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(54) **Laundry washing-drying machine and washing-drying cycle**

(57) The present invention relates to a laundry washing-drying machine comprising: a washing tub containing a rotatable drum adapted to receive laundry; a water supply circuit to supply water into said washing tub; a washing product supplier to supply a washing products into said washing tub; a drain circuit provided with a drain pump which activation causes liquid to be drained from said washing tub; and a control unit configured for making said laundry washing-drying machine to perform a washing-drying cycle. Such a washing-drying cycle comprises the following phases: a) a wetting phase in which clean water and washing detergent are admitted into said washing tub; b) a main washing phase during which said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum; c) a first drain phase in which said drain pump is activated for draining liquid from said washing tub; d) a rinsing phase comprising two or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum, and then said drain pump is activated for draining rinse water from said washing tub, e) a final spin phase during which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and said drain pump is activated for draining liquid from said washing tub; f) a hot-air drying phase during which hot air is circulated into said rotatable drum so that it passes through the laundry, removing moisture from the latter. Between the end of the main washing phase b) and the second of the two or more rinsing cycles of the rinsing phase d), the speed of the drum is kept below the threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum.

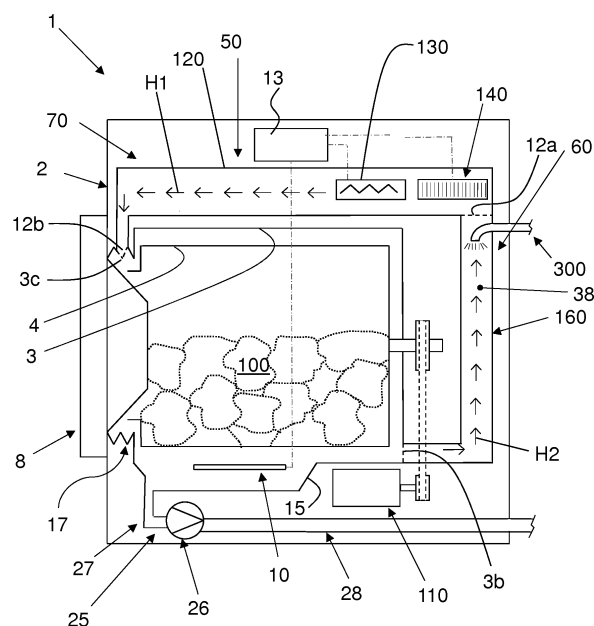


FIG. 5

Description

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

[0002] In particular, the present invention refers to a laundry washing-drying machine capable of performing a more efficient control of the zeolite particles deposited onto the washed-dried laundry during a washing-drying cycle.

BACKGROUND ART

[0003] Nowadays the use of laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry) is widespread.

[0004] Laundry washing-drying machines generally comprise an external casing provided with a washing tub which contains a rotatable perforated drum where the laundry is placed.

[0005] A loading/unloading door ensures access to the drum.

[0006] Laundry washing-drying machines typically comprise a water inlet circuit and a products supply unit for the introduction of water and washing/rinsing products (i.e. detergent, softener, etc.) into the tub.

[0007] Known laundry washing-drying machines are also provided with water draining devices comprising a drain pump that may operate both during the initial phases of the washing program and at the end of the same to drain the dirty water.

[0008] According to the known technique, a complete washing-drying program typically includes different phases during which the laundry to be washed-dried is subjected to adequate treatments.

[0009] A washing-drying cycle usually comprises a wetting phase, a main washing phase, a rinsing phase, a final spin phase, and a hot-air drying phase.

[0010] In the wetting phase clean water and washing detergent are admitted into the washing tub, in such a way to wet the laundry contained therein.

[0011] The wetting phase is followed by a main washing phase during which the drum is rotated at relatively low speed (typically 40-50 rpm); during the wetting phase and/or during the main washing phase the liquid contained in the tub is typically heated to a predetermined temperature based on the washing program selected by the user. As mentioned above, during the main washing phase the drum is rotated at a relatively low speed, so as to apply a mechanical cleaning action to the laundry. At the end of the main washing phase the drum is typically rotated at a quite high rotation speed (typically comprised between 300 - 1100 rpm), in such a way that dirty washing liquid (i.e. water mixed with detergent) is extracted from the laundry, and this dirty washing liquid is drained by the water draining devices.

[0012] This phase is followed by a rinsing phase which usually comprises one or more rinsing cycles. In the rinsing cycle, clean rinse water is first added to the laundry,

the drum is rotated at low speed (typically 40-50 rpm), so that water is absorbed by the laundry, and then the drum is subjected to a spin at a quite high speed (typically comprises between 300-1100 rpm), so as to extract from the laundry water, detergent and possible dirty particles not previously removed: contemporaneously or after this spin, the dirty water extracted from the laundry is drained from the tub to the outside by the water draining devices. At the end of each rinsing cycle, therefore, a spin phase is conducted to squeeze the laundry and improve water extraction. The spin of the last rinsing cycle is performed at a speed higher (typically comprised between 800-1800 rpm) than the previous ones, so as to extract from the laundry as much water as possible; the last spin is therefore the final spin phase of the washing-drying cycle.

[0013] After the final spin phase, before removing the laundry from the washing drum, a hot-air drying phase is performed, during which hot air (heated by an electric heater or a heat pump system for example between 70°C and 100°C), is circulated into the washing drum, so that it passes through the laundry, removing moisture from the latter. During this phase the drum is typically rotated at low speed (e.g. 40-50 rpm), so as to favour the contact of hot air with all the laundry contained in the drum.

[0014] This known technique has however a problem; nowadays many detergents contain zeolite particles that are used in order to reduce the water hardness during the washing cycle; these particles have also the property of absorbing a great amount of water at room-temperature; spinning the laundry at a speed higher than around 300 rpm causes such zeolite particles, containing water absorbed during the previous phases, to deeply penetrate into the laundry weave, so that they can't be removed together with water by the water draining devices. During the hot-air drying phase zeolite particles, touched by hot air, releases water and in the end, also due to the slow movements of the drum which tumble the laundry, they come out from the laundry, appearing as an unpleasant white powder on the laundry when the latter is extracted from the machine; in addition these zeolite particles can obstruct one or more of the components of the hot air circuit (for example the evaporator typically present in the latter)

[0015] The presence of zeolite particles containing water into the laundry during hot-air phase causes also the drawback of worsening the performances of the hot-air phase, since an additional amount of water has to be extracted from the laundry.

[0016] Therefore the object of the invention is providing a laundry washing-drying machine provided with a washing-drying cycle which guarantees that the laundry is clean (and in particular not dirtied by any white powder due to the presence of zeolite particles) at the end of the washing-drying cycle.

[0017] It is another object of the invention to provide a laundry washing-drying machine provided with a washing-drying cycle having a high efficiency even while using a detergent containing zeolite particles, without worsen-

ing the washing performances.

DISCLOSURE OF INVENTION

[0018] The applicant has found that by keeping, between the end of a main washing phase and the second of two or more rinsing cycles of a rinsing phase of a washing-drying cycle, the speed of the rotatable drum of a washing drying machine below a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, zeolite particles contained in the detergent do not deeply penetrate into the laundry weave, so that they can be easily removed together with water by the water draining devices of the machine, and they do not appear as an unpleasant white powder on the laundry when the latter is extracted from the machine after the end of the washing-drying cycle.

[0019] Advantageously, if a certain amount of additional water is added during a first rinsing phase without activating any spinning phases, the risk of later formation of an excessive amount of zeolite powder particles deposited onto the laundry in the washing tub due to a later on activated spinning phase in a washing-drying cycle is still more reduced.

[0020] In compliance with the above aims, according to the present invention there is provided a laundry washing-drying machine as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0021] Such a laundry washing-drying machine of the present invention is of the type comprising:

- a washing tub containing a rotatable drum adapted to receive laundry;
- a water supply circuit to supply water into said washing tub;
- a washing product supplier to supply a washing products into said washing tub;
- a drain circuit provided with a drain pump which activation causes liquid to be drained from said washing tub; and
- a control unit configured for making said laundry washing-drying machine to perform a washing-drying cycle.

[0022] Such a washing-drying cycle comprises the following phases:

- a) a wetting phase in which clean water and washing detergent are admitted into said washing tub;
- b) a main washing phase during which said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum;

c) a first drain phase in which said drain pump is activated for draining liquid from said washing tub;

d) a rinsing phase comprising two or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum, and then said drain pump is activated for draining rinse water from said washing tub,

e) a final spin phase during which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and said drain pump is activated for draining liquid from said washing tub;

f) a hot-air drying phase during which hot air is circulated into said rotatable drum so that it passes through the laundry, removing moisture from the latter.

[0023] Furthermore, in such a washing-drying cycle between the end of said a main washing phase b) and the second of said two or more rinsing cycles of said rinsing phase d), the speed of said rotatable drum is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum.

[0024] In this way, since the speed of the rotatable drum is kept below said threshold speed value between the end of the main washing phase b) and the second of said two or more rinsing cycles of the rinsing phase d), a preliminary spin phase is not present in such a portion of the laundry washing-drying cycle. It is underlined that in the first rinsing cycle of the rinsing phase the presence of zeolite particles in the water within the tub is still high, and therefore if a spin phase were performed in this part of the rinsing phase the risk that zeolite particles deeply penetrate into the laundry, so that they can't be removed in a further rinsing cycle, would be very high; keeping the speed of the drum below threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum in the first rinsing cycle of the rinsing phase ensures that the zeolite particle do not deeply penetrate into the laundry and so that these zeolite particles can be easily removed from the laundry together with the rinsing water.

[0025] Furthermore and preferably, in one embodiment of the present invention, said control unit is configured for making said laundry washing-drying machine to perform also a standard washing cycle comprising:

a1) a standard wetting phase in which clean water and washing detergent are admitted into said washing tub;

b1) a standard main washing phase during which said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum;

c1) a first standard drain phase in which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and in which said drain pump is activated for draining liquid from said washing tub;

d1) a standard rinsing phase comprising one or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum, said drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and said drain pump is activated for draining rinse water from said washing tub,

wherein the amount of clean rinse water added to the laundry during the first of said two or more rinsing cycles of said rinsing phase d) of said washing-drying cycle is higher than the amount of clean rinse water added to the laundry during said one or more rinsing cycles of said standard rinsing phase d1) of said standard washing cycle.

[0026] In this way the laundry washing-drying machine of the present invention, in addition to be allowed to perform a washing-drying cycle as disclosed above with no preliminary spinning phase between the end of the main washing phase b) and the second of said two or more rinsing cycles of the rinsing phase d), is also allowed to perform a standard washing-drying cycle, wherein a first spin phase occurs during a first standard drain phase c1).

[0027] Furthermore, by adding more clean rinse water during the first of said two or more rinsing cycles of said rinsing phase d) of said washing-drying cycle rather than during said one or more rinsing cycles of said standard rinsing phase d1), it is possible to compensate the absence of the spin phase in the first rinsing cycle of the washing-drying cycle; in fact the lower squeezing of the laundry (and therefore the lower extraction from the latter of water mixed with dirt particles and detergent), can be compensated by adding more clean water in this rinsing cycle, since more clean water increases the dilution of the dirt particles and detergent, with the effect of reducing the concentration of such dirt particles and detergent into the laundry.

[0028] In another advantageous embodiment of the present invention, said control unit is configured for making said laundry washing-drying machine to perform also a standard washing cycle comprising:

a1) a standard wetting phase in which clean water and washing detergent are admitted into said washing tub;

b1) a standard main washing phase during which

said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum;

c1) a first standard drain phase in which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and in which said drain pump is activated for draining liquid from said washing tub;

d1) a standard rinsing phase comprising one or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum, said drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and said drain pump is activated for draining rinse water from said washing tub,

wherein, the number of rinsing cycles of said rinsing phase d) of said washing-drying cycle is higher than the number of rinsing cycles of said standard rinsing phase d1) of said standard washing cycle.

[0029] Increasing the number of rinsing cycles of the rinsing phase d) with respect to the number of rinsing cycles of the standard rinsing phase d1) of said standard washing cycle has the effect of compensating the lack of the spin phase in the first rinsing cycle of the washing-drying cycle; in fact the lower squeezing of the laundry (and therefore the lower extraction from the latter of water mixed with dirt particles and detergent), can be compensated by one or more rinsing cycles.

[0030] In still another advantageous embodiment of the present invention, both the features separately disclosed above (adding more water to a single rinsing cycle and adding one or more rinsing cycles) can be contemporaneously present, with the effect of improving more and more the rinsing effect.

[0031] Furthermore and preferably, in whichever embodiment of the present invention, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), the amount of clean rinse water added to the laundry during any rinsing cycle may be lower than the amount of clean rinse water added to the laundry during a previous rinsing cycle. In fact, since after the first rinsing cycle a big amount of dirt particles, detergent, and zeolites have already been removed from the laundry, the following rinsing cycles can be advantageously performed using a lower amount of clean water; which reduces the overall water consumption of the washing-drying cycle.

[0032] In a further advantageous embodiment of the invention, between the beginning of said rinsing phase and said final spin, the speed of said rotatable drum is

kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum.

[0033] In this way, being the speed of the rotatable drum lower than such a threshold speed value, there is no preliminary spinning phase between the rinsing phase and the final spin phase.

[0034] Furthermore and preferably, said wetting phase a) and/or said main washing phase b) and/or an intermediary phase between them comprise a heating phase during which the water introduced into said washing tub is heated at a predetermined temperature based on the washing-drying program selected by the user.

[0035] In this way, the introduction of the heating phase allows the water introduced into the washing tub to be heated in order to obtain better washing results.

[0036] Furthermore and preferably, between said rinsing phase d) and said a final spin phase e) there is a laundry heating phase k) in which the laundry is heated.

[0037] In this way, the heating phase k) allows the fibers of the laundry to be released before the final spin phase e), which allows obtaining a better water extraction from the laundry.

[0038] Furthermore and preferably, said laundry heating phase k) is performed by introducing clean water into said washing tub and heating said clean water in order to produce a certain amount of cold vapour that heats the laundry contained in said rotatable drum.

[0039] In this way, the water outflow is facilitated; furthermore, the folds present in the laundries once squeezed are also reduced.

[0040] In another advantageous embodiment of the invention, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), at the end of at least one rinsing cycle, before and/or contemporaneously to the activation of said drain pump for draining rinse water from said washing tub, said rotatable drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter.

[0041] In this way, at the end of at least one rinsing cycle starting from the second of said two or more rinsing cycles of said rinsing phase d), a spinning phase is present. After the first rinsing cycle, in which a spin has not to be performed, the amount of zeolite particles within the laundry is already highly reduced, and so the risk that the detrimental effect of zeolite particles deeply penetrating into the laundry is highly reduced too; for this reason one or more spinning phases at a speed at which the laundry sticks to the lateral surface of the rotatable drum (having the effect of better removing water mixed with dirt particles and detergent from the laundry) can be provided in one or more of the rinsing cycles following the first one.

[0042] Furthermore and preferably, said rinsing phase d) of said washing-drying cycle comprises three or more rinsing cycles, and, starting from the second of said three or more rinsing cycles, at the end of at least two rinsing

cycles, before and/or contemporaneously to the activation of said drain pump for draining rinse water from said washing tub, said rotatable drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter.

[0043] Furthermore and preferably, starting from the third of said three or more rinsing cycles of said rinsing phase d) of said washing-drying cycle, the speed at which said rotatable drum is rotated in order to stick said laundry to the lateral surface of the rotatable drum is higher than the speed at which said rotatable drum is rotated in order to stick said laundry to the lateral surface of the rotatable drum in a previous rinsing cycle. This is possible, since after any rinsing cycle the amount of zeolite particles contained into the laundry is more and more reduced, and therefore even if they deeply penetrate into the laundry, their reduced amount makes their detrimental effect very low.

[0044] In a further aspect thereof the invention is related to a washing-drying cycle in a washing-drying machine comprising:

- a washing tub containing a rotatable drum adapted to receive laundry;
- a water supply circuit to supply water into said washing tub;
- a washing product supplier to supply a washing products into said washing tub;
- a drain circuit provided with a drain pump which activation causes liquid to be drained from said washing tub;
- a control unit configured for making said laundry washing-drying machine to perform said washing-drying cycle,

wherein washing-drying cycle comprises the following phases:

- a) a wetting phase in which clean water and washing detergent are admitted into said washing tub;
- b) a main washing phase during which said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum;
- c) a first drain phase in which said drain pump is activated for draining liquid from said washing tub;
- d) a rinsing phase comprising two or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum is rotated at speed causing the laundry to tumble inside said rotatable drum, and then said drain pump is activated for draining

rinse water from said washing tub,

e) a final spin phase during which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter, and said drain pump is activated for draining liquid from said washing tub;

f) a hot-air drying phase during which hot air is circulated into said rotatable drum so that it passes through the laundry, removing moisture from the latter.

[0045] Furthermore, between the end of said a main washing phase b) and the second of said two or more rinsing cycles of said rinsing phase d), the speed of said rotatable drum is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum.

[0046] Advantageously, in the washing-drying cycle according to the invention, during said rinsing phase d), starting from the second of said two or more rinsing cycles of said rinsing phase d), the amount of clean rinse water added to the laundry during any rinsing cycle is lower than the amount of clean rinse water added to the laundry during a previous rinsing cycle.

[0047] Preferably, in the washing-drying cycle according to the invention, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), at the end of at least one rinsing cycle, before and/or contemporaneously to the activation of said drain pump for draining rinse water from said washing tub, said rotatable drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter.

[0048] More preferably, in the washing-drying cycle according to the invention said rinsing phase d) of said washing-drying cycle comprises three or more rinsing cycles, wherein, starting from the second of said three or more rinsing cycles, at the end of at least two rinsing cycles, before and/or contemporaneously to the activation of said drain pump for draining rinse water from said washing tub, said rotatable drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum, so as to squeeze said laundry and extract water from the latter.

[0049] In a further advantageous embodiment, in the washing-drying cycle according to the invention between the beginning of said rinsing phase and said final spin, the speed of said rotatable drum is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum.

[0050] According to an advantageous embodiment, in the washing-drying cycle according to the invention said wetting phase a) and/or said main washing phase b) comprise a heating phase during which the water introduced

into said washing tub is heated at a predetermined temperature based on the washing-drying program selected by the user.

[0051] In a further advantageous embodiment, in the washing-drying cycle according to the invention, between said rinsing phase d) and said a final spin phase e) there is a laundry heating phase k) in which laundry is heated.

[0052] Preferably, in the washing-drying cycle according to the invention, said laundry heating phase k) is performed by introducing clean water into said washing tub and heating said clean water in order to produce a certain amount of cold vapour that heats the laundry contained in said rotatable drum.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of preferred embodiments of the invention, provided with reference to the enclosed drawings. In said drawings:

- Figure 1 shows a perspective view of a laundry washing-drying machine according to the present invention;
- Figure 2 shows a schematic frontal view of the internal of the laundry washing-drying machine of Figure 1, in which the air treating system has not been illustrated;
- Figure 3 shows a perspective view of the laundry washing-drying machine of Figure 1 with some parts removed;
- Figure 4 shows the air heating device of the laundry washing-drying machine of Figure 1;
- Figure 5 shows a schematic lateral cross section of the laundry washing-drying machine of Figure 1, in which the water supply circuit has not been illustrated.

DETAILED DESCRIPTION OF THE INVENTION

[0054] The present invention has been described with reference to a laundry washing-drying machine of the front-loading type; anyway it is evident that the invention can be applied, substantially without any modification, to a top-loading type laundry washing-drying machine.

[0055] With reference to Figure 1 a laundry washing-drying machine 1 is illustrated, in which a control unit 13 (only schematically illustrated) is configured for allowing the laundry washing-drying machine 1 to perform a washing-drying cycle according to the invention.

[0056] The laundry washing-drying machine 1 comprises an external casing or housing 2, in which a washing

tub 3 is provided that contains a drum 4 where the laundry 100 to be treated (i.e. washed and/or dried) can be loaded, as illustrated in Figure 5.

[0057] The tub 3 and the drum 4 both preferably have a substantially cylindrical shape, thus forming a substantially annular gap 17 therebetween.

[0058] The housing 2 is advantageously provided with a loading/unloading door 8 which allows access to the drum 4.

[0059] The tub 3 is preferably suspended in a floating manner inside the housing 2, advantageously by means of a number of coil springs and shock-absorbers, not illustrated.

[0060] The drum 4 is advantageously rotated by an electric motor 110, 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.

[0061] The lower portion 3a of the tub 3 preferably comprises a seat or sump 15 suitable for receiving a heater device 10. Preferably the seat 15 is made in a single piece with the tub 3, for example by injection moulding.

[0062] The heater device 10 preferably comprises an electrical resistor of serpentine type. The heater device 10 is advantageously horizontally placed in the seat 15, and it extends preferably substantially from the rear part up to the front part of the tub 3.

[0063] Between the lower side of the heater 10 and the upper surface 15a of the seat 15 a gap 16 is defined, as illustrated for example in Figure 2.

[0064] A water supply circuit 5 is arranged in the upper part of the laundry washing-drying machine 1 and is suited to supply water into the tub 3. The water supply circuit of a laundry washing-drying machine is well known in the art, and therefore it will not be described in detail.

[0065] The laundry washing-drying machine 1 advantageously comprises a preferably removable drawer 6 provided with various compartments suited to be filled with washing and/or rinsing products (i.e. detergent D, softener, etc.).

[0066] In a preferred embodiment, the water is supplied into the tub 3 from the water supply circuit 5, advantageously by making it flow through the drawer 6 and then through a supply pipe 18.

[0067] The water which reaches the tub 3 can, in this case, selectively contain one of the products contained in the compartments of the drawer 6, or such water can be clean and in this case it may reach the tub 3 directly, for example bypassing the compartments of the drawer 6, or passing through an empty compartment of the drawer 6.

[0068] 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.

[0069] The water supply circuit 5 also preferably comprises a water flow sensor, not illustrated, for example a flow meter, which makes it possible to calculate the quan-

tity of water supplied into the tub 3.

[0070] Laundry washing-drying machine 1 advantageously comprises a water outlet circuit, called also drain circuit, 25 suitable for withdrawing liquid from the lower portion 3a of the tub 3.

[0071] The water outlet circuit 25 advantageously comprises a drain pump 26, a first pipe 27 connecting the tub 3 to the drain pump 26 and an outlet pipe 28 ending outside the housing 2. Advantageously, the first pipe 27 is fluidly connected to the seat 15. The water outlet circuit 25 is suited to drain the liquid, i.e. dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside.

[0072] The water outlet circuit 25 advantageously comprises a filtering device, not shown in the figures, placed between the bottom of the tub 3 and the drain pump 26 and adapted to retain all the undesirable bodies (for example buttons that have come off the laundry, coins erroneously introduced into the laundry washing machine, etc.) which could damage or obstruct the drain pump 26.

[0073] This filtering device can preferably be removed, and then for example cleaned, for example through a gate 14 placed advantageously on the front of the housing 2 of the laundry washing-drying machine 1.

[0074] Activation of the drain pump 26 drains the liquid, i.e. dirty water or water mixed with washing and/or rinsing products, from the tub 3 to the outside.

[0075] Laundry washing-drying machine 1 may advantageously further comprises a recirculation circuit 30, illustrated only in Figure 2, adapted to drain liquid from the the lower portion 3a of the tub 3 and to re-admit such a liquid into an upper region of the tub 3.

[0076] The recirculation circuit 30 preferably comprises the drain pump 26 and a recirculation pipe 31. The recirculation pipe 31 advantageously ends with a terminal nozzle 31a, placed advantageously in an upper region of the tub 3.

[0077] The exit of the drain pump 26 is advantageously fluidly connected to a valve, not illustrated, properly controlled in order to allow selective drainage of the water exiting drain pump 26 towards the outside through the outlet pipe 28, or towards the upper region of the tub 3 through the recirculation pipe 31.

[0078] In a further embodiment, not illustrated, the recirculation circuit may comprise a dedicated recirculation pipe connecting a bottom region of the tub with a higher region of the latter, and provided with a dedicated recirculation pump; in this case the recirculation circuit is advantageously completely separated from the water outlet circuit.

[0079] In general, the recirculation circuit is properly realized for transferring a portion of a liquid from a region of the tub to another region of the tub in order to enhance absorption of washing liquid by the laundry.

[0080] The laundry washing-drying machine 1 advantageously comprises a liquid level sensor device 19 suited to sense (or detect) the liquid level inside the tub 3.

[0081] The sensor device 19 preferably comprises a

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

[0082] As already mentioned, laundry washing-drying machine 1 advantageously comprises a control unit 13, connected to the various parts of the laundry washing-drying machine 1 in order to ensure its operation. The control unit 13 is preferably connected to the water inlet circuit 5, the water outlet circuit 25, the heating device 10 and the electric motor and receives information from the various sensors provided on the laundry washing-drying machine 1, like the pressure sensor 19, a temperature sensor, etc.

[0083] Laundry washing-drying machine 1 advantageously comprises an interface unit 12, connected to control unit 13, accessible to the user and by means of which the user may select and set the washing/drying parameters, like for example a desired washing and/or drying program depending, for example, on the type and on the dirty-level of the products to wash. Usually, other parameters can optionally be inserted by the user, for example the value of the washing temperature, the different rotating speed of the drum 4 in each of the laundry washing phases, the duration of washing program, the load in terms of weight of the laundry to be washed, etc.

[0084] The laundry washing machine 1 is advantageously provided with an air treating system 50 which is structured to circulate inside the tub 3 a stream of hot air H1 having a low moisture content, and which flows through the drum 4 and over the laundry 100 located inside the drum 4 to dry the laundry 100.

[0085] The air treating system 50 is preferably structured for gradually drawing air from tub 3, cooling down the stream of moisture-laden air H2 exiting the tub 3, so as to extract and retain the surplus moisture in the moist air, and heating the dehumidified air to a predetermined temperature, preferably higher than that of the moist air arriving from tub 3. Finally the heated, dehumidified air H1 is conveyed again into the tub 3, where it flows over the laundry 100 stored inside the drum 4 to dry the laundry 100, as said above.

[0086] The air treating system 50 is advantageously housed inside the external casing or housing 2, and preferably comprises an air cooling device 60, an air heating device 70 arranged downstream of the air cooling device 60 and an air circulating device 140.

[0087] The air cooling device 60 is preferably attached to the back of tub 3 and is fluidly connected to the tub 3, preferably at an outlet hole 3b provided on the bottom of the tub 3 itself. The air cooling device 60 is structured to cool down the air H2 arriving from tub 3 so as to extract the surplus moisture in the air drawn from tub 3.

[0088] The air heating device 70 is preferably fluidly connected to both the tub 3 and the air cooling device 60, so as to allow the dehumidified air to flow from the air cooling device 60 to the tub 3, and it is structured to heat up the dehumidified air arriving from the air cooling device 60 before this air returns back into tub 3 through an inlet hole 3c.

[0089] In the example shown, the air cooling device 6 preferably comprises a coldwater condenser 160 which is preferably, but not necessarily, arranged on the back of tub 3, and which preferably uses a rain/shower of cold water arriving advantageously from a water mains 300 to cool down and dehumidify the moist air H2 that arrives from tub 3 and flows upwards in the air cooling device 60 up to the top of the latter. The moist air H2 advantageously flows upwards through a condensing duct 38.

[0090] The air heating device 70 is preferably rigidly attached to the top of tub 3.

[0091] Advantageously the air heating device 70 comprises a tubular body 120 and a heating element 130.

[0092] The tubular body 120 is preferably structured for being firmly fixed to the tub 3, preferably on the top of the latter, and preferably comprises a first opening or mouth 12a fluidly connected to, i.e. in direct communication with, the air cooling device 6, and a second opening or mouth 12b fluidly connected to, i.e. in direct communication with, the inside of a 17 bellows connecting the tub 3 to the housing 2, or fluidly connected directly to the inside of tub 3, preferably close to the front opening of tub 3 in correspondence of its inlet hole 3c.

[0093] The heating element 130 preferably comprises a resistor, or other equivalent heating element, which is housed inside the tubular body 120, and is structured to heat up, when electrically powered, the air that flows through the tubular body 120.

[0094] The air circulating device 140 preferably comprises an electric centrifugal fan 40, or other equivalent air circulating device, which is preferably housed inside the tubular body 120, preferably upstream of resistor 130, and is structured to circulate through the tubular body 120 an airflow that subsequently flows across the tub 3 and the air cooling device 60 for finally returning back to tubular body 120.

[0095] The centrifugal fan 40 is preferably recessed on a portion of the tubular body 120 suitably shaped to form the outer volute or impeller housing of centrifugal fan 40.

[0096] Preferably, though not necessarily, the air heating device 70 furthermore comprises one or more temperature sensors 37 which are located inside, or faced to the inside of, tubular body 120 and are structured for measuring the temperature of the air H1 flowing inside tubular body 120, preferably close to the second opening or mouth 12b of the tubular body 120.

[0097] The air treating system 50, therefore, allows the laundry 10 to be dried when the laundry washing and drying machine is performing a drying cycle, usually after a washing cycle.

[0098] Furthermore, after a drying cycle a condenser

cleaning cycle is also preferably performed.

[0099] The laundry to be washed is first placed inside the drum 4. In a further embodiment, the selection of the desired washing program may be performed before placing the laundry into the drum 4.

[0100] In a first embodiment according to the present invention, the control unit 13 is configured for allowing the laundry washing-drying machine 1 to perform a washing-drying cycle comprising the phases illustrated in the following.

[0101] A laundry wetting phase a) is activated wherein a quantity of detergent D together with a first quantity of water W is introduced into the tub 3, substantially forming a washing solution intended to wet the laundry.

[0102] The introduction of the quantity of detergent D takes place preferably through the water inlet circuit 5; the quantity of detergent D, be it powder or liquid, is preferably brought out of the apposite compartment of the drawer 6 by the first quantity of water W that passes through the proper compartment of the drawer 6 (in different embodiments, the quantity of detergent D and the first quantity of water W may be advantageously introduced singularly, i.e. one independently from the other, into the tub 3, preferably, but not necessarily, at different times).

[0103] Advantageously, all the quantity of detergent D and all the first quantity of water W introduced into the tub 3 in such a laundry wetting phase a) fall down on the lower portion 3a of the tub 3.

[0104] Therefore substantially all the detergent D and the water W preferably reach the lower portion 3a of the tub 3 without any absorption from the laundry.

[0105] That is advantageously guaranteed by the advantageous lateral position of the supply pipe 18 with respect to the tub 3. The detergent D and the water W, in fact, fall down until the lower portion 3a of the tub 3 by flowing inside the annular gap 17 between the tub 3 and the drum 4.

[0106] In a different embodiment, detergent D and the water W can be provided directly to the laundry 100.

[0107] Once such a laundry wetting phase a) above described is completed, a main washing phase b) is activated, during which the washing drum 4 is rotated at speed causing the laundry to tumble inside said rotatable drum 4, exerting a mechanical washing action on the laundry contained in the washing tub 3.

[0108] Such a main washing phase b) is constituted by several repeated time sections, each of them being formed by a first period of time, for example about 13 seconds, during which the washing drum 4 is rotated at a rotation speed, for example at about 40 rpm, followed by a second, shorter period of time of about 3 seconds during which the washing drum 4 is stopped until it does not rotate. Each of such repeated time sections constituted by such a first period of time and such a second, shorter period of time is repeated, for example, 10 to 15 times. A consistent mechanical action exerted by the rotation of the washing drum 3 is thus obtained during such

a main washing phase b).

[0109] After the main washing phase b), a first drain phase c) occurs, in which the drain pump 26 is activated for draining liquid from the washing tub 3. During such a first drain phase c) the washing drum 4 is rotated at a rotation speed, for example at 50 rpm, so as to cause at least part of the water and detergent contained in the laundry to be extracted from the latter and drained off the washing tub 3.

[0110] After the first drain phase c), a rinsing phase d) comprising preferably four rinsing cycles occurs, wherein clean rinse water is first added to the laundry, the rotatable drum 4 being rotated at speed, for example at about 50 rpm, causing the laundry to tumble inside the rotatable drum 4, and then the drain pump 26 is activated for draining rinse water from the washing tub 3.

[0111] A threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum 4 is advantageously set at 90 (for a drum diameter of 490 mm).

[0112] Between the end of the main washing phase b) and the second of such preferably four rinsing cycles of the rinsing phase d), the speed of the rotatable drum 4 is advantageously kept at 50 rpm, below the 90 rpm threshold speed value. Thus, being the rotation speed value lower than the threshold speed value, no spinning phase occurs during this portion of the laundry washing cycle. Therefore the risk that zeolite particles deeply penetrate into the laundry, so that they can't be removed together with water by the water draining devices, appearing as an unpleasant white powder on the laundry when the latter is extracted from the machine, is avoided.

[0113] During the rinsing phase d), starting from the second of the preferably four rinsing cycles, the amount of clean rinse water added to the laundry during any rinsing cycle is advantageously lower than the amount of clean rinse water added to the laundry during a previous rinsing cycle. Thus, for example, the amount of clean rinse water added to the laundry during the first, second, third and four rinsing cycle is, respectively, 10 litres, 9 litres, 9 litres and 8 litres (such an amount may be equal in each of two or more successive rinsing cycles, as long as it is lower than the amount in a previous rinsing cycle). Thus, a minor amount of added clean rinse water is required as the laundry washing cycle proceeds.

[0114] When such a rinsing phase d) is completed, a final draining phase e) is activated, during which the washing drum 4 is rotated at a speed 1400-1600rpm, which is above the 90 rpm threshold speed value, and the drain pump 26 is activated for draining liquid from said washing tub 3.

[0115] Then, when such a final draining phase e) is completed, a hot-air drying phase (f) is activated, during which hot air is circulated into the rotatable drum 4 so that it passes through the laundry, removing moisture from the latter.

[0116] Optionally and preferably, such a wetting phase a) and/or such a main washing phase b) may further com-

prise an additional heating phase during which the water introduced into the washing tub 3 is heated at a predetermined temperature, for example from 20 °C to 60 °C, based on the washing program selected by the user.

[0117] Optionally and preferably, between such a rinsing phase d) and such a final spin phase e) there is a laundry heating phase k) in which the laundry is heated, by introducing clean water into the washing tub 3 and heating said clean water in order to produce a certain amount of cold vapour that heats the laundry contained in the rotatable drum 4. In this way, the water outflow is facilitated and the folds usually present in the laundries once squeezed are also reduced.

[0118] In the first advantageous embodiment of the present invention, the rinsing phase d) comprised four rinsing phases; however, such a rinsing phase d) may comprise any number of rinsing phases greater than 1 (at least 2), as long as, between the end of the main washing phase b) and the second of such two or more rinsing cycles of the rinsing phase d), the speed of the rotatable drum 4 is kept below the threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum 4, in order not to have a spin phase in that portion of the laundry washing cycle.

[0119] In a second advantageous embodiment of the present invention, the control unit 13 is configured for allowing the laundry washing-drying machine 1 to perform the same washing-drying cycle as disclosed above with reference to the first embodiment with the following additional features in the rinsing phase d) of the laundry-washing cycle.

[0120] Starting from the second of such preferably four rinsing cycles of the rinsing phase d), at the end of each rinsing cycle, before and/or contemporaneously to the activation of the drain pump 26 for draining rinse water from the washing tub 3, the rotatable drum 4 is rotated at a spin speed of about 350-650 rpm which is higher than the 90 rpm threshold speed value. Thus, such a rotation speed of the rotatable drum 4 at the end of each rinsing cycle is adapted to allow the laundry to stick to the lateral surface of the rotatable drum 4, so as to be squeezed for the water extraction.

[0121] Furthermore, starting from the third of the preferably four rinsing cycles of the rinsing phase d), the speed at which the rotatable drum 4 is rotated in order to stick the laundry to the lateral surface of the rotatable drum 4 is higher than the speed at which the rotatable drum 4 is rotated in order to stick the laundry to the lateral surface of the rotatable drum 4 in a previous rinsing cycle. For example, the third and fourth rinsing cycles of the rinsing phase d) are respectively of 850-1100 rpm and of 1400-1600 rpm.

[0122] In this way, while there is still no spin phase in the portion of the laundry washing cycle between the end of the washing phase b) and the second of the preferably four rinsing cycles of the rinsing phase d), as described above with reference to the first embodiment, on the contrary, starting from such a second rinsing cycle, a spin

phase occurs at the end of each rinsing phase, during which the amount of clean rinse water is decreasing and the rotation speed of the rotatable drum 4 is increasing as the laundry washing cycle proceeds. Thus, starting from such a second rinsing cycle, a spin phase occurs at the end of each rinsing cycle at a continuous increasing rotation speed of the rotatable drum 4 in the presence of a continuous reduced addition of clean rinse water to obtain better squeezing of the laundry inside the washing drum.

[0123] As already disclosed above with reference to the first embodiment, also in the second embodiment of the present invention the rinsing phase d) may comprise any number of rinsing phases greater than 1 (at least 2), as long as the requirements related to the speed of the rotatable drum 4 between the end of the main washing phase b) and the second of such two or more rinsing cycles of the rinsing phase d) are still maintained.

[0124] In a third preferred embodiment of the present invention, the control unit is configured for allowing the laundry washing-drying machine 1 to perform, in addition to the washing-drying cycle as disclosed above with reference to the first or to the second embodiment, also a standard washing cycle comprising the following phases:

a1) a standard wetting phase in which clean water and washing detergent are admitted in the washing tub 3;

b1) a standard main washing phase during which the rotatable drum 4 is rotated at speed of preferably 50rpm causing the laundry to tumble inside the rotatable drum 4;

c1) a first standard drain phase in which the rotatable drum is rotated at a speed of preferably 850-1100 rpm above the 90 rpm threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum 4, so as to squeeze the laundry and extract water from the latter, and in which the drain pump 26 is activated for draining liquid from the washing tub 3;

d1) a standard rinsing phase comprising one or more rinsing cycles wherein clean rinse water is first added to the laundry, the rotatable drum 4 being rotated at speed of preferably 50 rpm causing the laundry to tumble inside the rotatable drum 4, and adapted to stick the laundry to the lateral surface of the rotatable drum 4, so as to squeeze the laundry and extract water from the latter, and the drain pump 26 is activated for draining rinse water from the washing tub 3, wherein the amount (for example 20 litres) of clean rinse water added to the laundry during the first of the two or more rinsing cycles of the rinsing phase d) of the washing-drying cycle disclosed above in the first or in the second embodiment is higher than the amount of 18 litres of clean rinse water added to

the laundry during such one or more rinsing cycles of the standard rinsing phase d1) of above.

[0125] In a fourth advantageous embodiment of the present invention, the control unit is configured for allowing the laundry washing-drying machine 1 to perform, in addition to the washing-drying cycle as disclosed above with reference to the first or to the second embodiment, also a standard washing cycle which differs from the standard washing cycle disclosed above with reference to the third embodiment only for the fact that the number (for example four) of rinsing cycles of the rinsing phase d) of the washing-drying cycle is higher than the number of rinsing cycles (for example three) of the standard rinsing phase d1) of the standard washing cycle, maintaining the amount of clean rinse water added to the laundry during the first of the two or more rinsing cycles of the rinsing phase d) of the washing-drying cycle equal to the amount of clean rinse water added to the laundry during such one or more rinsing cycles of the standard rinsing phase d1).

[0126] In a fifth advantageous embodiment of the present invention, the control unit is configured for allowing the laundry washing-drying machine 1 to perform, in addition to the washing-drying cycle as disclosed above with reference to the first or to the second embodiment, also a standard washing cycle which differs from the standard washing cycle disclosed above with reference to the fourth embodiment only for the fact that the amount of clean rinse water added to the laundry during the first of the two or more rinsing cycles of the rinsing phase d) of the washing-drying cycle is higher than the amount of clean rinse water added to the laundry during such one or more rinsing cycles of the standard rinsing phase d1) (as it was in the third embodiment), still maintaining the number (for example four) of rinsing cycles of the rinsing phase d) of the washing-drying cycle higher than the number of rinsing cycles (for example three) of the standard rinsing phase d1) of the standard washing cycle, as it was in the fourth embodiment disclosed above.

[0127] In other words, the fifth embodiment is a combination of the third and of the fourth embodiment; in fact, the features related to the amount of clean rinse water added and to the number of rinsing cycles, singularly present respectively in the third and in the four embodiments, are contemporaneously present in the fifth embodiment.

[0128] It is underlined that the laundry washing-drying machine illustrated in the enclosed figures, and with reference to which some embodiments according to the invention have been described, is of the front-loading type; however it is clear that the invention can be applied as well to a top-loading washing machine, substantially without any modification. Furthermore, it is also underlined that the laundry washing-drying machine illustrated in the enclosed figures, and with reference to which some embodiments according to the invention have been described, present a recirculation circuit 30 and/or a heater

device 10; however it is clear that the invention can be applied as well to laundry washing machines that are free of such a recirculation circuit 30 and/or a heater device 10, substantially without any modification.

[0129] 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. Laundry washing-drying machine (1) comprising:

- a washing tub (3) containing a rotatable drum (4) adapted to receive laundry;
- a water supply circuit (5) to supply water into said washing tub (3);
- a washing product supplier (6) to supply a washing products into said washing tub (3);
- a drain circuit (25) provided with a drain pump (26) which activation causes liquid to be drained from said washing tub (3);
- a control unit (13) configured for making said laundry washing-drying machine (1) to perform a washing-drying cycle comprising the following phases:

- a) a wetting phase in which clean water and washing detergent are admitted into said washing tub (3);
- b) a main washing phase during which said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4);
- c) a first drain phase in which said drain pump (26) is activated for draining liquid from said washing tub (3);
- d) a rinsing phase comprising two or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4), and then said drain pump (26) is activated for draining rinse water from said washing tub (3),
- e) a final spin phase during which said rotatable drum (4) is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter, and said drain pump (26) is activated for draining liquid from said washing tub (3);
- f) a hot-air drying phase during which hot

air is circulated into said rotatable drum (4) so that it passes through the laundry, removing moisture from the latter,

characterized in that

between the end of said a main washing phase b) and the second of said two or more rinsing cycles of said rinsing phase d), the speed of said rotatable drum (4) is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4).

2. Laundry washing-drying machine (1), according to claim 1, wherein said control unit (13) is configured for making said laundry washing-drying machine (1) to perform also a standard washing cycle comprising:

a1) a standard wetting phase in which clean water and washing detergent are admitted into said washing tub (3);

b1) a standard main washing phase during which said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4);

c1) a first standard drain phase in which said rotatable drum is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter, and in which said drain pump (26) is activated for draining liquid from said washing tub (3);

d1) a standard rinsing phase comprising one or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4), said drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and

extract water from the latter, and said drain pump (26) is activated for draining rinse water from said washing tub (3),

wherein the amount of clean rinse water added to the laundry during the first of said two or more rinsing cycles of said rinsing phase d) of said washing-drying cycle is higher than the amount of clean rinse water added to the laundry during said one or more rinsing cycles of said standard rinsing phase d1) of said standard washing cycle.

3. Laundry washing-drying machine (1), according to claim 1 or 2, wherein said control unit (13) is configured for making said laundry washing-drying machine (1) to perform also a standard washing cycle

comprising:

a1) a standard wetting phase in which clean water and washing detergent are admitted into said washing tub (3);

b1) a standard main washing phase during which said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4);

c1) a first standard drain phase in which said drain pump (26) is activated for draining liquid from said washing tub (3);

d1) a standard rinsing phase comprising one or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4), said drum is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter, and said drain pump (26) is activated for draining rinse water from said washing tub (3),

wherein the number of rinsing cycles of said rinsing phase d) of said washing-drying cycle is higher than the number of rinsing cycles of said standard rinsing phase d1) of said standard washing cycle.

4. Laundry washing-drying machine (1) according to claim 1 or 2 or 3, wherein, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), the amount of clean rinse water added to the laundry during any rinsing cycle is lower than the amount of clean rinse water added to the laundry during a previous rinsing cycle.

5. Laundry washing-drying machine (1) according to one or more of the previous claims, wherein, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), at the end of at least one rinsing cycle, before and/or contemporaneously to the activation of said drain pump (26) for draining rinse water from said washing tub (3), said rotatable drum (4) is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter.

6. Laundry washing-drying machine (1) according to claim 5, wherein said rinsing phase d) of said washing-drying cycle comprises three or more rinsing cycles, and wherein, starting from the second of said three or more rinsing cycles, at the end of at least two rinsing cycles, before and/or contemporaneously to the activation of said drain pump (26) for draining

rinse water from said washing tub (3), said rotatable drum (4) is rotated at a spin speed adapted to stick said laundry to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter.

7. Laundry washing-drying machine (1) according to claim 6, wherein, starting from the third of said three or more rinsing cycles of said rinsing phase d) of said washing-drying cycle, the speed at which said rotatable drum (4) is rotated in order to stick said laundry to the lateral surface of the rotatable drum (4) is higher than the speed at which said rotatable drum (4) is rotated in order to stick said laundry to the lateral surface of the rotatable drum (4) in a previous rinsing cycle.
8. Laundry washing-drying machine (1) according to claim 1 or 2 or 3 or 4, wherein between the beginning of said rinsing phase and said final spin, the speed of said rotatable drum (4) is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4).
9. Laundry washing-drying machine (1) according to one or more of the previous claims, wherein said wetting phase a) and/or said main washing phase b) comprise a heating phase during which the water introduced into said washing tub (3) is heated at a predetermined temperature based on the washing-drying program selected by the user.
10. Laundry washing-drying machine (1) according to one or more of the previous claims, wherein between said rinsing phase d) and said a final spin phase e) there is a laundry heating phase k) in which laundry is heated.
11. Laundry washing-drying machine (1) according to claim 10, wherein said laundry heating phase k) is performed by introducing clean water into said washing tub (3) and heating said clean water in order to produce a certain amount of cold vapour that heats the laundry contained in said rotatable drum (4).
12. Washing-drying cycle in a washing-drying machine (1) comprising:
 - a washing tub (3) containing a rotatable drum (4) adapted to receive laundry;
 - a water supply circuit (5) to supply water into said washing tub (3);
 - a washing product supplier (6) to supply a washing products into said washing tub (3);
 - a drain circuit (25) provided with a drain pump (26) which activation causes liquid to be drained from said washing tub (3);
 - a control unit (13) configured for making said

laundry washing-drying machine (1) to perform said washing-drying cycle,

wherein washing-drying cycle comprises the following phases:

- a) a wetting phase in which clean water and washing detergent are admitted into said washing tub (3);
- b) a main washing phase during which said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4);
- c) a first drain phase in which said drain pump (26) is activated for draining liquid from said washing tub (3);
- d) a rinsing phase comprising two or more rinsing cycles wherein clean rinse water is first added to the laundry, said rotatable drum (4) is rotated at speed causing the laundry to tumble inside said rotatable drum (4), and then said drain pump (26) is activated for draining rinse water from said washing tub (3),
- e) a final spin phase during which said rotatable drum (4) is rotated at a speed above a threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter, and said drain pump (26) is activated for draining liquid from said washing tub (3);
- f) a hot-air drying phase during which hot air is circulated into said rotatable drum (4) so that it passes through the laundry, removing moisture from the latter,

characterized in that

between the end of said a main washing phase b) and the second of said two or more rinsing cycles of said rinsing phase d), the speed of said rotatable drum (4) is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4).

13. Washing-drying cycle according to claim 12, wherein, during said rinsing phase d), starting from the second of said two or more rinsing cycles of said rinsing phase d), the amount of clean rinse water added to the laundry during any rinsing cycle is lower than the amount of clean rinse water added to the laundry during a previous rinsing cycle.
14. Washing-drying cycle according to claim 12 or 13, wherein, during said rinsing phase d) of said washing-drying cycle, starting from the second of said two or more rinsing cycles of said rinsing phase d), at the end of at least one rinsing cycle, before and/or contemporaneously to the activation of said drain pump (26) for draining rinse water from said washing tub (3), said rotatable drum (4) is rotated at a spin

speed adapted to stick said laundry to the lateral surface of the rotatable drum (4), so as to squeeze said laundry and extract water from the latter.

15. Washing-drying cycle according to claim 12 or 13, wherein between the beginning of said rinsing phase and said final spin, the speed of said rotatable drum (4) is kept below said threshold speed value at which the laundry sticks to the lateral surface of the rotatable drum (4).

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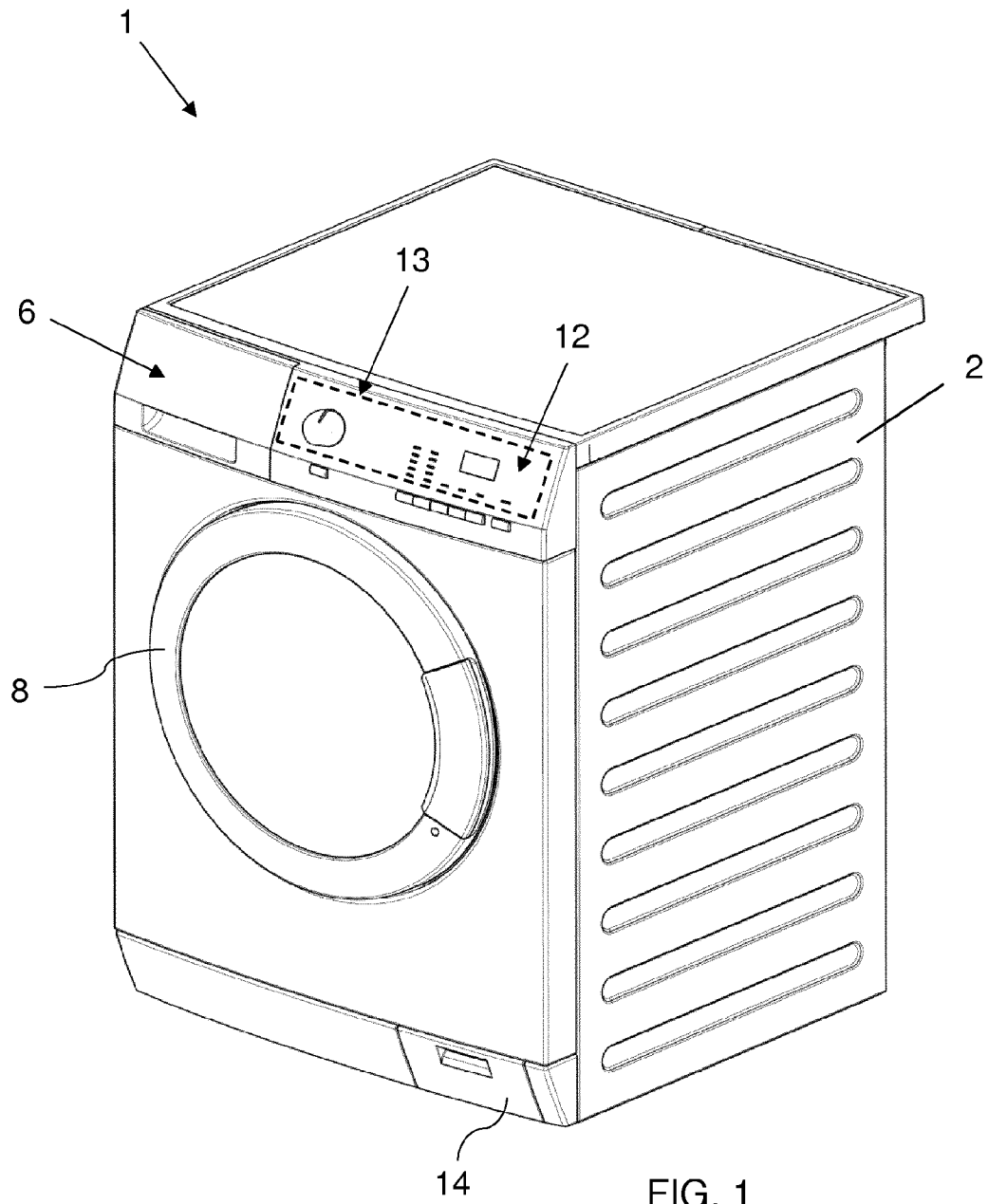


FIG. 1

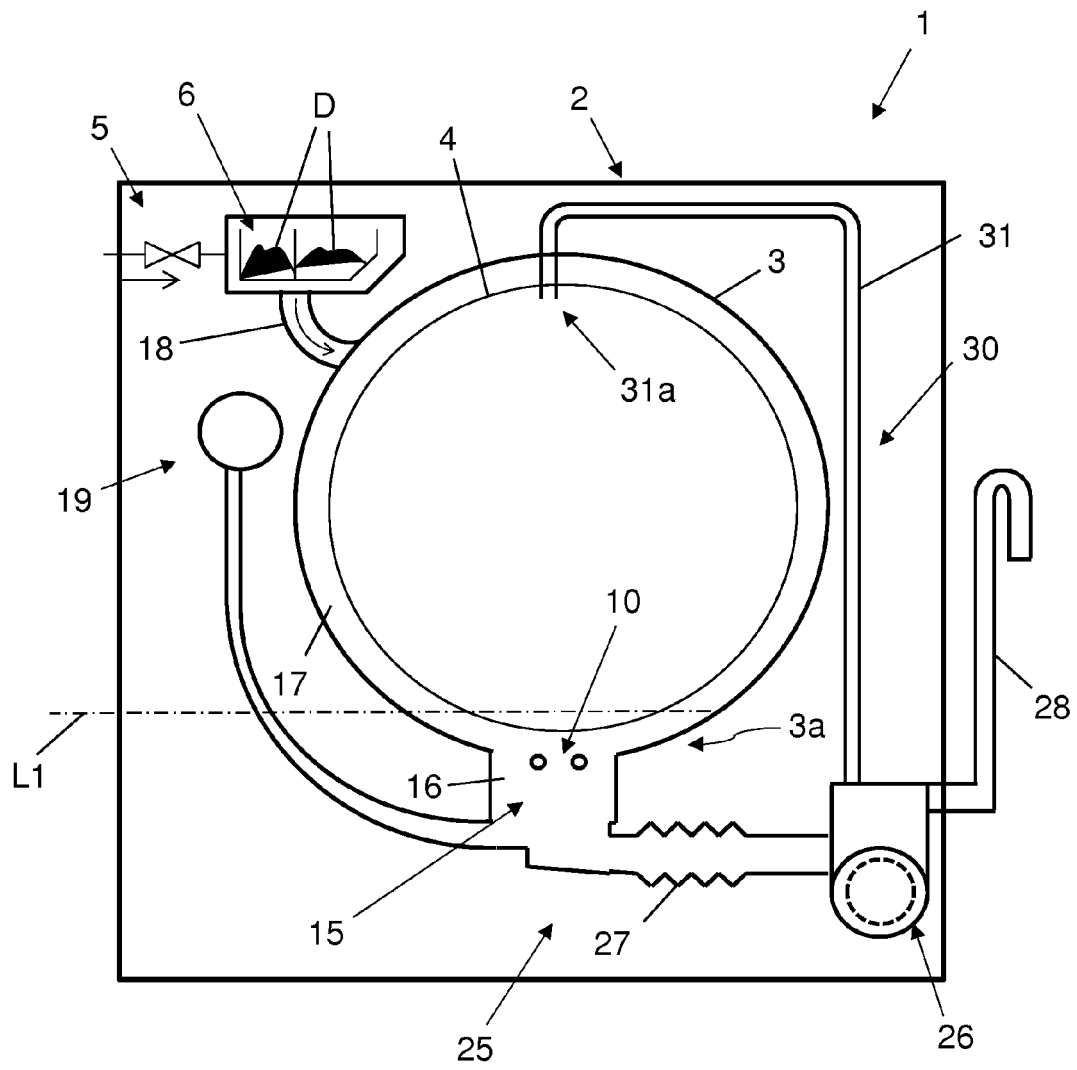
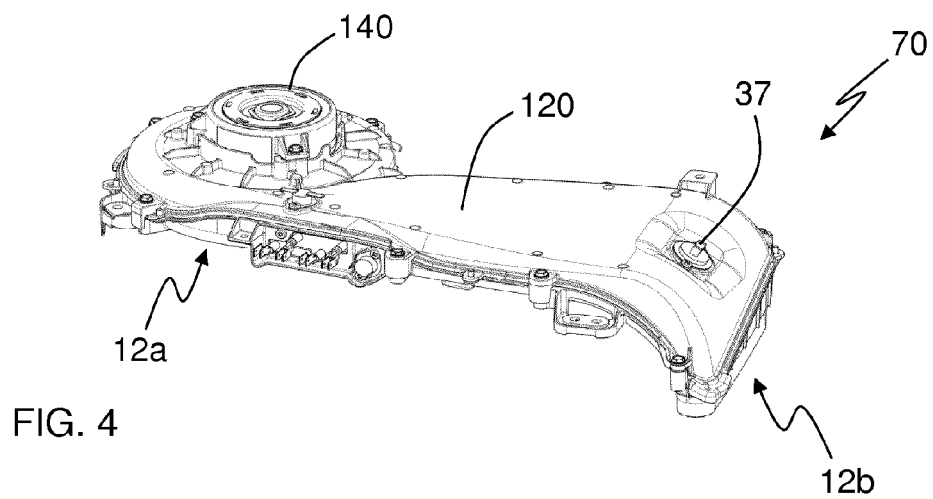
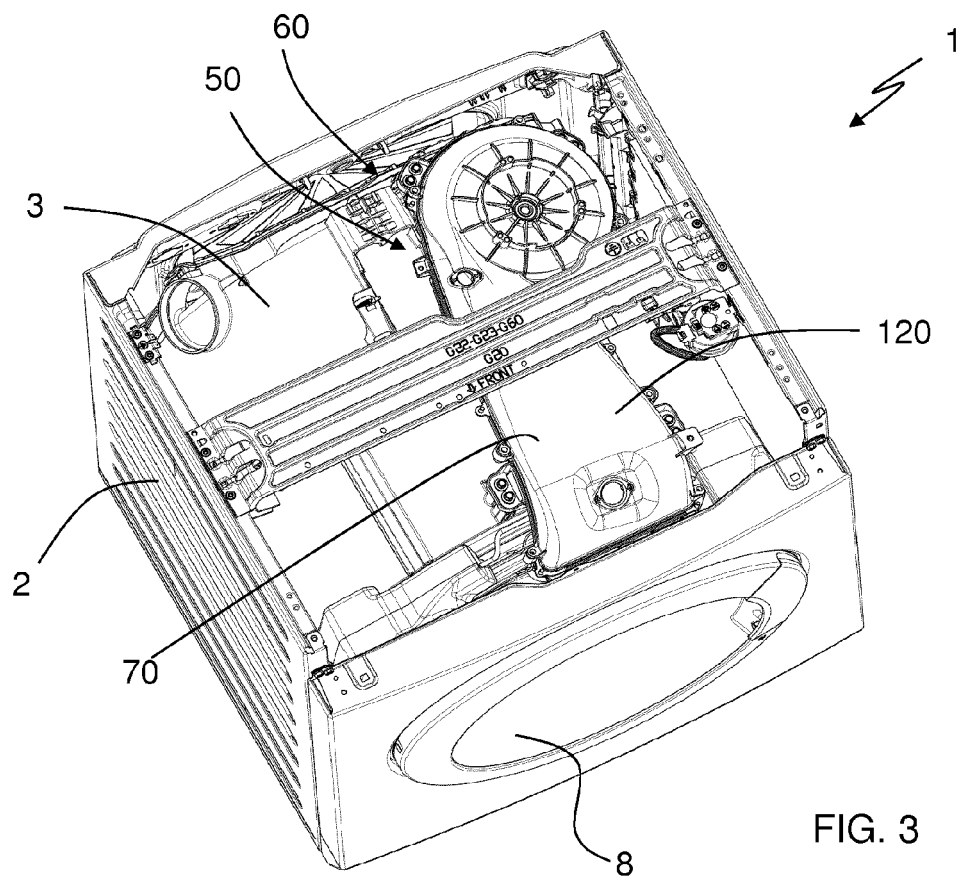


FIG. 2



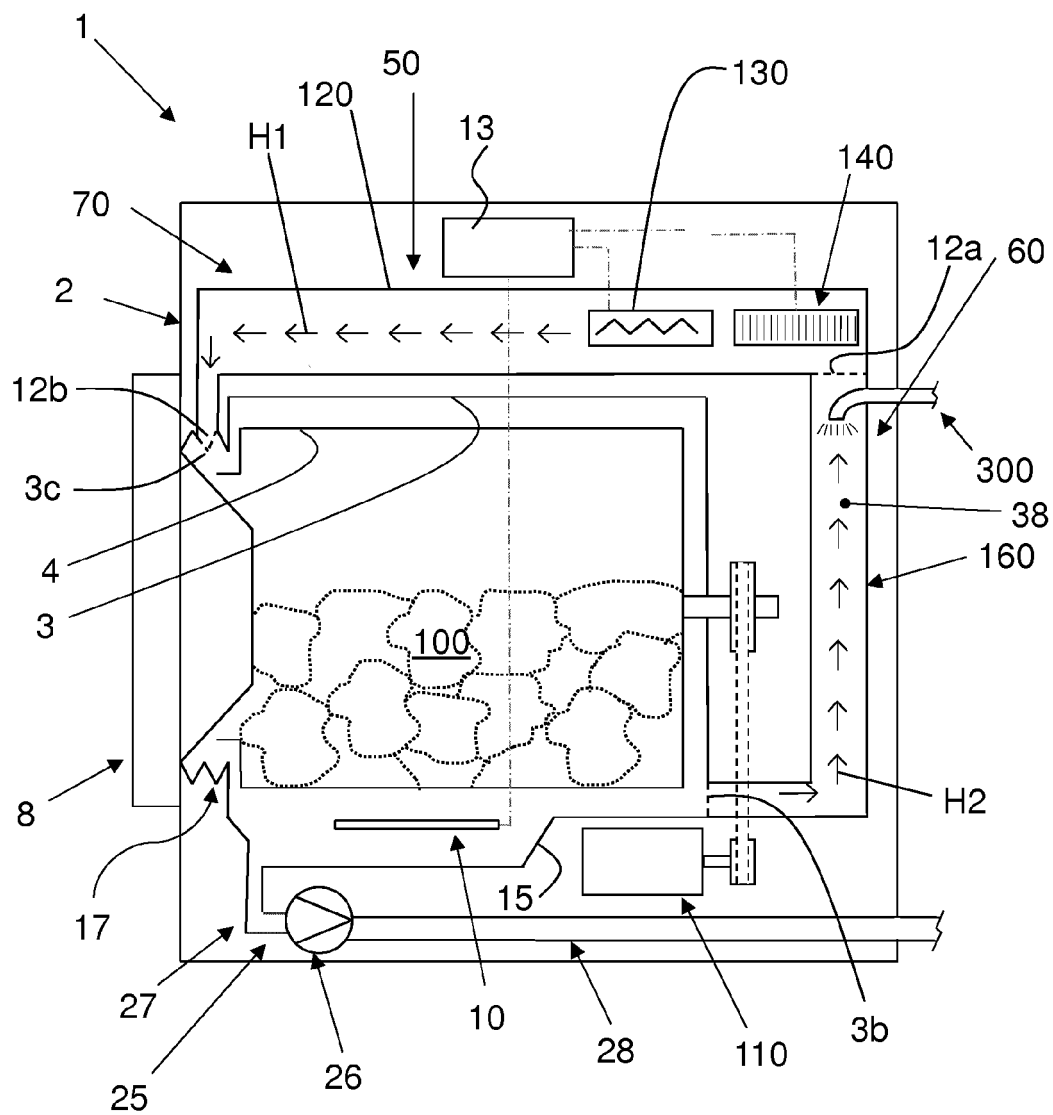


FIG. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 14 19 3107

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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	EP 1 967 632 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 10 September 2008 (2008-09-10)	1,2,4,8,9,12,13,15	INV. D06F25/00 D06F33/02
A	* the whole document *	3,5-7,10,11,14	
A	----- DE 10 2008 027808 A1 (MIELE & CIE [DE]) 25 June 2009 (2009-06-25) * the whole document * -----	1-15	
			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 26 January 2015	Examiner Jezierski, Krzysztof
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 2
 EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 19 3107

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-01-2015

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1967632 A2	10-09-2008	EP 1967632 A2	10-09-2008
		KR 20080081471 A	10-09-2008
		US 2008216249 A1	11-09-2008

DE 102008027808 A1	25-06-2009	NONE	

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EPO FORM P0459

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