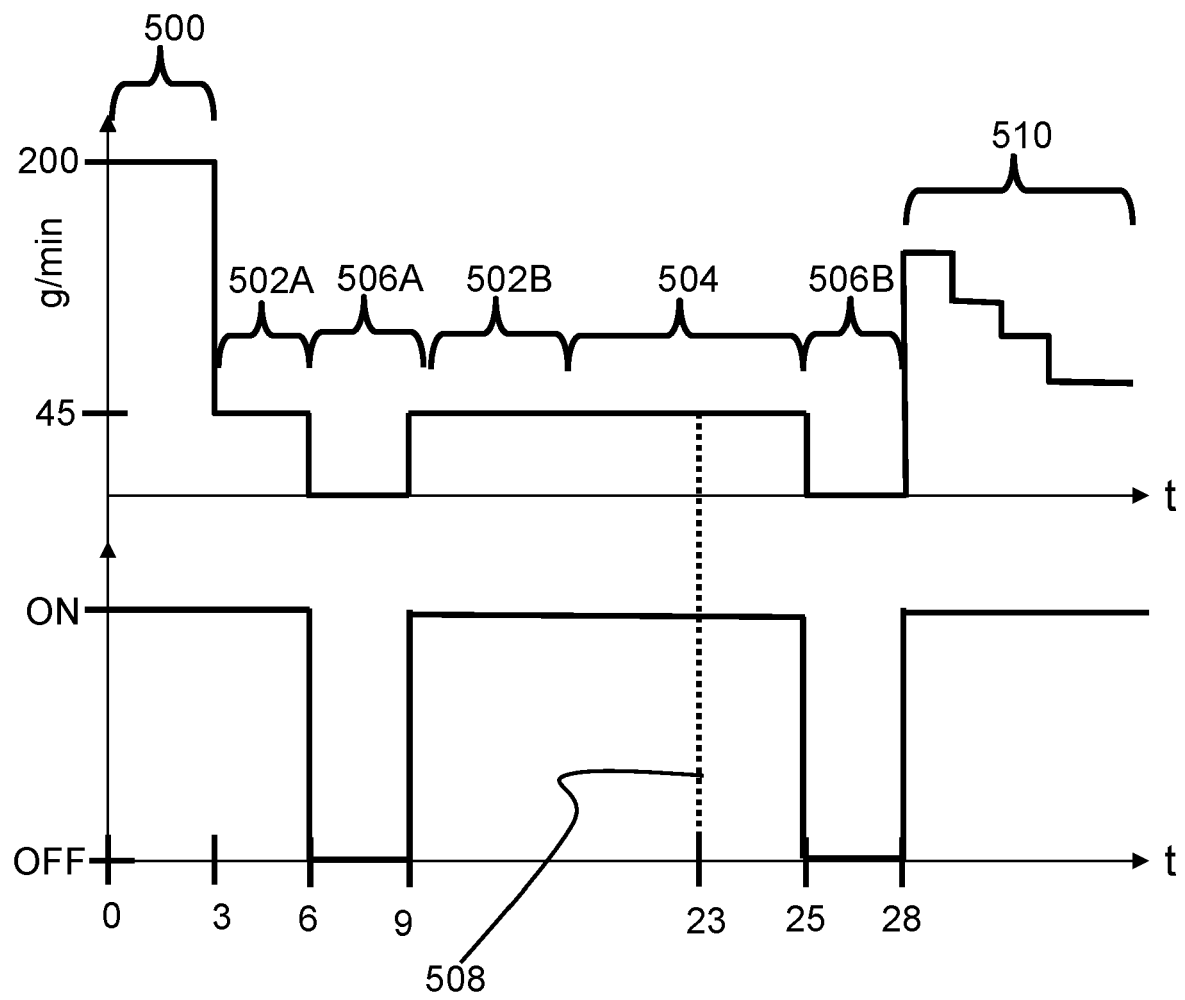


FIG.7

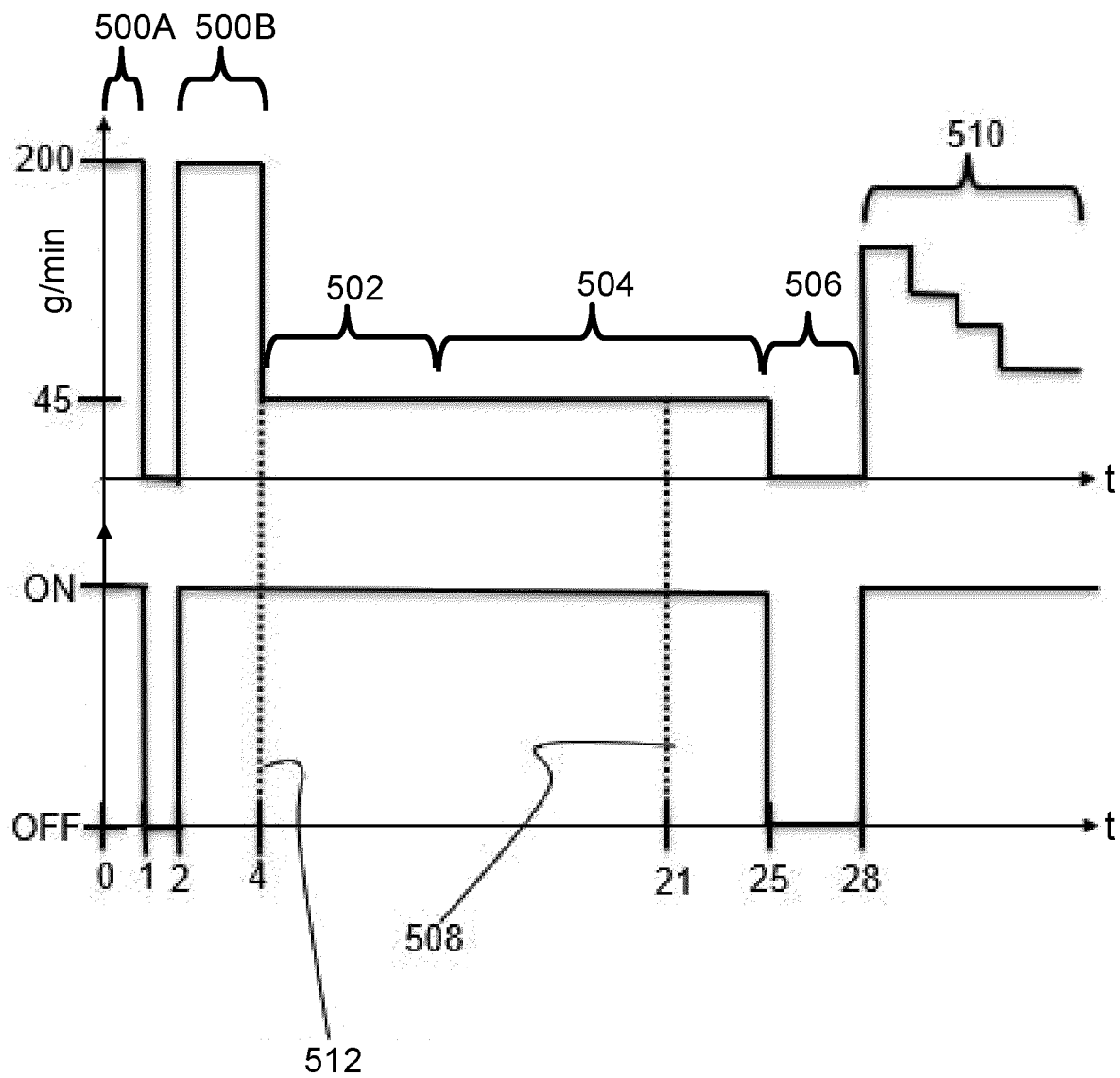


FIG.8



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Application Number

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