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(54) **Fabric treating appliance provided with steam generation and method for controlling the amount of generated steam**

(57) A fabric treating appliance provided with steam generation, allows to provide steam cycles according to the user's inputs and settings with precise amounts of generated steam, and comprises a steam generator having a heater for evaporating water, a control unit apt to determine partial amounts of evaporated water evaporated by the steam generator and measured according to a sampling rate, said control unit comprising a processing unit capable of summing the partial amounts of evaporated water in order to obtain an actual value of total amount of evaporated water, and a heater controller apt to turning off the heater if the actual value of total amount of evaporated water exceeds a preset threshold value of evaporated water.

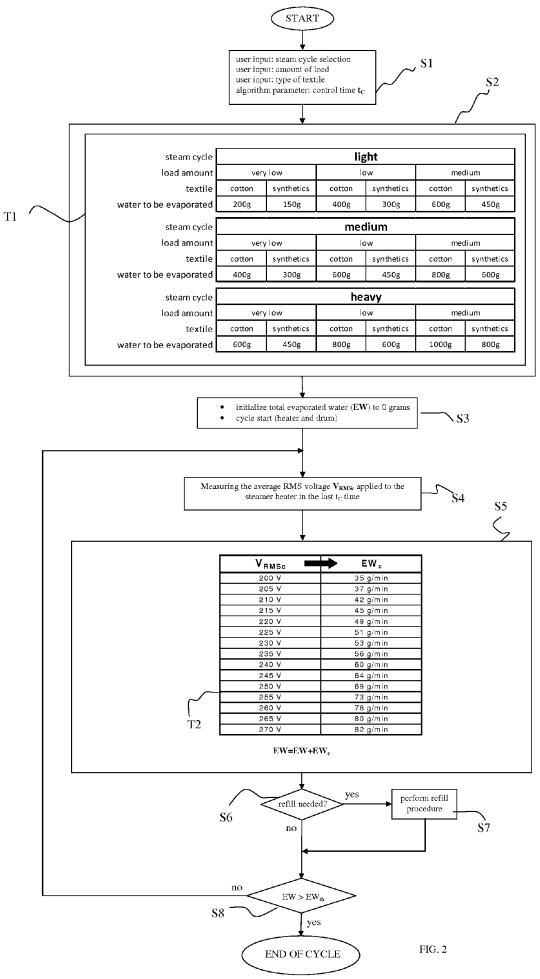

FIG. 2

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Description

[0001] The present invention relates to a fabric treating appliance, provided with steam generation and a method for controlling the amount of generated steam in the same.

[0002] Recently, the use of steam generation functionality has become quite common in several types of fabric treatment appliances, such as washing machines, clothes dryers, fabric refreshing machines and the like.

[0003] The provision of steam can be envisaged for different reasons depending on the fabric treatment appliance in which a steamer generator is present, for example, the latter may be used to heat water, heat a load of fabric items and any water absorbed by the fabric items, de-wrinkle or refresh fabric items, remove odors from fabric items, sanitize the fabric items, sanitize components of the fabric treatment appliance and so on.

[0004] In particular, in domestic washing machines clothes refreshment functionality by means of steam has become more and more important.

[0005] An additional important application is the use of steam during washing as disclosed in WO 2006/101372 by LG Electronics. In this patent application, the different advantages of steam in a washing cycle are explained: in the pre-wash phase, while the water loads into the wash tub, the steam works with the water to help soak the fabrics more thoroughly; during the washing phase, if the steam is added while the detergent is mixed with the water, the steam increases the temperature of the wash tub to improve the cleaning power, which also helps to activate the detergent; in the post-wash phase, the steam lends more high temperatures to the tub to sterilize the clothes. It also softens the clothes to remove hard wrinkles that formed while the clothes tossed in the tub.

[0006] In general, fabric treatment appliances provided with steam generation according to the known art comprise a steam generator supplied with water for the conversion to steam thereof. For example U.S. Patent Application 2009/0056389 discloses a washing machine comprising a water supply for filling a steam generation chamber of the steam generator with water, and a heating element of the steam generator heating the water present in the steam generation chamber to generate steam. Steam generated in the steam generation chamber flows from the steam generation chamber to a fabric treatment chamber via a steam supply conduit attached to the steam generator.

[0007] The European Patent application EP 1 873 297 discloses two different methods for controlling the steam generation in fabric treating appliance. A first one consists in detecting the water level and the temperature in a steam generation chamber and turning the heater creating the steam on or off according to the values detected. Applicants have noted that this control method is suitable only for continuous steam generation, while it does not allow a precise control of steam when steam is required only in some working cycles (e.g. for de-wrinkling) of the appliance. Indeed, in the know art the duration of a refreshing/de-wrinkling cycle is pre-determined and specified into a digital memory of the machine electronic controller: the user selects the program and specifies the textile and the amount of the load and, according to these inputs the electronic controller selects the cycle time duration: so, the duration of this cycle is fixed and does not depend on non user-set external parameters, as explained also in U.S. Patent Application No. 2009/0056389.

[0008] The second method disclosed in the European Patent application EP 1 873 297 is based on defining a variable operation limit time of the steamer according to several parameters, namely a temperature variation of the water, a level of a voltage applied to the heater and a quantity of water accommodated in the steam generator.

[0009] The second method also comprises a step of updating the operation limit time by being decided at least twice. Namely, the operation limit time can be updated by considering a temperature variation of the water in the course of driving the heater.

[0010] However, Applicants have realized that also the above described control method does not guarantee a precise control of the amount of generated steam. As a consequence, if the amount of the generated steam is lower than the expected one, the steam cycle will not offer optimal performances in treating the fabrics while, if the amount of steam is higher than the one required, a part of steam will remain unused, with a consequent waste of energy and water.

[0011] Hence, the technical problem underlying the present invention is to provide a control of the steam generation which overcomes the drawbacks mentioned above with reference to the known art.

[0012] Such a problem is solved by the fabric treating appliance provided with steam generation according to claim 1 and by the method for controlling the amount of generated steam according to claim 10.

[0013] The present invention provides several relevant advantages. The main advantage lies in that the fabric treating appliance provided with steam generation and the respective control method according to the present invention, allows providing steam cycles according to the user's inputs and settings with very precise amounts of generated steam, thus avoiding both insufficient steam in order to perform the inputted cycle and energy waste. Moreover, the manufacturing of a fabric treating appliance according to the present invention does not require any additional cost to a standard machine.

[0014] Other advantages, features and the operation modes of the present invention will be made apparent from the following detailed description of some embodiments thereof, given by way of a non-limiting example. Reference will be made to the figures of the annexed drawings, wherein:

- Figure 1 shows a perspective diagram of a drum type laundry machine provided with steam generation according to the present invention;
- Figure 2 shows a flow chart of a method for controlling the amount of generated steam in a fabric treating appliance provided with steam generation according to a first embodiment of the present invention;
- Figure 3 shows a flow chart of a method for controlling the amount of generated steam in a fabric treating appliance provided with steam generation according to a second embodiment; and
- Figure 4 shows a flow chart of a method for controlling the amount of generated steam in a fabric treating appliance provided with steam generation according to a third embodiment.

[0015] With reference initially to Figure 1, the present invention will be described, by way of non-limiting examples, with reference to a laundry machine provided with steam generation, in particular for providing it with refreshing/de-wrinkling cycles capability. It will be apparent to the one skilled in the art that the same inventive concept can be applied also to different fabric treating appliance such as washing machines, clothes dryers, fabric refreshing machines and the like in order to heat water, heat a load of fabric items, removing odors therefrom, sanitize them, sanitize components of the fabric treatment appliance and so on. Alternatively or in addition, the steam is provided for the washing cycle itself.

[0016] More particularly, a laundry machine 1 according to the present invention comprises a cabinet 10 configuring an exterior of the laundry machine, a tub 20, for example a cylindrical one horizontally supported within the cabinet 10 to store water therein, a drum 30 for holding fabric items, rotatably provided within the tub 20 and having preferably perforated holes (not shown in the drawing) for enabling water and steam to be introduced into the drum 30, a driving motor (also not shown) for driving the drum 30, and at least one steam generator 50 for supplying steam into the drum 30.

[0017] The above elements included in the laundry machine 1 are considered to be known in the art and they will be therefore not further detailed in the following.

[0018] It is to be understood that the invention is applicable to any type of steam generator 50, although a specific embodiment will be described below.

[0019] As an example, according to a possible preferred embodiment, the steam generator 50 is a tank-type steam generator, storing a volume of water and heating it by an heater (not shown) in order to convert the water to steam. Alternatively, according to a different embodiment of the invention, the steam generator 50 may be an in-line steam generator, such as the one described in U.S. patent application Ser. No. 11/848,550 "Fabric Treatment appliance with steam generator having a variable thermal output", that converts the water to steam as the former flows through the steam generator.

[0020] Other examples of steam generators which might be used in the present invention in an alternative manner are disclosed in U.S. patent application Ser. No. 11/464,528, titled "Removal of Scale and Sludge in a Steam Generator of a Fabric Treatment Appliance," U.S. patent application Ser. No. 11/450,836, titled "Prevention of Scale and Sludge in a Steam Generator of a Fabric Treatment Appliance," or U.S. patent application Ser. No. 11/450,714, titled "Draining Liquid From a Steam Generator of a Fabric Treatment Appliance," all filed Jun. 9, 2006, in addition to U.S. patent application Ser. No. 11/464,509, titled "Water Supply Control for a Steam Generator of a Fabric Treatment Appliance," U.S. patent application Ser. No. 11/464,514, titled "Water Supply Control for a Steam Generator of a Fabric Treatment Appliance Using a Weight Sensor," or U.S. patent application Ser. No. 11/464,513, titled "Water Supply Control for a Steam Generator of a Fabric Treatment Appliance Using a Temperature Sensor".

[0021] In addition, the laundry machine 1 further comprises a control panel 40 connected to a respective control unit (not shown) for allowing the user to input different parameters of washing and, in particular, steaming cycles, as will be better described in the following. Also, the control unit is associated to a processing unit and a storage medium (both not shown) such as an EPROM memory or any other electronic non-volatile memory capable of storing information relating to the washing and steaming cycles.

[0022] With reference now to Figure 2, a flow chart shows a method for controlling the amount of generated steam in the laundry machine 1 provided with steam generator 50 according to the present embodiment.

[0023] In particular, the method comprises a first step S1 of inputting specific conditions and parameters of the desired steam cycle to be performed by the laundry machine 1. More precisely, by means of the control panel 40, a user can select a plurality of different parameters, which will be called in the following, globally, "user's inputs". The available possibilities comprise:

- Selection of the "strength" of desired steam cycle (e.g. a light, medium or heavy steam cycle);
- Selection of the amount of fabric load to be treated in the machine (e.g. very low, low, medium load);
- Selection of the type of textile (e.g. cotton, synthetics, etc.) in which the loaded items are realized.

[0024] It is to be understood that only some of the above listed user's inputs as well as additional inputs not listed can be selected via the control panel 40 by the user. For example the amount of load can be automatically determined by a load sensor positioned in the machine 1 and therefore there is no need that this value is inputted by the user. Alternatively, a torque sensor can be used for the same purpose. Setting the above user's inputs results in a selection of a desired steam cycle.

[0025] Furthermore, still in the first step S1 of the meth-

od of the invention, a control time t_c is also defined. t_c represents the sampling rate at which the amount of water evaporated by the steam is measured, as will be better described in the following. It should be noted that this parameter is preferably not inputted by the user, but it is determined in advance during the setup of the laundry machine, i.e. when the laundry machine is installed at the user's home it is already fixed and stored in the same.

[0026] Next, in step S2, a total amount of water to be evaporated in the whole steaming cycle on the basis of the above-mentioned user's inputs is calculated. For this purpose, a Table T1, correlating amounts of water to be evaporated to the specific selected user's inputs of the desired steam cycle, is stored in the storage medium. This Table is obtained by means of several field tests which have been performed on all models of appliance including a steam generator according to the invention and have been preferably realized on the premises of the Applicants when the various appliances are built. The Table is "machine dependent" and - even for the same model - it can differ due to the fact that the same model is sold in different countries having different requirements or preferences. Therefore, Table 1 depends, among others, on the machine model and on the market in which the machine 1 is distributed. Given the selected user's inputs corresponding to a desired steam cycle as indicated above, stored Table T1 is looked up in order to retrieve from the same a threshold value of evaporated water EW_{th} corresponding to the total amount of water that has to be evaporated in order to achieve the selected steam cycle.

[0027] As already mentioned, the threshold values EW_{th} stored in Table is determined experimentally, and it may depend on the specific design of the laundry machine, therefore a given model of appliance may have stored a Table T1 including different values than another appliance's model or appliance for another market.

[0028] Within the same Table 1, according to the different user's inputs, different amounts of water to be transformed in steam can be required. By way of example, as can be seen in Table T1, a light steam cycle, with a low load of synthetics, will require a lower amount of water to be evaporated than a heavy steam cycle with a medium load of cotton.

[0029] It should be also noted that other additional parameters, such as the hardness of water present in the region where the appliance has to be installed, can be taken into account in order to define such threshold values EW_{th} and they can be for example selected during the appliance's set up.

[0030] Once the threshold value EW_{th} has been determined from the user's inputs via the look up Table T1, the steam cycle starts in step S3. In more detail, in step S3 the control unit activates the heater of the steam generator 50 in order to produce steam which is supplied to the drum 30. At the same time, the control unit initializes a variable EW which defines the total amount of evaporated water EW at a given point in time during the steaming cycle, which is set equal to 0 at the beginning of the cycle itself.

[0031] It should be noted that the total amount of water evaporated in a specific time interval during the steam cycle depends theoretically substantially only on the power/energy provided thereto, which corresponds to the power absorbed by the heater. However, not all the power provided to the appliance is used to heat water: there are intrinsic losses and thermal inertia that prevents to make a one-to-one correspondence between the power and the total amount of water evaporated. In order to solve this problem, in the machine 1 of the invention, given a steamer system, i.e. given the characteristics of the laundry machine, it is possible to evaluate a characteristic function or, alternatively, a look-up Table T2, correlating the root mean square (RMS) of the current I_{RMS} or voltage V_{RMS} of the AC power of the mains or alternatively the peak voltage of the mains to a corresponding amount of evaporated water.

[0032] Therefore, it is possible for the control unit to calculate in a very precise way the amount of water actually evaporated.

[0033] In particular, with reference to the present embodiment, the method according to the present invention comprises a step S4 wherein the control unit measures an average RMS voltage value V_{RMSc} applied to the heater of the steam generator, during for example the same control time t_c previously defined. To this purpose, the laundry machine according to the present invention comprises a voltmeter or any other voltage measuring device operatively connected to the control unit. However, also another parameter can be measured for example by detecting the current applied to the heater and then calculating its RMS, I_{RMSc}, as long as such a value is available to the control unit.

[0034] Still with reference to Figure 2, once the average RMS voltage value V_{RMSc} applied to the heater is determined via the experimental measure, in step S5 of the method of the invention, using the look-up Table T2, the amount of water EW_c evaporated during said time interval t_c. is determined in the control unit. Indeed, Table T2 correlates respective values of V_{RMSc} to partial amounts of the amount of water EW_c evaporated in a given interval. Also additional and/or different parameters can be considered in order to make a one-to-one correlation between such a parameter and the evaporated water, for example by considering the peak voltage value of the mains.

[0035] After each time interval t_c, the actual value of total amount of evaporated water EW which has evaporated since the beginning of the steaming cycle, EW, which was initially set to 0 at the beginning of the cycle, is increased of the partial amounts of evaporated water EW_c determined according to the mean voltage value measured during the time interval t_c and using Table T2.

[0036] Then, the actual value of total amount of evaporated water EW is compared with the threshold value EW_{th} previously determined according to the user's in-

puts in step S8.

[0037] If the actual value of total amount of evaporated water EW has reached the threshold value EW_{th}, then a heater controller connected to said control unit turns off the heater of the steam generation, thus terminating the steam cycle.

[0038] Otherwise, if the actual value of total amount of evaporated water EW is lower than the threshold value EW_{th}, i.e. it is lower than the amount of water that has to be evaporated according to the user inputs, then step S4 is repeated so that the control unit measures a new average RMS voltage V_{RMSc} in a successive time interval t_{c+1} and calculate a new amount of evaporated water EW_{c+1} in this interval. Generally, the average RMS voltage V_{RMSc} is variable during the overall steam cycle, as the mains voltage is subjected to considerable oscillations, since a 10% variation from the nominal value is allowed and higher variations are to be expected. As can be seen from Table T2, representing an example of the correspondence between the measured average RMS voltage V_{RMSc} and the amount of evaporated water per minute, a variation from 230 V to 205 V in the average RMS voltage V_{RMSc}, corresponding to about a 10% variation in the voltage value, corresponds to a 30% variation of the amount of evaporated water, thus considerably affecting the amount of evaporated water in different intervals during the steam cycle.

[0039] In addition, different countries have different mains voltages and therefore this has to be taken into account when the calculation of the evaporated water is made, in order to obtain, for example, a "high steam cycle" which is the same in all countries. In the invention, using the Table T2, it is very easy to overcome the difficulty to set up a machine having a steamer performing substantially the same steaming cycles in all cases. It is sufficient to prepare and save different Tables T2 containing the correct correspondence of V_{RMS} and the evaporated water for - among other parameters - the mains of that specific country where the appliance will be distributed. Moreover, the variations of voltage in the mains tolerated in different countries are also different, which again have consequences in the amount of evaporated steam. All these "possible sources of errors" in the correct calculation of the evaporated water are taken into account in the present invention in a simple manner using a Table T2 correlating the evaporated water with the RMS of the voltage/current of the mains at a given "sampling frequency" determined by the choice of t_c.

[0040] Accordingly, the control unit by means of the processing unit will determine a new partial amount of evaporated water EW_{c+1} to be summed to the total of evaporated water EW previously determined. In other words, EW is updated at each interval t_c.

[0041] Then, step S8 is repeated checking again if the new total amount of evaporated water EW has reached the threshold value EW_{th}. Again, if the new total amount of evaporated water EW is still lower than the threshold value EW_{th} steps S4 and S5 will be repeated, otherwise the heater is turned off and the cycle is terminated.

[0042] During steam generation, for example after step S5, the control unit preferably, according to an optional step of the method of the invention, also further controls the quantity of water in the steam generator 50, e.g. the water contained in the tank if a tank-type generator is used. If the water level detected by the control unit is lower than a predetermined level (for example defined by the amount of water required to completely cover the heater) than a refill procedure is performed in step S7. In fact, in case of water shortage in the tank, the amount of generated steam can be lower than the expected one in a given time interval since the heater can be only partially submersed by water. This can also result in malfunction or damage of the heater or other parts in the steam generator 50, due to overheating. This refill procedure for example consists in opening a water supply valve and it can envisage either a temporary interruption of the steam generation or a continuation thereof. In the latter case, as will be seen in the following with reference to the other embodiments of the present invention, the transient condition determined by the refill operation can be taken into account when determining the partial amount of evaporated water.

[0043] From the above, it has been shown that the appliance according to the present invention can provide coherent and consistent steam cycles as the amount of generated steam can be precisely calculated since it is directly connected to the RMS voltage. In fact, by selecting a suitable sampling rate for measuring the partial amount of evaporated water, it possible to finely control the steam cycle by precisely determining the total amount of evaporated water. By measuring a plurality of partial amounts of evaporated water EW_c according to a suitable sampling rate (e.g. each 1 sec., 1 min., etc) it is possible to obtain a very precise total amount of evaporated water, taking into accounts variations of steam generation during the cycle. It should also be noted that the sampling rate - and, accordingly, the selected time intervals - can vary during the steam cycle, being shorter during particular phases of the cycle when a more precise control is required. In fact, the shorter the time intervals are, the more reliable the control of generated steam is.

[0044] Furthermore, Table T1 and Table T2 can be easily obtained as their values can be determined experimentally. In particular, as previously mentioned, Table T1 can be obtained by experimentally determining the amount of steam required for a suitable treating of the fabrics, and Table T2 can be built by means of laboratory tests on the steam generator and on the fabric appliance comprising it.

[0045] In any case, it will be apparent to the one skilled in the art that either Table T1 or Table T2 can be substituted by analytical functions, for example determined by interpolating or fitting the experimental values obtained in the field tests.

[0046] In order to obtain an even more precise control of the steam cycle, it is possible to consider also different

parameters affecting the amount of evaporated water during a sampling time. In particular, in Figures 3 and 4 alternative embodiments of the method according to the present invention are described, wherein a new modified Table T2 further considers the variation of the amounts of evaporated water according to different operative phases of the steam generation (Table T2') and according to the evaporated water temperature (Table T2"), respectively.

[0047] In the following therefore, with now reference to figs. 3 and 4, only the modified phase S5 (called phase S5' in fig. 3 and phase S5" in fig. 4) will be described, being the other phases of the method of these two additional embodiments of the invention analogous to the phases already described with reference to the method of fig. 2.

[0048] More precisely, with reference to Figure 3, a steam generation phase can comprise several operative sub-phases, e.g. a start up (i.e. a cycle initialization), a transient (i.e. the condition during the refill operations) and a working phase. During each phase, the heater operates according to different conditions and the amount of steam produced during such phases is accordingly different: in the start-up period for example the drum and the other parts of the appliance are all rather "cold" therefore a low steam production is expected; in the refill phase on the contrary the appliance's elements are already at a certain "relatively high" temperature (i.e. above room temperature) and therefore a higher production of steam in the same interval is expected.

[0049] Therefore, in the embodiment shown in Figure 3, Table T2' takes into account different partial amounts of evaporated water on the basis of the steam phase condition, i.e. in which subphase the steamer is working. For example, the control unit can consider start up values for the partial amount of evaporated water during the first minutes of the steam cycles, transient ones when refill of the water tank occurs, and working values in all other cases. More precisely, in this case to a single column of voltage values, three different columns of values of partial amounts of evaporated water EW'_c are corresponding namely a first column for the start up the cycle, a second one for a transient phase and a third one for the working phase. Accordingly, in this embodiments, step S5' includes the following: the control unit, after detecting the voltage value V_{RMSc}, looks up the value of partial amount of evaporated water EW_c considering the first column during the cycle initialization, the second one during refill operations, and the third one in all other cases.

[0050] The update of the evaporated water EW'_c is performed as in the previous embodiment continuously updating the value EW'.

[0051] Instead, with reference to Figure 4, the correlation between the partial amounts of evaporated water EW''_c and the power consumption in this further embodiment also takes into consideration the effect of the temperature in the steam generator 50. In particular, the amount of evaporated water gradually decreases for temperatures in the steam generator 50 lower than 100°C, being virtually zero below 80°C. Accordingly, in this embodiment of the method of the invention, the partial amounts of evaporated water are corrected by a function of the temperature f(T) varying from 0 (below 80°C) to 1 (above 100°C) depending on the detected temperature. In particular, as it can be noticed by the graph adjacent to Table T2" and depicted in Figure 4, the value of the function f(T) varies linearly according to the temperature. According to a different embodiment not shown, also a different dependency can be envisaged.

[0052] The method according to the present embodiment of fig. 4 comprises a further step S9 of detecting the temperature T in the steam generator 50 before the step S5" can be performed . Then, in step S5" the control unit will look up the value of partial amount of water EW''_c in Table T2", first obtaining the value f(T) according to the measured temperature T and then multiplying the value f(T) for a parameter fixed in Table T2" and which depends on the measured V_{RMSc}.

[0053] It will be also apparent to the one skilled in the art that the solutions provided in these alternative embodiments can be easily combined thus obtaining an even more precise control of the steam cycle.

Claims

1. A fabric treating appliance (1) comprising:

   a. a steam generator (50) having a heater for evaporating water;
   b. a control unit apt to calculate partial amounts of evaporated water (EW_c) evaporated by said steam generator and measured according to a sampling rate, said control unit comprising a processing unit capable of summing said partial amounts of evaporated water (EW_c) in order to obtain an actual value of total amount of evaporated water (EW) by said steam generator at a given time; and
   c. a heater controller apt to turn off the heater if said actual value of total amount of evaporated water (EW) exceeds a preset threshold value of evaporated water (EW_{th}).

2. The appliance (1) according to claim 1, wherein said total amount of evaporated water (EW) is calculated and updated at said sampling rate.

3. The appliance (1) according to claim 1 or 2, wherein said partial amounts of evaporated water (EW_c) are correlated to respective root means square voltage or current values (V_{RMSc}) of said steam generator (50) measured according to said sampling rate.

4. The appliance (1) according to any of the preceding claims, further comprising a storage medium storing

a look-up table (T2) correlating said root means square voltage or current values (V_{RMSc}) to said partial amounts of evaporated water (EW_c).

5. The appliance (1) according to claim 4, wherein said storage medium further store a second look-up Table (T1) correlating a plurality of threshold values of evaporated water (EW_{th}) to respective desired steam cycle, said desired steam cycle being inputted by a user of the appliance.

6. The appliance (1) according to any of claim 3 to 6, wherein said steam generation comprises a plurality of different operative phases, said partial amounts of evaporated water (EW_c) correlated to said respective root means square voltage or current values varying according to the current operative phase among said operative phases.

7. The appliance (1) according to any of claims 3 to 6, wherein said actual values of partial amounts of evaporated water (EW_c) correlated to said respective root means square voltage or current values are variable according to a temperature value (T) measured in said steam generator (50).

8. A method for controlling the amount of steam generated by a fabric treating appliance (1) provided with steam generation, comprising the steps of:

a. defining a sampling rate;
b. measuring a partial amount of evaporated water (EW_c) according to said sampling rate;
c. summing said partial amount of evaporated water (EW_c) in order to obtain an actual value of total amount of evaporated water (EW);
d. turning off the steam generation if said total amount of evaporated water (EW) exceeds a preset threshold value (EW_{th}) else repeating said steps b and c.

9. The method according to claim 8, further comprising a step (S5) of correlating said partial amounts of evaporated water (EW_c) to respective root means square voltage or current values measured according to said sampling rate.

10. The method according to claim 9, comprising a further step (S3) of measuring the average RMS voltage (V_{RMSc}) applied to the heater of the steam generator (50) during specific time intervals (t_c), defined by said sampling rate, in order to determine said power consumption values.

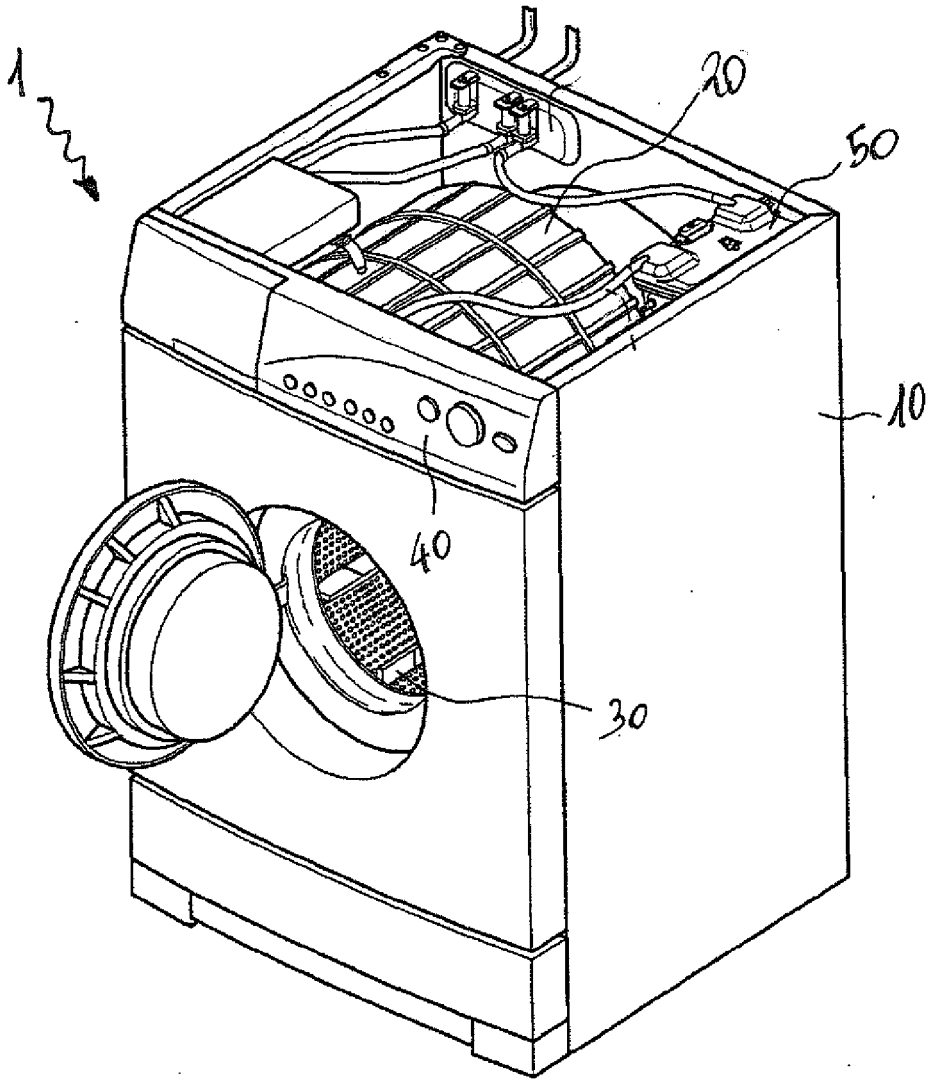
11. The method according to claim 10, wherein said steam generation comprises a plurality of different operative phases, said partial amounts of evaporated water (EW_c) correlated to said respective root means square voltage or current values varying according to a current operative phase.

12. The method according to claim 11, wherein said current operative phase includes a working phase, and/or a refill phase and/or a start-up phase.

13. The method according to any of claims 10 or 11, comprising a further step (S4') of measuring a temperature of steam generation (T), said partial amounts of evaporated water (EW_c) correlated to said respective root means square voltage or current respective values being variable according to said temperature of steam generation.

14. The method according to any of claims 8 to 13, comprising a further steps of inputting a steam treating condition of the fabric and/or a load amount thereof and determining a total amounts of water to be evaporated (EW_{th}) according to the inputted condition and/or load amount.

FIG. 1



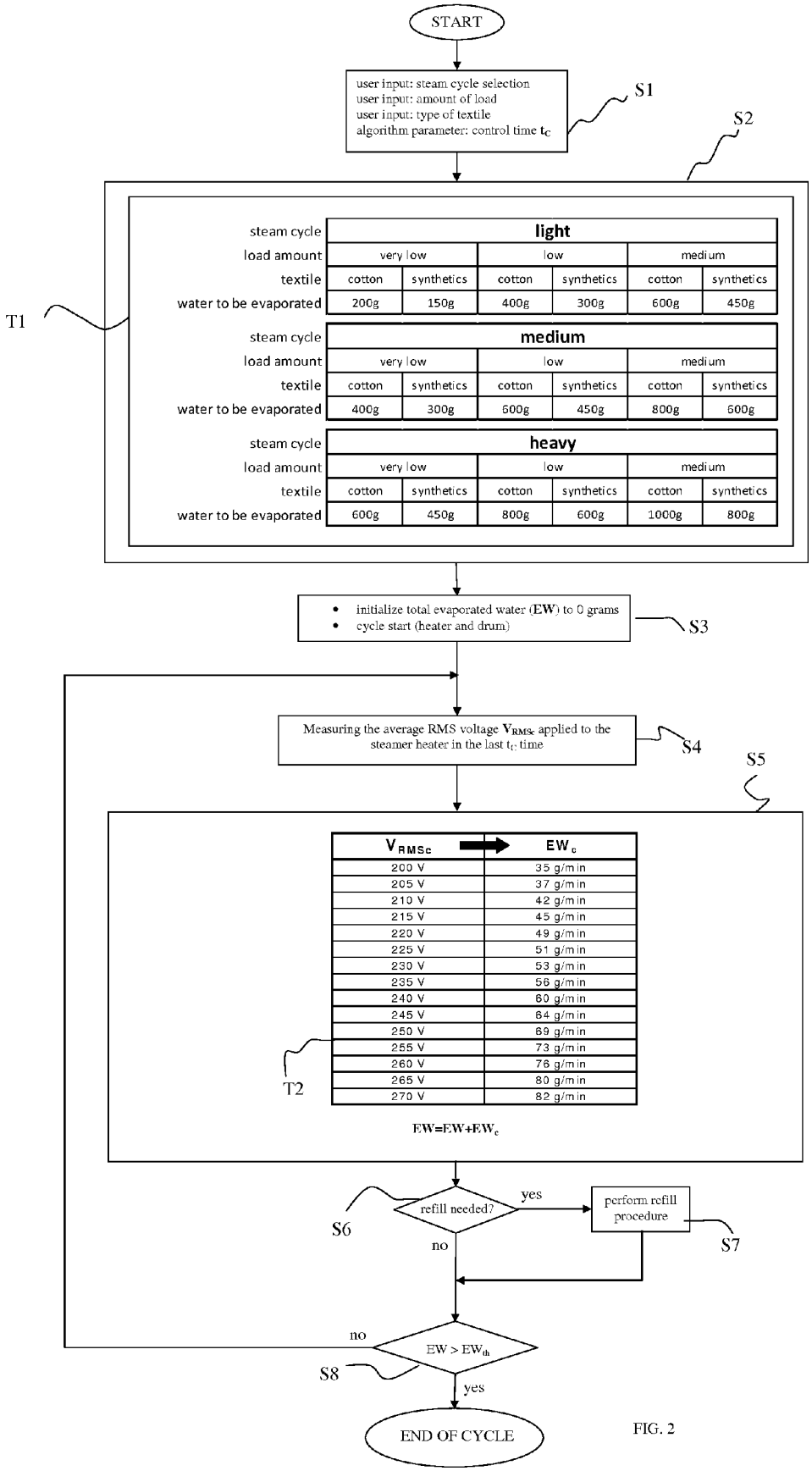

START
user input: steam cycle selection
user input: amount of load
user input: type of textile
algorithm parameter: control time t_C
S1
S2
T1
steam cycle | light
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 200g | 150g | 400g | 300g | 600g | 450g
steam cycle | medium
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 400g | 300g | 600g | 450g | 800g | 600g
steam cycle | heavy
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 600g | 450g | 800g | 600g | 1000g | 800g
initialize total evaporated water (EW) to 0 grams
cycle start (heater and drum)
S3
Measuring the average RMS voltage V_{RMSc} applied to the steamer heater in the last t_C time
S4
S5
V_{RMSc} → EW_c
200 V | 35 g/min
205 V | 37 g/min
210 V | 42 g/min
215 V | 45 g/min
220 V | 49 g/min
225 V | 51 g/min
230 V | 53 g/min
235 V | 56 g/min
240 V | 60 g/min
245 V | 64 g/min
250 V | 69 g/min
255 V | 73 g/min
260 V | 76 g/min
265 V | 80 g/min
270 V | 82 g/min
T2
$EW=EW+EW_c$
S6
refill needed?
yes
no
perform refill procedure
S7
no
$EW > EW_{th}$
S8
yes
END OF CYCLE

FIG. 2

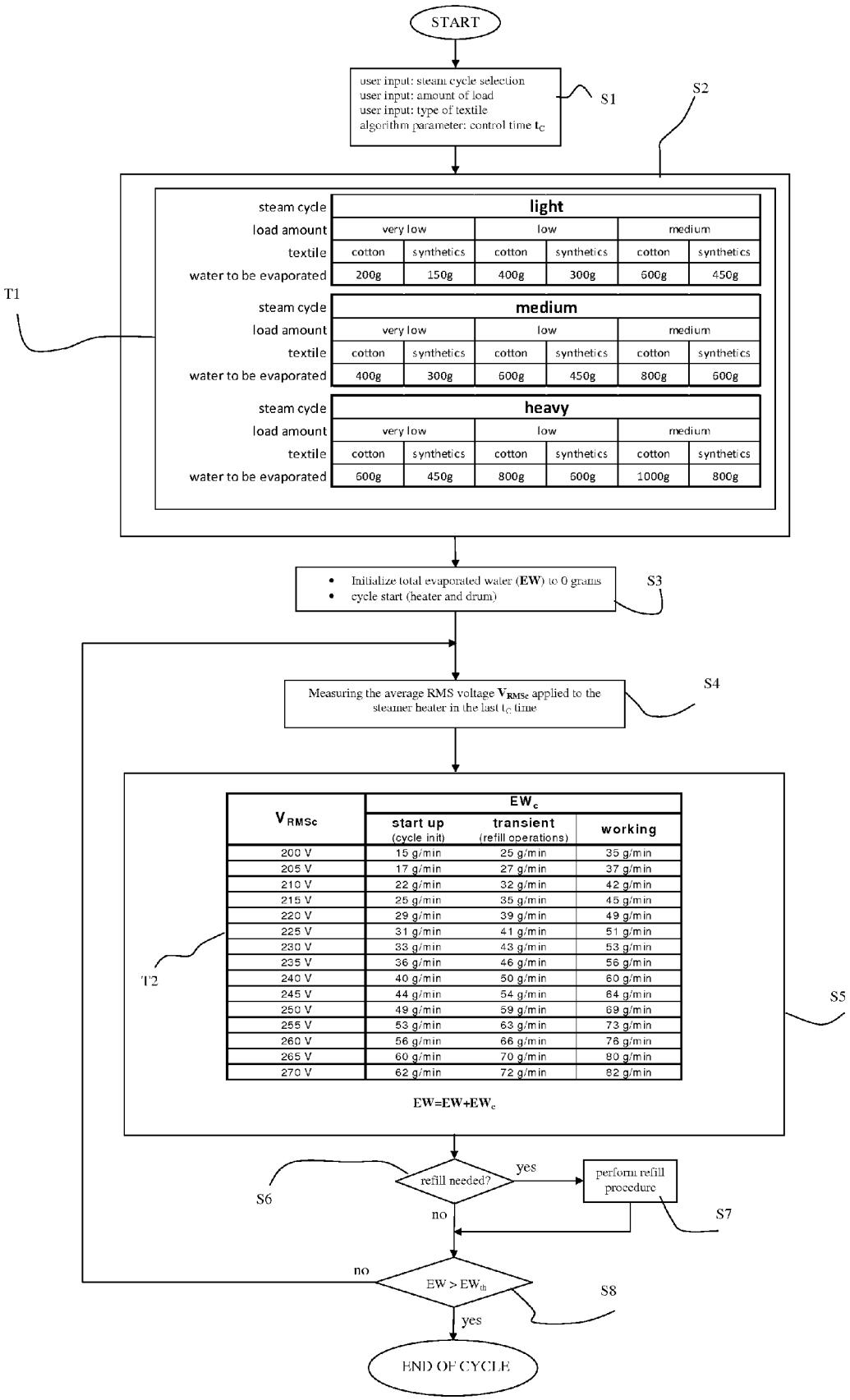
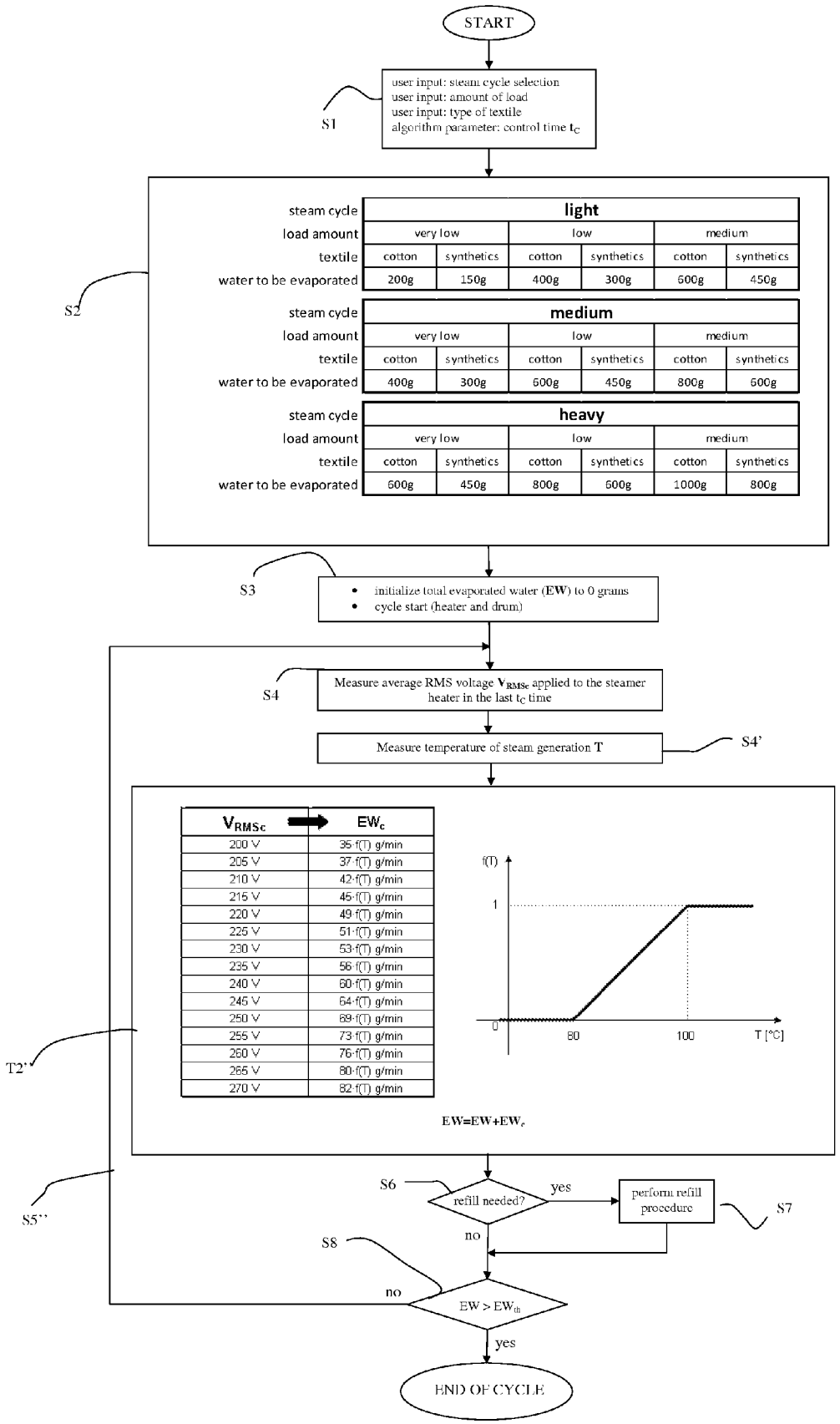

START
user input: steam cycle selection
user input: amount of load
user input: type of textile
algorithm parameter: control time t_C
S1
S2
T1
steam cycle | light
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 200g | 150g | 400g | 300g | 600g | 450g
steam cycle | medium
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 400g | 300g | 600g | 450g | 800g | 600g
steam cycle | heavy
load amount | very low | low | medium
textile | cotton | synthetics | cotton | synthetics | cotton | synthetics
water to be evaporated | 600g | 450g | 800g | 600g | 1000g | 800g
Initialize total evaporated water (EW) to 0 grams
cycle start (heater and drum)
S3
Measuring the average RMS voltage V_{RMSc} applied to the steamer heater in the last t_C time
S4
T2
V_{RMSc} | EW_c start up (cycle init) | EW_c transient (refill operations) | EW_c working
200 V | 15 g/min | 25 g/min | 35 g/min
205 V | 17 g/min | 27 g/min | 37 g/min
210 V | 22 g/min | 32 g/min | 42 g/min
215 V | 25 g/min | 35 g/min | 45 g/min
220 V | 29 g/min | 39 g/min | 49 g/min
225 V | 31 g/min | 41 g/min | 51 g/min
230 V | 33 g/min | 43 g/min | 53 g/min
235 V | 36 g/min | 46 g/min | 56 g/min
240 V | 40 g/min | 50 g/min | 60 g/min
245 V | 44 g/min | 54 g/min | 64 g/min
250 V | 49 g/min | 59 g/min | 69 g/min
255 V | 53 g/min | 63 g/min | 73 g/min
260 V | 56 g/min | 66 g/min | 76 g/min
265 V | 60 g/min | 70 g/min | 80 g/min
270 V | 62 g/min | 72 g/min | 82 g/min
$EW=EW+EW_c$
S5
refill needed?
yes
perform refill procedure
S6
S7
no
$EW > EW_{th}$
no
yes
S8
END OF CYCLE

FIG. 3



steam cycle	light					
load amount	very low		low		medium	
textile	cotton	synthetics	cotton	synthetics	cotton	synthetics
water to be evaporated	200g	150g	400g	300g	600g	450g

steam cycle	medium					
load amount	very low		low		medium	
textile	cotton	synthetics	cotton	synthetics	cotton	synthetics
water to be evaporated	400g	300g	600g	450g	800g	600g

steam cycle	heavy					
load amount	very low		low		medium	
textile	cotton	synthetics	cotton	synthetics	cotton	synthetics
water to be evaporated	600g	450g	800g	600g	1000g	800g

V_{RMSc}	EW_c
200 V	35·f(T) g/min
205 V	37·f(T) g/min
210 V	42·f(T) g/min
215 V	45·f(T) g/min
220 V	49·f(T) g/min
225 V	51·f(T) g/min
230 V	53·f(T) g/min
235 V	56·f(T) g/min
240 V	60·f(T) g/min
245 V	64·f(T) g/min
250 V	69·f(T) g/min
255 V	73·f(T) g/min
260 V	76·f(T) g/min
265 V	80·f(T) g/min
270 V	82·f(T) g/min

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 5750

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 507 031 A1 (LG ELECTRONICS INC [KR]) 16 February 2005 (2005-02-16) * paragraphs [0012], [0027]; figures 2, 4 *	1-14	INV. D06F39/00
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D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 October 2011	Westermayer, Wilhelm

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