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(54) **METHOD FOR CONTROLLING A LAUNDRY WASHING MACHINE AND LAUNDRY WASHING MACHINE**

VERFAHREN ZUR STEUERUNG EINER WASCHMASCHINE UND WASCHMASCHINE

PROCÉDÉ DE COMMANDE D'UNE MACHINE À LAVER LE LINGE ET MACHINE À LAVER LE LINGE

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(56) References cited:
EP-A1- 2 228 482 **US-A1- 2008 104 770**

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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 controlling a laundry washing machine which is configured to detect the so called "siphon phenomenon" or "natural water drainage" caused by a draining system of the laundry washing machine and, at the same time, is able to deactivate the "siphon phenomenon" when the latter is detected.

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 and drying machines (i.e. laundry washing machines which can also dry laundry), is widespread.

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

In addition, in the present description when reference is made to "water", the term "water" may denote water as such, washing water, washing liquid, washing liquor or the like.

Laundry washing machines generally comprise an external casing provided with a washing tub which contains a rotatable perforated drum where the laundry is placed; a motor which rotates the drum in the washing tub; a water supply system which supplies wash water and/or detergent into the washing tub/drum; and a water draining system which discharges/drains wash water from the washing tub.

Water draining system generally comprises a discharge hole arranged at the base of the washing tub for discharging the water; a draining pump for discharging the water from the washing tub; a hose with one end connected to the discharge hole and the other end connectable to the draining pump for delivering the water contained in the washing tub to the pump; a discharge hose having an end connected to the draining pump, and the other end to a house draining pipe system; and a floating ball arranged in the hose and structured to open or close the discharge hole with the pressure of the column of water contained in the discharge hose.

When laundry is put into the drum and a detergent and wash water are supplied into the washing tub by the water supply unit, the ball closes the discharge hose; then the motor begins to rotate the drum, and thus, a washing operation begins. To assure that the ball be arranged in the closed position before the prefixed amount of washing water is loaded into the washing tub, known washing machines control methods perform the steps of loading a prefixed amount of water into the washing tub; stop the water loading, turning on and off (in around a second) the draining pump impulsively to generate a water column in the discharge hose that, once the pump is stopped, pushes the ball against the discharge hole to close the latter.

When draining pump is impulsively activated to cause, as explained above, the discharge hole to be closed by the ball, an unintended drainage of water from the tub towards the discharge hose called "siphonic phenomenon" or "natural drainage" may occur, thereby resulting in a floor flooding when the discharge hose is incorrectly connected to the house draining pipe system.

US 7,921,492 B2 discloses a method of controlling a laundry washing machine which is designed to detect the siphon phenomenon by performing an intermittent water supply operation and then detecting a variation of the water level in the washing tub if the water level in the washing tub has been uniform since an intermittent water supply operation. More in detail, the method comprises the steps of: performing an intermittent water supply operation by repeatedly opening and closing water supply valves a predefined number of times; primarily detecting a variation in a water level in the tub during the intermittent water supply operation; if the result of the primary detection indicates that the water level in the tub has been uniform, performing a continuous water supply operation by maintaining the water supply valves to be open for a predefined amount of time; secondarily detecting a variation in the water level in the tub during the continuous water supply operation; and if the result of the secondary detection indicates that the water level in the tub has increased, discharging water from the tub by closing the water supply valves and by turning on a water discharge pump.

[0004] It is an object of the invention to provide an improved method for controlling a washing machine which, on one hand, is able to assure high reliability in detecting the siphon phenomenon and, on the other hand, is able to deactivate the siphon phenomenon with certainty.

[0005] Advantages, objects, and features of the invention will be set forth in part in the description and drawings which follow and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention.

DISCLOSURE OF INVENTION

[0006] According to the present invention, there is provided a method for controlling a laundry washing machine comprising: performing a starting continuous water supply in the tub/drum so that a prefixed amount of water in the tub is loaded; after the water supply operation has been completed, sensing water levels in the tub two or more times, at prefixed intervals, one another; detecting a siphon phenomenon based on sensed water levels; performing an intermittent draining of the water from the tub to cause the siphon phenomenon to be deactivated, when the siphon phenomenon has been detected.

[0007] Preferably the steps of: performing a starting continuous water supply, performing the sensing of water

levels, performing the detection and deactivation of said siphon phenomenon, are all executed before starting the washing, and/or rinsing, and/or spinning phases of a washing program.

[0008] Preferably the method comprises the steps of sensing two or more times the level of water contained in the tub to determine respective water levels; performing prefixed waiting intervals between two consecutive water levels sensing; and detecting the absence of a siphon phenomenon, if the level variation between at least two consecutive sensed water levels is lower than a prefixed first level interval.

[0009] Preferably the method comprises the steps of detecting a siphon phenomenon if the number of consecutive determined water level variations being greater than said first level interval, reaches a prefixed threshold.

[0010] Preferably the method comprises the step of detecting a siphon phenomenon if a measured water level is lower than a prefixed water level threshold.

[0011] Preferably the performing of an intermittent draining of the water from the tub to deactivate the siphon phenomenon comprises draining all the water from the tub; performing a prefixed interval wherein water drainage from the tub is interrupted; performing at least one or more draining of the water from the tub, lasting a prefixed drainage interval, wherein each draining is performed after a prefixed interval from a previous performed water draining.

[0012] Preferably the starting continuous water supply is executed after an impulsive drainage of water from the tub has been performed.

[0013] Preferably the starting continuous water supply comprises the step of continuously loading said prefixed amount of water in the tub so that a tangential drum water level of water in the tub is reached.

[0014] Preferably the method comprises rotating the drum during the starting continuous water supplying to increase the drainage of water from the tub (3) due to siphon phenomenon.

[0015] Preferably the method comprises rotating the drum during the prefixed waiting intervals to increase the drainage of water from the tub (3) due to siphon phenomenon.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] 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 the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In particular:

- Figure 1 shows schematically a front view of a laundry washing machine implementing the method according to the invention;
- Figure 2 shows schematically a front view of a laundry washing machine after a first water loading;
- Figure 3 shows schematically a front view of a laundry washing machine during the deactivation of siphon;
- Figure 4 shows schematically a front view of a laundry washing machine after first draining;
- Figure 5 is a simplified flow chart of the basic operations of a method for controlling the washing machine of Figure 1 according to a the present invention;
- Figure 6 shows in detail operation of the flow chart of Figure 5;
- Figures 7 and 8 show in detail some steps of the flow chart of Figure 6;

DETAILED DESCRIPTION OF THE INVENTION

[0017] The method of 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 this type of application. On the contrary, the present invention can be conveniently applied to other equipments, like for example laundry washing and drying machines (called also washer/driers), wherein one or more steps of introducing water inside a washing tub is required.

[0018] With reference to Figure 1, a laundry washing machine 1 according to the invention is described, in which a method of the invention is implemented.

[0019] The laundry washing machine 1 is a front loading laundry washing machine. The present invention has proved to be particularly successful when applied to front loading laundry washing machines. It should in any case be underlined that the present invention is not limited to this type of application. On the contrary, the present invention can be usefully applied to different types of washing devices, for example top loading laundry washing machines or top loading laundry washing and drying machines.

[0020] The laundry washing machine 1 comprises an external casing, or simply casing, 2, in which a washing tub 3 is provided that contains a rotatable, preferably perforated, drum 4, where the laundry 10 to be washed can be loaded. The washing tub 3 and the drum 4 both have preferably a substantially cylindrical shape. The casing 2 is provided with a loading/unloading opening, not illustrated, which can be closed/opened by a door, also not illustrated, which allows access to the washing tub 3 and the drum 4. The washing tub 3 is preferably suspended in a floating manner inside the casing 2, advantageously by means of a number of coil springs and shock-absorbers (not illustrated). 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.

[0021] A water supply system 5 and preferably a detergent supply system 6 are arranged preferably in the upper part of the laundry washing machine 1 and are structured to supply water and washing/rinsing products (i.e. detergent, softener, etc.) into the washing tub 3.

[0022] The detergent supply system 6 advantageously comprises a removable drawer 13 provided with various compartments suited to be filled with washing and/or rinsing products.

[0023] In the embodiment herein described, the water flowing through the water supply system 5 is advantageously supplied into the washing tub 3 by making it flow through the drawer 13 and through a supply pipe 9 which extends toward the tub 3. The supply pipe output 9a of the supply pipe 9 advantageously ends in correspondence of the tub 3.

[0024] Preferably the supply pipe output 9a ends in correspondence of a lateral side of the tub 3, as shown in the example of Figure 1; alternatively the supply pipe output 9a of the supply pipe 9 may advantageously end in correspondence of a bellows (not illustrated), connecting the access opening of the tub 3 to the loading/unloading opening of the casing 2. The water supply system 5 further comprises a main pipe 15 which opportunely connects the drawer 13 to an external water supply line E, preferably by means of a controlled supply valve 11.

[0025] In a preferred embodiment, the water which reaches the washing tub 3 can selectively contain one of the products contained in the compartments of the drawer 13, or such water can be clean (i.e. without products), depending on the phase of the washing program which is actually performed; in the initial phases of the washing program, for example, the detergent is conveyed into the tub 3 by the incoming water, while in other phases, for example during the rinsing phase, only water is conveyed into the tub 3.

[0026] 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.

[0027] The laundry washing machine 1 further comprises a water draining system 16 which is configured to drain the wash water, i.e. dirty water or water mixed with washing and/or rinsing products, from the washing tub 3 to the outside.

[0028] The water draining system 16 advantageously comprises a discharge hole 18 disposed at the base of the washing tub 3 for discharging the water, a draining pump 19 for discharging the wash water from the washing tub 3, a hose 20 with one end fluidly connected to the discharge hole 18 and the other end fluidly connected to the draining pump 19 for delivering the wash water contained in the washing tub 3 to the draining pump 19, and a draining suction pipe 21 having an end fluidly connected to the draining pump 19, and the other end designed to be fluidly connected to a house draining pipe system (not illustrated).

[0029] According to a preferred embodiment, the water draining system 16 further comprises preferably, thought not necessarily, a closing valve 22, which is arranged between the discharge hole 18 and the hose 20 and is configured to open or close the discharge hole 18 to maintain all wash water in the washing tub, during several prefixed washing phase.

[0030] Preferably, though not necessarily, the valve 22 comprises a valve body and a valve seat (not illustrated) in form of a diaphragm structured to surround the discharge hole 18.

[0031] Preferably, though not necessarily the valve 22 comprises a ball 23 which is freely moveable or floatable inside of the hose 20 from and towards the valve seat, and is designed to engage with the valve seat to shut the discharge hole 18. Preferably, though not necessarily, the ball 23 is made of floatable material e.g. plastic and floats on the water depending on the water level in the draining suction pipe 21. When the water level rises, the ball 23 is raised towards the valve seat until the ball surface closes the discharge hole 18.

[0032] The laundry washing machine 1 may be advantageously provided with a one or more liquid level sensor device 25 (schematically illustrated in Figure 1) designed to sense or detect the water/liquid level inside the tub 3. The sensor device 25 may preferably comprise a level sensor, for example mechanical, electro-mechanical, optical, etc., configured to sense or detect the water level inside the tub 3. The sensor device 25 may preferably comprise in addition to or as a replacement of the mechanical, electro-mechanical, optical, sensor, a pressure sensor which senses the pressure in the tub 3.

[0033] From the values sensed by the sensor device 25 it is possible to determine the water level LW of the wash water contained in the tub 3.

[0034] A control unit 24 is connected to the various parts of the laundry washing machine 1 in order to ensure its operation. The control unit 24 is preferably connected to the controlled supply valve 11, the draining pump 19, the electric motor, and it receives information from the water level sensor device 25.

[0035] The control unit 24 is preferably connected also to an interface unit 24a (only schematically illustrated in enclosed Figures) which is accessible to the user and by means of which the user selects and sets the washing parameters, for example the desired washing program. Advantageously, 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, the type of fabric of the load, etc.

[0036] The interface unit 24a also preferably comprises a display where some pieces of information are opportunely displayed.

[0037] Based on the parameters acquired by said interface unit 24a, the control unit 24 sets and controls the various parts of the laundry washing machine 1 in order to carry out the desired washing program.

[0038] A preferred embodiment of the method for controlling the laundry washing machine 1 according to the invention is described here below with reference to the

laundry washing machine 1 shown in Figures from 2 to 4 and with reference to the flow charts of Figures from 5 to 8.

[0039] Referring to Figure 5, the method for controlling the laundry washing machine 1 according to a preferred embodiment of the present invention comprises a step 100 wherein the laundry 10 to be washed is first placed inside the drum 4; a step 110 wherein a desired washing program is selected by the user (clearly, in a further advantageous embodiment, step 110 can be performed before step 100); a step 120 wherein a siphon detection procedure is performed to detect the presence/absence of a siphon phenomenon; a step 130 wherein a siphon deactivation procedure is performed when a siphon phenomenon has been detected, and a step 150 wherein the control unit 24 sets the laundry washing machine 1 so that it starts the washing, and/or rinsing, and/or spinning phases of the selected washing program.

[0040] Preferably, but not necessarily, step 150 comprises a step 140 wherein a certain amount of water is loaded in the tub 4.

[0041] Referring to Figure 6, the siphon detection procedure performed by the method advantageously comprises a step 200 wherein the control unit 24 controls the water supply system 5 to cause the tub 3 to be loaded with a prefixed amount of water.

[0042] This prefixed amount of water is preferably small with respect to the total amount of water which has to be loaded in order to completely soak the laundry (which depends on the type and quantity of laundry and on the shape of the laundry machine), in such a way that if there is a siphon phenomenon, the amount of water wasted due to the siphon and to the siphon detection procedure is small. For example this prefixed amount of water may be 3 litres, while the total amount of water which has to be loaded in order to completely soak the laundry is 24 litres. More in general, this prefixed amount of water may be preferably comprised between 1/9 and 1/7 of the total amount of water which has to be loaded in order to completely soak the laundry.

[0043] According to a preferred embodiment, the control unit 24 controls the water supply system 5 so that the water is supplied in the tub 3 continuously as far as the sensed water level reaches a prefixed water level PWL, for example a tangential drum water level TDWL. The tangential drum water level TDWL may be defined as the level of the water in the tub 3, wherein the water contained in the tub 3 laps against the external surface of the bottom part of the drum 4 so that the laundry is not soaked with the water.

[0044] The applicant has found that reaching the drum water level TDWL allows improving accuracy in detecting the siphon phenomenon because the sensed water levels are not affected by water absorption due to laundry. As a matter of the fact, laboratory tests made by the applicant proved that water absorption due to laundry may cause significant water level variations which may determine a wrong detection of siphon phenomenon.

[0045] Anyway, in a different advantageous embodiment, the water may be supplied in the tub 3 continuously as far as the sensed water level reaches a prefixed water level PWL which is higher than the level TDWL at which the water contained in the tub 3 laps against the external surface of the bottom part of the drum 4.

[0046] According to a further embodiment, provided that the laundry washing machines 1 is provided that a valve 22 with a ball 23, or a similar floating closure element, in the step 200, preferably, though not necessarily the control unit 24 may turn on the draining pump 19 impulsively, for example the draining pump 19 may be activated for one second, so that a vertical water column level is loaded in the draining suction pipe 21 and after draining pump 19 is turned off, the water column level moves by gravitation towards the ball 23 (or similar floating closure element) causing the discharge hole 18 to be closed.

[0047] Preferably, though not necessarily, according to a further embodiment, provided that the laundry washing machines 1 is provided that a valve 22 with a ball 23, or a similar floating closure element, in the step 200, control unit 24 controls the water supply system 5 and, at the same time, turns on impulsively the draining pump 19 so that, on one hand, the water column produced in the draining suction pipe 21 pushes the ball 23 (or similar floating closure element) towards the discharged hole 18 so that the discharged hole 18 is maintained closed and, on the other hand, water in the tub 4 reaches the prefixed water level PWL, preferably the prefixed tangential drum water level TDWL.

[0048] Preferably, though not necessarily according to a further embodiment, during the step 200, control unit 24 further commands the electric motor to cause the drum 4 to rotate in a clockwise or counter clockwise direction with a prefixed rotational speed, so that water flow drained through the draining suction pipe 21 due to a possible current siphon phenomenon, is increased and, as a consequence, the sensed water level varies quickly and the siphon phenomenon may be detected rapidly.

[0049] When the water in the tub 3 has reached the prefixed amount, i.e. the prefixed water level PWL, and preferably TDWL, the control unit 24 closes supply valve 11 so that water loading is stopped, and the method performs the step 210 for detecting whether the siphon phenomenon is present or absent.

[0050] Referring to Figure 7, in the step 210 the method comprises the step 300 of detecting/measuring the water level in the tub 3 at a prefixed first time t1, preferably by means of the sensor device 25, so that a first sensed water level WL1=WL(t1) is determined; the step 310 of waiting a prefixed first waiting interval $\Delta t1$; the step 320 of detecting/measuring the water level in the tub 3 at a second time $t2=t1+\Delta t1$, preferably by means of the sensor device 25, so that a second sensed water level WL2=WL(t2) is determined; and the step 330 of verifying whether the second sensed water level WL2 is lower than the first sensed water level WL1 of a prefixed first level

interval ΔWL1.

[0051] Preferably, though necessarily, the first waiting interval Δt1 may be set to assure that water level in the tub 3 remains stable in absence of siphon phenomenon, even if laundry tends to absorb a certain amount of water. Preferably, though necessarily, the first waiting interval Δt1 may be comprised between about 2 and 5 seconds, preferably about 4 second.

[0052] Preferably in the step 330 the method adds the second sensed water level WL2 to the first level interval ΔWL1, and it compares the first sensed value WL1 with the sum of second sensed water level WL2 and the first level interval ΔWL1 (WL2+ΔWL1).

[0053] In other words in the step 210 the method performs: sensing two or more times the level of water contained in the tub 3 to determine respective water levels WL1, WL2; performing prefixed waiting intervals Δt1 between two consecutive water levels sensing WL1, WL2; and detecting the absence of a siphon phenomenon if the level variation ΔW between at least two consecutive determined water levels WL1, WL2 is lower than the first level interval ΔWL1.

[0054] According to a preferred embodiment, the first level interval ΔWL1 may be comprised between about 2 and 5 mm, preferably about 3 mm.

[0055] If the sum of second sensed water level WL2 and the first level interval ΔWL1 WL2+ΔWL1 is bigger than the first sensed water level WL1 (output NO of step 330), the method detects that siphon phenomenon is absent and performs the step 150, i.e. starts the washing, rinsing, spinning phases of the selected washing program.

[0056] In other words, the method detects the absence of a siphon phenomenon if the level variation ΔW between at least two consecutive determined water levels WL1, WL2 is lower than the first level interval ΔWL1.

[0057] On the contrary, if the sum of second sensed water level WL2 and the first level interval ΔWL1 (WL2+ΔWL1) is lower than the first sensed water level WL1 (outputs YES of steps 210, 330), the method performs the step 220 (shown in Figure 6), wherein the second water level WL2 is compared with a water level threshold WT.

[0058] In other words, in step 210 the machine detects if a siphon phenomenon could have took place (outputs YES of steps 210) or not (outputs NO of steps 210); if the detection states that the siphon phenomenon has not took place (outputs NO of steps 210), the washing cycle proceed as an usual washing cycle (step 150), otherwise (outputs YES of steps 210), the machine preferably performs further checks (step 220 and following) in order to verify if a siphon phenomenon has actually took place.

[0059] In detail, in the step 220, if the second sensed water level WL2 is lower than the water level threshold WT, the method detects that a siphon phenomenon is actually taking place, and performs the siphon deactivation procedure in the step 130 (afterwards disclosed in detail).

[0060] Preferably, though not necessarily, the water level threshold WT may be set according to one or more technical features characterizing the laundry washing machine 1.

[0061] According to a preferred embodiment, the water level threshold WT may be comprised between about 10 and 20 mm, preferably about 15 mm.

[0062] In the step 220, if the second sensed water level WL2 is not lower than the water level threshold WT, namely the water level in the tub 3 during the first waiting interval Δt1 has not decreased of a quantity greater than a water level threshold WT (which means that a siphon phenomenon could have took place or not, since the water level reduction could have been due to a siphon, but also to the water absorption by the laundry), the methods performs step 230, wherein it checks whether the siphon detection step 210 has been performed a prefixed number of times ND (prefixed threshold).

[0063] In the step 230, if the siphon detection (disclosed in the step 210) has not been performed a prefixed number of times ND, the methods repeats again operations performed in siphon detection step 210.

[0064] Preferably, number of times ND may be set according to on one or more technical features characterizing the laundry washing machine 1.

[0065] According to a preferred embodiment, number of times ND wherein method performs detection of siphon phenomenon procedure, may be comprised between 2 and 6, preferably 5 times.

[0066] On the contrary, if the siphon detection procedure (disclosed in the step 210) has been performed for the prefixed number of times ND, the methods detects a siphon phenomenon and performs the siphon deactivation procedure in the step 130. In other words, the method detects a siphon phenomenon whether water level variation ΔW remains consecutively greater than said first level interval ΔWL1 for the prefixed number of times ND. In fact, if the water level inside the tub continues to decrease, it is very likely that a siphon phenomenon is occurring.

[0067] Referring to Figure 8, the siphon deactivation procedure performed by the method, provides the performing of an intermittent draining of the water from the tub 3 to deactivate the siphon phenomenon, this intermittent draining comprising: draining all the water from the tub 3; performing a prefixed waiting interval Δti wherein water drainage from the tub is interrupted; performing at least one or more draining of the water from the tub 3, lasting a prefixed drainage interval ΔAi, wherein each draining is performed after a prefixed interval from a previous performed water draining.

[0068] Preferably, the siphon deactivation procedure performed by the method, provides for activating the draining pump 19 two or more times consecutively, so that two or more drainages of the water contained in the tub 3 is executed, by alternating between two consecutive water drainages a prefixed pause or waiting interval Δti, wherein the draining pump 19 is maintained switched

off.

[0069] Laboratory tests performed by the Applicant proved that after a single activation of the draining pump 19 to drain all the water contained in the tub 3 the siphon phenomenon may occur again. In fact, water absorbed by the laundry during the siphon detection procedure may go back in the tub 3 (due to gravity) even after the single activation of the draining pump 19 has taken place, so that a siphon phenomenon could be reactivated by this water even after the first activation of the draining pump 19. Applicant has found that, if after the first activation of the draining pump 19 for discharging all the water contained in the tub 3, the drain pump 19 is kept turned-off for a certain prefixed waiting interval Δti (so as to allow water absorbed by the laundry during the siphon detection procedure to go back in the tub 3), and then by turning-on again the drain pump 19 for a prefixed drainage interval ΔAi, it is possible to guarantee the deactivation also of a possible new siphon phenomenon due to the water previously absorbed by the laundry that goes back in the tub 3. Applicant has also found that this advantageous effect is increased if this turning-off of the draining pump and reactivation of the latter is performed a plurality of times. Referring to Figure 8 and according to a preferred embodiment of the present invention, the step 130 associated with the siphon deactivation procedure preferably comprises the step 400, in which the control unit 24 turns on the draining pump 19 so that all the water contained in the tub 3 is discharged through the draining suction pipe 21. In detail, draining pump 19 is preferably maintained turned-on until the sensed water level measured by the sensor device 25 is about zero.

[0070] Afterwards the method performs the step 410 wherein the control unit 24 maintains the draining pump 19 turned-off for a first prefixed waiting interval Δti_1.

[0071] Afterwards the method performs the step 420, wherein the control unit 24 turns-on draining pump 19 for a prefixed first drainage interval ΔAi_1; the step 430 wherein the draining pump 19 is turned-off for a prefixed second waiting interval (Δti_2) (which may be equal or different to the first prefixed waiting interval); preferably the step 440 wherein the control unit 24 turns-on draining pump 19 for a prefixed second drainage interval ΔAi_2 (which may be equal or different to the first prefixed drainage interval); and preferably the step 450, wherein the control unit 24 turns off draining pump 19 for the prefixed third waiting interval (Δti_3) (which may be equal or different to the first and second prefixed waiting intervals).

[0072] It should be pointed out that the method may comprise one or more additional alternate drainage intervals ΔAi (having respectively the same or different length) and/or one or more waiting intervals Δti (having respectively the same or different length).

[0073] Moreover, it should be pointed out that waiting intervals Δti and drainage intervals ΔAi may be set according to on one or more technical features characterizing the laundry washing machine 1.

[0074] Preferably, all the waiting intervals Δti may be about 6 seconds, whereas the drainage intervals ΔAi may be about 10 second.

[0075] Afterwards the method performs the step 150 (Figure 5) the control unit 24 sets the laundry washing machine 1 so that it starts the washing, rinsing, spinning phases of the selected washing program. Preferably, during step 150 control unit 24 commands the water supply system 5 to cause the tub 3 to be loaded with a prefixed amount of water.

[0076] It has thus been shown that the present invention allows all the set objects to be achieved. In particular, the control method of the invention makes it possible to assure high reliability in detecting the siphon phenomenon and, on the other hand, is able to deactivate the siphon phenomenon with certainty.

[0077] 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 controlling a laundry washing machine (1), said laundry washing machine (1) comprising a washing tub (3) external to a washing drum (4) designed to contain laundry (10);
   said method being **characterized by** comprising:

   - performing a starting continuous water supply in the tub (3)/drum (4), so that a prefixed amount of water in the tub (3) is loaded;
   - after said starting continuous water supply operation has been completed, stop the water loading and sensing water levels (WL,WL1, WL2) in the tub (3) two or more times at prefixed intervals (Δt1), one another;
   - detecting a siphon phenomenon in the draining circuit based on sensed water levels (WL, WL1, WL2);
   - performing an intermittent draining of the water from the tub (3) to cause the siphon phenomenon to be deactivated, when the siphon phenomenon has been detected.

2. Method according to claim 1, wherein the steps of performing a starting continuous water supply, performing the sensing of water levels (WL), performing the detection and deactivation of said siphon phenomenon, are all executed before starting the washing, and/or rinsing, and/or spinning phases of a washing program.

3. Method according to claims 1 or 2, comprising the steps of:

- sensing two or more times the level of water contained in the tub (3) to determine respective water levels (WL,WL1,WL2);
- performing prefixed waiting intervals (Δt1) between two consecutive water levels sensing; and
- detecting the absence of a siphon phenomenon, if the level variation (ΔW) between at least two consecutive determined water levels (WL1, WL2) is lower than a prefixed first level interval (ΔWL1).

4. Method according to claim 3, comprising the steps of detecting a siphon phenomenon, if the number of consecutive determined water level variations (ΔW) being greater than said first level interval (ΔWL1), reaches a prefixed threshold (ND).

5. Method according to any of previous claims, comprising the step of detecting a siphon phenomenon, if a measured water level (WL2) is lower than a prefixed water level threshold (WT).

6. Method according to any of the previous claims wherein the performing of an intermittent draining of the water from the tub (3) to deactivate the siphon phenomenon comprises the steps of:

- draining all the water from the tub (3);
- performing a prefixed waiting interval (Δti) wherein water drainage from the tub is interrupted;
- performing at least one or more draining of the water from the tub (3), lasting a prefixed drainage interval (ΔAi), wherein each draining is performed after a prefixed waiting interval (Δti) from a previous performed water draining.

7. Method according to any of the previous claims, wherein said starting continuous water supply is executed after an impulsive drainage of water from the tub (3) has been performed.

8. Method according to any of the previous claims, wherein said starting continuous water supply comprises the step of continuously loading said prefixed amount of water in the tub so that a prefixed water level (PWL) of water in the tub (3) is reached.

9. Method according to claim 8, wherein said prefixed water level (PWL) is a tangential drum water level (TDWL) at which the water contained in the tub (3) laps against the external surface of the bottom part of the drum (4) so that the laundry is not soaked with the water.

10. Method according to any of the previous claims, comprising rotating the drum (4), during said starting continuous water supplying to increase the drainage of water from the tub (3) due to siphon phenomenon.

11. Method according to any of the previous claims, comprising rotating the drum (4), during said prefixed waiting intervals to increase the drainage of water from the tub (3) due to siphon phenomenon.

12. A laundry washing machine (1) comprising a control unit (24) designed to implement a method according to any of the preceding claims.

Patentansprüche

1. Verfahren zum Steuern einer Waschmaschine (1), wobei die Waschmaschine (1) einen Waschbehälter (3) außerhalb einer Waschtrommel (4) aufweist, die zum Enthalten von Wäsche (10) ausgelegt ist;
wobei das Verfahren **dadurch gekennzeichnet ist, dass** es Folgendes aufweist:

- Ausführen einer beginnenden fortlaufenden Wasserzufuhr in den Behälter (3)/die Trommel (4), sodass eine vorgegebene Menge an Wasser im Behälter (3) geladen wird;
- nach dem Abschließen des Verfahrens der beginnenden fortlaufenden Wasserzufuhr, Anhalten der Wasserladung und zwei- oder mehrmaliges Abfühlen von Wasserpegeln (WL, WL1, WL2) im Behälter (3) in vorgegebenen Intervallen (Δt1), eines dem anderen;
- Erkennen einer Siphonerscheinung im Ablasskreis auf Grundlage von abgefühlten Wasserpegeln (WL, WL1, WL2);
- Ausführen eines intermittierenden Ablassens des Wassers aus dem Behälter (3), um zu bewirken, dass die Siphonerscheinung deaktiviert wird, wenn die Siphonerscheinung erkannt wurde.

2. Verfahren nach Anspruch 1, wobei die Schritte des Ausführens einer beginnenden fortlaufenden Wasserzufuhr, des Ausführens des Abfühlens von Wasserpegeln (WL), des Ausführens der Erkennung und Deaktivierung der Siphonerscheinung alle vor dem Starten der Wasch- und/oder Spül- und/oder Schleuderphase eines Waschprogramms ausgeführt werden.

3. Verfahren nach einem der Ansprüche 1 oder 2, aufweisend die Schritte des:

- zwei- oder mehrmaligen Abfühlens des Pegels von Wasser, das im Behälter (3) enthalten ist, zum Bestimmen von jeweiligen Wasserpegeln (WL, WL1, WL2);
- Ausführens von vorgegebenen Warteinterval-

len (Δt1) zwischen zwei aufeinanderfolgenden Wasserpegelabfühlungen; und
- Erkennens der Abwesenheit einer Siphonerscheinung, wenn die Pegelvariation (ΔW) zwischen mindestens zwei aufeinanderfolgenden bestimmten Wasserpegeln (WL1, WL2) geringer als ein vorgegebenes erstes Pegelintervall (ΔWL1) ist.

4. Verfahren nach Anspruch 3, aufweisend die Schritte des Erkennens einer Siphonerscheinung, wenn die Anzahl von aufeinanderfolgenden bestimmten Wasserpegelvariationen (ΔW), die größer als das erste Pegelintervall (ΔWL1) sind, eine vorgegebene Schwelle (ND) erreicht.

5. Verfahren nach einem der vorhergehenden Ansprüche, aufweisend den Schritt des Erkennens einer Siphonerscheinung, wenn ein gemessener Wasserpegel (WL2) niedriger als eine vorgegebene Wasserpegelschwelle (WT) ist.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Ausführen eines intermittierenden Ablassens des Wassers aus dem Behälter (3), um zu bewirken, dass die Siphonerscheinung deaktiviert wird, die folgenden Schritte aufweist:

- Ablassen des gesamten Wassers aus dem Behälter (3);
- Ausführen eines vorgegebenen Warteintervalls (Δti), wobei das Ablassen von Wasser aus dem Behälter unterbrochen wird;
- Ausführen von mindestens einem oder mehr Ablassen des Wassers aus dem Behälter (3), was über ein vorgegebenes Ablassintervall (ΔAi) hin andauert, wobei jedes Ablassen nach einem vorgegebenen Warteintervall (Δti) von einem vorher ausgeführten Wasserablassen ausgeführt wird.

7. Verfahren nach einem der vorhergehenden Ansprüche, wobei die beginnende fortlaufende Wasserzufuhr ausgeführt wird, nachdem ein impulsives Ablassen von Wasser aus dem Behälter (3) ausgeführt wurde.

8. Verfahren nach einem der vorhergehenden Ansprüche, wobei die beginnende fortlaufende Wasserzufuhr den Schritt des fortlaufenden Ladens der vorgegebenen Menge von Wasser in den Behälter aufweist, sodass ein vorgegebener Wasserpegel (PWL) von Wasser im Behälter (3) erreicht wird.

9. Verfahren nach Anspruch 8, wobei der vorgegebene Wasserpegel (PWL) ein tangentialer Trommelwasserpegel (TDWL) ist, auf dem das Wasser, das im Behälter (3) enthalten ist, an die Außenfläche des Bodenteils der Trommel (4) schlägt, sodass die Wäsche nicht mit Wasser getränkt wird.

10. Verfahren nach einem der vorhergehenden Ansprüche, aufweisend das Drehen der Trommel (4) während der beginnenden fortlaufenden Wasserzufuhr zum Steigern des Ablassens von Wasser aus dem Behälter (3) aufgrund der Siphonerscheinung.

11. Verfahren nach einem der vorhergehenden Ansprüche, aufweisend das Drehen der Trommel (4) während der vorgegebenen Warteintervalle zum Steigern des Ablassens von Wasser aus dem Behälter (3) aufgrund der Siphonerscheinung.

12. Waschmaschine (1), aufweisend eine Steuereinheit (24), die zum Implementieren eines Verfahrens gemäß einem der vorhergehenden Ansprüche ausgelegt ist.

Revendications

1. Procédé de commande de lave-linge (1), ledit lave-linge (1) comprenant une cuve (3) de lavage à l'extérieur d'un tambour (4) de lavage conçu pour contenir du linge (10) ;
ledit procédé étant **caractérisé en ce qu'**il comprend les opérations consistant à :

- exécuter une alimentation en eau continue de départ dans la cuve (3)/le tambour (4), de façon à ce qu'une quantité prédéterminée d'eau soit chargée dans la cuve (3) ;
- après que ladite alimentation en eau continue de départ s'est achevée, arrêter le chargement d'eau et détecter les niveaux d'eau (WL, WL1, WL2) dans la cuve (3) deux ou plusieurs fois à des intervalles (Δt1) prédéterminés, l'une l'autre ;
- détecter un phénomène de siphon dans le circuit de vidange en fonction des niveaux d'eau (WL, WL1, WL2) détectés ;
- exécuter une vidange intermittente d'eau de la cuve (3) pour désactiver le phénomène de siphon quand celui-ci a été détecté.

2. Procédé selon la revendication 1, dans lequel les étapes consistant à effectuer une alimentation en eau continue de départ, effectuer la détection des niveaux d'eau (WL), effectuer la détection et la désactivation dudit phénomène de siphon
sont toutes exécutées avant de commencer les phases de lavage et/ou de rinçage et/ou d'essorage d'un programme de lavage.

3. Procédé selon la revendication 1 ou 2, comprenant les étapes consistant à :

- détecter deux fois ou plus le niveau d'eau contenu dans la cuve (3) pour déterminer les niveaux d'eau respectifs (WL, WL1, WL2) ;
- respecter des intervalles d'attente (Δt1) prédéterminés entre deux détections consécutives de niveau d'eau ; et
- détecter l'absence de phénomène de siphon, si la variation (ΔW) de niveau entre au moins deux niveaux d'eau (WL1, WL2) déterminés consécutivement est inférieure à un premier intervalle de niveau (ΔWL1) prédéterminé.

4. Procédé selon la revendication 3, comprenant l'étape consistant à détecter un phénomène de siphon, si le nombre de variations (ΔW) de niveau d'eau déterminées consécutivement est supérieur audit premier intervalle de niveau (ΔWL1) et atteint un seuil (ND) prédéterminé.

5. Procédé selon l'une quelconque des revendications précédentes, comprenant l'étape consistant à détecter un phénomène de siphon, si un niveau d'eau mesuré (WL2) est inférieur à un seuil (WT) de niveau d'eau.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'exécution d'une vidange intermittente de l'eau de la cuve (3) pour désactiver le phénomène de siphon comprend les étapes consistant à :

- vidanger toute l'eau de la cuve (3) ;
- respecter un intervalle d'attente (Δti) prédéterminé pendant lequel on interrompt la vidange de l'eau de la baignoire ;
- effectuer au moins une ou plusieurs vidanges de l'eau de la cuve (3), d'une durée égale à un intervalle de vidange (ΔAi) prédéterminé, dans lequel chaque vidange est effectuée après un intervalle d'attente (Δti) prédéterminé à partir d'une vidange d'eau effectuée précédemment.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite alimentation en eau continue de départ est effectuée après l'exécution d'une vidange impulsionnelle d'eau de la cuve (3).

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite alimentation en eau continue de départ comprend l'étape consistant à charger en continu ladite quantité prédéterminée d'eau dans la cuve de façon à atteindre un niveau (PWL) prédéterminé d'eau dans la cuve (3).

9. Procédé selon la revendication 8, dans lequel ledit niveau d'eau (PWL) prédéterminé est un niveau d'eau (TDWL) tangentiel au tambour, auquel l'eau contenue dans la cuve (3) clapote contre la surface externe de la partie inférieure du tambour (4) de sorte que le linge ne trempe pas dans l'eau.

10. Procédé selon l'une quelconque des revendications précédentes, comprenant l'opération consistant à faire tourner le tambour (4) pendant ladite alimentation en eau continue de départ pour augmenter la vidange d'eau de la cuve (3) en raison du phénomène de siphon.

11. Procédé selon l'une quelconque des revendications précédentes, comprenant l'opération consistant à faire tourner le tambour (4) pendant lesdits intervalles d'attente prédéterminés pour augmenter la vidange d'eau de la cuve (3) en raison du phénomène de siphon.

12. Lave-linge (1) comprenant une unité de commande (24) conçue pour mettre en oeuvre un procédé selon l'une quelconque des revendications précédentes.

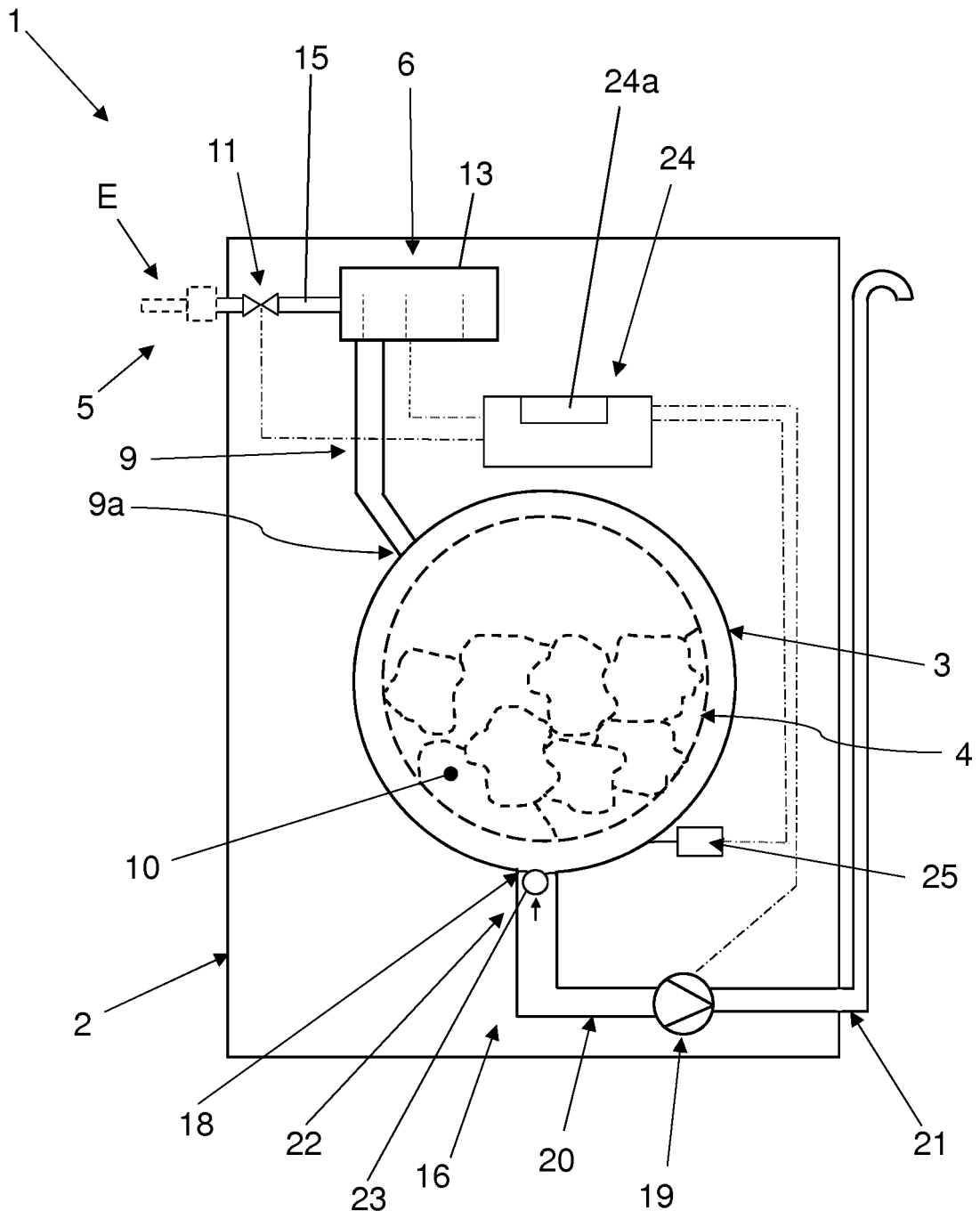

Fig. 1

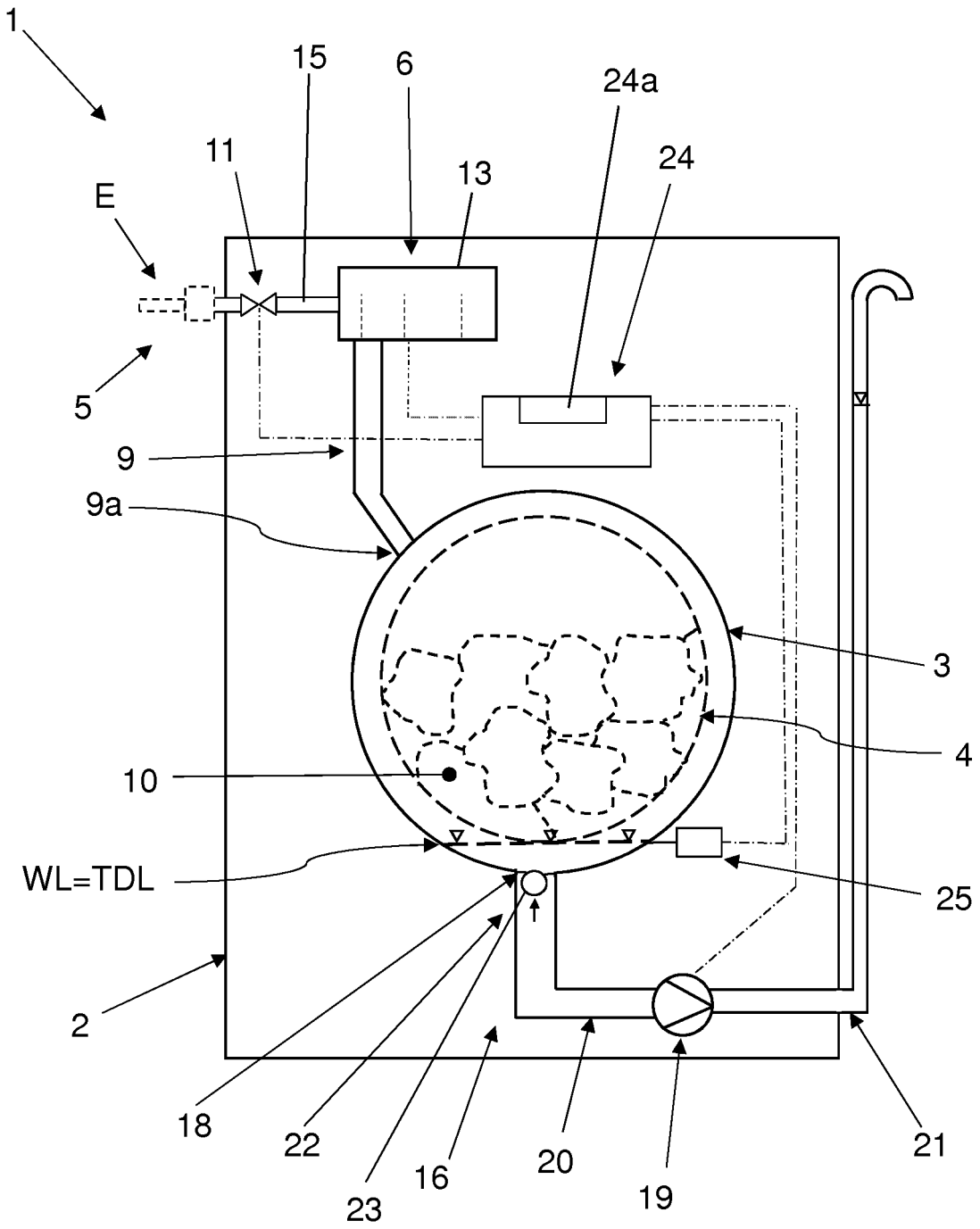

Fig. 2

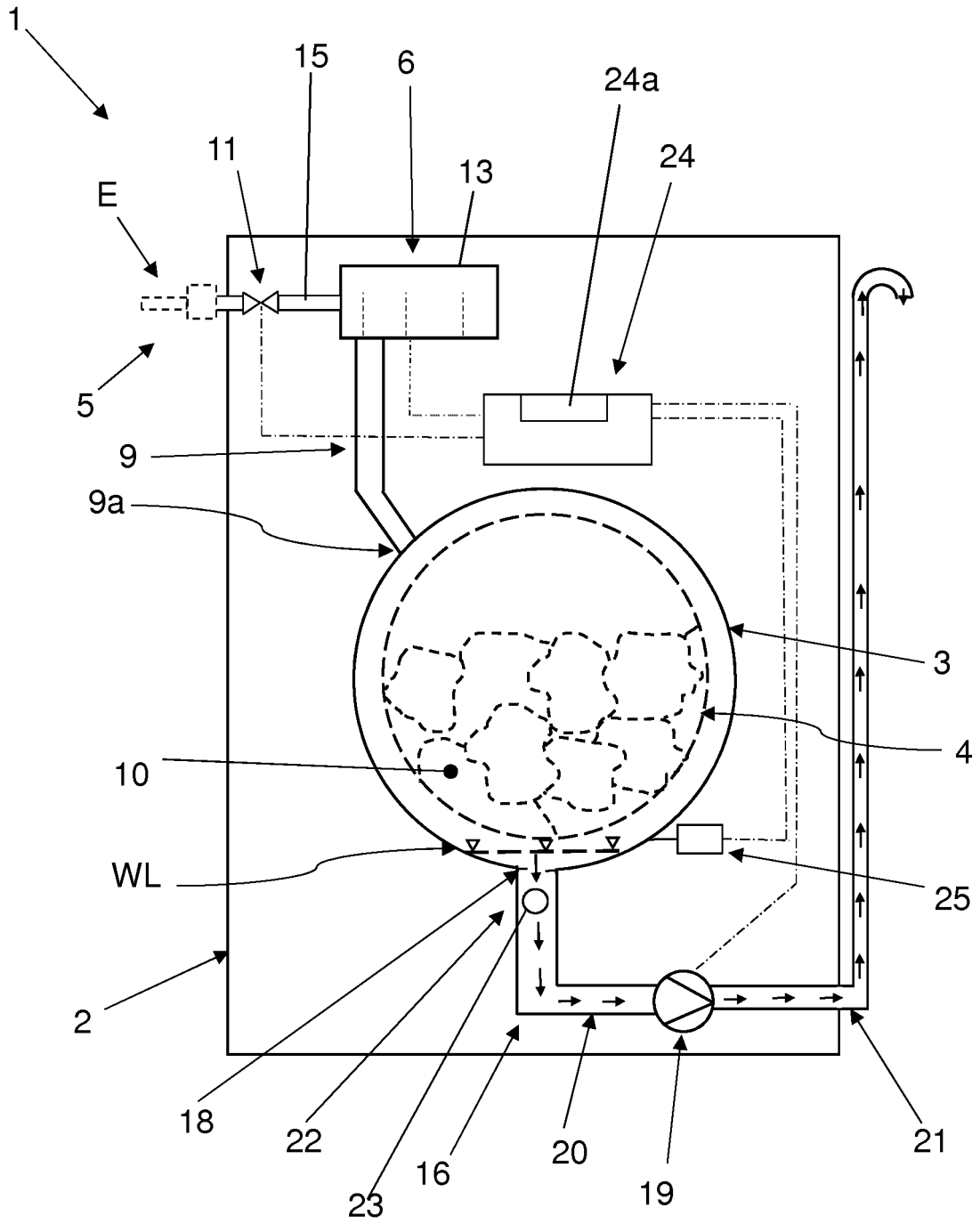

Fig. 3

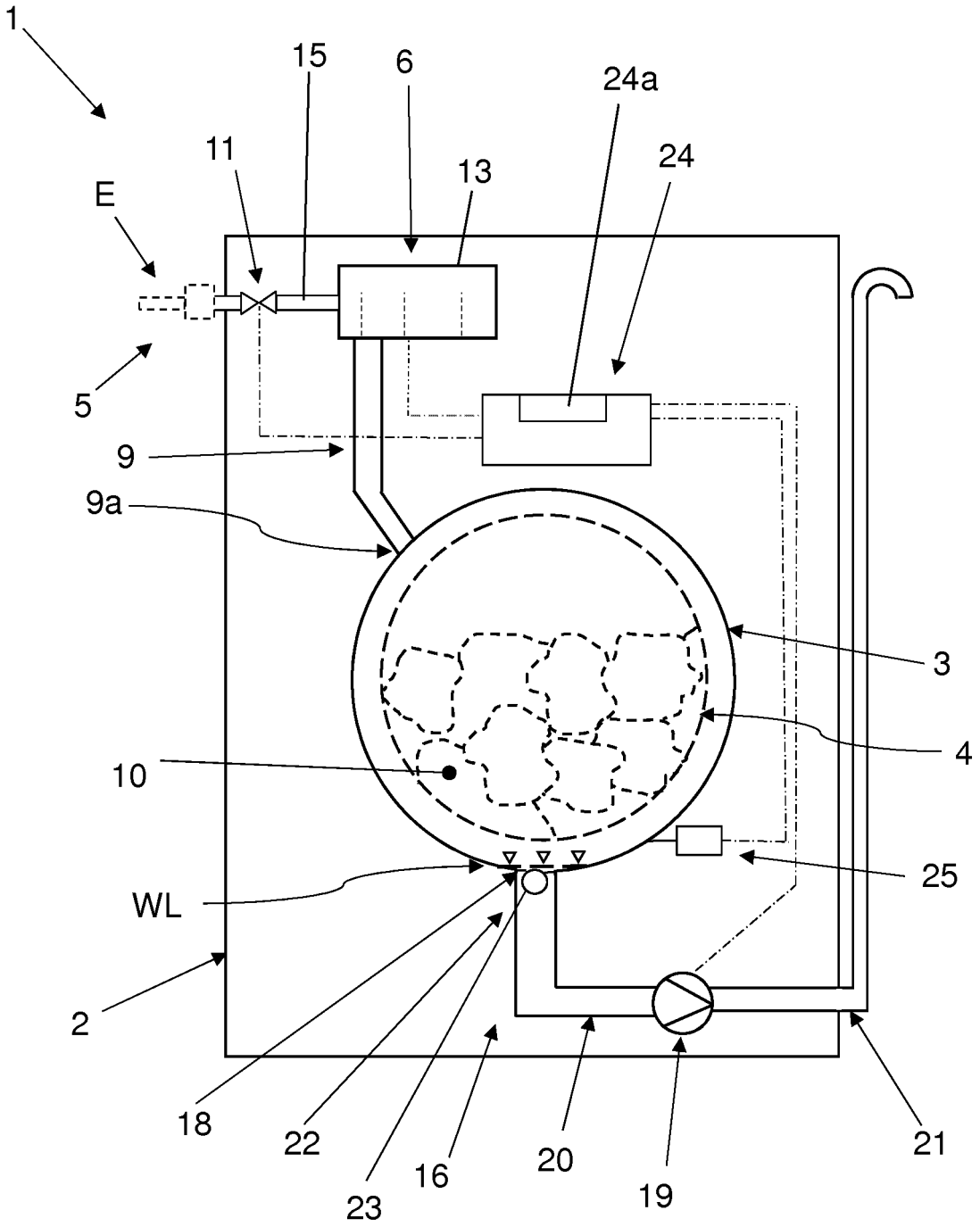

Fig. 4

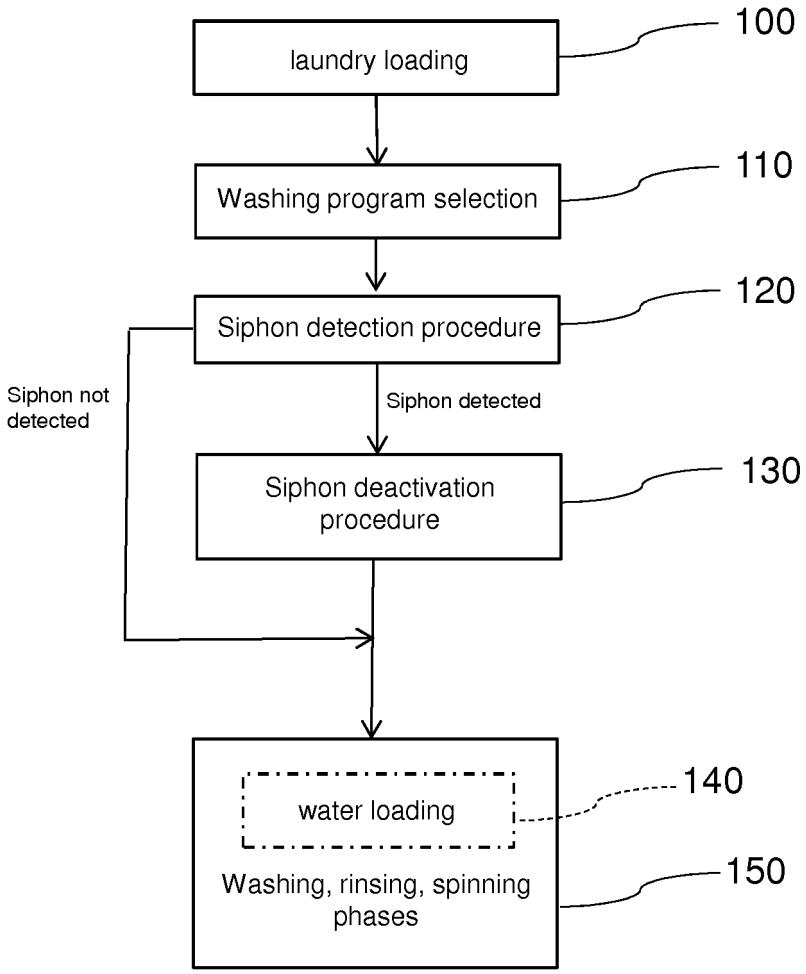
laundry loading
100
Washing program selection
110
Siphon detection procedure
120
Siphon not detected
Siphon detected
Siphon deactivation procedure
130
water loading
140
Washing, rinsing, spinning phases
150

Fig. 5

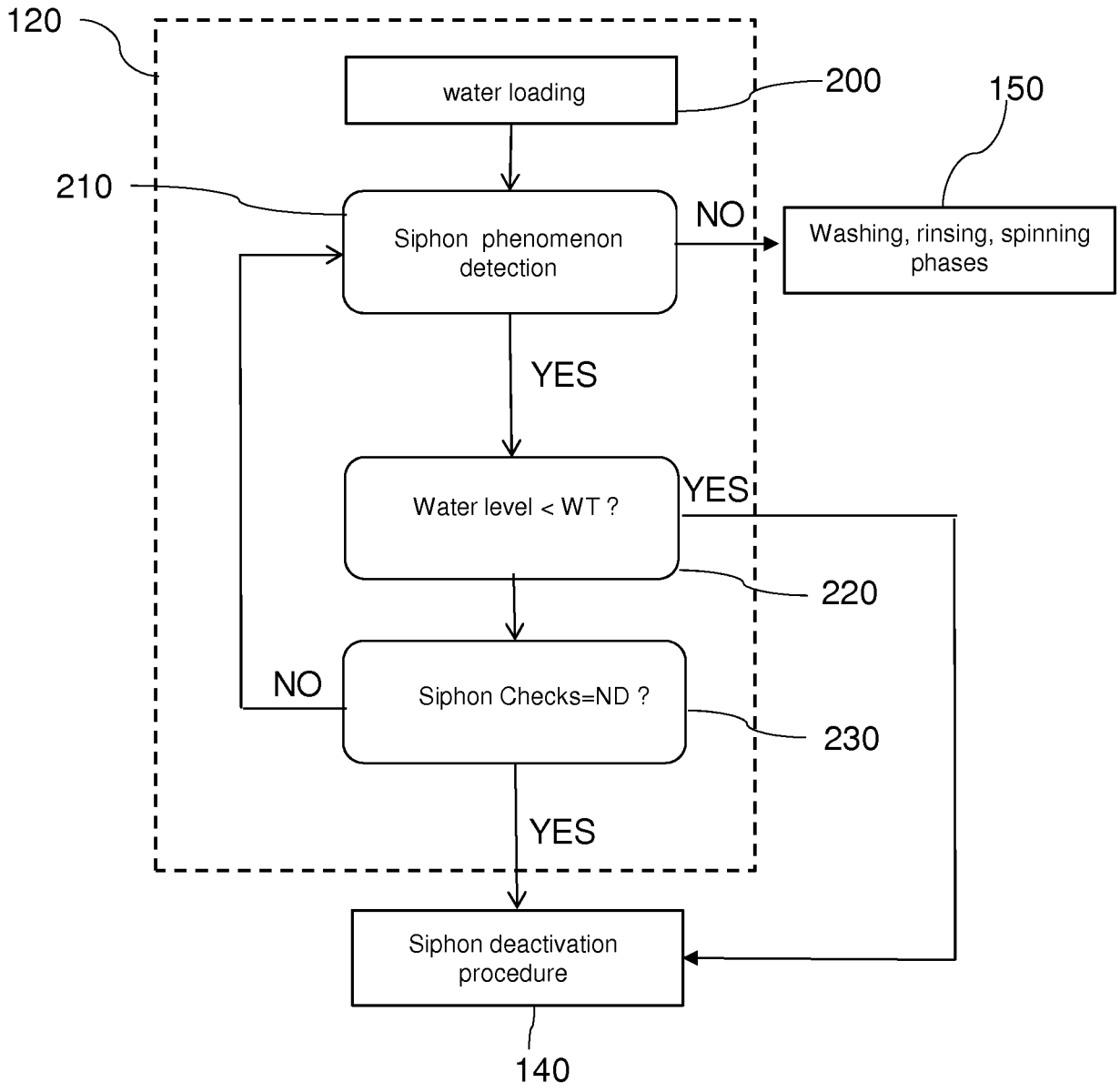
120
water loading
200
150
210
Siphon phenomenon detection
NO
Washing, rinsing, spinning phases
YES
Water level < WT ?
YES
220
NO
Siphon Checks=ND ?
230
YES
Siphon deactivation procedure
140

Fig. 6

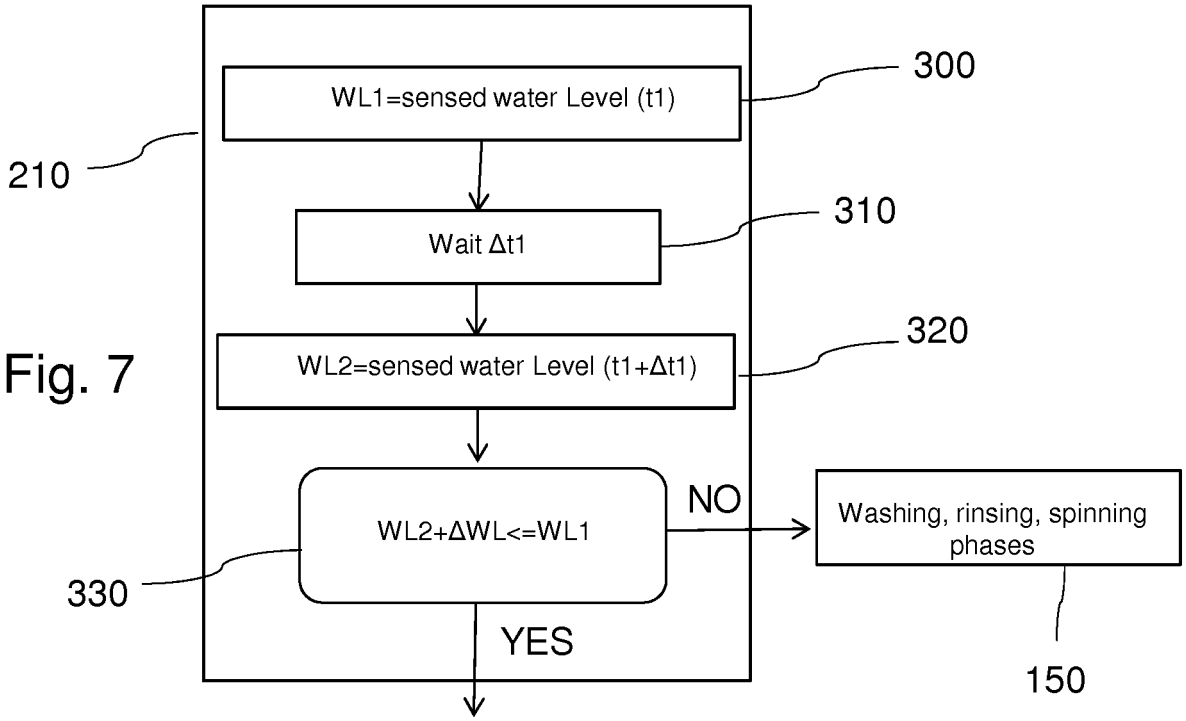
WL1=sensed water Level (t1)
300
210
Wait Δt1
310
WL2=sensed water Level (t1+Δt1)
320
WL2+ΔWL<=WL1
NO
Washing, rinsing, spinning phases
330
YES
150

Fig. 7

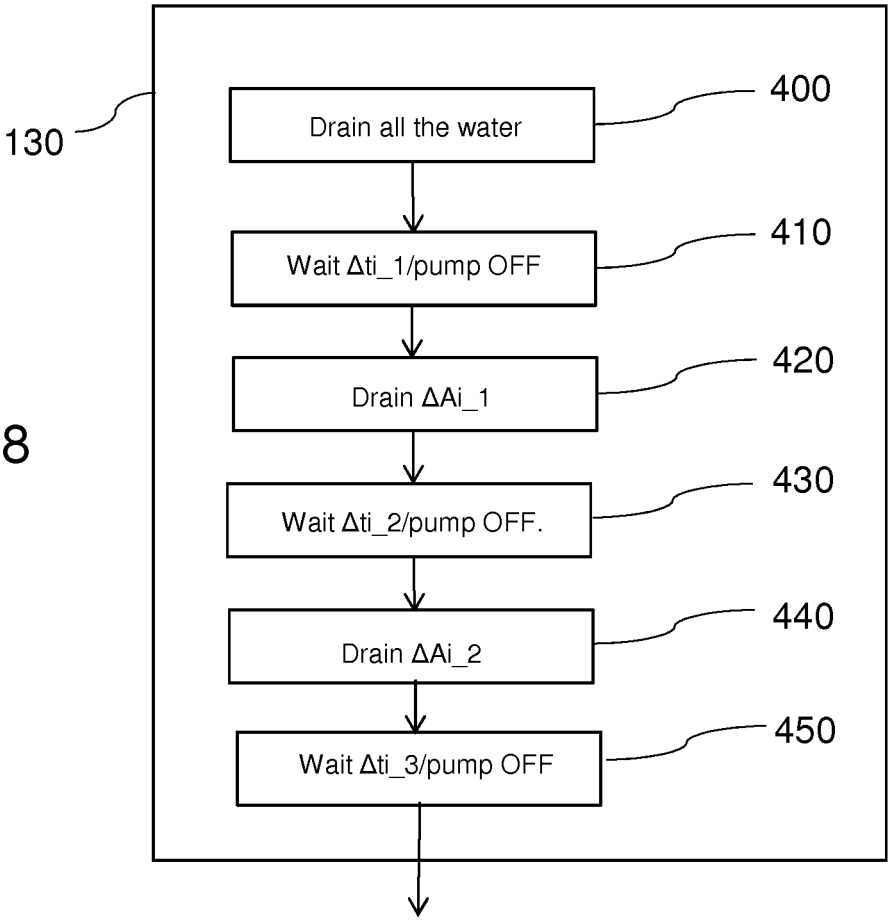
130
Drain all the water
400
Wait Δti_1/pump OFF
410
Drain ΔAi_1
420
Wait Δti_2/pump OFF.
430
Drain ΔAi_2
440
Wait Δti_3/pump OFF
450

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 7921492 B2 **[0003]**