



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**27.06.2018 Bulletin 2018/26**

(51) Int Cl.:  
**D06F 35/00** <sup>(2006.01)</sup> **D06F 39/00** <sup>(2006.01)</sup>

(21) Application number: **16206424.0**

(22) Date of filing: **22.12.2016**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**MA MD**

- **MANCINI, Mauro**  
**60044 Fabriano (AN) (IT)**
- **ZIMAR, Alessio**  
**60030 Castelbellino (AN) (IT)**
- **VENANZETTI, Tiziana**  
**60030 Rosora (AN) (IT)**

(71) Applicant: **Whirlpool EMEA S.p.A.**  
**20016 Pero (MI) (IT)**

(74) Representative: **Santonicola, Paolo**  
**PGA S.p.A.**  
**Via Mascheroni, 31**  
**20145 Milano (IT)**

(72) Inventors:  
• **COLUCCI, Nicola**  
**60044 Fabriano (AN) (IT)**

(54) **METHOD FOR TREATING TEXTILE ARTICLES IN A LAUNDRY WASHING MACHINE AND  
LAUNDRY WASHING MACHINE CONFIGURED TO IMPLEMENT THE METHOD**

(57) A method for treating textile articles (L) in a laundry washing machine (1) is disclosed, the washing machine (1) comprising an inner volume (V) wherein the articles (L) are contained, movimentation means (17) configured to move the articles (L) within the volume (V) and steaming means (9) configured to generate steam to be delivered within the volume (V) for preventing or reducing the bacterial growth on the articles (L).

The method comprises a heating phase (HP), during which the movimentation means (17) are switched on at

least most of the time and the steaming means (9) are switched on at least most of the time, and a cooling phase (CP), during which the movimentation means (17) are continuously or intermittently switched on and the steaming means (9) are switched off at least most of the time. The heating phase (HP) and the cooling phase (CP) are repeated at least once.

Furthermore a laundry washing machine (1) comprising control means (21) configured to implement the method is disclosed.

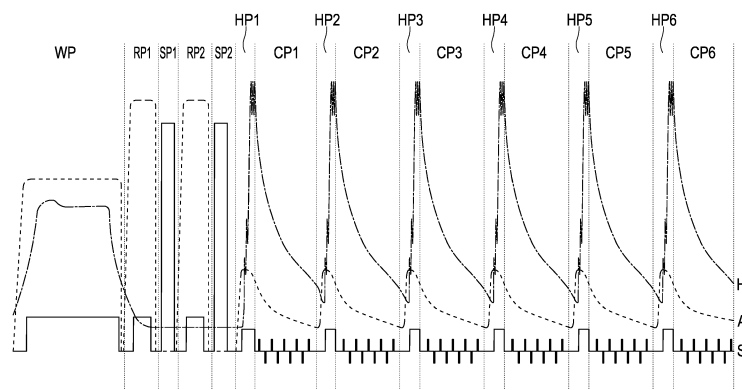


FIG.9

## Description

**[0001]** This specification and the following claims relate to a method for treating textile articles, in particular wet textile articles, in a laundry washing machine and to a laundry washing machine configured to implement the method.

**[0002]** Several washing treatments of textile articles in laundry washing machine have been developed in order to provide an effective removal action of bacteria and/or odours. An example of those treatments can be found in European patent EP2746442, that discloses a washing treatment in which the speed of rotation of the washing machine drum is subject to a plurality of increases alternated with respective decreases, each increase and each decrease being executed while maintaining or bringing the temperature of the washing water contained in the drum to determined values effective to reduce significantly the bacterial load in the textile articles.

**[0003]** If the textile articles are not dried after the washing and are left wet in the drum of the washing machine, bacteria, molds and fungi may proliferate in the textile articles after the washing, so that the beneficial effects of the previous washing treatment are lost completely or partially.

**[0004]** A first aim is to thwart the proliferation of bacteria, molds and fungi in the textile articles left wet in the drum of the laundry washing machine after a washing treatment. A further aim is the provision of a laundry washing machine that can be effectively used for removing or reducing bad smells and/or creases from textile articles. A further aim is to provide a laundry washing machine comfortable to be used and with reduced energy consumptions.

**[0005]** These aims and further remarkable aims are achieved by the following aspects.

**[0006]** A first aspect relates to a method for treating textile articles in a laundry washing machine, the washing machine comprising an inner volume wherein said articles are contained, movimentation means configured to move said articles within said volume and steaming means configured to generate steam to be delivered within said volume for preventing or reducing the bacterial growth on said articles, the method comprising the steps of:

a) performing a heating phase, during which:

- said movimentation means are switched on at least most of the time and
- said steaming means are switched on at least most of the time;

b) performing a cooling phase, during which:

- said movimentation means are continuously or intermittently switched on and

- said steaming means are switched off at least most of the time;

c) repeating at least once steps a) and b).

**[0007]** A second aspect, dependent from the first aspect, relates to a method wherein the cooling phase has a duration of between 30 minutes and 350 minutes, preferably a duration of between 40 minutes and 160 minutes, more preferably a duration of around 40 minutes or around 52 minutes or around 70 minutes or around 100 minutes or around 160 minutes.

**[0008]** A third aspect, dependent from the first aspect or from the second aspect, relates to a method wherein in step c) one to nine repetitions of steps a) and b) are carried out, preferably one to five.

**[0009]** A fourth aspect, dependent from any previous aspect, relates to a method wherein the heating phase in step a) includes a first heating sub-phase and a second heating sub-phase, said steaming means being continuously switched on during the first heating sub-phase and being intermittently switched on during the second heating sub-phase, the second heating sub-phase having in particular a duration of between 1 minute and 10 minutes, preferably of between 2 minutes and 4 minutes.

**[0010]** A fifth aspect, dependent from any previous aspect, relates to a method, the washing machine further comprising collecting means configured to contain water to be evaporated by means of said steaming means, loading means configured to supply said collecting means with water and sensing means configured to detect at least one parameter related to the water in said collecting means, wherein the heating phase is preceded by a filling phase, the loading means being switched on during the filling phase to load water in said collecting means, and wherein the filling phase is stopped when a predetermined amount of water in said collecting means is detected by the sensing means, said predetermined amount of water being in particular comprised between 0,1 liters and 3 liters, preferably between 0,2 liters and 2 liters, more preferably between 0,4 liters and 0,6 liters.

**[0011]** A sixth aspect, dependent from the fourth aspect and from the fifth aspect, relates to a method wherein during the first heating sub-phase the continuous activation of said steaming means is interrupted at least once and wherein during the interruption a routine is executed, such routine being configured to guarantee a sufficient amount of water in said collecting means and comprising in particular the activation of said sensing means in order to detect a temperature gradient and/or a water amount, wherein preferably during the first heating sub-phase the continuous activation of said steaming means is interrupted two or three times.

**[0012]** A seventh aspect, dependent from the fourth aspect and from the fifth aspect, relates to a method wherein the switch over from the first heating sub-phase to the second heating sub-phase is carried out when said sensing means detect that the temperature of water in

said collecting means has reached a predetermined upper temperature threshold, said upper temperature threshold being in particular comprised between 80°C and 95°C, preferably between 83°C and 89°C, more preferably between 85°C and 87°C and wherein preferably during the second heating sub-phase said steaming means are switched off when said sensing means detect that the temperature of water in said collecting means has reached said upper temperature threshold and are switched on when said sensing means detect that the temperature of water in said collecting means has reached a predetermined lower temperature threshold, the difference between said upper temperature threshold and said lower temperature threshold being in particular comprised between 1°C and 10°C, preferably between 2°C and 5°C, more preferably between 2°C and 3°C.

**[0013]** An eighth aspect, dependent from any aspect from the fifth aspect to the seventh aspect, relates to a method wherein said loading means are intermittently switched on, the duration of each activation of said loading means being in particular less than 3 seconds, preferably less than 2 seconds, more preferably less than 1 second.

**[0014]** An ninth aspect, dependent from any aspect from the fifth aspect to the eighth aspect, relates to a method wherein at the end of the cooling phase said loading means are activated if said sensing means detect that the temperature of the water in said collecting means overcomes a reference temperature value, said reference temperature value being in particular comprised between 55°C and 70°C, preferably comprised between 56°C and 65°C, more preferably between 58°C and 62°C.

**[0015]** A tenth aspect, dependent from any aspect from the fifth aspect to the ninth aspect, relates to a method wherein during the filling phase said movimentation means are switched off.

**[0016]** An eleventh aspect, dependent from any previous aspect, relates to a method wherein during the cooling phase said movimentation means are periodically activated according to an activation profile in which a switching-on period is alternated to a switching-off period, the duration of the switching-off period being comprised between two times and twenty times the duration of the switching-on period, preferably between five times and ten times the duration of the switching-on period, more preferably between seven times and nine times the duration of the switching-on period.

**[0017]** A twelfth aspect, dependent from any previous aspect, relates to a method, the washing machine further comprising a rotatable perforated drum, said volume being internal to said drum and said movimentation means are so configured that their activation causes the rotation of said drum, wherein:

- during the heating phase said drum rotates at a speed comprised between 30 rpm and 60 rpm, preferably between 30 rpm and 50 rpm, more preferably

between 38 rpm and 42 rpm and

- during the cooling phase said drum rotates at a speed comprised between 15 rpm and 45 rpm, preferably between 20 rpm and 35 rpm, more preferably between 25 rpm and 30 rpm,

wherein in particular the washing machine further comprises an aperture configured to gain access to said volume, a door configured to open and/or close said aperture and locking means configured to lock said door in its closing position, said locking means being enabled during said heating phase and during said cooling phase, and wherein preferably the opening of said door and/or the disablement of said locking means cause the interruption or the end of the method.

**[0018]** A thirteenth aspect, dependent from any previous aspect, relates to a method wherein at the beginning of the method a washing phase takes place, said washing phase being preferably followed by a spinning phase, and wherein said articles are wet during steps a) to c), wherein in particular the washing machine further comprises heating means configured to heat up the water during the washing phase, at least one heating element being shared between said heating means and said steaming means, said shared heating element being in particular an electric resistance.

**[0019]** A fourteenth aspect, dependent from the thirteenth aspect, relates to a method, the washing machine further comprising a tub configured to contain water, said volume being internal to said tub, said shared heating element being positioned in said tub below said volume, wherein during the heating phase and during the cooling phase the water amount in the tub is regulated so that the water level stays between said volume and said shared heating element.

**[0020]** A fifteenth aspect relates to a laundry washing machine comprising an inner volume wherein said articles are contained, movimentation means configured to move said articles within said volume, steaming means configured to generate steam to be delivered within said volume for preventing or reducing the bacterial growth on said articles and control means, characterized in that said control means are configured to implement on said laundry washing machine the method according to any previous aspect.

**[0021]** All above aspects will be clearly detailed in the following description accompanied by Figures 1 to 9, wherein:

- Figure 1 represents a washing machine configured to implement the method according to the present solution;
- Figure 2 represents an element of the washing machine depicted in Figure 1;
- Figures 3 to 6 represent, in the way of flowcharts, a first embodiment of the method according to the present solution;

- Figures 7 and 8 represent, in the way of graphs, a second embodiment of the method according to the present solution and
- Figure 9 represents, in the way of a graph, a third embodiment of the method according to the present solution.

**[0022]** In Figure 1 a laundry washing machine 1 is shown. The laundry washing machine 1 is configured to perform at least a washing treatment on textile articles L. Optionally, the washing machine, if equipped with suitable drying means (e.g. an airflow heater or a heat pump circuit), can perform also a drying treatment on the textile articles L after the washing treatment. In such an option, the washing machine is commonly named "washing-drying machine" or "washer-dryer".

**[0023]** The washing machine 1 includes a cabinet 12 configured to house the structural and functional components of the washing machine 1. The cabinet 12, whose shape is usually a parallelepiped shape, is internally hollow due to its structural function and can be manufactured by assembling a plurality of panels (e.g. plastic and/or metallic panels). For gaining access to the interior of the cabinet 12 (and in particular for loading/unloading the textile articles L) a loading aperture is carved out in a panel of the cabinet 12. In the exemplary representation of the washing machine 1 visible in Figure 1, the loading aperture is carved out in the frontal panel of the washing machine 1. Therefore the washing machine 1 is commonly named "front-loading washing machine". It should be however underlined that current solution is not limited to front-loading washing machines, since all teachings that will be described in detail can be equally implemented in any different kind of laundry washing machines, for instance in a "top-loading washing machine" (i.e. in a laundry washing machine whose loading aperture is carved out in the upper panel of the cabinet). In order to keep closed the loading aperture during the operation of the washing machine 1, a door 5 is provided. The articulation of the door 5 can be obtained by means of one or more hinges connecting the door 5 to the cabinet 12. In order to make the opening of the door 5 more comfortable, a handle 6 is mounted on the door 5. Finally locking means configured to lock the door 5 in the closing position are provided. The locking means are associated to the cabinet 12 and/or to the door 5 and have the function of preventing the opening of the door 5 during each potentially dangerous working phase of the washing machine 1.

**[0024]** The washing machine 1 comprises an inner volume V wherein textile articles L are contained. This inner volume V can be advantageously internal to a rotatable perforated drum 18. The drum 18 acts as a hollow containment structure for the textile articles L. For instance, the drum 18 is obtained by calendering a perforated sheet-metal around an axis, so that an axial-symmetrical (in particular cylindrical) structure is obtained. This axial-symmetrical structure constitutes the lateral wall of the

drum 18, to which a front wall and a rear wall are firmly connected. The front wall is ring-shaped, so that a front aperture configured to gain access to the volume V is obtained in the drum 18. The drum 18 is mounted in the cabinet 12 so that the rotation axis of the drum 18 is substantially horizontal. It should be however underlined that current solution is not limited to horizontal axis washing machines, since all teachings that will be described in detail can be equally implemented in vertical axis washing machines or in inclined axis washing machines. The door 5 is configured to prevent any access to the front aperture of the drum 18 in its closing position.

**[0025]** The washing machine 1 comprises movimentation means configured to move textile articles L within the volume V. Advantageously the movimentation means are configured to move textile articles L within the drum 18. In the exemplary washing machine 1 shown in Figure 1, an electric motor 17 configured to rotate the drum 18 is included in the movimentation means. The electric motor 17 shown in Figure 1 is a so-called "direct drive motor", since it's directly coupled to the rotation shaft 19 of the drum 18. It should be however underlined that current solution is not limited to directly-driven washing machines, since all teachings that will be described in detail can be equally implemented in washing machines where-in the electric motor 17 is coupled to the drum 18 by means of suitable transmission means (including for instance at least one pulley and at least one belt).

**[0026]** Advantageously, the washing machine 1 further comprises a tub 10 configured to contain water W, the volume V being internal to the tub 10. The tub 10 is a container preferably made of plastic material and connected to the cabinet 12 by means of suitable suspension means (e.g. springs and/or dampers). The drum 18 is internal to the tub 10 and is free to rotate within the tub 10. The tub 10 is provided with an aperture 20 substantially aligned with the respective apertures of the cabinet 12 and of the drum 18. The door 5 is configured to close the aperture 20 in its closing position.

**[0027]** A hydraulic circuit is associated to the tub 10 for allowing the water W to be loaded into the tub 10 and to be discharged from the tub 10. The hydraulic circuit comprises at least one water inlet 2 connected to a water supply network and at least one loading duct 13. Loading means are associated to the water inlet 2 and/or to the loading duct 13. For instance, the loading means comprise at least one electrovalve 3 (usually a couple of electrovalves). When the electrovalve 3 is switched on, there is a flow of water from the network to the tub 10 due to the opening position of the electrovalve 3. At the contrary, when the electrovalve 3 is switched off, the flow of water from the network to the tub 10 is interrupted due to the closing position of the electrovalve 3. The loading duct 13 leads the water to the tub 10. Advantageously, the path of the water passes through a washing agents compartment 4. In such a way, the washing agents are withdrawn from the compartment 4 and carried by the water flow to the tub 10 through a hopper 11. Moreover the

hydraulic circuit comprises a discharging duct 16 connected to the sump 15 (i.e. to the bottom portion of the tub 10). Draining means are associated to the sump 15 and/or to discharging duct 16. For instance, the draining means comprise a drain pump 14. When the drain pump 14 is switched on, there is a flow of water from the tub 10 to the outside of the washing machine 1. At the contrary, when the drain pump 14 is switched off, the flow of water from the tub 10 to the outside of the washing machine 1. Finally, the hydraulic circuit can comprise a recirculation circuit (equipped with pumps and/or valves) configured to define a closed loop for the water, the tub 10 being included in this closed loop.

**[0028]** The washing machine 1 further comprises heating means configured to heat up the water during the washing phase. The heating means includes a resistance 9 acting as heating element. The resistance 9 is positioned in the tub 10 below the volume V.

**[0029]** In Figure 2 a resistance 9 apt to be mounted in the washing machine 1 is shown. Such a resistance 9 comprises a supporting plate 9s configured to be fixed to a wall of the tub 10, a couple of terminals 9r configured to allow the electric supply of the resistance 9 and a heating tube 9p. The heating tube 9p has a substantial coil-like shape and comprises a electric filament surrounded by an insulating layer, the insulating layer being in turn surrounded by a watertight covering. The watertight covering is typically made of a material with a really low susceptibility to be damages by high temperatures and/or corrosive agents. Suitable materials for the manufacturing (or for the coating) of the watertight covering are titanium and stainless steel.

**[0030]** Advantageously, the washing machine 1 further comprises sensing means configured to detect at least one parameter related to the water W collected in the tub. The sensing means include a pressure sensor 7 mounted in the sump 15 below the resistance 9 and a temperature sensor 8 mounted in the tub 10 near the resistance 9.

**[0031]** The pressure sensor 7 is able to detect the pressure of the water. Since the tub 10 is a rigid body, the pressure of the water W in the sump 15 is directly connected to the amount of water W collected in the tub 10. Therefore the pressure sensor 7 is able to detect the water level P reached by the water W in the tub 10. Preferably the pressure sensor 7 is a linear sensor or anyway a sensor able to detect a plurality of water levels in the tub 10.

**[0032]** The temperature sensor 8 is able to detect the temperature of the water. For instance, a negative temperature coefficient thermistor (comprising an electric component whose resistance changes as a function of the temperature) can be used as a temperature sensor 8 for detecting the temperature of the water W in the tub 10. In addition, the temperature sensor 8 is able to detect if the resistance 9 is completely submerged in the water W or if the resistance 9 is at least partly emerged. Such an additional detection is really useful for guaranteeing

a proper operation of the washing machine 1. If an emerged condition is detected for the resistance 9, proper actions could be taken (e.g. loading of water in the tub 10 and/or switching off of the resistance 9). For the temperature sensor 8 to be able to detect any emerged condition of the resistance 9, it's convenient to position the temperature sensor 8 at the same height of the resistance 9, or better at a height slightly greater than the height of the resistance 9: in this way it's certain that, when the resistance 9 is emerged, the temperature sensor 8 is emerged as well. Advantageously, the temperature sensor 8 is mounted to the tub 10 by means of the supporting plate 9s of the resistance 9.

**[0033]** In order to detect quickly if the resistance 9 is emerged, a thermal bridge 25 (made of a conductive material, e.g. copper) can be used for connecting the temperature sensor 8 and the heating tube 9p: in such a way the temperature sensor 8 becomes able to detect the temperature of the resistance 9 by thermal conduction through the thermal bridge 25. Advantageously the thermal bridge 25 connects the temperature sensor 8 with the first stretch of the heating tube 9p and the resistance 9 (as shown in Figure 1) is mounted in the tub 10 slightly inclined downwards, so that the temperature sensor 8 is able to detect also the partial and/or incipient emersion of the resistance 9.

**[0034]** The washing machine 1 is equipped with control means for the electronics controls of the electric loads of the washing machine 1. In particular the control means comprise a control unit 21 operatively connected with the sensing means (in particular with the pressure sensor 7 and with the temperature sensor 8) and with the electric loads (in particular with the resistance 9, with the electric motor 17, with the electrovalve 3, with the drain pump 14 and with the locking means of the door 5). Advantageously the control unit 21 is further operatively connected with a user interface 22, that comprises selection means (configured to allow the user of the washing machine 1 to select at least one washing treatment and/or at least one operative parameter of the washing machine 1) and indication means (configured to allow the user of the washing machine 1 to be informed about the status of the washing machine 1 and/or about at least one operative parameter of the washing machine 1). Selection means can comprise knobs and/or buttons, whilst indication means can comprise at least one acoustic emitter and/or at least one display. With such an architecture, the control unit 1 is able to receive input signals from the sensing means and from the selection means and to transmit output signals to the electric loads and to the indication means.

**[0035]** The washing machine 1 comprises steaming means configured to generate steam to be delivered within the volume V for preventing or reducing the bacterial growth on textile articles L (in particular when textile articles L are wet). Collecting means configured to contain water to be evaporated by means of the steaming means, loading means configured to supply collecting means

with water and sensing means configured to detect at least one parameter related to the water in the collecting means are associated to the steaming means.

**[0036]** In an embodiment of the present solution, the steaming means comprises a heater configured to evaporate the water in a manually loadable reservoir. The reservoir is separated from the tub and it is connected to the tub 10 by means of a hose. So the steam generated by the heater is delivered to the tub 10 through the hose in order to perform desired anti-bacterial action on the textile articles L. The sensing means are connected to the control unit 21, so that the control unit 21 can for instance switch the heater off when the water level in the reservoir is too low.

**[0037]** In the preferred embodiment of the present solution (shown in Figure 1), at least one heating element is shared between the heating means and the steaming means, the shared heating element being in particular the resistance 9 that is therefore used also for generating steam to be delivered within the volume V and then for preventing or reducing the bacterial growth on the textile articles L.

**[0038]** According to the preferred embodiment, the tub 10 belongs to the collecting means. According to the preferred embodiment, the loading means include the electrovalve 3 and the loading duct 13. According to the preferred embodiment, the loading means include the electrovalve 3 and the loading duct 13. According to the preferred embodiment, the draining means include the drain pump 14 and the discharging duct 16. According to the preferred embodiment, the sensing means include the pressure sensor 7 and the temperature sensor 8. According to the preferred embodiment, the movimentation means include the electric motor 17 (configured so that the activation of the electric motor 17 causes the rotation of the drum 18). According to the preferred embodiment, the control means include the control unit 21. According to the preferred embodiment, the locking means include a door lock configured to lock the door 5 in the closing position (e.g. when the steaming means and/or the movimentation means are switched on). According to the preferred embodiment, the selection means comprises at least one knob 23 configured to allow the user to select at least one treatment cycle making use of steam and/or at least one button 21 configured to allow the user to select at least one treatment option making use of steam. According to the preferred embodiment, the indication means comprises at least one (light or acoustic) emitter configured to provide the user with at least one piece of information related to selected treatment cycle or option making use of steam.

**[0039]** According to the preferred embodiment, the control unit 21 is able to regulate the water amount in the tub 21 so that the water level P stays between the volume V and the resistance 9. In this regulation, the control unit 21, on the basis of the input signals received from the sensing means (in particular from the pressure sensor 7 and from the temperature sensor 8) is able to send output

signals to the loading means and/or the steaming means (in particular to the electrovalve 3 and to the resistance 9), so that the water level P mainly stays between the lowest point of the drum 18 and the highest point of the resistance 9. The fact that the water level P doesn't exceed the lowest point of the drum 18 avoids the textile articles L to get wetter, whilst the fact that the water level P doesn't fall below the highest point of the resistance 9 avoids the washing machine 1 to be damaged or to work improperly.

**[0040]** Figures 3 to 9 show, by means of flowcharts or graphs, the method according to the present solution for treating the textile articles L in the washing machine 1. In particular, the graphs (Figures 7 to 9) includes three experimental curves:

- a first curve S (continuous line) representing the angular speed  $s$  (expressed in rpm) of the drum 18 function of the time  $t$  (expressed in minutes);
- a second curve A (stippled line) representing the amount  $a$  (expressed in litres) of the water W in the tub 10 function of the time  $t$  (expressed in minutes) and
- a third curve H (dash-dot line) representing the temperature  $h$  (expressed in °C) of the water W in the tub 10 function of the time  $t$  (expressed in minutes).

**[0041]** The method comprises a heating phase and a cooling phase, heating phase and cooling phase being repeated at least once. Advantageously, one to nine repetitions of the heating phase and of the cooling phase are carried out, in particular one (as in Figures 7 and 8) to five (as in Figure 9) repetitions. Preferably, the method has a several hours duration (in particular, around 360 minutes).

**[0042]** The steaming means are switched on at least most of the time during the heating phase and are switched off at least most of the time during the cooling phase. In particular the resistance 9 is activated in a continuous manner during the heating phase (the driving of the resistance 9 during the heating phase will be described in detail later), whilst is switched off during the whole cooling phase.

**[0043]** The movimentation means are switched on at least most of the time during the heating phase and are continuously or intermittently switched on during the cooling phase. In particular, during the heating phase the drum 18 rotates at least most of the time at a speed comprised between 30 rpm and 60 rpm, preferably between 30 rpm and 50 rpm, more preferably between 38 rpm and 42 rpm, whilst during the cooling phase the drum 18 rotates continuously or intermittently at a speed comprised between 15 rpm and 45 rpm, preferably between 20 rpm and 35 rpm, more preferably between 25 rpm and 30 rpm.

**[0044]** During the heating phase, steam is generated by the resistance 9 evaporating the water W in the tub 10. The steam passes through the perforations of the drum 18 and reaches the volume V where it can exercise

its anti-bacterial properties on the textile articles L. The electric motor 17 can be driven by the control unit 21 so that the drum 18 rotates at a constant speed (e.g. around 40 rpm). The rotation of the drum 18 allows the tumbling of the textile articles L in the drum 18 and consequently their untangling, so that the steam can come into contact with all textile articles L in the drum 18. Preferably, the direction of the rotation of the drum 18 doesn't change during the heating phase.

**[0045]** During the cooling phase, the volume V is plenty of steam that continues to perform its anti-bacterial action on the textile articles L. Even though the resistance 9 is (mainly) switched off, additional steam may be generated in the cooling phase (especially at the beginning of the cooling phase) due to the thermal inertia of the resistance 9. The electric motor 17 can be driven by the control unit 21 so that the drum 18 rotates according to a predetermined duty cycle wherein rotation in the clockwise direction is alternated to the rotation in the anticlockwise direction. The rotation of the drum 18 is in particular at a quite low speed (e.g. around 30 rpm both in the clockwise and in the anticlockwise direction) and has an overall duration rather short compared with the total cooling phase time. The intermittent rotation of the drum 18 guarantees anyway an agitation of the textile articles L sufficient for the steam to be effective during the cooling phase. Hence the movimentation means of the washing machine 1 are periodically activated during the cooling phase according to an activation profile in which a switching-on period is alternated to a switching-off period. Advantageously the duration of each switching-off period is comprised between two times and twenty times the duration of each switching-on period, preferably between five times and ten times the duration of each switching-on period, more preferably between seven times and nine times the duration of each switching-on period. According to an advantageous embodiment of the solution, the control unit 21 drives the electric motor 17 so that, during the cooling phase, the drum 18 follows a periodic speed profile, wherein the profile of each period is composed of a rotation in the clockwise direction lasting between 3 and 4 seconds, a stop lasting between 56 and 57 seconds, a rotation in the anticlockwise direction lasting between 3 and 4 seconds and a further stop lasting between 56 and 57 seconds (the rotation speed in the clockwise direction being equal to the rotation speed in the anticlockwise direction).

**[0046]** In order to limit the electrical consumptions due to the resistance 9 and consequently to save energy, the cooling phase is advantageously rather longer than the heating phase. In particular, the cooling phase has a duration of between 30 minutes and 350 minutes, preferably a duration of between 40 minutes and 160 minutes, more preferably a duration of around 40 minutes or around 52 minutes or around 70 minutes or around 100 minutes or around 160 minutes. The heating phase has instead a duration of between 10 minutes and 25 minutes, preferably a duration of between 13 minutes and 25 minutes,

more preferably a duration of between 13 minutes and 20 minutes.

**[0047]** The heating phase is preceded by a filling phase, the electrovalve 3 being switched on during the filling phase to load water W in the tub 10. The filling phase is stopped when a predetermined amount of water W in the tub 10 is detected by the pressure sensor 7. Even in order to limit the electrical consumptions due to the resistance 9 and consequently to save energy, this predetermined amount of water W is rather low and is in particular comprised between 0,1 lt and 3 lt, preferably between 0,2 lt and 2 lt, more preferably between 0,4 lt and 0,6 lt. A predetermined water level P situated between the resistance 9 and the drum 18 corresponds to the predetermined amount of water W. In the washing machine 1 shown in Figure 1, the predetermined water level P is reached with a water amount in the tub 18 equal to 0,5 lt, whilst the levels corresponding to the highest point of the resistance 9 and to the lowest point of the drum 18 respectively are reached with water amounts in the tub equal to 0,2 lt and to 0,6 lt respectively.

**[0048]** During the filling phase, the resistance 9 can be always switched off or can be always switched on. Alternatively the resistance 9 can be switched on when the pressure sensor 7 detects that water level P in the tub has reached the highest point of the resistance 9. During the filling phase the electric motor 17 is switched off and consequently the drum 18 does not rotate. In order to prevent the water inflow coming from the hopper 11 from entering into the drum 18 (and then from reaching the textile articles L in the volume V), the electrovalve 3 is driven by the control unit 21 in order to perform an impulsive loading. According to this impulsive loading, the electrovalve 3 is intermittently switched on, the duration of each activation of the electrovalve 3 is in particular less than 3 seconds, preferably less than 2 seconds, more preferably less than 1 second. The impulsive loading allows the water inflow coming from the hopper 11 to stick to the internal walls of the tub 10 up to the sump 15.

**[0049]** At the end of the cooling phase, the water W remained in the sump 15 can be drained by switching on the drain pump 14, then the tub 10 is refilled for performing the successive heating phase. However the water W remained in the sump 15 at the end of the cooling phase advantageously is not drained, but it's kept in the sump 15. Before the successive heating phase, a replenishment of the tub 10 is carried out to reinstate a water amount of around 0,5 lt in the tub 10. If the drain of the water W between the cooling phase and the successive heating phase is avoided, actually appreciable energy and water savings are obtained and the generation of calcareous deposits on the heating tube 9p of the resistance 9 is advantageously thwarted.

**[0050]** Advantageously, the heating phase includes a first heating sub-phase and a second heating sub-phase.

**[0051]** The resistance 9 is continuously switched on during the first heating sub-phase in order to heat up quickly the water W to be vaporised until the temperature

of the water W becomes equal to a predetermined upper temperature threshold, the upper temperature threshold being in particular comprised between 80°C and 95°C, preferably between 83°C and 89°C, more preferably between 85°C and 87°C.

**[0052]** During the first heating sub-phase the continuous activation of the resistance 9 is interrupted at least once. During the interruption a routine is executed, to verify that the amount of water W remained in the tub 10 is able to guarantee a proper operation of the resistance 9 and in general of the washing machine 1. The amount of water W that guarantees proper operating conditions should keep the resistance 9 fully submerged: therefore it should overcome 0,2 lt. According to the routine, when the temperature sensor 8 detects the water W in the tub 10 has reached an intermediate temperature threshold, the resistance 9 is switched off for a predetermined interruption period (this interruption period being less than 3 minutes, preferably less than 1 minute). At the end of the interruption period, the amount of water W in the tub 10 is measured by means of the pressure sensor 7. If the pressure sensor 7 detects an adequate amount of water W, then the resistance 9 is switched on again. Otherwise the electrovalve 3 is switched on in order to reinstate initial filling conditions (0,5 lt) or anyway in order to load into the tub 10 the missing amount of water W. After this refilling, the resistance 9 is finally switched on in order to continue the heating up of the water W. In alternative or in addition to the water amount detected by the pressure sensor 7, the temperature gradient detected by the temperature sensor 8 during the interruption period can be used in aforementioned routine. Instead, if the resistance 9 is partially or completely emerged, the temperature detected by the temperature sensor 8 doesn't fall during the interruption period because the heat of the resistance 9 is not dissipated by the water W. Therefore, if there isn't a sufficient decrease of the temperature detected by the temperature sensor 8 during the interruption period, a refilling of water W into the tub 10 should be necessary.

**[0053]** Advantageously, during the first heating sub-phase the continuous activation of the resistance 9 is interrupted two or three times in order to execute aforementioned routines. Preferably, the first intermediate temperature threshold is set to around 40°C, the second intermediate temperature threshold is set to around 50°C and the (possible) third intermediate temperature threshold is set to around 60°C.

**[0054]** When the temperature sensor 8 detects the temperature of the water W in the tub 10 has reached the upper temperature threshold (for instance around 86°C or around 88°C), there is the switching-over from the first heating sub-phase to the second heating sub-phase. The second heating sub-phase is intended to maintain the temperature of the water W in the tub 10 substantially constant for a predetermined duration, the predetermined duration being between 1 minute and 10 minutes, preferably between 2 minutes and 4 minutes,

more preferably around 3 minutes. Since the temperature of the water W is quite high, there is a significant generation of steam during the second heating sub-phase. In order to get the maintenance of the temperature of the water W during the second heating sub-phase, a predetermined lower temperature is set, so that the difference between the upper temperature threshold and the lower temperature threshold is comprised between 1°C and 10°C, preferably between 2°C and 5°C, more preferably between 2°C and 3°C. A suitable value for the lower temperature threshold is around 84°C. During the second heating sub-phase, the resistance 9 is switched off when the temperature sensor 8 detects that the temperature of the water W in the tub 10 has reached the upper temperature threshold and is switched on when the temperature sensor detects that the temperature of the water W in the tub has reached the predetermined lower temperature threshold. Advantageously, when the resistance 9 is switched off during the second heating sub-phase, a routine is carried out, in order to load water W into the tub 10 if a refilling is necessary to reinstate proper operating conditions.

**[0055]** When the predetermined duration of the second heating sub-phase has elapsed, there is the switching-over from the second heating sub-phase and the cooling phase, so the resistance 9 is definitively switched off. During the cooling phase, the temperature of the water W in the tub 10 decreases. Advantageously at the end of the cooling phase, the temperature sensor 8 is activated in order to measure the temperature of the water W. Measured temperature is then compared by the control unit 21 with a reference temperature value, this reference temperature value corresponding to the highest temperature able to guarantee that the detections of the pressure sensor 7 during the successive heating phase won't be affected by significant errors. The reference temperature value is comprised between 55°C and 70°C, preferably comprised between 56°C and 65°C, more preferably between 58°C and 62°C. If measured temperature of the water W in the tub 10 overcomes reference temperature value, then the electrovalve 3 is activated in order to reduce the temperature of the water W in the tub 10 by means of fresh water loading. Alternatively, the cooling phase is prolonged until the temperature of the water W falls below the reference temperature value.

**[0056]** Advantageously, even though a predetermined overall duration of the method is set (e.g. around 360 minutes or around 720 minutes or around 1440 minutes), the method may be interrupted or ended at any time by the user desiring withdrawing the textile articles L from the drum 18. For instance, the opening of the door 5 causes the interruption or the end of the method. Alternatively, since the locking means are advantageously enabled during the heating phase and during the cooling phase in order to protect the user from the possible risks due to the high temperatures in the drum 18, the disablement of the locking means cause the interruption or the end of the method. Alternatively, the interruption or

the end of the method is requested by the user by means of a dedicated selector included in the user interface 22.

**[0057]** The method according to the present solution is conceived to be used in combination with wet textile articles L. Therefore the textile articles L can be loaded into the drum 18 after having been washed by hand (and then already wet). Advantageously dry textile articles L are loaded into the drum 18 and at the beginning of the method a washing phase takes place, preferably followed by a spinning phase. If the washing machine is a washer-dryer equipped with drying means, then a drying phase may be performed at the end of the method. In this way, the user can load dirty textile articles L in the washing machine and, at the end of the method, can withdraw the same textile articles L washed, sanitised and (possibly) dried.

**[0058]** The flowchart in Figure 3 depicts exemplary phases of the method in a possible embodiment designed to be performed on wet textile articles L. Block B represents the begin of the heating phase (and then it may correspond with the end of the washing/spinning phase or alternatively with the end of a cooling phase). The temperature of the water W in the tub 10 is measured in block B by means of the temperature sensor 8. In block F the control unit 21 compares measured temperature with the reference temperature value. For instance the control unit 21 checks if measured temperature is higher than 60°C. If the measured temperature is higher than the reference temperature value, block R1 is executed, block R1 representing a first temperature lowering stage intended to avoid temperature influence on the successive calibration of the pressure sensor 7. Preferably a second temperature lowering stage (represented by block R2) is performed after the first temperature lowering stage.

**[0059]** The flowchart in Figure 4 depicts exemplary sub-stages of any temperature lowering stage R in a possible embodiment of the present solution. Block Rp represents the filling of the water W into the tub 10 in order to load fresh water W able to cool down the tub 10. During the filling of the water W, the electrovalve 3 is driven by the control unit 21 in order to perform an impulsive loading. Block Rs represents the maintenance of filled water W in the tub 10 for lowering the temperature. Optional block Rd represents the draining of the water W by means of the draining pump 14, such draining being performed if the embodiment of the method includes more than one temperature lowering stage.

**[0060]** If the temperature measured in block B isn't higher than the reference temperature value or after the execution of the temperature lowering stages, block Z is executed, wherein the pressure sensor 7 and/or the temperature sensor 8 are calibrated. Block M represents the filling phase, wherein the electrovalve 3 performs the impulsive loading of the water W into the tub 10. When the pressure sensor 7 detects the resistance 9 is covered with the water W, the resistance 9 is switched on to heat up the temperature of the water W in the tub 10. Block

K1 represents a first interruption stage performed to ensure proper operating conditions of the washing machine 1. This first interruption stage is in particular performed when the temperature sensor 8 detects a temperature of the water W equal to 40°C. Block K2 represents a second interruption stage performed to ensure proper operating conditions of the washing machine 1. This second interruption stage is in particular performed when the temperature sensor 8 detects a temperature of the water W equal to 50°C.

**[0061]** The flowchart in Figure 5 depicts exemplary sub-stages of any interruption stage K in a possible embodiment of the present solution. Block Kp represents the switching off of the resistance 9. Block Ks represents the activation of the pressure sensor 7 and/or the temperature sensor 8 in order to detect the water amount in the tub 10 and/or the temperature gradient. If proper operating conditions of the washing machine 1 are detected, the interruption stage K terminates. Otherwise in block Km the tub 10 is refilled, the impulsive loading being adopted for loading fresh water W into the tub 10.

**[0062]** Block N represents the second heating sub-phase whose exemplary sub-stages are depicted in Figure 6. In block Np the temperature sensor 8 detects that the temperature of the water W in the tub 10 has reached the temperature of 86°C and then has reached the upper temperature threshold. Then the pressure sensor 7 and/or the temperature sensor 8 are activated in order to detect the water amount in the tub 10 and/or the temperature gradient. If proper operating conditions of the washing machine 1 are detected, in block Nf the resistance 9 is activated intermittently for 3 minutes in order to maintain the temperature of the water W in the tub 10 almost constant. Otherwise in block Nq the tub 10 is refilled, fresh water W being loaded impulsively into the tub 10. Then in block Ns proper operating conditions of the washing machine 1 are checked again. In case potentially improper operating conditions of the washing machine 1 are detected again, the tub 10 is refilled in block Nm adopting the impulsive loading.

**[0063]** Block D represents the cooling phase, during which the resistance 9 is kept switched off. Final block X represents an optional draining phase following the cooling phase. In the draining phase, the drain pump 14 is activated for a predetermined time (e.g. around 10 seconds) sufficient to substantially empty the tub 10.

**[0064]** The graphs in Figures 7 and 8 depict exemplary phases of the method in a further embodiment of the present solution designed to be performed on wet textile articles L. This embodiment starts with the filling phase FP1 wherein the electrovalve 3 is open impulsively until the pressure sensor 7 detects that a water amount equal to 0,5 litres is present in the tub 10. The filling phase FP1 lasts around 4 minutes in total. During the filling phase FP1 the electric motor 17 and the resistance 9 are both switched off.

**[0065]** At the end of the filling phase FP1, the electrovalve 3 is closed and first heating phase FH1 begins. The

resistance 9 is switched on in the first heating phase FH1 order to heat water W up. Simultaneously the electric motor 17 is activated in order to provoke the rotation of the drum 18 at a constant speed lower than the satellisation speed, e.g. 40 rpm. When the temperature sensor 8 detects a temperature of the water W equal to 40°C, the first routine is driven by the control unit 21 that switches off the resistance 9 for a time sufficient for the pressure sensor 7 and for the temperature sensor 8 to detect the water amount and the temperature gradient respectively. In particular, if a water amount less than 0,2 It is detected the electrovalve 3 is open impulsively for loading missing amount of water W. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water W. If the water amount is instead adequate, the resistance 9 is switched on again. When the temperature sensor 8 detects a temperature of the water W equal to 50°C, the second routine is driven by the control unit 21 that switches off the resistance 9 for a time sufficient for the pressure sensor 7 and for the temperature sensor 8 to detect the water amount and the temperature gradient respectively. In particular, if a water amount less than 0,2 It is detected the electrovalve 3 is open impulsively for loading missing amount of water W. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water W. If the water amount is instead adequate, the resistance 9 is switched on again until the temperature of the water W in the tub 10 becomes equal to 86°C. The first heating phase FH1 lasts around 13 minutes.

**[0066]** There is then the switch over from the first heating phase FH1 to second heating phase SH1. The temperature sensor 8 has detected a temperature of the water W equal to 86°C. The resistance 9 is switched off. In the meantime the pressure sensor 7 and for the temperature sensor 8 are activated to detect the water amount and the temperature gradient respectively. In particular, if a water amount less than 0,2 It is detected the electrovalve 3 is open impulsively for loading missing amount of water. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water. When the temperature sensor 21 detects a temperature of the water W equal to 84°C the resistance 9 is switched on again. The operation of the resistance 9 during the second heating phase SH1 is periodic in order to maintain the temperature of the water W in the tub 10 comprised between 84°C and 86°C. The duration of the second heating phase SH1 is around 3 minutes. During the whole second heating phase SH1 the drum 18 keeps a constant rotation speed (around 40 rpm).

**[0067]** As soon as the duration of the second heating phase SH1 has elapsed, the resistance 9 is definitively switched off and the cooling phase CP1 begins. The temperature of the water W in the tub 10 decreases in a progressive way. In the meantime the electric motor 17 is driven by the control unit 21 so that the drum 18 moves

according to a periodic driving profile composed of a stop lasting around 9 minutes, a rotation in the clockwise direction (e.g. at 30 rpm) lasting around 1 minute, a further stop lasting around 9 minutes and finally a rotation in the anticlockwise direction (e.g. at 30 rpm) lasting around 1 minute. When a time period equal to around 160 minutes has elapsed, the temperature sensor 9 is investigated. If the temperature sensor 9 detects that the water W in the tub 10 has a temperature lower than 60°C the control unit 21 terminates the second heating phase SH1.

**[0068]** During the filling phase FP2 the electrovalve 3 is open impulsively in order to load an amount of water W equal to the evaporated amount. When the pressure sensor 7 detects that a water amount equal to 0,5 litres is present in the tub 10, the electrovalve 3 is closed. The filling phase FP2 lasts around 4 minutes in total. During the filling phase FP2 the electric motor 17 and the resistance 9 are both switched off.

**[0069]** At the end of the filling phase FP2, the electrovalve 3 is closed and first heating phase FH2 begins. The resistance 9 is switched on in the first heating phase FH2 order to heat water W up. Simultaneously the electric motor 17 is activated in order to provoke the rotation of the drum 18 at a constant speed lower than the satellisation speed, e.g. 40 rpm. When the temperature sensor 8 detects a temperature of the water W equal to 40°C, the first routine is driven by the control unit 21 that switches off the resistance 9 for a time sufficient for the pressure sensor 7 and for the temperature sensor 8 to detect the water amount and the temperature gradient respectively. In particular, if a water amount less than 0,2 It is detected the electrovalve 3 is open impulsively for loading missing amount of water W. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water W. If the water amount is instead adequate, the resistance 9 is switched on again. When the temperature sensor 8 detects a temperature of the water W equal to 50°C, the second routine is driven by the control unit 21 that switches off the resistance 9 for a time sufficient for the pressure sensor 7 and for the temperature sensor 8 to detect the water amount and the temperature gradient respectively. In particular, if a water amount less than 0,2 It is detected the electrovalve 3 is open impulsively for loading missing amount of water W. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water W. If the water amount is instead adequate, the resistance 9 is switched on again until the temperature of the water W in the tub 10 becomes equal to 86°C. The first heating phase FH2 lasts around 13 minutes.

**[0070]** There is then the switch over from the first heating phase FH2 to second heating phase SH2. The temperature sensor 8 has detected a temperature of the water W equal to 86°C. The resistance 9 is switched off. In the meantime the pressure sensor 7 and for the temperature sensor 8 are activated to detect the water amount and the temperature gradient respectively. In particular,

if a water amount less than 0,2 It is detected the electro-valve 3 is open impulsively for loading missing amount of water. At the contrary, if a water amount higher than 0,6 It is detected, the drain pump 14 is activated for discharging exceeding amount of water. When the temperature sensor 21 detects a temperature of the water W equal to 84°C the resistance 9 is switched on again. The operation of the resistance 9 during the second heating phase SH2 is periodic in order to maintain the temperature of the water W in the tub 10 comprised between 84°C and 86°C. The duration of the second heating phase SH1 is around 3 minutes. During the whole second heating phase SH1 the drum 18 keeps a constant rotation speed (around 40 rpm).

**[0071]** As soon as the duration of the second heating phase SH2 has elapsed, the resistance 9 is definitively switched off and the cooling phase CP2 begins. The temperature of the water W in the tub 10 decreases in a progressive way. In the meantime the electric motor 17 is driven by the control unit 21 so that the drum 18 moves according to a periodic driving profile composed of a stop lasting around 9 minutes, a rotation in the clockwise direction (e.g. at 30 rpm) lasting around 1 minute, a further stop lasting around 9 minutes and finally a rotation in the anticlockwise direction (e.g. at 30 rpm) lasting around 1 minute. When a time period equal to around 160 minutes has elapsed, the temperature sensor 9 is investigated. If the temperature sensor 9 detects that the water W in the tub 10 has a temperature lower than 60°C the control unit 21 terminates the second heating phase SH2 and can activate the drain pump 14 in order to discharge the amount of water W remained in the tub 10. The overall duration of the embodiment depicted in Figures 7 and 8 is equal to around 360 minutes.

**[0072]** The graph in Figure 9 depicts exemplary phases of the method in a further embodiment of the present solution designed to be performed on dry and dirty textile articles L. This embodiment includes a washing phase WP that is followed by a couple of rinsing phases RP and a couple of spinning phases SP. Advantageously, the washing phase WP has a remarkable anti-bacterial and/or anti-odour effectiveness (for instance it implements the teachings in European patent EP2746442).

**[0073]** In order to preserve washed textile articles L to a possible proliferation of bacteria and to the consequent generation of bad smells, while they are left in the volume V after the washing, the steaming means and the movimentation means are used for performing several times (in particular six times) the heating phase HP and the cooling phase CP.

**[0074]** Heating phases HP and cooling phases CP in the embodiment depicted in Figure 9 are quite similar to the heating phases and to the cooling phases depicted in Figures 7 and 8. The only noticeable exception to this similarity could be represented by the duration of each cooling phase CP in Figure 9. Since six cooling phases CP are carried out in total, the duration of each cooling phase CP is around 40 minutes, whilst the duration of

the cooling phase cP1 and of the cooling phase CP2 in Figures 7 and 8 is equal to around 160 minutes.

**[0075]** Several important advantages are achieved. First of all, proliferation of bacteria, molds and fungi in the textile articles L when they are left wet in the drum 18 is heavily and effectively thwarted. With particular reference to the embodiment depicted in Figure 9, the fact that the steaming means and the movimentation means are switched on shortly after the completion of the washing cycle ensures a quick and prompt response to the vulnerability of the wet textile articles L to bacteria after the washing. Furthermore since a quite long duration can be set in the control unit 21 (e.g. around 360 minutes or around 720 minutes or around 1440 minutes), the method remains fully effective against the proliferation of bacteria, molds and fungi even if the textile articles L are left wet in the drum 18 for many hours.

**[0076]** Additionally, the use of steam, combined with an adequate movimentation, provides an effective action against bad smells (e.g. cigarette smoke, food, smog and sweat) and an effective action of relaxation of the textile fibres, that removes creases and makes more comfortable the successive ironing of the textile articles L.

**[0077]** Additionally, the method according to the present solution is user-friendly, since the may be stopped by the user at any time, and energy efficient, since the resistance 9 is switched on for a relatively short time and the water amount to be evaporated is really low.

**[0078]** These advantages and further outstanding advantages are made available by the present solution as defined by the following claims. Several variants are possible to the person skilled in the art. In particular, different temperature values and/or different water amount values and/or rotation speed values may be adopted by the person skilled in the art. In particular, regarding to the water amount and the rotation speed, it should be underlined that the values in the embodiment shown in Figures 7 and 8 are purely indicative and are believed to be optimal in combination with a structure of the washing machine 1 designed to include a tub 10 having a capacity of around 58 litres. If the structure of the washing machine 1 and/or the capacity of the tub 10 are different, the values of the water amount and the values of the rotation speed should be modified accordingly. Just in order to provide an example of the opportune slight modifications, if the washing machine 1 is a big-size washing machine 1 with enlarged dimensions of the tub 10, the constant rotation speed of the drum 18 during the heating phase is advantageously increased from around 40 rpm up to around 48 rpm, in order to take into account the variation of the satellisation speed due to the bigger diameter of the drum 18.

## Claims

1. Method for treating textile articles (L) in a laundry washing machine (1), the washing machine (1) com-

prising an inner volume (V) wherein said articles (L) are contained, movimentation means (17) configured to move said articles (L) within said volume (V) and steaming means (9) configured to generate steam to be delivered within said volume (V) for preventing or reducing the bacterial growth on said articles (L), the method comprising the steps of:

a) performing a heating phase (HP), during which:

- said movimentation means (17) are switched on at least most of the time and
- said steaming means (9) are switched on at least most of the time;

b) performing a cooling phase (CP), during which:

- said movimentation means (17) are continuously or intermittently switched on and
- said steaming means (9) are switched off at least most of the time;

c) repeating at least once steps a) and b).

2. Method according to claim 1, wherein the cooling phase (CP) has a duration of between 30 minutes and 350 minutes, preferably a duration of between 40 minutes and 160 minutes, more preferably a duration of around 40 minutes or around 52 minutes or around 70 minutes or around 100 minutes or around 160 minutes.
3. Method according to claim 1 or 2, wherein in step c) one to nine repetitions of steps a) and b) are carried out, preferably one to five.
4. Method according to any previous claim, wherein the heating phase (HP) in step a) includes a first heating sub-phase (FH) and a second heating sub-phase (SH), said steaming means (9) being continuously switched on during the first heating sub-phase (FH) and being intermittently switched on during the second heating sub-phase (SH), the second heating sub-phase (SH) having in particular a duration of between 1 minute and 10 minutes, preferably of between 2 minutes and 4 minutes.
5. Method according to any previous claim, the washing machine (1) further comprising collecting means (10) configured to contain water to be evaporated by means of said steaming means (9), loading means (3) configured to supply said collecting means (10) with water and sensing means configured to detect at least one parameter related to the water in said collecting means (10), wherein the heating phase (HP) is preceded by a filling phase (FP), the loading

means (3) being switched on during the filling phase (FP) to load water in said collecting means (10), and wherein the filling phase (FP) is stopped when a predetermined amount of water in said collecting means (10) is detected by the sensing means, said predetermined amount of water being in particular comprised between 0,1 liters and 3 liters, preferably between 0,2 liters and 2 liters, more preferably between 0,4 liters and 0,6 liters.

6. Method according to claims 4 and 5, wherein during the first heating sub-phase (FH) the continuous activation of said steaming means (9) is interrupted at least once and wherein during the interruption a routine is executed, such a routine being configured to guarantee a sufficient amount of water in said collecting means (10) and comprising in particular the activation of said sensing means in order to detect a temperature gradient and/or a water amount, wherein preferably during the first heating sub-phase (FH) the continuous activation of said steaming means (9) is interrupted two or three times.
7. Method according to claims 4 and 5, wherein the switch over from the first heating sub-phase (FH) to the second heating sub-phase (SH) is carried out when said sensing means detect that the temperature of water in said collecting means (10) has reached a predetermined upper temperature threshold, said upper temperature threshold being in particular comprised between 80°C and 95°C, preferably between 83°C and 89°C, more preferably between 85°C and 87°C and wherein preferably during the second heating sub-phase (SH) said steaming means (9) are switched off when said sensing means detect that the temperature of water in said collecting means (10) has reached said upper temperature threshold and are switched on when said sensing means detect that the temperature of water in said collecting means (10) has reached a predetermined lower temperature threshold, the difference between said upper temperature threshold and said lower temperature threshold being in particular comprised between 1°C and 10°C, preferably between 2°C and 5°C, more preferably between 2°C and 3°C.
8. Method according to any claim from 5 to 7, wherein said loading means (3) are intermittently switched on, the duration of each activation of said loading means (3) being in particular less than 3 seconds, preferably less than 2 seconds, more preferably less than 1 second.
9. Method according to any claim from 5 to 8, wherein at the end of the cooling phase (CP) said loading means (3) are activated if said sensing means detect that the temperature of the water in said collecting means (10) overcomes a reference temperature val-

ue, said reference temperature value being in particular comprised between 55°C and 70°C, preferably comprised between 56°C and 65°C, more preferably between 58°C and 62°C.

10. Method according to any claim from 5 to 9, wherein during the filling phase (FP) said movimentation means (17) are switched off.

11. Method according to any previous claim, wherein during the cooling phase (CP) said movimentation means (17) are periodically activated according to an activation profile in which a switching-on period is alternated to a switching-off period, the duration of the switching-off period being comprised between two times and twenty times the duration of the switching-on period, preferably between five times and ten times the duration of the switching-on period, more preferably between seven times and nine times the duration of the switching-on period.

12. Method according to any previous claim, the washing machine (1) further comprising a rotatable perforated drum (18), said volume (V) being internal to said drum (18) and said movimentation means (17) are so configured that their activation causes the rotation of said drum (18), wherein:

- during the heating phase (HP) said drum (18) rotates at a speed comprised between 30 rpm and 60 rpm, preferably between 30 rpm and 50 rpm, more preferably between 38 rpm and 42 rpm and

- during the cooling phase (CP) said drum (18) rotates at a speed comprised between 15 rpm and 45 rpm, preferably between 20 rpm and 35 rpm, more preferably between 25 rpm and 30 rpm,

wherein in particular the washing machine (1) further comprises an aperture (20) configured to gain access to said volume (V), a door (5) configured to open and/or close said aperture (20) and locking means configured to lock said door (5) in its closing position, said locking means being enabled during said heating phase (HP) and during said cooling phase (CP), and wherein preferably the opening of said door (5) and/or the disablement of said locking means cause the interruption or the end of the method.

13. Method according to any previous claim, wherein at the beginning of the method a washing phase (WP) takes place, said washing phase (WP) being preferably followed by a spinning phase (SP), and wherein said articles (L) are wet during steps a) to c), wherein in particular the washing machine (1) further comprises heating means configured to heat up the water

during the washing phase, at least one heating element being shared between said heating means and said steaming means (9), said shared heating element being in particular an electric resistance.

14. Method according to claim 13, the washing machine (1) further comprising a tub configured to contain water, said volume (V) being internal to said tub, said shared heating element being positioned in said tub below said volume (V), wherein during the heating phase (HP) and during the cooling phase (CP) the water amount in the tub is regulated so that the water level (P) stays between said volume (V) and said shared heating element.

15. Laundry washing machine (1) comprising an inner volume (V) wherein said articles (L) are contained, movimentation means (17) configured to move said articles (L) within said volume (V), steaming means (9) configured to generate steam to be delivered within said volume (V) for preventing or reducing the bacterial growth on said articles (L) and control means (21), **characterized in that** said control means (21) are configured to implement on said laundry washing machine (1) the method according to any previous claim.

**FIG.1**

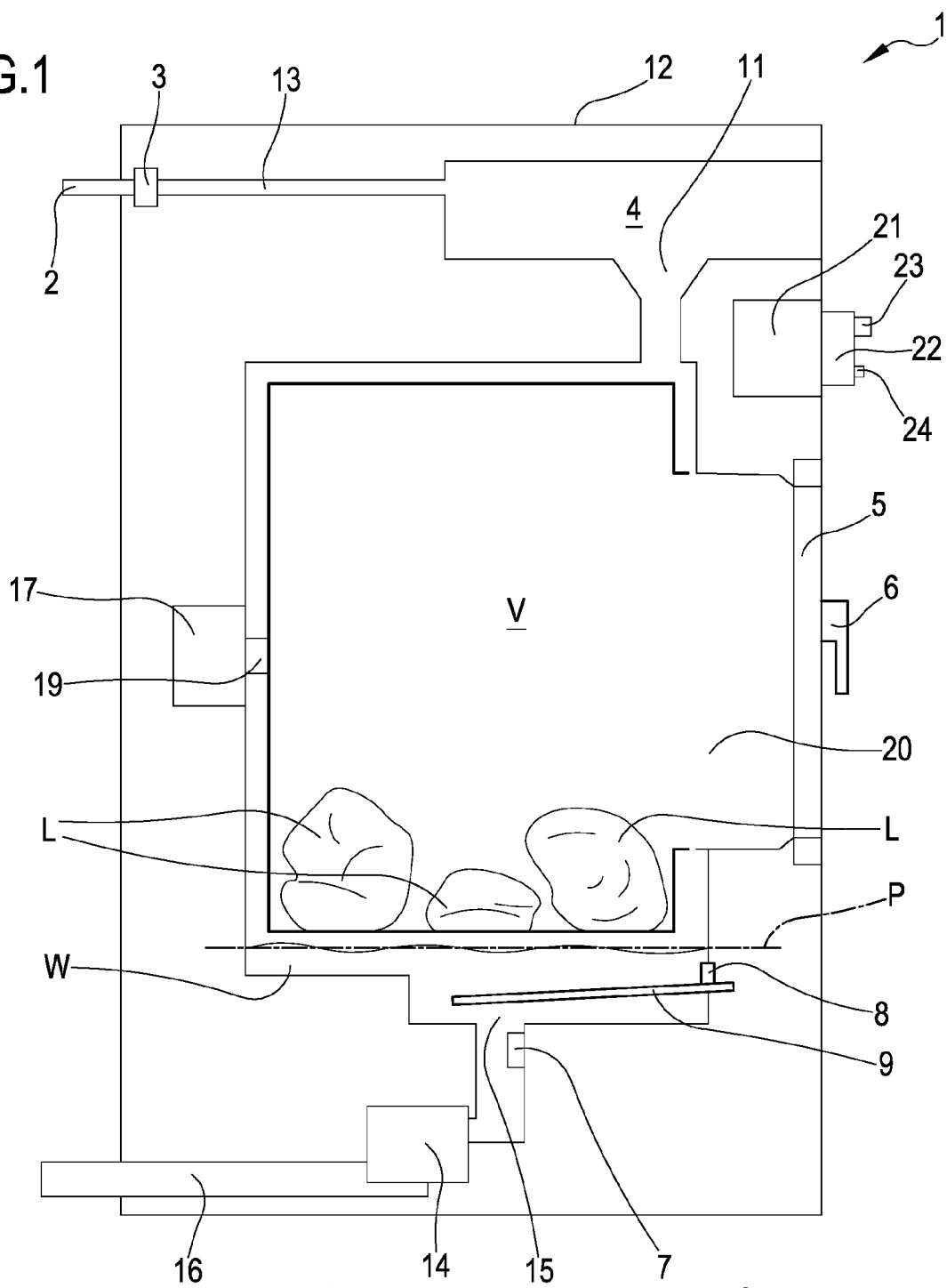
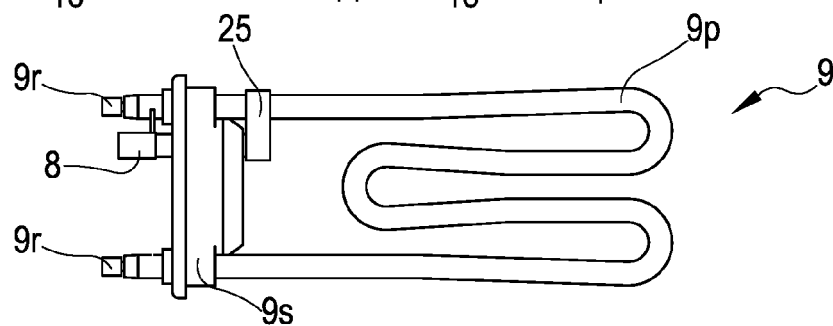


FIG.2



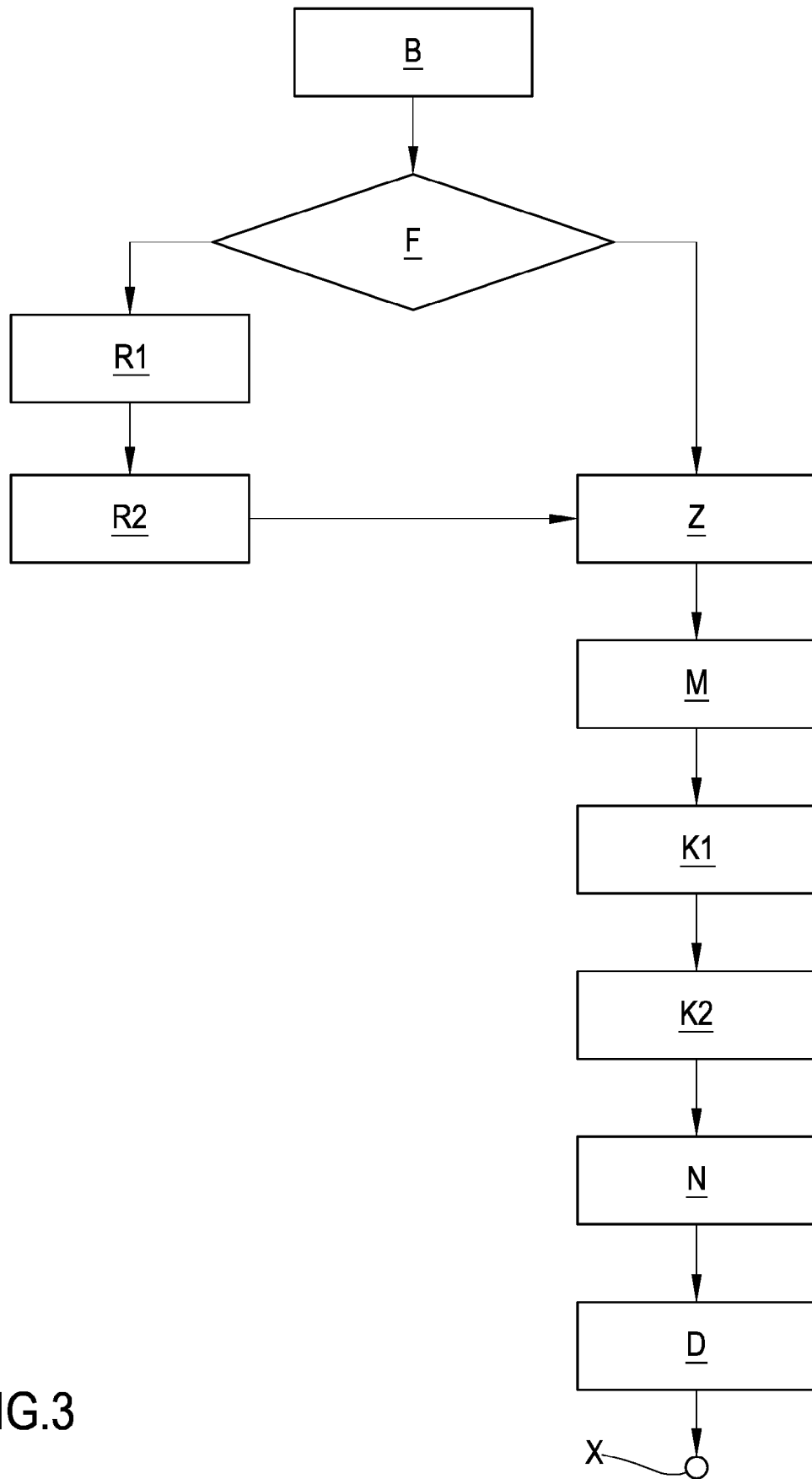


FIG.3

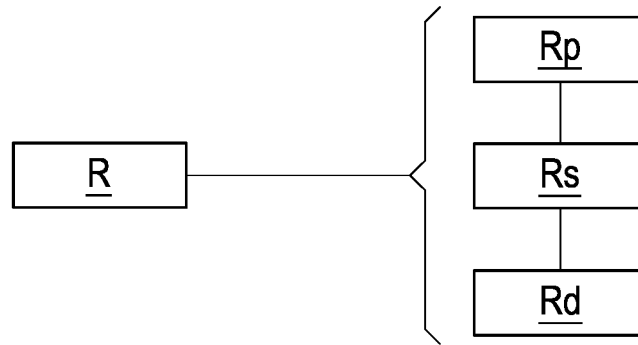


FIG.4

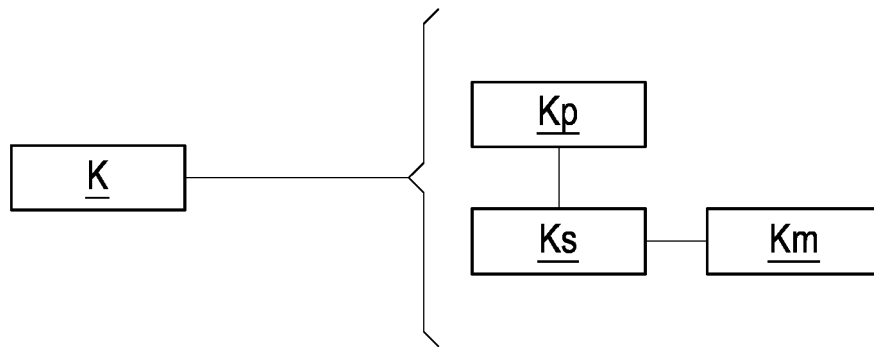


FIG.5

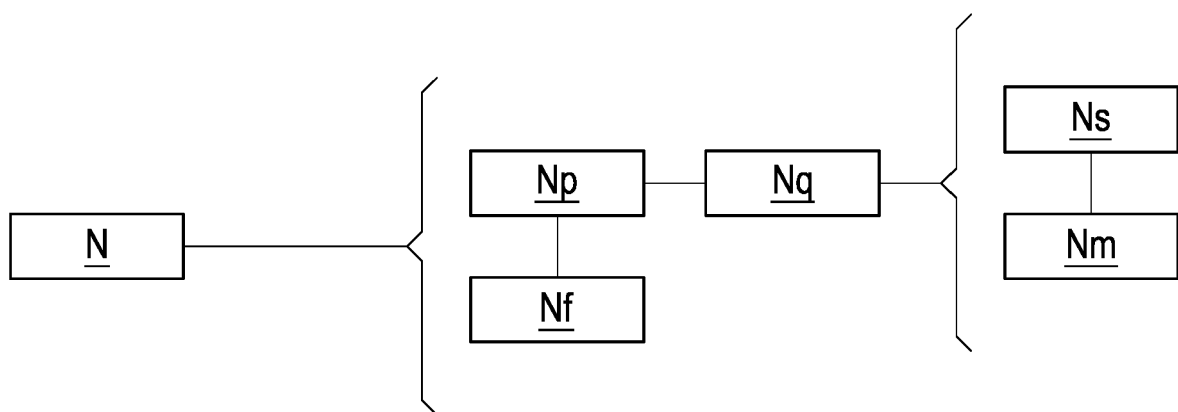


FIG.6

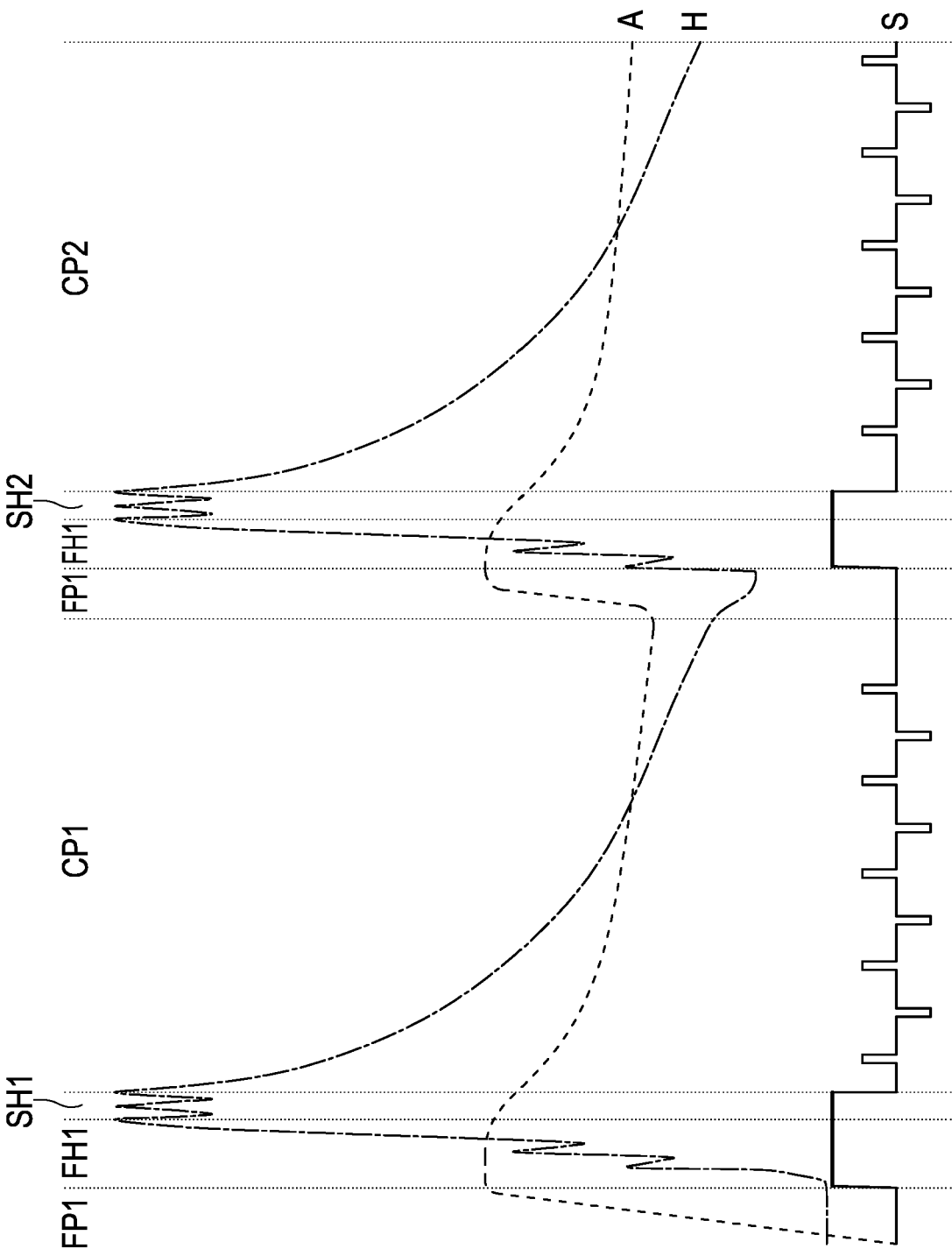


FIG.7

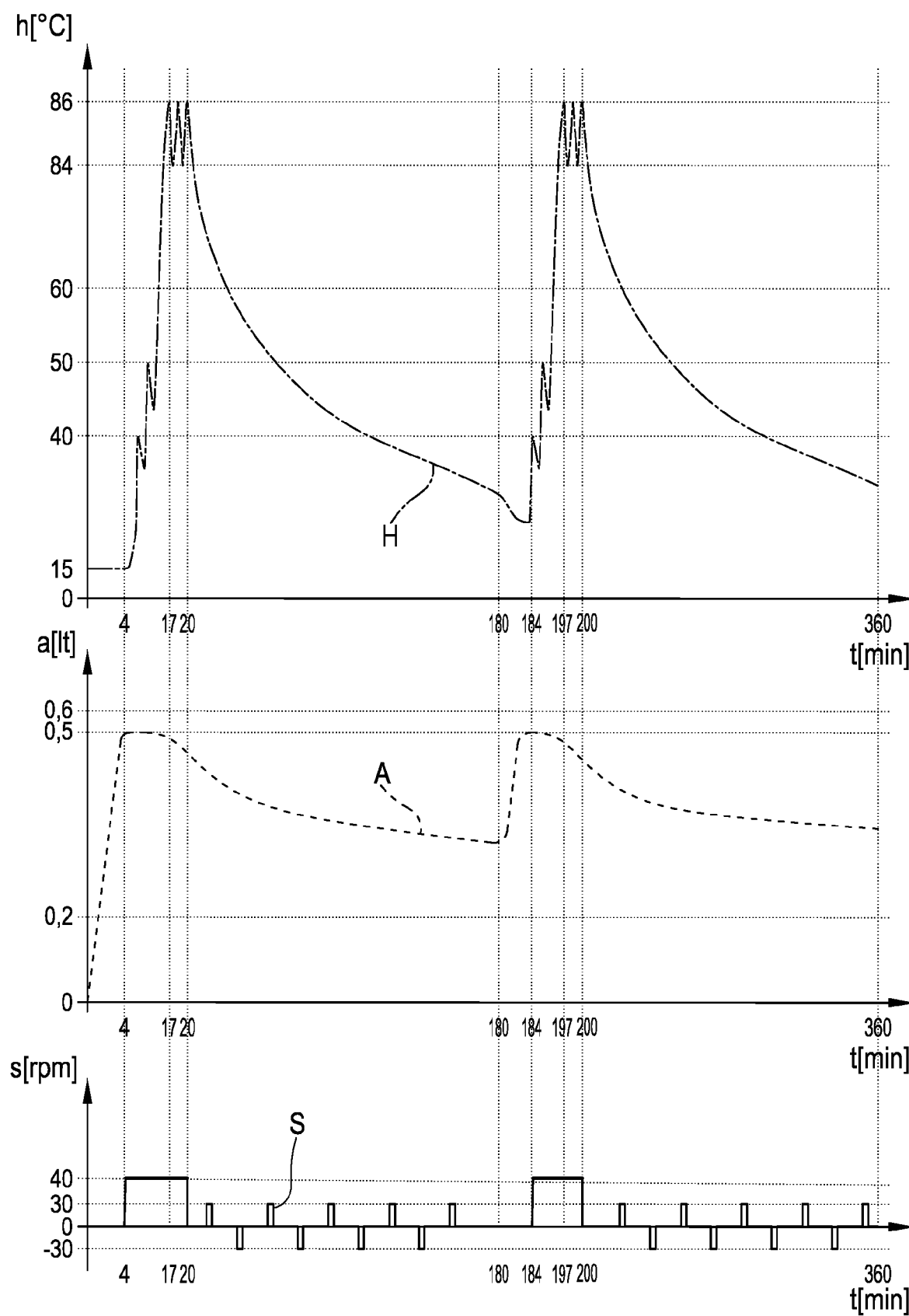


FIG.8

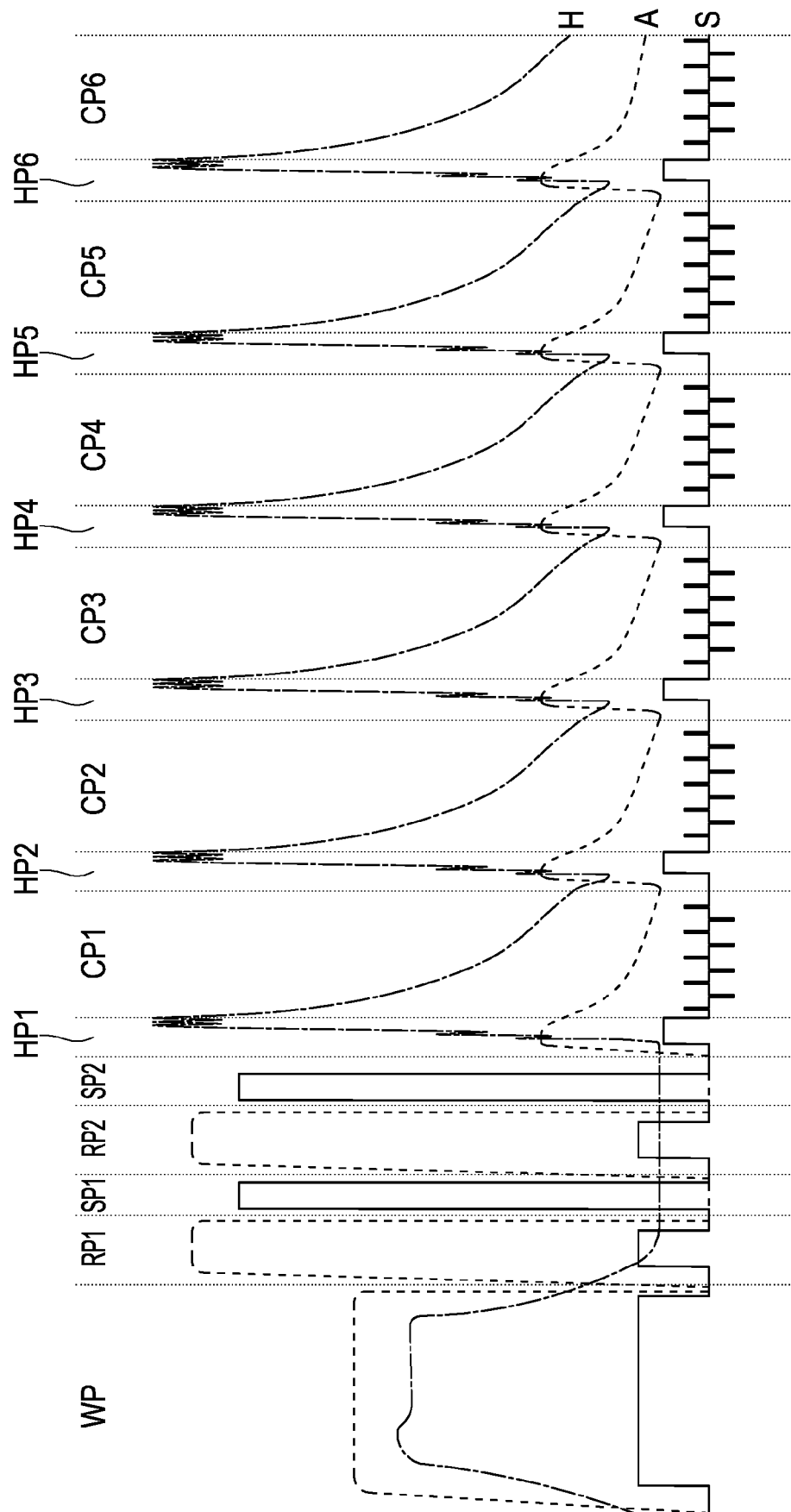


FIG.9



## EUROPEAN SEARCH REPORT

Application Number  
EP 16 20 6424

5

10

15

20

25

30

35

40

45

50

55

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                   |                                                        |                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                                                                                                     | Relevant to claim                                      | CLASSIFICATION OF THE APPLICATION (IPC)    |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 2 426 245 A1 (MIELE & CIE [DE])<br>7 March 2012 (2012-03-07)<br>* paragraph [0007] *<br>* paragraphs [0010] - [0012] *<br>* paragraphs [0016], [0019] *<br>* paragraphs [0023] - [0031] *<br>* figures 1-4 *                                   | 1-15                                                   | INV.<br>D06F35/00<br><br>ADD.<br>D06F39/00 |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 1 507 028 A1 (LG ELECTRONICS INC [KR])<br>16 February 2005 (2005-02-16)<br>* paragraphs [0018] - [0023] *<br>* paragraphs [0027] - [0030] *<br>* paragraphs [0033] - [0037] *<br>* figures 1-4 *                                               | 1,3,5,<br>12,13,15                                     |                                            |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 2006/101345 A1 (LG ELECTRONICS INC [KR]; PARK SEOG KYU [KR]; PARK KWANG CHEOL [KR])<br>28 September 2006 (2006-09-28)<br>* paragraphs [0044] - [0049] *<br>* paragraphs [0051] - [0053] *<br>* paragraphs [0055] - [0057] *<br>* figures 1-9 * | 1,3,5,<br>12,13,15                                     | TECHNICAL FIELDS<br>SEARCHED (IPC)         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 1 956 132 A1 (LG ELECTRONICS INC [KR])<br>13 August 2008 (2008-08-13)<br>* paragraphs [0018] - [0021] *<br>* paragraphs [0023] - [0029] *<br>* figures 1-5 *                                                                                   | 1,15                                                   | D06F                                       |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                   |                                                        |                                            |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                   | Date of completion of the search<br><b>6 June 2017</b> | Examiner<br><b>Weidner, Maximilian</b>     |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                                                                                                   |                                                        |                                            |

EPO FORM 1503 03.82 (P04C01)

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

EP 16 20 6424

5

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

06-06-2017

10

15

20

25

30

35

40

45

50

55

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| EP 2426245 A1                             | 07-03-2012          | EP 2426245 A1              | 07-03-2012          |
|                                           |                     | ES 2528728 T3              | 12-02-2015          |
| EP 1507028 A1                             | 16-02-2005          | CN 1580359 A               | 16-02-2005          |
|                                           |                     | CN 1818190 A               | 16-08-2006          |
|                                           |                     | EP 1507028 A1              | 16-02-2005          |
|                                           |                     | EP 1657345 A2              | 17-05-2006          |
|                                           |                     | KR 20050017488 A           | 22-02-2005          |
|                                           |                     | US 2005034248 A1           | 17-02-2005          |
|                                           |                     | US 2007130697 A1           | 14-06-2007          |
| WO 2006101345 A1                          | 28-09-2006          | AU 2006225458 A1           | 28-09-2006          |
|                                           |                     | EP 1861539 A1              | 05-12-2007          |
|                                           |                     | ES 2539396 T3              | 30-06-2015          |
|                                           |                     | JP 5243238 B2              | 24-07-2013          |
|                                           |                     | JP 2008534048 A            | 28-08-2008          |
|                                           |                     | TW I329691 B               | 01-09-2010          |
|                                           |                     | US 2008250819 A1           | 16-10-2008          |
|                                           |                     | WO 2006101345 A1           | 28-09-2006          |
| EP 1956132 A1                             | 13-08-2008          | CN 101235585 A             | 06-08-2008          |
|                                           |                     | EP 1956132 A1              | 13-08-2008          |
|                                           |                     | ES 2370739 T3              | 22-12-2011          |
|                                           |                     | KR 20080071428 A           | 04-08-2008          |
|                                           |                     | US 2008178397 A1           | 31-07-2008          |

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- EP 2746442 A [0002] [0072]