(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 503 048 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.09.2012 Bulletin 2012/39

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

(21) Application number: **11159617.7**

(22) Date of filing: **24.03.2011**

(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

(71) Applicant: **Electrolux Home Products Corporation N.V.**
1130 Brussel (BE)

(72) Inventors:
- **Bondi, Martino**
  33080 Porcia (PN) (IT)
- **Gasparini, Mirko**
  33080 Porcia (PN) (IT)

(74) Representative: **Nardoni, Andrea et al**
Electrolux Italia S.p.A.
Corso Lino Zanussi, 30
33080 Porcia (PN) (IT)

(54) Method for washing laundry in a laundry washing machine and laundry washing machine

(57) The present invention relates to a method for washing laundry in a laundry washing machine comprising a washing tub external to a rotatable washing drum suited to receive laundry; the method comprises a washing phase in which laundry (30) loaded into the washing drum (4) is washed with water and detergent; a rinsing phase in which the laundry (30) is rinsed by clean water; and a spinning phase in which the washing drum (4) is rotated in such a way to extract water from the loaded laundry (30). The method comprises, between the rinsing phase and the spinning phase, a heating phase in which the laundry (30) is heated.

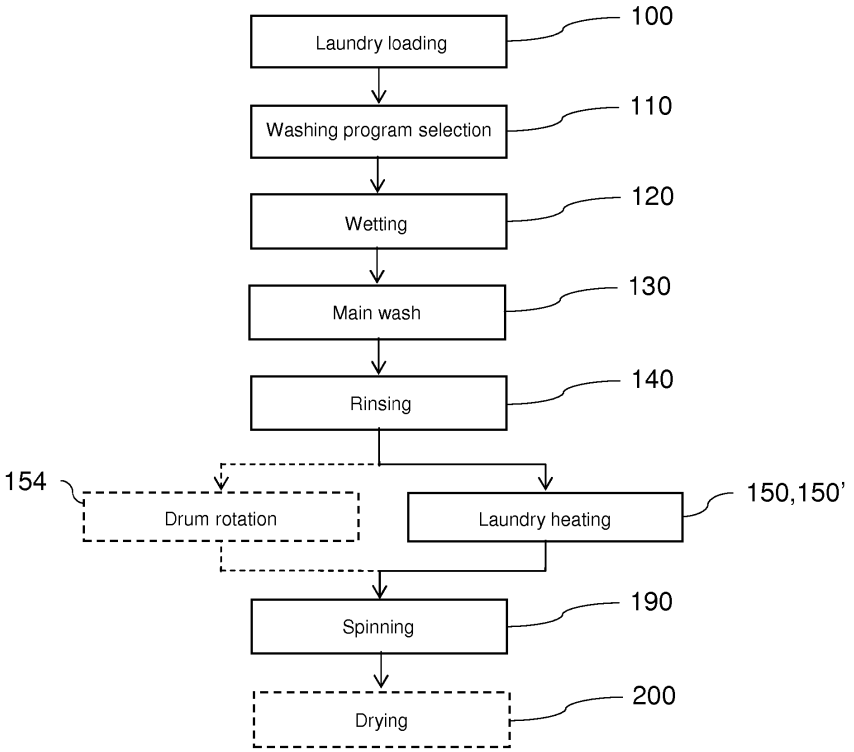

FIG. 3

EP 2 503 048 A1

Description

[0001] The present invention concerns the field of laundry washing techniques.

[0002] In particular, the present invention refers to a method for washing laundry in a laundry washing machine, and a laundry washing machine implementing the method.

BACKGROUND ART

[0003] Nowadays the use of laundry washing machines, both "simple" laundry washing machines (i.e. laundry washing machines which can only wash and rinse laundry) and laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry), is widespread.

[0004] In the present description the term "laundry washing machine" will refer to both simple laundry washing machines and laundry washing-drying machines.

[0005] Laundry washing machines generally comprise an external casing provided with a washing tub which contains a rotatable perforated drum where the laundry is placed.

[0006] A loading/unloading door ensures access to the tub and the drum.

[0007] Laundry washing machines typically comprise a detergent supply unit and a water inlet circuit for the introduction of water and washing/rinsing products (i.e. detergent, softener, etc.) into the tub.

[0008] Known laundry washing machines are also provided with water draining devices to drain the water from the tub.

[0009] According to the known technique, a complete washing cycle typically includes different phases during which the laundry to be washed is subjected to adequate treatments.

[0010] A washing cycle usually comprises a laundry wetting phase with addition of a washing detergent, and a main washing phase during which, according to the washing program selected by the user, the water contained in the tub is heated to a predetermined temperature and the drum is rotated, so as to apply a mechanical cleaning action to the laundry.

[0011] After the main wash phase the water contained in the drum is drained from the tub.

[0012] A successive step of the cycle comprises a rinsing phase which usually comprises one or more rinsing cycles. In each rinsing cycle, clean rinse water is added to the laundry, the drum is rotated, and the water is then drained from the tub to the outside of the washing machine.

[0013] After the rinsing phase a final spinning phase allows the extraction of the residual water contained in the wet laundry.

[0014] In the spinning phase the drum is rotated, typically at a high rotation speed, for example about 1300-1500 rpm, to obtain the extraction of the water from the laundry.

[0015] The water extracted during the spinning phase is drained towards the outside by means of the water draining devices.

[0016] However, the washing cycle of the known art pose some drawbacks.

[0017] A first drawback posed by this known technique is the fact that during the spinning phase the laundry is pushed against the internal surface of the drum by the centrifugal force acting on it, and therefore the fibres constituting the textiles of the laundry are made very compacted, and consequently much water remains trapped in the laundry, which remains quite wet also after the spinning phase.

[0018] A further drawback is represented by the fact that at the end of the spinning phase, when the drum stops, the laundry remains attached to the inner surface of the drum causing difficulty for the user to take out the laundry.

[0019] The object of the present invention is therefore to overcome the drawbacks posed by the known technique.

[0020] It is a first object of the invention to implement a washing method for washing laundry in a washing laundry machine that makes it possible to obtain, at the end of the spinning phase, a laundry which is more dry than with the prior art methods.

[0021] It is a further object of the invention to implement a washing method that makes it possible to obtain a more easy detachment of the laundry at the end of the washing cycle.

DISCLOSURE OF INVENTION

[0022] The present invention therefore relates, in a first aspect thereof, to a method for washing laundry in a laundry washing machine comprising a washing tub external to a rotatable washing drum suited to receive laundry, the method comprising:

- a washing phase in which laundry loaded into the washing drum is washed with water and detergent;
- a rinsing phase in which the laundry is rinsed by clean water; and
- a spinning phase in which the washing drum is rotated in such a way to extract water from the loaded laundry. The method comprises, between the rinsing phase and the spinning phase, a heating phase in which the laundry is heated.

[0023] Preferably the heating phase comprises directly heating the loaded laundry. Advantageously the heating phase comprises heating the loaded laundry with hot air. Preferably the heating phase comprises heating the loaded laundry with infrared rays.

[0024] In a further embodiment the heating phase comprises heating the water that wets the loaded laundry.

[0025] In a further embodiment the heating phase com-

prises heating the loaded laundry with steam.

[0026] In a further embodiment thereof the heating phase comprises heating water in the washing tub.

[0027] Advantageously the step of heating water in the washing tub comprises heating the water remaining in the tub after the rinsing phase.

[0028] Preferably the method comprises the step of adding a quantity of water into the washing tub between the rinsing phase and the heating phase. Preferably the heating phase comprises heating the added quantity of water.

[0029] In a further embodiment the method comprises re-circulating the water in the washing tub during the heating phase.

[0030] Advantageously the heating phase comprises increasing the temperature of the loaded laundry up to a predetermined temperature. Preferably the predetermined temperature is set according to the type of the loaded laundry and/or to the quantity of the loaded laundry.

[0031] In a further embodiment the duration of the heating phase is prefixed and corresponds to a predetermined heating time. Preferably the predetermined heating time is selectable by the user.

[0032] In an advantageous embodiment the predetermined heating time depends on the type of the loaded laundry and/or on the quantity of the loaded laundry Advantageously, the heating phase of the loaded laundry comprises the activation of a heating device.

[0033] Preferably, the heating device belongs to the group comprising: electric resistance, air heater, steam source, microwaves source, infra-red rays, and combinations thereof.

[0034] In a second aspect thereof, the present invention concerns a laundry washing machine suited to implement the method of the invention described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of some of its preferred embodiments, provided with reference to the enclosed drawings. In said drawings:

- Figure 1 shows a front view of a laundry washing machine implementing the method according to the invention;
- Figure 2 shows a side view of the laundry washing machine shown in Figure 1;
- Figure 3 is a simplified flow chart of the basic operations of a method for washing laundry in the washing machine of Figure 1 according to a first embodiment of the invention;
- Figure 4 shows in detail an operation of the flow chart of Figure 3;
- Figure 5 shows a further embodiment of Figure 4;
- Figure 6 shows a construction variant of the laundry washing machine of Figure 1;
- Figure 7 is a simplified flow chart of the basic operations of a method for washing laundry in the washing machine of Figure 6;
- Figure 8 shows a further embodiment of Figure 7;
- Figure 9 shows another construction variant of the laundry washing machine of Figure 1;
- Figure 10 is a simplified flow chart of the basic operations of a method for washing laundry in the washing machine of Figure 9;
- Figure 11 shows a further embodiment of Figure 10.

DETAILED DESCRIPTION OF THE INVENTION

[0036] With reference to Figure 1 and Figure 2, a laundry washing machine 1 is illustrated, in which a method according to a first embodiment of the invention is advantageously implemented.

[0037] The laundry washing machine 1 comprises an external casing or housing 2 in which a washing tub 3 is provided, containing a rotatable perforated drum 4 where the laundry 30 to be washed can be loaded.

[0038] The tub 3 and the drum 4 both have preferably a substantially cylindrical shape.

[0039] A hollow space 12 is defined between the tub 3 and the drum 4.

[0040] The housing 2 is provided with a loading/unloading door 8 which allows access to the washing tub 3 and the drum 4.

[0041] The tub 3 is preferably suspended in a floating manner inside the housing 2, advantageously by means of a number of coil springs and shock-absorbers that are not illustrated in the enclosed Figures.

[0042] The tub 3 is preferably connected to the casing 2 by means of an elastic bellows 7, or gasket.

[0043] The drum 4 is advantageously rotated by an electric motor 11 which preferably transmits the rotating motion to the shaft 14 of the drum 4, advantageously by means of a belt/pulley system 13. In a different embodiment of the invention, the motor 11 can be directly associated with the shaft 14 of the drum 4.

[0044] A water inlet circuit 5 is arranged preferably in the upper part of the laundry washing machine 1 and is suited to supply water and washing/rinsing products (i.e. detergent, softener, etc.) into the tub 3.

[0045] The water inlet circuit 5 preferably comprises a removable drawer 6 provided with various compartments suited to be filled with washing and/or rinsing products.

[0046] The water inlet circuit of a laundry washing machine is well known in the art, and therefore will not be described in detail.

[0047] In the embodiment herein described, the water is supplied into the tub 3 by making it flow through the drawer 6.

[0048] In a preferred embodiment, the water which reaches the tub 3 can selectively contain one of the products contained in the compartments of the drawer 6, or such water can be clean and in this case it may reach

the tub 3 directly, bypassing the compartments of the drawer 6.

[0049] In an alternative embodiment of the invention, a further separate water supply pipe can be provided, which supplies exclusively clean water into the tub 3.

[0050] The water inlet circuit 5 also preferably comprises a water flow sensor, for example a flow meter, which makes it possible to calculate the quantity of water supplied into the tub 3.

[0051] Laundry washing machine 1 advantageously comprises a water outlet circuit 15.

[0052] The water outlet circuit 15 advantageously comprises a drain pump 16, a first pipe 17 connecting the tub 3 to the drain pump 16 and an outlet pipe 18 ending outside the housing 2. The water outlet circuit 15 is suited to drain the liquid, i.e. dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside.

[0053] The water outlet circuit 15 preferably comprises a filtering device, not shown in the figures, placed between the bottom of the tub 3 and the drain pump 16 and adapted to retain all the undesirable bodies (for example buttons that have come off the laundry, coins erroneously introduced into the laundry washing machine, etc.) that have passed through the holes located on the surface of the drum 4, or fallen onto the bottom of the tub 3 while passing between the drum 4 and the tub 3, which could damage or obstruct the drain pump 16.

[0054] This filtering device can preferably be removed, and then for example cleaned, e.g. through a gate placed advantageously on the front or back wall of the housing 2 of the laundry washing machine 1, not shown herein; in a further embodiment, not illustrated, the filtering device can be accessed for example by the internal of the drum 4, for example by a suitable opening obtained therein and selectively closed by a suitable cover, or by a removable lifter of the drum 4.

[0055] Advantageously, laundry washing machine 1 comprises a device 19 suited to sense (or detect) the water level inside the tub 3.

[0056] The device 19 preferably comprises a pressure sensor which senses the pressure in the tub 3. In another embodiment the device 19 comprises a level sensor (for example mechanical, electro-mechanical, optical, etc.) adapted to sense (or detect) the water level inside the tub 3.

[0057] Advantageously, the laundry washing machine 1 comprises a heating device 20 adapted to heat the laundry 30 and/or the water inside the laundry 30 and/or the free water inside the tub 3. The heating device 20 preferably comprises a microwaves source. In further embodiments the heating device 20 could comprise, for example, a steam source, an air heater, an electrical heater, etc.

[0058] Advantageously, the laundry washing machine 1 comprises a temperature sensor, not illustrated in the figures, for sensing the temperature T.

[0059] In a preferred embodiment the temperature sensor senses the temperature of the water present in the tub 3. In a further embodiment, the temperature sensor could sense the air temperature inside the tub 3. The sensed temperature T gives also an indication of the temperature Tr of the laundry 30. For example, it is possible to estimate the temperature Tr of the laundry 30 from the sensed temperature T by knowing the weight of the laundry 30. The weight of the laundry 30 can be advantageously calculated in know manner, for example through the current absorbed by the motor 11, or by a weight sensor, or derived directly from the parameters inputted by the user.

[0060] Laundry washing machine 1 advantageously comprises a control unit 22 connected to the various parts of the laundry washing machine 1 in order to ensure its operations. The control unit 22 is preferably, but not necessarily, connected to the water inlet circuit 5, the water outlet circuit 15, the heating device 20 and the electric motor 11 and receives information from the various sensors provided on the laundry washing machine 1, like for example the flow meter of the water inlet circuit 5, the pressure sensor 19 (or the level sensor) on the bottom of the tub 3, the temperature sensor, etc.

[0061] Laundry washing machine 1 advantageously comprises an interface unit, not visible in the enclosed Figures, connected to control unit 22, accessible to the user and by means of which the user may select and set the washing parameters, such as, for example, a desired washing program. Preferably, other parameters can optionally be inserted by the user, for example the washing temperature, the spinning speed, the load in terms of weight of the laundry to be washed, etc.

[0062] Based on the parameters acquired by said interface unit, the control unit 22 sets and controls the various parts of the laundry washing machine 1 in order to carry out the desired washing program.

[0063] A first embodiment of the washing method according to the invention is described here below with reference to the washing machine 1 shown in Figures 1 and 2 and with reference to the operation flow chart of Figure 3.

[0064] The laundry 30 to be washed is first placed inside the drum 4 (step 100). By operating on the interface unit the user selects the desired washing program (step 110) depending for example on the type and on the dirty-level of the products to wash. Furthermore, as said before, in a preferred embodiment it is possible for the user to insert some parameters directly by the interface unit, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of washing cycle, etc.

[0065] Once the user has selected the desired washing program, the control unit 22 sets the laundry washing machine 1 so that it starts the washing cycle.

[0066] In a further embodiment, above described step 110 may be performed before step 100, i.e. before placing the laundry 30 into the drum 4.

[0067] In a first phase (step 120), also called wetting

phase, a quantity of clean water is introduced into the tub 3 for wetting, preferably completely, the laundry 30. A prefixed quantity Qd of detergent is preferably also added at this stage.

[0068] The introduction of clean water preferably takes place through the water inlet circuit 5 that will provide for feeding clean water into the tub 3.

[0069] The quantity of detergent Qd is preferably taken from the drawer 6 and is advantageously, but not necessarily, determined by the control unit 22.

[0070] The quantity of detergent Qd is preferably based on the washing program selected by the user, and advantageously depends on the quantity of loaded laundry 30 (i.e. weight) and, preferably, also on the type (e.g. cotton, wool, silk, etc.) of loaded laundry 30. Preferably, during the wetting phase the clean water is also heated through the activation of the heating device 20.

[0071] Once the wetting phase has been completed, a main wash is started (step 130).

[0072] The main wash can be a typical wash cycle of known washing machines. It advantageously comprises successive rotations of the drum 4, preferably in clockwise and/or anticlockwise direction, advantageously at a pre-determined rotational speed. The main wash cycle is advantageously achieved by heating the water that washes the laundry 30 and keeping the temperature of the water to a desired and prefixed value or inside a prefixed temperature range. The water temperature during the main wash preferably depends on the washing program set by the user, or it may advantageously be a prefixed temperature set directly by user through the interface unit.

[0073] In a preferred embodiment the heating of the water is obtained by activating the heating device 20. At the same time, the water temperature T is preferably controlled by the control unit 22 through the value sensed by the temperature sensor.

[0074] Once the main wash cycle has been completed, a rinsing phase is performed (step 140). The rinsing phase, as well known in the art, comprises the removal from the laundry 30 of the dirty water produced during the main wash cycle.

[0075] This dirty water usually also comprises the detergent added in the wetting phase and used to wash the laundry 30.

[0076] The rinsing phase advantageously starts by draining the free dirty water from the tub 3, for example by activating the drain pump 16 and, optionally, by contemporaneously rotating the drum 4 so as to extract dirty water from the laundry 30 by the centrifugal force; the rinsing phase continues by introducing clean water inside the tub 3, which penetrates into the laundry 30; preferably during this phase the drum 4 is rotated at a low speed (e.g. at [40-60] rpm), so as to enhance the absorption of clean water by the laundry. The drum 4 is then rotated at a higher speed (e.g. [600-1000] rpm), so as to extract the water and the possible residual detergent contained in the laundry 30 by means of the centrifugal force which allows the ejection of the water outwardly through the holes of the drum 4.

[0077] The water expelled outside the drum 4 falls down on the bottom of the tub 3 and is removed from the tub 3; the removal operation preferably includes the drainage of the water from the tub 3 towards the outside of the washing machine 1 by means of the drain pump 16 that takes the water from the bottom of the tub 3 and conveys it towards the outside through the outlet duct 18. The drainage of the water from the tub 3 towards the outside of the washing machine 1 is advantageously performed contemporaneously with or after the rotation of the drum at higher speed, so as to extract the rinsing water from the laundry.

[0078] The rinsing phase may preferably comprise several consecutive cycles of the type just described, i.e. consecutive steps of introduction of clean water followed by rotations of the drum 4 and drainage of the water from the tub 3 to the outside.

[0079] Once the rinsing phase has been completed, the laundry 30 is substantially clean and contains residual substantially clean water. The quantity of residual water remaining inside the laundry 30 after the rinsing phase depends on the rotational speed of the drum 4 during the above mentioned rotation at a higher speed of the final rinsing cycle. According to the invention, the washing program comprises at this point a heating phase of the laundry 30 (step 150).

[0080] After the rinsing phase, in fact, the residual water inside the laundry 30 is substantially cold, typically a temperature value around 20° C.

[0081] The heating of laundry 30 is advantageously carried out by the activation of the heating device 20.

[0082] In a preferred embodiment, the laundry 30 may be heated directly, for example by a source of hot air, or of infrared rays (in this case the heating device advantageously comprises said source of hot air, or of infrared rays). In a further preferred embodiment the laundry 30 is heated by heating the water that wets the laundry 30, for example by a microwave generator, preferably comprised in the heating device 20.

[0083] In both the above mentioned cases, the activation of the heating device 20 raises the temperature of the laundry 30 to a heating temperature Tr.

[0084] In a first embodiment of the invention, shown in detail in Figure 4, the heating phase (step 150) takes place for a predetermined heating time t_{rp}, i.e. a time control is provided for the heating phase.

[0085] In this case, in the first step of the heating phase, the heating device 20 is activated (step 160).

[0086] If the heating time t_r (i.e. the time lapsed from the beginning of the heating phase) is less than the predetermined heating time t_{rp} (output "Yes" of step 170), the heating device 20 is kept activated.

[0087] When the heating time t_r reaches the predetermined heating time t_{rp} (output "No" of step 170), the heating device 20 is turned off (step 180) and the heating phase ends.

[0088] The predetermined heating time t_{rp} is advantageously set according to the type of loaded laundry and/or the quantity of loaded laundry. For example for cotton laundry, the heating time t_{rp} may be comprised between 10 and 15 minutes.

[0089] Hence the washing program continues with a spinning phase (step 190). According to the known techniques, the spinning phase preferably comprises one or more high-speed rotation cycles of the drum 4 to remove from the laundry 30 as much water as possible. Expression "high-speed" has to be interpreted as a speed which allows removing a suitable quantity of water from the laundry by the centrifugal force; suitable values of speed are for example from 800 rpm to 1600 rpm.

[0090] During this phase, as known, the water from the laundry 30 is ejected by the centrifugal force outwardly through the holes of the drum 4.

[0091] The water expelled outside the drum 4 falls down on the bottom of the tub 3 and is removed from the tub 3 (after or contemporaneously with the spinning phase) by means of the drain pump 16 that takes the water from the bottom of the tub 3 and conveys it towards the outside through the outlet duct 18.

[0092] During the spinning phase, the laundry 30 is subjected to a high centrifugal force and therefore it is pressed peripherally against the inner surface 4a of the drum 4.

[0093] Once the spinning phase (step 190) terminates, the washing program is completed.

[0094] At this point, the user takes the laundry 30 out to proceed with the subsequent drying and/or ironing.

[0095] In case the washing program is performed in a laundry washing-drying machine, after the spinning phase (step 190) the laundry 30 may be advantageously subjected to a drying phase inside the drum 4 (step 200).

[0096] According to the invention, the heating phase of the laundry 30 (step 150) after the rinsing phase (step 140) and before the spinning phase (step 190) in the washing program described above, acts advantageously on the fibers of laundry 30.

[0097] The heating of laundry 30 determines the stretching or spreading of the fibers of the fabric from which the laundry 30 is constituted.

[0098] This stretching action reduces the negative effect on the laundry 30 due to the centrifugal force during the spinning phase when the laundry 30 is pressed against the inner surface 4a of the drum 4.

[0099] Thanks to the heating phase of the laundry 30, the fibres constituting the textiles of the laundry are stretched or spread, i.e. they are made less compacted, and consequently water can easily be extracted from the textile by the centrifugal force during the spinning phase.

[0100] Moreover, thanks to the heating phase of the laundry 30, the surface tension of the water contained in the laundry 30 is reduced, which favours the extraction of the water from the laundry 30 during the spinning phase.

[0101] Still advantageously, the laundry 30 washed with the washing method of the invention and therefore subjected to the heating phase after the rinsing phase and before the spinning phase, is softer to the touch than laundry 30 washed with the washing program of the prior art.

[0102] A further advantage deriving from the stretching action on the fibers during the heating phase is that at the end of spinning phase the laundry 30 is easily detached from the inside surface 4a of the drum 4. This facilitates the extraction of laundry 30 from the drum 4 for the user.

[0103] With reference to the flow chart of Figure 5 another embodiment of the heating phase of the method of the invention (step 150') is illustrated.

[0104] This embodiment differs from the one previously described with reference to Figure 4 for the fact that the activation of the heating device 20 depends not only on the control of a time interval (step 170) but also on the control of the temperature Tr of the laundry 30.

[0105] As mentioned above, the temperature Tr of the laundry 30 can be preferably estimate from the sensed temperature T. The sensed temperature T may be, for example, the temperature of the water present in the tub 3 or the air temperature inside the tub 3. Clearly any other technique or method may be used to determine or estimate the temperature Tr of the laundry 30.

[0106] In the example of Figure 5, after the rinsing phase (step 140), a first check of the laundry temperature Tr is performed (step 151). If the laundry temperature Tr is below a predetermined minimum temperature Tmin (output "Yes" of step 151) the heating device 20 is activated (step 160).

[0107] It follows a second check of the laundry temperature Tr (step 152). If the laundry temperature Tr is higher than a predetermined maximum temperature Tmax (output "Yes" of step 152), the heating device 20 is deactivated (step 153).

[0108] The control of the heating time t_r is then performed (step 170) in the same way as described with reference to Figure 4.

[0109] If the heating time t_r is less than the predetermined heating time t_{rp} (output "Yes" of step 170), the washing program goes back to the temperature control by checking the minimum temperature Tmin (step 151) and the maximum temperature Tmax (step 152). When the heating time t_r reaches the predetermined heating time t_{rp} (output "No" of step 170), the heating device 20 is turned off (step 180) and the heating phase (step 150') ends. Hence the washing program continues with a spinning phase (step 190) and, in case of a laundry washing-drying machine, it may also comprise a drying phase (step 200).

[0110] During the heating phase, therefore, the laundry temperature Tr is kept in a temperature range between the minimum temperature Tmin and the maximum temperature Tmax for a predetermined time interval t_{rp}.

[0111] The minimum temperature Tmin is preferably comprised between 20°C and 30°C, and the maximum

temperature Tmax is preferably comprised between 45°C and to 55 °C.. In a further preferred embodiment, the minimum temperature Tmin and the maximum temperature Tmax are preferably chosen very close to each other so that the temperature Tr of the laundry 30 during the heating phase is kept substantially constant.

[0112] In this case, the minimum temperature Tmin and the maximum temperature Tmax are both preferably chosen equal to 55° C.

[0113] The predetermined temperature Tr is advantageously set according to the type of the loaded laundry and/or the quantity of loaded laundry.

[0114] The predetermined time interval t_{rp} is advantageously comprised between 10 and 15 minutes for cotton laundry.

[0115] During the heating phase (step 150 or 150'), one or more rotation cycles of the drum 4 are preferably performed (step 154).

[0116] In a preferred embodiment, a continuous rotation is performed, preferably at a low rotation speed, for example comprised between around 1 and 2 rpm; this range of rotation speeds is particularly advantageous, because it allows moving the laundry in such a way to obtain an effective heating of the latter, without increasing the energy consumption of the machine due to the rotation of the drum, and, in the case in which a certain quantity of water remains in the bottom of the tub, without causing an excessive absorption of the water by the laundry.

[0117] In further embodiments, successive rotation cycles are performed at prefixed time interval, preferably at low speed (for example around [1—2] rpm, with the same advantages mentioned above).

[0118] In another advantageous embodiment, during the heating phase (150 or 150') the drum 4 is rotated by applying, about every minute, a rotation speed of about [30-60] rpm for about one second; in such a way the drum performs about one or two rotations every minute.

[0119] In any of the above described cases, however, the low rotation of the drum 4 during the heating phase (150 or 150') causes the laundry 30 to be gently moved up-side down so that a more uniform heating of the laundry 30 is obtained.

[0120] A construction variant of the washing machine 300 implementing the method of the invention is shown on Figure 6.

[0121] This embodiment differs from the washing machine 1 shown in Figures 1 and 2 for the fact that the heating device comprises an electrical resistor 320 placed on the bottom of the tub 3.

[0122] Figure 7 shows the flow chart of the washing program of the invention performed in the washing machine 300 of Figure 6.

[0123] The initial phases of the washing program from the loading of the laundry (step 100) to the rinsing phase (step 140) are the same as described above.

[0124] After the rinsing phase (step 140) a first prefixed quantity of clean water Qw (step 153) is introduced in the tub 3. The prefixed quantity Qw of clean water is preferably set to reach a first level L1 in the tub 3. At this level L1 the water substantially covers the resistor 320 and wets the lower portion of the laundry 30. The introduction of clean water takes place advantageously through the water inlet circuit 5. The amount of water Qw introduced in this phase may be of a small entity, such for example comprised between 1.8 liters and 2.2 liters in a 7 Kg load washing machine. The amount of water Qw depend on the specific shape of the washing tub 3 and on the position of the electrical resistor 320 in the tub 3; the amount of water Qw is advantageously not lower than the minimum amount of water necessary to completely cover the electrical resistor 320, so as to avoid the overheating of the latter.

[0125] The successive step comprises a heating phase (step 150 or 150') performed by the activation of the electrical resistor 320, so that the clean water Qw which covers the electrical resistor 320 is advantageously heated.

[0126] The heating phase preferably may be of the type described above, either with a time control (step 150) or with a time and temperature control (step 150').

[0127] The heated water Qw at level L1 advantageously heats the laundry 30 which is partially immersed therein.

[0128] The heated water may also advantageously leads to the creation of steam that increases efficiency in heating the laundry 30.

[0129] In a further embodiment, in order to increase uniform heating of the laundry 30, one or more rotation cycles of the drum 4 during the heating phase (step 150 or 150') are preferably performed (step 154).

[0130] In this way, in the same way as described above with reference to Figure 3, the laundry 30 is gently moved up-side down so that the hated water wets and heats uniformly the laundry 30.

[0131] Once the heating phase (step 150 or 150') has been completed, the washing program continues with a spinning phase (step 190) and, in case of a laundry washing-drying machine, it may also comprise a further drying phase (step 200).

[0132] In the embodiment just described, the water level L1 is sufficient to cover the electrical resistor 320 and also to keep the lower portion of the laundry 30 wetted.

[0133] In a further embodiment, the prefixed quantity of water Qw' introduced in the tub 3 is preferably set to reach a second level L2 in the tub 3, indicated by a dashed line in Figure 6. At this level L2 the water substantially covers the resistor 320 while it does not wet the laundry 30. The amount of water Qw' introduced in this phase may be further reduced, such for example 1.5 liters in a 7 Kg load washing machine; however the amount of water Qw' must be not lower than the minimum amount of water necessary to completely cover the electrical resistor 320, so as to avoid the overheating of the latter.

[0134] In the successive heating phase (step 150 or 150') the heated water Qw' leads to the creation of steam

which in turn heats the laundry 30.

[0135] In order to increase uniform heating of the laundry 30, rotation cycles of the drum 4 are again preferably performed (step 154) during the heating phase (step 150 or 150'). Thanks to the introduction of a smaller quantity of water Qw' the consumption of water is further reduced.

[0136] Figure 8 shows the flow chart of a further embodiment of the washing program of the invention performed in the washing machine 300 of Figure 6.

[0137] This method differs from the method described with reference to Figure 7 for the fact that the introduction of clean water after the rinsing phase and before the heating phase (step 150 or 150') is advantageously avoided (i.e. it is not performed).

[0138] In this case, the water subjected to heating in the heating phase is the residual water left on the bottom of the tub 3 at the end of the rinsing phase. Clearly, the rinsing phase (step 140') in this case terminates without, or with an only partial, drainage of the water outside, as instead usually occurs.

[0139] This embodiment is preferably implemented when the rinsing phase provides for successive rinsing cycles. In this case, successive drainages of water take place after introduction of clean water and drum rotation, except in the last cycle in which the water drainage is omitted (or performed only partially) and the residual water is kept on the bottom of the tub 3. Because of the multiple drainage operations with expulsion of water, the residual water in the last cycle may be considered substantially clean and advantageously heated in the heating phase (step 150 or 150').

[0140] Therefore in the embodiment of Figure 8, as said before, the step of adding water after the rinsing phase and before the heating phase is advantageously omitted and the overall consumption of water for washing the laundry 30 is further reduced.

[0141] Figure 9 shows a construction variant washing machine 400 implementing the method of the invention.

[0142] This washing machine 400 differs from the washing machine 300 shown in Figure 6 for the fact that the water outlet circuit 415 is advantageously provided with a recirculation circuit 416 adapted to drain liquid from a bottom region of the tub 3 and to re-admit such a liquid into a higher region of the tub 3.

[0143] The water outlet circuit 415 advantageously comprises a drain pump 16, a first pipe 17 connecting the tub 3 to the drain pump 16, an outlet pipe 18 ending outside the housing 2 and a recirculation pipe 61 with a terminal nozzle 61a. The recirculation pipe 61 advantageously ends in an upper region of the tub 3. A two-way valve 65 is preferably interposed between the drain pump 16, the outlet pipe 18 and the recirculation pipe 61. The two-way valve 65 is preferably properly controlled by the control unit 22 in order to allow selective drainage towards the outside through the outlet duct 18 or towards the upper region of the tub 3 through the recirculation pipe 61.

[0144] In a further embodiment, not illustrated, the recirculation circuit comprises a dedicated recirculation pipe connecting a bottom region of the tub with and higher region of the latter, and provided with a dedicated recirculation pump; in this case the recirculation circuit is advantageously completely separated from the water outlet circuit. Recirculation circuit of a laundry washing machine is well known in the art, and therefore will not be described in more detail.

[0145] Figure 10 shows the flow chart of the washing program of the invention performed in the washing machine 400 of Figure 9.

[0146] The initial phases of the washing program from the loading of the laundry (step 100) to the rinsing phase (step 140) are the same as described above.

[0147] After the rinsing phase (step 140) a prefixed quantity of clean water Qw (step 153) is introduced in the tub 3. The prefixed quantity Qw of clean water is preferably set to reach a first level L1 in the tub 3. At this level L1 the water substantially covers the resistor 320 and wets the lower portion of the laundry 30. The introduction of clean water takes place advantageously through the water inlet circuit 5. The amount of water Qw introduced in this phase may be of a small entity, such for example comprised between 1.8 liters and 2.2 liters in a 7 Kg load washing machine. The amount of water Qw depend on the specific shape of the washing tub 3 and on the position of the electrical resistor 320 in the tub 3; the amount of water Qw is advantageously not lower than the minimum amount of water necessary to completely cover the electrical resistor 320, so as to avoid the overheating of the latter.

[0148] The successive step comprises a heating phase (step 150 or 150') by means of the activation of the electrical resistor 320. The clean water Qw which covers the electrical resistor 320 is therefore advantageously heated.

[0149] The heating phase preferably may be of the type described above, either with a time control (step 150) or with a time and temperature control (step 150').

[0150] The heated water Qw at level L1 advantageously heats the laundry 30 which is partially immersed therein.

[0151] The heated water may also advantageously leads to the creation of steam that increases efficiency in heating the laundry 30.

[0152] In a further embodiment, as already described above, the prefixed quantity of water Qw' introduced in the tub 3 is preferably set in such a way to reach a second level L2, indicated by a dashed line in Figure 9, that covers the resistor 320 but does not wet the laundry 30.

[0153] According to this embodiment, during the heating phase (step 150 or 150') a recirculation phase (step 155) advantageously occurs. The recirculation phase (step 155) preferably includes the activation of the recirculation circuit 416.

[0154] The heated water from the bottom of the tub 3 is drained towards the upper part of the tub 3 preferably by means of the drain pump 16 that takes the water from

the bottom of the tub 3 and conveys it towards the upper part of the tub 3 through the recirculation pipe 61, via the valve 65 opportunely driven by the control unit 22.

[0155] The heated water conveyed by the recirculation pipe 61 advantageously wets the laundry 30 from above. A more homogenous wetting and heating of the laundry 30 is therefore obtained.

[0156] To further facilitate the heating of the laundry 30, during the heating phase (step 150 or 150') and the recirculation phase (step 155), one or more rotation cycles of the drum 4 are preferably performed (step 154).

[0157] Once the heating phase (step 150 or 150') has been completed, the washing program continues with a spinning phase (step 190) and, in case of a laundry washing-drying machine, it may also comprise a further drying phase (step 200).

[0158] Figure 11 shows the flow chart of a further embodiment of the washing program of the invention performed in the washing machine 400 of Figure 9.

[0159] This embodiment differs from the method described with reference to Figure 10 for the fact that the introduction of clean water after the rinsing phase and before the heating phase (step 150 or 150') is advantageously avoided.

[0160] In this case, as already explained before with reference to the embodiment of Figure 8, the water subjected to heating in the heating phase is the residual water left on the bottom of the tub 3 at the end of the rinsing phase.

[0161] In this embodiment, the overall consumption of water for washing the laundry 30 is further reduced.

[0162] It has to be noted that the recirculation circuit 416 may be advantageously used for recirculation of liquid (water or water with detergent) also during the wetting and/or the main wash phase, as well know in the art.

[0163] It has thus been shown that the present invention allows all the set objects to be achieved. In particular, it makes it possible to obtain a washing cycle of a laundry washing machine that allows spreading or stretching (i.e. making less compacted) the fibres constituting the textiles of the laundry, so that water can easily be extracted from the textile by the centrifugal force during the spinning phase; this allows obtaining a drier laundry after the spinning phase.

[0164] While the present invention has been described with reference to the particular embodiments shown in the figures, it should be noted that the present invention is not limited to the specific embodiments illustrated and described herein; on the contrary, further variants of the embodiments described herein fall within the scope of the present invention, which is defined in the claims.

[0165] It is underlined that the laundry washing machines illustrated in the enclosed figures, and with reference to which some embodiments of the method according to the invention have been described, are of the front-loading type; however it is clear that the method according to the invention can be applied as well to a top-loading washing machine, substantially without any modification.

Claims

1. Method for washing laundry (30) in a laundry washing machine (1; 300; 400) comprising a washing tub (3) external to a rotatable washing drum (4) suited to receive laundry (30), the method comprising:

   - a washing phase in which laundry (30) loaded into said washing drum (4) is washed with water and detergent;
   - a rinsing phase in which said laundry (30) is rinsed by clean water; and
   - a spinning phase in which said washing drum (4) is rotated in such a way to extract water from said loaded laundry (30),

   characterized in that
   the method comprises, between said rinsing phase and said spinning phase, a heating phase in which said laundry (30) is heated.

2. Method according to claim 1, **characterized in that** said heating phase comprises directly heating said loaded laundry (30).

3. Method according to claim 1, **characterized in that** said heating phase comprises heating the water that wets said loaded laundry (30).

4. Method according to any of the preceding claims, **characterized in that** said heating phase comprises heating said loaded laundry (30) with steam.

5. Method according to any of the preceding claims, **characterized in that** said heating phase comprises heating water in said washing tub (3).

6. Method according to claim 5, **characterized in that** said step of heating water in said washing tub (3) comprises heating the water remaining in said tub after said rinsing phase.

7. Method according to any of the preceding claims, comprising the step of adding a quantity (Qw, Qw') of water into said washing tub (3) between said rinsing phase and said heating phase.

8. Method according to claim 7, **characterized in that** said heating phase comprises heating said added quantity (Qw, Qw') of water.

9. Method according to any of the preceding claims, comprising re-circulating the water in the washing tub (3) during said heating phase.

10. Method according to any of the preceding claims, **characterized in that** the heating phase comprises increasing the temperature of said loaded laundry

(30) up to a predetermined temperature (Tr).

11. Method according to claim 10, **characterized in that** said predetermined temperature (Tr) is set according to the type of said loaded laundry (30) and/or to the quantity of said loaded laundry (30).

12. Method according to any of the preceding claims, **characterized in that** the duration of said heating phase is prefixed and corresponds to a predetermined heating time (t_r).

13. Method according to claim 12, **characterized in that** said predetermined heating time (t_r) is selectable by the user.

14. Method according to claim 12, **characterized in that** said predetermined heating time (t_r) depends on the type of said loaded laundry (30) and/or on the quantity of said loaded laundry (30).

15. A laundry washing machine (1; 300; 400) suited to implement a method according to any of the preceding claims.

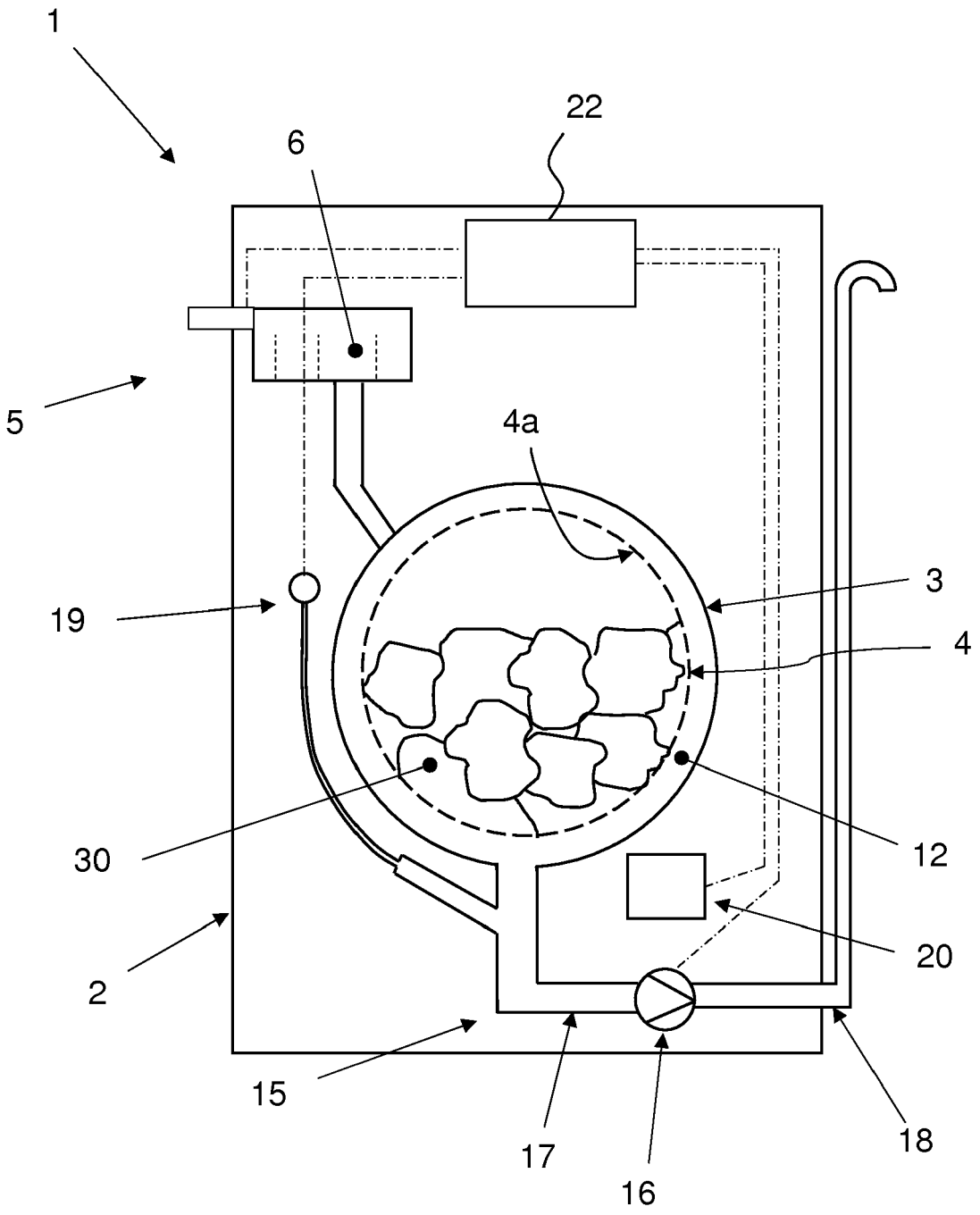

FIG. 1

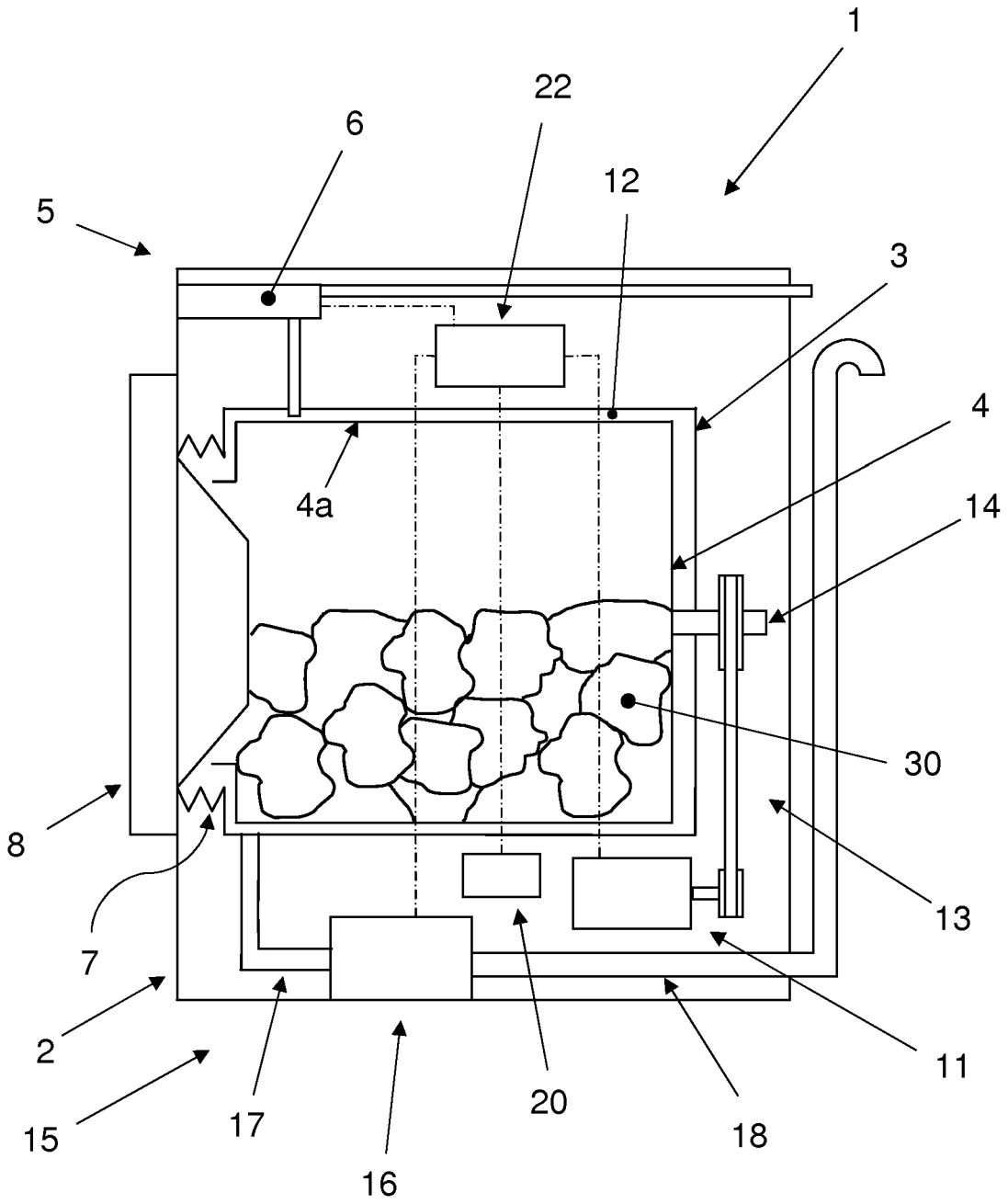

FIG. 2

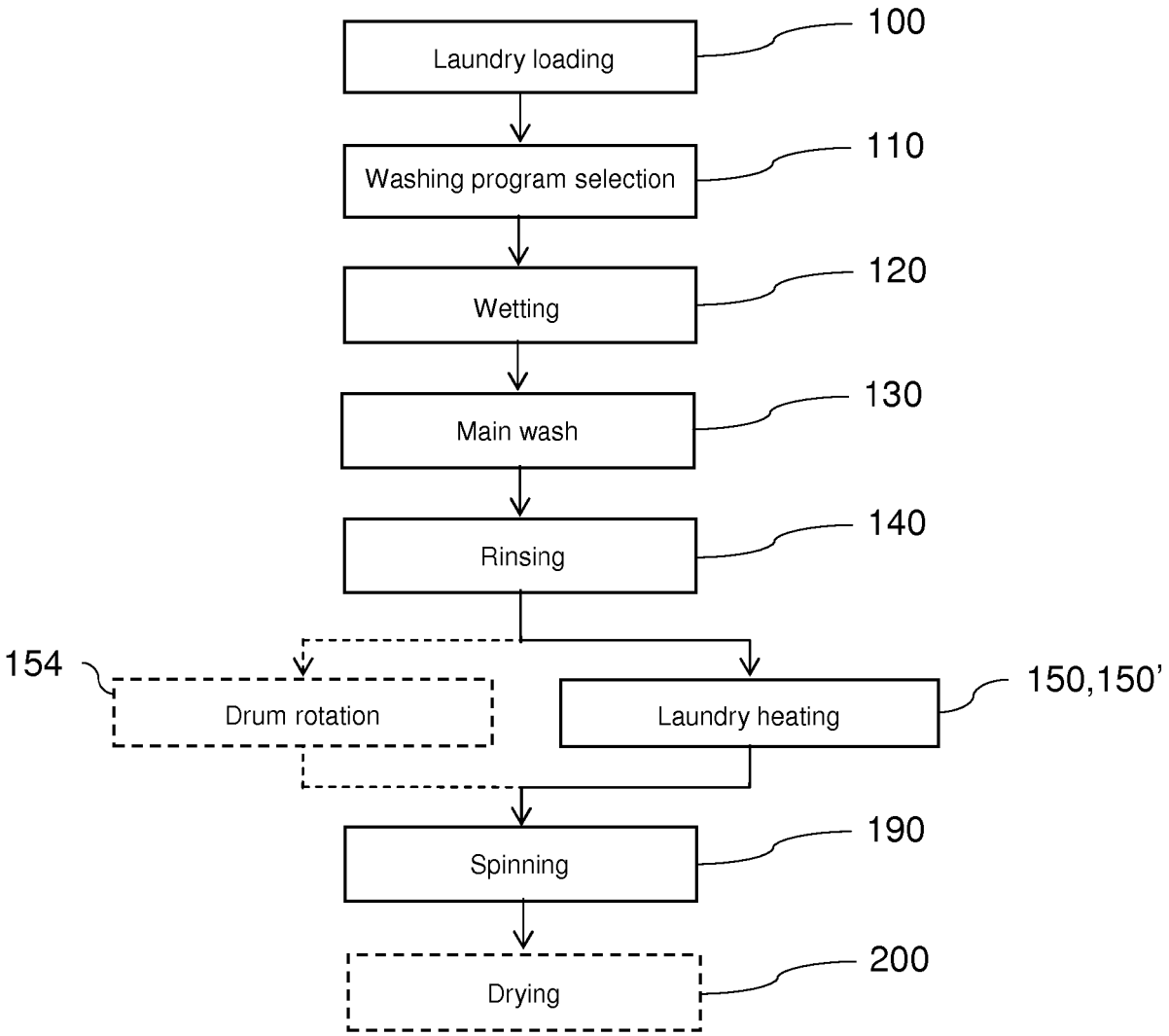
Laundry loading
100
Washing program selection
110
Wetting
120
Main wash
130
Rinsing
140
154
Drum rotation
Laundry heating
150,150'
Spinning
190
Drying
200

FIG. 3

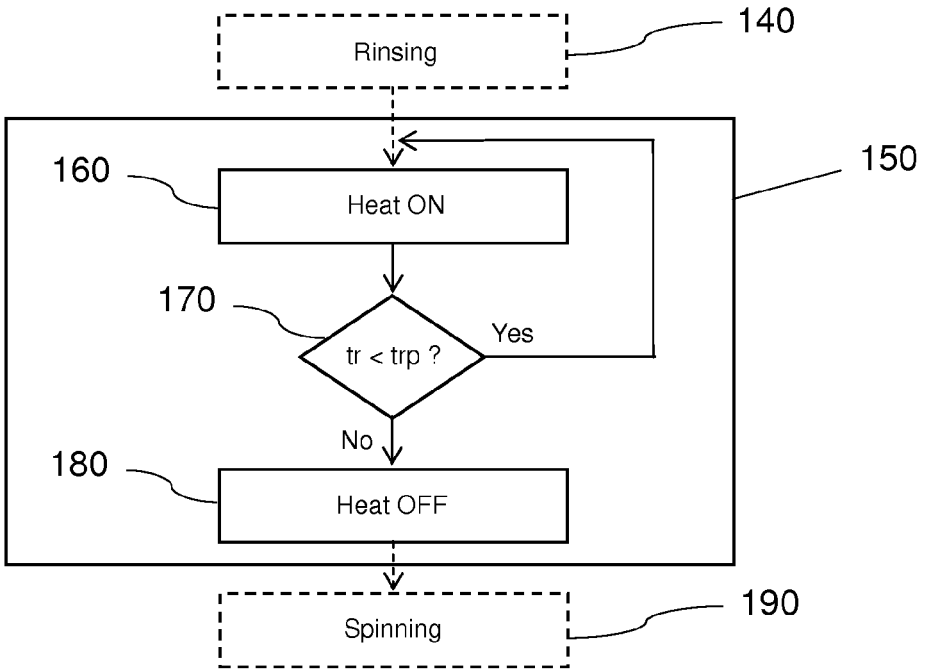
Rinsing
140
150
160
Heat ON
170
tr < trp ?
Yes
No
180
Heat OFF
Spinning
190

FIG. 4

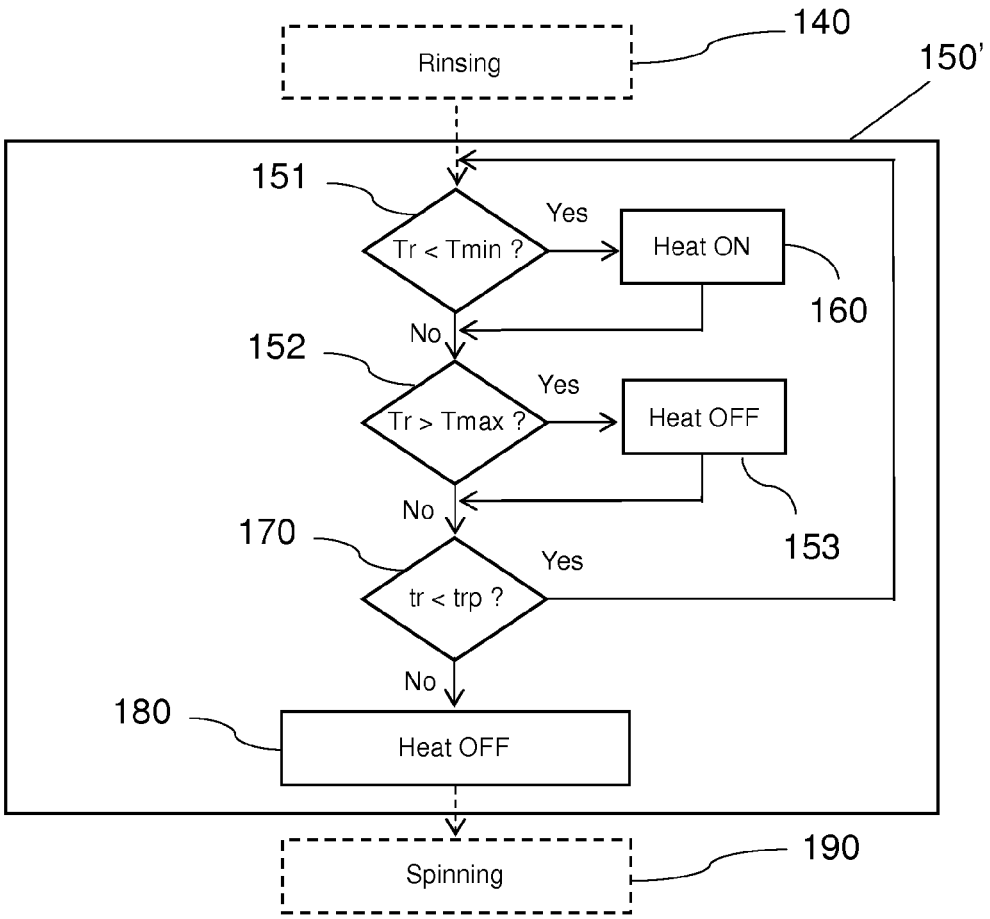
Rinsing
140
150'
151
Tr < Tmin ?
Yes
Heat ON
160
No
152
Tr > Tmax ?
Yes
Heat OFF
153
No
170
tr < trp ?
Yes
No
180
Heat OFF
Spinning
190

FIG. 5

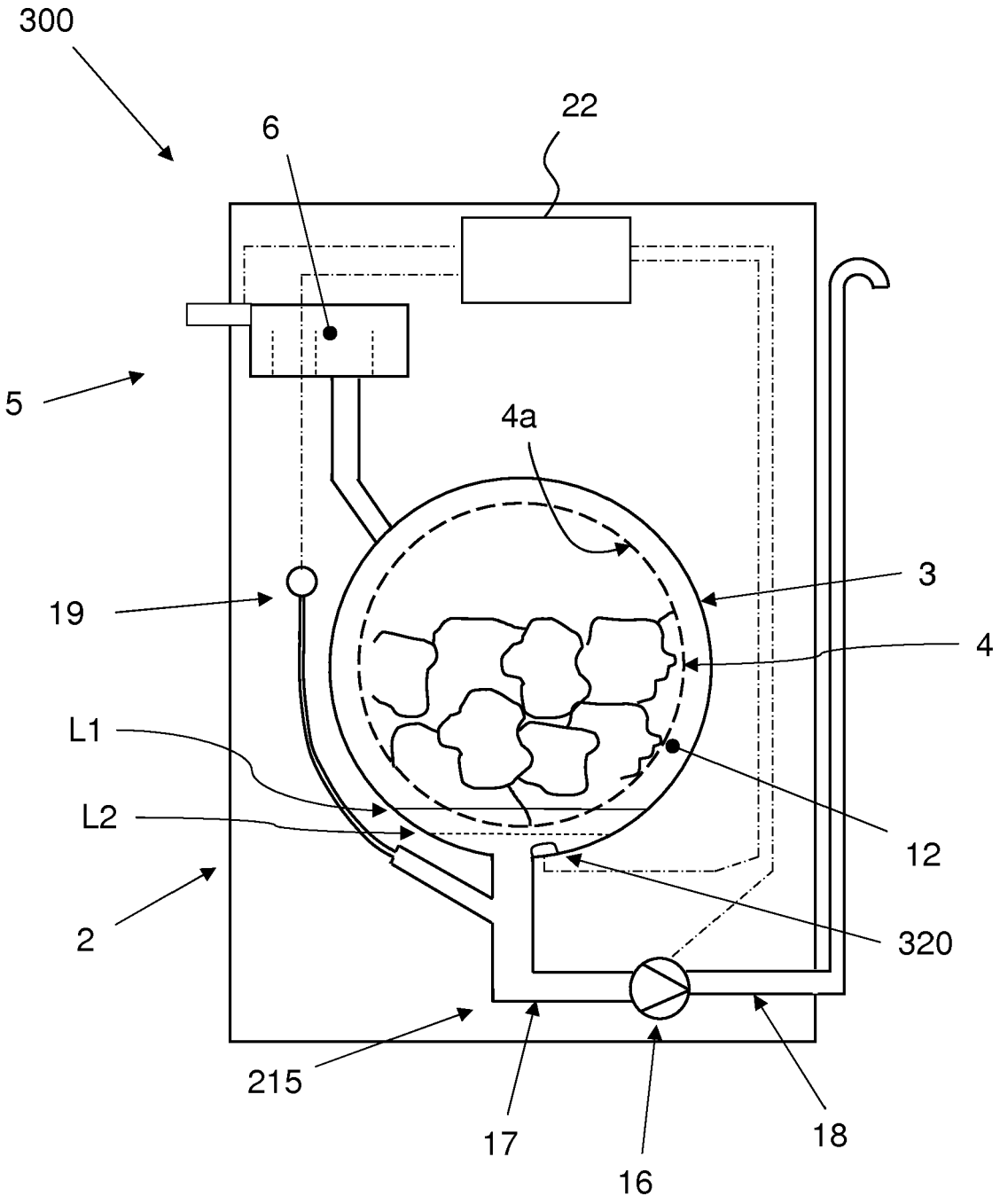

FIG. 6

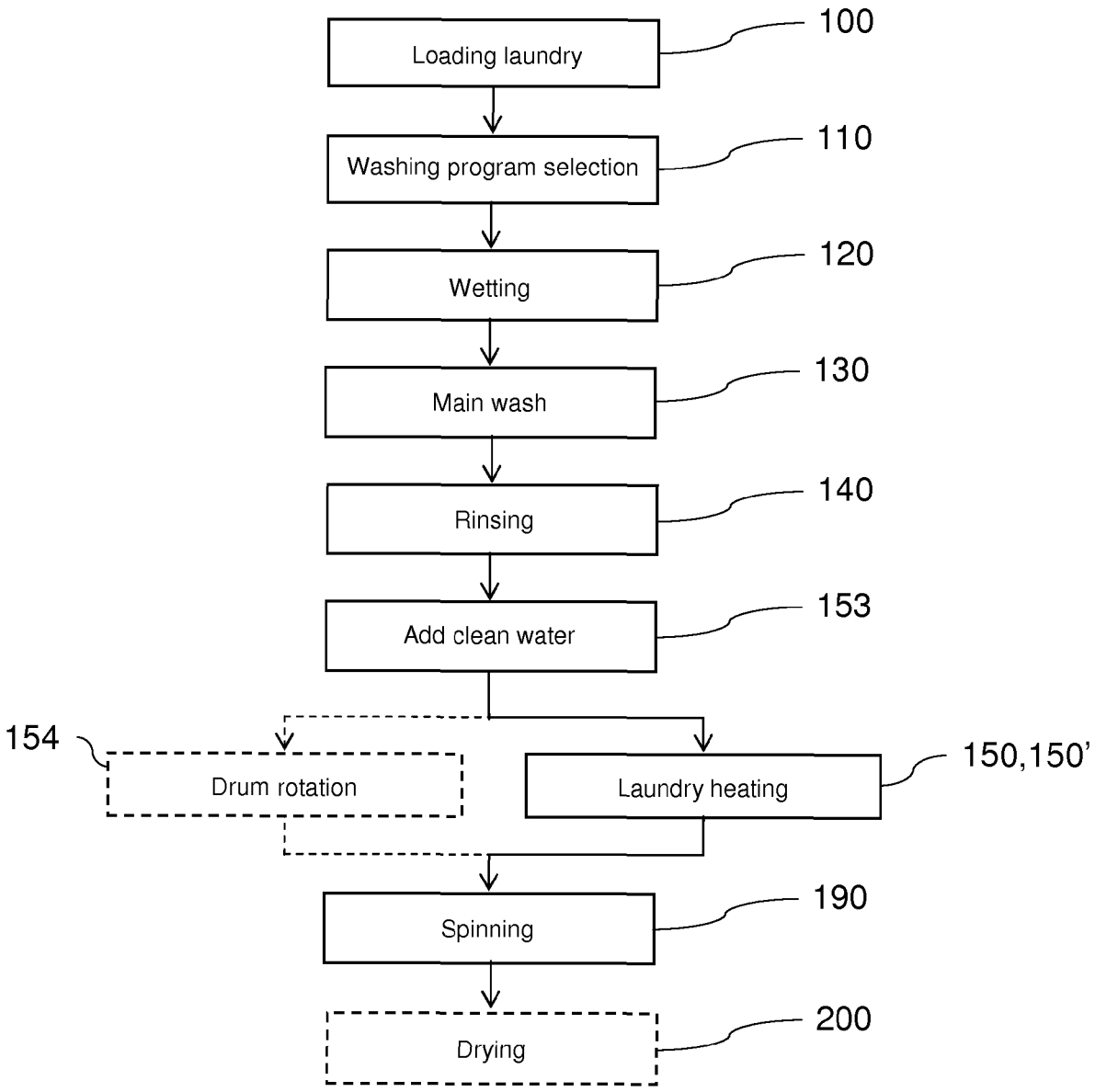
Loading laundry
100
Washing program selection
110
Wetting
120
Main wash
130
Rinsing
140
Add clean water
153
154
Drum rotation
Laundry heating
150,150'
Spinning
190
Drying
200

FIG. 7

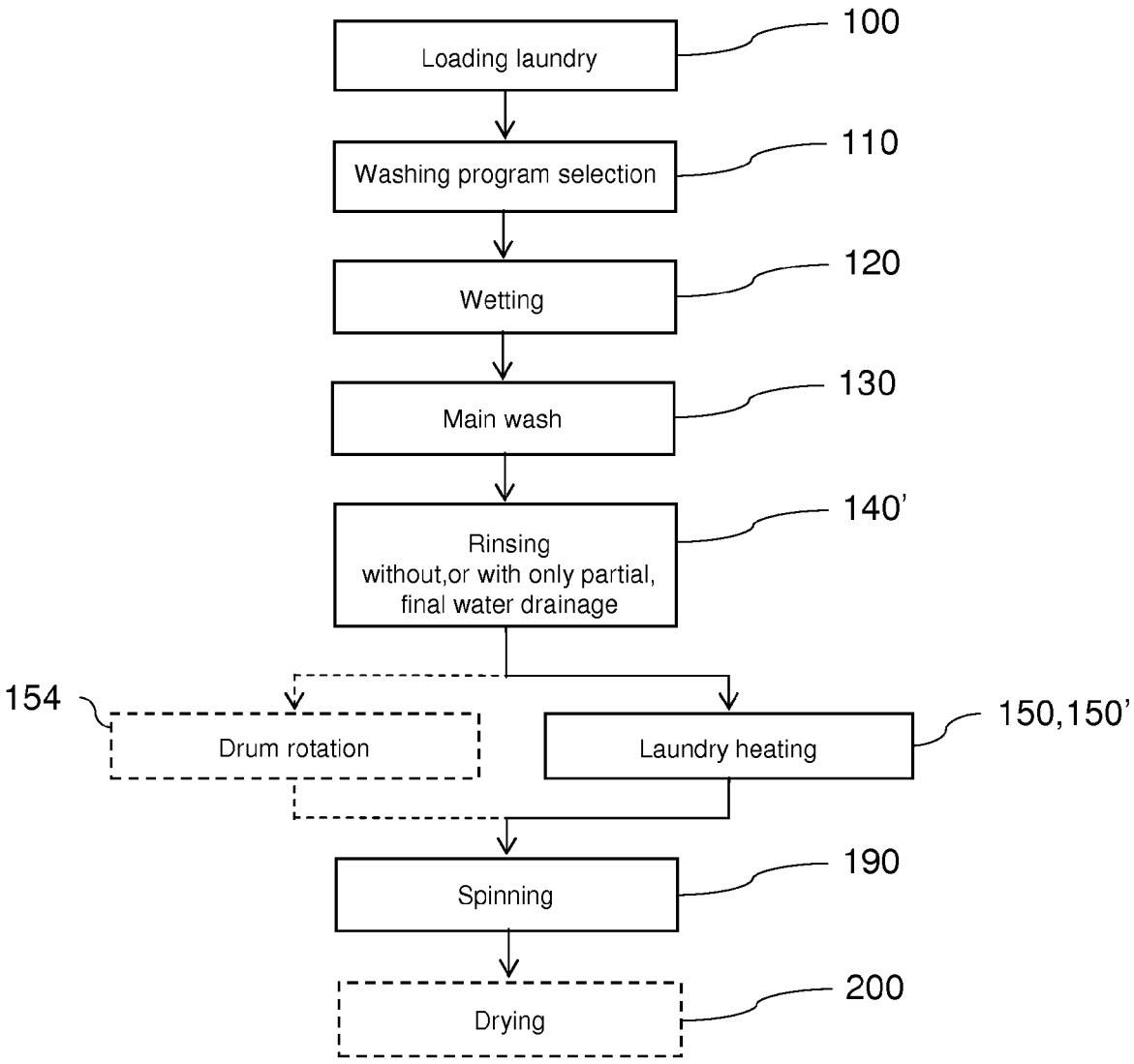
Loading laundry
100
Washing program selection
110
Wetting
120
Main wash
130
Rinsing
without,or with only partial,
final water drainage
140'
154
Drum rotation
Laundry heating
150,150'
Spinning
190
Drying
200

FIG.8

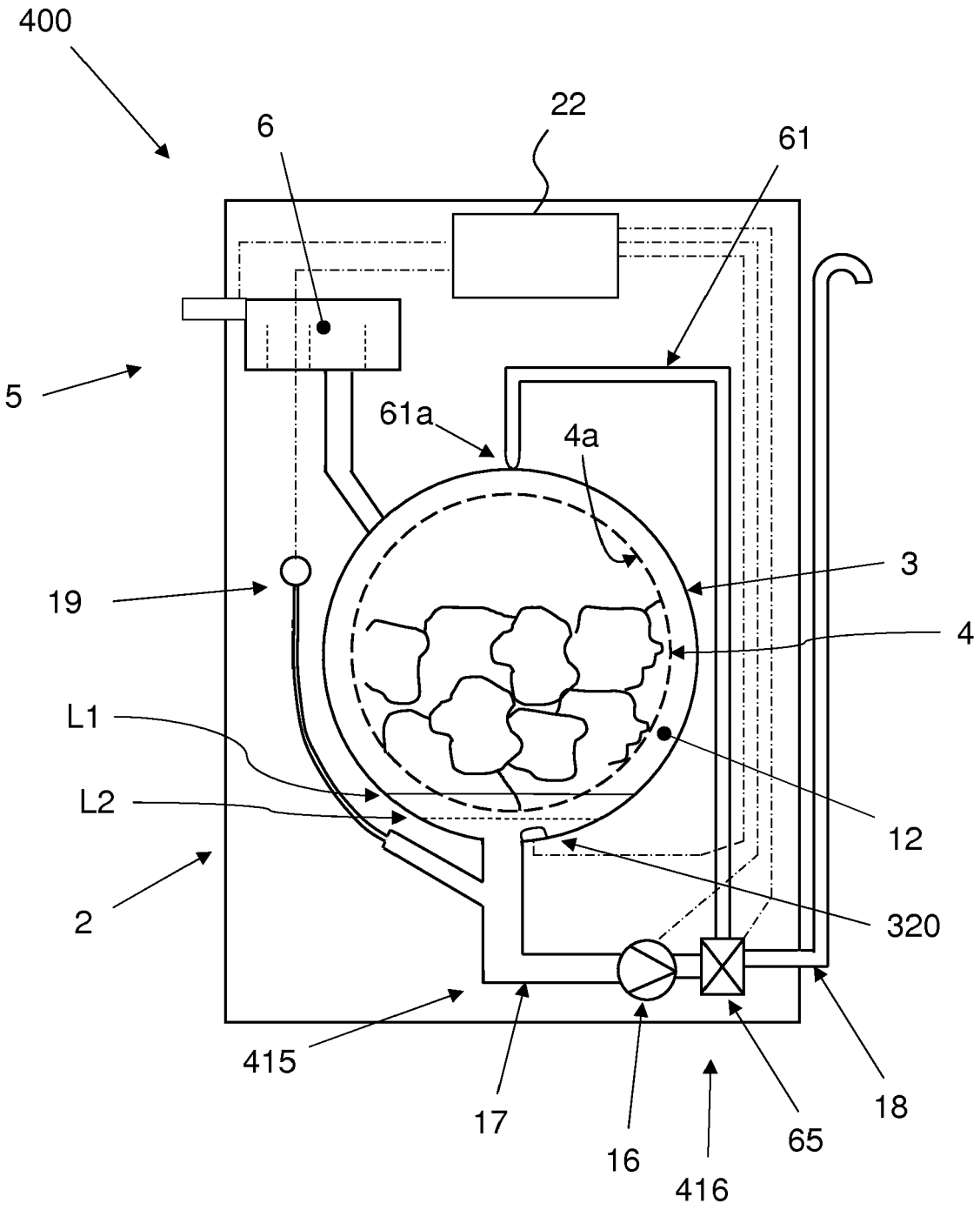

FIG. 9

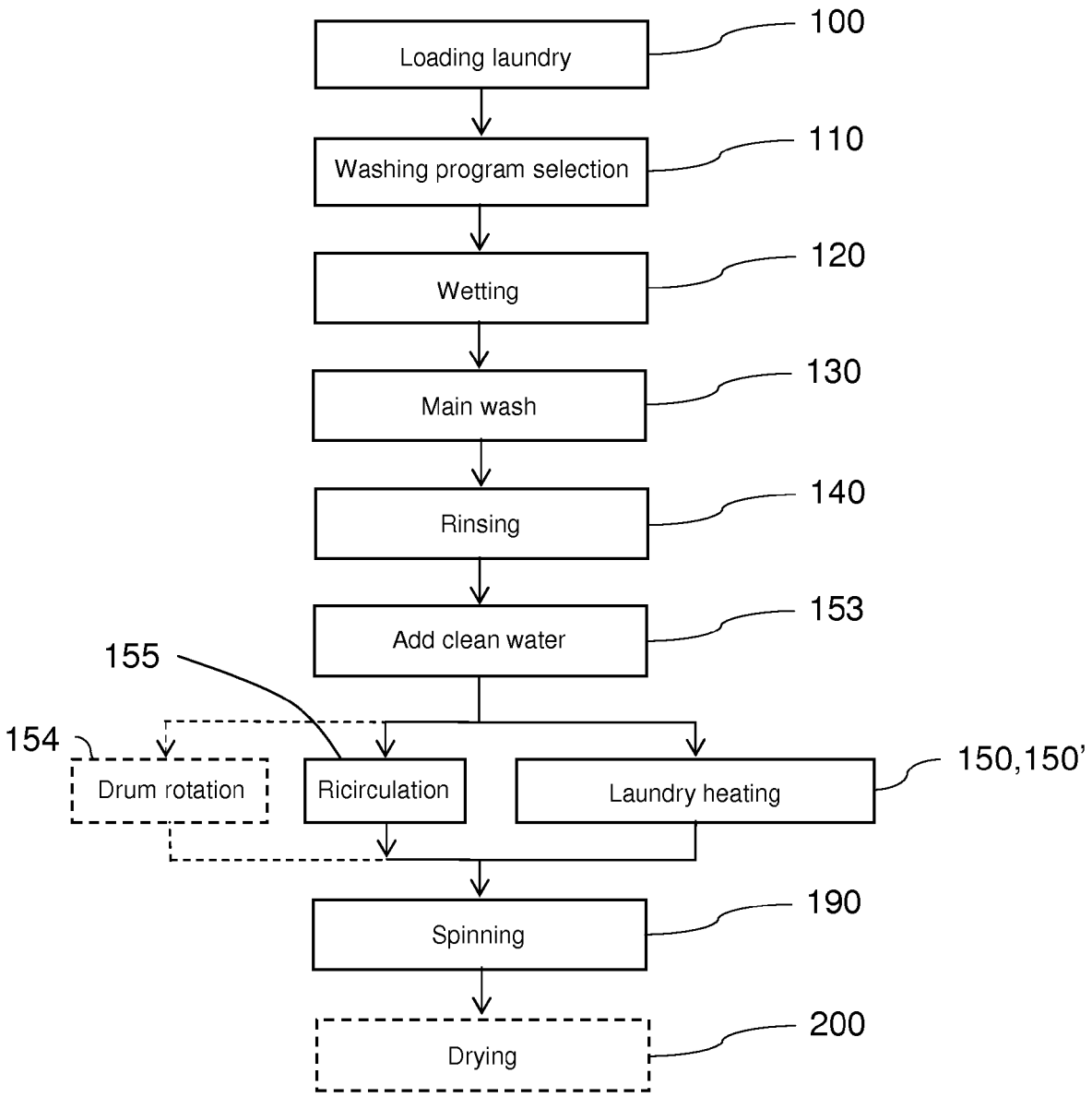
Loading laundry
100
Washing program selection
110
Wetting
120
Main wash
130
Rinsing
140
Add clean water
153
155
154
Drum rotation
Ricirculation
Laundry heating
150,150'
Spinning
190
Drying
200

FIG. 10

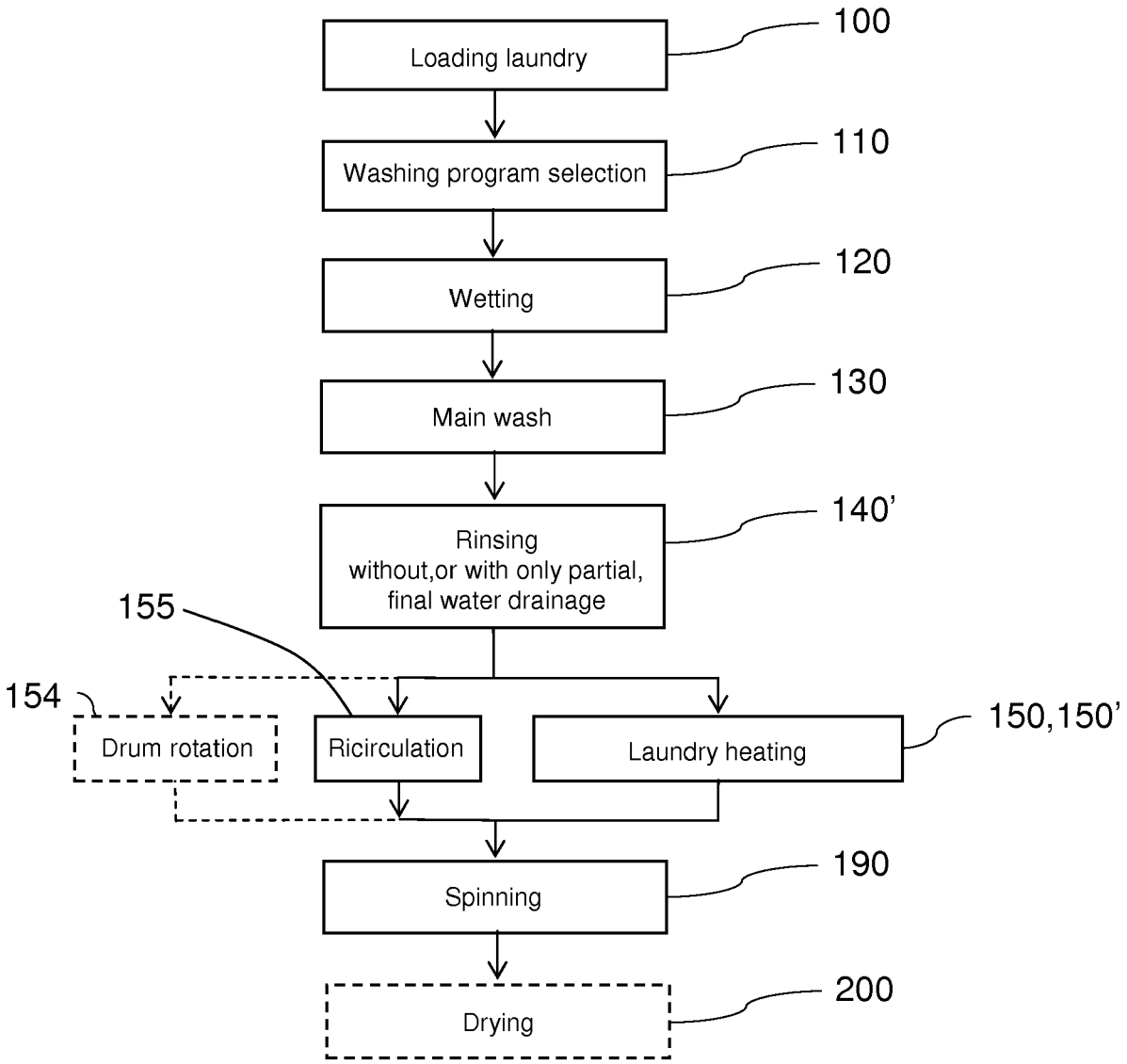
Loading laundry
100
Washing program selection
110
Wetting
120
Main wash
130
Rinsing
without,or with only partial,
final water drainage
140'
155
154
Drum rotation
Ricirculation
Laundry heating
150,150'
Spinning
190
Drying
200

FIG. 11

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 15 9617

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	WO 2008/030051 A2 (LG ELECTRONICS INC [KR]; KIM PYOUNG HWAN [KR]; SHIN SU HEE [KR]; JEONG) 13 March 2008 (2008-03-13) * paragraph [0070] - paragraph [0091]; figures 4-5 *	1,2,4,15	INV. D06F39/00 D06F35/00
X	EP 2 009 167 A2 (DAEWOO ELECTRONICS CORP [KR]) 31 December 2008 (2008-12-31) * paragraph [0032] - paragraph [0044]; figures 1, 4 *	1-5,15	
X A	EP 0 597 509 A1 (CANDY SPA [IT]) 18 May 1994 (1994-05-18) * figure 4 * * * * *	1,3,10, 15 2,4-9, 11-14	
X	US 2008/115294 A1 (SCHAUB HARTMUT [DE] ET AL) 22 May 2008 (2008-05-22) * column 5, line 1, paragraph 32 - line 36, paragraph 33; figures *	1-3,5,7, 8,10,15	

TECHNICAL FIELDS SEARCHED (IPC)
D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 October 2011	Diaz y Diaz-Caneja

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 15 9617

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.

12-10-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008030051 A2	13-03-2008	AU 2007293786 A1	13-03-2008
		CA 2661318 A1	13-03-2008
		CN 101512060 A	19-08-2009
		EP 2061921 A2	27-05-2009
		KR 20080022984 A	12-03-2008
		US 2010017968 A1	28-01-2010
EP 2009167 A2	31-12-2008	EP 2372007 A1	05-10-2011
		US 2008289117 A1	27-11-2008
		US 2011072861 A1	31-03-2011
EP 0597509 A1	18-05-1994	DE 69313974 D1	23-10-1997
		DE 69313974 T2	22-01-1998
		ES 2108811 T3	01-01-1998
		IT 1256377 B	04-12-1995
US 2008115294 A1	22-05-2008	CN 101111634 A	23-01-2008
		DE 102005003694 A1	27-07-2006
		EA 200701304 A1	28-02-2008
		EP 1846607 A1	24-10-2007
		WO 2006079427 A1	03-08-2006
		KR 20070099602 A	09-10-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82