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(54) **METHOD FOR WASHING LAUNDRY IN A LAUNDRY WASHING MACHINE WITH AN AUTOMATIC DOSING DEVICE AND LAUNDRY WASHING MACHINE**

(57) The present invention relates to a method for washing laundry during a washing cycle in a laundry washing machine (1) comprising a washing drum (4); a washing tub (3) external to the washing drum (4); a water supply unit (5) to supply water (W) into the washing tub (3); an automatic dosing device (58) comprising a compartment suitable for receiving a quantity of detergent (D) sufficient for a plurality of washing cycles; a recirculation circuit (30) and a concentration sensor device (80).

The method comprises the steps of: introducing a first prefixed quantity (Q1d) of detergent (D) and a first prefixed quantity (Q1w) of water (W) into the washing tub (3); activating the recirculation circuit (30) for mixing the first prefixed quantity (Q1d) of detergent (D) with the first prefixed quantity (Q1w) of water (W); determining the current concentration value (V) of the detergent (D); comparing the current concentration value (V) with one or more prefixed concentration levels (T1, T2) and either introducing or not introducing a second quantity (Q2d) of detergent (D) into the washing tub (3) according to the result of the comparison. The first prefixed quantity (Q1d) of detergent (D) and/or the second quantity (Q2d) of detergent (D) is determined on the base of the amount of laundry load (L).

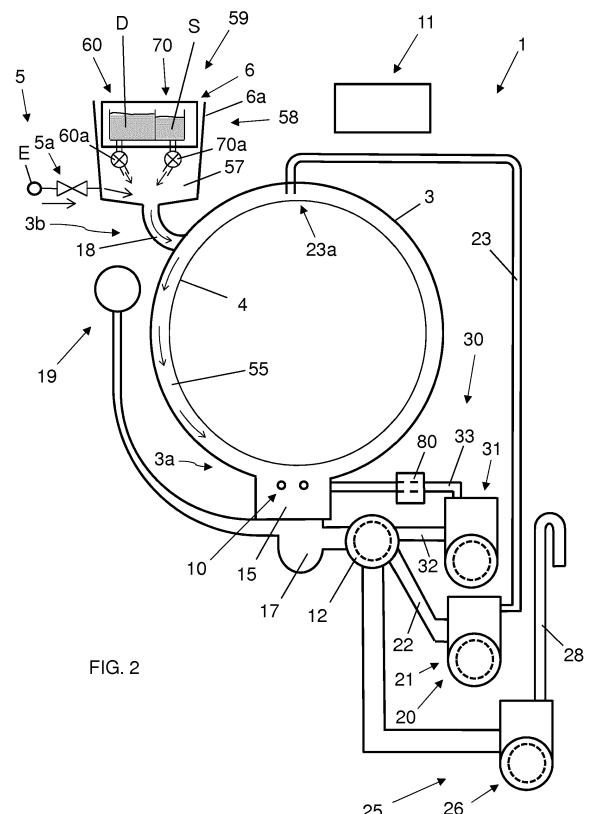


FIG. 2

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 equipped with a detergent automatic dosing device which is capable of performing a more efficient delivering of the detergent.

BACKGROUND ART

[0003] Nowadays the use of laundry washing machines, both "simple" laundry washing machines (i.e. laundry washing machines which can only wash and rinse laundry) and laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry), is widespread.

[0004] In the present description the term "laundry washing machine" will refer to both simple laundry washing machines and laundry washing-drying machines. Laundry washing machines generally comprise an external casing provided with a washing tub which contains a rotatable perforated drum where the laundry is placed. A loading/unloading door ensures access to the drum.

[0005] Laundry washing machines typically comprise a water supply unit and a products supply unit, preferably a drawer, for the introduction of water and washing/rinsing products (i.e. detergent, softener, rinse conditioner, etc.) into the tub.

[0006] Laundry washing machines of known type are also advantageously equipped with an automatic dosing device which is able to dose powder, liquid or other kinds of wash products from a container into the tub. In particular, the device comprises a container which is filled with a large amount of detergent that is then dispensed in a predetermined dose when necessary at any single washing cycle. The detergent in the container is therefore advantageously sufficient for several washing cycles.

[0007] According to the known technique, the detergent is typically conveyed into the tub at the beginning of the washing cycle together with a proper amount of water so that the laundry is being fully saturated or substantially fully saturated. It follows a main washing phase during which the laundry is treated by means of said solution of water and detergent. The water is typically heated to a predetermined temperature based on the washing program selected by the user. During the main washing phase the drum is rotated, so as to apply also a mechanical cleaning action on the laundry. At the end of the main washing phase the drum is typically rotated at high rotational speed, in such a way that dirty washing liquid (i.e. water mixed with detergent) is extracted from the laundry. The dirty washing liquid is drained to the outside by a water draining device.

[0008] A successive step of the cycle typically comprises a rinsing phase which usually comprises one or more rinsing cycles.

[0009] In a rinsing cycle, clean rinse water may be first added to the laundry. The rinse water is absorbed by the laundry and the rinse water removes from the laundry detergent and/or dirty particles not previously removed by washing liquid in the main washing cycle. The drum is then rotated to extract water and dirty particles/detergent from the laundry: the dirty water extracted is drained from the tub to the outside by the water draining device.

[0010] However, washing cycles in laundry washing machines equipped with an automatic dosing device of the known art pose some drawbacks.

[0011] A drawback posed by the washing cycles of the known art lies in that the same predetermined dose of detergent is dispensed at any washing cycle irrespective of the type of detergent which is currently used.

[0012] It is known, in fact, that detergents available in the market may be of different type according to their concentration.

[0013] Detergents are substantially grouped by the producers in three main categories, namely: regular, concentrated or super concentrated. Producers usually suggest a preferred amount of detergent usable for each category considering the soil level, the laundry load amount and the water hardness.

[0014] For example, an amount of ~120ml is suggested in case of a regular liquid detergent with soft/medium water, normal soil and a medium load (3-4 kg), an amount of ~70ml in case of a concentrated liquid detergent and an amount of 25÷37ml in case of a super-concentrated liquid detergent.

[0015] Dispensing of the same predetermined dose of detergent in the tub irrespective of the type of detergent currently loaded in the container may lead to the use of an overdose of concentrated or super-concentrated detergent for washing the laundry.

[0016] This may firstly worsen the rinsing performances due to a high residual detergent amount in the washed laundry. It could cause skin irritations or allergic reactions. Moreover, an excess of foam could be generated during the wash with a detrimental effect on washing results.

[0017] It follows that more water and more energy consumption is required during the rinsing phase.

[0018] Furthermore incorrect dosage of concentrated or super-concentrated detergent, i.e. higher than necessary,

may increase laundry washing costs due to the detergent costs themselves.

[0019] The object of the present invention is therefore to overcome the drawbacks posed by the known technique.

[0020] It is an object of the invention to provide a method for washing laundry in a laundry washing machine equipped with an automatic dosing device that makes it possible to dose the correct amount of detergent in a washing cycle according to the concentration of the same detergent.

[0021] It is another object of the invention to provide a method for washing laundry in a laundry washing machine equipped with an automatic dosing device that makes it possible to maintain the duration of the rinsing phase at the expected duration. It is a further object of the invention to provide a method for washing laundry in a laundry washing machine equipped with an automatic dosing device that makes it possible to maintain the water and/or energy consumption during the rinsing phase at the expected values.

[0022] It is another object of the invention to provide a method for washing laundry in a laundry washing machine equipped with an automatic dosing device that makes it possible to save detergent refilling costs.

DISCLOSURE OF INVENTION

[0023] The applicant has found that by providing a method for washing laundry in a laundry washing machine comprising an automatic dosing device which supplies detergent in a plurality of washing cycles, a mixing recirculation circuit and a concentration sensor device, wherein the method comprises an initial phase of introducing water and detergent for washing the laundry and by providing a step of detecting the concentration of the detergent through said concentration sensor device it is possible to dose the correct amount of detergent during the washing cycle.

[0024] The present invention relates, therefore, to a method for washing laundry during a washing cycle in a laundry washing machine comprising:

- a washing drum adapted to receive laundry;
- a washing tub external to said washing drum;
- a water supply unit to supply water into said washing tub;
- an automatic dosing device to supply detergent into said washing tub comprising a compartment suitable for receiving a quantity of detergent sufficient for a plurality of washing cycles;
- a first recirculation circuit suitable for withdrawing liquid from a bottom region of said washing tub and for re-admitting such a liquid into said bottom region of said washing tub;
- a concentration sensor device arranged in said first recirculation circuit or at said bottom region of said washing tub;
- a control unit for controlling functioning of said laundry washing machine; wherein the method comprises an initial phase comprising the steps of:

- a) introducing a first prefixed quantity of detergent into said washing tub;
- b) introducing a first prefixed quantity of water into said washing tub;
- c) activating said first recirculation circuit for mixing said first prefixed quantity of detergent with said first prefixed quantity of water at said bottom region of said washing tub;
- d) providing data from said concentration sensor device to said control unit relating to the concentration of said detergent for determining the current concentration value of said detergent;
- e) comparing said current concentration value of said detergent with one or more prefixed concentration levels stored in said control unit and either introducing a second quantity of detergent or not introducing any quantity of detergent into said washing tub according to the result of said comparison;

wherein said first prefixed quantity of detergent and/or said second quantity of detergent is determined on the base of the amount of laundry load.

[0025] In a preferred embodiment of the invention, the initial phase further comprises a step f) of introducing a second quantity of water into the washing tub for washing the laundry.

[0026] Preferably, the step f) of introducing a second quantity of water into the washing tub is carried out by means of a sequence of partial loads of water into the washing tub.

[0027] According to a preferred embodiment of the invention, the step f) of introducing a second quantity of water is carried out after the step e).

[0028] According to a further preferred embodiment of the invention, the step f) of introducing a second quantity of water is carried out after said step c) and before said step e) for determining said amount of laundry load (L).

[0029] In a preferred embodiment of the invention, the first prefixed quantity of detergent in the step a) is determined assuming that the concentration level of the detergent is comprised in a preselected range of a plurality of concentration ranges defined by said one or more prefixed concentration levels stored in the control unit and the step e) comprises

the step of either introducing a second quantity of detergent into the washing tub if the current concentration value of the detergent falls out of the preselected range or not introducing any quantity of detergent into the washing tub if the current concentration value of the detergent falls within the preselected range.

[0030] In a further preferred embodiment of the invention, the first prefixed quantity of detergent in the step a) is determined assuming that the concentration level of the detergent has a preselected value and the step e) comprises the step of either introducing a second quantity of detergent into the washing tub if the current concentration value of the detergent is different from of the preselected value or not introducing any quantity of detergent into the washing tub if the current concentration value of the detergent is equal to the preselected value.

[0031] Preferably, said one or more prefixed concentration levels stored in the control unit define respective concentration ranges.

[0032] In a preferred embodiment of the invention, said one or more prefixed concentration levels stored in the control unit are two levels which define three concentration ranges, preferably a low concentration range, a medium concentration range and a high concentration range.

[0033] In a further preferred embodiment of the invention, said one or more prefixed concentration levels stored in the control unit is only one level which defines two concentration ranges, preferably a low concentration range and a high concentration range.

[0034] According to a preferred embodiment of the invention, the first quantity of water plus the second quantity of water is a quantity of water required to fully saturate, or substantially fully saturate, the laundry.

[0035] In a preferred embodiment of the invention, the amount of laundry load is determined by detecting and/or estimating the amount of laundry load in the laundry drum, preferably by evaluating working parameters of the laundry washing machine.

[0036] Preferably, the step of evaluating working parameters of the laundry washing machine comprises the step of detecting the weight of the load by means of a weight sensor associated to the laundry drum.

[0037] More preferably, the step of evaluating working parameters of the laundry washing machine comprises the step of measuring the electrical and/or mechanical parameters of an electric drum motor, the step of measuring the electrical and/or mechanical parameters of an electric drum motor preferably comprising the step of measuring the electric current and/or the induced voltage and/or the torque of the electric drum.

[0038] In a preferred embodiment of the invention, the first prefixed quantity of detergent and/or the second quantity of detergent is determined on the base of the water hardness level.

[0039] Preferably, the water hardness level is a parameter set by a user at the beginning of the washing cycle or at the time of installation of the laundry washing machine.

[0040] Alternatively, the water hardness level is a parameter determined by means of a water hardness sensor of the laundry washing machine.

[0041] According to a preferred embodiment of the invention, the first prefixed quantity of detergent and/or the second quantity of detergent is determined on the base of the laundry soil level.

[0042] Preferably, the laundry soil level is determined on the base of the washing cycle selected set by a user.

[0043] Alternatively, the laundry soil level is determined on the base of a soil sensor associated to the washing laundry machine.

[0044] In a further preferred embodiment of the invention, the method further comprises a further step, after the initial phase, of withdrawing liquid from a bottom region of the washing tub and re-admitting such a liquid into the washing drum in order to enhance absorption of the liquid by the laundry.

[0045] Preferably, the further step of introducing liquid into the washing drum is carried out by means of a second recirculation circuit suitable for withdrawing liquid from the bottom region of the washing tub and for re-admitting such a liquid into an upper region of the washing tub.

[0046] According to a preferred embodiment of the invention, after said initial phase the method comprises at least a step of washing the laundry by rotating the washing drum during which the laundry is subjected to a mechanical action and at least a step of draining dirty liquid from the washing tub to the outside.

[0047] Preferably, the step of washing the laundry further comprises a step of heating the liquid which wets the laundry

[0048] In a preferred embodiment of the invention, the laundry washing machine additionally comprises a water softening device and the method further comprises a step of conveying water through the water softening device before the water is supplied into the washing tub.

[0049] In a further 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

[0050] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of preferred embodiments of the invention, provided with reference to the enclosed draw-

ings. In said drawings:

- Figure 1 shows a perspective view of a laundry washing machine implementing the method according to a first embodiment of the invention;
- Figure 2 shows a schematic view of the laundry washing machine of Figure 1;
- Figure 3 shows the laundry washing machine of Figure 1 with the external casing removed;
- Figure 4 shows the laundry washing machine of Figure 3 from another point of view;
- Figure 5 shows a partial view of the laundry washing machine of Figure 1 with the external casing partially removed;
- Figure 6 is a plan view of some components of the laundry washing machine of Figure 3 isolated from the rest;
- Figure 6A shows a perspective view of some components of the laundry washing machine isolated from the rest according to a further embodiment of the laundry washing machine;
- Figure 7 is a simplified flow chart of the basic operations of a method for washing laundry in the laundry washing machine of Figure 2 according to a first embodiment of the invention;
- Figures 8 to 14 show further embodiments of Figure 7.

DETAILED DESCRIPTION OF THE INVENTION

[0051] The present invention has proved to be particularly advantageous when applied to laundry washing machines, as described below. It should in any case be underlined that the present invention is not limited to laundry washing machines. On the contrary, the present invention can be conveniently applied to laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry).

[0052] In the present description, therefore, the term "laundry washing machine" will refer to both simple laundry washing machines and laundry washing-drying machines.

[0053] With reference to Figures from 1 to 6 a laundry washing machine 1 is illustrated, in which a method according to the invention is advantageously implemented. The laundry washing machine 1 comprises an external casing or housing 2, in which a washing tub 3 is provided that contains a perforated washing drum 4 where the laundry to be treated can be loaded.

[0054] The tub 3 and the drum 4 both preferably have a substantially cylindrical shape. Between the tub 3 and the drum 4 a gap 55 is defined.

[0055] The housing 2 is provided with a loading/unloading door 8 which allows access to the drum 4.

[0056] The tub 3 is preferably suspended in a floating manner inside the housing 2, advantageously by means of a number of coil springs and shock-absorbers 9. The drum 4 is advantageously rotated by an electric motor, not illustrated, which preferably transmits the rotating motion to the shaft of the drum 4, advantageously by means of a belt/pulley system. In a different embodiment of the invention, the motor can be directly associated with the shaft of the drum 4. The drum 4 is advantageously provided with holes which allow the liquid flowing therethrough. Said holes are typically and preferably homogeneously distributed on the cylindrical side wall of the drum 4.

[0057] The tub 3 is preferably connected to the casing 2 by means of an elastic bellows 7, or gasket.

[0058] The tub 3 preferably comprises two complementary hemi-shells 13 and 14 structured for being reciprocally coupled to form the tub 3.

[0059] The bottom region 3a of the tub 3 preferably comprises a seat 15, or sump, suitable for receiving a heating device 10, as illustrated in Figure 5. The heating device 10, when activated, heats the liquid inside the sump 15.

[0060] The heating device 10 preferably comprises an electrical resistor of serpentine type. The heating device 10 is horizontally placed in the sump 15 and it extends substantially from a front part up to a rear part of the sump 15.

[0061] In different embodiments, nevertheless, the bottom region of the tub may be configured differently. For example, the bottom region of the tub may not comprise a seat for the heating device. The heating device may be advantageously placed in the annular gap between the tub and the drum.

[0062] In further embodiments, then, the heating device may not be present. The required heated water may come from an external hot water source.

[0063] In further embodiments the heating device may be different and suitable to heat the liquid in the tub, for example a hot air stream, a steam flow, microwaves source, infra-red rays, etc..

[0064] A water supply unit 5 is arranged in the upper part of the laundry washing machine 1 and is suited to supply water into the tub 3 from an external supply line E. The water supply unit 5 advantageously comprises a controlled supply valve 5a which is properly controlled, opened and closed, during the washing cycle. The water supply unit 5 also preferably comprises a water flow sensor (not shown), for example a flow meter, which makes it possible to calculate the quantity of water supplied into the tub 3.

[0065] The water supply unit 5 may then preferably comprise a water softening device for removal of calcium, magnesium and/or certain other metal cations in hard water before entering the tub. The water softening device advantageously comprises water softening agents for reducing the hardness degree of the water to be supplied to the washing

tub. The water softening device basically comprises a water-softening agent container and a regeneration-agent reservoir. The water-softening agent container is crossed by the fresh water arriving from the external water supply line. The water-softening agent container is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container. The regeneration-agent reservoir instead is fluidly connected to the water-softening agent container and is structured for receiving a given quantity of salt or other regeneration agent which is able to regenerate the water softening function of the water softening agent stored inside the water-softening agent container.

[0066] The water supply unit 5 may then preferably comprise a water hardness sensor which detects the water hardness entering the laundry washing machine 1. The water hardness sensor may be a sensor based on impedance and/or conductivity water analysis.

[0067] The water supply unit of a laundry washing machine is well known in the art, and therefore it will not be further described in detail.

[0068] The laundry washing machine 1 advantageously comprises a wash products supplier 59 to supply wash products during a washing cycle, such as detergent, rinse additives, fabric softener or fabric conditioners, waterproofing agents, fabric enhancers, rinse sanitization additives, chlorine-based additives, etc..

[0069] In the preferred embodiment here illustrated and described, the wash products supplier 59 advantageously comprises a detergent supplier 60 to supply detergent D into the tub 3 and a rinse additive supplier 70 to supply at least one rinse additive S into the tub 3. In a preferred embodiment, for example, the rinse additive S may comprise a softener.

[0070] In the preferred embodiment here described and illustrated, the detergent supplier 60 and the rinse additive supplier 70 are part of a removable drawer 6 provided with various compartments suited to be filled with said detergent D and rinse additive S.

[0071] In different embodiments, nevertheless, the removable drawer may comprise further compartments suited to be filled with other type of wash products, such as fabric conditioners, waterproofing agents, fabric enhancers, rinse sanitization additives, chlorine-based additives, i.e. products which are suitable to be used in the washing cycle.

[0072] According to a preferred aspect of the washing laundry machine 1 of the present invention, each compartment of the drawer 6 is filled with a large amount of wash product, detergent D or softener S, which is then dispensed in a predetermined dose during the washing cycle. The detergent D and the softener S in the compartments are advantageously sufficient for multiple washing cycles. The wash products supplier 59 therefore define an automatic dosing device 58 which is suited to dose the detergent D or the softener S from the respective compartment of the drawer 6 into the tub 3. At this purpose, the automatic dosing device 58 preferably comprises a flushing chamber 57.

[0073] In the preferred embodiment here illustrated and described, the flushing chamber 57 is advantageously defined by the bottom of the housing 6a which receives the removable drawer 6.

[0074] In different embodiments, nevertheless, the flushing chamber may be a separate mixing chamber.

[0075] A dose of detergent D is preferably conveyed from the compartment of the drawer 6 into the flushing chamber 57 by activating a first feeding pump 60a. Analogously, a dose of softener S is preferably conveyed from the compartment of the drawer 6 into the flushing chamber 57 by activating a second feeding pump 70a.

[0076] In the preferred embodiment here illustrated, the water is supplied into the tub 3 from the water supply unit 5 by making it flow through the flushing chamber 57 and then through a supply pipe 18 together with the dose of detergent D, or the dose of softener S.

[0077] The water which reaches the tub 3 can be clean water if the wash products are not conveyed into the flushing chamber 57 from the respective compartment.

[0078] In an alternative embodiment of the invention, a further separate water supply pipe can be provided, which supplies exclusively clean water into the tub 3, thus bypassing the flushing chamber 57.

[0079] The automatic dosing device 58 here described is only one of the possible preferred embodiments. In different embodiments, nevertheless, the automatic dosing device may be differently realized, as known in the art.

[0080] The supply pipe 18, as schematically illustrated in figure 2 and visible in Figure 4, is preferably arranged laterally with respect to the tub 3 and preferably terminates at an upper region 3b of the tub 3. More preferably, the supply pipe 18 terminates at a rear side of the washing tub 3.

[0081] Laundry washing machine 1 advantageously comprises a water outlet circuit 25 suitable for withdrawing liquid from the bottom region 3a of the tub 3.

[0082] The water outlet circuit 25 preferably comprises a main pipe 17, a draining pump 26 and an outlet pipe 28 ending outside the housing 2.

[0083] The water outlet circuit 25 preferably further comprise a filtering device 12 arranged between the main pipe 17 and the draining pump 26. The filtering device 12 is adapted to retain all the undesirable bodies (for example buttons that have come off the laundry, coins erroneously introduced into the laundry washing machine, etc.).

[0084] This filtering device 12 can preferably be removed, and then cleaned, through a gate 14 placed advantageously on the front wall of the housing 2 of the laundry washing machine 1, as illustrated in Figure 1.

[0085] The main pipe 17 connects the bottom region 3a of the tub 3 to the filtering device 12. An inlet end 17a of the

main pipe 17 is advantageously positioned at the lower point of the tub 3, more preferably at the lower point of the sump 15. An outlet end 17b of the main pipe 17 is connected to a front part 12a of the filtering device 12, as illustrated in Figure 6.

[0086] In a further embodiment, not illustrated, the filtering device 12 may be provided directly in the tub 3, preferably obtained in a single piece construction with the latter. In this case the filtering device 12 is fluidly connected to the outlet of the tub 3, in such a way that water and washing liquid drained from the tub 3 enters the filtering device 12.

[0087] The draining pump 26 is preferably connected to a rear part 12b of the filtering device 12 and conveys the liquid to the outlet pipe 28 through an outlet 29, the latest better visible in Figure 5 where the outlet pipe 28 has been removed. Activation of the drain pump 26 drains the liquid, for example dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside. Laundry washing machine 1 advantageously comprises a first recirculation circuit 30, or mixing circuit 30. The mixing circuit 30 is adapted to drain liquid from the bottom region 3a of the tub 3 and to re-admit such a liquid (recirculated mixing liquid) into a first region of the tub 3, which corresponds substantially to the same bottom region 3a of the tub 3.

[0088] Preferably, the mixing circuit 30 is adapted to drain liquid from the bottom of the sump 15 and to re-admit such a liquid again into the sump 15. More preferably, the liquid is re-admitted again into the sump 15 below the heating device 10. The mixing circuit 30 preferably comprises a first recirculation pump 31, a first pipe 32 connecting the filtering device 12 to the first recirculation pump 31 and a second recirculation pipe 33 advantageously provided with a terminal portion 34, or nozzle, better visible in Figure 5. The terminal portion 34 advantageously ends inside the sump 15, as mentioned above.

[0089] The liquid from the bottom region 3a of the tub 3 is conveyed again towards the bottom region 3a of the tub 3 by activation of the first recirculation pump 31. Advantageously, the liquid from the bottom region 3a of the tub 3 is conveyed towards the bottom region 3a of the tub 3 in the gap 55 between the tub 3 and the drum 4.

[0090] In a further embodiment, not illustrated, the mixing circuit may comprise a dedicated pipe connecting the bottom region of the tub to the recirculation pump; in this case the mixing circuit is advantageously completely separated from the water outlet circuit, i.e. completely separated from the filtering device 12 and the main pipe 17.

[0091] The mixing circuit is preferably realized for transferring a portion of a liquid from a bottom region of the tub to the same bottom region for mixing and/or dissolution of the products, as better described below.

[0092] In general, the mixing circuit is preferably realized for transferring liquid from a bottom region of the tub and for re-admitting such a liquid into the washing tub such that at least a portion of the re-admitted liquid reaches the bottom region of the washing tub without entering the washing drum.

[0093] More preferably, the mixing circuit is realized for transferring liquid from a bottom region of the tub and for re-admitting such a liquid into the washing tub such that all, or substantially all, the re-admitted liquid reaches the bottom region of the washing tub without entering the washing drum.

[0094] According to a preferred aspect of the invention, laundry washing machine 1 preferably comprises a concentration sensor 80 for determining the concentration of a product (wash product) mixed/dissolved in water. The concentration sensor 80 is preferably arranged in the first recirculation circuit 30, for example along the second recirculation pipe 33 as illustrated in Figure 2.

[0095] In a further preferred embodiment, illustrated in particular in Figure 6A, the concentration sensor 80 is preferably arranged in the first recirculation circuit 30 along the first pipe 32, more preferably close to the first recirculation pump 31.

[0096] In other preferred embodiments, the concentration sensor may be arranged in other suitable zones at the bottom region 3a of the tub 3, preferably inside the tub 3 and in the gap 55.

[0097] Any suitable concentration sensor may be used. For example, the concentration sensor may be an electrical conductivity sensor preferably having a pair of electrodes. Other preferred concentration sensors may comprise a pH sensor, an oxidation/reduction sensor, a chemical sensor, and the like, capable of generating a signal proportional to the concentration of the wash product.

[0098] Further to the concentration sensor, a water hardness sensor may be also arranged in suitable zones at the bottom region 3a of the tub 3, rather than in the water supply unit 5 as mentioned above. The water hardness sensor may eventually coincide with the concentration sensor. In this case, the sensor may detect the water hardness from a quantity of clean water opportunely introduced into the tub 3. The water hardness detection may be advantageously carried out at the beginning of the washing cycle or more preferably by means of a dedicated hardness cycle carried out just after the installation of the laundry washing machine and its connection to the external supply line E.

[0099] Laundry washing machine 1 preferably comprises a second recirculation circuit 20 adapted to drain liquid from the bottom region 3a of the tub 3 and to re-admit such a liquid into a second region 3b, or upper region, of the tub 3.

[0100] The second recirculation circuit 20 preferably comprises a second recirculation pump 21, a second pipe 22 connecting the filtering device 12 to the second recirculation pump 21 and a second recirculation pipe 23, preferably provided with a terminal nozzle 23a arranged preferably at the upper region 3b of the tub 3. The terminal nozzle 23a is opportunely arranged so that the liquid is sprayed directly into the drum 4 through its holes. More preferably the terminal nozzle 23a is integrally formed in the bellows 7, as visible in Figure 3, and the liquid is therefore advantageously sprayed

in a direction against the perforated drum 4. The terminal nozzle 23a, therefore, enhances distribution of liquid over the laundry through the perforated drum 4.

[0101] The liquid from the bottom region 3a of the tub 3 is conveyed towards the upper region 3b of the tub 3 by activation of the second recirculation pump 21.

[0102] The second recirculation circuit 20 is advantageously activated in order to improve wetting of the laundry inside the drum 4 and for reducing the water required in the whole washing cycle.

[0103] In general, the second recirculation circuit is properly realized for transferring a portion of a liquid from a bottom region of the tub, preferably from the sump, to an upper region of the tub in order to enhance absorption of the liquid by the laundry.

[0104] Advantageously, laundry washing machine 1 comprises a device 19 suited to sense (or detect) the liquid level inside the tub 3.

[0105] 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 of the liquid inside the tub 3. In another embodiment, not illustrated, laundry washing machine 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.

[0106] In a preferred embodiment of the invention, laundry washing machine 1 further comprises a load amount detection device. The load amount detection device gives indication of the amount of load (weight) of the laundry. The load amount detection device may comprise, for example, a weight sensor placed on the dampers (coil springs and shock-absorbers 9). In different embodiments, measurements may be carried out using Hall sensors, magnet sensors or using strain gage devices.

[0107] In another embodiment of the invention, the amount of load may be determined by measuring the electrical parameters of the electric drum motor, like the electric current and/or the induced voltage. The electrical current through the electric drum motor is at least approximately proportional to the torque of the electric drum motor. For example, the electric current measured gives a measure of the torque of the electric drum motor and from the torque the amount of load is determined.

[0108] In further embodiments, the torque of the electric drum motor may be detected and/or calculated differently, for example by means of a torque sensor associated to the drum motor.

[0109] Laundry washing machine 1 advantageously comprises a control unit 11 connected to the various parts of the laundry washing machine 1 in order to ensure its operation. The control unit 11 is preferably connected to the water supply unit 5, the water outlet circuit 25, the recirculation circuits 30, 20, the heating device 10 and the electric motor and receives information from the various sensors provided on the laundry washing machine 1, like the concentration sensor 80, the pressure sensor 19, the water hardness sensor, the load amount detection device, a temperature sensor, etc.

[0110] Laundry washing machine 1 advantageously comprises an interface unit 16, connected to the control unit 11, accessible to the user and by means of which the user may select and set the washing parameters, like for example a desired washing program. Usually, other parameters can optionally be inserted by the user, for example the washing temperature, the spinning speed, the load in terms of weight of the laundry to be washed, etc..

[0111] Based on the parameters acquired by said interface 16, the control unit 11 sets and controls the various parts of the laundry washing machine 1 in order to carry out the desired washing program.

[0112] A first embodiment of the washing method according to the invention is described here below with reference to Figure 7.

[0113] The laundry to be washed is first placed inside the drum 4 (step 100 of Figure 7). The user fills, or has already previously filled, the compartments of the drawer 6 with the wash products, i.e. detergent D and softener S, needed for a plurality of washing cycles of the laundry.

[0114] Advantageously, as will be better explained below, the user does not have to worry about the type of detergent D is using. In other words, the user may indifferently fill the compartment of the drawer 6 with a regular, or a concentrated or a super concentrated detergent D.

[0115] By operating on the interface unit 16 the user selects the desired washing program (step 110) depending, for example, on the type and on the soil level of the laundry to wash. Furthermore, as said before, in a preferred embodiment it is possible for the user to insert some parameters directly by the interface unit 16, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of the washing program, etc.

[0116] Once the user has selected the desired washing program, the control unit 11 sets the laundry washing machine 1 so that it may start the washing program.

[0117] In a further embodiment, the selection of the desired washing program (step 110) may be performed before placing the laundry into the drum 4 (step 100).

[0118] From the desired washing program or the parameters inserted directly by the user, the control unit 11 may evaluate other working parameters which may be advantageously used during the washing cycle. Working parameters

which may advantageously used are, for example, the soil level of the laundry, the amount of load of the laundry L (for example half or full load), the water hardness etc..

[0119] If the amount of load of the laundry L, in the following indicated as laundry load amount L, is not inserted by the user, in a successive phase (step 120) the laundry load amount L, preferably in terms of laundry weight (Kg) is detected or evaluated. This step may comprise either a direct measurement in case a load amount detection device is present or an indirect evaluation of the laundry load amount, as explained above.

[0120] Successively, a first prefixed quantity Q1d of detergent D (step 130) and a first prefixed quantity Q1w of water W (step 140) are introduced into the tub 3.

[0121] The first prefixed quantity Q1d of detergent D introduced into the tub 3 at this stage may be preferably evaluated as the quantity of detergent D required to wash the predetermined laundry load amount L, assuming that the detergent D is a super concentrated detergent. For example, with a medium laundry load amount L (3-4 kg) the first quantity Q1d of detergent D may be set at 30ml. Such a value is preferably determined according to the amount of super concentrated liquid detergent suggested by the detergent suppliers. The first quantity Q1d of detergent D and its relation with the laundry load amount L is advantageously stored in the memory of the control unit 11 or is adequately calculated by a suitable algorithm before its introduction into the tub 3.

[0122] The following table exemplary shows a correlation between the detergent liquid type and the amount of detergent for a medium load (3-4kg) suggested by a supplier (which may hence be advantageously stored in the memory of the control unit 11):

Table 1

Detergent liquid type	Amount of detergent for medium load
Regular	~ 120ml
Concentrated	~ 70ml
Super concentrated	~ 30ml

[0123] The memory then preferably comprises one or more analogous tables storing the correlation between the detergent liquid type and the amount of detergent for different loads L. For example for a high load (load>4kg):

Table 2

Detergent liquid type	Amount of detergent for high load
Regular	~ 160ml
Concentrated	~ 85ml
Super concentrated	~ 50ml

[0124] Alternatively, the amount of detergent for different loads may be calculated by a suitable algorithm starting from a standard situation. For example, the amount of detergent for a high load may be calculated adding a percentage of 30% to the standard medium load value or analogously the amount of detergent for a low load may be calculated subtracting a percentage of 40% to the standard medium load value.

[0125] In further preferred embodiments of the invention, the first prefixed quantity Q1d of detergent D introduced into the tub 3 may be preferably set at a fixed minimum value assuming a minimum laundry load amount L and assuming that the detergent D is a super concentrated detergent D. For example, the first quantity Q1d of detergent D may be set at 20ml which substantially corresponds to the use of a super concentrated detergent D with a low load L (for example 1-2 kg).

[0126] The first quantity Q1w of water W is a known prefixed quantity of water, for example 10 litres.

[0127] The introduction of the first quantity Q1d of detergent D takes place preferably through the detergent supplier 60: the first quantity Q1d of detergent D, preferably liquid detergent, is conveyed from the respective compartment of the drawer 6 into the flushing chamber 57 by activating the first feeding pump 60a; the first prefixed quantity Q1w of water W is supplied into the tub 3 from the water supply unit 5 by making it flow through the flushing chamber 57 and then through the supply pipe 18 together with the first quantity Q1d of detergent D. The first quantity Q1w of water W is conveyed to the flushing chamber 57 by activating (opening) the supply valve 5a of the water supply unit 5.

[0128] In order to convey the first quantity Q1w of water W (for example said 10 litres) the supply valve 5a is activated for a predetermined water supplying time, for example 60 sec.. The water supplying time obviously depends on the flow rate of the supply valve 5a.

[0129] As said above, the first quantity Q1d of detergent D and the first quantity Q1w of water W are introduced into the tub 3 through the supply pipe 18.

[0130] In different embodiments, the first quantity Q1d of detergent D and the first quantity Q1w of water W may be advantageously introduced singularly into the tub 3 in different times.

[0131] The first quantity Q1d of detergent D and the first quantity Q1w of water W introduced into the tub 3 in said phases (steps 130 and 140) fall down on the bottom region 3a of the tub 3 by flowing inside the gap 55 between the tub 3 and the drum 4.

[0132] A small quantity of detergent D introduced into the tub 3 and flowing inside the gap 55 may enter the drum 4, due to the position of the supply pipe 18.

[0133] A relevant quantity of detergent D introduced into the tub 3 reaches in any case the bottom region 3a of the tub 3, filling the sump 15.

[0134] Therefore almost all the detergent D reaches the bottom region 3a of the tub 3 with a minimum absorption from the laundry arranged inside the drum 4. According to the invention, the mixing circuit 30 is then activated (step 150). Activation of the mixing circuit 30 is advantageously carried out through activation of the first recirculation pump 31.

[0135] In a first preferred embodiment of the invention, activation of the mixing circuit 30 preferably starts at the same time of activation of the supply valve 5a.

[0136] In a further preferred embodiment of the invention, activation of the mixing circuit 30 more preferably starts after a delay time from activation of the supply valve 5a, for example after a delay time of 20 sec.. In this case, the delay time ensures that the first recirculation pump 31 is working properly, i.e. guarantees that a quantity of liquid (detergent D and/or water W) reaches the sump 15 when the first recirculation pump 31 is activated.

[0137] In different embodiments, nevertheless, the activation of the mixing circuit 30 may start even before activation of the supply valve 5a or, on the contrary, activation of the mixing circuit 30 may start after the supply valve 5a has been de-activated (closed). In the latter, the mixing circuit 30 is activated after all the quantity Q1d of detergent D and all the first quantity Q1w of water W have been introduced into the tub 3.

[0138] When the mixing circuit 30 is activated (step 150), the wash liquid (water W and detergent D) is drained from the bottom region 3a of the tub 3 and re-admitted into to the same bottom region 3a of the tub 3. In particular, the liquid (water W and detergent D) is drained from sump 15 and re-admitted again into the sump 15. More preferably, the wash liquid (water W and detergent D) is drained from sump 15 and re-admitted again into the sump 15 below the heating device 10. Activation of the mixing circuit 30 advantageously mixes the detergent D and the water W at the bottom region 3a of the tub 3, more preferably inside the sump 15.

[0139] The mixing action causes the quantity Q1d of detergent D to be properly and homogeneously diluted in the first quantity Q1w of water W.

[0140] During activation of the mixing circuit 30, therefore, a homogeneous liquid mixture of detergent D and water W flows through the second recirculation pipe 33.

[0141] During activation of the mixing circuit 30, advantageously, the concentration sensor 80 is activated for detection of the wash liquid concentration flowing through the second recirculation pipe 33 (step 150).

[0142] Since the first quantity Q1d of detergent D and the first quantity Q1w of water W are known prefixed quantities, the control unit 11 from the values coming from the concentration sensor 80 may evaluate the current type of detergent D (step 160), i.e. may evaluate the concentration of the detergent D. Preferably at this stage it is possible to evaluate if the detergent D is a regular or a concentrated or a super concentrated detergent D.

[0143] If the current type of detergent D is a super concentrated detergent D (output "Yes" of step 170), the method proceeds with the introduction of a second quantity Q2w of water W (step 180). This means, in fact, that the first prefixed quantity Q1d of detergent D previously introduced into the tub 3 (step 130) was the correct required dose since it was correctly assumed to be a super concentrated detergent D.

[0144] The second quantity Q2w of water W is supplied into the tub 3 from the water supply unit 5 by making it flow through the flushing chamber 57 and then through the supply pipe 18.

[0145] The second quantity Q2w of water W is preferably a quantity of water that together with the first quantity Q1w of water W already introduced into the tub 3 fully saturate, or substantially fully saturate, the laundry.

[0146] The second quantity Q2w of water W (step 180), and hence the total amount of water $Q_w = Q_{1w} + Q_{2w}$ introduced into the tub 3, is thus preferably determined on the base of the predetermined laundry load amount L.

[0147] For example, with a medium laundry load amount L (3-4 kg) the second quantity Q2w of water W is set at 6 litres so that the total amount of water $Q_w = Q_{1w} + Q_{2w} = 16$ litres fully saturate, or substantially fully saturate, the laundry.

[0148] In further embodiments, nevertheless, the second quantity Q2w of water W introduced into the tub 3 (step 180) may be differently determined. For example, the second quantity Q2w of water W may be set at a pre-fixed value, irrespective of the laundry load amount L (for example the second quantity Q2w of water W may be set at 15 litres so that a total amount of water $Q_w = Q_{1w} + Q_{2w} = 25$ litres is always introduced into the tub 3. This guarantees that also in the worst situation with a full load in the tub 3, the laundry is fully saturated, or substantially fully saturated, with water.

[0149] If the current type of detergent D is not a super concentrated detergent D (output "No" of step 170), the method

proceeds with the adjustment of the quantity of detergent D inside the tub 3 (step 190) with the introduction of a second quantity Q2d of detergent D into the tub 3.

[0150] This means, in fact, that the first prefixed quantity Q1d of detergent D previously introduced into the tub 3 (step 130) was not the correct required dose since it was incorrectly assumed to be a super concentrated detergent D.

[0151] The second quantity Q2d of detergent D is preferably a quantity of detergent that added to the first quantity Q1d of detergent D already introduced into the tub 3 guarantees the best performance of the detergent D having the current concentration level as previously detected (step 160).

[0152] In a preferred embodiment of the invention, the second quantity Q2d of detergent D (step 190) is a quantity such that the total amount of detergent $Q_d = Q_{1d} + Q_{2d}$ introduced into the tub 3 matches the dose suggested by the supplier.

[0153] For example, if the current type of detergent D detected in step 160 is a regular detergent D, then the second quantity Q2d of detergent D is set at 90ml so that the total amount of detergent $Q_d = Q_{1d} + Q_{2d} = 30 + 90 = 120\text{ml}$ introduced into the tub 3 matches the 120ml of regular detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see Table 1 above).

[0154] Again, for example, if the current type of detergent D detected in step 160 is a concentrated detergent D, then the second quantity Q2d of detergent D is set at 40ml so that the total amount of detergent $Q_d = Q_{1d} + Q_{2d} = 30 + 40 = 70\text{ml}$ introduced into the tub 3 matches the 70ml of concentrated detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see Table 1 above).

[0155] The introduction of the second quantity Q2d of detergent D takes place preferably through the detergent supplier 60: the second quantity Q2d of detergent D is conveyed from the respective compartment of the drawer 6 into the flushing chamber 57 by activating the first feeding pump 60a; the second quantity Q2w of water W is supplied into the tub 3 (step 180) from the water supply unit 5 by making it flow through the flushing chamber 57 and then through the supply pipe 18 together with the second quantity Q2d of detergent D. In the preferred embodiment of the invention, as described above, the evaluation of the detergent concentration (step 160) gives the indication that the detergent D is a regular or a concentrated or a super concentrated detergent D (or, in other words, it has a low, a medium or a high concentration). This may preferably be carried out by comparing the values V coming from the sensor 80 with two prefixed levels T1 and T2 which define three ranges: if $V < T1$ the detergent is a regular detergent; if $T1 \leq V < T2$ the detergent is a concentrated detergent; if $V > T2$ the detergent is a super concentrated detergent.

[0156] Accordingly, the second quantity Q2d of detergent D is selected between two values, for example the choice is between 80ml and 70ml (as described above). Therefore the adjustment phase (step 190) comprises a discrete optimization. The prefixed levels T1 and T2 are advantageously stored in the control unit 11.

[0157] In a further preferred embodiment of the invention, the evaluation of the detergent concentration (step 160) may give continuous values of concentration for the detergent D. Accordingly, the choice of the second quantity Q2d of detergent D (step 190) is based on continuous concentrations, i.e. the adjustment phase (step 190) comprises a continuous optimization.

[0158] After the introduction of the second quantity Q2d of detergent D, the introduction of the second quantity Q2w of water W is performed (step 180).

[0159] Preferably, after the introduction of the second quantity Q2w of water W the mixing circuit 30 is maintained activated causing the detergent D to be properly and homogeneously diluted in the total quantity $Q_w = Q_{1w} + Q_{2w}$ of water W. The washing cycle then continues (step 200) according to the washing cycle selected up to the end of the cycle.

[0160] In particular, during the washing cycle the second recirculation circuit 20 is advantageously activated. The wash liquid comprising the total amount of water and detergent from the bottom region 3a of the tub 3 is conveyed towards the upper region 3b of the tub 3 by activation of the second recirculation pump 21. The second recirculation circuit 20 is advantageously activated in order to improve wetting of the laundry inside the drum 4.

[0161] The laundry is also subjected to a mechanical action by rotating the washing drum 4.

[0162] The washing cycle then advantageously comprises one or more rinsing cycles during which clean rinse water is added to the laundry and drum is rotated to extract water and dirty particles/detergent from the laundry: the dirty water extracted is drained from the tub to the outside by the water draining device. Once the washing cycle has been completed, in case of a laundry washing-drying machine, a drying phase (step 210) may be also preferably performed.

[0163] The method according to the steps above described, advantageously, automatically doses the correct amount Qd of detergent D on the base of the detected/evaluated concentration of the same detergent D.

[0164] Therefore, the user does not have to worry about the type of detergent D with which he fills the drawer 6 and at the same time the method assures that the washing cycle is carried out avoiding the use of overdose of detergent, in particular overdoses of concentrated or super-concentrated detergent.

[0165] Still advantageously, the use of correct amount of detergent avoids any excess of residuals on the laundry after the rinsing phase. This makes it possible to maintain the duration of the rinsing phase at the expected duration.

[0166] In turn, this makes it possible to maintain the water and/or energy consumption during the rinsing phase at the expected values.

[0167] Advantageously, avoiding the use of overdose of detergent makes it possible to save costs for detergent refilling.

[0168] With reference to the flow chart of Figure 8 another embodiment of the washing method of the invention is illustrated.

[0169] Phases and/or steps with the same reference numbers of the first embodiment correspond to phases and/or steps described above for the first embodiment.

[0170] In this embodiment it is assumed that the detergent D may be of two types, namely regular or concentrated.

[0171] In step 130', the first prefixed quantity Q1'd of detergent D introduced into the tub 3 is preferably evaluated as the quantity of detergent D required to wash the predetermined laundry load amount L, assuming that the detergent D is a concentrated detergent. For example, with a medium laundry load amount L (3-4 kg) the first quantity Q1'd of detergent D may be set at 70ml, here again according to the amount of concentrated liquid detergent suggested by the detergent supplier (as illustrated in Table 1).

[0172] The successive evaluation of the detergent concentration (step 160') gives the indication that the detergent D is a regular or a concentrated detergent D (i.e. it has a low or a high concentration). This may preferably be carried out by comparing the values V coming from the sensor 80 with a prefixed level T1' which define two ranges: if $V < T1'$ the detergent is a regular detergent; if $V > T1'$ the detergent is a concentrated detergent.

[0173] The prefixed level T1' is advantageously stored in the control unit 11.

[0174] In step 190', accordingly, the second quantity Q2'd of detergent D is preferably a quantity of detergent that added to the first quantity Q1'd of detergent D already introduced into the tub 3 guarantees the best performance of the detergent D. The second quantity Q2'd of detergent D is preferably a quantity such that the total amount of detergent $Q'd = Q1'd + Q2'd$ introduced into the tub 3 matches the dose suggested by the supplier.

[0175] For example, the second quantity Q2'd of detergent D is set at 50ml so that the total amount of detergent $Q'd = Q1'd + Q2'd = 70 + 50 = 120\text{ml}$ introduced into the tub 3 matches the 120ml of regular detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see again Table 1).

[0176] The second quantity Q2'd of detergent D is therefore advantageously a unique predetermined value.

[0177] With reference to the flow chart of Figure 9 a further embodiment of the washing method of the invention is illustrated.

[0178] This embodiment differs from that previously described with reference to Figure 7 in that the soil level parameter is a parameter which is detected/evaluated during each washing cycle, as indicated with block 123. Preferably, the level soil parameter is evaluated on the base of the desired washing cycle selected by the user. In different more sophisticated embodiments the level soil parameter may be detected by means of a suitable soil sensor.

[0179] Any suitable soil sensor may be used. For example, the soil sensor may be an optical sensor.

[0180] The level soil parameter is advantageously used, further to the predetermined laundry load amount L, for determining the first prefixed quantity Q1d of detergent D which is introduced into the tub 3 in step 130". The same level soil parameter is then advantageously used for determining the second quantity Q2d of detergent D which is introduced into the tub 3 in the adjustment step 190". For example, as illustrated in the following table, the first quantity Q1d of detergent D for a medium load (3-4kg) is selected according to the soil level (normal, very):

Table 3

Detergent liquid type	Soil level	
	Normal	Very
Regular	~ 120ml	~ 180ml
Concentrated	~ 70ml	~ 105ml
Super concentrated	~ 30ml	~ 50ml

[0181] One or more analogous tables are then stored in the memory for different loads (for example a table for high load, i.e. load $L > 4\text{kg}$).

[0182] With reference to the flow chart of Figure 10 a further embodiment of the washing method of the invention is illustrated.

[0183] This embodiment differs from that previously described with reference to Figure 7 in that the water hardness parameter is considered a parameter already stored in the memory of the control unit 11, as indicated with block 101 in dashed line. For example, and preferably, the water hardness may be set by the user at the time of the installation of the machine and its connection to the external water supply line E. More preferably, the water hardness may be measured by means of a suitable water hardness sensor.

[0184] The water hardness parameter is advantageously used, further to the predetermined laundry load amount L, for determining the first prefixed quantity Q1d of detergent D which is introduced into the tub 3 in step 130. The water

hardness parameter is then advantageously used for determining the second quantity Q2d of detergent D which is introduced into the tub 3 in the adjustment step 130. For example, as illustrated in the following table, the first quantity Q1d of detergent D for a medium load (3-4kg) is selected according to the detected water hardness (soft, medium or hard):

Table 4

Detergent liquid type	Water hardness		
	Soft	Medium	Hard
Regular	~90ml	~120ml	~150ml
Concentrated	~50ml	~70ml	~85ml
Super concentrated	~25ml	~30ml	~46ml

[0185] One or more analogous tables are then stored in the memory for different loads (for example a table for high load, i.e. load $L > 4\text{kg}$).

[0186] With reference to the flow chart of Figure 11 a further embodiment of the washing method of the invention is illustrated.

[0187] This embodiment differs from that previously described with reference to Figure 7 in that the water hardness parameter is a parameter which is detected/evaluated during each washing cycle, as indicated with block 125. Preferably, the water hardness may be measured by means of a suitable water hardness sensor opportunely arranged in the water supply unit 5, for example downstream of the supply valve 5a. In a further preferred embodiment, the water hardness may be measured by means of the same concentration sensor 80, in case the concentration sensor 80 is suitable for the purpose.

[0188] With reference to the flow chart of Figure 12 a further preferred embodiment of the washing method of the invention is illustrated.

[0189] This embodiment substantially corresponds to the combination of the methods previously described with reference to Figures 9 and 10. Here, both the soil level parameter (step 123) and the water hardness parameter (step 101) are advantageously used, further to the predetermined laundry load amount L, for determining the first prefixed quantity Q1d of detergent D which is introduced into the tub 3 (step 130^{III}). The same parameters are then advantageously used for determining the second quantity Q2d of detergent D which is introduced into the tub 3 in the adjustment step (step 190^{III}).

[0190] With reference to the flow chart of Figure 13 a further embodiment of the washing method of the invention is illustrated.

[0191] The laundry to be washed is first placed inside the drum 4 (step 100).

[0192] The user fills, or has already previously filled, the compartments of the drawer 6 with the wash products, i.e. detergent D and softener S, needed for a plurality of washing cycles of the laundry, as already explained above.

[0193] By operating on the interface unit 16 the user selects the desired washing program (step 110) depending, for example, on the type and on the soil level of the laundry to wash. Furthermore, as said before, in a preferred embodiment it is possible for the user to insert some parameters directly by the interface unit 16, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of the washing program, etc.

[0194] Once the user has selected the desired washing program, the control unit 11 sets the laundry washing machine 1 so that it may start the washing program. Successively, a first prefixed quantity Q1d of detergent D (step 130^{IV}) and a first prefixed quantity Q1w of water W (step 140) are introduced into the tub 3.

[0195] The first prefixed quantity Q1d of detergent D introduced into the tub 3 may be a minimum quantity of detergent D (for example 20ml).

[0196] The first quantity Q1w of water W is a known prefixed quantity of water, for example 10 litres.

[0197] The first quantity Q1d of detergent D and the first quantity Q1w of water W introduced into the tub 3 in said phases (steps 130^{IV} and 140) fall down on the bottom region 3a of the tub 3 by flowing inside the gap 55 between the tub 3 and the drum 4.

[0198] The mixing circuit 30 is then activated (step 150).

[0199] Activation of the mixing circuit 30 is advantageously carried out through activation of the first recirculation pump 31.

[0200] Activation of the mixing circuit 30 causes the quantity Q1d of detergent D to be properly and homogeneously diluted in the first quantity Q1w of water W. During activation of the mixing circuit 30, advantageously, the concentration sensor 80 is activated for detection of the wash liquid concentration flowing through the second recirculation pipe 33 (step 150).

[0201] Since the first quantity Q1d of detergent D and the first quantity Q1w of water W are known prefixed quantities, the control unit 11 from the values coming from the concentration sensor 80 may evaluate the current type of detergent

D (step 160), i.e. may evaluate the concentration of the detergent D.

[0202] If the first quantity $Q1d$ of detergent D according to its concentration is considered sufficient for washing the predetermined laundry load amount L, namely the first quantity $Q1d$ of detergent D is not below a minimum threshold $Qmin$ (output "Yes" of step 172), the method proceeds with the introduction of a second quantity $Q2w$ of water W (step 180). This means, in fact, that the first prefixed quantity $Q1d$ of detergent D previously introduced into the tub 3 (step 130^{IV}) was the correct required dose.

[0203] The second quantity $Q2w$ of water W is preferably a quantity of water that together with the first quantity $Q1w$ of water W already introduced into the tub 3 fully saturate, or substantially fully saturate, the laundry.

[0204] The second quantity $Q2w$ of water W (step 180), and hence the total amount of water $Qw=Q1w+Q2w$ introduced into the tub 3, is thus preferably determined on the base of the predetermined laundry load amount L.

[0205] For example, with a medium laundry load amount L (3-4 kg) the second quantity $Q2w$ of water W is set at 6 litres so that the total amount of water $Qw=Q1w+Q2w=16$ litres fully saturate, or substantially fully saturate, the laundry.

[0206] If the first quantity $Q1d$ of detergent D according to its concentration is considered not sufficient for washing the predetermined laundry load amount L, namely the first quantity $Q1d$ of detergent D is below a minimum threshold $Qmin$ (output "No" of step 172), the method proceeds with the adjustment of the quantity of detergent D inside the tub 3 (step 190^{IV}) with the introduction of a second quantity $Q2d$ of detergent D into the tub 3.

[0207] This means, in fact, that the first prefixed quantity $Q1d$ of detergent D previously introduced into the tub 3 (step 130) was not the correct required dose.

[0208] The second quantity $Q2d$ of detergent D is preferably a quantity of detergent that added to the first quantity $Q1d$ of detergent D already introduced into the tub 3 guarantees the best performance of the detergent D having the current concentration level as previously detected in step 160.

[0209] In a preferred embodiment of the invention, the second quantity $Q2d$ of detergent D (step 190^{IV}) is a quantity such that the total amount of detergent $Qd=Q1d+Q2d$ introduced into the tub 3 matches the dose suggested by the supplier.

[0210] For example, in case of a medium laundry load amount L, if the current type of detergent D detected in step 160 corresponds to a regular detergent D, then the second quantity $Q2d$ of detergent D is set at 110ml so that the total amount of detergent $Qd=Q1d+Q2d=20+100=120$ ml introduced into the tub 3 matches the 120ml of regular detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see Table 1 above).

[0211] If the current type of detergent D detected in step 160 is a concentrated detergent D, then the second quantity $Q2d$ of detergent D is set at 50ml so that the total amount of detergent $Qd=Q1d+Q2d=20+50=70$ ml introduced into the tub 3 matches the 70ml of concentrated detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see Table 1 above).

[0212] If the current type of detergent D detected in step 160 is a super concentrated detergent D, then the second quantity $Q2d$ of detergent D is set at 10ml so that the total amount of detergent $Qd=Q1d+Q2d=20+10=30$ ml introduced into the tub 3 matches the 30ml of concentrated detergent suggested by the supplier for a medium laundry load amount L (3-4 kg) (see Table 1 above).

[0213] In the preferred embodiment of the invention here described, the evaluation of the detergent concentration (step 160) gives the indication that the detergent D is a regular or a concentrated or a super concentrated detergent D. As said above, this may preferably be carried out by comparing the values V coming from the sensor 80 with two prefixed levels $T1$ and $T2$: if $V<T1$ the detergent is a regular detergent; if $T1\leq V<T2$ the detergent is a concentrated detergent; if $V>T2$ the detergent is a super concentrated detergent.

[0214] Accordingly, the second quantity $Q2d$ of detergent D is selected between three values, for example the choice is between 100ml, 50ml and 10ml (as described above).

[0215] After the introduction of the second quantity $Q2d$ of detergent D, the introduction of the second quantity $Q2w$ of water W is performed (step 180).

[0216] Preferably, after the introduction of the second quantity $Q2w$ of water W the mixing circuit 30 is maintained activated causing the detergent D to be properly and homogeneously diluted in the total quantity $Qw=Q1w+Q2w$ of water W. The washing cycle then continues (step 200) according to the washing cycle selected up to the end of the cycle, as already explained above.

[0217] Once the washing cycle has been completed, in case of a laundry washing-drying machine, a drying phase (step 210) may be also preferably performed.

[0218] The method according to the steps above described, advantageously, automatically doses the correct amount Qd of detergent D on the base of the detected/evaluated concentration of the same detergent D.

[0219] The introduction of the first quantity $Q1d$ in step 130^{IV} is substantially carried out exclusively for detecting its concentration in the following step 160. Therefore, the user does not have to worry about the type of detergent D with which he fills the drawer 6 and at the same time the method assures that the washing cycle is carried out avoiding the use of overdose of detergent, in particular overdoses of concentrated or super-concentrated detergent.

[0220] Still advantageously, the use of correct amount of detergent avoids to take actions on the rinsing phase to

eliminate the excess of detergent residuals trapped into the laundry. This makes it possible to maintain the duration of the rinsing phase at the expected duration.

[0221] In turn, this makes it possible to maintain the water and/or energy consumption during the rinsing phase at the expected values.

[0222] Advantageously, avoiding the use of overdose of detergent makes it possible to save costs for detergent refilling.

[0223] With reference to the flow chart of Figure 14 a further embodiment of the washing method of the invention is illustrated.

[0224] This embodiment differs from the embodiments previously described, among other features, in the way the load amount of the laundry L is evaluated.

[0225] The laundry to be washed is first placed inside the drum 4 (step 100).

[0226] The user fills, or has already previously filled, the compartments of the drawer 6 with the wash products, i.e. detergent D and softener S, needed for a plurality of washing cycles of the laundry, as explained above.

[0227] By operating on the interface unit 16 the user selects the desired washing program (step 110) depending, for example, on the type and on the soil level of the laundry to wash. Furthermore, as said before, in a preferred embodiment it is possible for the user to insert some parameters directly by the interface unit 16, for example the value of the washing temperature, the rotating speed of the drum 4 in the spinning phase, the duration of the washing program, etc.

[0228] Once the user has selected the desired washing program, the control unit 11 sets the laundry washing machine 1 so that it may start the washing program.

[0229] In a further embodiment, the selection of the desired washing program (step 110) may be performed before placing the laundry into the drum 4 (step 100). Successively, a first prefixed quantity Q1d of detergent D (step 130^V) and a first prefixed quantity Q1w of water W (step 140) are introduced into the tub 3.

[0230] The first prefixed quantity Q1d of detergent D introduced into the tub 3 at this stage may be preferably a minimum quantity of detergent, assuming that the detergent D is a super concentrated detergent. For example, the first quantity Q1d of detergent D may be set at 20ml. Such a value is preferably determined according to the amount of super concentrated liquid detergent suggested by the detergent suppliers for a low laundry load amount.

[0231] The first quantity Q1w of water W is a known prefixed quantity of water, for example 10 litres.

[0232] The introduction of the first quantity Q1d of detergent D takes place preferably through the detergent supplier 60: the first quantity Q1d of detergent D, preferably liquid detergent, is conveyed from the respective compartment of the drawer 6 into the flushing chamber 57 by activating the first feeding pump 60a; the first prefixed quantity Q1w of water W is supplied into the tub 3 from the water supply unit 5 by making it flow through the flushing chamber 57 and then through the supply pipe 18 together with the first quantity Q1d of detergent D. The first quantity Q1d of detergent D and the first quantity Q1w of water W introduced into the tub 3 in said phases (steps 130^V and 140) fall down on the bottom region 3a of the tub 3 by flowing inside the gap 55 between the tub 3 and the drum 4, as said above.

[0233] According to the invention, the mixing circuit 30 is then activated (step 150). Activation of the mixing circuit 30 is advantageously carried out through activation of the first recirculation pump 31.

[0234] Activation of the mixing circuit 30 advantageously mixes the detergent D and the water W at the bottom region 3a of the tub 3, more preferably inside the sump 15.

[0235] The mixing action causes the quantity Q1d of detergent D to be properly and homogeneously diluted in the first quantity Q1w of water W.

[0236] During activation of the mixing circuit 30, therefore, a homogeneous liquid mixture of detergent D and water W flows through the second recirculation pipe 33.

[0237] During activation of the mixing circuit 30, advantageously, the concentration sensor 80 is activated for detection of the wash liquid concentration flowing through the second recirculation pipe 33 (step 150).

[0238] Since the first quantity Q1d of detergent D and the first quantity Q1w of water W are known prefixed quantities, the control unit 11 from the values coming from the concentration sensor 80 may evaluate the current type of detergent D (step 160), i.e. may evaluate the concentration of the detergent D. Preferably at this stage it is possible to evaluate if the detergent D is a regular or a concentrated or a super concentrated detergent D.

[0239] The method then proceeds with a wetting phase (step 180") comprising a sequence of partial loads of water into the tub 3. Each partial load provides for loading a corresponding water amount in the washing tub 3 and each water load phase is followed (or partially superimposed) by a water absorption phase. During said partial loads, the level of free water inside the washing tub 3 is measured, preferably through said pressure sensor 19. The free water corresponds to the water inside the gap 55, between the tub 3 and the drum 4, which is not absorbed by the laundry.

[0240] The course of the free water inside the tub 3 and the duration of said water absorption phases give an indication of the water absorption capacity by the laundry and therefore an indication of the type of laundry (for example by comparing the duration of the water absorption phases with experimental data stored in the control unit 11).

[0241] In particular, at the end of the wetting phase (step 180"), the control unit 11 may evaluate (estimate) the laundry load amount L (step 120") in terms of weight (kg).

[0242] During partial loads of the wetting phase (step 180") the total water introduced into the tub 3 is advantageously

calculated. The total water introduced into the tub 3 corresponds to a second quantity Q2w of water W.

[0243] At the end of the wetting phase (step 180"), the laundry is preferably fully saturate, or substantially fully saturate, with water.

[0244] After the wetting phase (step 180") and the laundry load amount L estimation phase (step 120"), the control (step 170") of the detergent concentration previously detected (step 160) is performed.

[0245] If the detected type of detergent D is a super concentrated detergent D (output "Yes" of step 170") and the laundry load amount L is a low laundry load amount L (output "Yes" of step 175), the method proceeds according to the washing cycle selected up to the end of the cycle (step 200).

[0246] This means, in fact, that the first prefixed quantity Q1d of detergent D previously introduced into the tub 3 (step 130) was the correct required dose since it was correctly assumed to be a super concentrated detergent D with a low load L.

[0247] If the laundry load amount L is not a low laundry load amount L (output "No" of step 175), the method proceeds with the adjustment of the quantity of detergent D inside the tub 3 (step 195) with the introduction of a second quantity Q2d of detergent D into the tub 3 taking into account of the laundry load amount L as previously evaluated in step 120".

[0248] The second quantity Q2d of detergent D2 is preferably a quantity of detergent that added to the first quantity Q1d of detergent D already introduced into the tub 3 guarantees the best performance of the super concentrated detergent D for the laundry load amount L as evaluated in step 120".

[0249] The method then proceeds according to the washing cycle selected up to the end of the cycle (step 200).

[0250] If the detected type of detergent D is not a super concentrated detergent D (output "No" of step 170"), the method proceeds with the adjustment of the quantity of detergent D inside the tub 3 (step 190V) with the introduction of a second quantity Q2d of detergent D into the tub 3 taking into account of its concentration as detected in step 160 and also of the laundry load amount L as previously evaluated in step 120".

[0251] This means, in fact, that the first prefixed quantity Q1d of detergent D previously introduced into the tub 3 (step 130) was not the correct required dose since it was incorrectly assumed to be a super concentrated detergent D.

[0252] The second quantity Q2d of detergent D2 is preferably a quantity of detergent that added to the first quantity Q1d of detergent D already introduced into the tub 3 guarantees the best performance of the detergent D having the detected concentration level and for the estimated laundry load amount L.

[0253] In a preferred embodiment of the invention, the second quantity Q2d of detergent D (step 190V) is a quantity such that the total amount of detergent $Q_d = Q_{1d} + Q_{2d}$ introduced into the tub 3 matches the dose suggested by the supplier.

[0254] The method according to the steps above described, advantageously, automatically doses the correct amount of detergent on the base of the detected/evaluated concentration of the same detergent and of the estimated laundry load amount.

[0255] Therefore, the user does not have to worry about the type of detergent D with which he fills the drawer 6 and at the same time the method assures that the washing cycle is carried out avoiding the use of overdose of detergent, in particular overdoses of concentrated or super-concentrated detergent.

[0256] Still advantageously, the use of correct amount of detergent avoid the prolonging of the rinsing phase to eliminate surplus detergent from the laundry. This makes it possible to maintain the duration of the rinsing phase at the expected duration. In turn, this makes it possible to maintain the water and/or energy consumption during the rinsing phase at the expected values.

[0257] Advantageously, avoiding the use of overdose of detergent makes it possible to save costs for detergent refilling.

[0258] It has thus been shown that the present invention allows all the set objects to be achieved. In particular, it makes it possible to provide a method for washing laundry in a laundry washing machine equipped with an automatic dosing device which doses the correct amount of detergent in any single washing cycle according to the concentration of the same detergent.

[0259] It is underlined that the laundry washing machines illustrated in the enclosed figures, and with reference to which some embodiments of the method according to the invention have been described, are of the front-loading type; however it is clear that the method according to the invention can be applied as well to a top-loading washing machine, substantially without any modification.

[0260] 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. A method for washing laundry during a washing cycle in a laundry washing machine (1) comprising:

- a washing drum (4) adapted to receive laundry;
- a washing tub (3) external to said washing drum (4);
- a water supply unit (5) to supply water (W) into said washing tub (3);
- an automatic dosing device (58) to supply detergent (D) into said washing tub (3) comprising a compartment suitable for receiving a quantity of detergent (D) sufficient for a plurality of washing cycles;
- a first recirculation circuit (30) suitable for withdrawing liquid from a bottom region (3a) of said washing tub (3) and for re-admitting such a liquid into said bottom region (3a) of said washing tub (3);
- a concentration sensor device (80) arranged in said first recirculation circuit (30) or at said bottom region (3a) of said washing tub (3);
- a control unit (11) for controlling functioning of said laundry washing machine (1);

wherein the method comprises an initial phase comprising the steps of:

- a) introducing a first prefixed quantity (Q1d; Q1'd) of detergent (D) into said washing tub (3);
- b) introducing a first prefixed quantity (Q1w) of water (W) into said washing tub (3);
- c) activating said first recirculation circuit (30) for mixing said first prefixed quantity (Q1d; Q1'd) of detergent (D) with said first prefixed quantity (Q1w) of water (W) at said bottom region (3a) of said washing tub (3);
- d) providing data from said concentration sensor device (80) to said control unit (11) relating to the concentration of said detergent (D) for determining the current concentration value (V) of said detergent (D);
- e) comparing said current concentration value (V) of said detergent (D) with one or more prefixed concentration levels (T1, T2; T1') stored in said control unit (11) and either introducing a second quantity (Q2d; Q2'd) of detergent (D) or not introducing any quantity of detergent (D) into said washing tub (3) according to the result of said comparison;

wherein said first prefixed quantity (Q1d; Q1'd) of detergent (D) and/or said second quantity (Q2d; Q2'd) of detergent (D) is determined on the base of the amount of laundry load (L).

2. Method according to claim 1, **wherein** said initial phase further comprises a step f) of introducing a second quantity (Q2w) of water (W) into said washing tub (3) for washing said laundry.
3. Method according to claim 2, **wherein** said step f) of introducing a second quantity (Q2w) of water (W) into said washing tub (3) is carried out by means of a sequence of partial loads of water into said washing tub (3).
4. Method according to claim 2 or 3, **wherein** said step f) of introducing a second quantity (Q2w) of water (W) is carried out after said step e).
5. Method according to claim 2 or 3, **wherein** said step f) of introducing a second quantity (Q2w) of water (W) is carried out after said step c) and before said step e) for determining said amount of laundry load (L).
6. Method according to any of the preceding claims, **wherein** said first prefixed quantity (Q1d; Q1'd) of detergent (D) in said step a) is determined assuming that the concentration level of said detergent (D) is comprised in a preselected range of a plurality of concentration ranges defined by said one or more prefixed concentration levels (T1, T2; T1') stored in said control unit (11) and said step e) comprises the step of either introducing a second quantity (Q2d) of detergent (D) into said washing tub (3) if said current concentration value (V) of said detergent (D) falls out of said preselected range or not introducing any quantity of detergent into said washing tub (3) if said current concentration value (V) of said detergent falls within said preselected range.
7. Method according to any of the preceding claims 1 to 5 **wherein** said first prefixed quantity of detergent in said step a) is determined assuming that the concentration level of said detergent (D) has a preselected value and said step e) comprises the step of either introducing a second quantity of detergent (D) into said washing tub (3) if said current concentration value of said detergent is different from of said preselected value or not introducing any quantity of detergent into said washing tub (3) if said current concentration value of said detergent is equal to said preselected value.
8. Method according to any of the preceding claims, **wherein** said one or more prefixed concentration levels (T1, T2; T1') stored in said control unit (11) define respective concentration ranges.
9. Method according to any of the preceding claims 2 to 8, **wherein** said first quantity (Q1w) of water (W) plus said

second quantity (Q2w) of water (W) is a quantity of water required to fully saturate, or substantially fully saturate, said laundry.

- 5 10. Method according to any of the preceding claims, **wherein** said amount of laundry load (L) is determined by detecting and/or estimating the amount of laundry load (L) in said laundry drum (4), preferably by evaluating working parameters of said laundry washing machine (1).
- 10 11. Method according to claim 10, **wherein** said step of evaluating working parameters of said laundry washing machine (1) comprises the step of detecting the weight of the load by means of a weight sensor associated to said laundry drum (4).
- 15 12. Method according to claim 11, **wherein** said step of evaluating working parameters of said laundry washing machine comprises the step of measuring the electrical and/or mechanical parameters of an electric drum motor, said step of measuring the electrical and/or mechanical parameters of an electric drum motor preferably comprising the step of measuring the electric current and/or the induced voltage and/or the torque of said electric drum.
- 20 13. Method according to any of the preceding claims, **wherein** said first prefixed quantity (Q1d; Q1'd) of detergent (D) and/or said second quantity (Q2d; Q2'd) of detergent (D) is determined on the base of the water hardness level.
- 25 14. Method according to claim 12, **wherein** said water hardness level is a parameter set by a user at the beginning of said washing cycle or at the time of installation of said laundry washing machine.
- 30 15. Method according to claim 14, **wherein** said water hardness level is a parameter determined by means of a water hardness sensor of said laundry washing machine.
- 35 16. Method according to any of the preceding claims, **wherein** said first prefixed quantity (Q1d; Q1'd) of detergent (D) and/or said second quantity (Q2d; Q2'd) of detergent (D) is determined on the base of the laundry soil level.
- 40 17. Method according to claim 16, **wherein** said laundry soil level is determined on the base of the washing cycle selected set by a user.
- 45 18. Method according to claim 16, **wherein** said laundry soil level is determined on the base of a soil sensor associated to said washing laundry machine.
- 50 19. Method according to any of the preceding claims, **wherein** it comprises a further step, after said initial phase, of withdrawing liquid from a bottom region (3a) of said washing tub (3) and re-admitting such a liquid into said washing drum (4) in order to enhances absorption of said liquid by said laundry.
- 55 20. Method according to claim 19, **wherein** said further step of introducing liquid into said washing drum (4) is carried out by means of a second recirculation circuit (20) suitable for withdrawing liquid from the bottom region (3a) of said washing tub (3) and for re-admitting such a liquid into an upper region (3b) of said washing tub (3).
21. Method according to any of the preceding claims, **wherein** after said initial phase the method comprises at least a step of washing said laundry by rotating said washing drum (4) during which the laundry is subjected to a mechanical action and at least a step of draining dirty liquid from said washing tub (3) to the outside.
22. Method according to claim 21, **wherein** said step of washing said laundry further comprises a step of heating the liquid which wets the laundry
23. Method according to any of the preceding claims, **wherein** said laundry washing machine (1) additionally comprises a water softening device and wherein the method further comprises a step of conveying water through said water softening device before it is supplied into said washing tub (3).
24. A laundry washing machine (1) suited to implement a method according to any of the preceding claims.

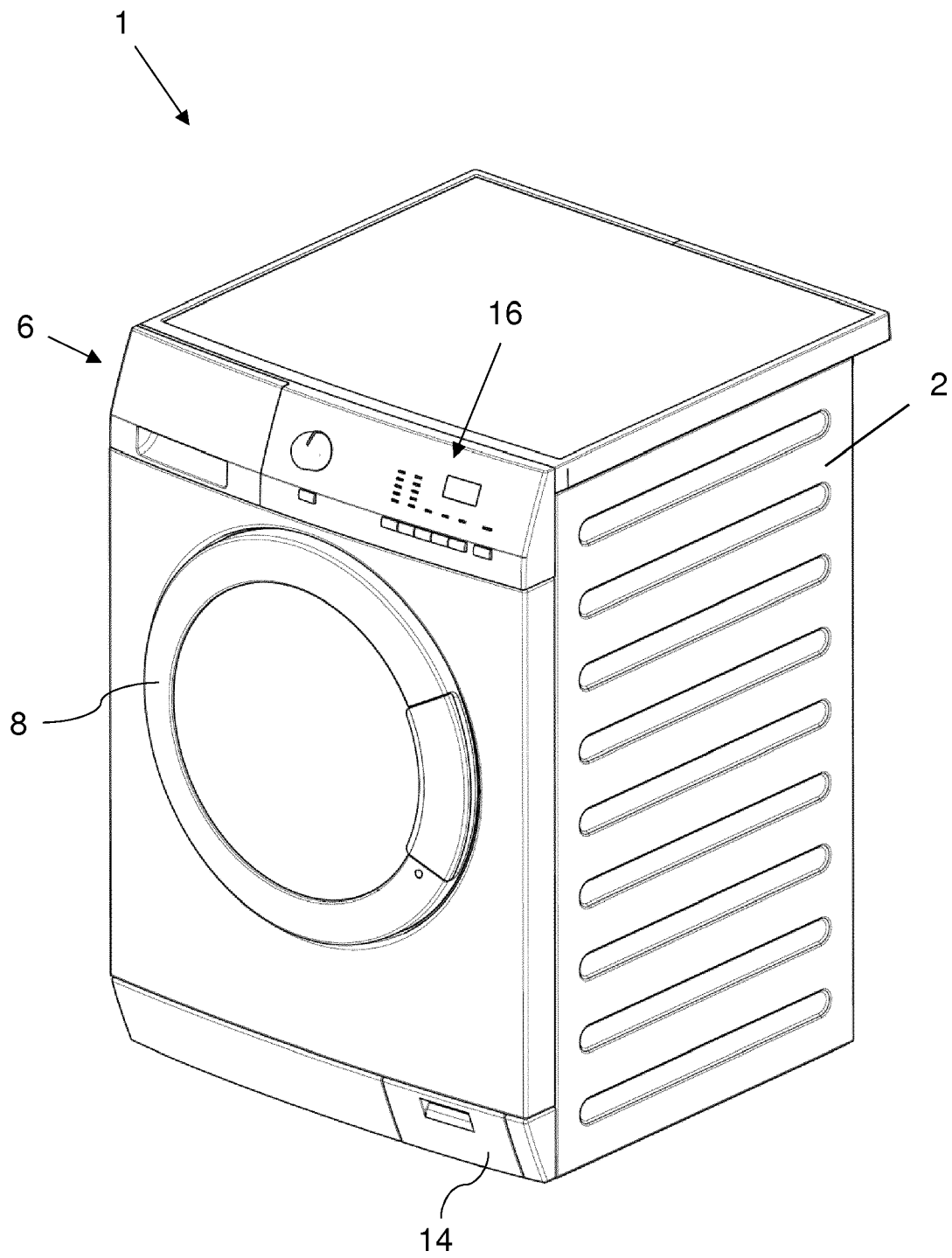


FIG. 1

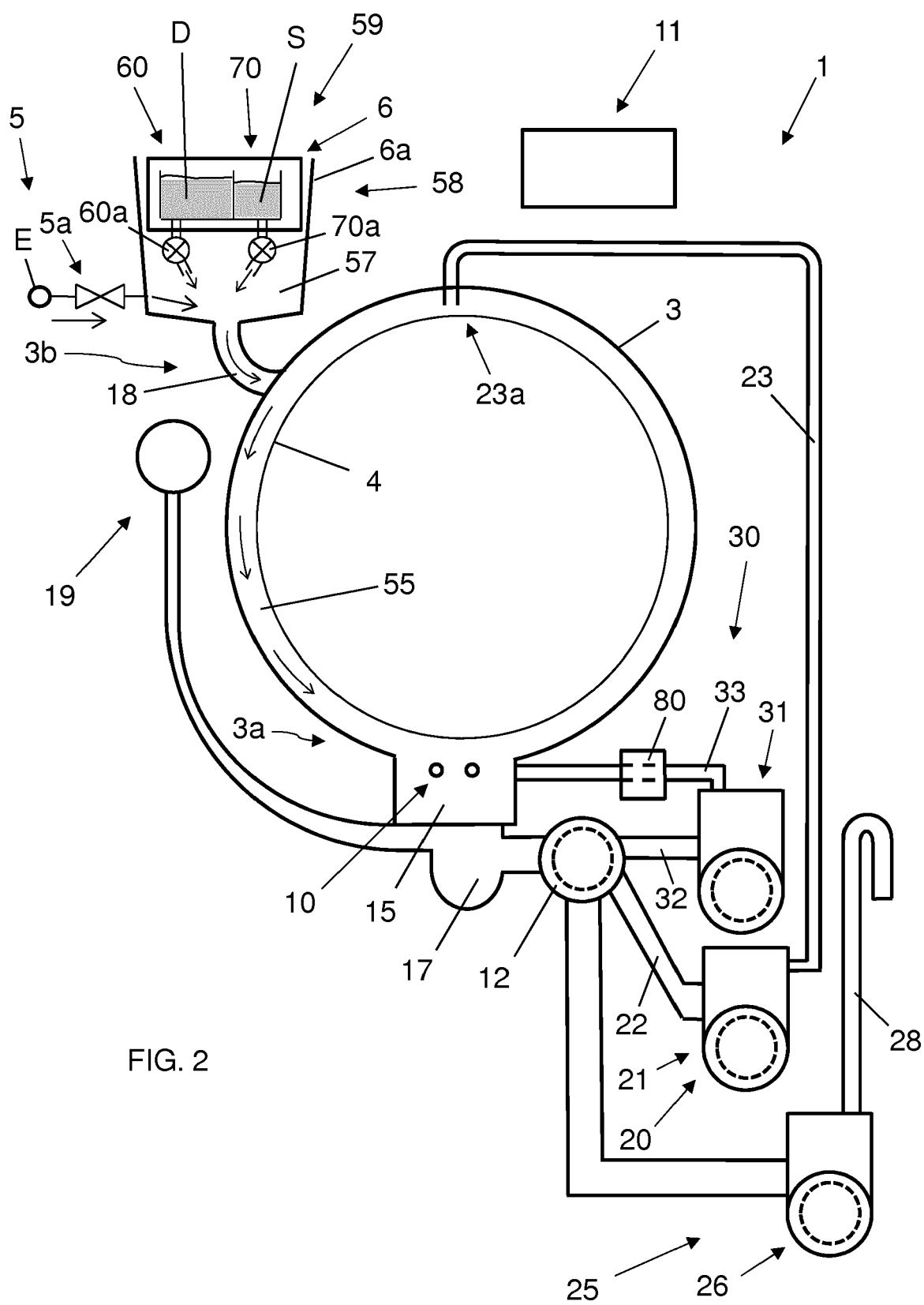


FIG. 2

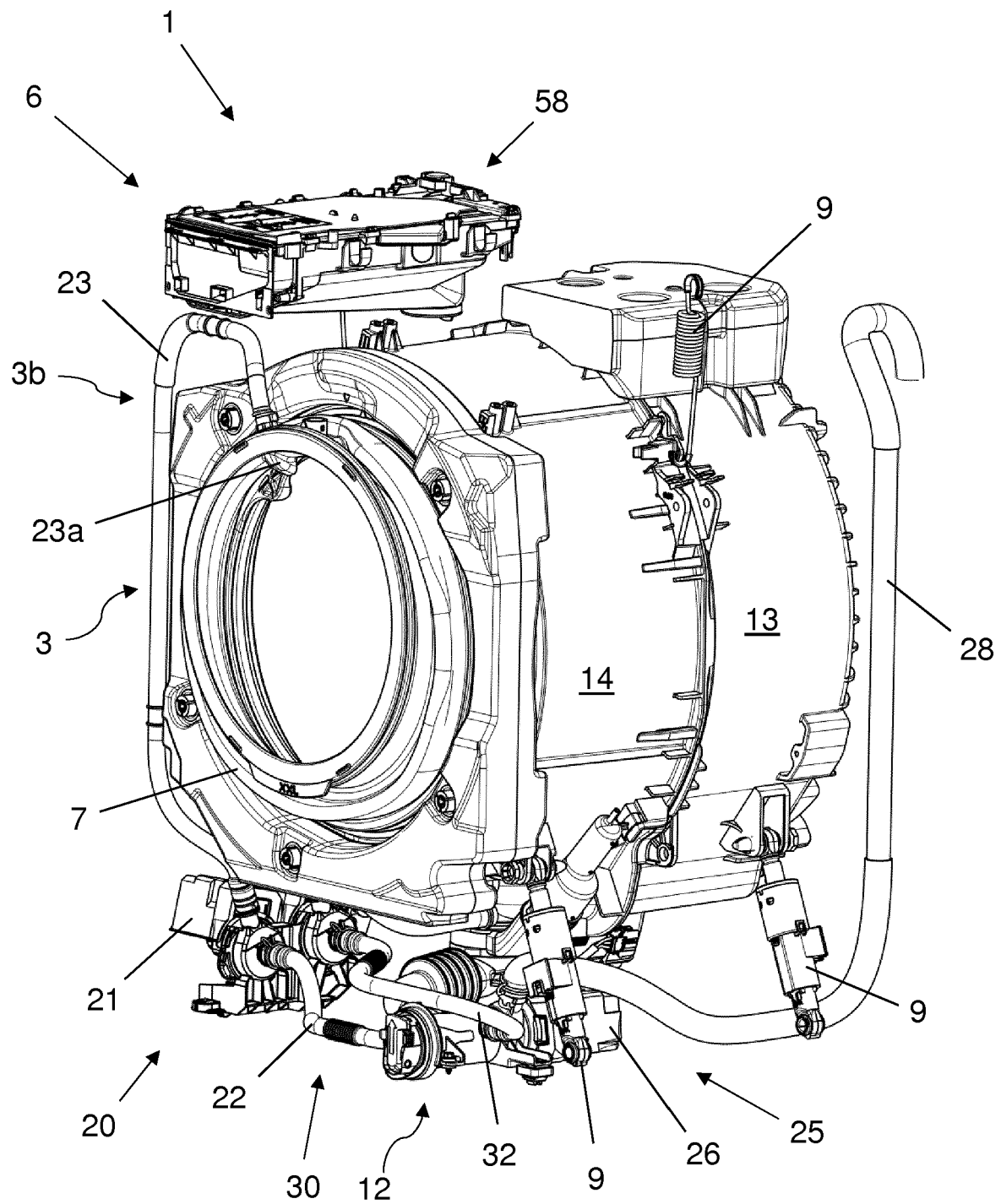


FIG. 3

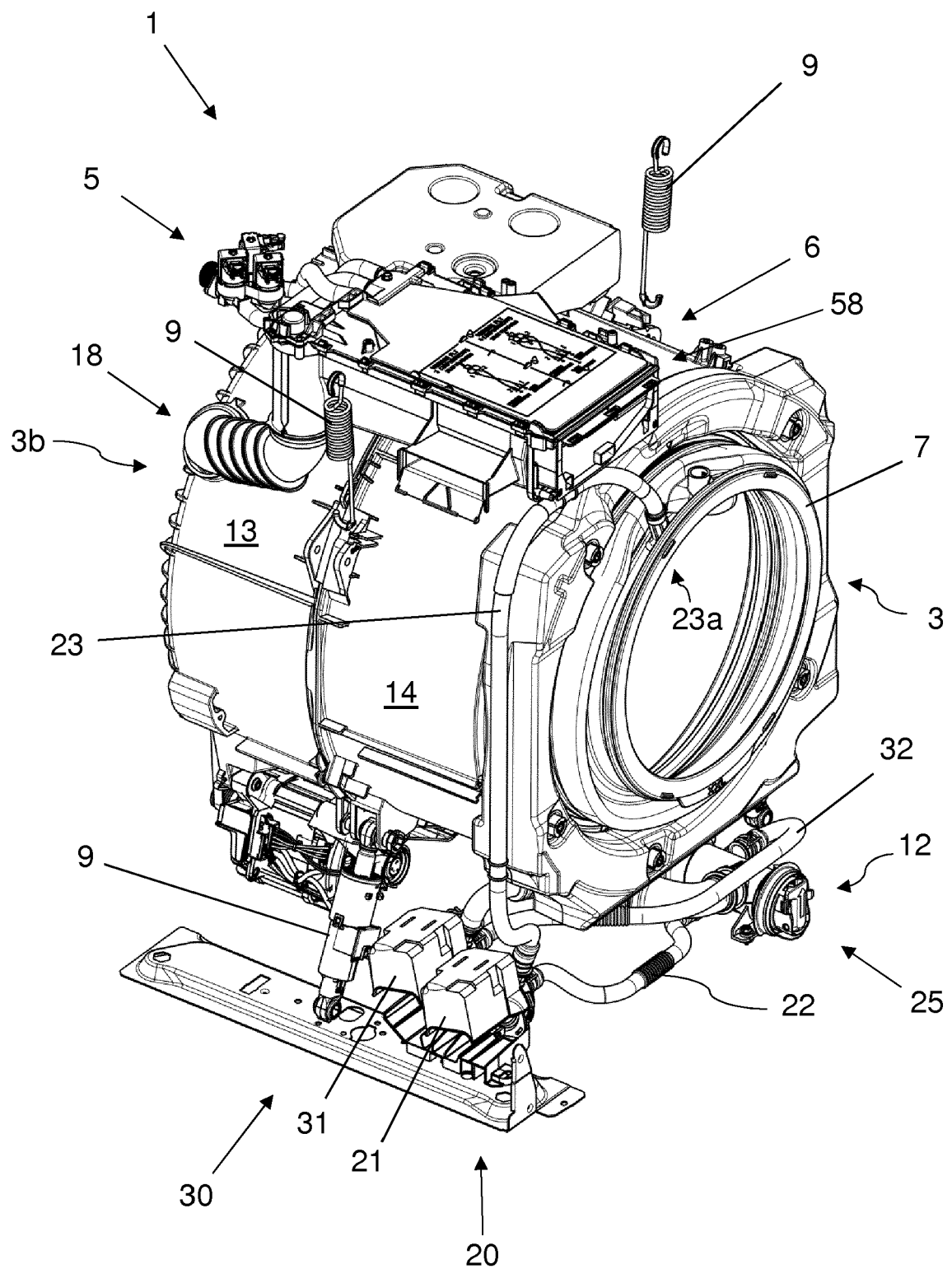
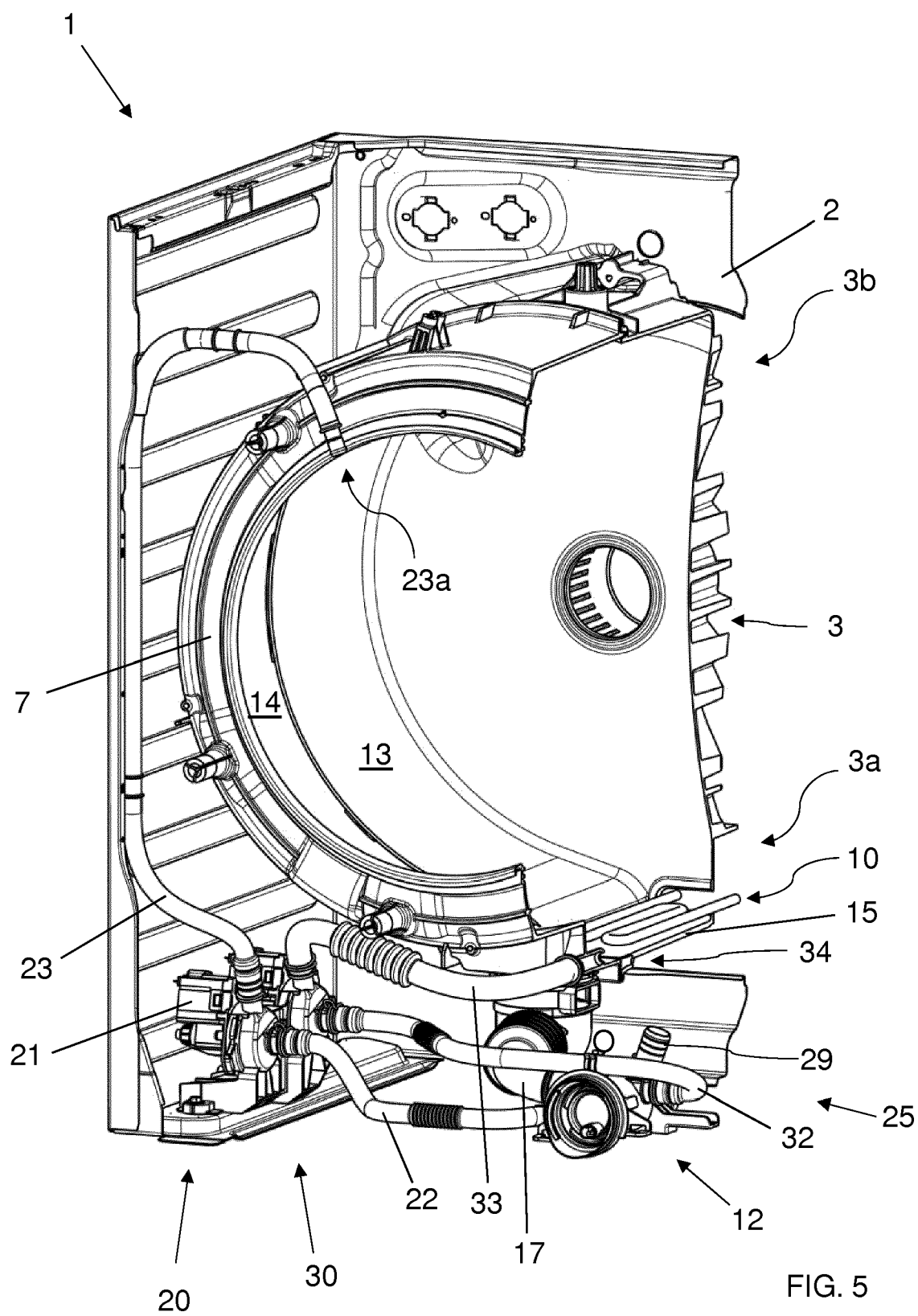
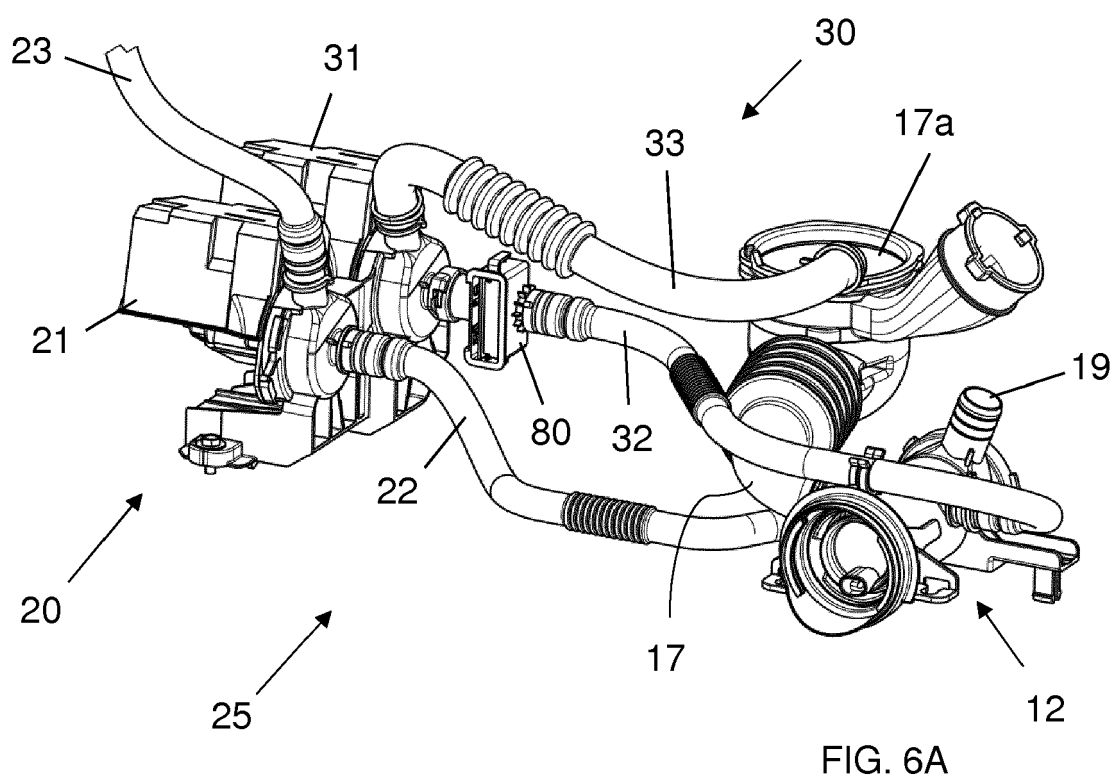
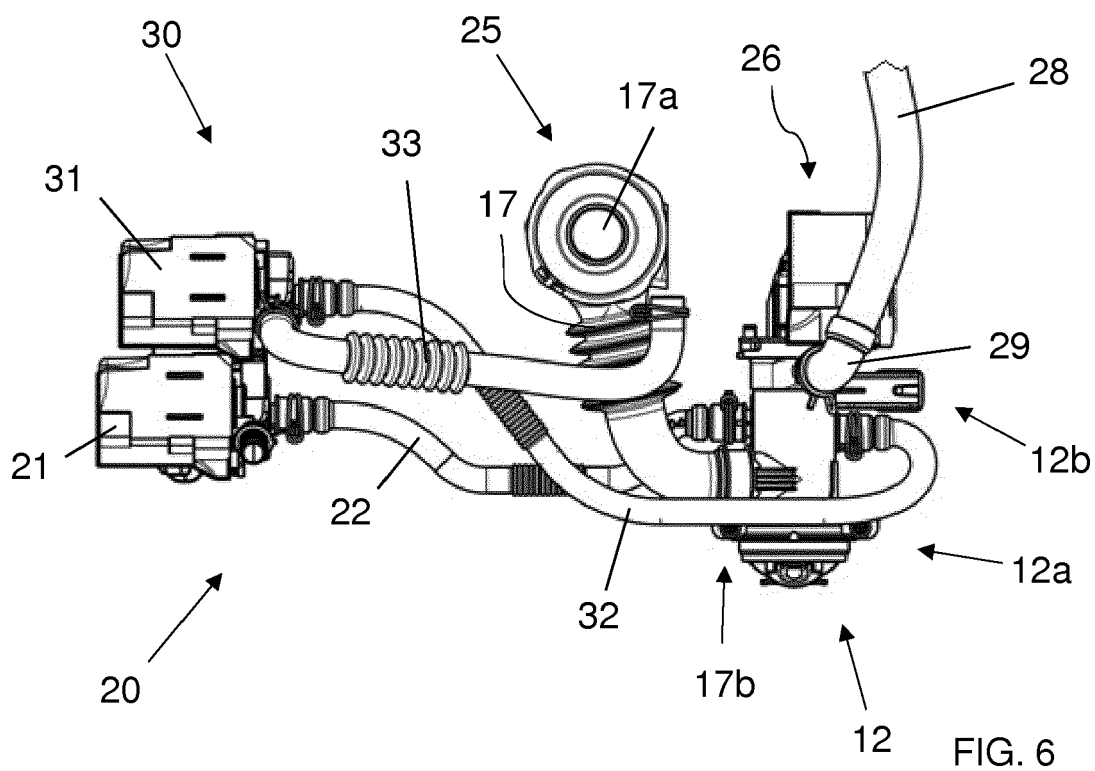


FIG. 4





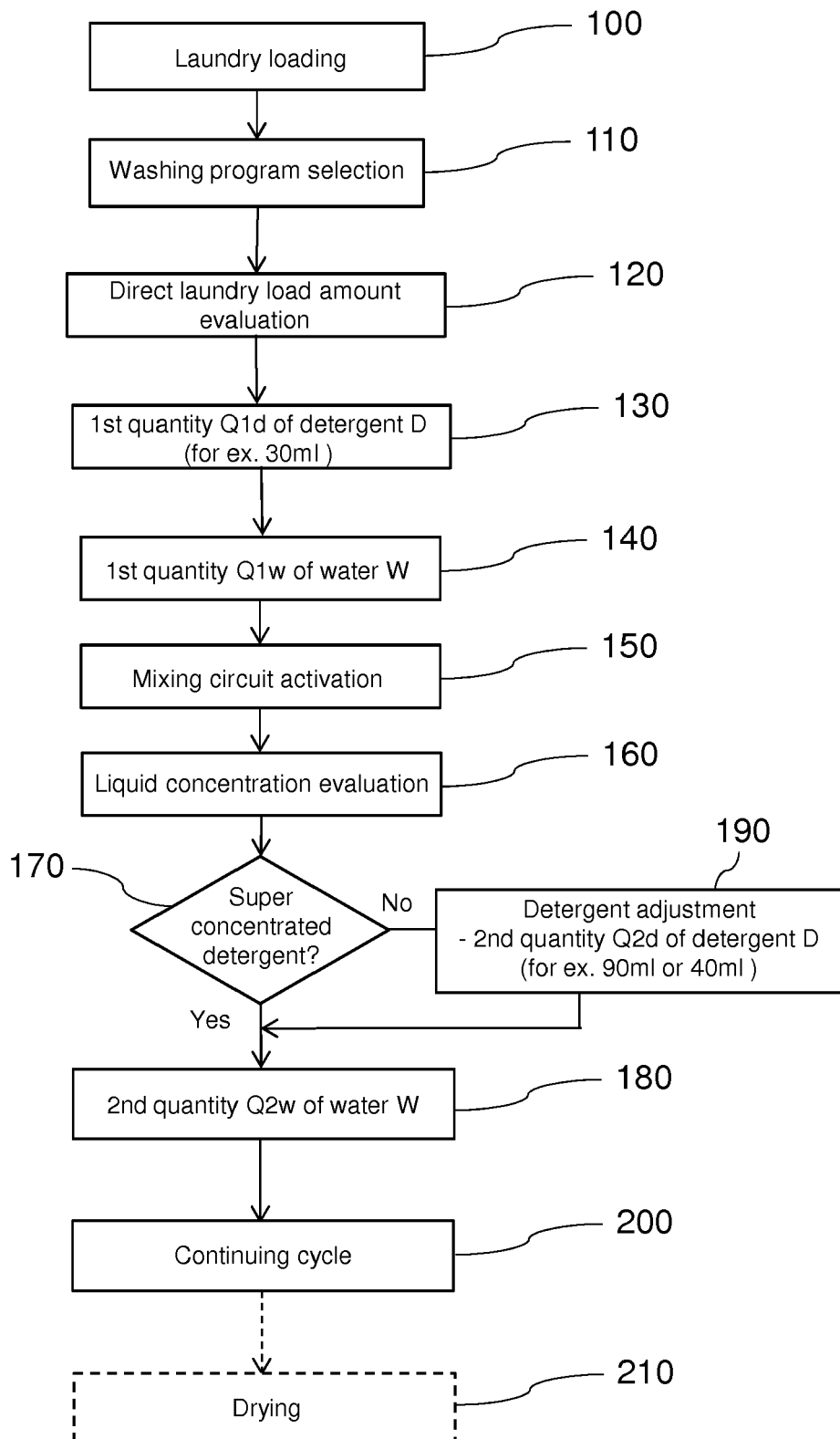


FIG. 7

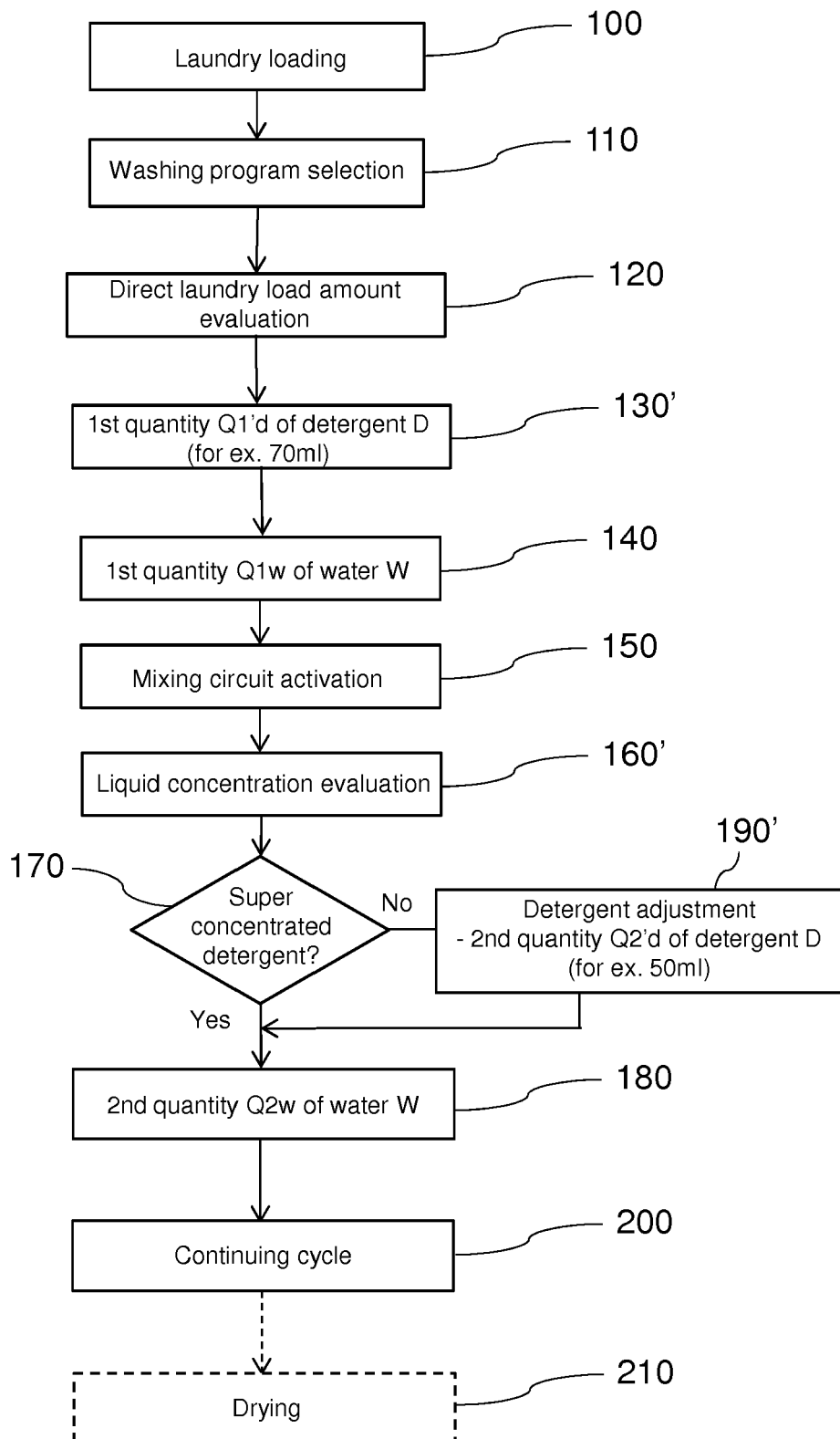


FIG. 8

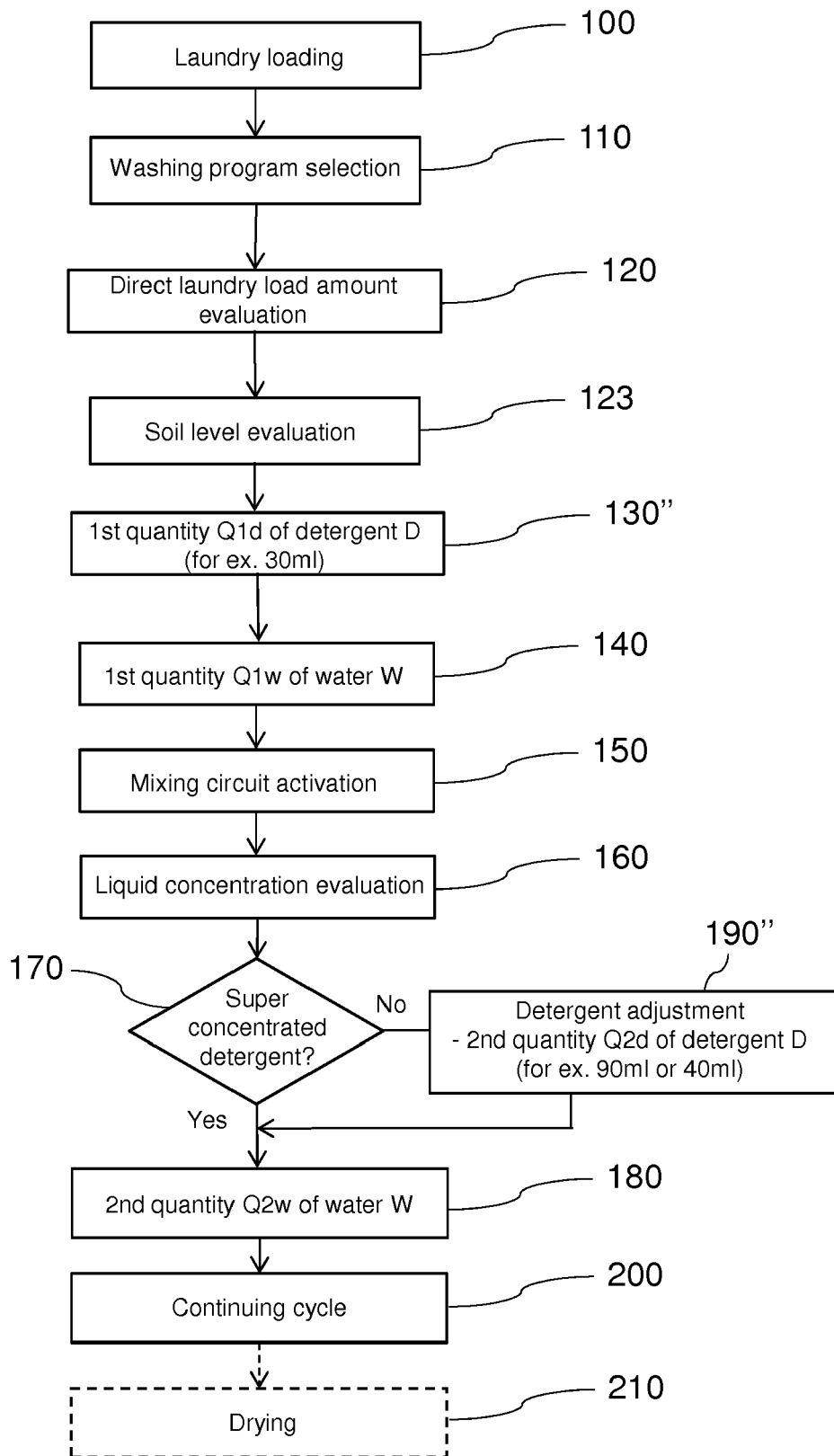


FIG. 9

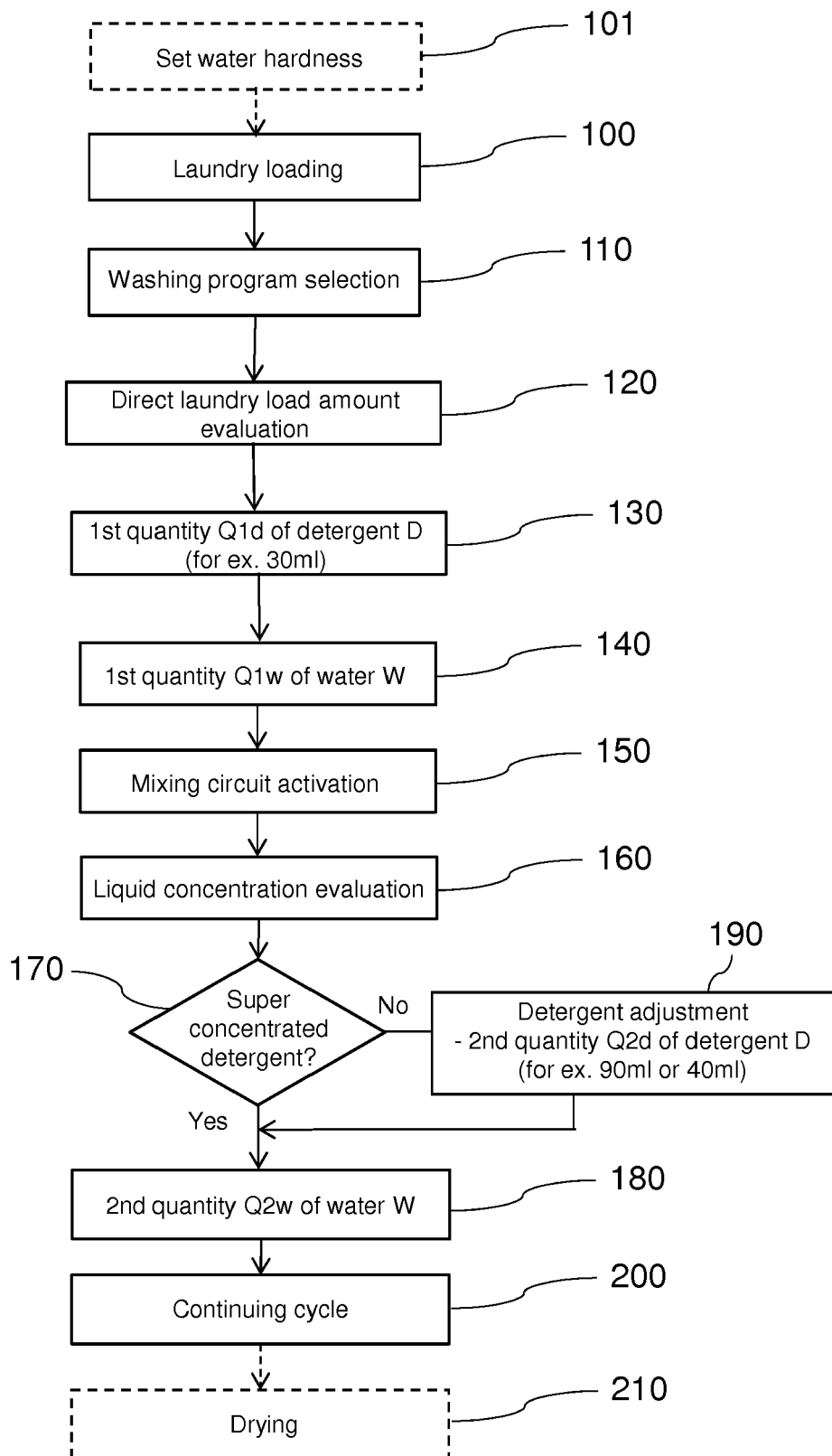


FIG. 10

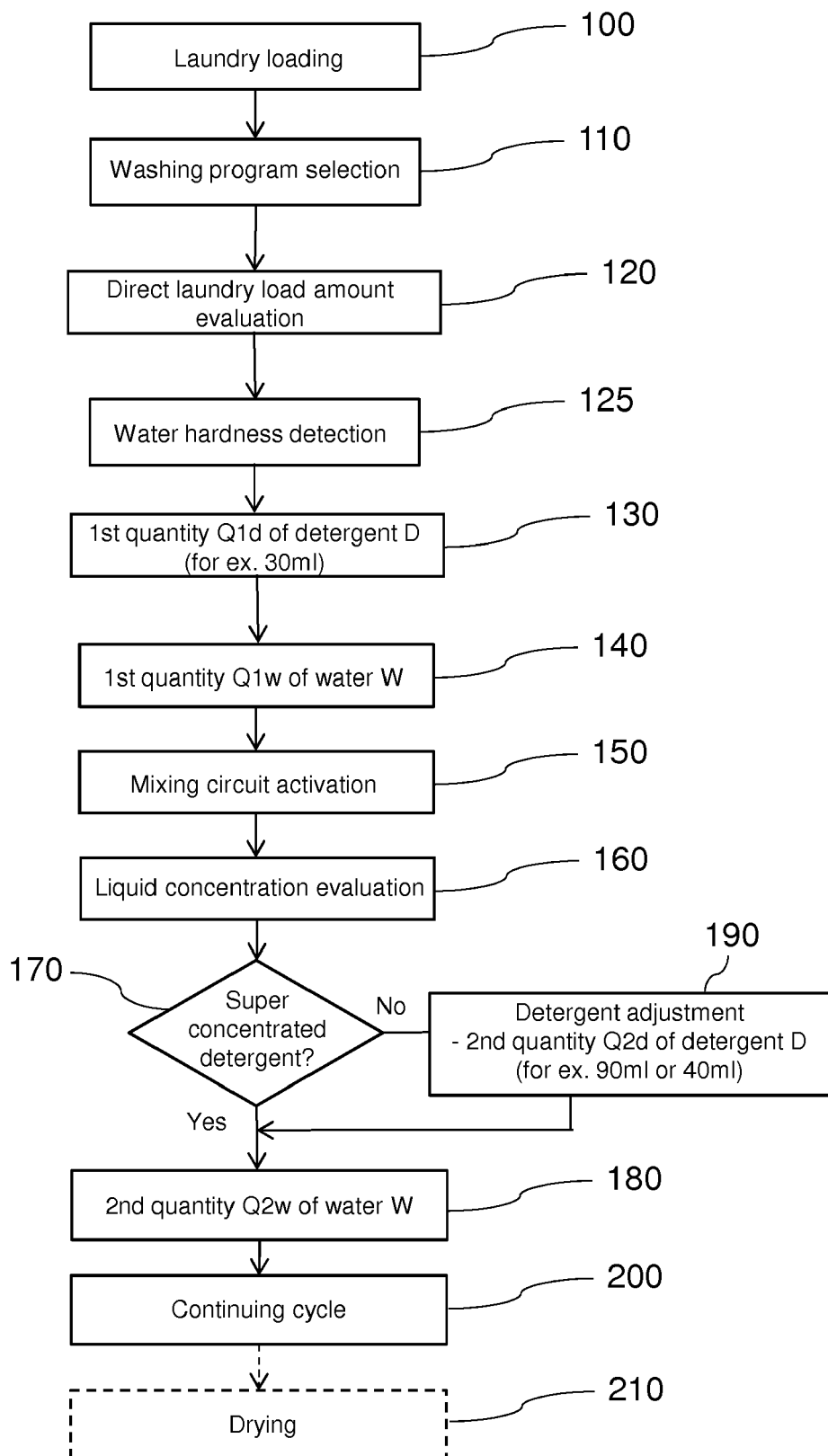


FIG. 11

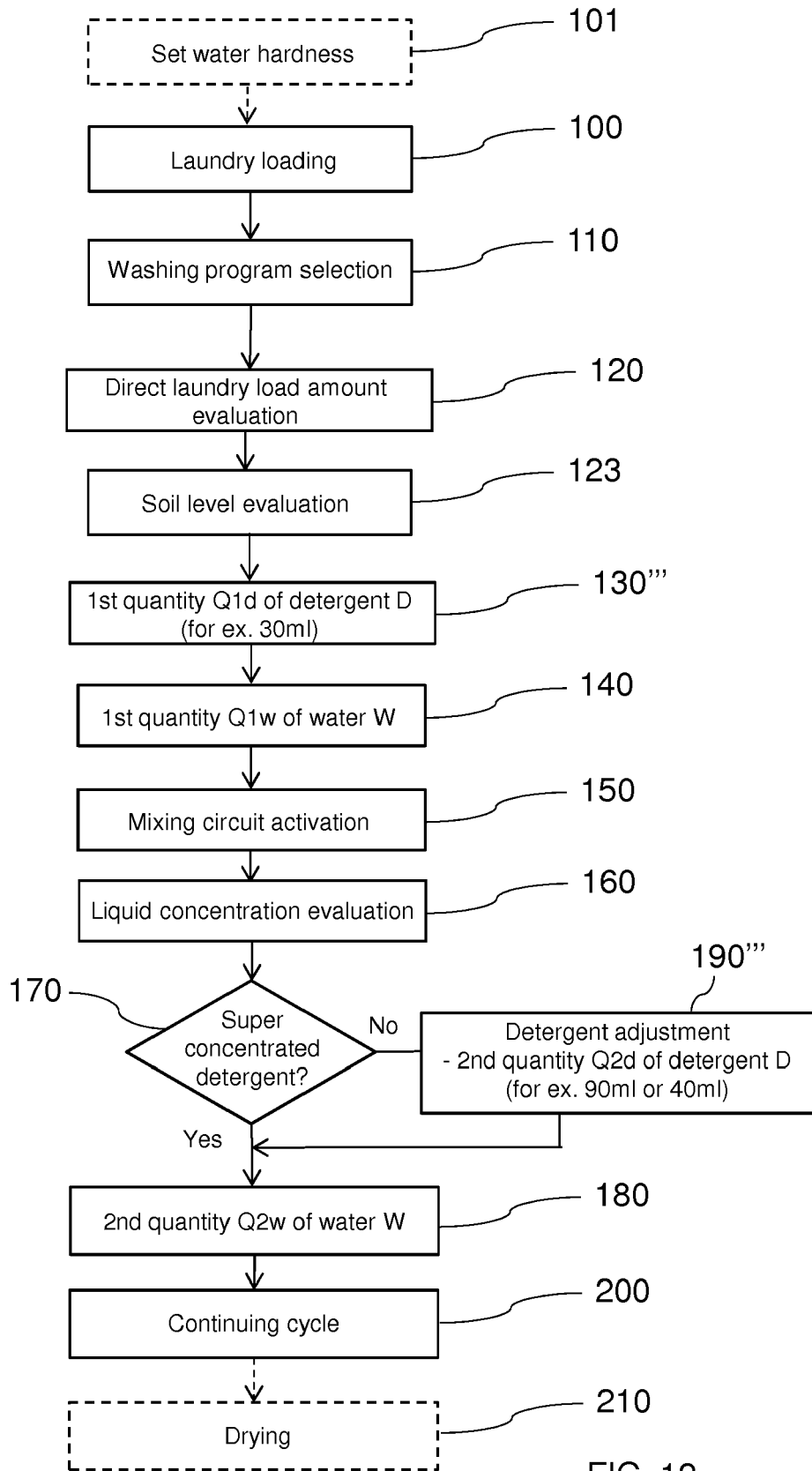


FIG. 12

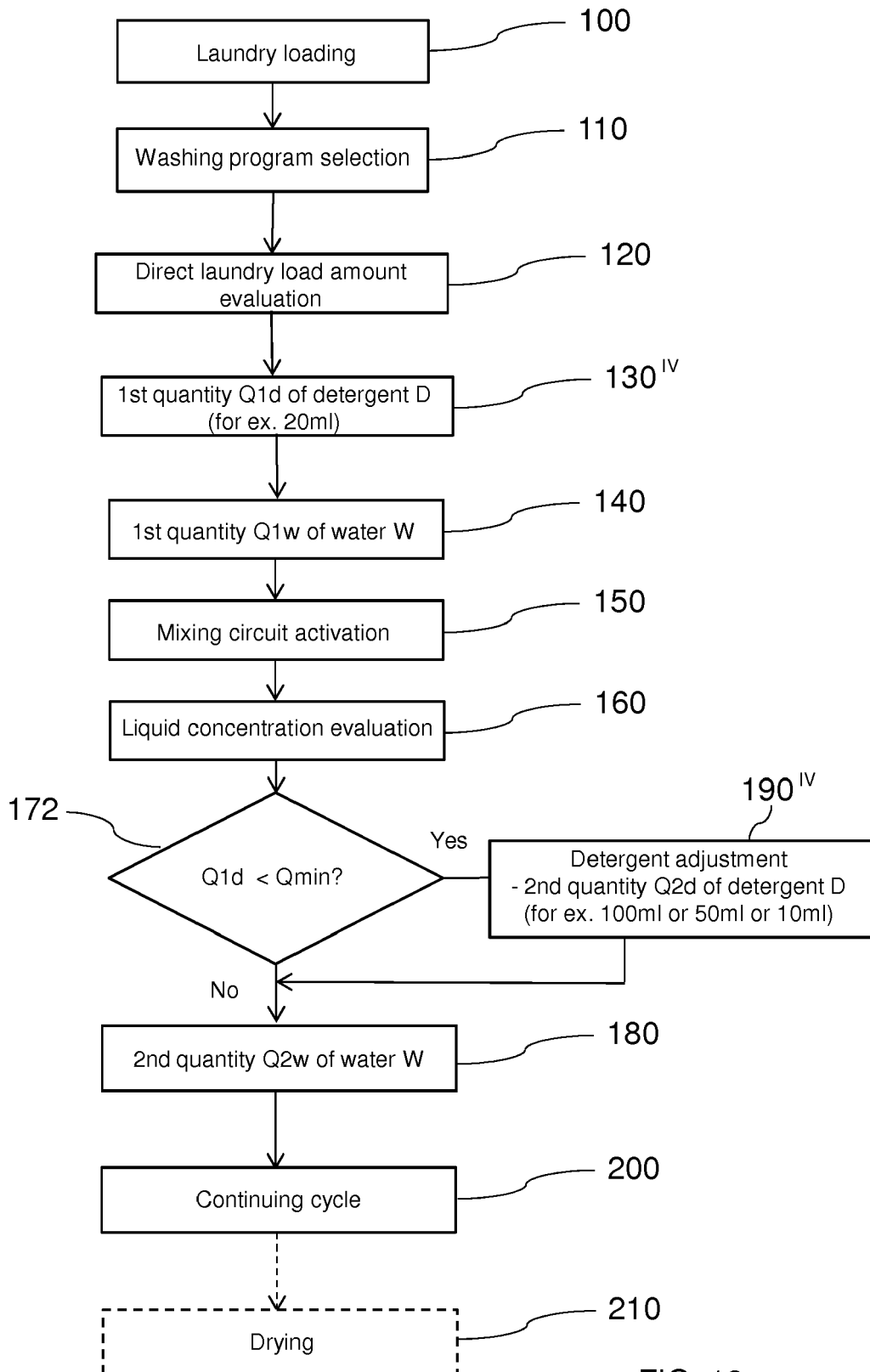


FIG. 13

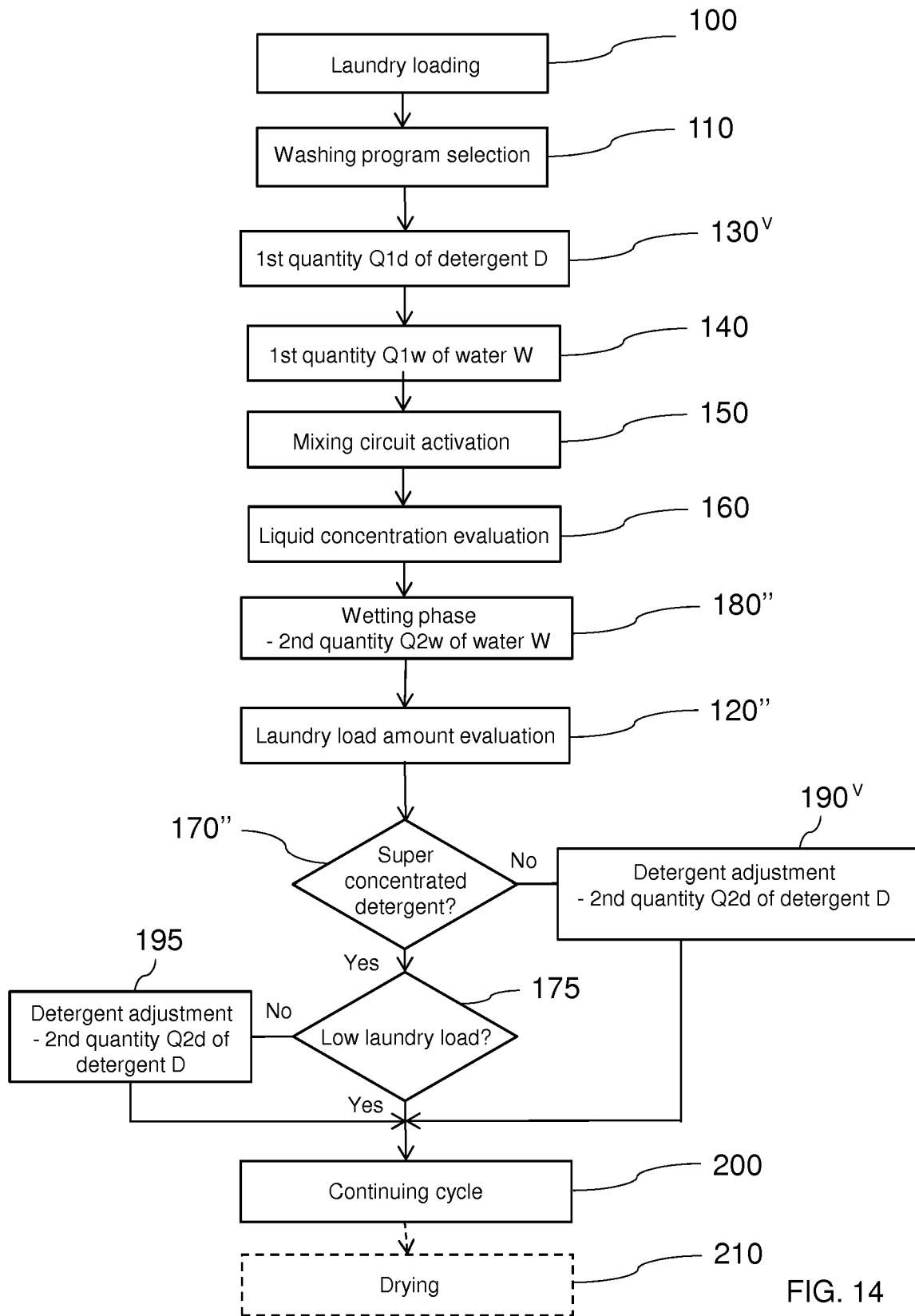


FIG. 14



EUROPEAN SEARCH REPORT

Application Number
EP 18 20 8333

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/000573 A1 (HENDRICKSON MICHAEL STEPHEN [US] ET AL) 7 January 2010 (2010-01-07) * paragraphs [0023], [0026], [0029], [0033], [0035]; figures *	1-4, 10-12, 21,22,24	INV. D06F33/02 D06F39/00 D06F39/08 D06F39/02
A	US 2012/266387 A1 (POLLETT JAMES QUENTIN [US] ET AL) 25 October 2012 (2012-10-25) * paragraphs [0030], [0030] - [0034]; claim 1; figures *	1-24	
A	EP 1 878 826 A1 (BRANDT IND [FR] FAGORBRANDT SAS [FR]) 16 January 2008 (2008-01-16) * paragraphs [0078] - [0090] *	1-24	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 March 2019	Examiner Stroppa, Giovanni
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