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(54) Process and machine for drying laundry

Verfahren und Maschine zum Trocknen von Wäsche

Procédé et machine permettant de sécher le linge

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Description

Field of the invention

[0001] The present invention relates to a process and a machine for drying laundry.

State of the art

[0002] Laundry-drier machines are typically provided with a cabinet, rotatably housed within which is a drum, designed to contain the laundry to be dried. In some solutions, the drum has a perforated cylindrical wall and is rotatably mounted within a tank: this is typically the case of the so-called washer-drier machines, i.e., machines that enable washing and subsequent drying of a load of laundry. Drier machines in a strict sense, instead, are not normally provided with a tank. In some solutions, the drum is constituted by a non-perforated cylindrical wall, associated to which are a front flange and a rear flange, provided with openings for passage of a flow of drying air. In other solutions, the drum basically consists of just the cylindrical wall, the open ends of which are rotatably constrained to respective front and rear containment elements, with interposition of suitable sliding seal means.

[0003] The machine has a ventilation system, for generating and conveying a forced flow of air, and heating means, for heating the air of the forced flow. The ventilation system typically comprises a ducting, associated to which are a fan and the means for heating the air. In the majority of known solutions, the heating means comprise at least one electrical resistance, but in recent times - mainly for reasons of energy efficiency - there has been a widespread use of heat pumps.

[0004] Irrespective of the type of heating means, the fan forces the air into the drum, via a delivery branch of the ventilation circuit after the air itself has been heated via heating means. The hot air traverses the inside of the drum and collects the moisture yielded by the laundry items contained therein, said items being thus progressively dried. The moist air exits from the drum through its front wall, which is provided with a central opening, used - in the case of front-loading machines - also for loading and unloading the laundry. Along the ventilation circuit, usually downstream of the opening of the drum, a filter is provided accessible to the user of the machine, having the function of withholding the fluff released by the garments in the course of the treatment and conveyed by the flow of forced air.

[0005] In traditional "condensation" machines, the front opening of the drum is in fluid communication with the intake branch of the ventilation system, upstream of the fan, along which there is a condenser device designed to extract the moisture from the air taken in from the drum, said dehumidified air being then re-heated and re-introduced into the drum via the delivery branch of the system. In heatpump machines, the corresponding evaporator is directly exploited to bring about condensation of the moisture of the air of the forced flow. The water resulting from condensation is collected in a suitable container, from which, via a pump, it is brought into a container accessible by the user, for corresponding manual emptying.

[0006] The drying programs that can be executed on known machines have a duration roughly comprised between 60 and 210 minutes. The temperature of the air is in general comprised between 55°C and 65°C, whilst the normal speed of rotation of the drum is in general between 30 and 60 r.p.m.. A drying program typically comprises at least one drying step, in the course of which the drum is set in rotation in the presence of the flow of heated air. In the course of the aforesaid step, there may be envisaged substeps, which include pauses in rotation of the drum, reversal of the direction of rotation, short variations of the speed of rotation of the drum. There are, for example, known solutions in which in the course of a first part of the drying step short substeps of high-speed centrifugation are envisaged, for example with a speed of rotation of the drum of 1000 r.p.m. and higher, for approximately two minutes see for instance EP 0684335 A1, upon which the preambles of claims 1 and 12 are based. These substeps of *"vigorous spinning"* have the purpose of facilitating detachment of water from the items of laundry by centrifugal force in order to reduce the overall drying time. This high-speed spinning has, however, the effect of causing considerable stresses on the garments being treated, with the risks of damage and wear that result therefrom. In addition, it can typically be implemented just on washer-drier machines, given that these are designed to reach such high speeds of rotation of the drum.

[0007] The end of the drying step is determined by reaching of a certain predetermined condition associated to the program itself, detected by the control system of the machine. Said predetermined condition is typically represented by reaching of a predetermined program time, or of a temperature of the drying air or of a certain rate of humidity of the air or moisture of the load of laundry. Passage of the predetermined program time can be measured by the control unit of the machine, typically provided with an internal clock of its own, whilst the temperature and/or humidity can be detected via suitable sensor means belonging to the control system. Consequently, once the predetermined condition is reached, the drying step is brought to an end.

[0008] The programs for drying laundry typically comprise also a final cooling step, which follows the drying step. In the course of said final step the drum is made to turn at the normal speed, with the means for heating the air inactive and the ventilation means active. This final cooling step is carried out mainly because, below a threshold of absolute humidity, it becomes more advantageous to work by reducing the temperature in order to have a higher relative humidity

and favour condensation. The cooling step hence enables, at the end of the treatment cycle, a desired degree of moisture for the garments treated, it being possible for said degree of moisture to be predetermined by the program or set by the user. The step of cooling is useful also in order to reduce the temperature of the garments in view of them being taken out of the drum, for the cases in which it is desired for said removal to be carried out immediately after the end of the program.

[0009] From the document No. EP 0 404 047 A1, on which the preambles of Claims 1 and 12 are based, a process and a machine for drying laundry are known in which, in the course of a drying step, short substeps of *"gentle spinning"* of the load are envisaged, namely, substeps in the course of which the drum is made to assume a speed of rotation that is equal to or slightly higher than the lowest speed that enables the laundry to be kept adherent to the walls of the drum. Typically, the speed of gentle spinning is of between 80 and 240 r.p.m., for machines with a drum having a diameter of between 40 and 50 cm.

[0010] The substeps of gentle spinning are interspersed with short substeps of fast rotation of the drum and with substeps of arrest of rotation and/or of rotation at low speed (20-40 r.p.m.); the aforesaid fast rotation implies drum speeds of between 250 and 600 r.p.m., which are hence higher than the normal drying speed (30-60 r.p.m.) and than the satellization speed (approximately 80-240 r.p.m.). The substeps of gentle spinning have a relatively short duration: consider, in this regard, that execution of the sequence of a substep of fast rotation, a substep of gentle spinning, and a substep of pause of rotation and/or of rotation at low speed implies a total time of agitation of the laundry of between 20 and 200 seconds. For this reason, in the course of the drying step, a plurality of said sequences is to be envisaged.

Summary of the invention

[0011] The methodology described in EP 0 404 047 A1 is particularly aimed at reducing possible dimensional shrinkage due to matting and/or stretching typical in the case of garments made of certain delicate fabrics, such as wool, mohair, camel hair, cashmere, etc. Even though it is effective in this sense, the methodology proposed in the aforesaid prior document does not solve, rather aggravates, a typical problem of drying programs of a known type, namely, formation of significant amounts of fluff, which are released by the garments in the course of the treatment, with consequent fast clogging of the purposely provided air filter.

[0012] The object of the present invention is mainly to solve, in a simple and inexpensive way, the aforesaid drawback. Said object is achieved, according to the present invention, by a process and a machine for drying laundry having the characteristics specified in the annexed claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

[0013] Further purposes, characteristics, and advantages of the invention will emerge clearly from the ensuing detailed description, with reference to the annexed drawing, which is provided purely by way of explanatory and non-limiting example, in which Figure 1 is a partial and schematic cross section of a laundry-drier machine according to the invention.

Description of preferred embodiments of the invention

[0014] Reference to "an embodiment" or "one embodiment" in the context of the present description is intended to indicate that a particular configuration, structure, or characteristic described in relation to the embodiment is comprised in at least one embodiment. Hence, phrases such as "in an embodiment" or "in one embodiment" and the like, that may be present in various points of the present description, do not necessarily all refer to one and the same embodiment. Moreover, the particular configurations, structures, or characteristics can be combined in any adequate way in one or more embodiments. The references used in what follows are merely provided for convenience and do not define the sphere of protection or the scope of the embodiments.

[0015] It is moreover pointed out that in the sequel of the present description only the elements useful for an understanding of the invention will be described in particular detail, taking for granted that the machine forming the subject of the invention comprises all the other elements in themselves known for normal operation of a laundry-drier machine.

[0016] With particular reference to Figure 1, designated as a whole by 1 is a laundry-drier machine according to the present invention. In the case illustrated, the machine 1 is a drier machine, namely, a machine designed to perform only drying functions, of the condensation type.

[0017] The machine 1 has a load-bearing structure or cabinet 2, rotatably mounted within which is a drum 3, designed for containing the laundry. The drum 3 has a generally cylindrical shape and is mounted for rotating about a substantially horizontal axis of rotation. Provided within the cabinet 2 are means, of a type in itself known, for rotatably supporting the drum 3, which can, for example, be of a rolling type, such as wheels or rollers, or of a sliding type, such as runners.

[0018] The cabinet 2 has a front face, comprising a front wall 2a, having an opening - not indicated - on which a door

4 is mounted for enabling access to the inside of the drum 3. In the front face of the cabinet 2, in particular in its upper region, a control panel or user interface of the machine is provided, designated as a whole by 5. The panel 5 forms part of a control system of the machine, which includes a control unit 6, preferably of an electronic microcontroller type, prearranged for controlling execution of a plurality of operating programs of the machine.

[0019] The panel 5 can comprise at least one ON/OFF button, means for selection and start of one from a plurality of operating programs, means for selection of parameters of the operating programs that can be set by the user, and, preferably, display means. The aforesaid selection and starting means comprise, for example, a rotary selector with a number of positions and a program start button, but for the purpose other means of a type in itself known in the sector can obviously be used. Also the means for the selection of optional program parameters can include a selector and/or keys. The display means can comprise a display or warning lights.

[0020] The machine 1 comprises ventilation means, designed for generating a forced flow of air, and heating means, designed for heating the air of the forced flow, and motor means designed to bring about rotation of the drum 3 in a range of speeds, for example comprised between 0 r.p.m. and approximately 250 r.p.m., preferably between 0 and approximately 150 r.p.m.

[0021] In the example of embodiment illustrated, the ventilation means include a substantially closed path for the air (not indicated), defined in a known way within the cabinet 2, and possibly comprising a hollow part of the door 4. The aforesaid path substantially extends between an opening of the front wall of the drum 3 and at least one opening of the rear wall of the drum 3. In Figure 1, the white arrows (one of which is designated by F) indicate the forced flow along the aforesaid path and through the drum 3. The ventilation means further comprise a fan 7 that is operative along the aforesaid path and that can be driven, at a controllable speed, by the same motor 8 that is to bring about rotation of the drum 3, with the aid of a suitable transmission, here represented by a belt 8a. In a variant embodiment, not represented, the fan 7 is provided with a motor of its own.

[0022] Along the path for the air a filter 9 is provided of conception and operation in themselves known, which can be inspected by the user of the machine 1 and is designed to retain the fluff released into the forced flow F by the garments being treated.

[0023] In the embodiment exemplified, the means for heating the air include a heat pump 10, which operates along the path for the air and comprises a first heat exchanger 11, a second heat exchanger 12, and a compressor 13, which is operatively set between the two heat exchangers 11 and 12. The heat pump 10 can possibly include a respective filter for the air, not illustrated, accessible by the user.

[0024] It should be noted that the use of a heat pump for heating the drying air is to be understood as envisaged merely by way of example. In said perspective, in fact, the heat pump 10 can be replaced by one or more traditional electrical resistances, for example positioned in the ventilation circuit downstream of the fan 7 and upstream of the drum 3. In an embodiment of this sort, in the case of condensation drier machine, in the ventilation circuit, preferably upstream of the fan, a known device for condensation of the air will be provided (for example, substantially in the position occupied in Figure 1 by the heat pump 10).

[0025] Once again with reference to the non-limiting example of Figure 1, designated by 14 is a tray for collecting the water produced by condensation of the moisture present in the air of the forced flow F at output from the drum 3. In the example, associated to the tray 14 is a pump 14a, which, via a duct 15, takes the condensation water from the tray 14 to a removable container 16, positioned in the top part of the machine 1. To the container 16 there can be associated an overflow duct, not represented, in communication with the tray 14 itself.

[0026] The drying programs that can be selected via the selection means of the user interface 5 comprise treatment programs that terminate when at least one condition arises, which can be detected by the control system of the machine. As per the known art, the condition or conditions that determine the end of one of said programs can comprise program time and/or temperature of the air of the forced flow and/or rate of moisture of the items of laundry.

[0027] The rate of moisture of the load of laundry can be measured, for example, according to the criteria taught by the Italian norm CEI EN 61121 Ed.2 2007-10, according to which the value of moisture of the load identifies the amount of water contained in weight percentage of the dry load, according to the formula:

$$\text{moisture} = (\text{weight of moist load} - \text{weight of dry load}) / \text{weight of dry load}$$

where the weight of the dry load can be determined according to a procedure described in the aforesaid norm.

[0028] The control logic of the machine 1 detects, in the course execution of a drying program, via sensor means described hereinafter, data representing a value of moisture and compares them with reference data contained in the control logic. The aforesaid reference data, which also represent values of moisture, are obtained following upon experimental characterization tests, conducted in standardized conditions in order to associate said reference data to a rate of moisture. The aforesaid reference data can be organized in the control logic with modalities in themselves known in

the sector, for example, in tabular form or using fuzzy-logic techniques.

[0029] Expiry of the program time can be easily measured by the control unit 6, the microcontroller of which is equipped with an internal clock of its own, whilst the temperature of the air and the moisture of the garments can be detected by the unit 6 via purposely provided sensor means, of a type in itself known. In the example of Figure 1, the temperature of the air is detected via a sensor 25 (for example, of an NTC type) positioned in the ventilation circuit immediately downstream of the drum 3, whilst the moisture of the items of laundry is detected by means of a sensor 26 (for example, a conductivity sensor), which operates directly inside the drum, so as to come into contact with the load.

[0030] For use of the machine, the user can set the garment or garments to be dried in the drum 3 and close the door 4. After turning on the machine 1, the user can select the treatment program and the possible settable options associated thereto (for example, a value of residual moisture desired for the load at the end of the treatment cycle) and then start execution of the program itself. The control unit 6 thus governs start of the drying step, in the course of which the motor 8, the fan 7, and the heat pump 10 are activated. The program proceeds with modalities in themselves known: for example, the motor 8 is controlled so as to produce a rotation of the drum at a first speed of between 30 and 60 r.p.m. and the heat pump is controlled, with the aid of the sensor 25, to obtain a heating of the drying air to a temperature of between 55 and 65°C. This part of the drying step may possibly comprise pauses in the rotation of the drum, or substeps of slower rotation of the drum, or reversal of rotation of the drum, according to techniques in themselves known.

[0031] The load of the drum 3 is then progressively dried and de-humidified. In the course of the drying step the control unit 6 monitors not only the temperature of the air of the forced flow F, by means of the sensor 25, but also the moisture of the load, by means of the sensor 26.

[0032] The drying step comprises at least one substep during which the drum 3 is brought to assume a second speed of rotation, higher than the first speed. The increase in speed is governed by the control unit 6, which controls in an appropriate way the adjustable-speed motor 8. The aforesaid second speed is in particular equal to or higher than the minimum speed that enables the laundry to be kept adherent to the walls of the drum 3. Typically, the second speed is comprised between 80 and 240 r.p.m., since the diameter of the drum ranges between 45 and 65 cm. In a preferred embodiment, the second speed is comprised between approximately 80 and approximately 120 r.p.m..

[0033] According to the invention, the aforesaid substep at the second speed - hereinafter referred to as "satellization substep" - is started by the control unit 6 when the latter detects, by means of the sensor 26, that the value of moisture of the load of laundry is equal to or lower than a first predetermined moisture threshold (as has been said, the sensor 26 detects data representing the value of moisture). The control system 6 contains information representing the threshold value; i.e., said value is stored in the control unit or is obtained by the control unit on the basis of data or algorithms stored therein. The aforesaid threshold value represents a value of moisture of the load preferably comprised between approximately 5% and 15%, even more preferably between approximately 8% and 10%. In the course of the satellization substep the ventilation means 7 and heating means 10 are kept active.

[0034] The invention is based upon the perception of the fact that the release of fluff by the garments being treated, into the forced flow of air, starts or is higher precisely when the moisture of the garments being treated is relatively low, or drops below of a certain level, as has been said roughly comprised between 5% and 15%. In practice, the moisture of the garments acts as a "cushion" and protects the garment from the action of rubbing against the peripheral wall of the drum, which generates release of fluff. However, as the drying process proceeds, the moisture of the garments is reduced, thus rendering progressively less effective this protective effect of the garment in regard to release of fluff.

[0035] The satellization substep hence envisages a second speed of rotation equal to or slightly higher than the minimum speed that enables the laundry to be kept adherent to the walls of the drum 3, so as to minimize the stresses on the garments, preventing damage and wear thereof: the garments are safeguarded, given that rubbing thereof on the drum is prevented in a period in which, since the garments are almost dry, they are more subject to getting wear and generation of fluff.

[0036] The satellization substep has a relatively long duration, as compared with the similar substeps envisaged in EP 0 404 047, and in any case preferably not shorter than approximately 5 minutes.

[0037] In one embodiment of the invention, the satellization substep proceeds, with the drum 3 kept in rotation at the aforesaid second speed, up to the end of the drying step. In effect, in this case, the end of the satellization substep coincides with the end of the drying step. Albeit less advantageous, it is, however, possible to envisage that the drying step proceeds beyond the satellization substep, for example, with a substep in which the drum is brought back to the first speed.

[0038] Preferably, the drying step, or the satellization substep, terminates when a condition is reached that can be detected by the control system of the machine 1.

[0039] In one embodiment, the aforesaid condition comprises reaching of a value of moisture of the load of laundry that is equal to or lower than a second predetermined threshold, which is lower than the first threshold. Consequently, when the control unit 6 detects, via the sensor 26, to the moisture of the load has dropped below the aforesaid second threshold, the drying step (or the satellization substep) terminates. For this purpose, the control system 6 contains information representing the value of the second threshold; i.e., said value is stored in the control unit or is obtained by

the control unit on the basis of data or algorithms stored therein. For example, in one embodiment, the value of the second threshold is determined by the user in an indirect way, following upon selection, using the user-interface means 5, of a parameter corresponding to the desired value of moisture of the load at the end of the program (i.e., at the end of the treatment cycle). Also the second threshold may, however, be predetermined. The value of the second threshold preferably represents a value of moisture of the load roughly comprised between approximately -3% and approximately 12%.

[0040] In another embodiment, the condition that causes the end of the drying step, or of the satellization substep, is expiry of a given period of time. Said period of time can be measured by the control unit 6 and can be, for example, measured starting from start of the drying program or from start of the satellization substep. In one embodiment, the aforesaid period of time may be variable, in particular determined as a function of the weight of the load of laundry. For this purpose, in one embodiment, the machine 1 is provided with means for detecting or estimating the load of laundry, of a conception in itself known. In one embodiment, for example, the weight of the load of laundry is estimated according to the temperature of the air of the forced flow F leaving the drum 3, which can be detected via the sensor 25. In an embodiment of this sort, the control unit 6 monitors the variation in time of the temperature of the air of the forced flow F, during an initial period of the drying step, by means of algorithms based upon the criterion whereby the higher the load, the lower the temperature gradient.

[0041] Irrespective of the methodology used to determine the end of the drying step or the satellization substep, the control unit 6 de-activates the heat pump 10, and possibly de-activates also the fan 7 and the motor 8, for example when to the end of the drying step there corresponds the end of the treatment program. In the case where the program envisages a final step of cooling of the garments, operation of just the heat pump 10 can be interrupted, keeping, instead, active the fan 7 and the motor 8, with the latter for example brought back to the first speed (30-60 r.p.m.). Possibly, between the end of the drying step and the start of the cooling step a pause, or a step of slow rotation of the drum 3 may be envisaged.

[0042] In the possible cooling step that follows the drying step the air of the forced flow F is passed in the drum 3 without being heated, with the drum 3 in rotation. In one embodiment, also in at least one part of the cooling step, the drum 3 is brought to assume the aforesaid second speed of rotation in order to carry out a satellization of the load. In this case, start of a satellization substep is preferably independent of the moisture of the garments and can be started either at the start of the cooling step itself or else after a pre-determined time following starting thereof.

[0043] From the description provided, the characteristics of the present invention emerge clearly, as likewise its advantages.

[0044] The process and machine according to the invention afford extremely satisfactory drying results, with a production of fluff by the garments that is reduced as compared to known solutions. The air filter or filters envisaged in the ventilation circuit hence more get clogged slowly, to the advantage of the user and of the efficiency of the treatment cycle. The need for maintenance and cleaning of the filters is reduced.

[0045] The solution according to the invention hence enables a greater care for the garments being treated, reducing rubbing thereof on the drum. The solution according to the invention is advantageous for multiple types of fabric, whether these be fabrics that are relatively far from delicate, such as cotton or towelling, or delicate fabrics, such as wool and the like. The drying methodology proposed is particularly advantageous also for dark-coloured garments, for which the production of fluff is associated to loss of colour.

[0046] It is clear that numerous variations may be made by the person skilled in the art to the laundry-drier machine described by way example, without thereby departing from the scope of the invention as defined in the annexed claims.

[0047] In the preferred embodiments previously exemplified, the drying step envisages a continuous satellization substep, i.e., with the drum kept at the second speed up to the end of the substep. In possible variant embodiments, the substep can be divided into at least two parts, interspersed by reversal of the direction of rotation and/or short pauses of rotation and/or short periods of rotation of the drum at speeds different from the second speed (for example at the first speed or at even slower speeds), where by "short period" is meant a time roughly of between 5 and 15 seconds.

[0048] The invention may, of course, be applied also to machines for washing and drying laundry, by introducing arrangements that are evident for the person skilled in the art, taking into account that in this case the laundry drum turns inside a tank.

Claims

1. A process for drying laundry in a machine for drying laundry (1), the process comprising execution of a drying phase during which air of a forced flow (F) is heated and made to pass through a rotating drum (3) containing a laundry load, wherein the drying phase comprises at least one sub-phase during which the drum (3) is brought to take on a determined rotation speed, which is equal to, or higher than, the lowest speed allowing to hold the laundry adhering to a wall of the drum (3), the process comprising the steps of:

- detecting, during the drying phase, a value of moisture of the laundry load, and
- starting the said sub-phase when the detected value of moisture is equal to, or lower than, a first determined threshold,

characterized in that said first determined threshold is a threshold representative of a value of dampness of the laundry load comprised between 5% and 15%.

2. The process according to claim 1, wherein the said sub-phase lasts substantially not less than 5 minutes.

3. The process according to claim 1 or 2, wherein at least one of the drying phase and the said sub-phase ends upon achievement of a condition which is detectable by a control system (5, 6, 25, 26) of the machine (1).

4. The process according to claim 3, wherein the said sub-phase continues, with the drum (3) kept in rotation at the said determined speed, until ending of the drying phase.

5. The process according to one of preceding claims, wherein during the said sub-phase at least one reversal of the direction of rotation of the drum (3) and/or a short pause in the rotation of the drum (3) and/or a short period of rotation of the drum (3) at a speed which is different from the said determined speed is provided for.

6. The process according to claim 3, wherein the said condition comprises at least one of

- achievement of a value of dampness of the laundry load which is equal to, or lower than, a second determined threshold, which is lower than the first threshold,
- expiration of a determined period of time.

7. The process according to claim 6, wherein the said period of time is determined as a function of the weight of the laundry load.

8. The process according to claim 6, wherein the second threshold is determined as a function of a parameter selectable by a user of the machine (1).

9. The process according to any one of the preceding claims, further comprising a cooling phase of the laundry load which follows the drying phase, wherein during the cooling phase air of the forced flow (F) is made to pass through the drum (3) without being heated, with the drum (3) set in rotation (3), where in particular for at least one part of the cooling phase the drum (3) is brought to take on the said determined rotation speed.

10. The process according to any one of the preceding claims, wherein said determined rotation speed is substantially comprised between 80 and 240 rpm, preferably between about 80 and 120 rpm.

11. The process according to claim 6 or claim 8, wherein said second threshold is representative of a value of dampness of the laundry load comprised between -3% and 12%.

12. A machine for drying laundry, having a cabinet (2) within which a rotatable laundry drum (3) is housed, the machine (1) having ventilation means (7), adapted to generate a forced flow of air (F), heating means (10), adapted to heat air of the forced flow (F), motor means (8, 8a), adapted to cause rotation of the drum (3), a control system (5, 6, 25, 26) prearranged for controlling execution of at least one operating program which comprises one drying phase, during which air of the forced flow (F) is heated and made to pass through the drum (3), wherein the drying phase includes at least one sub-phase during which the drum (3) is brought to take on a determined rotation speed, which is equal to, or greater than, the lowest speed allowing to hold the laundry adhering to a wall of the drum (3), wherein

- the control system (5, 6, 25, 26) comprises sensor means (26) for detecting, during the drying phase, values of moisture of the laundry load contained in the drum (3),

characterized in that

- the control system (5, 6, 25, 26) contains information which is representative of a first moisture threshold value representative of a value of dampness of the laundry load comprised between 5% and 15%, and
- the control system (5, 6, 25, 26) is prearranged for starting the said sub-phase when a detected value of

moisture is equal to, or lower than, the said first threshold value.

13. The machine according to claim 12, wherein the control system (5, 6, 25, 26) is prearranged for controlling continuation of the said sub-phase, with the drum (3) kept at the determined speed, until achievement of a condition which is detectable by the control system (5, 6, 25, 26).

14. The machine according to claim 12, wherein

- the control system (5, 6, 25, 26) contains information representative of a second moisture threshold value, lower than the first moisture threshold value, and wherein the control system (5, 6, 25, 26) is prearranged for stopping the said sub-phase when a detected value of moisture is equal to, or lower than, the second threshold value, or
- the control system (5, 6, 25, 26) is prearranged for stopping the said sub-phase upon expiration of a determined period of time.

15. The machine according to claim 14, wherein the control system (5, 6, 25, 26) comprises means for estimating the weight of the laundry load and is prearranged for determining the said determined period of time as a function of the weight of the laundry load.

Patentansprüche

1. Verfahren zum Trocknen von Wäsche in einer Maschine zum Wäschetrocknen (1), wobei das Verfahren das Ausführen einer Trocknungsphase umfasst, während der Luft einer erzwungenen Strömung (F) erwärmt wird und zum Durchführen durch eine rotierende Trommel (3), in der eine Wäscheladung beinhaltet ist, gebracht wird, wobei die Trocknungsphase mindestens eine Teilphase umfasst, während der die Trommel (3) dazu gebracht wird, eine bestimmte Drehgeschwindigkeit anzunehmen, die gleich der oder höher als die geringste Geschwindigkeit ist, die ein Halten der Wäsche an einer Wand der Trommel (3) erlaubt, wobei das Verfahren die Schritte umfasst:

- Detektieren, während der Trocknungsphase, eines Wertes der Feuchtigkeit der Wäscheladung und
- Starten der Teilphase, wenn ein Wert der Feuchtigkeit detektiert wird, der gleich dem oder geringer als ein erster bestimmter Schwellenwert ist, **gekennzeichnet dadurch, dass** der erste bestimmte Schwellenwert ein Schwellenwert ist, der repräsentativ für einen Wert der Feuchte der Wäscheladung zwischen 5 % und 15 % ist.

2. Verfahren nach Anspruch 1, wobei die Teilphase im Wesentlichen nicht weniger als 5 Minuten dauert.

3. Verfahren nach Anspruch 1 oder 2, wobei mindestens eine der Trocknungsphase und der Teilphase beim Erreichen einer Bedingung, die durch ein Steuersystem (5, 6, 25, 26) der Maschine (1) detektierbar ist, endet.

4. Verfahren nach Anspruch 3, wobei die Teilphase mit der Trommel (3), die in Drehung mit der bestimmten Geschwindigkeit gehalten wird, fortgesetzt wird, bis die Trocknungsphase endet.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei während der Teilphase mindestens eine Umkehr der Richtung der Drehung der Trommel (3) und/oder eine kurze Pause der Rotation der Trommel (3) und/oder eine kurze Dauer einer Rotation der Trommel (3) bei einer Geschwindigkeit, die unterschiedlich von der bestimmten Geschwindigkeit ist, vorgesehen ist.

6. Verfahren nach Anspruch 3, wobei die Bedingung mindestens eines umfasst von einem

- Erreichen eines Wertes der Feuchte der Wäscheladung, die gleich einem oder geringer als ein zweiter bestimmter Schwellenwert, der geringer als der erste Schwellenwert ist und einem
- Ablaufen einer bestimmten Zeitdauer.

7. Verfahren nach Anspruch 6, wobei die Zeitdauer als eine Funktion des Gewichts der Wäscheladung bestimmt ist.

8. Verfahren nach Anspruch 6, wobei der zweite Schwellenwert als eine Funktion eines Parameters, der von einem Benutzer der Maschine (1) auswählbar ist, bestimmt wird.

9. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend eine Kühlungsphase der Wäscheladung, die auf die Trocknungsphase folgt, wobei während der Kühlungsphase Luft der erzwungenen Strömung (F) dazu gebracht wird, durch die Trommel (3) hindurchgeführt zu werden, ohne erhitzt zu werden, wobei die Trommel (3) in Rotation (3) versetzt wird und insbesondere für mindestens einen Teil der Kühlungsphase die Trommel (3) dazu gebracht wird, die bestimmte Rotationsgeschwindigkeit anzunehmen.

10. Verfahren nach einem der vorhergehenden Ansprüche, wobei die bestimmte Drehgeschwindigkeit im Wesentlichen zwischen 80 und 240 U/min, vorzugsweise zwischen etwa 80 und 120 U/min, liegt.

11. Verfahren nach einem der Ansprüche 6 oder 8, wobei der zweite Schwellenwert repräsentativ für einen Wert einer Feuchte der Wäscheladung zwischen -3% und 12 % ist.

12. Maschine zum Trocknen von Wäsche mit einem Gehäuse (2), in dem eine drehbare Wäschetrommel (3) beherbergt ist, wobei die Maschine (1) Ventilationsmittel (7) umfasst, die eingerichtet sind, eine erzwungene Strömung einer Luft (F) zu generieren, Heizmittel (10), die eingerichtet sind, Luft der erzwungenen Strömung (F) zu erwärmen, Motormittel (8, 8a), die eingerichtet sind, eine Rotation der Trommel (3) hervorzurufen, ein Steuersystem (5, 6, 25, 26), das eingerichtet ist, um das Ausführen mindestens eines Betriebsprogramms, das eine Trocknungsphase umfasst, zu steuern, während Luft einer erzwungenen Strömung (F) erwärmt und dazu gebracht wird, durch die Trommel (3) hindurchgeführt zu werden, wobei die Trocknungsphase mindestens eine Teilphase umfasst, während der die Trommel (3) dazu gebracht wird, eine bestimmte Drehgeschwindigkeit anzunehmen, die gleich der oder größer als die geringste Geschwindigkeit ist, die ein Halten der Wäsche an einer Wand der Trommel (3) erlaubt, wobei

- das Steuersystem (5, 6, 25, 26) Sensormittel (26) zum Detektieren von Werten der Feuchtigkeit der Wäscheladung, die in der Trommel (3) enthalten ist, umfasst,

dadurch gekennzeichnet, dass

- das Steuersystem (5, 6, 25, 26) Informationen enthält, die repräsentativ für einen ersten Feuchtigkeitsschwellenwert, der repräsentativ für einen Wert der Feuchte einer Wäscheladung zwischen 5 % und 15 % ist, und
- das Steuersystem (5, 6, 25, 26) eingerichtet ist, um die Teilphase zu starten, wenn ein Wert der Feuchtigkeit detektiert wird, der gleich dem oder geringer als der erste Schwellenwert ist.

13. Maschine nach Anspruch 12, wobei das Steuersystem (5, 6, 25, 26) eingerichtet ist, um ein Fortsetzen der Teilphase zu steuern, bei der die Trommel (3) in der vorbestimmten Geschwindigkeit gehalten wird, bis eine Bedingung erreicht wird, die durch das Steuersystem (5, 6, 25, 26) detektiert wird.

14. Maschine nach Anspruch 12, wobei

- das Steuersystem (5, 6, 25, 26) Informationen beinhaltet, die repräsentativ für einen zweiten Feuchteschwellenwert sind, der geringer als der erste Feuchteschwellenwert ist, und wobei das Steuersystem (5, 6, 25, 26) eingerichtet ist, um die Teilphase zu stoppen, wenn ein Wert der Feuchte detektiert wird, der gleich dem oder geringer als der zweite Schwellenwert ist, oder
- das Steuersystem (5, 6, 25, 26) eingerichtet ist, um die Teilphase beim Erreichen einer bestimmten Zeitdauer zu stoppen.

15. Maschine nach Anspruch 14, wobei das Steuersystem (5, 6, 25, 26) Mittel zum Bestimmen des Gewichts der Wäscheladung umfasst und eingerichtet ist, die bestimmte Zeitdauer als Funktion des Gewichts der Wäscheladung zu bestimmen.

Revendications

1. Procédé pour sécher le linge dans une machine à sécher le linge (1), le procédé comprenant l'exécution d'une phase de séchage pendant laquelle l'air d'un flux forcé (F) est chauffé et entraîné au travers d'un tambour rotatif (3) contenant une charge de linge, la phase de séchage comportant au moins une sous-phase pendant laquelle le tambour (3) prend une vitesse de rotation déterminée, laquelle est supérieure ou égale à la plus faible vitesse permettant de maintenir le linge plaqué contre une paroi du tambour (3), le procédé comportant les étapes de :

- détecter, pendant la phase de séchage, une valeur d'humidité de la charge de linge, et
- démarrer ladite sous-phase lorsque la valeur d'humidité détectée est inférieure ou égale à un premier seuil déterminé,

caractérisé en ce que ledit premier seuil déterminé est un seuil représentatif d'une valeur de l'humidité de la charge de linge comprise entre 5% et 15%.

2. Procédé selon la revendication 1, dans lequel ladite sous-phase ne dure sensiblement pas moins de 5 minutes.

3. Procédé selon la revendication 1 ou 2, dans lequel au moins l'une de la phase de séchage et de ladite sous-phase se termine lors de l'obtention d'une condition pouvant être détectée par un système de commande (5, 6, 25, 26) de la machine (1).

4. Procédé selon la revendication 3, dans lequel ladite sous-phase se poursuit, le tambour (3) étant maintenu en rotation à ladite vitesse déterminée, jusqu'à la fin de la phase de séchage.

5. Procédé selon l'une des revendications précédentes, dans lequel, pendant ladite sous-phase, au moins une inversion du sens de rotation du tambour (3) et/ou une courte pause dans la rotation du tambour(3) et/ou une courte période de rotation du tambour (3) à une vitesse différente de ladite vitesse déterminée, est prévue.

6. Procédé selon la revendication 3, dans lequel ladite condition comporte au moins :

- l'obtention d'une valeur d'humidité de la charge de linge inférieure ou égale à un deuxième seuil déterminé, inférieur au premier seuil, et/ou
- l'expiration d'une durée déterminée.

7. Procédé selon la revendication 6, dans lequel ladite durée est déterminée en fonction du poids de la charge de linge.

8. Procédé selon la revendication 6, dans lequel le deuxième seuil est déterminé en fonction d'un paramètre ajustable par un utilisateur de la machine (1).

9. Procédé selon l'une quelconque des revendications précédentes, comportant, de plus, une phase de refroidissement de la charge de linge suite à la phase de séchage, pendant la phase de refroidissement, l'air du flux forcé (F) étant entraîné au travers du tambour (3) sans être chauffé, le tambour (3) étant entraîné en rotation, en particulier pendant au moins une partie de la phase de refroidissement, le tambour (3) prenant ladite vitesse de rotation déterminée.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite vitesse de rotation déterminée est sensiblement comprise entre 80 et 240 tours par minute, de préférence entre 80 et 120 tours par minute environ.

11. Procédé selon la revendication 6 ou la revendication 8, dans lequel ledit deuxième seuil est représentatif d'une valeur d'humidité de la charge de linge comprise entre -3% et 12%.

12. Machine à sécher le linge, comportant un châssis (2) à l'intérieur duquel est logé un tambour rotatif destiné au linge (3), la machine (1) comportant des moyens de ventilation (7), agencés pour générer un flux d'air forcé (F), des moyens de chauffage (10), agencés pour chauffer l'air du flux forcé (F), des moyens moteur (8, 8a), agencés pour entraîner la rotation du tambour (3), un système de commande (5, 6, 25, 26) préconfiguré pour commander l'exécution d'au moins un programme de fonctionnement comportant une phase de séchage, pendant laquelle l'air du flux forcé (F) est chauffé et entraîné au travers du tambour (3), la phase de séchage comprenant au moins une sous-phase pendant laquelle le tambour (3) prend une vitesse de rotation déterminée, laquelle est supérieure ou égale à la plus faible vitesse permettant de maintenir le linge plaqué contre une paroi du tambour (3),

- le système de commande (5, 6, 25, 26) comportant des capteurs (26) pour détecter, pendant la phase de séchage, des valeurs d'humidité de la charge de linge contenue dans le tambour (3),

caractérisée en ce que

- le système de commande (5, 6, 25, 26) contient une information représentative d'une première valeur de seuil d'humidité représentative d'une valeur d'humidité de la charge de linge comprise entre 5% et 15%, et

- le système de commande (5, 6, 25, 26) est préconfiguré pour démarrer ladite sous-phase lorsqu'une valeur d'humidité détectée est inférieure ou égale à ladite première valeur de seuil.

13. Machine selon la revendication 12, dans laquelle le système de commande (5, 6, 25, 26) est préconfiguré pour commander la poursuite de ladite sous-phase, le tambour (3) étant maintenu à la vitesse déterminée, jusqu'à l'obtention d'une condition pouvant être détectée par le système de commande (5, 6, 25, 26).

14. Machine selon la revendication 12, dans laquelle

- le système de commande (5, 6, 25, 26) contient une information représentative d'une deuxième valeur de seuil d'humidité, inférieure à la première valeur de seuil d'humidité, le système de commande (5, 6, 25, 26) étant préconfiguré pour arrêter ladite sous-phase lorsqu'une valeur d'humidité détectée est inférieure ou égale à la deuxième valeur de seuil, ou
- le système de commande (5, 6, 25, 26) est préconfiguré pour arrêter ladite sous-phase à l'expiration d'une durée déterminée.

15. Machine selon la revendication 14, dans laquelle le système de commande (5, 6, 25, 26) comporte des moyens pour estimer le poids de la charge de linge et est préconfiguré pour déterminer ladite durée déterminée en fonction du poids de la charge de linge.

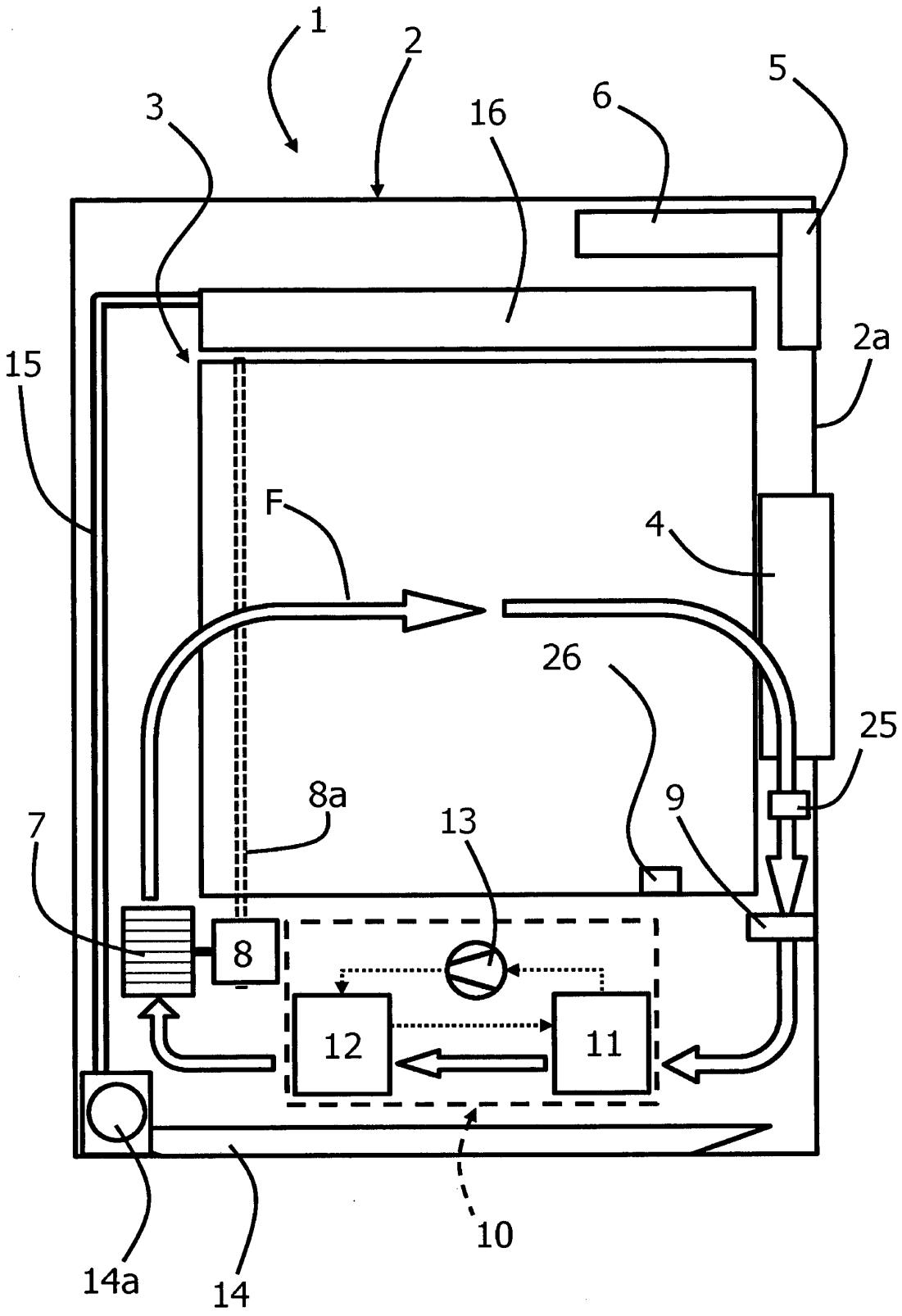

Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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