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

Verfahren zum Waschen von Wäsche in einer Waschmaschine und Waschmaschine

Procédé de lavage du linge dans une machine à laver le linge et machine à laver le linge

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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.

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 inside which there is a rotatable perforated drum in which 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 that may operate both during the initial phases of the washing cycle and at the end of the same to drain the dirty water.

[0009] In particular, a known complete washing cycle typically includes a first laundry wetting phase with addition of a washing detergent, a second washing phase, a following rinsing phase and a final spinning phase.

[0010] According to a known technique, the initial wetting phase includes a first step intended to introduce in the tub the quantity of water necessary for wetting the laundry completely and a successive step intended to introduce the proper quantity of detergent according to the type of laundry to be washed.

[0011] A wetting method is disclosed in document DE4116673. In this document a front load washing machine is described wherein a new wetting method is performed. The first step of the method provides for a rotation of the drum at 600 rpm so that the loaded laundry is forced outwardly against the inner surface of the drum by the action of the centrifugal force. The laundry is therefore displaced so as to form a ring which adheres to the inner surface of the drum while a central hollow area is formed. During this rotation, the water necessary for wetting the laundry is introduced in the central hollow area formed by the laundry ring by means of a spraying hose displaced in the front area of the washing machine close to the access door.

[0012] After a predetermined time interval, the rotational speed of the drum is reduced at approximately 50 rpm. At this stage, additional washing water carrying a quantity of detergent is introduced in the drum by means of the spraying hose.

[0013] In the illustrated embodiment, therefore, the introduction of detergent takes place while the drum rotates at low rotational speed with the laundry substantially resting on the bottom of the drum.

[0014] In general, in the washing machines of the known type the introduction of detergent takes place while the drum is rotating at low rotational speed or also while the drum remains stationary, in any case with the laundry resting on the bottom of the drum. However, the methods of introducing the detergent belonging to the known art pose some drawbacks.

[0015] A first drawback posed by the known techniques is constituted by the fact that the detergent introduced in the drum does not reach uniformly the laundry.

[0016] In particular if the detergent is introduced in the drum by means of a spraying hose displaced in the front area of the washing machine close to the front access door, the laundry near the front access door receives more detergent than the laundry at the back of the drum.

[0017] In general, the laundry in the position close to the point of delivery of the detergent, like a spraying hose, receives more detergent than the laundry in other positions.

[0018] Another drawback posed by the known techniques is represented by the fact that when the amount of loaded laundry is high, as for example a full load, the circulation of the detergent introduced in the drum may be impeded by the laundry itself. The detergent, therefore, may accumulate in a zone close to the point of its delivery.

[0019] A further drawback posed by the known techniques is represented by the fact that part of the detergent introduced into the tub goes outsides the drum and there it mixes with the free water present in the tub. This part of detergent is not efficiently utilised in the washing phase of the laundry.

[0020] US5,345,637 discloses a wash system having a rotatable wash basket for receiving fabric items disposed within an imperforate wash tub. A quantity of wash liquid is initially applied to the fabric items while the fabric items are tumbled within the wash basket until the fabric items are saturated with wash liquid and have had a chance to roll-up. The washing liquid is then extracted from the fabric items and the extracted wash liquid is stored for later use in a holding tank. A portion of the stored wash liquid is reintroduced from the holding tank to a mixing tank and mixed with detergent to form a wash liquor having a detergent concentration within a predetermined range. This wash liquor is then continuously passed through the fabric items while the wash basket rotates at a speed to maintain the fabric items against a peripheral wall of the wash basket. US6,058,743 discloses a washing machine including a wash-and-dewatering sink, a motor rotating the wash-and-dewatering sink, a

detergent fluid supply device supplying detergent fluid to clothes in the wash-and-dewatering sink, and control unit controlling both the motor and the detergent fluid supply device in such a manner, when the wash-and-dewatering sink is rotated by the motor, detergent fluid is supplied to the clothes in the wash-and-dewatering sink by the detergent fluid supply device.

[0021] The object of the present invention is therefore to overcome the drawbacks posed by the known techniques.

[0022] 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 a more uniform distribution of the detergent in the laundry than the method of the prior art.

[0023] It is another object of the invention to implement a washing method that makes it possible to optimise the dosage of the detergent in order to reduce the quantity of detergent used for washing the laundry compared to the known technique.

DISCLOSURE OF INVENTION

[0024] 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 loading phase in which laundry is loaded into the washing drum;
- a wetting phase in which the loaded laundry is wetted;
- a detergent introducing phase in which a detergent is introduced inside the washing tub. During the detergent introducing phase the washing drum is rotated at a reference rotational speed in which the loaded laundry is stuck to the inner surface of the washing drum.

[0025] Preferably the detergent introduction phase comprises the introduction of a quantity of detergent in a central area of the washing drum.

[0026] Advantageously the detergent introduction phase comprises the use of a quantity of detergent-conveying water for conveying the detergent into the tub.

[0027] In a preferred embodiment the reference rotational speed is stated based on the quantity and/or on the type of the loaded laundry.

[0028] Advantageously the reference rotational speed is comprised between 80 rpm and 120 rpm, preferably between 90 rpm and 110 rpm, more preferably equal to 100 rpm. Preferably the washing drum is set rotating at the reference rotational speed for a pre-established period of time deemed sufficient to introduce the desired quantity of detergent into the washing tub.

[0029] In a preferred embodiment the method comprises, after the wetting phase and before the detergent introducing phase, a step of draining from the washing tub the free water outside the loaded laundry.

[0030] In a further embodiment the method comprises, after the draining phase and before the detergent introducing phase, a further rotation phase of the washing drum so as to extract a quantity of water from the loaded laundry, and a further draining phase of the quantity of water from the washing tub.

[0031] Preferably, the quantity of detergent conveying water is substantially equal to the quantity of water extracted from the loaded laundry in the further rotation phase.

[0032] In a preferred embodiment the detergent introduction phase comprises the introduction of the quantity of detergent in a central area of the washing drum by means of a recirculation circuit taking liquids from a bottom region of the washing tub. Opportunely, the method further comprises an off-balance control step of the loaded laundry in the washing drum after the draining phase.

[0033] Advantageously the method further comprises the step of heating the detergent conveying water.

[0034] In a preferred embodiment the method is performed in a front loading washing machine having a front door access.

[0035] In a second aspect thereof, the present invention concerns a laundry washing machine suited to implement the method of the invention described above.

[0036] Preferably the laundry washing machine is a front loading washing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] 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 schematic front view of a laundry washing machine implementing the method according to the invention;
- Figure 2 shows a schematic 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 the laundry washing machine shown in Figure 1 in a particular operating configuration;
- Figure 5 shows a side view of the laundry washing machine shown in Figure 4;
- Figure 6 is a simplified flow chart of the basic operations of a further embodiment of the method for washing laundry in the washing machine of fig. 1;
- Figure 7 shows a construction variant of the laundry washing machine of Figure 1;
- Figure 8 shows a side view of the laundry washing machine shown in Figure 7;

- Figure 9 is a simplified flow chart of the basic operations of a method for washing laundry in the washing machine of Figure 7.

DETAILED DESCRIPTION OF THE INVENTION

[0038] 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.

[0039] The laundry washing machine 1 comprises an external casing or housing 2, in which a washing tub 3 is provided that contains a rotatable perforated drum 4, where the laundry 30 to be washed can be loaded.

[0040] The tub 3 and the drum 4 both have preferably a substantially cylindrical shape.

[0041] A hollow space 12 is defined between the tub 3 and the drum 4.

[0042] The housing 2 is provided with a front loading/unloading door 8 which allows access to the washing tub 3 and the drum 4.

[0043] 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 herein.

[0044] The tub 3 is preferably connected to the casing 2 by means of an elastic bellows 7, or gasket.

[0045] 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.

[0046] 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.

[0047] The water inlet circuit 5 advantageously comprises a removable drawer 6 provided with various compartments suited to be filled with washing and/or rinsing products.

[0048] In the embodiment herein described, the water is advantageously supplied into the tub 3 by making it flow through the drawer 6 and through a supply pipe 9 which extends toward the front side of the washing machine 1. Te supply pipe 9 is provided with an output 9a placed preferably in the proximity of the front door 8. Advantageously, the supply pipe output 9a faces a sloping inner portion 8a of the door 8 so that, as better explained below, the liquid coming from the supply pipe 9 is directed towards the central part of the drum 4.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] Laundry washing machine 1 advantageously comprises a water outlet circuit 15.

[0053] 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.

[0054] 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.

[0055] This filtering device can preferably be removed, and then for example cleaned, through a gate or porthole 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 reached for example via 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.

[0056] Advantageously laundry washing machine 1 comprises a device 19 suited to sense (or detect) the water level inside the tub 3.

[0057] The device 19 preferably comprises a pressure sensor which senses the pressure in the tub 3, which value is related to the level of free water contained in the tub 3. In another embodiment, not illustrated, 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.

[0058] Advantageously, but not necessarily, the laundry washing machine 1 comprises a heating device 20, contained preferably in a suitable seat, not illustrated, obtained advantageously at the bottom of the tub 3, comprising preferably an electric resistor adapted to come into contact with the water, or water and detergent, present on the bottom of the tub 3 to heat said water.

[0059] Advantageously, the laundry washing machine 1 may comprise a temperature sensor, not illustrated in the figures, for sensing the temperature of the water present in the tub 3.

[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

operation. The control unit 22 preferably is connected to the water inlet circuit 5, the water outlet circuit 15 and the electric motor 11 and is advantageously adapted to receive information from the various sensors provided on the laundry washing machine 1, like the flow meter of the water inlet circuit 5, the device 19 (e.g. pressure sensor or 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, for example a desired washing program. Usually, 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, the control unit 22 sets and controls the various parts of the laundry washing machine 1 in order to carry out a 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, 2, 4 and 5 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, the user advantageously may set some parameters directly as desired, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of washing, 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 the laundry 30 may be loaded into the drum 3 (step 100) after the selection of the desired washing program (step 110).

[0067] In the first phase (step 120), also called wetting phase, a quantity of clean water is introduced into the tub 3 for wetting completely the laundry 30.

[0068] This phase preferably comprises the introduction of clean water into the tub 3 while the drum 4 advantageously is set rotating, preferably at a low number of revolutions, for example about 30-50 rpm, in order to move the laundry 30 and to facilitate the penetration of the water in the laundry 30, so as to obtain a better and a more homogeneous wetting of the laundry 30.

[0069] 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.

[0070] In a preferred embodiment of the invention the inlet circuit 5 comprises a bypass duct, not illustrated, that bypasses the compartments of the drawer 6, so as to allow supplying exclusively clean water (i.e. without detergent) into the tub 3.

[0071] In an alternative embodiment of the invention, not shown, the laundry washing machine 1 comprises a separate water supply pipe, separated form the inlet circuit 5, adapted to supply clean water directly into the tub 3.

[0072] After a certain time has lapses, the rotations of the drum 4 terminates, the laundry 30 inside the drum 4 is substantially completely wet, and a certain quantity of free water, or excess water, fills at least partially the hollow space 12.

[0073] In the successive phase of the cycle (step 123), the excess water is advantageously removed from the tub 3.

[0074] The removal operation preferably includes the drainage of the water from the tub 3 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.

[0075] This phase ends when substantially all the excess water has been drained outside the laundry washing machine 1.

[0076] This is advantageously sensed by means of the device 19 (e.g. pressure sensor or level sensor), which senses the absence of water inside the tub 3.

[0077] In another embodiment, the drain pump 16 can be operated for a pre-established period of time deemed sufficient to empty the tub 3 completely. In this case the device 19 can be preferably omitted.

[0078] At the end of the draining phase, the laundry 30 inside the drum 4 is substantially completely wet and the hollow space 12 is substantially free of water.

[0079] Clearly any other method may be used to implement the first wetting phase, as known in the prior art.

[0080] In the successive phase (step 130) a quantity of washing detergent D is advantageously introduced in the drum 4.

[0081] The introduction of detergent D takes place preferably through the water inlet circuit 5; the quantity of detergent D, be it powder or liquid, is preferably brought out of the apposite compartment of the drawer 6 by a given quantity of clean detergent-conveying water W, that passes through the proper compartment of the drawer 6.

[0082] The detergent D and the detergent-conveying water W then flow through the supply pipe 9 up to the supply pipe output 9a, and they are advantageously directed towards the central part of the drum 4 by the sloping inner portion 8a of the door 8.

[0083] The quantity of detergent D taken from the drawer 6 is determined advantageously by the control unit 22.

[0084] The quantity of detergent D 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 of loaded laundry 30.

[0085] In an alternative embodiment of the invention,

the introduction of detergent D may take place without the use of conveying water; in this case the detergent is preferably a liquid detergent, which is automatically brought out of the apposite compartment of the drawer 6 (or out of another suitable detergent-container provided in the washing machine, for example a cartridge), for example by means of a suitable dosing device (comprising for example a peristaltic pump).

[0086] According to the invention, during the introduction of the detergent D (step 130) the drum 4 is set rotating (step 135) at a reference rotation speed Sd sufficient to "spread" the laundry 30 into the inner surface 4a of the drum 4, as shown in Figures 4 and 5. The laundry 30 is advantageously stuck against the inner surface 4a of the drum 4 by means of the centrifugal force.

[0087] The laundry 30 therefore is displaced so as to form a laundry ring 30a with an inner cavity 30b at the central area of the drum 4.

[0088] The detergent D and the conveying water W (or, alternatively, only detergent and not water W in the embodiment in which the introduction of detergent D takes place without the use of conveying water) ejected from the supply pipe output 9a are advantageously sprayed in the inner cavity 30b defined by the laundry ring 30a. In this way the detergent D and the conveying water W reach the laundry 30 along its entire length and any portion of the laundry 30, from the front door 8 up to the back of the drum 4, receives a proper quantity of detergent D.

[0089] Advantageously, the detergent D is uniformly distributed in the laundry 30. Furthermore, the detergent D introduced in the inner cavity 30b defined by the laundry ring 30a remains confined inside the laundry 30 without detergent D wasted outside the drum 4. This permits to reduce the quantity of detergent D to be introduced in the tub 3 for washing the laundry 30.

[0090] The reference rotation speed Sd is preferably based on the quantity of loaded laundry 30, and preferably also on the diameter of the drum 4. The quantity of loaded laundry 30, i.e. the weight of the laundry 30, can be advantageously obtained by the control unit 22 in different ways.

[0091] The weight can be, for example, one of the parameters introduced by the user when setting the washing program.

[0092] In further embodiment, the weight of the laundry 30 can be advantageously obtained by means of suitable weight sensors provided in the laundry washing machine 1, for example sensors that can be associated with the shock-absorbers of the tub 3.

[0093] Again, the control unit 22 may advantageously obtain the weight of the laundry 30 by measuring the power absorbed by the motor for the rotation of the drum 4 with the laundry 30 inserted therein. In this case, it is possible to set a brief rotation cycle of the drum 4 before the introduction of clean water, therefore with dry laundry 30, in order to measure the moment of inertia of the laundry 30 based on the power absorbed by the electric motor 11 and thus obtain the weight of the laundry 30 itself by means of simple calculations.

[0094] Preferred values for the reference rotation speed Sd are in the range comprised between 80 rpm and 120 rpm, more preferably between 90 rpm and 110 rpm, even more preferably a value equal to 100 rpm.

[0095] It has to be noted that the reference rotation speed Sd of the drum 4 which permits the laundry 30 to be stuck at the inner surface 4a of the drum 4 through the centrifugal force does not necessary have to be constant but may vary, preferably inside the cited ranges. Furthermore, the drum 4 is preferably set rotating at the reference rotation speed Sd for a pre-established period of time which is deemed sufficient to permit the introduction of the quantity of requested washing detergent D from the drawer 6 into the tub 3.

[0096] Once the detergent introduction phase has been completed (step 130), a main wash may be started (step 140).

[0097] The main wash can be a typical wash cycle of known washing machines. It advantageously comprises successive rotations of the drum 4, in clockwise and/or anticlockwise direction, at a pre-determined rotational speed.

[0098] The main wash cycle is advantageously achieved by heating the water that washes the laundry 30 and keeping the temperature of the water at a desired and prefixed value or inside a prefixed temperature range. The water temperature preferably may depend on the washing program set by the user or may be the temperature inserted directly by user through the interface unit.

[0099] In the preferred embodiment, the heating of the water is advantageously obtained by activating the heating device 20. At the same time, the water temperature is advantageously controlled by the control unit 22 through the value sensed by the temperature sensor.

[0100] Once the main wash cycle has been completed, the washing program may continue with a spinning phase (step 160) and, in case of a laundry washing-drying machine, it may also comprise a further drying phase (step 170).

[0101] The spinning phase (step 160) and the drying phase (step 170) may be of the known type and therefore will not be described in detail.

[0102] In a preferred embodiment of the method of the invention, after the draining phase (step 123) and before the phase of introducing detergent (step 130) with drum rotation (step 135), a control step, not illustrated, may advantageously be performed for controlling and trying to reduce the off-balance state of the loaded laundry 30 contained in the washing drum 4.

[0103] The off-balance control step, as known in the art, may comprise one or more drum rotation cycles to detect the off-balance of the loaded laundry 30, and one or more stopping of the washing drum 4, so as to modify the distribution of the laundry 30 inside the drum 4. This control is performed for reducing the problems that may

be originated by off-balance conditions, during the rotation of the drum 4 at the reference rotation speed Sd.

[0104] During the off-balance control step the drain pump 16 is preferably activated to drain the residual water from the tub 3 to the outside.

[0105] In a preferred embodiment, if the off-balance of the laundry is high and if off-balance control step is not able to balance the loaded laundry (i.e. to reduce the off-balance state of the loaded laundry 30), during the introduction of the detergent D (step 130) the drum 4 may be preferably rotated (step 135) at a reduced reference rotation speed Sd', lower than the reference rotation speed Sd sufficient to "spread" the laundry 30 into the inner surface 4a of the drum 4.

[0106] During the rotation at the reduced reference rotation speed Sd', the laundry 30 is not completely "spread" and stuck into the inner surface 4a of the drum 4, but it may partially move inside the drum 4; in this case the advantageous effect of supplying the detergent while the laundry is completely "spread" and stuck into the inner surface 4a of the drum 4 is only partial, but the reduced rotation speed allows avoiding excessive vibrations of the washing machine.

[0107] Advantageously the reduced reference rotation speed Sd' is comprised between 65 rpm and 80 rpm, preferably 70 rpm.

[0108] A further embodiment of the method of the invention is described with reference to the flow chart of Figure 6.

[0109] This embodiment differs from the one described above with reference to Figure 3 for the fact that before the phase of introducing detergent (step 130) while the drum rotates (step 135), there is a further step (125) in which a certain quantity of water We is extracted from the completely wet laundry 30, by means of a high speed rotation of the drum 4, and drained outside.

[0110] During this step (125), the further quantity of water We is extracted from the completely wet laundry 30 advantageously by setting the drum 4 rotating at a higher rotational speed, for example about 350 rpm.. This quantity of water We is advantageously drained outside the washing machine, preferably via the water outlet circuit 15, during a further draining phase, not illustrated in the enclosed figures, which may take place contemporaneously with the further step (125) or after the further step (125). Advantageously, the quantity of water extracted We from the laundry 30 is monitored (continuously or not) by the control unit 22, for example by monitoring the level of the water in the tub 3, preferably via the pressure sensor 19 or level sensor, so as to stop the rotation of the drum 4 when the desired quantity of water We has been removed from the laundry 30.

[0111] In a further embodiment the high speed drum rotation is performed for a prefixed time, for example for 60 sec.

[0112] After the extraction of the desired quantity of water We from the laundry 30, the laundry 30 is not completely wet anymore.

[0113] In the successive phase, however, of introducing detergent (step 130) through a given quantity of clean, detergent conveying water W, the quantity of detergent conveying water W is preferably set equal to the quantity of water We previously extracted from the laundry 30.

[0114] After introducing the detergent D and the detergent conveying water W (step 130), therefore, the laundry 30 is again substantially completely wet.

[0115] Advantageously the ratio between the quantity of detergent D and the total quantity of water inside the laundry 30 is opportunely selected in such a way that the effect of this mixture water/detergent on the loaded laundry 30 is optimal.

[0116] Also in this embodiment, a further control step, the same described with reference to the embodiment of Figure 3, may advantageously be performed for controlling the off-balance state of the loaded laundry 30 contained in the washing drum 4. In this case, the control step may advantageously be performed after the draining phase (step 123) and before the step just described of draining a further quantity of extracted water We from the laundry 30 (step 125) by setting the drum 4 rotating at a high rotational speed. Preferably, if the off-balance of the laundry is high and if off-balance control step is not able to balance the loaded laundry (i.e. to reduce the off-balance state of the loaded laundry 30), step 125 is not performed. In this case, depending on the -balance state of the loaded laundry 30 (i.e. on how the laundry of off-balanced), during the following introduction of the detergent D (step 130) the drum 4 may be rotated (step 135) at the reference rotation speed Sd or at the above mentioned reduced reference rotation speed Sd'.

[0117] In a further embodiment, not illustrated, before the step (125) in which a certain quantity of water We is extracted from the completely wet laundry 30, by means of a high speed rotation of the drum 4, and drained outside, there may be a further step in which the rotation speed of the washing drum 4 is took at the reference rotation speed Sd, or also at a value higher (e.g. 140 rpm); preferably, before this further step in which the rotation speed of the washing drum 4 is took at the reference rotation speed Sd, or also at a value higher (e.g. 140 rpm), a further control step, the same described with reference to the embodiment of Figure 3, may advantageously be performed for controlling the off-balance state of the loaded laundry 30 contained in the washing drum 4. Also in this case if the off-balance of the laundry is high and if the off-balance control step is not able to balance the loaded laundry (i.e. to reduce the off-balance state of the loaded laundry 30), this further step in which the rotation speed of the washing drum 4 is took at the reference rotation speed Sd, or also at a value higher, is preferably not performed.

[0118] Figures 7 and 8 show a construction variant of the laundry washing machine of Figure 1.

[0119] This washing machine 200 differs from the one shown in Figures 1 and 2 due to the fact that the water outlet circuit 215 is provided with a recirculation circuit

216 adapted to drain the liquid from the bottom of the tub 3, and to re-admit such liquid into an another part of the tub 3, preferably into an upper region of the tub 3. The water outlet circuit 215 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. The recirculation pipe 61 ends in the proximity of the front door 8 with a terminal nozzle 61a. The terminal nozzle 61a faces the sloping inner portion 8a of the door 8 so that the liquid coming from the recirculation pipe 61 is directed towards the central part of the drum 4.

[0120] A two-way valve 65 is interposed between the drain pump 16, the outlet pipe 18 and the recirculation pipe 61.

[0121] The two-way valve 65 is properly controlled by the control unit 22 in order to allow selective drainage towards the outside through the outlet duct 18 or towards the tub 3 through the recirculation pipe 61.

[0122] The water is supplied into the tub 3 by making it flow through the drawer 6 and a supply pipe 9 which supply pipe output 9a ends in correspondence of an upper portion of the tub 3.

[0123] A washing method according to the invention is described here below with reference to the washing machine 200 shows on Figures 7 and 8 and with reference to the operation flow chart of Figure 9.

[0124] The initial phases of the washing program from the loading of the laundry (step 100) to the drainage phase (step 123) are the same as described above with reference to the first embodiment of the invention.

[0125] In the successive phase (step 130) a washing detergent D is introduced in the drum 4.

[0126] The introduction of detergent D takes place preferably through the water inlet circuit 5; the quantity of detergent D, be it powder or liquid, is preferably brought out of the apposite compartment of the drawer 6 by a given quantity of clean, detergent conveying water W that passes through the proper compartment.

[0127] The detergent D and the conveying water W then flow through the supply pipe 9 up to the supply pipe output 9a and there introduced inside the tub 3.

[0128] The quantity of detergent D taken from the drawer 6 is determined advantageously by the control unit 22 as already described above with reference to the first embodiment of the invention.

[0129] According to the invention, during the introduction of the detergent (step 130) the drum 4 is set rotating (step 135) at a reference rotation speed Sd sufficient to spread and stick the laundry 30 to the inner surface 4a of the drum 4, as described above.

[0130] Part of the detergent D and the conveying water W introduced inside the tub 3 by means of the supply pipe 9 reaches externally the laundry 30 while part of the detergent D and the conveying water W falls down on the bottom of the tub 3 so as to reach a liquid level L, as shown in Figure 7.

[0131] According to this embodiment, during the rotation of the drum 4 (step 135) the recirculation circuit 216 is activated (step 138).The detergent D and the conveying water W from the bottom of the tub 3 are drained towards the upper part of the tub 3 by means of the drain pump 16. The drain pump 16 takes the detergent D and the conveying water W from the bottom of the tub 3 and conveys them towards the upper part of the tub 3 through the recirculation pipe 61 via the valve 65 opportunely driven by the control unit 22.

[0132] The detergent D and the conveying water W therefore flow through the recirculation pipe 61 up to the terminal nozzle 61a and here advantageously directed towards the central part of the drum 4 by the sloping inner portion 8a of the door 8.

[0133] As said before, during the introduction of the detergent D (step 130) the drum 4 is set rotating (step 135) at a reference rotational speed Sd so that the laundry 30 is stuck against the inner surface 4a of the drum 4.

[0134] The laundry 30 therefore is displaced so as to form a laundry ring 30a with an inner cavity 30b at the central area of the drum 4.

[0135] The detergent D and the conveying water W ejected from the terminal nozzle 61a of the recirculation pipe 61 are advantageously sprayed in the inner cavity 30b defined by the laundry ring 30a. In this way the detergent D and the conveying water W reach the laundry 30 along its entire length and any portion of the laundry 30, from the front door 8 up to the back of the drum 4, receives a proper quantity of detergent D. Advantageously, the detergent D is uniformly distributed on the laundry 30. Furthermore, the detergent D introduced in the inner cavity 30b defined by the laundry ring 30a remains confined inside the laundry 30 without detergent D wasted outside the drum 4. This permits to reduce the quantity of detergent D to be introduced in the tub 3 for washing the laundry 30.

[0136] Once the detergent introduction phase (step 130) has been completed, the washing program continues with a main wash phase (step 140) and the following phases to complete the washing program, as described above.

[0137] In a further embodiment, the detergent D and the conveying water W on the bottom of the tub 3 before being re-circulated and introduced in the inner cavity 30b are also advantageously heated by means of the activation of the heating device 20.

[0138] Again, it has to be noted that the reference rotation speed of the drum which permits the laundry 30 to be stuck at the inner surface 4a of the drum 4 through the centrifugal force does not necessary have to be constant but may vary, preferably inside an opportune range which that ensures the centrifugal effect.

[0139] In a further embodiment, the introduction of detergent D may take place without the use of detergent conveying water.

[0140] In this case, only the detergent D (preferably liquid detergent) is subjected to recirculation.

[0141] In another embodiment, the introduction of de-

tergent D may take place without the use of detergent conveying water and the detergent D may be subjected to re-circulation together with residual water left on the bottom of the tub 3 at the end of a preceding phase of the washing program. The preceding phase, for example a wetting phase, must terminate in this case without a complete drainage of the water outside the washing machine.

[0142] 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 more uniform distribution of the detergent in the laundry compared to the solutions of known type.

[0143] 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.

[0144] 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; 200) comprising a washing tub (3) external to a rotatable washing drum (4) suited to receive laundry (30), the method comprising:

   - a loading phase in which laundry (30) is loaded into said washing drum (4);
   - a wetting phase in which said loaded laundry (30) is wetted;
   - a detergent introducing phase in which a detergent (D) is introduced inside said washing tub (3), said detergent introducing phase comprises the use of a quantity of detergent-conveying water (W) for conveying said quantity of detergent (D) into said tub (3);

   during said detergent introducing phase said washing drum (4) is rotated at a reference rotational speed (Sd) in which said loaded laundry (30) is stuck to the inner surface (4a) of said washing drum (4) and the method comprising, after said wetting phase and before said detergent introducing phase, a step of draining from said washing tub (3) the free water present outside said loaded laundry (30);
   characterized in that after said draining phase and before said detergent introducing phase, the method comprises a further rotation phase of said washing drum (4) so as to extract a quantity of water (We) from said loaded laundry (30), and a further draining phase of said quantity of water (We) from said washing tub (3), wherein said quantity of detergent conveying water (W) is substantially equal to said quantity of water (We) extracted from said loaded laundry (30) in said further rotation phase.

2. Method according to claim 1, **characterized in that** said detergent introducing phase comprises the introduction of a quantity of detergent (D) in a central area of said washing drum (4).

3. Method according to any of the preceding claims, **characterized in that** said reference rotational speed (Sd) is stated based on the quantity and/or on the type of said loaded laundry (30).

4. Method according to any of the preceding claims, **characterized in that** said reference rotational speed (Sd) is comprised between 80 rpm and 120 rpm.

5. Method according to any of the preceding claims, **characterized in that** said washing drum (4) is rotated at said reference rotational speed (Sd) for a pre-established period of time sufficient to introduce the desired quantity of said detergent (D) into said washing tub (3).

6. Method according to any of the preceding claims, **characterized by** further comprising an off-balance control step of said loaded laundry (30) in said washing drum (4) after said draining phase.

7. Method according to claim 2, **characterized in that** said detergent introduction phase comprises the introduction of said quantity of said detergent (D) in a central area of said washing drum (4) by means of a re-circulation circuit (216) taking liquids from a bottom region of said washing tub (3).

8. Method according to any of the preceding claims, **characterized by** further comprising the step of heating said detergent conveying water (W).

9. Method according to any of the preceding claims, **characterized by** being performed in a front loading washing machine (1; 200) having a front door access (8).

10. A laundry washing machine (1; 200) suited to implement a method according to any of the preceding claims.

11. Laundry washing machine (1; 200) according to claim 10, **characterized by** being a front loading washing machine.

Patentansprüche

1. Verfahren zum Waschen von Wäsche (30) in einer Waschmaschine (1; 200), umfassend einen Waschbottich (3), der sich außerhalb einer drehbaren Waschtrommel (4) befindet, die geeignet ist, um Wäsche (30) aufzunehmen, wobei das Verfahren Folgendes umfasst:

   - eine Ladephase, bei der die Wäsche (30) in die Waschtrommel (4) geladen wird;
   - eine Anfeuchtphase, bei der die geladene Wäsche (30) angefeuchtet wird;
   - eine Waschmittel-Einführphase, bei der ein Waschmittel (D) in das Innere des Waschbottichs (3) eingeführt wird, wobei die Waschmittel-Einführphase die Verwendung einer gewissen Menge von Waschmittel beförderndem Wasser (W) umfasst, um die Waschmittelmenge (D) in den Bottich (3) zu befördern;

   während der Waschmittel-Einführphase wird die Waschtrommel (4) auf einer Bezugsdrehzahl (Sd) gedreht, bei der die geladene Wäsche (30) an der inneren Oberfläche (4a) der Waschtrommel (4) haftet, und wobei das Verfahren nach der Anfeuchtphase und vor der Waschmittel-Einführphase einen Schritt umfasst, bei dem man das freie Wasser, das außerhalb der geladenen Wäsche (30) vorhanden ist, aus dem Waschbottich (3) ablaufen lässt;
   dadurch gekennzeichnet, dass nach der Ablaufphase und vor der Waschmittel-Einführphase das Verfahren eine weitere Drehphase der Waschtrommel (4), um eine Wassermenge (We) aus der geladenen Wäsche (30) zu entziehen, und eine weitere Phase, bei der man die Wassermenge (We) aus dem Waschbottich (3) ablaufen lässt, umfasst, wobei die Menge des Waschmittel befördernden Wassers (W) im Wesentlichen gleich der Wassermenge (We) ist, die aus der geladenen Wäsche (30) in der weiteren Drehphase entzogen wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Waschmittel-Einführphase die Einführung einer Menge von Waschmittel (D) in einen zentralen Bereich der Waschtrommel (4) umfasst.

3. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Bezugsdrehgeschwindigkeit (Sd) basierend auf der Menge und/oder der Art der geladenen Wäsche (30) angegeben wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Bezugsdrehzahl (Sd) zwischen 80 RPM und 120 RPM liegt.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Waschtrommel (4) während eines vorbestimmten Zeitraums, der ausreicht, um die gewünschte Menge des Waschmittels (D) in den Waschbottich (3) einzuführen, auf der Bezugsdrehzahl (Sd) gedreht wird.

6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es ferner einen Schritt zum Kontrollieren der Unwucht der geladenen Wäsche (30) in der Waschtrommel (4) nach der Ablaufphase umfasst.

7. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** die Waschmittel-Einführphase die Einführung der Menge des Waschmittels (D) in einen mittleren Bereich der Waschtrommel (4) anhand eines Umlaufkreislaufs (216) umfasst, der Flüssigkeiten aus einem unteren Bereich des Waschbottichs (3) aufnimmt.

8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** er ferner den Schritt des Erhitzens des Waschmittel befördernden Wassers (W) umfasst.

9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** er in einer Frontlader-Waschmaschine (1; 200) ausgeführt wird, die einen Vordertürzugang (8) aufweist.

10. Waschmaschine (1; 200), die geeignet ist, um ein Verfahren nach einem der vorhergehenden Ansprüche umzusetzen.

11. Waschmaschine (1; 200) nach Anspruch 10, **dadurch gekennzeichnet, dass** sie eine Frontlader-Waschmaschine ist.

Revendications

1. Procédé pour laver du linge (30) dans une machine à laver le linge (1 ; 200) comprenant une cuve de lavage (3) externe à un tambour de lavage rotatif (4) approprié pour recevoir du linge (30), le procédé comprenant :

   - une phase de chargement dans laquelle du linge (30) est chargé dans ledit tambour de lavage (4) ;
   - une phase de mouillage dans laquelle ledit linge chargé (30) est mouillé ;
   - une phase d'introduction de détergent dans laquelle un détergent (D) est introduit à l'intérieur de ladite cuve de lavage (3), ladite phase d'introduction de détergent comprend l'utilisation d'une quantité d'eau de transport de détergent

(W) pour transporter ladite quantité de détergent (D) dans ladite cuve (3) ;

Pendant ladite phase d'introduction de détergent, ledit tambour de lavage (4) est amené à tourner à une vitesse de rotation de référence (Sd) à laquelle ledit linge chargé (30) est collé à la surface intérieure (4a) dudit tambour de lavage (4) et le procédé comprenant, après ladite phase de mouillage et avant ladite phase d'introduction de détergent, une étape de purge, à partir ladite cuve de lavage (3), de l'eau libre présente à l'extérieur dudit linge chargé (30) ;
caractérisé par le fait qu'après ladite phase de purge et avant ladite phase d'introduction de détergent, le procédé comprend une phase supplémentaire de rotation dudit tambour de lavage (4) de façon à extraire une quantité d'eau (We) dudit linge chargé (30), et une phase supplémentaire de purge de ladite quantité d'eau (We) à partir de ladite cuve de lavage (3), ladite quantité d'eau de transport de détergent (W) étant sensiblement égale à ladite quantité d'eau (We) extraite dudit linge chargé (30) dans ladite phase supplémentaire de rotation.

2. Procédé selon la revendication 1, **caractérisé par le fait que** ladite phase d'introduction de détergent comprend l'introduction d'une quantité de détergent (D) dans une région centrale dudit tambour de lavage (4).

3. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** ladite vitesse de rotation de référence (Sd) est définie sur la base de la quantité et/ou du type dudit linge chargé (30).

4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** ladite vitesse de rotation de référence (Sd) est comprise entre 80 tr/min et 120 tr/min.

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** ledit tambour de lavage (4) est amené à tourner à ladite vitesse de rotation de référence (Sd) pendant une période de temps préétablie suffisante pour introduire la quantité souhaitée dudit détergent (D) dans ladite cuve de lavage (3).

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il comprend en outre une étape de contrôle de déséquilibre dudit linge chargé (30) dans ledit tambour de lavage (4) après ladite phase de purge.

7. Procédé selon la revendication 2, **caractérisé par le fait que** ladite phase d'introduction de détergent comprend l'introduction de ladite quantité dudit détergent (D) dans une région centrale dudit tambour de lavage (4) au moyen d'un circuit de recirculation (216) prélevant des liquides à partir d'une région inférieure de ladite cuve de lavage (3).

8. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il comprend en outre l'étape de chauffage de ladite eau de transport de détergent (W).

9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il est mis en oeuvre dans une machine à laver à chargement frontal (1 ; 200) ayant un accès à porte avant (8).

10. Machine à laver le linge (1 ; 200) appropriée pour mettre en oeuvre un procédé selon l'une quelconque des revendications précédentes.

11. Machine à laver le linge (1 ; 200) selon la revendication 10, **caractérisée par le fait qu'**elle est une machine à laver à chargement frontal.

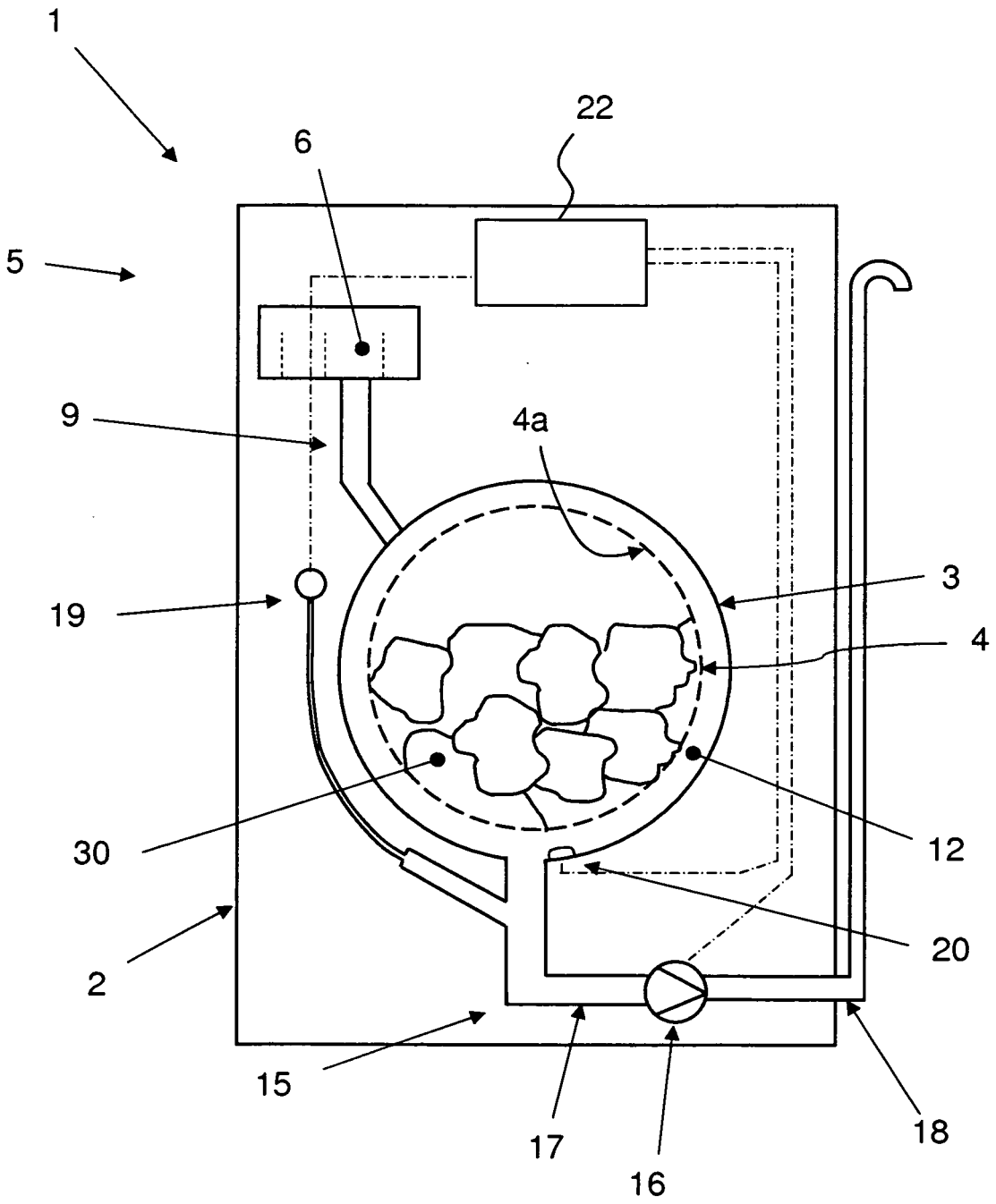


FIG. 1

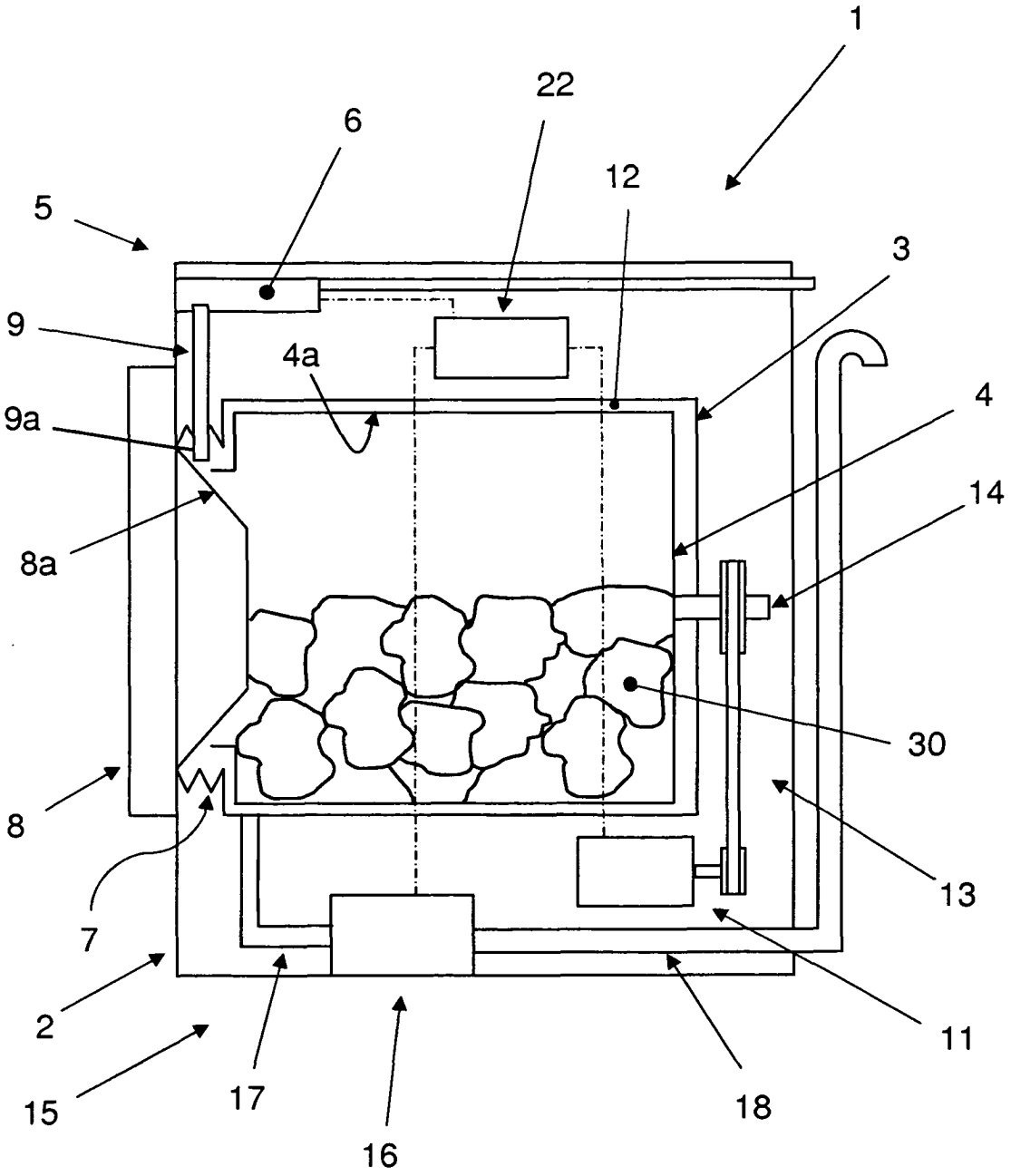


FIG. 2

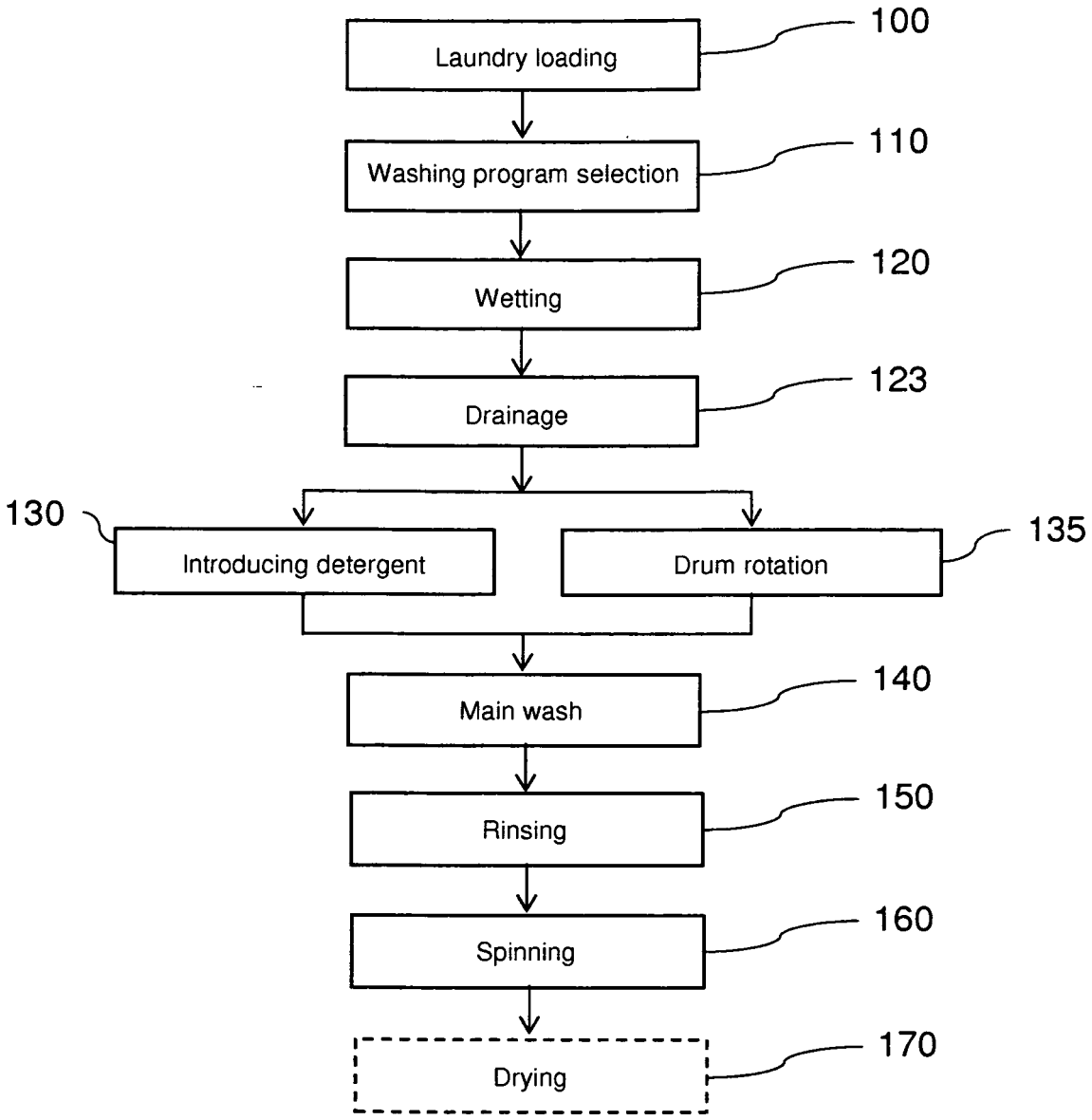

Laundry loading
100
Washing program selection
110
Wetting
120
Drainage
123
130
Introducing detergent
Drum rotation
135
Main wash
140
Rinsing
150
Spinning
160
Drying
170

FIG. 3

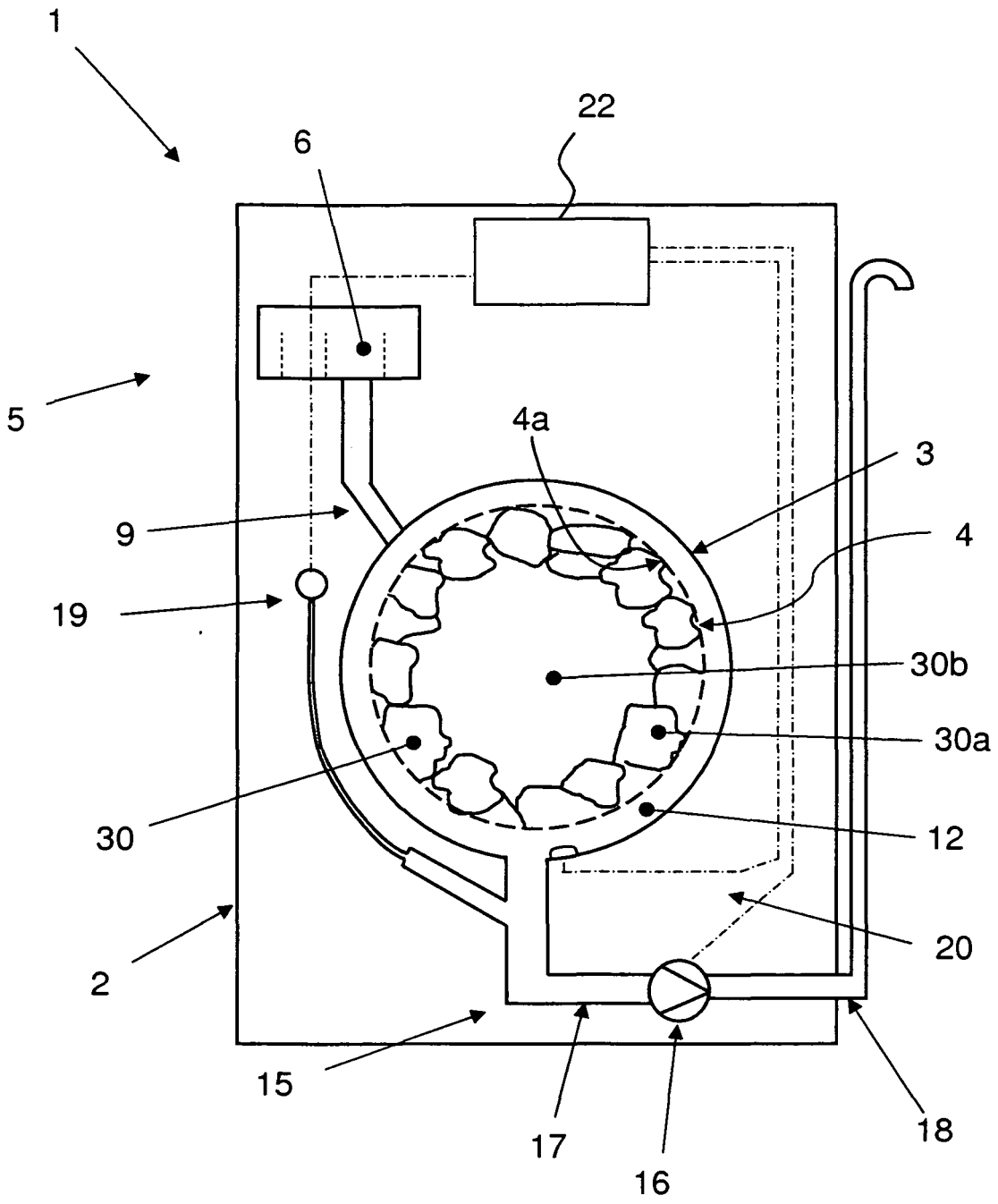


FIG. 4

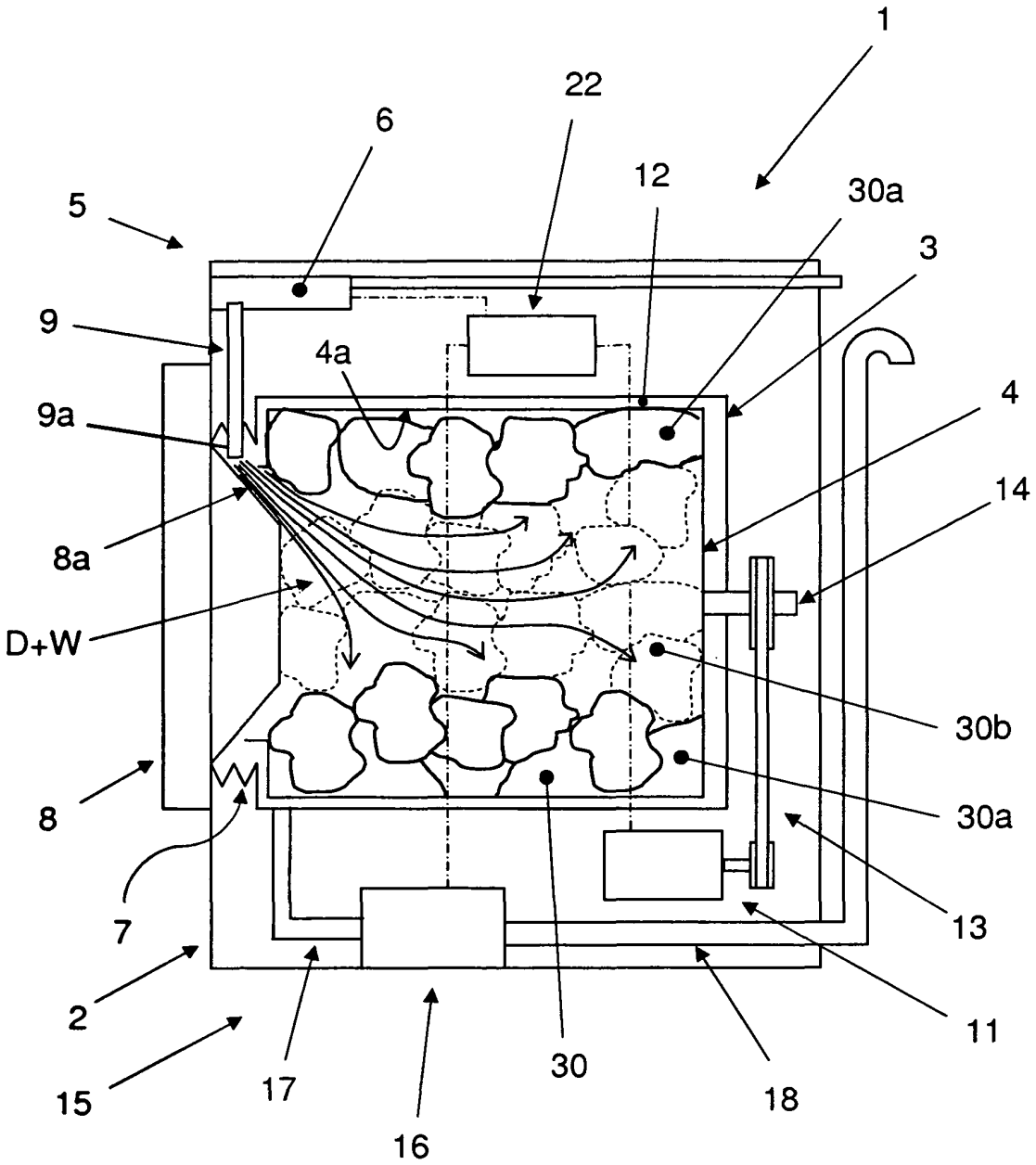


FIG. 5

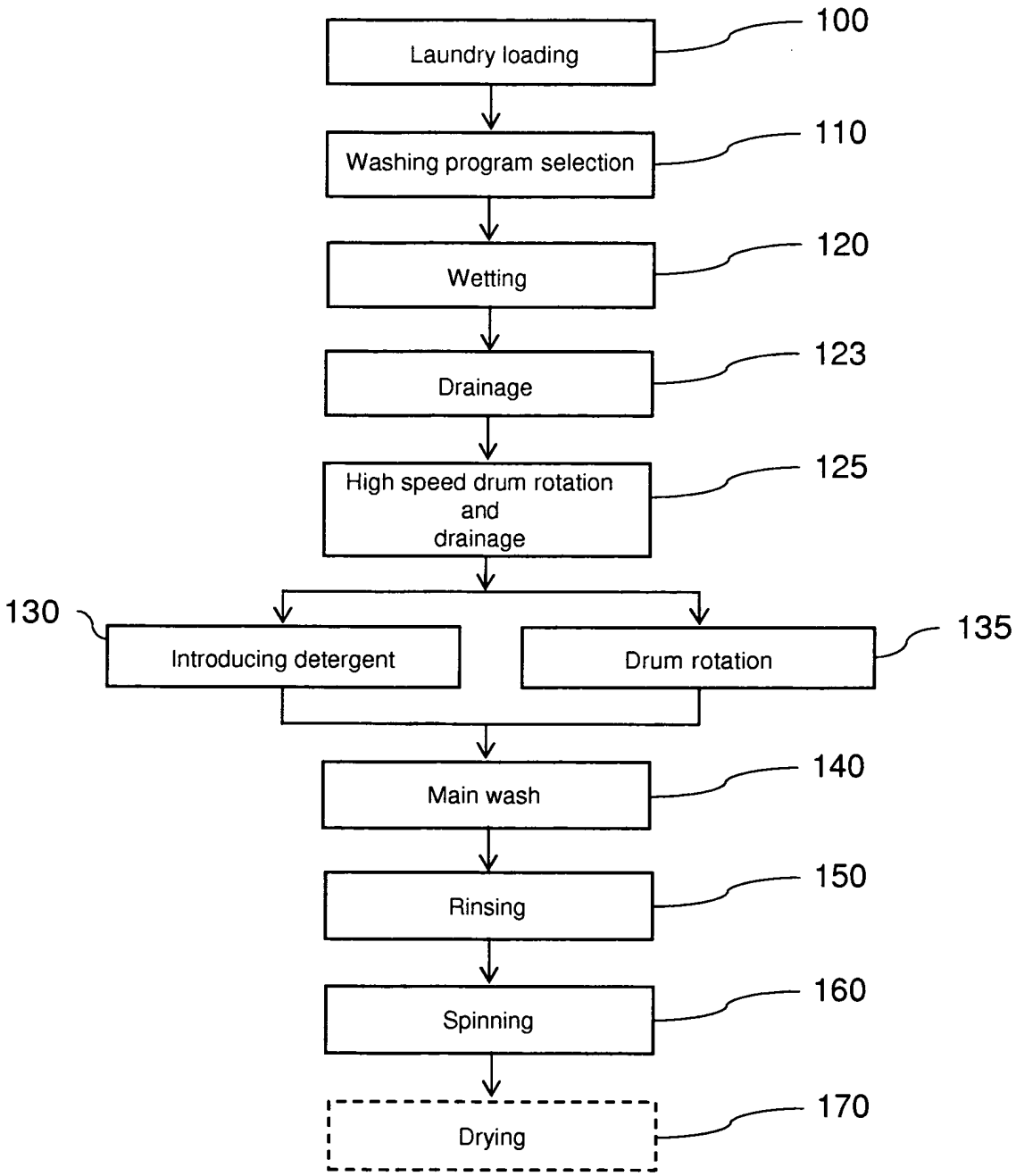

Laundry loading
100
Washing program selection
110
Wetting
120
Drainage
123
High speed drum rotation and drainage
125
130
Introducing detergent
Drum rotation
135
Main wash
140
Rinsing
150
Spinning
160
Drying
170

FIG. 6

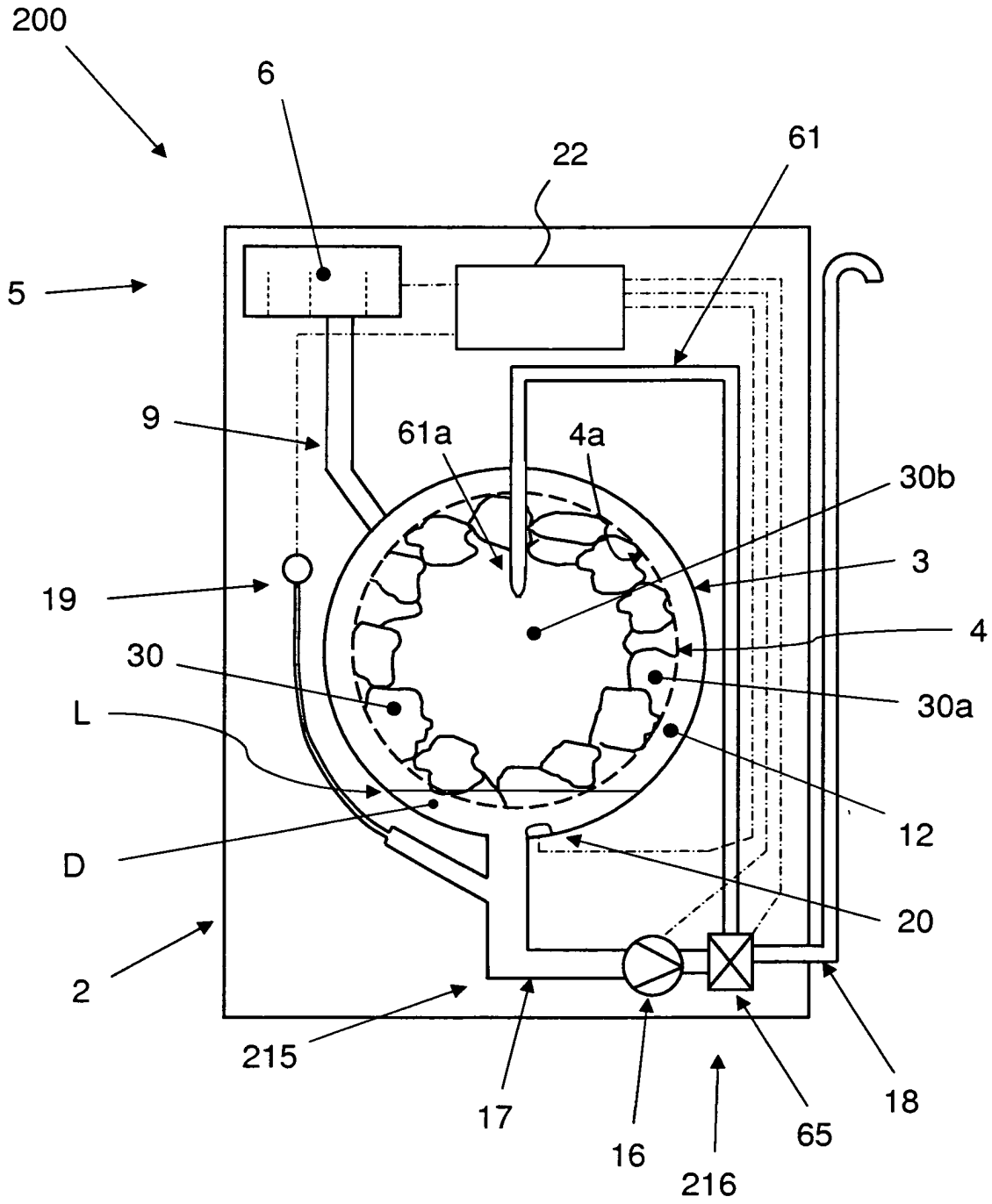


FIG. 7

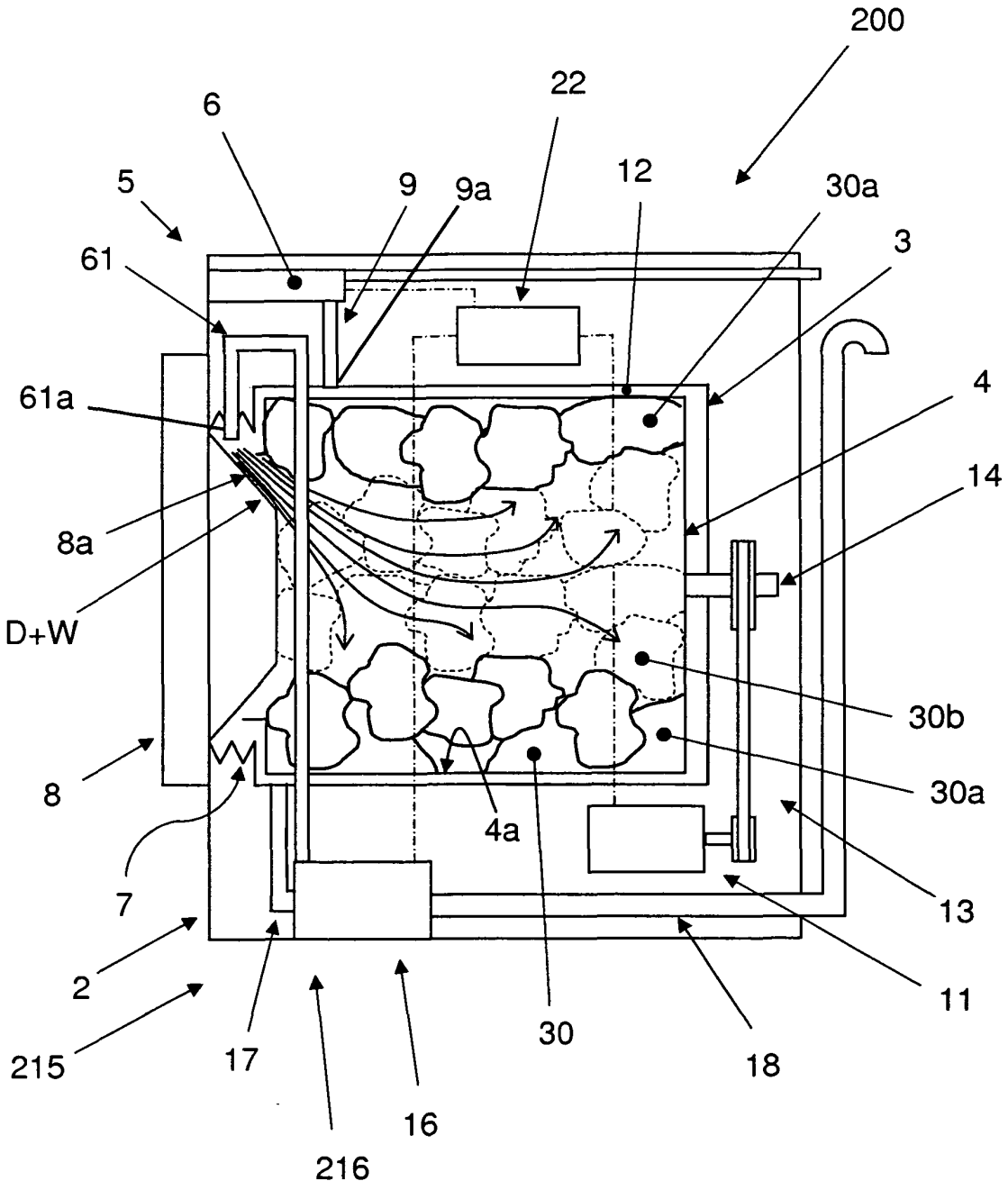

200
22
6
5
9
9a
12
30a
3
61
61a
4
14
8a
D+W
30b
30a
8
4a
13
7
2
11
215
17
30
18
16
216

FIG. 8

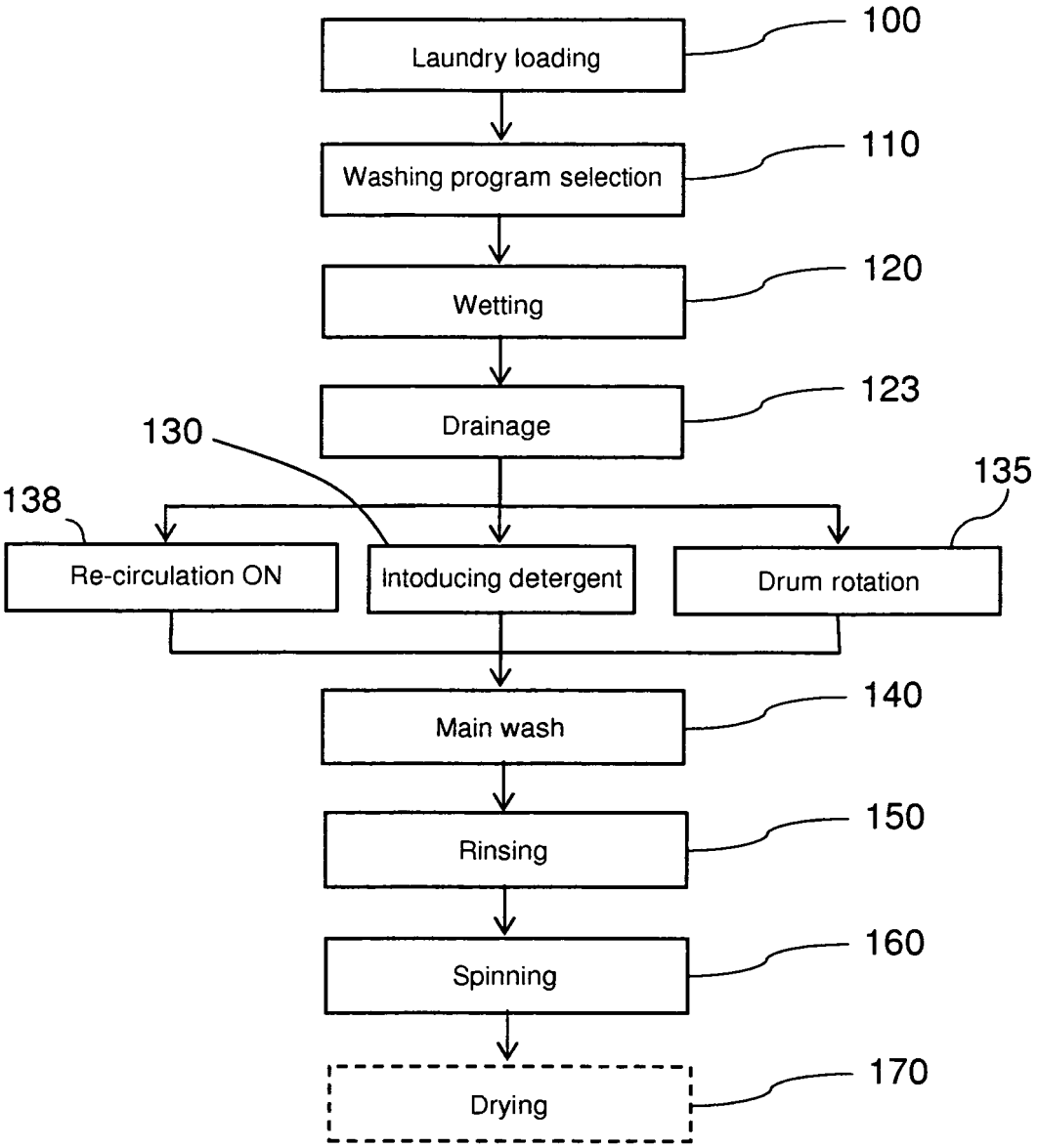

Laundry loading
100
Washing program selection
110
Wetting
120
Drainage
123
130
135
138
Re-circulation ON
Intoducing detergent
Drum rotation
Main wash
140
Rinsing
150
Spinning
160
Drying
170

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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- US 5345637 A **[0020]**
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