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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 Wäschewaschmaschine sowie Wäschewaschmaschine

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 capable of performing a more efficient foam level control.

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 drum.

[0007] Laundry washing machines typically comprise a water inlet circuit and a products supply unit 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 comprising a drain pump that may operate both during the initial phases of the washing program and at the end of the same to drain the dirty water.

[0009] According to the known technique, a complete washing program 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 the drum is rotated and the water contained therein is typically heated to a predetermined temperature based on the washing program selected by the user. During the main washing phase the drum is rotated so as to apply also a mechanical cleaning action on the laundry. Immediately after the main washing phase, in an intermediate draining phase the drum is typically rotated at high rotation speed, in such a way that dirty washing liquid (i.e. water mixed with detergent) is extracted from the laundry, and this dirty washing liquid is drained by the water draining devices.

[0011] After the intermediated drain phase, the washing cycle typically comprises a rinsing phase which usually comprises one or more rinsing cycles. In the rinsing cycle, clean rinse water is first added to the laundry, so as to be absorbed by the laundry and remove from the latter detergent and/or dirty particles not previously removed by washing liquid, and then the drum is rotated at high speed to extract water and dirty particles/detergent from the laundry: the dirty water extracted is drained from the tub to the outside by the water draining devices.

[0012] After the rinsing phase, a final spinning phase allows the extraction of the residual water contained in the wet laundry.

[0013] The water extracted during the final spinning phase is drained towards the outside by means of the water draining devices (during or after the spinning phase).

[0014] Each time the drum is rotated at high speed, and in particular in the intermediated drain phase following the main wash phase, it can happen that an excessive foam formation inside the washing tub occurs, due to the high mechanical action exerted by the high speed rotating drum on the water mixed with detergent present inside the tub.

[0015] An excessive amount of foam in the washing tub can compromise the correct functioning of the drain pump (and in some cased it can also damage the latter) and it can also reduce the rinsing performances of the washing machine, with the risk that an excessive amount of detergent particles remains in the clothes at the end of the washing cycle.

[0016] In addition, an excessive amount of foam can reach the detergent box passing through the tub water inlet, and can overflow.

[0017] Several actions to be activated when an excessive foam formation has been detected have been proposed in the art. For example, the International Patent application published as WO 2007/074037 discloses a washing machine and a control method wherein a sensor detects an excessive foam formation level during the washing process; according to the foam level detected by the sensor, the control method provides the foam to be mixed with water, by varying accordingly the speed and the runtime of the washing cycle, and by activating a draining pump as the drum starts moving so as to drain the water-foam mixture.

[0018] The EP 1 867 773 A1 discloses a method for washing laundry in a washing machine which comprises a washing phase, a draining phase and a rinsing phase.

[0019] During a repetition of the washing step, water can be added.

[0020] In other cases, known in the art traditional machines provide different solutions to reduce an excessive amount of foam formation when the detected foam amount exceeds a pre-determined threshold value, such as, for example, by decreasing the drum rotation speed, by increasing the temperature of the washing cycling and/or by spraying water onto the foam.

[0021] However, the laundry washing machines of the known art pose some drawbacks. In fact, in particular when using a detergent with high foaming properties, and if the drum is accelerated quickly in order to reach the spin speed, the known methods for removing the foam when an excessive foam amount is detected can be not

so effective, with the result that an excessive amount of foam can remain in the washing tub, creating the above mentioned drawbacks.

[0022] Therefore the object of the invention is providing a laundry washing machine with a washing system which reduces the risk that an excessive foam amount present in the washing tub negatively affects one or more phases of the washing cycle, and in particular the phases in which washing liquid is drained by the drain pump.

[0023] It is another object of the invention to provide a laundry washing machine that makes it possible to improve the washing efficiency of the machine itself.

DISCLOSURE OF INVENTION

[0024] The applicant has found that by adding, immediately after the main washing phase end before the intermediate draining phase, a foam prevention phase during which the formation of foam is hindered, wherein said foam prevention phase is performed even if foam is not present in the washing tub, the risk of formation of an excessive foam amount in the washing tub in the following spinning phase is highly reduced.

[0025] The foam prevention phase is a phase to be performed, immediately after the main wash, independently on the actual presence or detection of foam in the tub; in other words, while the known methods are "active methods", that performs some corrective actions only if and after that the foam is detected (which can be too late, in particular when using a detergent having a high foam formation activity), the claimed method is a sort of "passive method", which directly intervenes on the causes of the foam formation (e.g. the water dilution, the rotation speed of the washing drum), in order to create conditions which are unfavourable to foam formation. Therefore the claimed method does not aim to intervene on the foam when already formed, but it tries to avoid foam formation from the beginning, independently of the fact that foam is already present or not.

[0026] Therefore the claimed method is much more effective than known "active methods" in protecting the correct functioning of the washing cycle, since the risk of having in the washing tub a foam amount so high that it is no more possible to reduce it by standard methods (e.g. reducing drum rotation or increasing the solution dilution) is highly reduced.

[0027] In a first aspect, in compliance with the above aim, according to the present invention there is provided a method for washing laundry in a laundry washing machine as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0028] Such a washing machine used in the method of the present invention is of the type comprising:

- a washing tub external to a rotatable washing drum adapted to receive laundry;
- a water supply circuit to supply water into said washing tub;
- a washing product supplier to supply a detergent into said washing tub.

[0029] Furthermore, the method of the present invention for washing laundry in such a laundry washing machine type comprises the following phases:

a) a laundry wetting phase which comprises the introduction of water and detergent into said washing tub and the supplying of said water and detergent to laundry contained in said washing tub;
b) a main washing phase during which said washing drum is rotated at a first rotation speed to exert a mechanical washing action on the laundry contained in said washing tub;
c) an intermediated draining phase during which said washing drum is rotated at a second rotation speed, higher than said first rotation speed, causing the extraction from said laundry of at least part of a solution of water and detergent therein contained, which is drained off said washing tub;
d) a rinsing phase comprising the introduction of water into said washing tub and the rotation of said washing drum at a third rotation speed;
e) a final draining phase during which said washing drum (4) is rotated at a fourth rotation speed, higher than said third rotation speed, causing the extraction from said laundry of at least part of the liquid therein contained, which is drained off said washing tub (3).

[0030] Furthermore, the method of the present invention for washing laundry in such a laundry washing machine further comprises, between said main washing phase b) and said intermediated draining phase c), a foam prevention phase b1) during which the formation of foam during the following intermediated draining phase c) is hindered, wherein said foam prevention phase b1) is performed even if foam is not present in said washing tub and comprises the following step: b1_a) a dilution step in which a first quantity of clean water is loaded into said washing tub (3) to reduce the detergent concentration in said washing tub (3), wherein during said dilution step b1_a) said washing drum (4) is rotated at a fifth rotation speed, lower than said second and forth rotating speeds, in order to increase the clean water absorption of the laundry, dilute possible foam and reduce new foam creation.

[0031] By the method of the present invention, the risk that an excessive foam amount is generated in the washing tub during the phases of the washing cycle is reduced.

[0032] Thus, the negative effects on the washing efficiency are prevented.

[0033] In said a laundry wetting phase a), in a first advantageous alternative, water and detergent are separately introduced into said washing tub, mixed therein after their introduction, and then supplied to laundry contained in said washing tub. In a second advantageous alternative, water and detergent are contemporaneously

introduced into said washing tub, thus their mixing occurs during the introduction itself into said washing tub and then the mixing is supplied to laundry contained in said washing tub.

[0034] Furthermore and preferably, though not necessarily, said first rotation speed of the washing drum during said main washing phase of the method of the present invention is comprised between 10 rpm to 80 rpm, preferably 40 rpm.

[0035] Furthermore and preferably, though not necessarily, said second rotation speed of the washing drum during the intermediated draining phase of the method of the present invention is comprised between 200 rpm to 1600 rpm, preferably 900 rpm.

[0036] By this way, at least part of said water and detergent contained in said laundry is extracted from the latter, and it can be drained off said washing tub, for example by activating a drain pump.

[0037] Furthermore and preferably, though not necessarily, said third rotation speed of the washing drum during said rinsing phase of the method of the present invention is comprised between 10 rpm to 80 rpm, preferably 40 rpm.

[0038] Furthermore and preferably, though not necessarily, said fourth rotation speed of the washing drum during the final draining phase of the method of the present invention is comprised between 400 rpm to 1800 rpm, preferably between 800 rpm and 1400 rpm.

[0039] In this way, at least part of the liquid contained in said laundry is extracted from the latter and can be drained off said washing tub, for example by activating a drain pump.

[0040] According to the invention, the foam prevention phase b1) comprises the following step: b1_a) a dilution step in which a first quantity of clean water is loaded into said washing tub to reduce the detergent concentration in the washing tub.

[0041] Furthermore and preferably, though not necessarily, said foam prevention phase b1) comprises also the following step:

b1_b) an evacuating step in which water is drained from said washing tub, in order to try to drain possible foam already present in the washing tub before performing said intermediate draining phase c).

[0042] Thus, in a first aspect of said foam prevention phase b1) of the method of the present invention, said foam prevention phase b1) may advantageously comprise at least a dilution step b1_a) in which a first quantity of clean water is loaded into said washing tub.

[0043] In this way, the concentration of detergent in the washing tub is reduced and, since the generation of foam is directly proportional to the detergent concentration, also the amount of foam generated is reduced.

[0044] Furthermore and preferably, though not necessarily, in said dilution step b1_a), the first quantity of clean water is loaded into the washing tub even if one or both the following conditions are fulfilled:

- the temperature of any internal region of said washing tub is below a prefixed first threshold;
- the level of the liquid inside said washing tub is above a prefixed second threshold.

[0045] Advantageously the first quantity of clean water is loaded into the washing tub whichever is the temperature of any internal region of said washing tub, thus, even if such a temperature is particularly low, such for example lower than a prefixed first threshold value of °C (e.g. lower than 20°C). In other words, the loading of the first quantity of clean water into the washing tub advantageously does not depend on the internal temperature of the tub. Advantageously the first quantity of clean water is loaded into the washing tub whichever is the level of the liquid inside said washing tub, thus, even if such a the level of the liquid is particularly high, such for example higher than a prefixed second threshold value of 200 mm (measured from the lower region of the washing tub). In other words, the loading of the first quantity of clean water into the washing tub advantageously does not depend on the water level internal to the tub.

[0046] According to the invention, during said dilution step b1_a), said washing drum is rotated at a fifth rotation speed, lower than said second rotation speed of the washing drum during the intermediated draining phase of the method of the present invention.

[0047] In this way, the clean water absorption of the laundry is increased, so that detergent present in the laundry is better diluted and new foam creation reduced.

[0048] Furthermore and preferably, though not necessarily, during said dilution step b1_a), said washing drum is rotated at a fifth rotation speed, lower than said forth rotation speed of the washing drum during the final draining phase of the method of the present invention.

[0049] Furthermore and preferably, though not necessarily, said fifth rotation speed of the washing drum dilution step b1_a) of the method of the present invention is comprised between 10 rpm to 80 rpm, preferably 40 rpm.

[0050] Furthermore and preferably, though not necessarily, during said dilution step b1_a), during a first time interval said washing drum is repeatedly rotated at said fifth rotation speed for a second time interval and then stopped for a third time interval during which the washing drum does not rotate. Each series constituted by such a second time interval followed by such a third time interval may be repeated as many times as necessary during such a first time interval.

[0051] By this series of repeated time intervals during which the washing drum alternatively rotates and does not rotate, the laundry inside the washing tub is subjected to a delicate movement.

[0052] Furthermore and preferably, though not necessarily, said first time interval is comprised between 1 minute and 6 minutes, preferably 3 minutes.

[0053] Furthermore and preferably, though not necessarily said second time interval is comprised between 2 second to 10 seconds, preferably 4 seconds.

[0054] Furthermore and preferably, though not necessarily said third time interval is comprised between 8 seconds and 20 seconds, preferably 12 seconds.

[0055] In this way, the time intervals during which the washing drum rotates are much shorter than the time intervals during which the washing drum does not rotate.

[0056] In a second aspect of said foam prevention phase b1) of the method of the present invention, said foam prevention phase b1) advantageously comprises at least an evacuating step b1_b) in which water is drained from said washing tub.

[0057] In this way, foam possibly already present in the washing tub before performing said intermediate draining phase c) is drained as much as possible during said evacuating step b1_b).

[0058] Furthermore and preferably, though not necessarily, during said evacuating step b1_b) said washing drum is not rotated.

[0059] In this way, due to the fact that said washing drum is not rotated, the possibility that more foam is generated due to the rotation of the drum is reduced..

[0060] Furthermore and preferably, though not necessarily, said foam prevention phase b1) comprises performing a single dilution step b1_a) followed by a single evacuating step b1_b).

[0061] In this way, by loading fresh water to dilute the washing solution (i.e. water mixed with detergent) present in the washing drum and then by evacuating the washing solution and the possible foam, better performances in in preventing the formation of foam are obtained.

[0062] Furthermore and preferably, though not necessarily, said foam prevention phase b1) comprises performing, after said evacuating step b1_b), one or more further dilution steps b1_a), each followed by a further evacuating step b1_b).

[0063] In this way the foam still possibly present in the washing drum after the execution of a first dilution step b1_a) followed by a first evacuating step b1_b) is removed, and the washing solution dilution is also increased, which reduces the risk of further foam formation.

[0064] The cycles of dilution step b1_a) followed by an evacuating step b1_b) may be repeated as many times as needed.

[0065] Furthermore and preferably, though not necessarily, during each dilution step b1_a) performed during said foam prevention phase b1), a same quantity of clean water can be loaded into said washing tub.

[0066] In this way, being the amount of clean water loaded into said washing tub always the same for each of said dilution step b1_a), the control of such a quantity of clean water loaded is rendered easier.

[0067] Alternatively, furthermore and preferably, though not necessarily, the quantity of clean water loaded into said washing tub during a dilution step b1_a) can be different from the quantity of clean water loaded into said washing tub during a following dilution step b1_a); more preferably, the quantity of clean water loaded into said washing tub during a dilution step b1_a) is higher than the quantity of clean water loaded into said washing tub during a following dilution step b1_a).

[0068] In this way, having already diluted the washing solution present in the washing drum through a first dilution step b1_a), there is a amount of detergent in the washing tub to be diluted in the following dilution step b1_a). Thus, it is sufficient loading a lower amount of clean water during the following dilution step b1_a), obtaining a water saving.

[0069] Furthermore and preferably, though not necessarily, during each evacuating step b1_b) except the last performed one, water is drained until the water level in the washing tub goes below a first prefixed threshold, but without completely emptying the washing tub, while in the last performed evacuation step b1_b), water is drained until substantially emptying the washing tub.

[0070] In this way, except the last performed evacuating step b1_b), some amount of water is left in the washing tub in order to make it easier the dilution of possible foam created during drum rotation.

[0071] On the contrary, during the last performed evacuating step b1_b), water present in the washing tub is completely drained until, at the end of said last performed evacuating step b1_b), the washing tub is completely empty.

[0072] In this way, the foam possibly present in the washing tub during the main washing phase is completely removed, too.

[0073] Furthermore and preferably, though not necessarily, said quantity of clean water loaded into said washing tub during said dilution step b1_a) is comprised between 1 to 5 litres, preferably between 2 to 4 litres, more preferably 3 litres.

[0074] Furthermore and preferably, though not necessarily, said wetting phase a) and/or said main washing phase b) comprise a heating phase during which the water introduced into said washing tub is heated at a predetermined temperature based on the washing program selected by the user.

[0075] Preferably predetermined temperature values of the washing program selected by the user are for examples in the range between 20 °C and 90 °C.

[0076] In this way, better washing cycles performances are obtained.

[0077] Furthermore and preferably, though not necessarily, the method of the present invention further comprises an auxiliary recirculating phase suitable for withdrawing liquid from a bottom region of said washing tub and for re-admitting such a liquid into an upper region of said washing tub.

[0078] In this way the liquid level inside said washing tub is decreased by activating said recirculation circuit; then, the re-admitted liquid wets the laundry, so as to further improve the dissolution of the water and detergent collected therein.

[0079] In a second aspect thereof, in compliance with the above aims, according to the present invention there is provided a laundry washing machine as claimed in

Claim 15 suited to implement the method of the invention described above.

[0080] Furthermore and preferably, though not necessarily, said laundry washing machine for washing laundry according to the method of the present invention further comprises a recirculation circuit suitable for withdrawing liquid from a bottom region of said washing tub and for re-admitting such a liquid into said washing tub in such a way that the re-admitted liquid wets the laundry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0081] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of preferred embodiments of the invention, provided with reference to the enclosed drawings.

[0082] In said drawings:

- Figure 1 shows a perspective view of a laundry washing machine implementing the method according to a first embodiment of the invention;
- Figure 2 shows a schematic view of the hydraulic circuit laundry washing machine of Figure 1, in which some elements have not been illustrated;
- Figure 3 shows a graph representing the drum speed, the amount of loaded water, the amount of water drained and the water level during some phases of the method for washing laundry in a laundry washing machine according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0083] The present invention has proved to be particularly advantageous when applied to laundry washing machines, as described below. It should in any case be underlined that the present invention is not limited to laundry washing machines.

[0084] On the contrary, the present invention can be conveniently applied to laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry).

[0085] In the present description, therefore, the term "laundry washing machine" will refer to both simple laundry washing machines and laundry washing-drying machines.

[0086] With reference to Figure 1 a laundry washing machine 1 is illustrated, in which a method according to a first embodiment of the invention is advantageously implemented.

[0087] The laundry washing machine 1 comprises an external casing or housing 2, in which a washing tub 3 is provided that contains a washing drum 4 where the laundry to be treated can be loaded, as illustrated in Figure 2.

[0088] The tub 3 and the drum 4 both preferably have a substantially cylindrical shape, thus forming a substantially annular gap 17 therebetween.

[0089] The housing 2 is provided with a loading/unloading door 8 which allows access to the drum 4.

[0090] 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, not illustrated.

[0091] The drum 4 is advantageously rotated by an electric motor, not illustrated, which preferably transmits the rotating motion to the shaft of the drum 4, advantageously by means of a belt/pulley system. In a different embodiment of the invention, the motor can be directly associated with the shaft of the drum 4.

[0092] The lower portion 3a of the tub 3 preferably comprises a seat 15 suitable for receiving a heater device 10. Preferably the seat 15 is made in a single piece with the tub 3, for example by injection moulding.

[0093] The heater device 10 preferably comprises an electrical resistor of serpentine type. The heater device 10 is advantageously horizontally placed in the seat 15 and it extends preferably substantially from the front part up to the rear part of the tub 3.

[0094] Between the lower side of the heater 10 and the upper surface 15a of the seat 15 a gap 16 is defined, as illustrated for example in Figure 2.

[0095] A water supply circuit 5 is arranged preferably in the upper part of the laundry washing machine 1 and is suited to supply water into the tub 3. The water supply circuit of a laundry washing machine is well known in the art, and therefore it will not be described in detail.

[0096] The laundry washing machine 1 advantageously comprises a removable drawer 6 provided with various compartments suited to be filled with washing and/or rinsing products (i.e. detergent D, softener, etc.).

[0097] In a preferred embodiment, the water is supplied into the tub 3 from the water supply circuit 5, advantageously by making it flow through the drawer 6 and then through a supply pipe 18.

[0098] The water which reaches the tub 3 can, in this case, 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, for example bypassing the compartments of the drawer 6, or passing through an empty compartment of the drawer 6.

[0099] 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.

[0100] The water supply 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.

[0101] Laundry washing machine 1 advantageously comprises a water outlet circuit 25 suitable for withdrawing liquid from the lower portion 3a of the tub 3.

[0102] The water outlet circuit 25 advantageously comprises a drain pump 26, a first pipe 27, only schematically represented in enclosed figures, connecting the tub 3 to the drain pump 26 and an outlet pipe 28 ending outside

the housing 2.

[0103] Advantageously, the first pipe 27 communicates with the upper surface 15a of the seat 15, preferably via a draining hole, not illustrated, provided in seat 15.

[0104] The water outlet circuit 25 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.

[0105] The water outlet circuit 25 preferably comprises a filtering device, not shown in the figures, placed between the bottom of the tub 3 and the drain pump 26 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.) which could damage or obstruct the drain pump 26.

[0106] This filtering device can preferably be removed, and then for example cleaned, for example through a gate 14 placed advantageously on the front of the housing 2 of the laundry washing machine 1.

[0107] Activation of the drain pump 26 drains the liquid, i.e. dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside.

[0108] Laundry washing machine 1 preferably, but not necessarily, further comprises a recirculation circuit 30 adapted to drain liquid from the the lower portion 3a of the tub 3 and to re-admit such a liquid into an upper region of the tub 3.

[0109] The recirculation circuit 30 preferably comprises the drain pump 26 and a recirculation pipe 31. The recirculation pipe 31 advantageously ends with a terminal nozzle 31a, placed advantageously in an upper region of the tub 3.

[0110] The exit of the drain pump 26 is advantageously fluidly connected to a valve, not illustrated, properly controlled in order to allow selective drainage of the water exiting drain pump 26 towards the outside through the outlet pipe 28, or towards the upper region of the tub 3 through the recirculation pipe 31.

[0111] In a further embodiment, not illustrated, the recirculation circuit may comprise a dedicated recirculation pipe connecting a bottom region of the tub with a 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.

[0112] In general, the recirculation circuit is properly realized for transferring a portion of a liquid from a region of the tub to another region of the tub in order to enhance absorption of washing liquid by the laundry.

[0113] The laundry washing machine 1 advantageously comprises a liquid level sensor device 19 suited to sense (or detect) the liquid level inside the tub 3.

[0114] The sensor device 19 preferably comprises a pressure sensor which senses the pressure in the tub 3. From the values sensed by the sensor device 19 it is possible to determine the level of the liquid inside the tub 3. In another embodiment, not illustrated, laundry washing machine 1 may preferably comprise (in addition to or as a replacement of the pressure sensor) a level sensor (for example mechanical, electro-mechanical, optical, etc.) adapted to sense (or detect) the liquid level inside the tub 3.

[0115] Laundry washing machine 1 advantageously comprises a control unit, not illustrated, connected to the various parts of the laundry washing machine 1 in order to ensure its operation. The control unit is preferably connected to the water inlet circuit 5, the water outlet circuit 25, the heating device 10 and the electric motor and receives information from the various sensors provided on the laundry washing machine 1, like the pressure sensor 19, a temperature sensor, etc.

[0116] Laundry washing machine 1 advantageously comprises an interface unit 12, connected to control unit, accessible to the user and by means of which the user may select and set the washing parameters, like 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.

[0117] Based on the parameters acquired by the interface 12, the control unit sets and controls the various parts of the laundry washing machine 1 in order to carry out the desired washing program.

[0118] A first embodiment of the washing method according to the invention is described herein below with reference to Figures 2 and 3.

[0119] The laundry to be washed is first placed inside the drum 4. By operating on the interface unit 12 the user selects the desired washing program 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 12, for example the value of the washing temperature, the different rotating speed of the drum 4 in each of the laundry washing phases, the duration of washing program, etc.

[0120] Once the user has selected the desired washing program, the control unit sets the laundry washing machine 1 so that it starts the washing program.

[0121] In a further embodiment, the selection of the desired washing program may be performed before placing the laundry into the drum 4.

[0122] According to the method for washing laundry of the present invention, a laundry wetting phase a) is activated wherein a quantity Qd of detergent D together with a first quantity $Q1_w$ of water W is introduced into the tub 3. The quantity Qd of detergent D and the first quantity $Q1_w$ of water W substantially form a washing solution intended to wet the laundry.

[0123] The introduction of the quantity Qd of detergent D takes place preferably through the water inlet circuit 5; the quantity Qd of detergent D, be it powder or liquid, is preferably brought out of the apposite compartment of the drawer 6 by the first quantity $Q1_w$ of water W that passes through the proper compartment of the drawer 6.

[0124] In different embodiments, the quantity Qd of detergent D and the first quantity $Q1_w$ of water W may be

advantageously introduced singularly (i.e. one independently from the other) into the tub 3, preferably, but not necessarily, at different times.

[0125] Advantageously, all the quantity Qd of detergent D and all the first quantity $Q1_w$ of water W introduced into the tub 3 in such a laundry wetting phase a) fall down on the lower portion 3a of the tub 3.

[0126] Therefore substantially all the detergent D and the water W reach the lower portion 3a of the tub 3 without any absorption from the laundry.

[0127] That is advantageously guaranteed by the advantageous lateral position of the supply pipe 18 with respect to the tub 3. The detergent D and the water W, in fact, fall down until the lower portion 3a of the tub 3, preferably by flowing inside the annular gap 17 between the tub 3 and the drum 4, as schematically illustrated in Figure 2.

[0128] Nevertheless, a certain quantity of the detergent D and/or of water W may also reach the laundry inside the drum 4.

[0129] The detergent D moves towards the lower portion 3a of the tub 3 due to its density which is higher than the density of water W.

[0130] In this advantageous embodiment he detergent D tends to accumulate in the gap 16 below the heater device 10.

[0131] At the same time, the water W inside the tub 3 reaches a first level L1.

[0132] In a preferred embodiment, the first level LI is advantageously a level at which the water W at least partially touches the drum 4.

[0133] Once such a laundry wetting phase a) above described is completed, according to the method for laundry washing of the present invention a main washing phase b) is activated, during which the washing drum 4 is rotated to exert a mechanical washing action on the laundry contained in the washing tub 3.

[0134] Such a main washing phase b) advantageously comprises several repeated time sections, each of them being preferably formed by a first period of time preferably of about 13 seconds, during which the washing drum 4 is rotated at a first rotation speed, for example at about 40 rpm, preferably followed by a second, shorter period of time preferably of about 3 seconds during which the washing drum 4 is stopped until it does not rotate. Each of such repeated time sections preferably constituted by such a first period of time and such a second, shorter period of time is repeated, for example, 10 to 15 times. A consistent mechanical action exerted by the rotation of the washing drum 3 is thus obtained during such a main washing phase b).

[0135] According to the method for laundry washing of the present invention, after the end of the main washing phase b) and before starting rotating the washing drum at high speed in the succeeding draining phase c), a foam prevention phase b1) is activated.

[0136] The foam prevention phase b1) is a phase performed at the end of the main wash phase b), independently on the actual presence or detection of foam in the tub, in order to create conditions which are unfavourable to foam formation.

[0137] In a first preferred embodiment of the present invention, the foam prevention phase b1) comprises a first dilution step b1_a), in which a first quantity of clean water, preferably about 3 litres, is loaded into the washing tub 3 to reduce the detergent concentration in the washing tub, followed by a first evacuating step b1_b), in which water is drained from the washing tub 3, in order to try to drain possible foam already present in the washing tub 3 before performing the intermediate following draining phase c).

[0138] Preferably, such a first quantity of clean water is loaded into the washing tub 3 even if one or both the following conditions are fulfilled: i) the temperature of any internal region of the washing tub 3 is below a prefixed first threshold, for example about 20 °C; or ii) the level of the liquid inside the washing tub 3 is above a prefixed second threshold, for example about 200 mm.

[0139] During the dilution step b1_a), a first time interval, of preferably about 3 minutes, is subdivided in several time sections each of them being preferably constituted by a second time interval, of preferably about 4 seconds, during which the washing drum 4 is rotated at a fifth rotation speed, preferably of about 40 rpm, and by a third time interval, of preferably about 12 seconds, during which the washing drum 4 is in a not-rotation phase. Such time sections constituted by such a second and such a third time intervals may be repeated as many times as needed, for example 10 to 15 times.

[0140] Such rotations of the washing drum 4 during such repeated time sections allow the clean water absorption of the laundry to be increased; furthermore, possible foam present in the washing drum 4 is better diluted and the risk of new foam creation is further reduced.

[0141] By comparing the speed and the rotation to not-rotation time ratio of the washing drum 4 during the previous disclosed main washing phase b) with the same data related to the washing drum 4 during such and dilution step b1_a), it is evident that the mechanical action exerted by the washing drum 4 during the dilution step b1_a) is more gentle than the same mechanical action during the main washing phase b).

[0142] In fact, the rotation speed of the washing drum 4 during the dilution step b1_a) (being preferably 40 rpm) is preferably lower than the rotation speed of the washing drum 4 during the main washing phase b) (being preferably 50 rpm); furthermore, the rotation to not-rotation time ratio of the washing drum 4 during the dilution step b1_a) (preferably 4 seconds versus 12 seconds) is preferably much lower than the rotation to not-rotation time ratio of the washing drum 4 during the main washing phase b) (preferably 13 seconds versus 3 seconds).

[0143] In such a first embodiment of the present invention, during the foam prevention phase b1), when such a first dilution step b1_a) is ended, such a first evacuating step b1_b) is preferably activated, during which the wash-

ing drum 4 is preferably not rotated. Such a first evacuating step b1_b) allows water to be drained from the washing tub 3, in order to drain also possible foam already present in the washing tub 3. During such a first evacuating step b1_b), water is preferably drained from the washing tub 3 in such a way not to leave completely empty the washing tub 3 drum, but leaving a minimum amount of water in the lower portion 3a of it, such as for example at an height lower than 25 mm. This minimum amount of water is useful to further dilute possible foam created during drum rotation.

[0144] When the first evacuating step b1_b) is ended, a second dilution step b1_a) is preferably activated, preferably followed by a second evacuating step b1_b), the second dilution step b1_a) being preferably substantially identical to the first dilution step b1_a) as above described, while the second evacuating step b1_b) preferably differs from the first evacuating step b1_b) for the fact that, at the end of the second evacuating step b1_b), the washing tub 3 is preferably completely empty.

[0145] Thus, at the end of the foam prevention phase b1), the possible foam present in the washing tub 3 after the laundry wetting phase a) or possibly created in it during the main washing phase b) is preferably drained off the washing tub 3 itself, allowing the following phases of the laundry washing cycle to obtain better performances in the absence of foam in the washing tub 3.

[0146] During each of the first and of the second dilution step b1_a) performed during the foam prevention phase b1), preferably the same quantity, preferably about 3 liters, of clean water is loaded into the washing tub 3. By loading always the same amount of clean water in each of the dilution step b1_a), the control of such a quantity of clean water loaded into the washing tub 3 is rendered easier.

[0147] Then, when such a foam prevention phase b1) is completed, an intermediated draining phase c) is activated, during which the washing drum 4 is rotated at a second rotation speed, higher than such a first rotation speed, for example 500 rpm, so as to cause at least part of the water and detergent contained in the laundry to be extracted from the latter and drained off the washing tub 3 (e.g. by activating the drain pump 26.

[0148] Then, when such an intermediated draining phase c) is completed, a rinsing phase d) is activated, comprising the introduction of water into the washing tub (3) and the rotation of the washing drum 4 at a third rotation speed, for example 50 rpm. Typically the rinsing phase d) comprises one or more rinsing cycles. In the rinsing cycle, the clean rinse water is first added to the laundry, so as to be absorbed by the laundry from which the detergent and/or dirty particles not previously removed by washing liquid are removed. Then, the drum is preferably rotated at high speed to extract water and dirty particles/detergent from the laundry; the dirty water extracted is drained from the tub to the outside by the water draining devices.

[0149] Then, when such a rinsing phase d) is completed, a final draining phase e) is activated, during which the washing drum 4 is rotated at a fourth rotation speed, higher than such a third rotation speed, for example at 1600 rpm, so as to cause at least part, preferably as much as possible, of the liquid contained in the laundry to be extracted from the latter.

[0150] The water extracted during the final draining phase is drained towards the outside, preferably by means of the drain pump 26, during or after the drum rotation at the fourth rotation speed.

[0151] Figure 3 shows a graph summarizing the drum speed, the amount of water loaded in the washing tub, the amount of water drained from the washing tub and the water level in the washing tub during the phases of the first embodiment above disclosed according to the method for washing laundry of the present invention.

[0152] In Figure 3, X-axis shows the time elapsed (in seconds) from the beginning of the washing method, Y-axis on the right side of the drawing shows the drum speed (in round per minute -rpm), Y-axis on the left side of the drawing shows the water level (in mm), measured by the sensor device 19.

[0153] Now the method according to the invention will be described with reference to Figure 3.

[0154] Before starting the method, user loads laundry in the washing drum 4 and preferably selects a washing program (e.g. cotton 60°C, synthetics 40°C, etc.) to be performed by the machine, e.g. by operating on an user interface, not illustrated. Then the method for washing laundry can be started (e.g. by pressing a start button on a user interface, not illustrated).

[0155] In a further advantageously embodiment, not illustrated, the laundry washing machine 1 can be adapted to automatically detect the kind of loaded laundry (e.g. by suitable sensors or procedures), in which case user is advantageously not required to select a washing program.

[0156] With reference to Figure 3, from the beginning of the washing cycle (not illustrated in Figure 3), to instant ta, the following phases are performed:

a) a laundry wetting phase which comprises the introduction of water and detergent (preferably contemporaneously) into the washing tub 3 and the supplying of this water and detergent to laundry contained in the washing tub;

b) a main washing phase during which the washing drum is rotated at a first rotation speed to exert a mechanical washing action on the laundry contained in the washing tub 3.

[0157] From instant ta to instant tg, a foam prevention phase b1) is performed, during which the formation of foam during a following intermediated draining phase c) (i.e. the phase from instant tg to th in Figure 3) is hindered, wherein this foam prevention phase b1) is performed even if foam is not present in the washing tub 3.

[0158] As mentioned above, from instant tg to instant

th, an intermediated draining phase c) is performed, during which the washing drum 4 is rotated at a second rotation speed, higher than above mentioned first rotation speed, causing the extraction from the laundry of at least part of a solution of water and detergent therein contained, which is drained off the washing tub 3 (preferably by activating the drain pump 26).

[0159] Figure 3 does not show the part of the method according to the invention following the intermediated draining phase c); anyway, after instant t_h the method advantageously comprises a rinsing phase d) comprising the introduction of water into the washing tub 3 and the rotation of the washing drum 4 at a third rotation speed, and a final draining phase e) during which the washing drum is rotated at a fourth rotation speed, higher than the third rotation speed (e.g. 1400 rpm), causing the extraction from the laundry of at least part of the liquid therein contained, which is drained off the washing tub.

[0160] With reference to Figure 3, the foam prevention phase b1) advantageously comprises a dilution step b1_a), from instant t_a to t_c, in which a first quantity of clean water (preferably around 3 litres) is loaded (from instant t_a to t_b,) into the washing tub 3 to reduce the detergent concentration in the latter.

[0161] During the first dilution step b1_1), from instant t_a to t_c the drum is preferably rotated at a fifth rotation speed, slightly lower than the first rotation speed and having longer interval periods of time during which the drum is stopped (no rotation) compared with the previous main washing phase b).

[0162] From instant t_c to t_d a first evacuating step b1_b) is performed, during which the washing drum is preferably not rotated; during such a first evacuating step b1_b), water and foam are drained from the washing tub (see the dotted line corresponding to "Water Drained" in Figure 3); at the same time, the water level inside the washing tub decreases in a very relevant way, in such a way that at the end of such evacuating step b1_b) a minimum amount of water only is left inside the washing tub 3.

[0163] Advantageously a second dilution step b1_b) is performed from instant t_d to t_f, during which a second quantity of clean water (preferably slightly lower than the first quantity of clean water mentioned above, see the line) is loaded into the washing tub (from instant t_d to t_e,) to further increase the dilution of the liquid solution present in the washing tub 3, and the drum 4 is preferably rotated in the same way as the first dilution step b1_a) disclosed above.

[0164] From instant t_f and t_g the second dilution step b1_a) ends and a second evacuating step b1_b) starts, while the washing drum is preferably not rotated; during such a second evacuating step b1_b), water and possible foam present in the washing tub 3 are drained from latter, leaving substantially completely empty the washing tub 3 (no water and no foam inside it).

[0165] After instant t_g the intermediate draining phase c) is performed, during which the washing drum 4 is rotated at a second rotation speed, higher than such a first rotation speed, causing the extraction from the laundry of at least part of the solution of water and detergent therein contained, which is drained off the washing tub 3. This intermediate draining phase c) ends at instant t_h after which one or more rinsing phases, not illustrated, and a final draining phase, also not illustrated, are advantageously performed.

[0166] Thus, the method for laundry washing of the present invention allows the reduction of foam creation during spinning and the foam elimination reinforcement before the end of wash spinning.

[0167] Furthermore, the following advantages are obtained: i) reduction of the balancing time of the spinning phase because normally high quantity of foam increases the water level and for this reason the balancing algorithm performs several trials until the water level is under a safe thresholds; ii) improvement of the rinsing efficiency due to the low or null presence of foam; iii) reduction of water consumption, energy consumption and time duration: in many known washing machines, if the end wash spin is skipped due to the presence of an excessive amount of foam, the washing cycle automatically adds a rinse phase.

[0168] In a second advantageous embodiment of the present invention, the foam prevention phase b1) preferably comprises only one dilution step b1_a), followed by only one evacuating step b1_b), wherein such an only one dilution step b1_a) is the same of the first dilution step b1_a) above described in the first embodiment of the present invention, while such an only one evacuating step b1_b) is the same of the second evacuating step b1_b) above described in such a first embodiment of the present invention.

[0169] In practice, in this second embodiment of the present invention, at the end of the only one evacuating step b1_b) all the water contained in the washing tub 3 is drained off, leaving completely empty the washing tub 3.

[0170] In a third advantageous embodiment of the present invention, the foam prevention phase b1) preferably comprises performing a cycle of a dilution step b1_a), preferably followed by an evacuating step b1_b), such a cycle being repeated as many times as needed, preferably according to the amount of foam detected in the washing tub 3.

[0171] In this third embodiment of the present invention, each dilution step b1_a) and each evacuating step b1_b) in such a cycle are preferably, respectively, the same of the first dilution step and of the first evacuating step b1_b) above described in the first embodiment of the present invention, with the proviso that, at the end of the evacuating step b1_b) of the very last cycle in the foam prevention phase b1), all the water contained in the washing tub 3 is drained off, leaving completely empty the washing tub 3.

[0172] In such a second and third embodiments of the present invention, wherein the foam prevention phase b1) comprises more than one cycle formed by a dilution

step b1_a) followed by an evacuating step b1_b), the amount of water loaded into the washing tub 3 during each of such dilution steps b1_a) is preferably always the same, preferably about 3 liters, as already described in the first embodiment of the present invention.

[0173] In a fourth advantageous embodiment of the present invention, the foam prevention phase b1) preferably comprises more than one cycle formed by a dilution step b1_a) followed by an evacuating step b1_b); preferably, as in such a second and third embodiments of the present invention above described, the quantity of clean water loaded into the washing tub 3 during a dilution step b1_a), preferably about 3 litres, is greater than the quantity of clean water loaded into the washing tub 3 during a following dilution step b1_a), for example 2 litres. In this way, having already reduced the detergent concentration in the washing drum 3 through a first dilution step b1_a), there is less detergent in the washing tub to be diluted in the following dilution step b1_a). Thus, it is sufficient to load a lower amount of clean water during the following dilution step b1_a), obtaining a water saving.

[0174] In a fifth preferred embodiment of the present invention, the foam prevention phase b1) preferably comprises only a dilution step b1_a), without being followed by any evacuating step b1_b). That means that the foam prevention phase b1) only comprises a dilution step b1_a) with the addition of clean water, followed by a rotation of the washing drum 4 without performing any evacuating step b1_b) before the rinsing phase d).

[0175] In a sixth advantageous embodiment of the present invention, the foam prevention phase b1) preferably comprises only an evacuating step b1_b), without being preceded by any dilution step b1_a). That means that the foam prevention phase b1) only comprises a foam evacuating step b1_b), during which the washing drum 4 is not rotated, without adding clean water, before the rinsing phase d).

[0176] Further variants of previous disclosed embodiments are also available.

[0177] For example, in any one of the first to sixth embodiments of the present invention disclosed above, such a wetting phase a) and/or such a main washing phase b) may further comprise an additional heating phase during which the water introduced into the washing tub 3 is heated at a predetermined temperature, for example from 30 °C to 90 °C, based on the washing program selected by the user.

[0178] Furthermore, in any one of the first to sixth embodiments of the present invention disclosed above, with or without such an additional heating phase, the method for laundry washing may further comprise an auxiliary recirculating phase suitable for withdrawing liquid from the lower portion 3a of the washing tub 3 and for re-admitting such a liquid into an upper region of the washing tub 3.

[0179] In this way, the liquid level inside the washing tub 3 is decreased by activating the recirculation circuit 30; then, the re-admitted liquid wets the laundry, so as to further improve the dissolution of the water and detergent collected therein.

[0180] All the advantages mentioned above with reference to the first embodiment are therefore also achieved in the second to sixth embodiments of the present invention and in any of the variants as above disclosed.

[0181] 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 laundry washing machine with improved foam reduction before the intermediate draining phase c) starts with respect to the machines of the prior art.

[0182] It is underlined that the laundry washing machine illustrated in the enclosed figures, and with reference to which some embodiments of the method according to the invention have been described, is 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.

[0183] Furthermore, it is also underlined that the laundry washing machine illustrated in the enclosed figures, and with reference to which some embodiments of the method according to the invention have been described, present a recirculation circuit 30 and/or a heater device 10; however it is clear that the method according to the invention can be applied as well to laundry washing machines that are free of such a recirculation circuit 30 and/or a heater device 10, substantially without any modification.

[0184] 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.

Claims

1. Method for washing laundry in a laundry washing machine (1) of the type comprising:

   - a washing tub (3) external to a rotatable washing drum (4) adapted to receive laundry;
   - a water supply circuit (5) to supply water into said washing tub (3);
   - a washing product supplier (6) to supply a detergent into said washing tub (3); the method for washing laundry comprising the following phases:

   a) a laundry wetting phase which comprises the introduction of water and detergent into said washing tub (3) and the supplying of said water and detergent to laundry con-

tained in said washing tub (3);
b) a main washing phase during which said washing drum (4) is rotated at a first rotation speed to exert a mechanical washing action on the laundry contained in said washing tub (3);
c) an intermediated draining phase during which said washing drum (4) is rotated at a second rotation speed, higher than said first rotation speed, causing the extraction from said laundry of at least part of a solution of water and detergent therein contained, which is drained off said washing tub (3);
d) a rinsing phase comprising the introduction of water into said washing tub (3) and the rotation of said washing drum (4) at a third rotation speed;
e) a final draining phase during which said washing drum (4) is rotated at a fourth rotation speed, higher than said third rotation speed, causing the extraction from said laundry of at least part of the liquid therein contained, which is drained off said washing tub (3),

characterized in that
it comprises, between said main washing phase b) and said intermediated draining phase c), a foam prevention phase b1) during which the formation of foam during the following intermediated draining phase c) is hindered, wherein said foam prevention phase b1) is performed even if foam is not present in said washing tub (3) and comprises the following step: b1_a) a dilution step in which a first quantity of clean water is loaded into said washing tub (3) to reduce the detergent concentration in said washing tub (3), wherein during said dilution step b1_a) said washing drum (4) is rotated at a fifth rotation speed, lower than said second and forth rotating speeds, in order to increase the clean water absorption of the laundry, dilute possible foam and reduce new foam creation.

2. Method according to claim 1, wherein said foam prevention phase b1) comprises also the following step: b1_b) an evacuating step in which water is drained from said washing tub (3), in order to try to drain possible foam already present in the washing tub (3) before performing said intermediate draining phase c).

3. Method according to claim 2, wherein in said dilution step b1_a) said first quantity of clean water is loaded even if one or both the following conditions are fulfilled:

- the temperature of any internal region of said washing tub (3) is below a prefixed first threshold;
- the level of the liquid inside said washing tub (3) is above a prefixed second threshold.

4. Method according to one of the claims 1 to 3, wherein, during said dilution step b1_a), during a first time interval said washing drum (4) is repeatedly rotated at said fifth rotation speed for a second time interval and then stopped for a third time interval.

5. Method according to one of the claims 1 to 4, wherein said fifth rotation speed is comprised between 10 rpm to 80 rpm, preferably 40 rpm.

6. Method according to claim 4 or 5, wherein said first time interval is comprised between 1 minute and 6 minutes, preferably 3 minutes, and wherein said second time interval is comprised between 2 second to 10 seconds, preferably 4 seconds, and wherein said third time interval is comprised between 8 seconds and 20 seconds, preferably 12 seconds.

7. Method according to one or more of claims 2 to 6, wherein during said evacuating step b1_b) said washing drum (4) is not rotated.

8. Method according to one or >more of claims 2 to 7, wherein said foam prevention phase b1) comprises performing a single dilution step b1_a) followed by a single evacuating step b1_b).

9. Method according to one or more of claims 2 to 7, wherein said foam prevention phase b1) comprises performing, after said evacuating step b1_b), one or more further dilution steps b1_a), each followed by a further evacuating step b1_b).

10. Method according to claim 9, wherein
during each dilution step b1_a) performed during said foam prevention phase b1), a same quantity of clean water is loaded into said washing tub (3);
or wherein
the quantity of clean water loaded into said washing tub (3) during a dilution step b1_a) is different from the quantity of clean water loaded into said washing tub (3) during a following dilution step b1_a);
or wherein
the quantity of clean water loaded into said washing tub (3) during a dilution step b1_a) is higher than the quantity of clean water loaded into said washing tub (3) during a following dilution step b1_a).

11. Method according to claim 9 or 10, wherein
during each evacuating step b1_b) except the last performed one, water is drained until the water level in the washing tub (3) goes below a first prefixed threshold, but without completely emptying the washing tub (3), while in the last performed evacu-

ation step b1_b), water is drained until substantially emptying the washing tub (3).

12. Method according to one or more of claims 2 to 11, wherein the quantity of clean water loaded into said washing tub (3) during said dilution step b1_a) is comprised between 1 to 5 litres, preferably between 2 to 4 litres, more preferably 3 litres.

13. Method according to any of the preceding claims, wherein said wetting phase a) and/or said main washing phase b) comprise a heating phase during which the water introduced into said washing tub (3) is heated at a predetermined temperature based on the washing program selected by the user.

14. Laundry washing machine comprising a control unit adapted to implement the method according to any of the preceding claims.

Patentansprüche

1. Verfahren zum Waschen von Wäsche in einer Waschmaschine (1), die Folgendes umfasst:

- einen Waschbehälter (3), der sich außerhalb einer zum Aufnehmen von Wäsche eingerichteten drehbaren Waschtrommel (4) befindet,
- einen Wasserzuführungskreislauf (5) zum Zuführen von Wasser in den Waschbehälter (3),
- eine Waschproduktzufuhr (6) zum Zuführen eines Waschmittels in den Waschbehälter (3),

wobei das Verfahren zum Waschen von Wäsche die folgenden Phasen umfasst:

a) eine Wäschedurchnässungsphase, welche die Einleitung von Wasser und Waschmittel in den Waschbehälter (3) und das Zuführen des Wassers und des Waschmittels zu in dem Waschbehälter (3) enthaltener Wäsche umfasst,
b) eine Hauptwaschphase, während derer die Waschtrommel (4) mit einer ersten Drehzahl gedreht wird, um eine mechanische Waschwirkung auf die in dem Waschbehälter (3) enthaltene Wäsche auszuüben,
c) eine Zwischenablassphase, während derer die Waschtrommel (4) mit einer zweiten Drehzahl gedreht wird, die höher ist als die erste Drehzahl, wodurch der Wäsche zumindest ein Teil einer in dieser enthaltenen Lösung aus Wasser und Waschmittel entzogen wird, welcher aus dem Waschbehälter (3) abgelassen wird,
d) eine Spülphase, welche die Einleitung von Wasser in den Waschbehälter (3) und die Drehung der Waschtrommel (4) mit einer dritten Drehzahl umfasst,
e) eine abschließende Ablassphase, während derer die Waschtrommel (4) mit einer vierten Drehzahl gedreht wird, die höher ist als die dritte Drehzahl, wodurch der Wäsche zumindest ein Teil der in dieser enthaltenen Flüssigkeit entzogen wird, welcher aus dem Waschbehälter (3) abgelassen wird,

dadurch gekennzeichnet, dass
es zwischen der Hauptwaschphase b) und der Zwischenablassphase c) eine Schaumunterbindungsphase b1) umfasst, während derer die Bildung von Schaum während der nachfolgenden Zwischenablassphase c) verhindert wird, wobei die Schaumunterbindungsphase b1) auch dann durchgeführt wird, wenn in dem Waschbehälter (3) kein Schaum vorhanden ist, und den folgenden Schritt umfasst: b1_a) einen Verdünnungsschritt, bei dem eine erste Klarwassermenge in den Waschbehälter (3) eingespeist wird, um die Waschmittelkonzentration in dem Waschbehälter (3) zu senken, wobei während des Verdünnungsschritts b1_a) die Waschtrommel (4) mit einer fünften Drehzahl gedreht wird, die niedriger ist als die zweite und vierte Drehzahl, um die Klarwasserabsorption der Wäsche zu erhöhen, etwaigen Schaum zu mindern und die Bildung von neuem Schaum zu verringern.

2. Verfahren nach Anspruch 1, wobei die Schaumunterbindungsphase b1) zudem den folgenden Schritt umfasst:
b1_b) einen Absaugschritt, bei dem Wasser aus dem Waschbehälter (3) abgelassen wird, um zu versuchen, etwaigen bereits in dem Waschbehälter (3) vorhandenen Schaum vor dem Durchführen der Zwischenablassphase c) abzulassen.

3. Verfahren nach Anspruch 2, wobei in dem Verdünnungsschritt b1_a) die erste Klarwassermenge auch dann eingespeist wird, wenn eine oder beide der folgenden Bedingungen erfüllt sind:

- die Temperatur eines Innenbereichs des Waschbehälters (3) liegt unterhalb eines vorab festgelegten ersten Grenzwerts,
- der Füllstand der Flüssigkeit in dem Waschbehälter (3) liegt über einem vorab festgelegten zweiten Grenzwert.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei während des Verdünnungsschritts b1_a) während eines ersten Zeitintervalls die Waschtrommel (4) wiederholt für ein zweites Zeitintervall mit der fünften Drehzahl gedreht und dann für ein drittes Zeitintervall angehalten wird.

5. Verfahren nach einem der Ansprüche 1 bis 4, wobei die fünfte Drehzahl im Bereich zwischen 10 UpM bis 80 UpM und bevorzugt bei 40 UpM liegt.

6. Verfahren nach Anspruch 4 oder 5, wobei das erste Zeitintervall im Bereich zwischen 1 Minute und 6 Minuten und bevorzugt bei 3 Minuten liegt und wobei das zweite Zeitintervall im Bereich zwischen 2 Sekunden bis 10 Sekunden und bevorzugt bei 4 Sekunden liegt und wobei das dritte Zeitintervall im Bereich zwischen 8 Sekunden und 20 Sekunden und bevorzugt bei 12 Sekunden liegt.

7. Verfahren nach einem oder mehreren der Ansprüche 2 bis 6, wobei während des Absaugschritts b1_b) die Waschtrommel (4) nicht gedreht wird.

8. Verfahren nach einem oder mehreren der Ansprüche 2 bis 7, wobei die Schaumunterbindungsphase b1) ein Durchführen eines einzigen Verdünnungsschritts b1_a) gefolgt von einem einzigen Absaugschritt b1_b) umfasst.

9. Verfahren nach einem oder mehreren der Ansprüche 2 bis 7, wobei die Schaumunterbindungsphase b1) nach dem Absaugschritt b1_b) ein Durchführen eines oder mehrerer weiterer Verdünnungsschritte b1_a) jeweils gefolgt von einem weiteren Absaugschritt b1_b) umfasst.

10. Verfahren nach Anspruch 9, wobei
während jedes während der Schaumunterbindungsphase b1) durchgeführten Verdünnungsschritts b1_a) eine gleiche Klarwassermenge in den Waschbehälter (3) eingespeist wird oder wobei
sich die während eines Verdünnungsschritts b1_a) in den Waschbehälter (3) eingespeiste Klarwassermenge von der während eines nachfolgenden Verdünnungsschritts b1_a) in den Waschbehälter (3) eingespeisten Klarwassermenge unterscheidet oder wobei
die während eines Verdünnungsschritts b1_a) in den Waschbehälter (3) eingespeiste Klarwassermenge höher ist als die während eines nachfolgenden Verdünnungsschritts b1_a) in den Waschbehälter (3) eingespeiste Klarwassermenge.

11. Verfahren nach Anspruch 9 oder 10, wobei während jedes Absaugschritts b1_b) außer dem letzten durchgeführten Wasser abgelassen wird, bis der Wasserfüllstand in dem Waschbehälter (3) unter einen ersten vorab festgelegten Grenzwert sinkt, ohne jedoch den Waschbehälter (3) vollständig zu entleeren, während im letzten durchgeführten Absaugschritt b1_b) Wasser abgelassen wird, bis der Waschbehälter (3) im Wesentlichen entleert ist.

12. Verfahren nach einem oder mehreren der Ansprüche 2 bis 11, wobei die während des Verdünnungsschritts b1_a) in den Waschbehälter (3) eingespeiste Klarwassermenge im Bereich zwischen 1 bis 5 Liter, bevorzugt zwischen 2 bis 4 Liter, und besonders bevorzugt bei 3 Litern liegt.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Durchnässungsphase a) und/oder die Hauptwaschphase b) eine Erwärmungsphase umfassen, während derer das in den Waschbehälter (3) eingeleitete Wasser basierend auf dem durch den Nutzer ausgewählten Waschprogramm auf eine vorab bestimmte Temperatur erwärmt wird.

14. Waschmaschine, die eine Steuereinheit umfasst, die dafür eingerichtet ist, das Verfahren nach einem der vorhergehenden Ansprüche umzusetzen.

Revendications

1. Procédé pour laver du linge dans une machine à laver le linge (1) du type comprenant :

- une cuve de lavage (3) externe à un tambour de lavage rotatif (4) adapté pour recevoir du linge ;
- un circuit d'alimentation d'eau (5) pour introduire de l'eau dans ladite cuve de lavage (3) ;
- un dispositif de fourniture de produit de lavage (6) pour introduire un détergent dans ladite cuve de lavage (3) ;

le procédé pour laver du linge comprenant les phases suivantes :

a) une phase de mouillage de linge qui comprend l'introduction d'eau et de détergent dans ladite cuve de lavage (3) et l'application de ladite eau et dudit détergent au linge contenu dans ladite cuve de lavage (3) ;
b) une phase de lavage principale pendant laquelle ledit tambour de lavage (4) tourne à une première vitesse de rotation afin d'exercer une action de lavage mécanique sur le linge contenu dans ladite cuve de lavage (3) ;
c) une phase de drainage intermédiaire pendant laquelle ledit tambour de lavage (4) tourne à une deuxième vitesse de rotation, supérieure à ladite première vitesse de rotation, entraînant l'extraction dudit linge d'au moins une partie d'une solution d'eau et de détergent contenue dans celui-ci, qui est drainée hors de ladite cuve de lavage (3) ;
d) une phase de rinçage comprenant l'introduction d'eau dans ladite cuve de lavage (3) et la mise en rotation dudit tambour de lavage (4) à une troisième vitesse de rotation ; et

e) une phase de drainage finale pendant laquelle le ledit tambour de lavage (4) tourne à une quatrième vitesse de rotation, supérieure à ladite troisième vitesse de rotation, entraînant l'extraction dudit linge d'au moins une partie du liquide contenu dans celui-ci, qui est drainée hors de ladite cuve de lavage (3),

caractérisé en ce qu'il comprend, entre ladite phase de lavage principale b) et ladite phase de drainage intermédiaire c), une phase de prévention de moussage b1) pendant laquelle la formation de mousse pendant la phase de drainage intermédiaire c) qui suit est empêchée, dans lequel ladite phase de prévention de moussage b1) est exécutée même s'il n'y a pas de mousse dans ladite cuve de lavage (3), et comprenant l'étape suivante : b1_a) une étape de dilution pendant laquelle une première quantité d'eau propre est chargée dans ladite cuve de lavage (3) dans le but de réduire la concentration en détergent dans ladite cuve de lavage (3), dans lequel, pendant ladite étape de dilution b1_a), ledit tambour de lavage (4) est mis en rotation à une cinquième vitesse de rotation, qui est inférieure auxdites deuxième et quatrième vitesses de rotation, dans le but d'augmenter l'absorption d'eau propre du linge, de diluer la mousse éventuelle et de réduire une nouvelle création de mousse.

2. Procédé selon la revendication 1, dans lequel ladite phase de prévention de mousse b1) comprend également l'étape suivante :
b1_b) une étape d'évacuation pendant laquelle de l'eau est drainée hors de ladite cuve de lavage (3), dans le but d'essayer de drainer la mousse éventuelle déjà présente dans la cuve de lavage (3) avant l'exécution de ladite phase de drainage intermédiaire c).

3. Procédé selon la revendication 2, dans lequel, pendant ladite étape de dilution b1_a), ladite première quantité d'eau propre est chargée même si une ou chacune des deux conditions suivante est/sont remplies :

- la température de toute région interne de ladite cuve de lavage (3) est inférieure à un premier seuil prédéfini ; et
- le niveau du liquide à l'intérieur de ladite cuve de lavage (3) est supérieur à un second seuil prédéfini.

4. Procédé selon l'une des revendications 1 à 3, dans lequel, pendant ladite étape de dilution b1_a), pendant un premier intervalle de temps, ledit tambour de lavage (4) est mis en rotation de façon répétée à ladite cinquième vitesse de rotation pendant un deuxième intervalle de temps et est ensuite arrêté pendant un troisième intervalle de temps.

5. Procédé selon l'une des revendications 1 à 4, dans lequel ladite cinquième vitesse de rotation est comprise entre 10 tpm et 80 tpm, et de préférence égale à 40 tpm.

6. Procédé selon la revendication 4 ou 5, dans lequel ledit premier intervalle de temps est compris entre 1 minute et 6 minutes, et de préférence égal à 3 minutes, et dans lequel ledit deuxième intervalle de temps est compris entre 2 secondes à 10 secondes, et de préférence égal à 4 secondes, et dans lequel ledit troisième intervalle de temps est compris entre 8 secondes et 20 secondes, et de préférence égal à 12 secondes.

7. Procédé selon une ou plusieurs des revendications 2 à 6, dans lequel, pendant ladite étape d'évacuation b1_b), ledit tambour de lavage (4) ne tourne pas.

8. Procédé selon une ou plusieurs des revendications 2 à 7, dans lequel ladite phase de prévention de moussage b1) comprend l'exécution d'une seule étape de dilution b1_a) suivie par une seule étape d'évacuation b1_b).

9. Procédé selon une ou plusieurs des revendications 2 à 7, dans lequel ladite phase de prévention de moussage b1) comprend l'exécution, après ladite étape d'évacuation b1_b), d'une ou de plusieurs étape(s) de dilution supplémentaire(s) b1_a), suivie(s) chacune par une étape d'évacuation supplémentaire b1_b).

10. Procédé selon la revendication 9,
dans lequel, pendant chaque étape de dilution b1_a) exécutée pendant ladite phase de prévention de moussage b1), une même quantité d'eau propre est chargée dans ladite cuve de lavage (3) ; ou
dans lequel la quantité d'eau propre chargée dans ladite cuve de lavage (3) pendant une étape de dilution b1_a) est différente de la quantité d'eau propre chargée dans ladite cuve de lavage (3) pendant une étape de dilution suivante b1_a) ; ou
dans lequel la quantité d'eau propre chargée dans ladite cuve de lavage (3) pendant une étape de dilution b1_a) est supérieure à la quantité d'eau propre chargée dans ladite cuve de lavage (3) pendant une étape de dilution suivante b1_a).

11. Procédé selon la revendication 9 ou 10, dans lequel, pendant chaque étape d'évacuation b1_b) à l'exception de la dernière étape exécutée, de l'eau est drainée jusqu'à ce que le niveau d'eau dans la cuve de lavage (3) soit inférieur à un premier seuil prédéfini, mais sans vider complètement la cuve de lavage (3), alors que lors de la dernière étape d'évacuation

b1_b) exécutée, l'eau est drainée jusqu'à ce que la cuve de lavage (3) soit sensiblement vidée.

12. Procédé selon une ou plusieurs des revendications 2 à 11, dans lequel la quantité d'eau propre chargée dans ladite cuve de lavage (3) pendant ladite étape de dilution b1_a) est comprise entre 1 litre à 5 litres, de préférence entre 2 litres à 4 litres, et mieux encore égale à 3 litres.

13. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite phase de mouillage a) et/ou ladite phase de lavage principale b) comprend/comprennent une phase de chauffage pendant laquelle l'eau introduite dans ladite cuve de lavage (3) est chauffée à une température prédéterminée qui est basée sur le programme de lavage sélectionné par l'utilisateur.

14. Machine à laver le linge comprenant une unité de commande adaptée pour mettre en œuvre le procédé selon l'une quelconque des revendications précédentes.

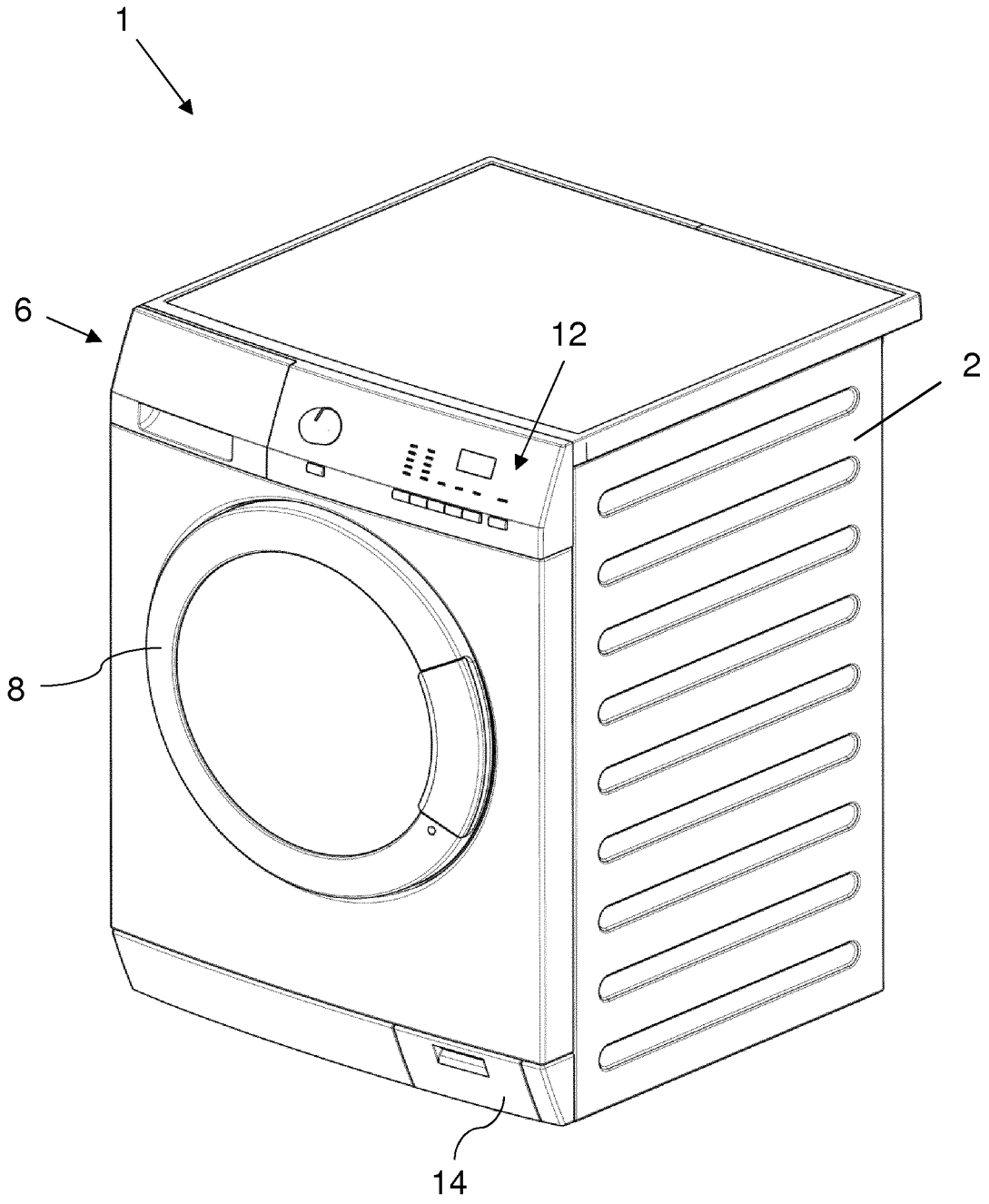


FIG. 1

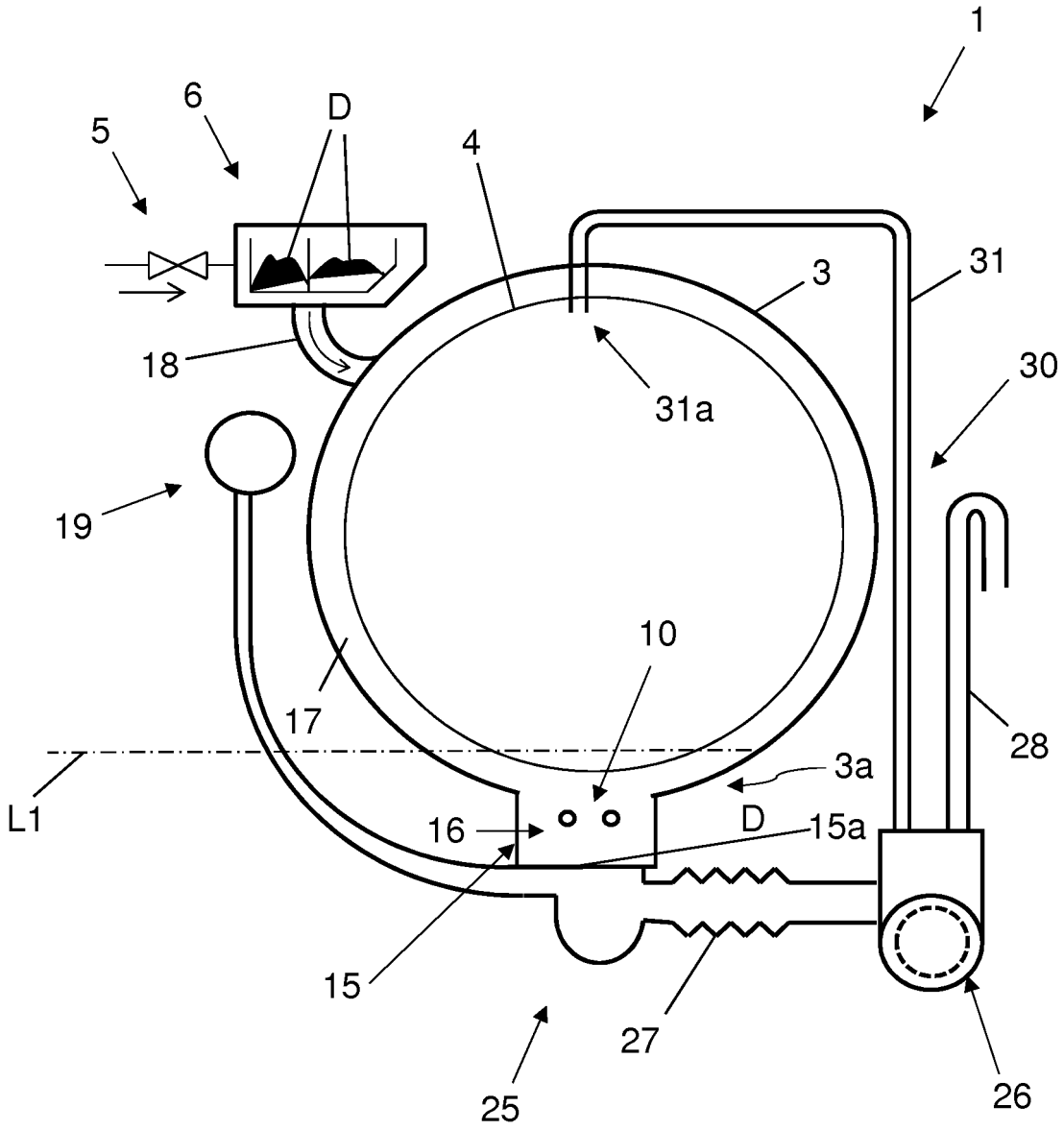
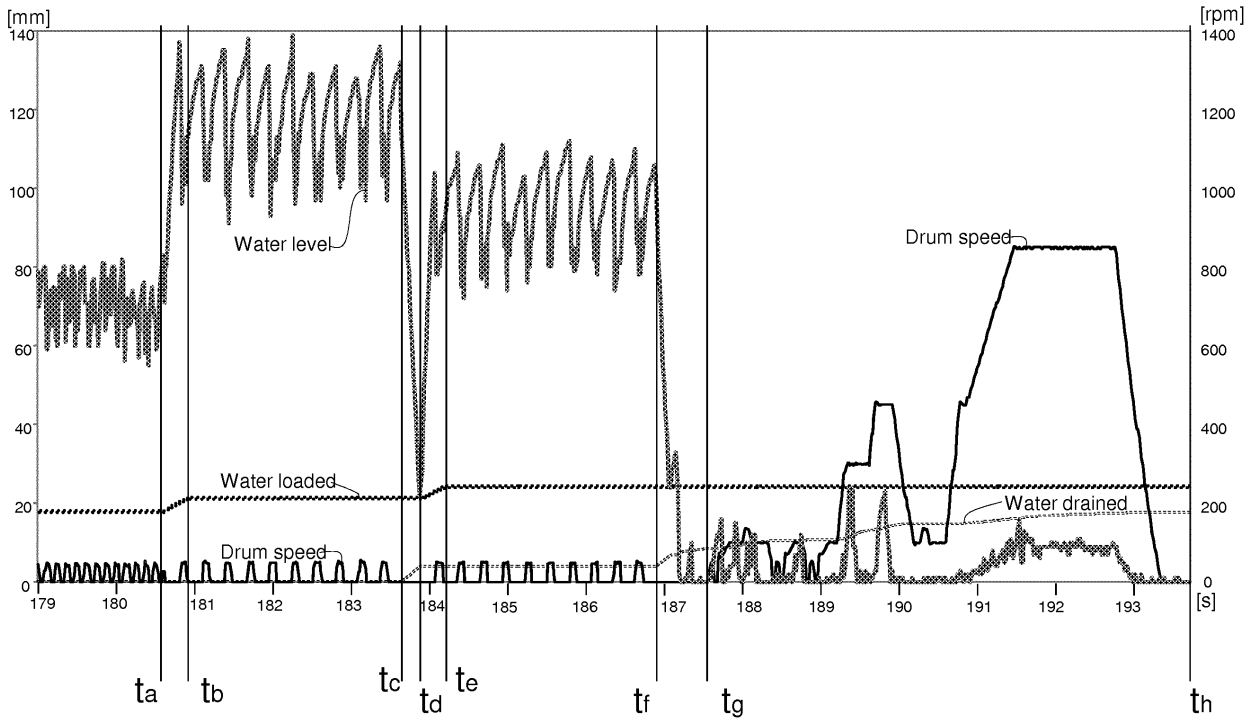


FIG. 2

FIG. 3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Drum speed
Water loaded
Water drained
Drum speed
179
180
181
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183
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REFERENCES CITED IN THE DESCRIPTION

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