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

Verfahren zum Waschen von Wäsche in einer Waschmaschine und Waschmaschine

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

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Description

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

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

[0003] More particularly, the present invention refers to a method for supplying water in a laundry washing machine during the washing program.

BACKGROUND ART

[0004] 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.

[0005] In the present description the term "laundry washing machine" will refer to both simple laundry washing machines and laundry washing and drying machines.

[0006] Laundry washing machines generally comprise an external casing provided with a washing tub which contains a rotatable perforated drum where the laundry is placed.

[0007] A loading/unloading door ensures access to the tub and the drum.

[0008] Laundry washing machines typically comprise a water supply unit and a detergent supply unit for the introduction of water and washing/rinsing products (i.e. detergent, softener, etc.) into the tub.

[0009] Known laundry washing machines are also provided with water draining devices that may operate both during the washing cycle and at the end of the same to drain the dirty water.

[0010] Heating means are typically provided in order to heat the liquid, typically water or water with detergent, inside the tub.

[0011] According to the known technique, a washing cycle typically includes different phases during which the laundry to be washed is subjected to adequate treatments.

[0012] A washing cycle usually comprises one or more phases during which the water is introduced into the tub. For example at the beginning of said cycle, the laundry is wetted by the introduction of a first quantity of water into the tub. During this wetting phase preferably a preset quantity of washing detergent is also added to form a washing solution which is then absorbed by the laundry.

[0013] Also in the following washing phase, further introduction phases of water may be provided in order to perform the desired washing cycle with the appropriate amount of washing liquor, i.e. water and/or washing/rinsing products.

[0014] An aim of the laundry washing machines producers is, therefore, the control of the exact amount of water introduced inside the tub.

[0015] A laundry washing machine belonging to the know technique comprising a precise detection of the inflowing water is disclosed in document EP0489405.

[0016] In this document the inflowing water volume is measured by a microcomputer connected to a flow meter.

[0017] The use of such a flow meter allows the load of the exact quantity of water needed during the different phases of the washing cycle, in order to standardize the water consumption of the machine.

[0018] For example, a water refilling in the wetting phase may be performed by loading the minimum quantity of water required.

[0019] Furthermore, laundry washing machines belonging to the know technique typically further comprise a liquid sensor device suited to sense (or detect) when the liquid level inside the tub reaches a dangerous, or overflow, level. The sensor device normally comprises a pressure sensor which senses the pressure in the tub.

[0020] When the value sensed by device reaches the overflow level, a malfunctioning of the machine occurs, typically a malfunctioning of the flow meter. The washing cycle is stopped and functioning of the machine is inhibited, until the machine is being repaired by a service operator.

[0021] However, the technique above described belonging to the known art poses some drawbacks.

[0022] A first drawback of this known technique is the fact that malfunctioning of the machine, in particular malfunctioning of the flow meter, always requires intervention of a service operator for maintenance, even if it is a temporary malfunctioning.

[0023] A further drawback of the know technique is the fact that a permanent failure of the flow meter always requires the substitution of the flow meter itself.

[0024] US2010/024490 discloses a method for determining the laundry load size in an automatic clothes washer comprising supplying water to two reference levels defining two amounts of water.

[0025] US2010/032026 discloses a monitoring device including first detection means of a flow rate of operative fluid in an electric household appliance towards a tank of the appliance and second detector means of the level of such a fluid in the tank.

[0026] The object of the present invention is therefore to overcome the drawbacks posed by the known technique.

[0027] It is a first object of the invention to implement a washing method that makes it possible to simplify maintenance.

[0028] It is a further object of the invention to implement a washing method that can reduce repairing costs.

[0029] 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

[0030] The applicant has found that by providing a method for washing laundry in a laundry washing machine comprising both a flow sensor for measuring the amount of water introduced into a washing tub, and a liquid level sensor device for detecting an overflow level of liquid in the washing tub, which method comprises controlling the quantity of water introduced inside the washing tub according to the values detected by the flow sensor if the liquid level inside the tub detected by the liquid level sensor device is lower than a safety level which is below an overflow level, and controlling the quantity of water introduced inside the tub according to the values of the liquid level detected by the liquid level sensor device if the liquid level inside the washing tub detected by the liquid level sensor device reaches the safety level, it is possible to simplify the maintenance of the machine.

[0031] In a first aspect thereof the present invention relates, therefore, to a method for washing laundry in a laundry washing machine, said laundry washing machine comprising:

- a washing tub external to a washing drum suited to receive said laundry;
- a water supply system suitable to convey water into said washing tub;
- a water flow sensor associated to said water supply system for measuring an amount of water introduced into said washing tub;
- a liquid level sensor device suitable for detecting an overflow level of liquid in said washing tub and to communicate the reaching of said overflow level to a control unit which causes stopping of said washing machine accordingly;

said method comprising one or more steps of conveying water from said water supply system to said washing tub wherein the quantity of water introduced inside said washing tub is controlled according to the values detected by said water flow sensor;
wherein said method comprises detecting the liquid level inside said washing tub by means of said liquid level sensor device and if said liquid level reaches a safety level which is below said overflow level then the quantity of water introduced inside said washing tub from said water supply system is controlled according to the values of the liquid level detected by said liquid level sensor device instead of according to the values detected by said water flow sensor.

[0032] Preferably, the safety level is a level for the liquid inside said washing tub which is higher than the maximum liquid level at which the machine is expected to work.

[0033] In a preferred embodiment of the invention, after the first step of conveying water from the water supply system to the washing tub which has been controlled according to the values detected by the liquid level sensor device, the method provides for using again the water flow sensor, instead of the liquid level sensor device, for controlling the quantity of water introduced inside the washing tub in the following one or more steps of conveying water from the water supply system to the washing tub.

[0034] In a further preferred embodiment of the invention, if the liquid level detected by the liquid level sensor device falls below the safety level, then the method provides for using again the water flow sensor, instead of said liquid level sensor device, for controlling the quantity of water introduced inside the washing tub.

[0035] In a further preferred embodiment of the invention, all the following steps of conveying water from the water supply system to the washing tub are controlled according to values detected by the liquid level sensor device.

[0036] In a preferred embodiment of the invention, after the liquid level reaches a safety level, the water flow sensor is not used anymore for determining the quantity of water supplied to the washing tub.

[0037] Opportunely, if the liquid level reaches a safety level a failure message is generated which indicates failure of the water flow sensor.

[0038] Preferably, the failure message is stored in a memory location of the machine and/or generates an alarm signal for the user.

[0039] Advantageously, if the liquid level reaches the overflow level the washing program is stopped until repairing of the machine.

[0040] In a second aspect thereof, the present invention concerns a laundry washing machine suited to implement the method of the invention described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] 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 a front view of a laundry washing machine implementing the method according to the invention;
- Figure 2 shows a side view of the laundry washing machine shown in Figure 1;
- Figure 3 is a simplified flow chart of the basic operations of a method for washing laundry in the washing machine of Figure 1 according to a first embodiment of the invention;
- Figure 4 shows in detail an operation of the flow chart of Figure 3;
- Figure 5 shows a further embodiment of Figure 4;
- Figure 6 shows a further embodiment of Figure 5;

- Figure 7 shows a further embodiment of Figure 2.

DETAILED DESCRIPTION OF THE INVENTION

[0042] 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.

[0043] With reference to Figures 1 and 2, a laundry washing machine 1 according to the invention is described, in which a method according to a first embodiment of the invention is implemented.

[0044] 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 loading washing devices, for example top loading laundry washing machines or top loading laundry washing and drying machines.

[0045] The laundry washing machine 1 comprises an external casing or casing 2, in which a washing tub 3 is provided that contains a rotatable perforated drum 4, where the laundry 10 to be washed can be loaded.

[0046] The tub 3 and the drum 4 both have preferably a substantially cylindrical shape.

[0047] The casing 2 is provided with a loading/unloading door 8 which allows access to the washing tub 3 and the drum 4.

[0048] The 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.

[0049] The tub 3 is preferably connected to the casing 2 and/or the door by means of an elastic bellows 7, or gasket.

[0050] The drum 4 is advantageously rotated by an electric motor 11 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.

[0051] A water supply system 5 and a detergent supply system 6 are arranged in the upper part of the laundry washing machine 1 and are suited to supply water W and washing/rinsing products (i.e. detergent, softener, etc.) into the tub 3.

[0052] 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.

[0053] In the embodiment herein described, the water W flowing through the water supply system 5 is advantageously supplied into the tub 3 by making it flow through the drawer 13 and through a supply pipe 9 which extends toward the tub 3.

[0054] The supply pipe output 9a of the supply pipe 9 advantageously ends in correspondence of the tub 3. Preferably the supply pipe output 9a ends in correspondence of a lateral side of the tub 3, as better visible in Figure 2; alternatively the supply pipe output 9a of the supply pipe 9 may advantageously end in correspondence of the bellows 7.

[0055] 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 17.

[0056] A water flow sensor 16, for example a flow meter, is arranged along the main pipe 15 between the supply valve 17 and the drawer 13. The flow meter 16, as better described below, makes it possible to calculate the quantity of water W supplied into the tub 3.

[0057] In different embodiments of the invention, the flow meter 16 may be arranged along the main pipe 15 between the supply valve 17 and the external supply line E.

[0058] In further alternative embodiments of the invention, the water supply system may be provided with a plurality of supply valves and/or a plurality of flow meters opportunely arranged to supply water and controlling its quantities to the different compartments of the drawer, as better described below with reference for example to the embodiment shown in Figure 7.

[0059] In a further alternative embodiment of the invention, the water supply system may comprise a first circuit to supply cold water, substantially of the type above described, and a separate second circuit to supply hot water arriving from an external source of hot water, which may be realized in a similar way to the first circuit. In this case, the first and the second circuits may be each provided with one or more supply valves and/or one or more flow meters.

[0060] In a preferred embodiment, the water W which reaches the tub 3 can selectively contain one of the products contained in the compartments of the drawer 13, or such water W 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 W in conveyed into the tub 3.

[0061] In an alternative embodiment of the invention, a further separate water supply pipe can be provided, which supplies exclusively clean water W into the tub 3.

[0062] The laundry washing machine 1 advantageously comprises a water outlet circuit 25.

[0063] The water outlet circuit 25 advantageously com-

prises a drain pump 26, a first pipe 27 connecting the tub 3 to the drain pump 26 and an outlet pipe 28 ending outside the casing 2. The water outlet circuit 25 is suited to drain the liquid, i.e. dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside.

[0064] Drainage of the liquid from the tub 3 towards the outside takes place activating the drain pump 26.

[0065] The laundry washing machine 1 may be advantageously provided with a recirculation circuit, not illustrated, adapted to drain liquid from a bottom region of the tub 3 and to re-admit such a liquid into a higher region of the tub 3 or into the drawer 13.

[0066] Laundry washing machine 1 is advantageously provided with a heating element 20, placed preferably in proximity of the bottom of the tub 3. The heating element 20 preferably comprises an electric resistor suited to come into contact with the liquid present on the bottom of the tub 3 to heat said liquid.

[0067] In further embodiments the heating device may be different and suitable to heat the liquid in the tub, for example microwaves source, infra-red rays, etc..

[0068] Advantageously the laundry washing machine 1 comprises a temperature sensor, not illustrated in the figures, for sensing the temperature of the liquid inside the tub 3. Preferably the temperature sensor is placed in correspondence or in proximity of said heating element 20, more preferably integrally made with it.

[0069] The laundry washing machine 1 advantageously comprises a liquid level sensor device 19 suited to sense (or detect) the liquid level inside the tub 3.

[0070] The sensor device 19 preferably comprises a pressure sensor which senses the pressure in the tub 3. From the values sensed by the sensor device 19 it is possible to determine the liquid level Ld of the liquid inside the tub 3. In another embodiment, not illustrated, laundry washing machine 1 may preferably comprise (in addition to or as a replacement of the pressure sensor) a level sensor (for example mechanical, electro-mechanical, optical, etc.) adapted to sense (or detect) the liquid level inside the tub 3.

[0071] In particular, from the values sensed by the sensor device 19 it is possible to determine when the liquid level Ld reaches an overflow level. More particularly, as illustrated in Figure 1, from the values sensed by the sensor device 19 it is possible to determine when the liquid level Ld reaches an overflow level Lo inside the tub 3.

[0072] The overflow level may be defined as a maximum limit value for the liquid which is higher, or much higher, than the maximum liquid level Lw at which the washing machine is expected to work.

[0073] Preferably, the overflow level Lo may be defined as a maximum limit value for the liquid inside the washing tub 3 which is lower than the top 3a of the washing tub 3 and higher than the maximum liquid level Lw at which the washing machine 1 is expected to work, as schematically illustrated in Figure 1.

[0074] A control unit 22 is connected to the various parts of the laundry washing machine 1 in order to ensure its operation. The control unit 22 is preferably connected to the water supply system 5, the input valve 17, the water outlet circuit 25, the heating element 20, the electric motor 11 and receives information from the various sensors provided on the laundry washing machine 1, like the flow meter 16, the liquid level sensor device 19, the temperature sensor, etc..

[0075] The control unit 22 is advantageously connected also to an interface unit 22a (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.

[0076] The interface unit 22a also preferably comprises a display where some pieces of information are opportunely displayed.

[0077] Based on the parameters acquired by said interface unit 22a, the control unit 22 sets and controls the various parts of the laundry washing machine 1 in order to carry out the desired washing program.

[0078] A first embodiment of the washing method according to the invention is described here below with reference to the laundry washing machine 1 shown in Figures 1 and 2 and with reference to the operation flow charts of Figures 3 and 4.

[0079] The laundry 10 to be washed is first placed inside the drum 4 (step 100). Preferably, by operating on the interface unit 22a the user selects the desired washing program (step 110) depending for example on the type and on the dirty-level of the laundry 10 to wash.

[0080] In a further embodiment, the selection of the desired washing program (step 110) may be performed before placing the laundry 10 into the drum 4 (step 100).

[0081] Furthermore, as said before, in a preferred embodiment it is possible for the user to insert some parameters directly by the interface unit 22a, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of washing cycle, etc.

[0082] At the same time, the washing and/or rinsing products are loaded inside the drawer 13 by the user. Different products may be loaded in the drawer 13, for example detergent, bleach, softener, etc.. In particular a proper quantity of detergent is loaded in the proper compartment of the drawer 13, the detergent being in granular, paste, gel or in liquid form.

[0083] It is clear that the drawer 13 may comprise different compartments with different shapes.

[0084] Once the user has selected the desired washing program, the control unit 22 sets the laundry washing machine 1 so that it starts the washing program (step 120).

[0085] In a successive phase the method provides for the activation of the sensors of the washing machine 1

(step 130), and advantageously the activation of the flow meter 16 and of the liquid level sensor device 19.

[0086] Afterwards, as globally indicated with the block 140, the successive phases for the selected washing program are performed. The operations carried out during such phases will depend on the selected washing program.

[0087] For example, a washing program preferably comprises an initial laundry wetting phase with addition of water and of a proper quantity of detergent. It preferably follows a washing phase during which the drum is rotated and the water contained therein is heated to a predetermined temperature based on the washing program selected by the user.

[0088] A successive phase of the washing program may preferably comprise a rinsing phase which preferably comprises one or more rinsing cycles. In the rinsing cycle clean rinse water is first added to the laundry 10, the drum 4 is then rotated to extract dirty water from the laundry 10 and finally the dirty water extracted is drained from the tub 3 to the outside.

[0089] After the rinsing phase a final spinning phase advantageously allows the extraction of the residual water contained in the wet laundry 10.

[0090] After the spinning phase the washing program may be considered completed (step 145). In one or more of said phases, therefore, an appropriate flow of water W is introduced into the tub 3 through the main pipe 15 and through the activation of the controlled supply valve 17 by the control unit 22.

[0091] The quantity of water W supplied into the tub 3 is controlled according to the values detected by the flow meter 16. In this way, it is possible to control the exact quantity of water W introduced during such phases in order, for example, to optimize the water consumption of the washing machine 1, or to ensure the correct ratio water/detergent.

[0092] At the same time, during the washing phases, the control unit 22 controls the values detected by the liquid level sensor device 19.

[0093] The values detected by the liquid level sensor device 19 are used for controlling that the liquid level Ld inside the tub 3 does not reach the overflow level Lo, as said above. If the liquid level Ld reaches the overflow level Lo, the control unit 22 preferably switches off the supply valve 17 and the washing machine 1 is stopped until a maintenance operation is executed. Preferably, also, the control unit 22 activates the drain pump 26 to drain all the liquid from the tub 3 to the outside.

[0094] This event, i.e. reaching of the overflow level Lo, is actually considered as caused by a failure or a malfunctioning of a part of the washing machine 1.

[0095] According to the present invention, as illustrated in Figure 4, during said washing phases (step 140) the method provides for a control of the detected value Ld by the liquid level sensor device 19 inside the tub 3 (step 150) with respect to a safety level Ls. The safety level Ls, as shown in Figure 1, is a liquid level set below the overflow level Lo. The safety level Ls is preferably set at a value higher than the maximum liquid level Lw defined before, i.e. the maximum liquid level Lw at which the washing machine 1 is expected to work.

[0096] Such level control phase (step 150) is preferably carried out continuously during the washing program. This means that this phase may preferably initiate just after the activation of the sensors, i.e. after activation of the flow meter 16 and of the liquid level sensor device 19 (step 130). Alternatively, this phase may preferably start at the beginning of the washing program.

[0097] If the value Ld detected by the liquid level sensor device 19 is less than the safety level Ls (output "Yes" of step 150), then the washing program continues with the current and the following programmed phases, globally indicated with the block 160 in Figure 4, by using the flow meter 16 as usual. In particular, the one or more phases which require the introduction of a predetermined quantity of water W inside the tub 3 are advantageously performed by using the flow meter 16, as described above.

[0098] In this way the washing machine 1 works efficiently in the normal operating mode by controlling the exact quantity of water W introduced during such phases, until the washing program is completed (step 145).

[0099] On the contrary, if the value Ld detected by the liquid level sensor device 19 is greater than, or equal to, the safety level Ls (output "No" of step 150), then the washing program continues with the current and the following programmed phases, globally indicated with the block 170 in Figure 4, by using the liquid level sensor device 19 instead of using the flow meter 16. The washing machine 1 works, therefore, in an alternative operating mode.

[0100] In this case, the values Ld detected by the liquid level sensor device 19 will be advantageously used to calculate the quantity of water W supplied into the tub 3.

[0101] In this alternative operating mode, the flow of water W introduced into the tub 3 through the main pipe 15 and the activation of the supply valve 17 is controlled according to the values Ld detected by the liquid level sensor device 19, instead of using the flow meter 16.

[0102] It is clear that the phases (block 170) of the washing program in the alternative operating mode and the phases (block 160) of the washing program in the normal operating mode are the substantially the same. The only difference between the two is actually the way to determine the quantity of water W supplied into the tub 3: in the normal operating mode the quantity of water W supplied into the tub 3 is determined by the flow meter 16 while in the alternative operating mode the quantity of water W supplied into the tub 3 is determined by the liquid level sensor device 19.

[0103] In this alternative operating mode the washing program may continue until the washing program is completed (step 145), even if the washing machine 1 could work less efficiently with respect to the normal operating mode where the flow meter 16 is used. The fact that the

value Ld detected by the liquid level sensor device 19 is greater than, or equal to, the safety level Ls may be caused by a malfunctioning of the flow meter 16. Nevertheless, thanks to the provision of said control phase (step 150), as explained above, the washing program may continue until it ends.

[0104] In case of malfunctioning of the flow meter 16, in fact, the control of the liquid level Ld inside the tub 3 is still performed thanks to the use of the liquid level sensor device 19. This avoids that the liquid level Ld inside the tub 3 reaches the overflow level Lo caused by the malfunctioning of the flow meter 16.

[0105] Advantageously, therefore, the washing program may continue without stopping the washing program itself.

[0106] In this case the flow meter 16 is not used anymore during the washing program.

[0107] Advantageously, the dangerous event of overflow is avoided and the user is not forced to call the service operator for maintenance, as it happens in the prior art technique.

[0108] In a preferred embodiment this abnormal situation, i.e. the malfunctioning of the flow meter 16, may be preferably stored as a piece of information in a memory location of the control unit 22.

[0109] This piece of information may be advantageously accessible to a service operator in following maintenance operations.

[0110] In addition, or alternatively, the abnormal situation may be communicated to the user, for example by means of a warning message such as an acoustic alarm or a text message.

[0111] The user may then decide either to call the service operator for maintenance or not to call it. In the latest, the washing machine 1 will continue to work in the alternative operating mode. In this case the washing machine 1 will use the values of the liquid level Ld detected by the liquid level sensor device 19 instead of the flow meter 16 for controlling water supply into the tub 3. Advantageously, maintenance and/or repairing costs for the flow meter 16 substitution are eliminated.

[0112] Actually, the described situation occurs when the flow meter 16 is subjected to a permanent failure.

[0113] It is clear that if the value Ld detected by the liquid level sensor device 19 reaches in any case the overflow level Lo, probably caused by a malfunctioning of another part of the washing machine 1 rather than the flow meter 16, the control unit 22 will switch off the supply valve 17 and the washing machine 1 will be stopped until a maintenance operation is executed.

[0114] In a preferred embodiment, all the following washing programs for the new loads of laundry 10 may be performed by using exclusively the liquid level sensor device 19.

[0115] The washing machine 1 will therefore continue to work in the alternative operating mode, at least until the user will call the service operator for repair/substitution of the flow meter 16.

[0116] With reference to Figure 5 a further embodiment of the washing phases (step 140') is described.

[0117] Here, if the value Ld detected by the liquid level sensor device 19 is less than the safety level Ls (output "Yes" of step 150), then the washing program continues with the current phase, indicated with the block 160', by using the flow meter 16 as usual. In particular, if the phase requires the introduction of a predetermined quantity of water W inside the tub 3, the phase itself is advantageously performed by using the flow meter 16, as described above.

[0118] In this way the washing machine 1 works efficiently in the normal operating mode by controlling the exact quantity of water W introduced during such phase.

[0119] If the current phase is the final phase of the washing program (output "Yes" of step 200) then the washing program is completed (step 145).

[0120] If the current phase is not the final phase of the washing program (output "No" of step 200) than the washing program back to the liquid level control (step 150) before performing the following programmed washing phase.

[0121] If the value Ld detected by the liquid level sensor device 19 is greater than, or equal to, the safety level Ls (output "No" of step 150), then the washing program continues with the current phase, indicated with the block 170', by using the liquid level sensor device 19 instead of using the flow meter 16.

[0122] During this phase (block 170'), the washing machine 1 works therefore in an alternative operating mode.

[0123] In this case, the values Ld detected by the liquid level sensor device 19 will be advantageously used to calculate the quantity of water W supplied into the tub 3.

[0124] In this alternative operating mode, the flow of water W introduced into the tub 3 through the main pipe 15 and the activation of the supply valve 17 is controlled according to the values Ld detected by the liquid level sensor device 19, instead of using the flow meter 16.

[0125] If the current phase is the final phase of the washing program (output "Yes" of step 200) then the washing program is completed (step 145).

[0126] If the current phase is not the final phase of the washing program (output "No" of step 200) than the washing program back to the liquid level control (step 150), before performing the following programmed washing phase.

[0127] It is clear that in the embodiment here described, it may happens that one or more phases (step 160') of the washing program may be performed by using the flow meter 16 and one or more phases (step 170') may be performed by using the liquid level sensor device 19 according to the result of the liquid level control phase (step 150).

[0128] The fact that the value Ld detected by the liquid level sensor device 19 is greater than, or equal to, the safety level Ls may be caused by a malfunctioning of the flow meter 16. Nevertheless, thanks to the provision of said control phase (step 150) the washing program may

continue.

[0129] In case of malfunctioning of the flow meter 16, in fact, the control of the liquid level Ld inside the tub 3 is still performed thanks to the use of the liquid level sensor device 19. This avoids that the liquid level Ld inside the tub 3 reaches the overflow level Lo caused by the malfunctioning of the flow meter 16.

[0130] Advantageously, the dangerous event of overflow may be avoided and the user is not forced to call the service operator for maintenance, as it happens in the prior art technique.

[0131] In a first possible mode of operation, the flow meter 16 may work correctly. In this case, the value Ld detected by the liquid level sensor device 19 will always be less than the safety level Ls, and all the washing phases (step 160') of the washing program will be performed by using the flow meter 16.

[0132] In a second possible mode of operation, the flow meter 16 may be subjected to a permanent failure. In this case, the value Ld detected by the liquid level sensor device 19 will always reach the safety level Ls, and all the washing phases (step 170') of the washing program will be performed by using of the liquid level sensor device 19.

[0133] In a further possible mode of operation, the flow meter 16 may be subjected to a temporary malfunctioning. In general, a temporary malfunctioning of a part of the washing machine 1 may occur.

[0134] In this case, when malfunctioning occurs, the value Ld detected by the liquid level sensor device 19 will reach the safety level Ls and the washing phase (step 170') of the washing program will be performed by using the liquid level sensor device 19.

[0135] Then, once the correct functioning of the flow meter 16, or of the part of the washing machine 1, will be restored, the following washing phases (step 160') of the washing program will be advantageously performed by using again the flow meter 16.

[0136] In a preferred embodiment these abnormal situations, i.e. the permanent or the temporary malfunctioning of the flow meter 16, may be preferably stored as a piece of information in a memory location of the control unit 22.

[0137] This piece of information may be advantageously accessible to a service operator in following maintenance operations.

[0138] In addition, or alternatively, the abnormal situations may be communicated to the user, for example by means of a warning message such as an acoustic alarm or a text message.

[0139] The user may then decide either to call the service operator for maintenance or not to call it.

[0140] In case intervention of the service operator is not requested and the flow meter 16 is subjected to a permanent failure, then the washing machine 1 will continue to work in the alternative operating mode. In this case the washing machine 1 will use the liquid level sensor device 19 instead of the flow meter 16. Advantageously, maintenance and/or repairing costs for the flow meter 16 substitution are eliminated.

[0141] In case intervention of the service operator is not requested and the flow meter 16 has been subjected solely to a temporary malfunctioning, then the washing machine 1 will continue to work in the normal operating mode. In this case the washing machine 1 will normally use the flow meter 16. Advantageously, maintenance costs are eliminated.

[0142] It is clear that if the value Ld detected by the liquid level sensor device 19 reaches in any case the overflow level Lo, probably caused by a malfunctioning of another part of the washing machine 1 rather than the flow meter 16, the control unit 22 will switch off the supply valve 17 and the washing machine 1 will be stopped until a maintenance operation is executed.

[0143] With reference to Figure 6 a further embodiment of the washing phases (step 140") is described.

[0144] This embodiment differs from the embodiment described with reference to Figure 5 for the fact that the washing phase (step 170") is carried out differently.

[0145] This washing phase (step 170") initiates by using the liquid level sensor device 19 instead of using the flow meter 16 (step 172), as previously described. During this phase, then, the method further provides for a continuous control of the detected value Ld by the liquid level sensor device 19 inside the tub 3 (step 175) with respect to a safety level Ls.

[0146] If the value Ld detected by the liquid level sensor device 19 remains greater than, or equal to, the safety level Ls (output "No" of step 175), then the current washing program continues with the current phase by using the liquid level sensor device 19 instead of using the flow meter 16 (step 176).

[0147] On the contrary, if the value Ld detected by the liquid level sensor device 19 falls below the safety level Ls (output "Yes" of step 175), then the current washing phase continues by using the flow meter 16, i.e. the washing machine 1 works in the normal operating mode (step 177).

[0148] In this preferred embodiment, therefore, as soon as the value Ld detected by the liquid level sensor device 19 falls below the safety level Ls then the washing machine 1 from the alternative operating mode is switched to the normal operating mode.

[0149] With reference to Figure 7 a construction variant of a laundry washing machine 101 is described.

[0150] The laundry washing machine 101 shows in Figure 7 differs from the laundry washing machine 1 described with reference to Figures 1 and 2 for the different construction of the water supply system 105.

[0151] The water supply system 105 comprises three pipes 15a, 15b, 15c which opportunely connect each compartment 13a, 13b, 13c of the drawer 13 to an external water supply line E by means of respective controlled supply valves 17a, 17b, 17c.

[0152] The input valves 17a, 17b, 17c are advantageously controlled by the control unit 22 so that a proper

quantity of removing water W may be conveyed to one, or more, of the compartments 13a, 13b, 13c for removing and conveying the desired product, for example the detergent or the bleach or the softener, into the tub 3.

[0153] A common water flow sensor 16, for example a flow meter, is arranged between the supply valves 17a, 17b, 17c and the external water supply line E. The flow meter 16 makes it possible to calculate the quantities of water W conveyed to the different compartments 13a, 13b, 13c of the drawer 13 and hence the quantity of water W supplied into the tub 3.

[0154] The input valves 17a, 17b, 17c are advantageously controlled by the control unit 22. The method according to the invention above described may be applied to the washing machine 101 without any particular modification.

[0155] In different embodiments a plurality of flow meters may be provided, for example a flow meter for each water supplying pipe.

[0156] In this case, the quantity of water W supplied into the tub may be easily calculated by the control unit from the values sensed by the various flow meters.

[0157] Finally, it should be noted that the various level controls above described are preferably designed to include hysteresis, as well known in the on-off control system.

[0158] It has thus been shown that the present invention allows all the set objects to be achieved. In particular, the washing method of the invention makes it possible to simplify maintenance of the washing machine.

[0159] While the present invention has been described with reference to the particular embodiments shown in the figures, it should be noted that the present invention is not limited to the specific embodiments illustrated and described herein; on the contrary, further variants of the embodiments described herein fall within the scope of the present invention, which is defined in the claims.

Claims

1. Method for washing laundry (10) in a laundry washing machine (1), said laundry washing machine (1) comprising:

   - a washing tub (3) external to a washing drum (4) suited to receive said laundry (10);
   - a water supply system (15) suitable to convey water (W) into said washing tub (3);
   - a water flow sensor (16) associated to said water supply system (5) for measuring an amount of water introduced into said washing tub (3);
   - a liquid level sensor device (19) suitable for detecting an overflow level (Lo) of liquid in said washing tub (3) and to communicate the reaching of said overflow level (Lo) to a control unit (22) which causes stopping of said washing machine (1) accordingly;

   said method comprising one or more steps of conveying water (W) from said water supply system (15) to said washing tub (3), wherein the quantity of water introduced inside said washing tub (3) is controlled according to the values detected by said water flow sensor (16);

   characterized in that

   said method comprises detecting the liquid level (Ld) inside said washing tub (3) by means of said liquid level sensor device (19), and if said liquid level (Ld) reaches a safety level (Ls) which is below said overflow level (Lo), then the quantity of water introduced inside said washing tub (3) from said water supply system (15) is controlled according to the values of the liquid level (Ld) detected by said liquid level sensor device (19) instead of according to the values detected by said water flow sensor (16).

2. Method according to claim 1, **wherein** said safety level (Ls) is a level for said liquid (Ld) inside said washing tub (3) which is higher than the maximum liquid level (Lw) at which the washing machine (1) is expected to work.

3. Method according to any of the preceding claims, **wherein** after the first step of conveying water (W) from said water supply system (15) to said washing tub (3) which has been controlled according to the values detected by said liquid level sensor device (19), the method provides for using again said water flow sensor (16), instead of said liquid level sensor device (19), for controlling the quantity of water introduced inside said washing tub (3) in the following one or more steps of conveying water (W) from said water supply system (15) to said washing tub (3).

4. Method according to claim 1 or 2, **wherein** if said liquid level (Ld) detected by said liquid level sensor device (19) falls below said safety level (Ls), then the method provides for using again said water flow sensor (16), instead of said liquid level sensor device (19), for controlling the quantity of water introduced inside said washing tub (3).

5. Method according to claim 1 or 2, **wherein** all said following steps of conveying water (W) from said water supply system (15) to said washing tub (3) are controlled according to values detected by said liquid level sensor device (19).

6. Method according to claim 5, **wherein** after said liquid level (Ld) reaches a safety level (Ls), said water flow sensor (16) is not used anymore for determining the quantity of water (W) supplied to said washing tub (3).

7. Method according to one or more of previous claims, **wherein** if said liquid level (Ld) reaches a safety level (Ls) a failure message is generated which indicates failure of said water flow sensor (16).

8. Method according to claim 7, **wherein** said failure message is stored in a memory location of the washing machine and/or generates an alarm signal for the user.

9. Method according to any of the preceding claims, **wherein** if said liquid level (Ld) reaches said overflow level (Lo) the washing program is stopped until repairing of said washing machine (1).

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

Patentansprüche

1. Verfahren zum Waschen von Wäsche (10) in einer Waschmaschine (1), wobei die Waschmaschine (1) Folgendes umfasst:

    - einen Waschbehälter (3) extern einer Waschtrommel (4), die geeignet ist, die Wäsche (10) aufzunehmen;
    - ein Wasserversorgungssystem (15), das geeignet ist, Wasser (W) in den Waschbehälter (3) zu befördern;
    - einen Wasserströmungssensor (16), der mit dem Wasserversorgungssystem (5) verbunden ist, um eine Wassermenge zu messen, die in den Waschbehälter (3) eingeführt wird;
    - eine Flüssigkeitsspiegel-Sensorvorrichtung (19), die geeignet ist, einen Überlaufspiegel (Lo) von Flüssigkeit in dem Waschbehälter (3) zu detektieren und das Erreichen des Überlaufspiegels (Lo) an eine Steuereinheit (22) zu kommunizieren, die entsprechend das Stoppen der Waschmaschine (1) bewirkt;

    wobei das Verfahren ein oder mehrere Schritte umfasst, das Wasser (W) von dem Wasserversorgungssystem (15) zu dem Waschbehälter (3) zu fördern, wobei die Menge des in den Waschbehälter (3) eingeführten Wassers gemäß der Werte gesteuert wird, die von dem Wasserströmungssensor (16) detektiert werden;
    dadurch gekennzeichnet, dass
    das Verfahren das Detektieren des Flüssigkeitsspiegels (Ld) in dem Waschbehälter (3) mittels der Flüssigkeitsspiegel-Sensorvorrichtung (19) umfasst, und wenn der Flüssigkeitsspiegel (Ld) einen Sicherheitsspiegel (Ls) erreicht, der unterhalb des Überlaufspiegels (Lo) liegt, wird die in den Waschbehälter (3) von dem Wasserversorgungssystem (15) eingeführte Wassermenge anstelle gemäß der von dem Wasserströmungssensor (16) detektierten Werte gemäß der Werte des Flüssigkeitsspiegels (Ld) gesteuert, der von der Flüssigkeitsspiegel-Sensorvorrichtung (19) detektiert wird.

2. Verfahren nach Anspruch 1, **wobei** der Sicherheitsspiegel (Ls) ein Spiegel für die Flüssigkeit (Ld) in dem Waschbehälter (3) ist, der höher als der maximale Flüssigkeitsspiegel (Lw) ist, bei dem die Waschmaschine (1) arbeiten soll.

3. Verfahren nach einem der vorangehenden Ansprüche, **wobei** das Verfahren nach dem ersten Schritt, Wasser (W) von dem Wasserversorgungssystem (15) zu dem Waschbehälter (3) zu fördern, der gemäß der Werte gesteuert wurde, die von der Flüssigkeitsspiegel-Sensorvorrichtung (19) detektiert wurden, bereitstellt, dass zur Steuerung der in den Waschbehälter (3) eingeführten Wassermenge erneut der Wasserströmungssensor (16) in den folgenden ein oder mehreren Schritten, Wasser (W) von dem Wasserversorgungssystem (15) zu dem Waschbehälter (3) zu fördern, anstelle der Flüssigkeitsspiegel-Sensorvorrichtung (19) verwendet wird.

4. Verfahren nach Anspruch 1 oder 2, **wobei,** wenn der von der Flüssigkeitsspiegel-Sensorvorrichtung (19) detektierte Flüssigkeitsspiegel (Ld) unter den Sicherheitsspiegel (Ls) fällt, das Verfahren bereitstellt, dass zur Steuerung der in den Waschbehälter (3) eingeführten Wassermenge erneut der Wasserströmungssensor (16) anstelle der Flüssigkeitsspiegel-Sensorvorrichtung (19) verwendet wird.

5. Verfahren nach Anspruch 1 oder 2, **wobei** alle folgenden Schritte, Wasser (W) von dem Wasserversorgungssystem (15) zu dem Waschbehälter (3) zu fördern, gemäß der von der Flüssigkeitsspiegel-Sensorvorrichtung (19) detektierten Werte gesteuert werden.

6. Verfahren nach Anspruch 5, **wobei,** nachdem der Flüssigkeitsspiegel (Ld) einen Sicherheitsspiegel (Ls) erreicht hat, der Wasserströmungssensor (16) nicht mehr zur Bestimmung der Wassermenge (W), die zu dem Waschbehälter (3) geführt wird, verwendet wird.

7. Verfahren nach einem oder mehreren der vorangehenden Ansprüche, **wobei,** wenn der Flüssigkeitsspiegel (Ld) einen Sicherheitsspiegel (Ls) erreicht, eine Fehlermeldung erzeugt wird, die ein Versagen des Wasserströmungssensors (16) anzeigt.

8. Verfahren nach Anspruch 7, **wobei** die Fehlermel-

dung an einem Speicherort der Waschmaschine gespeichert wird und/oder ein Alarmsignal für den Nutzer erzeugt.

9. Verfahren nach einem der vorangehenden Ansprüche, wobei, wenn der Flüssigkeitsspiegel (Ld) den Überlaufspiegel (Lo) erreicht, das Waschprogramm gestoppt wird, bis die Waschmaschine (1) repariert wird.

10. Eine Waschmaschine (1), die so konfiguriert ist, dass sie ein Verfahren nach einem der vorangehenden Ansprüche implementiert.

Revendications

1. Procédé de lavage de linge (10) dans une machine à laver le linge (1), ladite machine à laver le linge (1) comprenant :

- une cuve de lavage (3), externe à un tambour de lavage (4), appropriée pour recevoir ledit linge (10) ;
- un système d'alimentation en eau (15) approprié pour transporter l'eau (W) dans ladite cuve de lavage (3) ;
- un capteur de flux d'eau (16) associé audit système d'alimentation en eau (5) pour mesurer une quantité d'eau introduite dans ladite cuve de lavage (3) ;
- un dispositif de capteur de niveau de liquide (19) approprié pour détecter un niveau de débordement (Lo) de liquide dans ladite cuve de lavage (3) et pour communiquer l'arrivée audit niveau de débordement (Lo) à une unité de commande (22) qui entraîne en conséquence l'arrêt de ladite machine à laver (1) ;

ledit procédé comprenant une ou plusieurs étapes de transport de l'eau (W) dudit système d'alimentation en eau (15) à ladite cuve de lavage (3), la quantité d'eau introduite à l'intérieur de ladite cuve de lavage (3) étant régulée en fonction des valeurs détectées par ledit capteur de flux d'eau (16) ;
caractérisé par le fait que :

ledit procédé comprend la détection du niveau de liquide (Ld) à l'intérieur de ladite cuve de lavage (3) au moyen dudit dispositif de capteur de niveau de liquide (19) et, si ledit niveau de liquide (Ld) atteint un niveau de sécurité (Ls) qui est inférieur audit niveau de débordement (Lo), alors la quantité d'eau introduite à l'intérieur de ladite cuve de lavage (3) à partir dudit système d'alimentation en eau (15) est régulée en fonction des valeurs du niveau de liquide (Ld) détectées par ledit dispositif de capteur de niveau de liquide (19) au lieu d'en fonction des valeurs détectées par ledit capteur de flux d'eau (16).

2. Procédé selon la revendication 1, **dans lequel** ledit niveau de sécurité (Ls) est un niveau pour ledit liquide (Ld) à l'intérieur de ladite cuve de lavage (3) qui est supérieur au niveau de liquide maximal (Lw) auquel la machine à laver (1) est attendue fonctionner.

3. Procédé selon l'une quelconque des revendications précédentes, **dans lequel,** après la première étape de transport d'eau (W) dudit système d'alimentation en eau (15) à ladite cuve de lavage (3) qui a été régulée en fonction des valeurs détectées par ledit dispositif de capteur de niveau de liquide (19), le procédé permet la réutilisation dudit capteur de flux d'eau (16), à la place dudit dispositif de capteur de niveau de liquide (19), pour réguler la quantité d'eau introduite à l'intérieur de ladite cuve de lavage (3) dans la ou les étapes suivantes de transport d'eau (W) dudit système d'alimentation en eau (15) à ladite cuve de lavage (3).

4. Procédé selon la revendication 1 ou 2, **dans lequel,** si ledit niveau de liquide (Ld) détecté par ledit dispositif de capteur de niveau de liquide (19) tombe en dessous dudit niveau de sécurité (Ls), alors le procédé permet la réutilisation dudit capteur de flux d'eau (16), à la place dudit dispositif de capteur de niveau de liquide (19), pour réguler la quantité d'eau introduite à l'intérieur de ladite cuve de lavage (3).

5. Procédé selon la revendication 1 ou 2, **dans lequel** toutes les étapes suivantes de transport d'eau (W) dudit système d'alimentation en eau (15) à ladite cuve de lavage (3) sont régulées en fonction des valeurs détectées par ledit dispositif de capteur de niveau de liquide (19).

6. Procédé selon la revendication 5, **dans lequel** après que ledit niveau de liquide (Ld) atteint un niveau de sécurité (Ls), ledit capteur de flux d'eau n'est plus utilisé pour déterminer la quantité d'eau (W) fournie à ladite cuve de lavage (3).

7. Procédé selon une ou plusieurs des revendications précédentes, **dans lequel** si ledit niveau de liquide (Ld) atteint un niveau de sécurité (Ls), un message d'échec est généré, lequel indique un échec dudit capteur de flux d'eau (16).

8. Procédé selon la revendication 7, **dans lequel** ledit message d'échec est stocké dans un emplacement de mémoire de la machine à laver et/ou génère un signal d'alarme pour l'utilisateur.

9. Procédé selon l'une quelconque des revendications

précédentes, **dans lequel** si ledit niveau de liquide (Ld) atteint ledit niveau de débordement (Lo), le programme de lavage s'arrête jusqu'à réparation de ladite machine à laver (1).

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

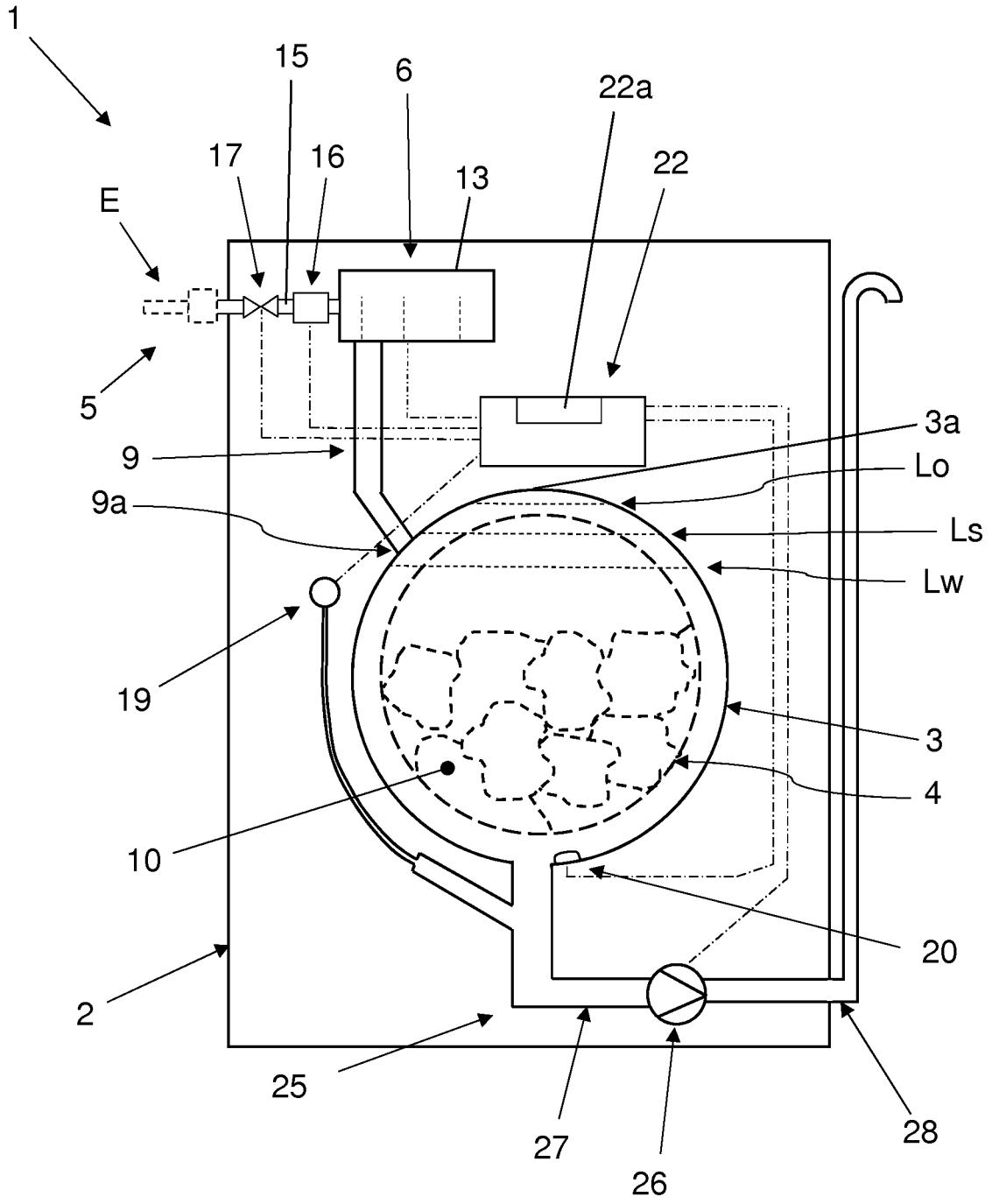

FIG. 1

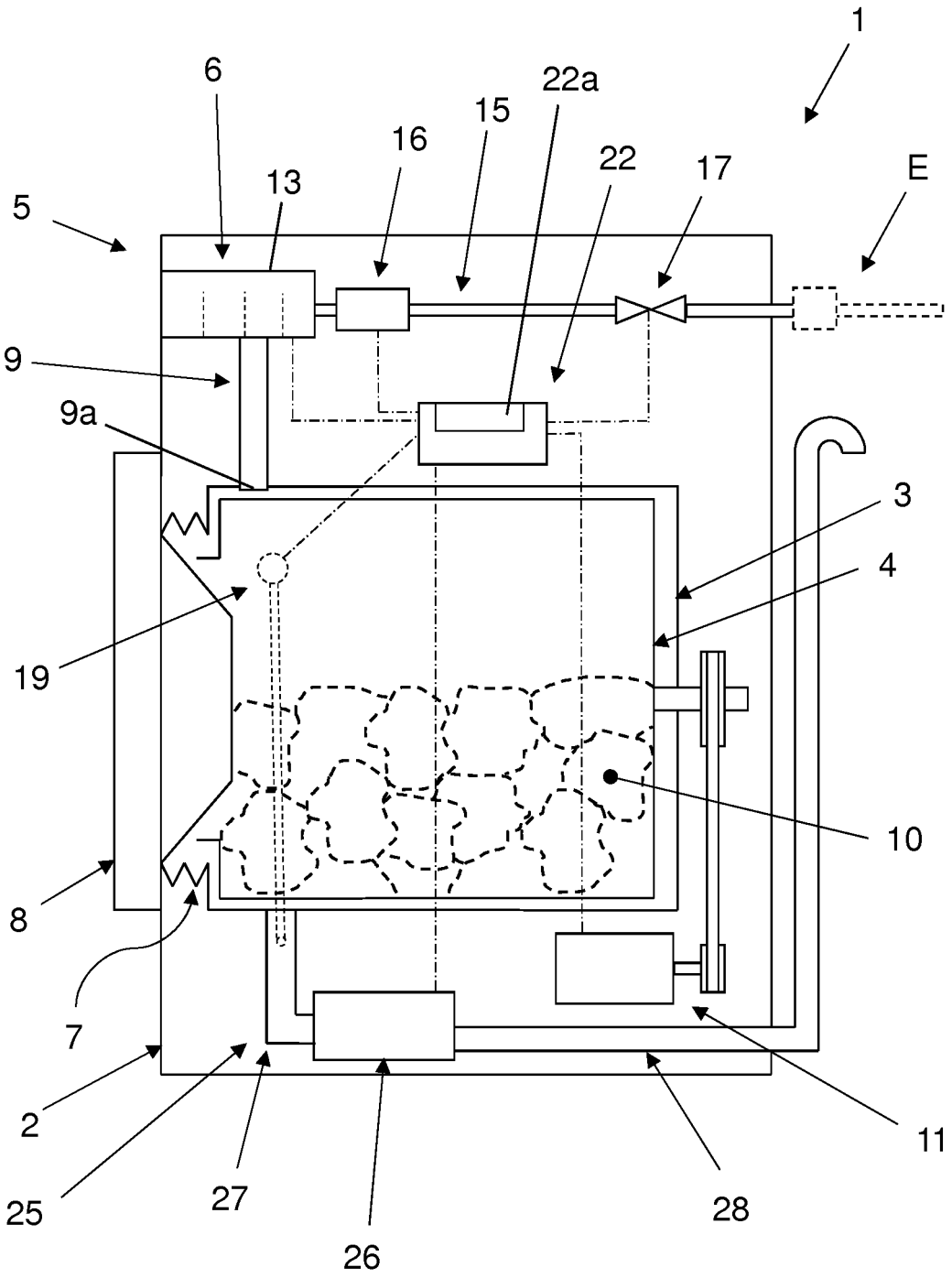

FIG. 2

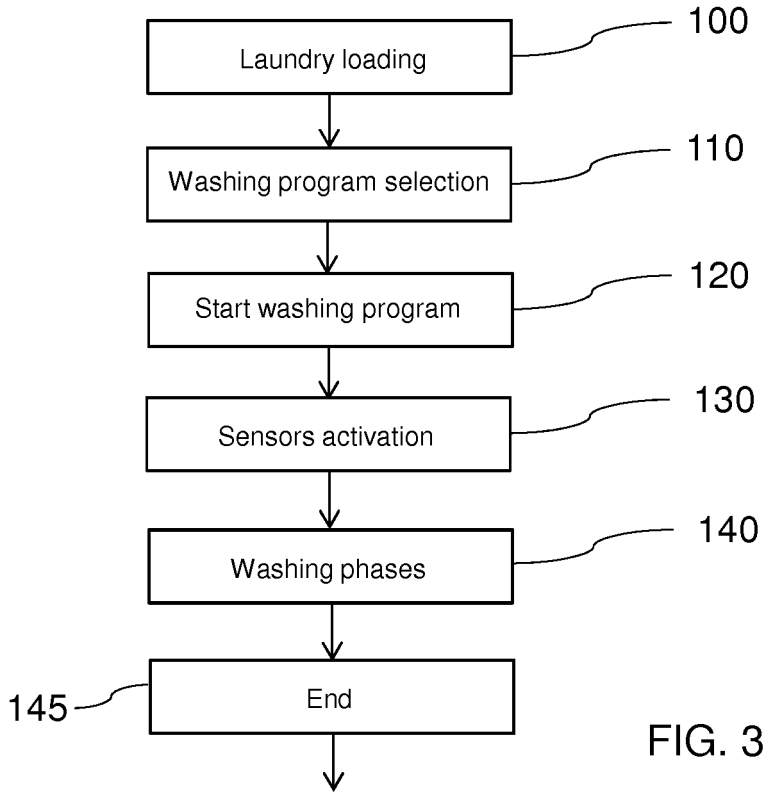
Laundry loading
100
Washing program selection
110
Start washing program
120
Sensors activation
130
Washing phases
140
End
145

FIG. 3

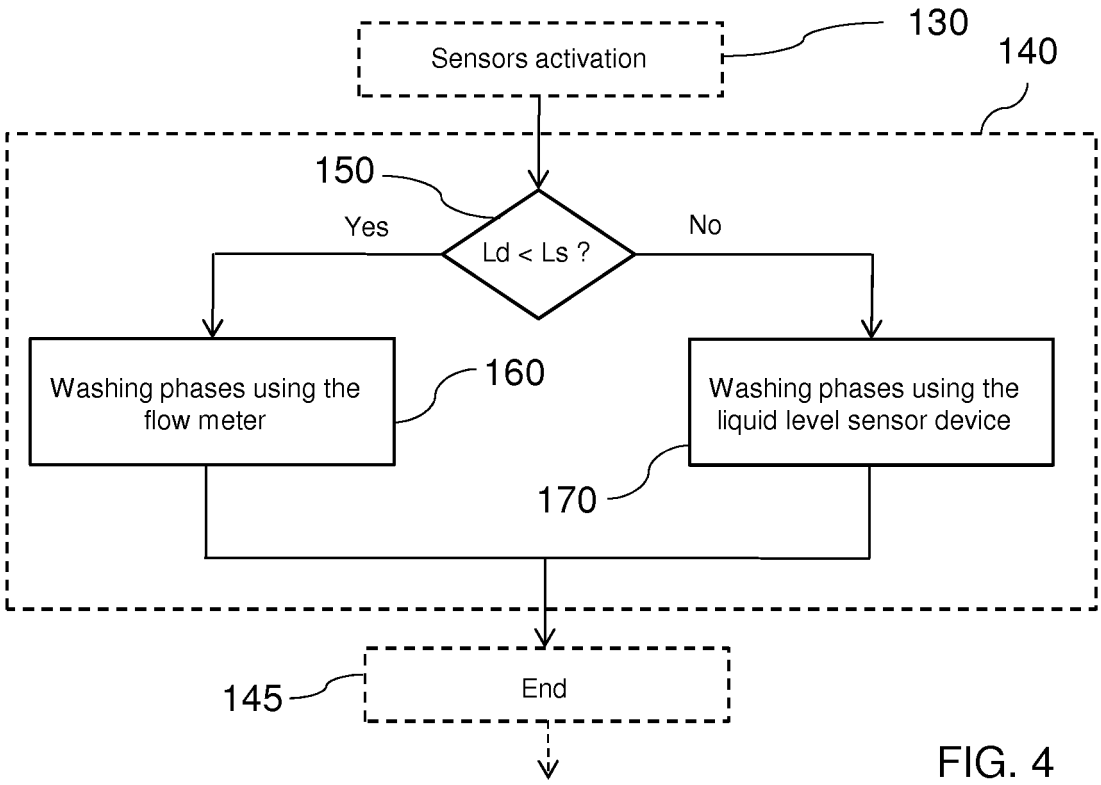
Sensors activation
130
140
150
Yes
Ld < Ls ?
No
Washing phases using the flow meter
160
Washing phases using the liquid level sensor device
170
End
145

FIG. 4

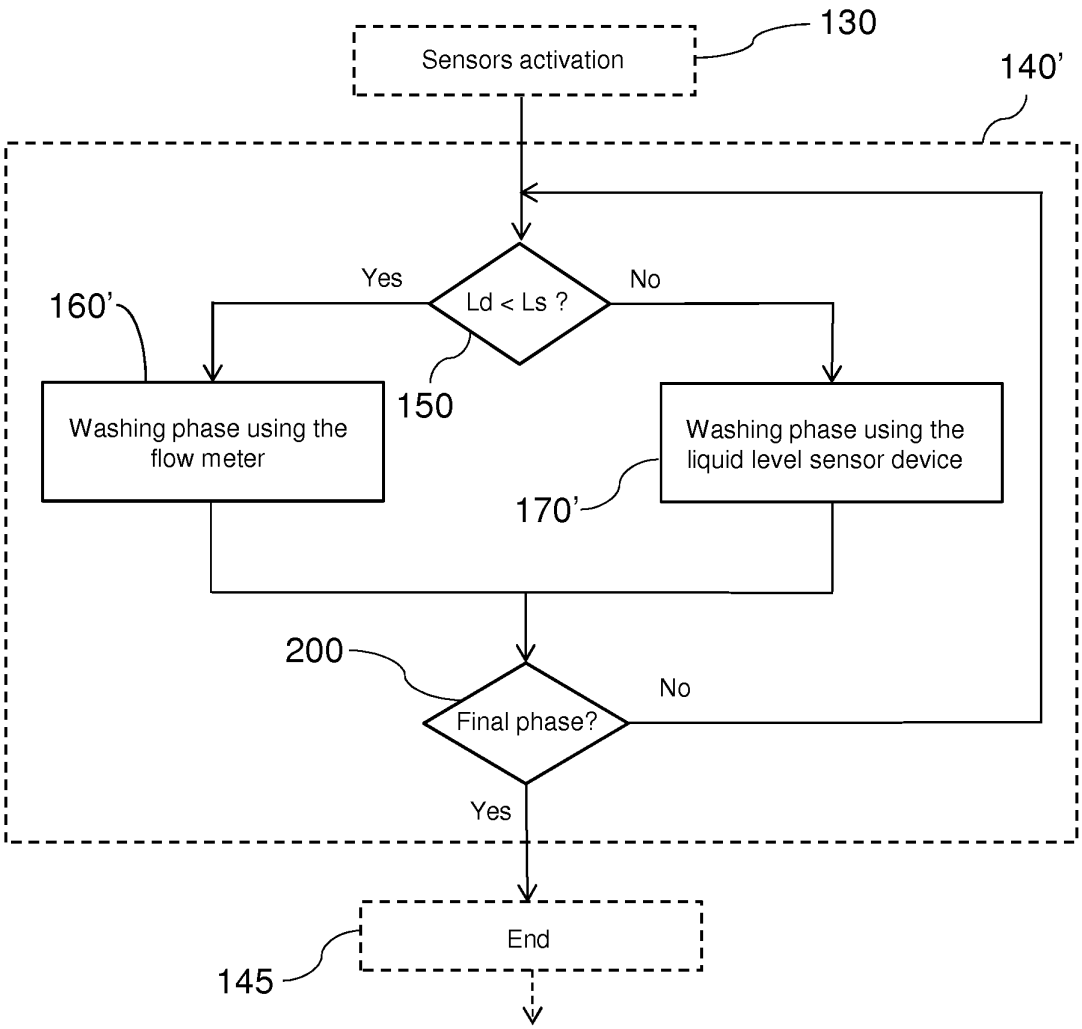
Sensors activation
130
140'
Yes
Ld < Ls ?
No
160'
150
Washing phase using the flow meter
Washing phase using the liquid level sensor device
170'
200
Final phase?
No
Yes
End
145

FIG. 5

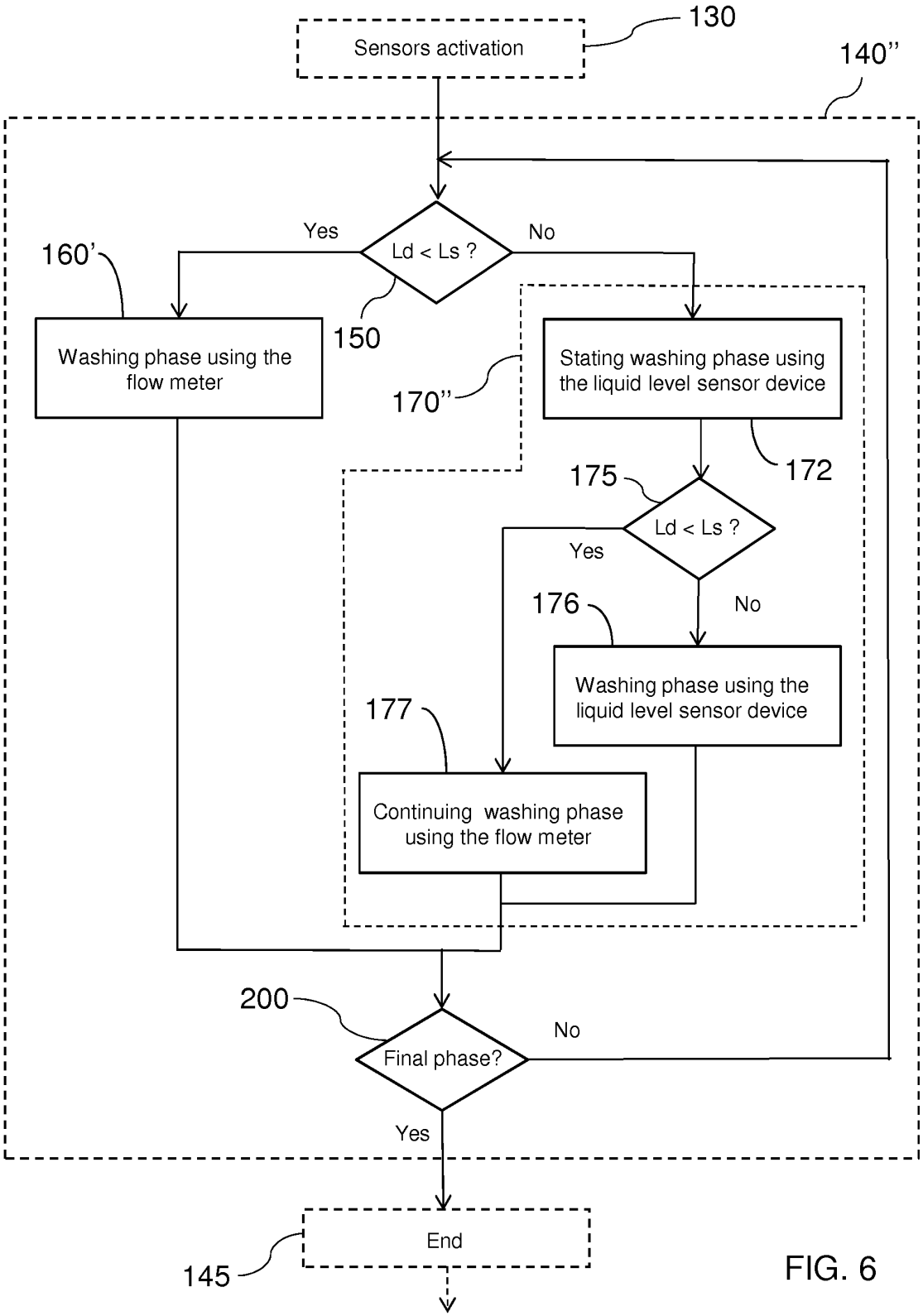
Sensors activation
130
140''
Yes
Ld < Ls ?
No
160'
150
Washing phase using the flow meter
170''
Stating washing phase using the liquid level sensor device
172
175
Ld < Ls ?
Yes
No
176
Washing phase using the liquid level sensor device
177
Continuing washing phase using the flow meter
200
Final phase?
No
Yes
End
145

FIG. 6

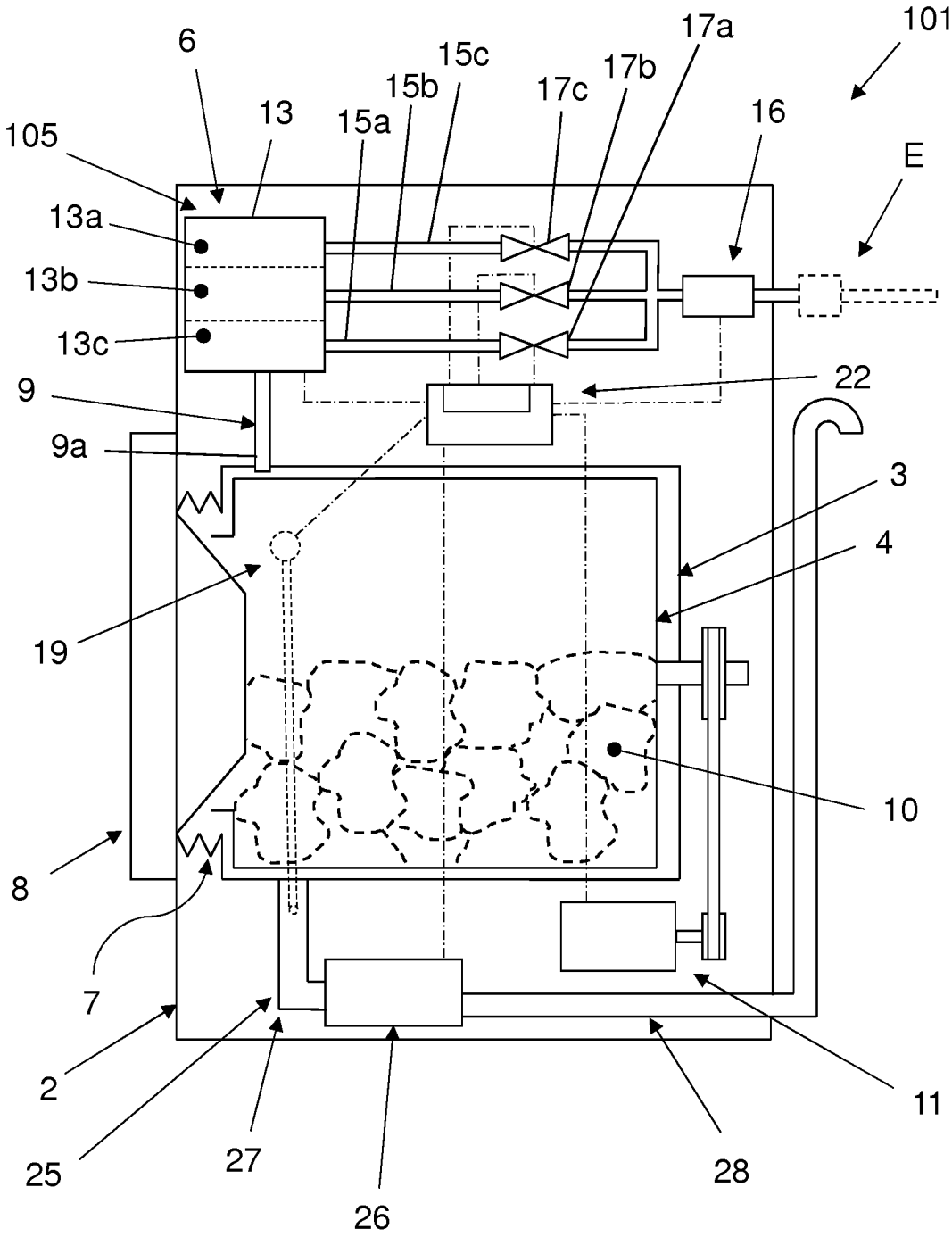
101
6
17a
15c
17b
15b
17c
13
15a
16
105
E
13a
13b
13c
22
9
9a
3
4
19
10
8
7
2
11
25
27
28
26

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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- US 2010024490 A **[0024]**
- US 2010032026 A **[0025]**