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(54) WASHING MACHINE AND CONTROL METHOD THEREOF

WASCHMASCHINE UND STEUERUNGSVERFAHREN DAFÜR

MACHINE À LAVER ET SON PROCÉDÉ DE COMMANDE

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Description

[0001] The present invention pertains to the technical field of household appliances, relates to a washing control method of a washing machine, and also relates to a washing machine that can implement the control method.

[0002] In general, during a wetting process of a washing program of a washing machine, it is necessary to control a water supply, and perform accurate water volume management based on different load weights and water absorption characteristics of load. It is known that a main method is to adjust the water supply based on a pressure sensor to reach a proper water level in a tub. This control method is generally applied to conventional washing program control, and usually, a water supply of a washing step is more than twice a dry load weight. A heating device located in a washing tub heats water at the bottom of the washing tub, to accelerate dissolution of detergent and stains, and improve activity of the detergent.

[0003] The publication DE 10 2007 028212 A1 discloses a method for treating laundry articles with an aqueous washing liquor in a washing machine with a liquor drain system arranged at the bottom of a liquor container, a rotatably mounted drum and a heating device for directly heating a load quantity of the laundry articles containing the washing liquor, wherein it comprises the steps addition of the washing liquor to the load in an amount less than or equal to an amount necessary to saturate the laundry with water ('saturation amount') and wetting of the laundry; heating the wetted laundry by the heating device; and addition of water at a temperature Tw of not more than 40 °C to rinse the suds out of the laundry. In an embodiment, the direct heating of the laundry items containing the washing liquor is carried out, among other things, with hot air. A washing machine is also disclosed with a program controller for controlling the program sequence, wherein the washing machine has a heating device for directly heating a load of laundry items containing the washing solution. The heating device is, inter alia, a device for generating hot air.

[0004] The publication EP 2 540 896 A1 discloses a method for washing laundry in a laundry washing machine comprising a washing tub external to a rotatable washing drum, wherein the laundry to be washed is loaded. The method comprises the steps of:

- providing a quantity of detergent;
- providing a first quantity of water to form with said quantity of detergent a quantity of washing solution;
- introducing said washing solution into said washing tub;
- recirculating said washing solution inside said washing tub by means of recirculation means until said washing solution is absorbed by said loaded laundry inside said washing drum and the level of said washing solution is below said washing drum;
- activating heating means for heating said wetted loaded laundry inside said washing drum;
- deactivating said heating means and maintaining said heated wetted loaded laundry inside said washing drum for a predetermined dry maintenance time;
- supplying a second quantity of water in said washing tub;
- rotating said washing drum;
- rinsing said loaded laundry by means of drum rotations and by means of liquid drainage from said washing tub.

[0005] The publication DE 197 43 508 A1 discloses a method for heating the washing solution in a washing machine which is at least partially filled with laundry, in particular in a washing machine which is also set up for drying, having at least one heating element, a heating medium passing by the at least one heating element, being heated by the latter and then being brought into contact with the washing solution. The heating medium can be, inter alia, air.

[0006] The publication US 2001/052249 A1 discloses a washing machine apparatus for washing a textile wash load having a wash tub and a recirculating wash liquid apparatus for recirculating wash liquid from said wash tub to said wash load.

[0007] The publication US 2008/0276382 A1 discloses a fabric treatment appliance capable of indicating when a fabric load is sanitized. A sanitizing laundry cycle is conducted by introduced heat into a tub and/or the drum, such as by steam or from a sump heater, to raise the temperatures of the clothes while washing the clothes loads. The heat may be introduced for a predetermined time or until the clothes load and/or wash liquid reaches a predetermined temperature.

[0008] An objective of the present invention is to provide an improved control method of a washing machine, to reduce detergent used in a washing program and improve heating efficiency.

[0009] The present invention provides a control method of a washing machine, including steps of a clothing wetting step, a clothing heating step and a clothing washing step, wherein the clothing wetting step includes a step of supplying water of a first specified volume V1 in a washing tub wherein the first specified volume V1 is less than the amount of water used for washing clothing during the clothing washing step, the clothing heating step includes heating air in the washing tub to heat the wetted clothing in the washing tub, the water absorbing clothing being substantially exposed to the air instead of being soaked in water, and the clothing washing step includes steps of refilling the washing tub with water and of washing the clothing, wherein the clothing wetting step comprises a first water supply process, wherein in this process the washing tub is filled with water through a detergent container until the first specified volume V1 is reached, then a pressure value related to a water volume in the washing tub is detected, and if the pressure value is always greater than a specified high value N1 within a

specified time t, a circulating pump is started to spray water from the bottom of the washing tub onto the clothing, so that the clothing is enabled to absorb the water, and then the clothing heating step is entered,
and wherein if the pressure value gets less than a specified low value N2 a second water supply process is entered, in the second water supply process, the washing tub is refilled with water, if the pressure value rises to be greater than the specified high value N1, then the water supply stops again and the pressure value is detected continuously in this case, and when the pressure value is less than the specified low value N2, the water supply restarts, and the process is repeated in this way; if during the second water supply process a specified time t is reached or a total amount of water supplied in the washing tub is reached a second specified volume V2 then the second water supply process ends and the circulating pump is started to spray water from the bottom of the washing tub onto the clothing, so that the clothing is enabled to absorb the water, wherein the specified high value N1 is greater than the specified low value N2. That means that during one washing program the total amount of water supplied within the wetting step is less than the total water supplied and used for washing the clothing within the following washing step.

[0010] In the clothing wetting step, because of less water is supplied, the same mixing concentration of detergent and water can be obtained by using less detergent compared to a wetting step with higher amount of supplied water. Therefore the efficiency of the used detergent is higher and the impact of the detergent on an environment is reduced. In addition, because of less water is supplied in the clothing wetting step, the heating efficiency is higher and less power is consumed in the clothing heating step. With the air heated and less water supplied, the water absorbing clothing is substantially exposed to the air instead of being usually soaked in water. As the clothing exposed to the air the clothing is heated directly by high temperature air, the heating efficiency is higher. The hot air also heats the entire washing environment, which provides heat storage for a subsequent washing program.

[0011] The clothing wetting step includes controlling a water supply, so that a total amount of water supplied in this step can be less than the amount of water required for saturating the clothing. The amount of water required for saturating the clothing is the amount of water which is needed to get a fully saturated clothing or respectively which dry clothing is capable to absorb. Said amount of water required for saturating the clothing defines a saturated water absorption rate of the clothing which is equal to the weight of water for getting fully saturated clothes divided by the weight of dry clothes. Further, the total amount of water supplied in the clothing wetting step can be about half of the water required for saturating the clothing.

[0012] To enable water to be sufficiently absorbed by the clothing, the clothing wetting step further includes starting a circulating pump to spray water from the bottom of the washing tub via a circulation channel onto the clothing.

[0013] The clothing heating step may include starting a heating device and a fan in an air circulation channel connected to the washing tub. Preferably, the heating device is installed within the air circulation channel. In other specific implementations, the washing machine may comprise an additional heating device in the washing tub which may be also started. If water in the washing tub is lower than a position where the additional heating device is installed, the heating device installed in the circulation channel can still heat air. When water overflows the additional heating device in the washing tub, the additional heating device may be started to heat the water in the washing tub.

[0014] The clothing wetting step may further include:

- filling the washing tub with water until a second specified volume V2 is reached,
- starting a circulating pump to spray water from the bottom of the washing tub onto the clothing, so that the clothing is enabled to absorb the water,
- dehydrating the clothing at a specified spinning speed and releasing water absorbed by the clothing back to the washing tub, wherein the spinning speed is set such that after dehydrating the remaining water absorbed by the clothing is being 1 time of the dry clothing weight,
- determining a water volume released by the dehydrating and determining the dry clothing weight based on the released water volume, and
- refilling the washing tub with water so that a total amount of water supplied in the clothing wetting step is a specified multiple of the dry clothing weight, wherein the total amount of water supplied is less than the amount of water required for saturating the dry clothing.

[0015] As mentioned before, one of the objectives of the clothing wetting step is to control the water supply so that the total amount water supplied is less than the amount of water required for saturating the dry clothing, because of the water absorption of the clothing, the water volume in the washing tub may not be stable and a conventional method in which only a pressure is detected within the washing tub for determining the volume of water not absorbed by the clothing may not control the water supply precisely enough. However, in the method of the preferred embodiment above, the second specified volume V2 of the water supplied minus the water volume released in the dehydrating step is the water volume absorbed by the clothing, and through a properly setting of the spinning speed, the amount of water absorbed by the clothing after dehydrating can be 1 time of the dry clothing weight, so that it can be concluded that the water volume absorbed by the clothing is about equal to the dry clothing weight. Then the water supply for refilling is

based on the dry clothing weight. Such a method of water supply control can get a more accurate control result.

[0016] The specified spinning speed for dehydrating the clothing ranges from 300 to 800 revolutions per minute and varies with a clothing material and/or a selected washing program. The specified spinning speed for dehydrating the clothing may be obtained in advance from experiments on clothing of different materials and/or on different material specific washing programs. For example, for towels or a towel washing program respectively, after dehydrating the clothing with a dehydrating spinning speed about 800 revolutions per minute may make water content remaining within the clothing 1 time of the dry towel weight. For general cotton clothing, a dehydrating spinning speed about 600 revolutions per minute may reach such an objective. For a chiffon material, a dehydrating spinning speed of about 300 revolutions per minute may be sufficient for the same objective.

[0017] The specified multiple of the dry clothing weight may be set less than the saturated water absorption rate of the clothing and greater than or equal to half of the saturated water absorption rate of the clothing. Under such a condition, the clothing can be sufficiently wetted and it avoids that too much water is dropped out of the clothing due to the clothing movement by rotating the drum. Because of less water is used and less detergent is needed to reach the same concentration, the detergent can be fully used. Further the efficiency of heating the clothing by the air is higher because less water has to be heated.

[0018] The circulating pump may be restarted after the washing tub is refilled with water, so that the water in the washing tub can be sufficiently absorbed by the clothing, thereby fully using the water and the detergent in the water.

[0019] The clothing wetting step of the present invention includes a first water supply process at the beginning. In this process, the washing tub is filled with water through a detergent container until the first specified volume V1 is reached. During the clothing wetting step a pressure value related to a water volume in the washing tub is detected, and if the pressure value is greater than a specified high value N1, a circulating pump is started to spray water from the bottom of the washing tub onto the clothing, so that the clothing can sufficiently absorb the water, and then the clothing heating step is entered. In this process, the first specified volume V1 is generally small, for example, 3.5 L, which is only needed to ensure that detergent is fully flushed into the washing tub from the detergent container. If the pressure value stays always higher than the specified high value N1, it means that the washing machine is loaded with a small amount of clothing and/or with clothing having a small saturating water absorption rate so the clothing can absorb only a small amount of water. In this case, no more water supply is needed, and the small load of clothing can get a better heating effect in the subsequent clothing heating step.

[0020] If the pressure value gets less than a specified low value N2 then a second water supply process is entered. In the second water supply process, the washing tub is refilled with water. If the pressure value rises to be greater than the specified high value N1 then the water supply stops again and the pressure value is detected continuously in this case, and when the pressure value is less than the specified low value N2, the water supply restarts. The process is repeated in this way; if during the second water supply process a specified time t is reached or a total amount of water supplied in the washing tub is reached a second specified volume V2 then the second water supply process ends, and the circulating pump is started to spray water from the bottom of the washing tub onto the clothing, so that the clothing sufficiently absorbs the water, wherein the specified high value N1 is greater than the specified low value N2. In this process, the specified time t of the water supply is set as one of conditions to make the clothing sufficiently absorb water. The specified time t may be set to, for example, 1 minute.

[0021] If the duration of the second water supply process reaches the specified time t, while the total water supply in the washing tub has not reached the second specified volume V2, then the clothing heating step is entered after the circulating pump sprays water onto the clothing. Under this condition, it means that the washing machine is loaded with a small amount of clothing, and therefore, a good heating effect can be achieved in the subsequent clothing heating step without additional water supply.

[0022] If the total water supply in the washing tub reaches the second specified volume V2 after the second water supply process ends then the clothing is dehydrated at a specified spinning speed after the circulating pump sprays water onto the clothing, wherein the spinning speed is set such that a remaining amount of water within the clothing is about 1 time of the dry clothing weight after said dehydrating. Then a water volume released by said dehydration is determined and the dry clothing weight is determined based on the released water volume, and finally the washing tub is refilled with water so that the total amount of water supplied in the clothing wetting step is a specified multiple of the dry clothing weight, wherein the total amount of water supplied is less than the amount of water required for saturating the dry clothing.

[0023] The present invention also provides a washing machine, including a control device and a washing tub, wherein the control device is configured to control operation of the washing machine according to one or any combination of the mentioned control methods.

[0024] Specific implementations of the present invention will be illustrated below with reference to the accompanying drawings.

FIG. 1 is a structural diagram of a washing machine;
FIG. 2 is a control flowchart of a washing program of a washing machine; and
FIG. 3 is a control flowchart of a clothing wetting step.

[0025] As shown in FIG. 1, a washing machine 100 has a washing tub 4 located in a housing 2. The washing tub 4 is internally provided with a drum 6 that can be driven to rotate. A wall surface of the drum 6 is provided with through holes (not shown in the figure), to communicate fluid with the washing tub 4. Detergent that enters the washing tub 4 can enter the drum 6. Air in the washing tub 4 and the drum 6 also can flow between each other. Clothing is washed in the drum 6.

[0026] The washing tub 4 is connected to an air circulation channel 8. The air circulation channel 8 is internally provided with a fan 81 and a heating device 82. The fan 81 and the heating device 82 may be started to supply hot air to the washing tub 4.

[0027] The bottom of the washing tub 4 is connected to a circulation channel 9. The circulation channel 9 is provided with a circulation pump 91. After the circulation pump 91 is started, the water with or without detergent is extracted from the bottom of the washing tub 4, pumped through the circulation channel 9 and sprayed onto the clothing.

[0028] The bottom of the washing tub 4 is also provided with a pressure sensor 11 to obtain a water pressure value in the washing tub 4. In other implementations, the pressure sensor may be alternatively disposed in other places suitable for obtaining a change of water pressure. For example, the pressure sensor may be disposed in a drainage channel 3 or on a damping support device 5.

[0029] The washing machine 100 further includes a detergent container or feed box 12 for supplying detergent to the washing tub 4. A water supply pipe 13 supplies water to the feed box 12.

[0030] The water supply pipe 13 is provided with a water valve 14. After the water valve 14 opens, the water supplied by the water supply pipe 13 flows into the feed box 12, mixes with the detergent in the feed box 12 and then flows into the washing tub 4 to participate in a clothing washing program.

[0031] The washing machine 100 is also provided with a control device 10, which is respectively connected to the water valve 14, the fan 81, the heating device 82, the circulating pump 91 and the pressure sensor 11 to receive information according to a program setting and to control the operation of each electrical element.

[0032] The washing machine 100 includes a plurality of washing programs. FIG. 2 shows a control process of one of the washing programs. The control process of the washing program includes a clothing wetting step P1, a clothing heating step P2 and a clothing washing step P3. The clothing wetting step P1 includes a water supply for filling the washing tub 4 with an amount of water which is less than the amount of water supplied and used for washing the clothing within the clothing washing step P3, the clothing heating step P2 includes starting the heating device 82 and the fan 81 in the air circulation channel 8 and supplying heated air into the washing tub 4 and drum 6 to heat the wetted clothing introduced into the drum 6 which is located in the washing tub 4, and the clothing washing step includes a further refilling of the washing tub with water and washing the clothing.

[0033] As shown in FIG. 3, the clothing wetting step P1 includes the following steps:

First step S1: A first water supply process is included, where the control device 10 opens the water valve 14 to supply a first specified volume V1 of water to the feed box 12 through the water supply pipe 13. The water mixes with the detergent in the feed box 12 and flows into the washing tub 4. In principle, a value of the first specified volume V1 needs to be enough to enable the detergent in the feed box 12 to be fully flushed, so that there is basically no residue in the feed box 12. The first specified volume V1 may be set to, for example, 3.5 L. In the water supply process, the control device 10 controls a driving device (not shown in the figure) to rotate the drum 6 at a low speed. The drum 6 may rotate at a low speed to keep turning the clothing, so that the clothing sufficiently absorbs the water introduced into the washing tub 4. A mixture of detergent and water partially permeates the clothing in the drum 6 and partially flows to the bottom of the washing tub 4.

[0034] Second step S2: The drum 6 rotates at a low speed, while a pressure value related to water volume in the washing tub 4 is continuously detected. For example, the pressure value is detected by the pressure sensor 11.

[0035] If the pressure value is greater than a specified high value N1, the water valve 14 remains closed, the drum 6 rotates and the pressure value is continuously detected. If the pressure value is always greater than the specified high value N1 within a specified time t, the second step S2 ends and a third step S3 is entered. In this case, it means that a small amount of clothing is introduced into the drum 6 which respectively absorbs a small amount of water, and a subsequent clothing heating step can be completed well. Therefore, there is no need to refill water.

[0036] If the pressure value drops to a value which is less than a specified low value N2, or the pressure value is less than the specified low value N2 after the first water supply process ends, a second water supply process is entered. The specified high value N1 is greater than the specified low value N2. In the second water supply process, the washing tub 4 is refilled with water. If the pressure value rises to a value which is higher than the specified high value N1, then the water supply stops and the pressure value is detected continuously in this case, and when the pressure value gets or is less than the specified low value N2, the water supply restarts, and the process is repeated in this way. When the duration of the second water supply process reaches the specified time t or a total water supply in the washing tub 4 reaches a second specified volume V2, the second water supply process ends and the third step S3 is entered. The specified time t is, for example, 1 minute, and the second specified volume V2 of the water supply is, for example, 5 liters. A control condition includes the duration of the second water supply process to allow the clothing to

absorb more water to a certain extent.

[0037] After the second step S2 is completed, a maximum total amount of water supplied is the second specified volume V2, and a minimum total amount of water supplied is the first specified volume V1, that is, there is no additional water supply in the second step S2.

[0038] Third step S3: The control device 10 starts the circulating pump 91, sprays water from the bottom of the washing tub 4 via the circulation channel 9 onto the clothing and the drum 6 rotates at a low speed, so that the clothing sufficiently absorbs the water. For example, the circulating pump 91 works until the pressure sensor 11 cannot detect a signal or a detected signal is close to zero which means that nearly all water which is not absorbed by the clothing is pumped out of the washing tub 4.

[0039] Before entering a fourth step S4 there is a determining step S0. The determining step S0 includes determining whether a total volume of water supplied to the washing tub 4 reaches the second specified volume V2. If the total water volume does not reach the second specified volume V2 within the specified time t, it means that a small amount of clothing is in the drum 6 and there is no need to refill additional water. If the total water volume reaches the second specified volume V2, the fourth step S4 is entered.

[0040] Fourth step S4: Dehydrate the clothing by rotating the drum 6 at a specified spinning speed, so that part of the water absorbed by the clothing is discharged from the clothing and flows back to the washing tub 4. A control point of this step is to control the amount of water remaining within the clothing such that after dehydrating the weight of the remaining water is 1 time of the dry clothing weight. The specified spinning speed for dehydrating the clothing ranges from 300 to 800 revolutions per minute, and varies with a clothing material. The specified spinning speed for dehydrating the clothing may be obtained in advance from experiments for clothing of different materials or for specific washing programs designed for clothing of different material respectively. For example, for towels, when the dehydrating spinning speed is set to be about 800 revolutions per minute the remaining water absorbed by the clothing can be 1 time of the dry towel weight after dehydrating with said spinning speed. For general cotton clothing, the dehydrating spinning speed can be set to be about 600 revolutions per minute to reach the same objective. For a chiffon material, a dehydrating spinning speed can be set to be about 300 revolutions per minute. In specific implementation, for example, when a user sets a program or a machine automatically recognizes the clothing material, the washing machine may select a corresponding speed after the clothing material or washing program is determined.

[0041] Fifth step S5: Because part of the water is discharged from the clothing in the fourth step S4, the pressure sensor 11 may detect a signal to determine a released water volume in the fourth step S4. Because the weight of water remaining in the clothing after said dehydration at the specified dehydrating spinning speed in the fourth step S4 is close to the dry clothing weight, the second specified volume V2 of the total water supply minus the released water volume is the water volume remaining in the clothing and the weight of the clothing in a dry state may be obtained accordingly.

[0042] To wash the clothing with less detergent while ensuring a good washing effect and obtaining a better air heating effect, the total water supply in the clothing wetting step P1 is determined as a specified multiple of the dry clothing weight, wherein the specified multiple is less than the amount of water required for saturating the clothing and greater than or equal to half of the amount of water required for saturating the clothing. For example, for general cotton fabric, the amount of the total water supplied in the washing tub 4 may range from 1.5 to 2 times of the weight of dry clothing introduced into the drum 6 located in the tub 4. For towels, the amount of the total water supply may be 2.5 or more times the dry towel weight. For chemical fiber fabric, the amount of the total water supply may be 1 time or slightly more than 1 time the dry clothing weight. After the total water supply is determined, the control device 10 may control the water valve 14 to refill the washing tub 4 with water until the expected total amount of water supply is reached.

[0043] Sixth step S6: The circulating pump 91 is restarted and the drum 6 rotates at a low speed, so that water in the washing tub 4 is sufficiently absorbed by the clothing. Generally, in this step, the water in the washing tub 4 is almost completely absorbed by the clothing. In practice, all the water that can be pumped by the circulating pump 91 is sprayed on the clothing, and the pressure sensor 11 detects no signal again or a detected signal is close to zero. In this case, the sixth step S6 ends.

[0044] The specific implementations described above and shown in the accompanying drawings are used only to illustrate the present invention. In the scope of the basic technical idea of the present invention, modifications in any form made to the present invention by a person of ordinary skill in the related art shall fall within the protection scope of the present invention, which is defined by the appended claims.

Claims

1. A control method of a washing machine (100), comprising a clothing wetting step (P1), a clothing heating step (P2) and a clothing washing step (P3), wherein the clothing wetting step (P1) comprises

   a step of supplying water of a first specified volume V1 in a washing tub (4) wherein the first specified volume V1 is less than the amount of water used for washing clothing during the clothing washing step (P3),

   wherein the clothing heating step (P2) comprises heating air in the washing tub (4) to heat

the wetted clothing in the washing tub (4), the water absorbing clothing being substantially exposed to the air instead of being soaked in water, and wherein the clothing washing step (P3) comprises steps of refilling the washing tub with water and washing the clothing,
wherein the clothing wetting step (P1) comprises a first water supply process, wherein in this process the washing tub (4) is filled with water through a detergent container (12) until the first specified volume V1 is reached,
then a pressure value related to a water volume in the washing tub (4) is detected,
characterized in that
if the pressure value is always greater than a specified high value N1 within a specified time t, a circulating pump (91) is started to spray water from the bottom of the washing tub (4) onto the clothing, so that the clothing is enabled to absorb the water, and then the clothing heating step is entered,
and in that
if the pressure value gets less than a specified low value N2 a second water supply process is entered, in the second water supply process, the washing tub (4) is refilled with water, if the pressure value rises to be greater than the specified high value N1, then the water supply stops again and the pressure value is detected continuously in this case, and when the pressure value is less than the specified low value N2, the water supply restarts, and the process is repeated in this way;
if during the second water supply process the specified time t is reached or a total amount of water supplied in the washing tub (4) is reached a second specified volume V2
then the second water supply process ends and the circulating pump (91) is started to spray water from the bottom of the washing tub onto the clothing, so that the clothing is enabled to absorb the water,
wherein the specified high value N1 is greater than the specified low value N2.

2. The control method according to claim 1, **characterized in that** the clothing wetting step (P1) comprises controlling a water supply, so that a total amount of water supplied in this step is less than the amount of water required for saturating the clothing.

3. The control method according to claim 2, **characterized in that** the total amount of water supplied in the clothing wetting step (P1) is controlled to be about half of the water required for the saturating the clothing.

4. The control method according to any of the claim 1 to 3, **characterized in that** the clothing wetting step (P1) comprises starting a circulating pump (91) to spray water from the bottom of the washing tub (4) via a circulation channel (9) onto the clothing, so that the clothing is enabled to absorb the water.

5. The control method according to any of the claims 1 to 4, **characterized in that** the clothing heating step (P2) comprises starting a heating device (82) and a fan (81) in an air circulation channel (8) connected to the washing tub (4).

6. The control method according to any of the claims 1 to 5, **characterized in that** the clothing wetting step (P1) comprises

- filling the washing tub (4) with water until a second specified volume V2 is reached,
- starting a circulating pump (91) to spray water from the bottom of the washing tub (4) onto the clothing, so that the clothing is enabled to absorb the water,
- dehydrating the clothing at a specified spinning speed and releasing water absorbed by the clothing back to the washing tub (4), wherein the spinning speed is set such that after dehydrating the remaining water absorbed by the clothing is being 1 time of the dry clothing weight,
- determining a released water volume released by the dehydrating and determining the dry clothing weight based on the released water volume, and
- refilling the washing tub (4) with water so that a total amount of water supplied in the clothing wetting step (P1) is a specified multiple of the dry clothing weight, wherein the total amount of water supplied is less than water required for saturating the dry clothing.

7. The control method according to claim 6, **characterized in that** the specified spinning speed for dehydrating the clothing ranges from 300 to 800 revolutions per minute and varies with a clothing material and/or a selected washing program.

8. The control method according to claim 6 or 7, **characterized in that** the specified spinning speed for dehydrating the clothing is obtained in advance from experiments on clothing of different materials and/or for different material specific washing programs.

9. The control method according to any of the claims 6 to 8, **characterized in that** the specified multiple of dry clothing weight is less than the amount of water required for saturating the clothing and greater than or equal to half of the amount of water required for saturating the clothing.

10. The control method according to any of the claims 6

to 9, **characterized in that** the circulating pump (91) is restarted after the washing tub (4) is refilled with water, so that the water in the washing tub is absorbed by the clothing.

11. The control method according to any of the claims 1 to 5, **characterized in that** if the duration of the second water supply process reaches the specified time t, while the total amount of water supplied in the washing tub (4) has not reached the second specified volume V2, then the clothing heating step is entered after the circulating pump sprays water onto the clothing.

12. The control method according to any of the claims 1 to 10, **characterized in that** if the total amount of water supplied in the washing tub (4) reaches the second specified volume V2 after the second water supply process ends then the clothing is dehydrated at a specified spinning speed after the circulating pump (91) sprays water onto the clothing, wherein the spinning speed is set to such that after dehydrating the remaining water absorbed by the clothing is being 1 time of the dry clothing weight, then a water volume released from the clothing by the dehydrating is determined and the dry clothing weight is determined based on the water volume released, and finally the washing tub (4) is refilled with water so that the total amount of water supplied in the clothing wetting step is a specified multiple of the dry clothing weight, wherein the total amount of water supplied is less than the amount of water required for saturating the dry clothing.

13. A washing machine (100), comprising a control device (10) and a washing tub (4), **characterized in that** the control device (10) is configured to control the operation of the washing machine according to the control method according to any one of claims 1 to 12.

Patentansprüche

1. Steuerverfahren für eine Waschmaschine (100), das einen Wäschebenetzungsschritt (P1), einen Wäscheerwärmungsschritt (P2) und einen Wäschewaschschritt (P3) umfasst, wobei der Wäschebenetzungsschritt (P1) Folgendes umfasst:

ein Zuführen eines ersten festgelegten Volumens V1 an Wasser zu einem Waschlaugenbehälter (4), wobei das erste festgelegte Volumen V1 geringer ist als die Wassermenge, die bei dem Wäschewaschschritt (P3) zum Waschen von Wäsche benutzt wird,
wobei der Wäscheerwärmungsschritt (P2) ein Erwärmen von Luft im Waschlaugenbehälter (4) zwecks Erwärmens der benetzten Wäsche im Waschlaugenbehälter (4) umfasst, wobei die wasseraufnehmende Wäsche im Wesentlichen der Luft ausgesetzt ist, statt in Wasser eingeweicht zu sein, und wobei der Wäschewaschschritt (P3) ein Wiederauffüllen des Waschlaugenbehälters mit Wasser und ein Waschen der Wäsche umfasst,
wobei der Wäschebenetzungsschritt (P1) einen ersten Wasserzufuhrvorgang umfasst, wobei der Waschlaugenbehälter (4) bei diesem Vorgang über einen Waschmittelbehälter (12) mit Wasser gefüllt wird, bis das erste festgelegte Volumen V1 erreicht ist, dann wird ein Druckwert zu einem Wasservolumen im Waschlaugenbehälter (4) erfasst,
dadurch gekennzeichnet, dass,
wenn der Druckwert innerhalb einer festgelegten Zeit t stets über einem festgelegten hohen Wert N1 liegt, eine Umwälzpumpe (91) eingeschaltet wird, die Wasser aus dem unteren Teil des Waschlaugenbehälters (4) auf die Wäsche sprüht, so dass die Wäsche das Wasser aufnehmen kann, und dann zum Wäscheerwärmungsschritt übergegangen wird,
und dass,
wenn der Druckwert unter einem festgelegten niedrigen Wert N2 liegt, zu einem zweiten Wasserzufuhrvorgang übergegangen wird, in dem der Waschlaugenbehälter (4) wieder mit Wasser aufgefüllt wird, wobei die Wasserzufuhr, wenn der Druckwert den festgelegten hohen Wert N1 übersteigt, wieder eingestellt und der Druckwert in diesem Fall kontinuierlich erfasst wird und, wenn der Druckwert unter dem festgelegten niedrigen Wert N2 liegt, wieder mit der Wasserzufuhr begonnen und der Vorgang auf diese Weise wiederholt wird,
wenn im Verlauf des zweiten Wasserzufuhrvorgangs die festgelegte Zeit t erreicht wird oder eine dem Waschlaugenbehälter (4) zugeführte Wassergesamtmenge ein zweites festgelegtes Volumen V2 erreicht, der zweite Wasserzufuhrvorgang beendet und die Umwälzpumpe (91) eingeschaltet wird, die Wasser aus dem unteren Teil des Waschlaugenbehälters auf die Wäsche sprüht, so dass die Wäsche das Wasser aufnehmen kann,
wobei der festgelegte hohe Wert N1 über dem festgelegten niedrigen Wert N2 liegt.

2. Steuerverfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** der Wäschebenetzungsschritt (P1) das Regeln einer Wasserzufuhr umfasst, so dass eine in diesem Schritt zugeführte Wassergesamtmenge geringer ist als eine zum Sättigen der Wäsche erforderliche Wassermenge.

3. Steuerverfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** die im Wäschebenetzungsschritt (P1) zugeführte Wassergesamtmenge so geregelt wird, dass sie etwa die Hälfte des zum Sättigen der Wäsche erforderlichen Wassers beträgt.

4. Steuerverfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** der Wäschebenetzungsschritt (P1) das Einschalten einer Umwälzpumpe (91) umfasst, die Wasser aus dem unteren Teil des Waschlaugenbehälters (4) über einen Umwälzkanal (9) auf die Wäsche sprüht, so dass die Wäsche das Wasser aufnehmen kann.

5. Steuerverfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Wäscheerwärmungsschritt (P2) ein Einschalten einer Heizvorrichtung (82) und eines Gebläses (81) in einem mit dem Waschlaugenbehälter (4) verbundenen Luftzirkulationskanal (8) umfasst.

6. Steuerverfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der Wäschebenetzungsschritt (P1) Folgendes umfasst:

   - Füllen des Waschlaugenbehälters (4) mit Wasser, bis ein zweites festgelegtes Volumen V2 erreicht ist,
   - Einschalten einer Umwälzpumpe (91), die Wasser aus dem unteren Teil des Waschlaugenbehälters (4) auf die Wäsche sprüht, so dass die Wäsche das Wasser aufnehmen kann,
   - Entfeuchten der Wäsche bei einer festgelegten Schleuderdrehzahl und Abgeben des von der Wäsche aufgenommenen Wassers zurück in den Waschlaugenbehälter (4), wobei die Schleuderdrehzahl so eingestellt wird, dass das verbleibende von der Wäsche aufgenommene Wasser nach dem Entfeuchten dem Wäschetrockengewicht entspricht,
   - Bestimmen eines beim Entfeuchten abgegebenen Wasservolumens und des Wäschetrockengewichts auf der Grundlage des abgegebenen Wasservolumens und
   - Wiederauffüllen des Waschlaugenbehälters (4) mit Wasser, so dass eine im Wäschebenetzungsschritt (P1) zugeführte Wassergesamtmenge ein festgelegtes Mehrfaches des Wäschetrockengewichts beträgt, wobei die zugeführte Wassergesamtmenge geringer ist als das zum Sättigen der trockenen Wäsche erforderliche Wasser.

7. Steuerverfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die festgelegte Schleuderdrehzahl zum Entfeuchten der Wäsche im Bereich von 300 bis 800 Umdrehungen pro Minute liegt und je nach Wäschematerial und/oder gewähltem Waschprogramm variiert.

8. Steuerverfahren nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** die festgelegte Schleuderdrehzahl zum Entfeuchten der Wäsche im Vorhinein durch Experimente an Wäsche aus verschiedenem Material und/oder für unterschiedliche materialspezifische Waschprogramme ermittelt wird.

9. Steuerverfahren nach einem der Ansprüche 6 bis 8, **dadurch gekennzeichnet, dass** das festgelegte Vielfache des Wäschetrockengewichts unter der zum Sättigen der Wäsche erforderlichen Wassermenge liegt und mindestens der Hälfte der zum Sättigen der Wäsche erforderlichen Wassermenge entspricht.

10. Steuerverfahren nach einem der Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** die Umwälzpumpe (91) wieder eingeschaltet wird, wenn der Waschlaugenbehälter (4) wieder mit Wasser aufgefüllt wird, so dass das Wasser im Waschlaugenbehälter von der Wäsche aufgenommen wird.

11. Steuerverfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass**, wenn die Dauer des zweiten Wasserzufuhrvorgangs die festgelegte Zeit t erreicht, während die dem Waschlaugenbehälter (4) zugeführte Wassergesamtmenge noch nicht das zweite festgelegte Volumen V2 erreicht hat, zum Wäscheerwärmungsschritt übergegangen wird, wenn die Umwälzpumpe Wasser auf die Wäsche gesprüht hat.

12. Steuerverfahren nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass**, wenn die dem Waschlaugenbehälter (4) zugeführte Wassergesamtmenge nach Beendigung des zweiten Wasserzufuhrvorgangs das zweite festgelegte Volumen V2 erreicht, die Wäsche bei einer festgelegten Schleuderdrehzahl entfeuchtet wird, wenn die Umwälzpumpe (91) Wasser auf die Wäsche gesprüht hat, wobei die Schleuderdrehzahl so eingestellt wird, dass das verbleibende von der Wäsche aufgenommene Wasser nach dem Entfeuchten dem Wäschetrockengewicht entspricht, ein beim Entfeuchten abgegebenes Wasservolumen und auf der Grundlage des abgegebenen Wasservolumens das Wäschetrockengewicht bestimmt wird und schließlich der Waschlaugenbehälter (4) wieder mit Wasser aufgefüllt wird, so dass die im Wäschebenetzungsschritt zugeführte Wassergesamtmenge ein festgelegtes Mehrfaches des Wäschetrockengewichts beträgt, wobei die zugeführte Wassergesamtmenge geringer ist als die zum Sättigen der trockenen Wäsche erforderliche Wassermenge.

13. Waschmaschine (100), die eine Steuervorrichtung

(10) und einen Waschlaugenbehälter (4) umfasst, **dadurch gekennzeichnet, dass** die Steuervorrichtung (10) so konfiguriert ist, dass sie den Betrieb der Waschmaschine dem Steuerverfahren nach einem der Ansprüche 1 bis 12 entsprechend steuert.

Revendications

1. Procédé de commande d'une machine à laver (100), comprenant une étape de mouillage du linge (P1), une étape de chauffage du linge (P2) et une étape de lavage du linge (P3), dans lequel l'étape de mouillage du linge (P1) comprend une étape d'alimentation d'eau d'un premier volume prédéterminé V1 dans une cuve de lavage (4),

dans lequel le premier volume prédéterminé V1 est inférieur à la quantité d'eau utilisée pour laver le linge durant l'étape de lavage du linge (P3),
dans lequel l'étape du chauffage du linge (P2) comprend le chauffage de l'air dans la cuve de lavage (4) de manière à chauffer le linge humide dans la cuve de lavage (4), le linge ayant absorbé l'eau étant essentiellement exposé à l'air plutôt que d'être immergé dans l'eau, et
dans lequel l'étape de lavage du linge (P3) comprend des étapes de réalimentation d'eau dans la cuve de lavage et de lavage du linge,
dans lequel l'étape de mouillage du linge (P1) comprend une première opération d'alimentation d'eau, la cuve de lavage (4), au cours de cette opération, étant remplie avec de l'eau en passant à travers un compartiment de lessive (12) jusqu'à ce que le premier volume prédéterminé V1 soit atteint,
puis une première valeur de pression liée au volume d'eau dans la cuve de lavage (4) est détectée,
caractérisé en ce que :

si la valeur de pression demeure supérieure à une valeur haute prédéterminée N1 pendant une durée prédéterminée t,
une pompe de circulation (91) est mise en marche pour pulvériser de l'eau depuis le fond de la cuve de lavage (4) sur le linge, de sorte que le linge puisse absorber l'eau,
puis l'étape de chauffage du linge est initiée, et **en ce que**
si la valeur de pression devient inférieure à une valeur basse prédéterminée N2, une deuxième opération d'alimentation d'eau est initiée, au cours de laquelle la cuve de lavage (4) est réalimentée avec de l'eau, et si la valeur de pression augmente pour devenir supérieure à la valeur haute prédéterminée N1, l'alimentation d'eau est à nouveau arrêtée et la valeur de pression est alors surveillée en continu, et lorsque la valeur de pression redescend en dessous de la valeur de pression basse prédéterminée N2, l'alimentation en eau se remet en marche, et l'opération est répétée de cette manière, et
si, pendant la deuxième opération d'alimentation d'eau, la durée prédéterminée t est atteinte ou si une quantité d'eau totale alimentée dans la cuve de lavage (4) atteint un deuxième volume prédéterminé V2,
la deuxième opération d'alimentation d'eau est arrêtée et la pompe de circulation (91) est mise en marche pour pulvériser de l'eau depuis le fond de la cuve de lavage sur le linge, de sorte à permettre au linge d'absorber de l'eau,
dans lequel la valeur haute prédéterminée N1 est supérieure à la valeur basse prédéterminée N2.

2. Procédé de commande selon la revendication 1, **caractérisé en ce que** l'étape de mouillage du linge (P1) comprend la commande d'une alimentation d'eau, de sorte qu'une quantité totale d'eau alimentée dans cette étape est inférieure à la quantité d'eau nécessaire pour saturer le linge.

3. Procédé de commande selon la revendication 2, **caractérisé en ce que** la quantité totale d'eau alimentée dans l'étape de mouillage du linge (P1) est réglée de sorte à correspondre environ à la moitié de la quantité d'eau nécessaire pour saturer le linge.

4. Procédé de commande selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** l'étape de mouillage du linge (P1) comprend la mise en marche d'une pompe de circulation (91) pour pulvériser de l'eau depuis le fond de la cuve de lavage (4) via un conduit de circulation (9) sur le linge, de sorte à permettre au linge d'absorber l'eau.

5. Procédé de commande selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** l'étape de chauffage du linge (P2) comprend la mise en marche d'un dispositif de chauffage (82) et d'un ventilateur (81) dans un conduit de circulation d'air (8) relié à la cuve de lavage (4).

6. Procédé de commande selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** l'étape de mouillage du linge (P1) comprend :

- l'alimentation de la cuve de lavage (91) avec de l'eau jusqu'à ce qu'un deuxième volume prédéterminé V2 soit atteint,

- la mise en marche d'une pompe de circulation (91) pour pulvériser de l'eau depuis le fond de la cuve de lavage (4) sur le linge, de sorte à permettre au linge d'absorber l'eau,
- l'essorage du linge à une vitesse de rotation prédéterminée et l'extraction de l'eau absorbée en retour dans la cuve de lavage (4), où la vitesse de rotation est réglée de sorte qu'après l'essorage, l'eau restante absorbée par le linge correspond à une quantité équivalente au poids du linge sec,
- la détermination d'un volume d'eau extrait par l'essorage et la détermination du poids du linge sec sur la base du volume d'eau extrait, et
- la réalimentation de la cuve de lavage (4) avec de l'eau de sorte qu'une quantité totale d'eau alimentée dans l'étape de mouillage du linge (P1) est un multiple prédéterminé du poids du linge sec, dans lequel la quantité totale alimentée est inférieure à la quantité nécessaire pour saturer le linge sec.

7. Procédé de commande selon la revendication 6, **caractérisé en ce que** la vitesse de rotation prédéterminée pour l'essorage du linge est de 300 à 800 tours par minute et varie selon un matériau du linge et/ou un programme de lavage sélectionné.

8. Procédé de commande selon la revendication 6 ou 7, **caractérisé en ce que** la vitesse de rotation prédéterminée pour l'essorage du linge est obtenue préalablement à partir d'expériences sur du linge de différents matériaux et/ou pour des différents programmes de lavage spécifiques au matériau du linge.

9. Procédé de commande selon l'une quelconque des revendications 6 à 8, **caractérisé en ce que** le multiple prédéterminé du poids du linge sec est inférieur à la quantité d'eau nécessaire pour saturer le linge et supérieur ou égal à la moitié de la quantité d'eau nécessaire pour saturer le linge.

10. Procédé de commande selon l'une quelconque des revendications 6 à 9, **caractérisé en ce que** la pompe de circulation (91) est remise en marche après que la cuve de lavage (4) est réalimentée avec de l'eau, de sorte que l'eau dans la cuve de lavage est absorbée par le linge.

11. Procédé de commande selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que**, si la durée de la deuxième opération d'alimentation d'eau atteint la durée prédéterminée t, alors que la quantité totale d'eau introduite dans la cuve de lavage (4) n'a pas atteint le deuxième volume prédéterminé V2, l'étape de chauffage du linge est initiée après que la pompe de circulation a pulvérisé de l'eau sur le linge.

12. Procédé de commande selon l'une quelconque des revendications 1 à 10, **caractérisé en ce que**, si la quantité totale d'eau alimentée dans la cuve de lavage (4) atteint le deuxième volume prédéterminé V2 après la fin de la deuxième opération d'alimentation d'eau, le linge est alors essoré à une vitesse de rotation prédéterminée après que la pompe de circulation (91) a pulvérisé de l'eau sur le linge, dans lequel la vitesse de rotation est réglée de sorte qu'après l'essorage, l'eau restante absorbée par le linge corresponde à une quantité égale au poids du linge sec, puis, un volume d'eau extrait du linge par l'essorage est déterminé et le poids du linge sec est déterminé sur la base du volume d'eau extrait, et enfin la cuve de lavage (4) est réalimentée avec de l'eau de sorte que la quantité totale d'eau introduite lors de l'étape de mouillage du linge correspond à un multiple prédéterminé du poids du linge sec, dans lequel la quantité totale d'eau introduite est inférieure à la quantité d'eau nécessaire pour saturer le linge sec.

13. Machine à laver (100), comprenant un dispositif de commande (10) et une cuve de lavage (4), **caractérisée en ce que** le dispositif de commande (10) est configuré pour commander le fonctionnement de la machine à laver selon le procédé de commande selon l'une quelconque des revendications 1 à 12.

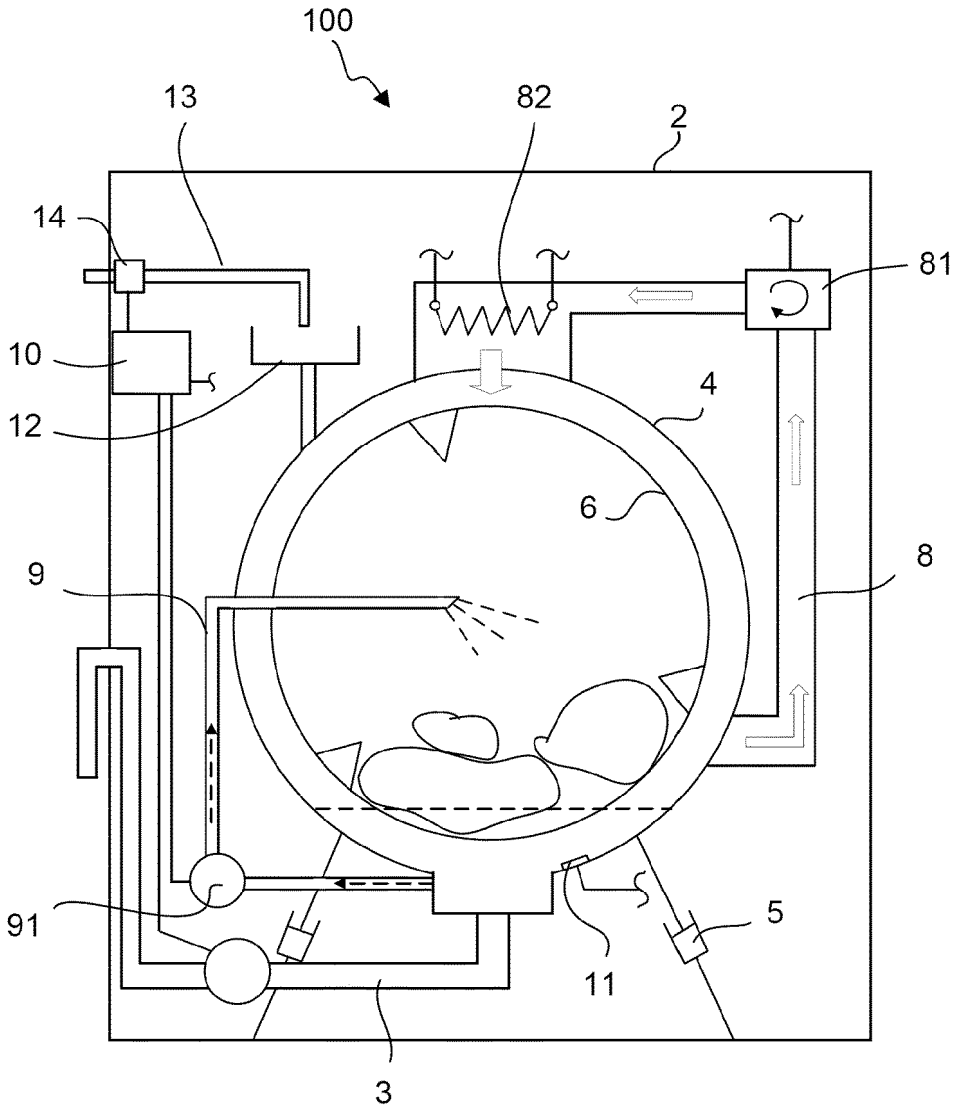

FIG. 1

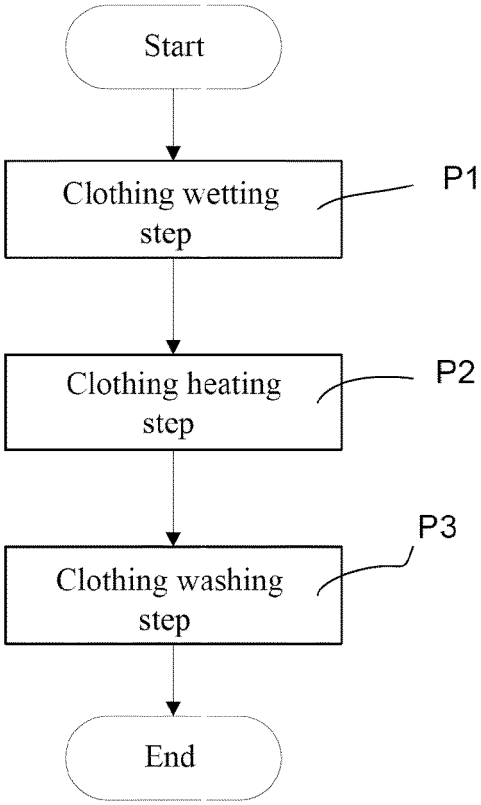
Start
Clothing wetting step
P1
Clothing heating step
P2
Clothing washing step
P3
End

FIG. 2

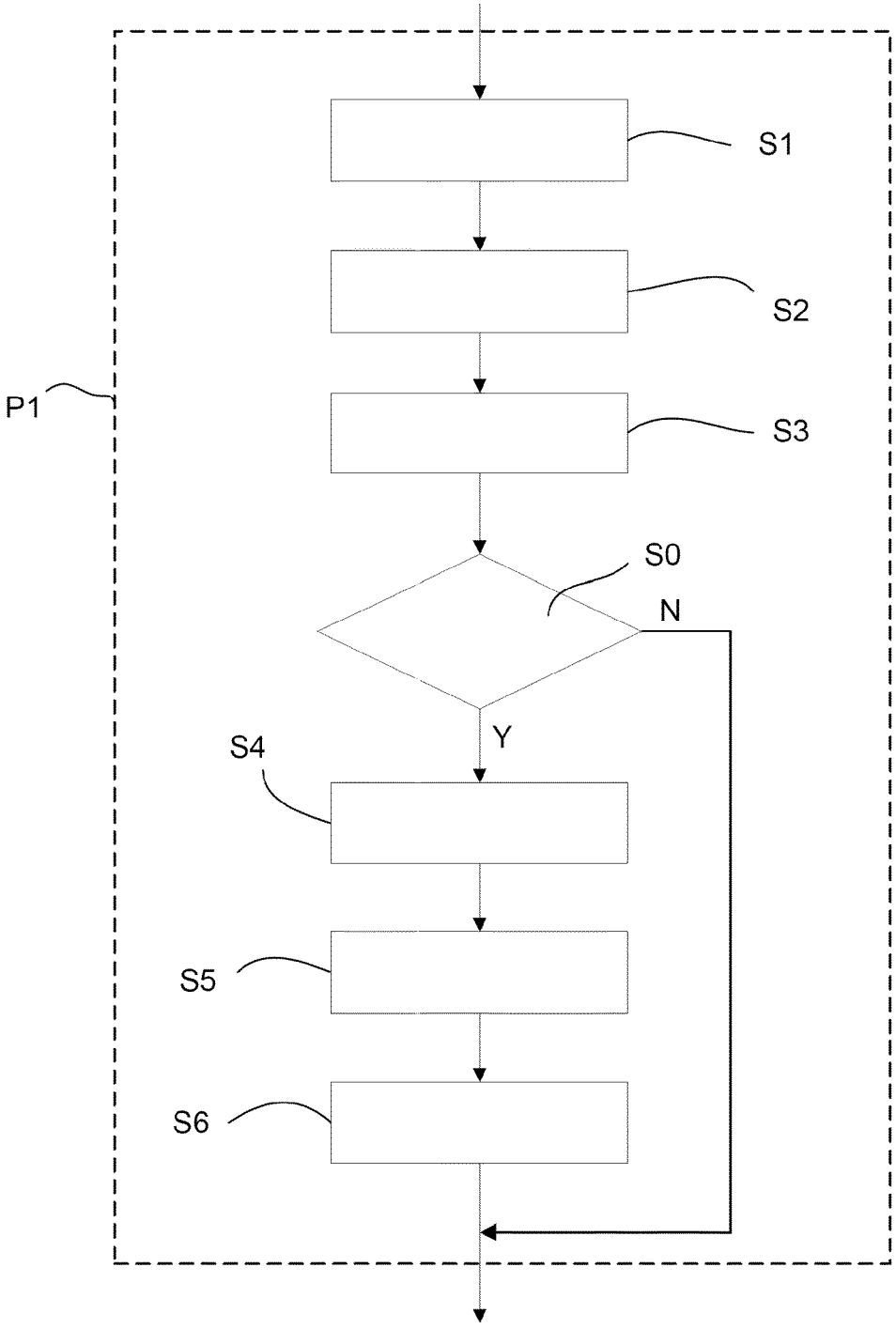

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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