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(54) Operation control method for a drum type washing machine

Verfahren zur Steuerung einer Trommelwaschmaschine

Procédé de commande d'une machine à laver à tambour

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(73) Proprietor: **LG Electronics, Inc.**
Seoul 150-721 (KR)

(72) Inventors:
- **Ahn, Byung Hwan**
  Gyeongsangnam-do (KR)
- **Kim, Kwang Soo**
  Gyeongsangnam-do (KR)

(74) Representative: **Neobard, William John et al**
Kilburn & Strode LLP
20 Red Lion Street
London WC1R 4PJ (GB)

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Description

Field of the Invention

[0001] The present invention relates to a method for controlling operation of a horizontal or tilt type drum washing machine, in which uniform introduction of hot air deep into an inside of a drum is made possible for enhancing drying capability and efficiency; and an operation control method thereof.

Discussion of the Related Art

[0002] In general, in the washing machines, there are a pulsator type washing machine of a top loading type, and a drum type washing machine (in general called as a drum washing machine) having a drum laid down in a horizontal direction, substantially.

[0003] As described before, since the drum is laid down in a horizontal direction, the drum washing machine performs the washing by a method in which laundry introduced into an inside of the drum is lifted and dropped during rotation of the drum.

[0004] Moreover, recently even demands on washing and drying machines increase gradually, which has not only washing and water extraction functions, but also a drying function.

[0005] Even in the drum washing machine, there are a drum washing machine of a type the drum thereof is laid down in a horizontal direction fully, and a tilted type drum washing machine of which drum is tilted at an angle from a horizontal plane, and, depending on a direction of introduction/taking out of laundry into/from the drum, there are a front loading type, and a top loading type drum washing machines.

[0006] FIGS. 1 and 2 illustrate basic exemplary structures of above washing and drying machines, schematically.

[0007] That is, the washing and drying machine is provided with a body 10, a tub 20 mounted on an inside of the body 10, a drum 30 rotatably mounted on an inside of the tub 20, washing water supply pipes 51 for guiding flow of the washing water, a driving unit for driving the drum 30, and a drying device for supplying heated air to an inside of the tub 20.

[0008] On a front of the body 10, there is an opening for introduction of laundry, with a door 40 thereon for opening/closing the opening. Between the front of the body 10 and the tub 20, there is a gasket 11.

[0009] The tub 20 is supported, and mounted in the body 10. There may be a washing water drying heater 80 on a bottom of an inside of the tub 20, for controlling a temperature of the washing water used for washing.

[0010] The drum 30 is rotatably mounted in the tub 20, and has a plurality of through holes 31 (see FIG 2) in a circumferential surface for flow in/out of the washing water.

[0011] The washing water supply pipe 51, for flow of the washing water, guides the washing water from a service pipe to the inside of the tub 20 through a water supply valve 52. There is a detergent box 53 in the washing water supply pipe 51 for storing detergent required for washing, so that the washing water being supplied to the inside of the tub 20 carries the detergent. The detergent box 53 in an upper space of the body 10 is designed to enable introduction of the detergent.

[0012] The washing water supply pipe 51 has an end connected to a front of an upper portion of the tub 20 for filling up the tub 20 with the washing water from a bottom thereof by free falling of the washing water.

[0013] The driving unit is provided with a drum driving motor 71, and a belt 72 for transmission of a driving power from the drum driving motor 71 to the drum 30. Recently, instead of the driving unit, a direct coupling type BLDC motor is used, which is mounted on a rear wall of the tub for direct transmission of the driving power from the motor to the drum.

[0014] The drying device is provided with a drying duct 60 for flow of air, a drying heater 61 in the drying duct 60, and a fan 62 for forced circulation of air. The drying duct 60 has one end connected to the tub 20 at a lower portion of a front side of an outside circumference thereof and the other end connected to the gasket 11, for circulation of air through the inside of the tub 20.

[0015] Connected to the drying duct 60, there is a cooling water supply pipe 54 for supplying cooling water to the air flowing along the drying duct 60 toward the drying heater after drying laundry to condense moisture therein. By removing the moisture from the air, the cooling water prevents drop of performance of the fan 62, and drop of efficiency of the drying heater 61.

[0016] The cooling water supply pipe 54 is connected to the water supply valve 52 for supplying washing water. The water supply valve 52 is operated such that only a very low rate of water is supplied to the drying duct 60 compared to a rate of the washing water supply to the drum 30 through the washing water supply pipe 51, if water supply to the drying duct 60 through the cooling water supply pipe 54 is required for condensing.

[0017] In the meantime, while the related art drum washing machine progresses drying by rotating the drum 30 at a low speed (about 20 - 30 rpm) after washing, and spinning, the hot air, heated and dried by the drying heater, is introduced into the inside of the drum through, in general, a connection portion to the gasket 11 on the front of the drum 30, converted into humid air by the drying action, and escapes through a lower side of a front of the drum 30 again.

[0018] That is, referring to FIGS. 1 and 3, because the drying duct draws humid air from the front side of the outside circumference of the tub, the hot air fails to be introduced deep into an inside of the drum 30, but circulates only on an entrance side and is directly discharged to a lower side of the front of the drum 30.

[0019] Therefore, since the hot air escapes the drum 30 before the hot air can be used fully for drying in the

drum 30, the drying performance, and efficiency are impaired, and input of unnecessary energy is required, resulting in waste of energy.

[0020] In short, with regard to a main flow path of the hot air in the related art drum washing machine, because the hot air fails to reach to the laundry located far from a hot air inlet fully, failing to dry the laundry uniformly to impair the drying performance, to require drying for a long time, the drying efficiency is also reduced.

[0021] EP-A-0816549 discloses a domestic washing machine having a closed drying circuit, air condensation of vapour and self cleaning filter.

[0022] JP-A-0833669 discloses a washer-dryer having inside a casing a tub supported by a suspension, a spin basket placed inside the tub and controlled in such a way that it is freely rotated about a horizontal axis by a driving motor; a dry air circulation passage through which dry air is fed into the spin basket; and a water storage tank.

[0023] EP-A-0761864, upon which the preamble of claim 1 is based, discloses a method and machine for drying laundry in which during its drying cycle the drum of the machine rotates at a speed which is lower than the spin speed but higher than the normal drying speed, so that the washing is distributed round the outside of the drum and does not impede the flow of drying air fed into its centre.

[0024] JP2002-35468 discloses a washing machine and drier.

[0025] The present application is directed to an operation control method thereof that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0026] An object of embodiments of the present invention is to provide an operation control method thereof, in which hot air can be blown deep into an inside of the drum, to introduce the hot air into an inside space of the drum uniformly for drying the laundry. That is, an object of embodiments of the present invention is to provide an operation control method thereof, which enables full use of the hot air introduced into the inside of the drum for enhancing the drying performance, and efficiency.

[0027] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0028] Aspects of an invention are defined in the appended claims.

[0029] In an embodiment, the hot air supplied to an inside of the drum is supplied to an inside of the drum is supplied from an upper portion of a front side of the drum to a lower portion of a rear side of the drum, or an upper portion of a rear side of the drum to a lower portion of a front side of the drum.

[0030] In an embodiment, the method further comprises at least one time of: a section for turning on a drum driving motor to accelerate a rotation speed of the drum to a speed equal to, or higher than a speed enough to keep the laundry in the drum attached to, and not fall off from, the inside surface of the drum; a section for maintaining the rotating speed of the drum at a speed equal to, or higher than a speed enough to keep the laundry in the drum attached to, and not fall off from, the inside surface of the drum; and a section for reducing the rotating speed of the drum to a low speed at which the laundry in the drum is unable to be attached to, but to fall off from, the inside surface of the drum, for progressing drying.

[0031] In an embodiment the section for reducing the rotating speed of the drum to a low speed at which the laundry in the drum may be unable to be attached to, but to fall off from, the inside surface of the drum, for processing drying includes the step of alternating a rotating direction of the drum.

[0032] In a further embodiment, the method further comprises the step of measuring dryness of the laundry in the drum in the middle of progressing a drying cycle.

[0033] In an embodiment, the dryness is measure in a state the drum is stationary, or the rotation speed of the drum is enough to keep the laundry attached to, and not fall from, the inside circumferential surface of the drum.

[0034] In an embodiment, depending on a result of measurement of the dryness, the method further comprises the steps of: raising the rotating speed of the drum to maintain a speed enough to keep the laundry attached to, and not fall off from, the inside surface of the drum for progressing drying, if measured dryness is below a preset dryness; and reducing the rotating speed of the drum to a low speed at which the laundry is unable to be attached to, but fall off from, the inside surface of the drum, for progressing drying, if measured dryness is higher than the preset dryness.

[0035] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

FIG 1 illustrates a side section of a related art washing and drying machine, schematically;

FIG 2 illustrates a front section of the washing and drying machine in FIG 1;

FIG 3 illustrates a diagram showing a main flow path of hot air on an entrance side of a drum in a related art drum washing machine, for reference;

FIG 4 illustrates a drum washing machine showing a hot air circulating structure;

FIG 5 illustrates a drum washing machine showing another hot air circulating structure;

FIG 6 illustrates a front view of a rear wall portion of

a tub cut along a I-I line in FIG 5 for showing a through hole structure in the tub;

FIG 7 illustrates a flow chart showing the steps of a first method for controlling operation of a drum washing machine embodying the present invention;

FIG 8 illustrates a flow chart showing steps for controlling operation of a drum washing machine;

FIG 9 illustrates a flow chart showing steps for controlling operation of a drum washing machine ;

FIG 10 illustrates a flow chart showing steps for controlling operation of a drum washing machine; and

FIG 11 illustrates a graph showing a rotation speed of a motor for driving the drum, and turn on/off states of drying heater and fan while drying.

[0036] In the various figures, like reference figures indicate like parts.

[0037] Referring to FIG 4, a drum washing machine includes a tub 20 for holding washing water, a drum 30 rotatably mounted on an inside of the tub 20, for introducing laundry therein, a drying heater 61 for heating air being supplied to the inside of the drum 30, a drying duct 60 forming a flow passage for supplying hot air heated by the drying heater 61, and fan 62 for forced supply of the hot air heated by the drying heater 61 to the inside of the drum 30, wherein a hot air inlet 60a is positioned at a front of the drum 30, and a humid air recovery opening 60b is positioned at a rear of the drum 30.

[0038] More specifically, the hot air inlet 60a is positioned at upper side of the front of the drum 30, and the humid air opening 60b is positioned at a lower side of the rear of the drum 30.

[0039] Even though FIG 4 illustrates a horizontal type drum washing machine, of course, the hot air supply and exhaust structure is also applicable to the tilt type drum washing machine.

[0040] A hot air circulating structure of the drum washing machine will be described.

[0041] Referring to FIG 4, in drying, the hot air is introduced into the inside of the drum through an upper portion of the front of the drum 30 by the forced air blow action of the fan 62, flows from the front to a rear of the drum along a direction of the arrow, passes a lower portion of a rear side of the drum, and is introduced into the drying duct 60 through the humid air recovery opening 60b in the rear wall of the tub 20.

[0042] Referring now to FIG 5, a drum washing machine includes a tub 20 for holding washing water, a drum 30 rotatably mounted on an inside of the tub 20, for introducing laundry therein, a drying heater 61 for heating air being supplied to the inside of the drum 30, a drying duct 60 forming a flow passage for supplying hot air heated by the drying heater 61, and fan 62 for forced supply of the hot air heated by the drying heater 61 to the inside of the drum 30, wherein a hot air inlet 60a is positioned at a rear of the drum 30, and a humid air recovery opening 60b is positioned at a front of the drum 30.

[0043] More specifically, the hot air inlet 60a is positioned at an upper side of the rear of the drum 30, and the humid air opening 60b is positioned at a lower side of the front of the drum 30.

[0044] It is preferable that there is a guide flow passage 21 at the lower side of the tub 20 for guiding humid air from the humid air recovery opening 60b at the lower side of the front of the drum 30 to the drying duct 60.

[0045] Meanwhile, even though FIG. 5 illustrates a tilt type drum washing machine, of course, the hot air supply and exhaust structure is also applicable to the horizontal type drum washing machine.

[0046] A hot air circulating structure of the drum washing machine will be described.

[0047] Referring to FIG. 5, in drying, the hot air is introduced into the inside of the drum through an upper portion of the rear of the drum 30 by the forced air blow action of the fan 62, flows from the rear to a front of the drum along a direction of the arrow, passes a lower portion of a front side of the drum, and flows toward the humid air recovery opening 60b of the drying duct 60 along the guide flow passage 21 in the lower side of the tub 20.

[0048] In the meantime, the drum type washing machine in accordance with the present disclosure, the tub 20 is formed of stainless steel, or plastic. Regardless of material of the tub 20, in the rear wall of the tub, there are the hot air inlet 60a for supplying hot air, and a hot air outlet 60c for discharge of the hot air (see FIG. 6).

[0049] It is favorable that the hot air inlet 60a and the hot air outlet 60c each has a shape of slot, especially in a shape of an arc in view of strength of the tub rear wall, and connected to the drying duct 60, directly.

[0050] Meanwhile, alike the related art drum, the drum of the present disclosure has a plurality of pass through holes in an outside circumferential surface of the drum, which are not shown in the drawings.

[0051] Next, the steps of operation control methods will be described with reference to FIGS. 7 ~ 11. First, referring to FIG. 7, an operation control method in accordance with embodiments will be described.

[0052] In a drying cycle, while rotating the drum at a speed equal to or higher than a speed (for an example, 100rpm) enough to keep the laundry to be attached to, and not to fall from, but not to be attached closely to, the inside surface of the drum, the hot air is supplied to an inside of the drum, for progressing drying.

[0053] The speed enough to keep the laundry to be attached to, and not to fall off from, but not to be attached closely to the inside surface of the drum, is a speed at which an outward acceleration acting on a point of an inside circumferential surface of the drum in a radial direction of the drum is equal to an acceleration of the gravity.

[0054] In the meantime, the hot air supplied to the inside of the drum flows in a direction along a driving shaft of the drum. That is, the hot air flows from the hot air inlet 60a (see FIG 4) in the front of the drum to the rear of the drum, or from the hot air inlet 60a (see FIG. 5) to the front of the drum. For this, it is preferable that the hot air is supplied from the upper side of the front of the drum to the lower side of the rear of the drum, or from the upper side of the rear of the drum to the lower side of the front of the drum.

[0055] According to this, if the hot air is supplied in the driving shaft direction of the drum in a state the drum rotates at the speed enough to keep the laundry to be attached to, and not to fall off from an inside surface of the drum, the hot air progresses along the driving shaft direction while swirling along the inside circumferential surface of the drum.

[0056] That is, the hot air progresses in a form of a swirl starting from the front side of the drum to the rear side of the drum until the hot air escapes therefrom, or the hot air progresses in a form of a swirl starting from the rear side of the drum to the front side of the drum until the hot air escapes therefrom. According to this, contact of the hot air with the laundry on the inside circumferential surface of the drum increases, to enhance the drying performance, and efficiency.

[0057] In the meantime, it is preferable that the drying cycle progressed thus includes an acceleration section in which the motor for driving the drum is turned on, to accelerate a rotation speed of the drum until the rotation speed reaches to a preset speed which is equal to, or higher than a speed enough to keep the laundry in the drum to be attached to, and not to fall off from the inside surface of the drum, a section for maintaining the rotation speed at the preset speed, and a section in which the rotation speed of the drum is reduced to a low speed (about 20 - 30rpm) at which the laundry in the drum is unable to be attached to, but to fall from the inside surface of the drum, for progressing drying.

[0058] It is more preferable that above acceleration, maintained speed, and low speed sections are performed at least once repeatedly before finish of the drying. This is for enhancing the drying efficiency by keeping exposing portions of the laundry that are not dried yet by changing positions of the laundry.

[0059] It is meantime, it is preferable that a rotation direction of the drum is alternated in the section drying is progressed in a low speed state in which the laundry falls from the inside surface of the drum.

[0060] Next, referring to FIG. 8, an operation control method in accordance with embodiments will be described.

[0061] The method for controlling drying laundry in a horizontal, or tilted type drum washing machine in accordance with the the present disclosure includes the steps of turning off a drum driving motor as spinning is finished, turning on a drying heater and a fan, and turning on the drum driving motor again before the laundry kept attached to an inside circumferential surface of the drum at the time of spinning falls to maintain a threshold speed enough to keep the laundry to be attached to the inside circumferential surface of the drum and supplying heated air into an inside of the drum, to progress drying.

[0062] That is, after turning off the driving motor, hot air is supplied while maintaining the drum at a speed higher than the threshold speed at which the laundry kept attached to the inside circumferential surface of the drum does not fall by turning on the drum driving motor again before the speed of the drum rotating by inertia drops to a speed at which the laundry kept attached to the inside circumferential surface of the drum falls.

[0063] In this instance, the drying heater and the fan may be turned on at the same time with turning off the drum driving motor when the spinning is finished, or the drying heater and the fan may be turned on after a predetermined time period is passed from the turning off of the drum driving motor. In this instance, no braking force is applied to the drum, so that the drum spinning in a state the drum driving motor is turned off as the spinning is finished rotates freely by the inertia. The drying heater and the fan may, or may not be turned on at the same time.

[0064] The hot air flows along a direction of a drum driving shaft line in the drum, for which it is preferable that the hot air is supplied from a front to a rear of the drum, or vice versa, like the first embodiment.

[0065] The dry progressing step includes a section in which the rotation speed of the drum is maintained at a speed equal to, or higher than a speed (for an example, 100rpm) enough to keep the laundry in the drum to be attached to, and not to fall off from, but not to be attached closely to, the inside circumferential surface of the drum, and optionally may include a section in which the rotation speed of the drum is reduced to a low speed (about 20 ~ 30rpm) at which the laundry in the drum is unable to be attached to the inside circumferential surface of the drum.

[0066] Thus, this reduces a drying time period as the drying heater and the fan are turned on starting from the inertial rotation of the drum following finishing of spinning to supply hot air, and drying laundry starting from right after the finishing of spinning, and to improve drying efficiency and performance as the rotation speed of the drum is maintained at a speed higher than the speed enough to keep the laundry in the drum to be attached to the inside circumferential surface of the drum, to make the hot air to progress in a form of a swirl.

[0067] Next, a reference example method for controlling operation of a drum washing machine will be described with reference to FIG. 9.

[0068] The drum washing machine is further provided with means in the drum 30 for determining dryness (for an example, an electrode sensor: not shown) of the laundry.

[0069] In this example, the method includes the steps of measuring dryness of laundry in the drum in a state

the drum is stationary after finish of spinning, supplying hot air to an inside of the drum while rotating the drum at a speed equal to or higher than a speed at which an outward acceleration acting on a point of an inside circumferential surface of the drum in a radial direction of the drum is equal to an acceleration of the gravity if the dryness measured in above step is below a preset dryness, and supplying hot air to an inside of the drum while rotating the drum at a reduced speed at which the laundry is unable to be attached to the inside surface of the drum if the dryness measured in above step is higher than the preset dryness, for drying.

[0070] Meanwhile, though it is preferable that the measurement of dryness is performed in a state the drum is stopped fully after the finish of spinning, the dryness may be measured in a state before the drum is stopped fully after the finish of spinning.

[0071] Moreover, the hot air flows in a direction the same or substantially same with a drum driving shaft in the drum. Especially, it is preferable that the hot air flows from a front to a rear of the drum, or vice versa.

[0072] Alike embodiments described before, in this example, it is preferable that a rotation direction of the drum is alternated in the section drying is progressed in a reduced speed state to a speed (about 20 - 30rpm) at which the laundry falls from the inside surface of the drum.

[0073] Next, a reference example method for controlling operation of a drum washing machine will be described, with reference to FIG. 10.

[0074] In this example, a method for controlling drying operation of a horizontal, or tilt type drum washing machine includes the steps of, after finish of spinning, supplying hot air to an inside of the drum while rotating the drum at a speed equal to, or higher than a speed (for an example, 100rpm) enough to keep the laundry to be attached to, and not to be fall off from an inside surface of the drum, and progressing the drying while maintaining a threshold speed which is a speed enough to keep the laundry to be attached to, and not to fall off from, an inside surface of the drum if the dryness detected in the middle of above step is below preset dryness, and progressing the drying in a reduced speed state to a speed (about 20 ~ 30rpm) at which the laundry falls off from the inside surface of the drum if the dryness is higher than the preset dryness.

[0075] That is, this example, the dryness is measured in a state the drum is rotated at a speed higher than a speed enough to keep the laundry to be attached to the inside circumferential surface of the drum, and the speed of the drum is controlled to maintain, or reduce according to a result of the measurement. This is because an accurate measurement of dryness is possible the same with a case when the drum is stationary as there is no position change of the laundry at the speed at which the laundry does not fall off from, but is kept attached to, the inside circumferential surface of the drum.

[0076] In the meantime, in the example too, the hot air flows in a direction the same with a drum driving shaft in a drum. Especially, alike foregoing embodiments, it is preferable that the hot air flows from a front to a rear of the drum, or vice versa.

[0077] Alike the foregoing examples, a rotation direction of the drum is alternated in the section the drying is progress in a reduced speed state to a speed (about 20 - 30rpm) at which the laundry in the drum falls off the inside surface of the drum.

[0078] Thus, the example enables to reduce a drying time period as the hot air is supplied to an inside of the drum starting from the inertial rotation of the drum following finishing of spinning, to progress drying, and to improve drying performance and efficiency as the rotation speed of the drum is maintained at a speed equal to, or higher than a speed enough to keep laundry not to fall off from the inside circumferential surface of the drum so that the hot air progresses while swirling at a dryness below a preset dryness.

[0079] If the measured dryness is higher than the preset dryness, the rotation speed of the drum is reduced, to change positions of the laundry, in which the a rotation direction of the drum is alternated, for changing positions of the laundry. According to this, portions of laundry dried less than other portions are exposed newly, to which the hot air comes into contact, to dry the less dried portions.

[0080] In the meantime, after the reduced speed state is over, the rotation speed of the drum rises again until the laundry is attached to the inside circumferential surface of the drum, when the dryness is detected again. According to this, above drying control process is repeated.

[0081] In the method for controlling drying operation in accordance with any the present disclosure, a portion of the clothes is liable to be inserted in the holes in the wall of the drum if the rotation speed of the drum is high excessively. Moreover, the clothes is liable be inserted in the holes in the wall of the drum, to make circulation of the clothes difficult if the drying time period is long excessively even if the rotation speed of the drum is not so high excessively, but only is maintained at a speed (for an example; 100rpm) enough to keep the laundry to be attached to an inside of the drum.

[0082] Therefore, in examples, it can be known it is preferable in view of clothes circulation that a section for progressing drying at a speed in which the laundry can not be attached to, but fall off from the inside surface of the drum in a state the drying heater and the fan are turned on, a section in which the drum driving motor is turned on to accelerate the drum to a speed higher than a speed enough to keep the laundry to be attached to, and not to fall off from the inside surface of the drum, and a section in which the rotation speed of the drum is maintained at a speed enough to keep the laundry to be attached to, and not to fall off from the inside surface of the drum, are mixed.

[0083] In the method for controlling drying operation in accordance with examples of the present disclsoure, a drying finish time point can be determined as follows.

[0084] The finish of drying may be simply set to finish the drying at the time the set time is reached. Or alternatively, the drying may be finished by setting a drying time period, measuring the dryness when the set drying time period is reached, and extending the drying time period according to the measured dryness. Or alternatively, regardless of a set drying time period, the finish of drying may be determined with reference to a preset dryness which is different from the set dryness in examples.

[0085] FIG. 11 illustrates a graph showing a rotation speed of a motor for driving the drum, and turn on/off states of drying heater and fan while drying.

[0086] Referring to FIG. 8, it can be known that a section for progressing drying at a speed in which the laundry can not be attached to, but fall off from the inside surface of the drum in a state the drying heater and the fan are turned on, a section in which the drum driving motor is turned on to accelerate the drum to a speed higher than a speed enough to keep the laundry to be attached to, and not to fall off from the inside surface of the drum, and a section in which the rotation speed of the drum is maintained at a speed enough to keep the laundry to be attached to, and not to fall off from the inside surface of the drum, are mixed.

[0087] Of course, a rotation direction of the drum can be alternated in the section in which the rotation speed of the drum is low (about 20 - 30rpm).

[0088] As has been described, the structure for supplying hot air in a drum washing machine and operation control method thereof has the following advantages.

[0089] The uniform introduction of hot air into the inside of the drum through out the drum enhances drying performance and efficiency.

[0090] That is, the introduction of hot air starting from a front to a rear or vice versa deep into the drum improves drying efficiency and performance. Especially, because the rotation speed of the drum is maintained at a speed enough to keep laundry not to fall off from the inside circumferential surface of the drum, such that the hot air comes into contact with the laundry while progressing in swirl, the drying performance and efficiency is improved.

[0091] The supply of hot air to the inside of the drum starting from the inertial rotation of the drum following finish of spinning enables to shorten a drying time period.

[0092] The alternation of the rotation direction of the drum in the section the dry is progressed at a low speed, to keep surfaces in contact with the hot air changing, permits to improve the drying efficiency, and the swirling of the hot air further improves the drying performance owing to the position changes of the laundry.

[0093] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, it is intended that the present invention covers modifications and variations of this invention provided they come within the scope of the appended claims.

Claims

1. A method for controlling operation of a horizontal or tilt type drum washing machine comprising a tub (20) for holding washing water, a drum (30) rotatably mounted in the tub, for introducing laundry therein, a drum driving motor for providing driving force to rotate the drum, a drying heater (61) for heating air being supplied to an inside of the drum (30), a drying duct (60) forming a flow passage for supplying hot air heated by the drying heater (61) to the inside of the drum (30), and a fan (62) for forced supply of the hot air heated by the drying heater (61) to the inside of the drum (30), and
the method comprising the step of, in progressing a drying cycle, rotating the drum (30) at a speed enough to keep the laundry attached to, and not fall off from, but not to be attached closely to, an inside surface of the drum (3), for progressing drying,
characterized in that the horizontal or tilt type drum washing machine further includes a hot air supply structure in which a hot air inlet (60a) of the drying duct (60) is positioned at a front side or a rear side of the drum (30), and a humid air recovery opening of the drying duct (60) is positioned at the rear side or the front side of the drum (30) opposite to the hot air inlet (60a),
the method comprising the steps of:

turning off the drum driving motor as spinning is finished;
turning on the drying heater and the fan;
after turning off the driving motor, supplying hot air to an inside of the drum (30) through the hot air inlet (60a) positioned at a front, or a rear of the drum (30), at the same time as the rotating of the drum (30), in progressing the drying cycle; and
supplying the hot air to an inside of the drum (30) while maintaining the drum at a speed higher than the threshold speed at which the laundry kept attached to the inside circumferential surface of the drum does not fall by turning on the drum driving motor again before the speed of the drum rotating by inertia drops to a speed at which the laundry kept attached to the inside circumferential surface of the drum falls.

2. The method as claimed in claim 1, wherein the hot air supplied to an inside of the drum (30) is supplied from an upper portion of a front side of the drum (30) to a lower portion of a rear side of the drum (30), or an upper portion of a rear side of the drum (30) to a lower portion of a front side of the drum (30).

3. The method as claimed in claim 1, further comprising at least one time of:

a section for turning on a drum driving motor (71) to accelerate a rotation speed of the drum (30) to a speed equal to, or higher than a speed enough to keep the laundry in the drum (30) attached to, and not fall off from, the inside surface of the drum (30);
a section for maintaining the rotating speed of the drum (30) at a speed equal to, or higher than a speed enough to keep the laundry in the drum (30) attached to, and not fall off from, the inside surface of the drum (30); and
a section for reducing the rotating speed of the drum to a low speed at which the laundry in the drum (30) is unable to be attached to, but to fall off from, the inside surface of the drum (30), for progressing drying.

4. The method as claimed in claim 3, wherein the section for reducing the rotating speed of the drum (30) to a low speed at which the laundry in the drum (30) is unable to be attached to, but to fall off from, the inside surface of the drum (30), for progressing drying includes the step of alternating a rotating direction of the drum (30).

5. The method as claimed in claim 1, further comprising the step of measuring dryness of the laundry in the drum (30) in the middle of progressing a drying cycle.

6. The method as claimed in claim 5, wherein the dryness is measure in a state the drum (30) is stationary, or the rotation speed of the drum (30) is enough to keep the laundry attached to, and not fall off from, the inside circumferential surface of the drum (30).

7. The method as claimed in claim 6, depending on a result of measurement of the dryness, further comprising the steps of:

raising the rotating speed of the drum (30) to maintain a speed enough to keep the laundry attached to, and not fall off from, the inside surface of the drum (30) for progressing drying, if measured dryness is below a preset dryness; and
reducing the rotating speed of the drum (30) to a low speed at which the laundry is unable to be attached to, but fall off from, the inside surface of the drum (30), for progressing drying, if measured dryness is higher than the preset dryness.

Patentansprüche

1. Verfahren zum Steuern des Betriebs einer Waschmaschine mit einer horizontalen oder geneigten Trommel, die einen Bottich (20) zum Aufnehmen des Waschwassers, eine im Bottich drehbar gelagerte Trommel (30) zum Einbringen des Waschguts, einen Trommelantriebsmotor zum Bereitstellen von Antriebskraft zum Rotieren der Trommel, ein Trocknungsheizelement (61) zum Erhitzen der Luft, die ins Innere der Trommel (30) geführt wird, einen Trocknungskanal (60) zum Bilden eines Durchlasses für die Zufuhr der durch das Trocknungsheizelement (61) erhitzten Luft ins Innere der Trommel (30) und ein Gebläse (62) zum erzwungenen Zuführen der vom Trocknungsheizelement (61) erhitzten Luft ins Innere der Trommel (30) umfasst, und
das Verfahren im fortschreitenden Trocknungszyklus den Schritt des Rotierens der Trommel (30) mit einer Geschwindigkeit umfasst, die groß genug ist, damit das Waschgut beim fortschreitenden Trocknen an einer Innenfläche der Trommel (3) haftet, sodass es weder davon abfällt, noch direkt daran haftet,
dadurch gekennzeichnet, dass die Waschmaschine mit der horizontalen oder geneigten Trommel des Weiteren einen Heißluftzufuhranschluss enthält, in welchem ein Heißlufteinlass (60a) des Trocknungskanals (60) auf einer Vorderseite oder einer Rückseite der Trommel (30) und eine Öffnung zur Wiedergewinnung für die feuchte Luft des Trocknungskanals (60) auf der Rückseite oder der Vorderseite der Trommel (30) gegenüber des Heißlufteinlasses (60a) positioniert ist;
wobei das Verfahren die folgenden Schritte umfasst:

Abschalten des Trommelantriebsmotors, wenn das Schleudern beendet ist;
Einschalten des Trocknungsheizelements und des Gebläses;
nach dem Abschalten den Antriebsmotors, Zuführen von heißer Luft ins Innere der Trommel (30) durch den Heißlufteinlass (60a), der auf einer Vorderseite oder einer Rückseite der Trommel (30) positioniert ist zeitgleich mit dem Rotieren der Trommel (30) im fortschreitenden Trocknungszyklus; und
Leiten der Heißluft ins Innere der Trommel (30), während die Trommel auf einer Geschwindigkeit gehalten wird, die höher ist, als die Schwellengeschwindigkeit, bei der das an der Innenumfangsfläche der Trommel haftende Waschgut nicht abfällt, indem der Trommelantriebsmotor wieder eingeschaltet wird, bevor die Geschwindigkeit der durch Trägheit rotierenden Trommel auf eine Geschwindigkeit fällt, bei der das an der Innenumfangsfläche der Trommel haftende Waschgut abfällt.

2. Verfahren nach Anspruch 1, wobei die Heißluft, die ins Innere der Trommel (30) geleitet wird, von einem oberen Abschnitt einer Vorderseite der Trommel (30) zu einem unteren Abschnitt einer Rückseite der Trommel (30) oder von einem oberen Abschnitt einer

Rückseite der Trommel (30) zu einem unteren Abschnitt einer Vorderseite der Trommel (30) geleitet wird.

3. Verfahren nach Anspruch 1, das ferner mindestens eins der Folgenden umfasst:

einen Teil zum Einschalten eines Trommelantriebsmotors (71), um eine Rotationsgeschwindigkeit der Trommel (30) auf eine Geschwindigkeit gleich oder höher als eine Geschwindigkeit zu beschleunigen, die groß genug ist, damit das Waschgut in der Trommel (30) an einer Innenfläche der Trommel (30) haftet, sodass es nicht davon abfällt;
einen Teil, um die Rotationsgeschwindigkeit der Trommel (30) bei einer Geschwindigkeit gleich oder höher als eine Geschwindigkeit zu halten, die groß genug ist, damit das Waschgut in der Trommel (30) an einer Innenfläche der Trommel (30) haftet, sodass es nicht davon abfällt; und
einen Teil, um die Rotationsgeschwindigkeit der Trommel auf eine geringe Geschwindigkeit zu reduzieren, mit der das Waschgut beim fortschreitenden Trocknen in der Trommel (30) nicht an der Innenfläche der Trommel (30) haften kann, sondern davon abfällt.

4. Verfahren nach Anspruch 3, wobei der Teil zum Reduzieren der Rotationsgeschwindigkeit der Trommel (30) auf eine niedrige Geschwindigkeit, bei der das Waschgut in der Trommel (30) nicht an der Innenfläche der Trommel (30) haften kann, sondern beim fortschreitenden Trocknen davon abfällt, den Schritt des Wechselns der Rotationsrichtung der Trommel (30) beinhaltet.

5. Verfahren nach Anspruch 1, das ferner den Schritt des Messens der Trockenheit des Waschguts in der Trommel (30) in der Mitte des Trocknungszyklus umfasst.

6. Verfahren nach Anspruch 5, wobei die Trockenheit im ruhenden Zustand der Trommel (30) gemessen wird oder wenn die Rotationsgeschwindigkeit der Trommel (30) groß genug ist, damit das Waschgut an der Innenumfangsfläche der Trommel (30) haftet, sodass es nicht davon abfällt.

7. Verfahren nach Anspruch 6, welches in Abhängigkeit vom Ergebnis der Trockenheitsmessung folgende Schritte umfasst:

Erhöhen der Rotationsgeschwindigkeit der Trommel (30), um eine Geschwindigkeit zu erhalten, die groß genug ist, damit das Waschgut an der Innenfläche der Trommel (30) haftet, sodass es beim fortschreitenden Trocknen, wenn die gemessene Trockenheit unter einer voreingestellten Trockenheit liegt, nicht davon abfällt; und
Reduzieren der Rotationsgeschwindigkeit der Trommel (30) auf eine niedrige Geschwindigkeit, bei der das Waschgut nicht an der Innenfläche der Trommel (30) haften kann, sondern beim fortschreitenden Trocknen abfällt, wenn die gemessene Trockenheit über der voreingestellten Trockenheit liegt.

Revendications

1. Procédé pour commander le fonctionnement d'une machine à laver à tambour de type horizontal ou à inclinaison comprenant une cuve (20) pour contenir de l'eau de lavage, un tambour (30) monté de façon rotative dans la cuve, pour y introduire du linge, un moteur d'entraînement de tambour pour fournir une force d'entraînement pour faire tourner le tambour, un élément chauffant de séchage (61) pour chauffer de l'air qui est distribué à une partie intérieure du tambour (30), une conduite de séchage (60) formant un passage d'écoulement pour distribuer de l'air chaud chauffé par l'élément chauffant de séchage (61) à la partie intérieure du tambour (30), et un ventilateur (62) pour la distribution forcée de l'air chaud chauffé par l'élément chauffant de séchage (61) à la partie intérieure du tambour (30), et
le procédé comprenant l'étape de, dans la progression d'un cycle de séchage, rotation du tambour (30) à une vitesse suffisante pour maintenir le linge attaché à une surface intérieure du tambour (3), et pour qu'il ne tombe de celle-ci, mais qu'il ne soit pas attaché étroitement à celle-ci, pour la progression du séchage,
caractérisé en ce que la machine à laver à tambour de type horizontal ou à inclinaison comprend en outre une structure d'alimentation en air chaud dans laquelle une entrée d'air chaud (60a) de la conduite de séchage (60) est positionnée sur un côté avant ou un côté arrière du tambour (30), et une ouverture de récupération d'air humide de la conduite de séchage (60) est positionnée sur le côté arrière ou le côté avant du tambour (30) de façon opposée à l'entrée d'air chaud (60a),
le procédé comprenant les étapes consistant à :

arrêter le moteur d'entraînement de tambour lorsque la rotation est finie ;
allumer l'élément chauffant de séchage et le ventilateur ;
après l'arrêt du moteur d'entraînement, distribuer de l'air chaud à une partie intérieure du tambour (30) à travers l'entrée d'air chaud (60a) positionnée à un avant ou un arrière du tambour (30), en même temps que la rotation du tambour

(30), dans la progression du cycle de séchage ; et

distribuer l'air chaud à une partie intérieure du tambour (30) tout en maintenant le tambour à une vitesse supérieure à la vitesse de seuil à laquelle le linge maintenu attaché à la surface circonférentielle intérieure du tambour ne tombe pas, en allumant de nouveau le moteur d'entraînement de tambour avant que la vitesse du tambour tournant sous l'effet de l'inertie ne chute à une vitesse à laquelle le linge maintenu attaché à la surface circonférentielle intérieure du tambour tombe.

2. Procédé selon la revendication 1, dans lequel l'air chaud distribué à une partie intérieure du tambour (30) est distribué d'une partie supérieure d'un côté avant du tambour (30) à une partie inférieure d'un côté arrière du tambour (30), ou d'une partie supérieure d'un côté arrière du tambour (30) à une partie inférieure d'un côté avant du tambour (30).

3. Procédé selon la revendication 1, comprenant en outre au moins une fois parmi :

une section pour allumer un moteur d'entraînement de tambour (71) pour accélérer une vitesse de rotation du tambour (30) jusqu'à une vitesse égale ou supérieure à une vitesse suffisante pour maintenir le linge dans le tambour (30) attaché à la surface intérieure du tambour (30), et pour qu'il ne tombe pas de celle-ci ;

une section pour maintenir la vitesse de rotation du tambour (30) à une vitesse égale ou supérieure à une vitesse suffisante pour maintenir le linge dans le tambour (30) attaché à la surface intérieure du tambour (30), et pour qu'il ne tombe pas de celle-ci ; et

une section pour réduire la vitesse de rotation du tambour à une faible vitesse à laquelle le linge dans le tambour (30) ne peut pas être attaché à la surface intérieure du tambour (30), mais peut tomber de celle-ci, pour la progression du séchage.

4. Procédé selon la revendication 3, dans lequel la section pour réduire la vitesse de rotation du tambour (30) à une faible vitesse à laquelle le linge dans le tambour (30) ne peut pas être attaché à la surface intérieure du tambour (30), mais peut tomber de celle-ci, pour la progression du séchage, comprend l'étape d'alternance d'une direction de rotation du tambour (30).

5. Procédé selon la revendication 1, comprenant en outre l'étape de mesure de la siccité du linge dans le tambour (30) au milieu de la progression d'un cycle de séchage.

6. Procédé selon la revendication 5, dans lequel la siccité est mesurée dans un état dans lequel le tambour (30) est stationnaire, ou la vitesse de rotation du tambour (30) est suffisante pour maintenir le linge attaché à la surface circonférentielle intérieure du tambour (30), et pour qu'il ne tombe pas de celle-ci.

7. Procédé selon la revendication 6, suivant un résultat de mesure de la siccité, comprenant en outre les étapes consistant à :

augmenter la vitesse de rotation du tambour (30) pour maintenir une vitesse suffisante pour maintenir le linge attaché à la surface intérieure du tambour (30), et pour qu'il ne tombe pas de celle-ci, pour la progression du séchage, si la siccité mesurée est inférieure à une siccité prédéterminée ; et

réduire la vitesse de rotation du tambour (30) à une faible vitesse à laquelle le linge ne peut pas être attaché à la surface intérieure du tambour (30), mais peut tomber de celle-ci, pour la progression du séchage, si la siccité mesurée est supérieure à la siccité prédéterminée.

FIG. 1

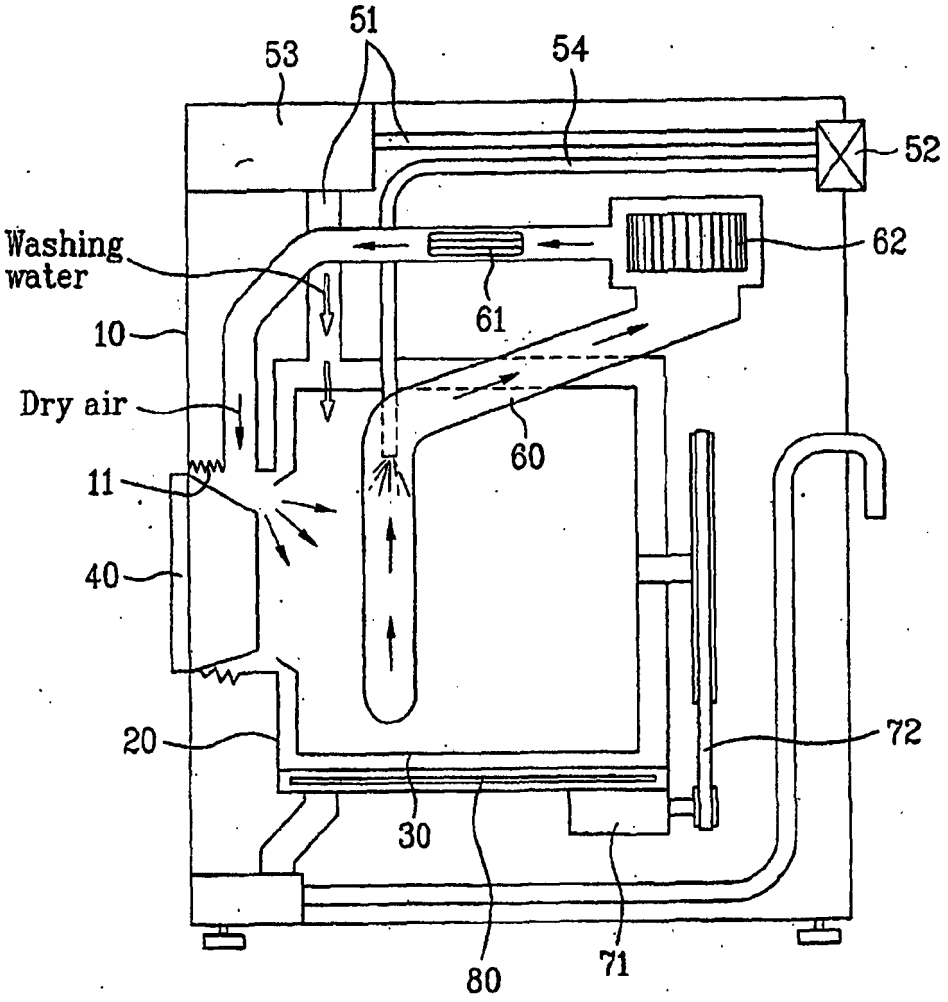


FIG. 2

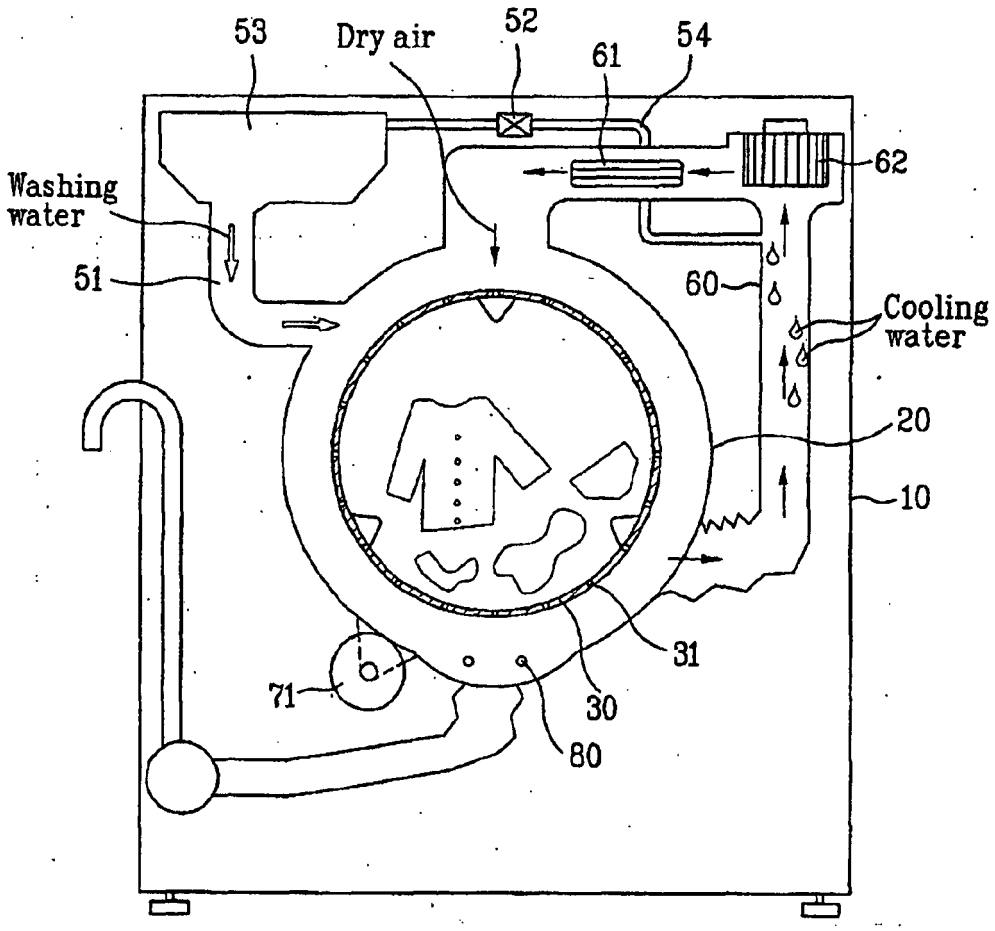

53
Dry air
52
61
54
62
Washing water
51
60
Cooling water
20
10
31
71
30
80

FIG. 3

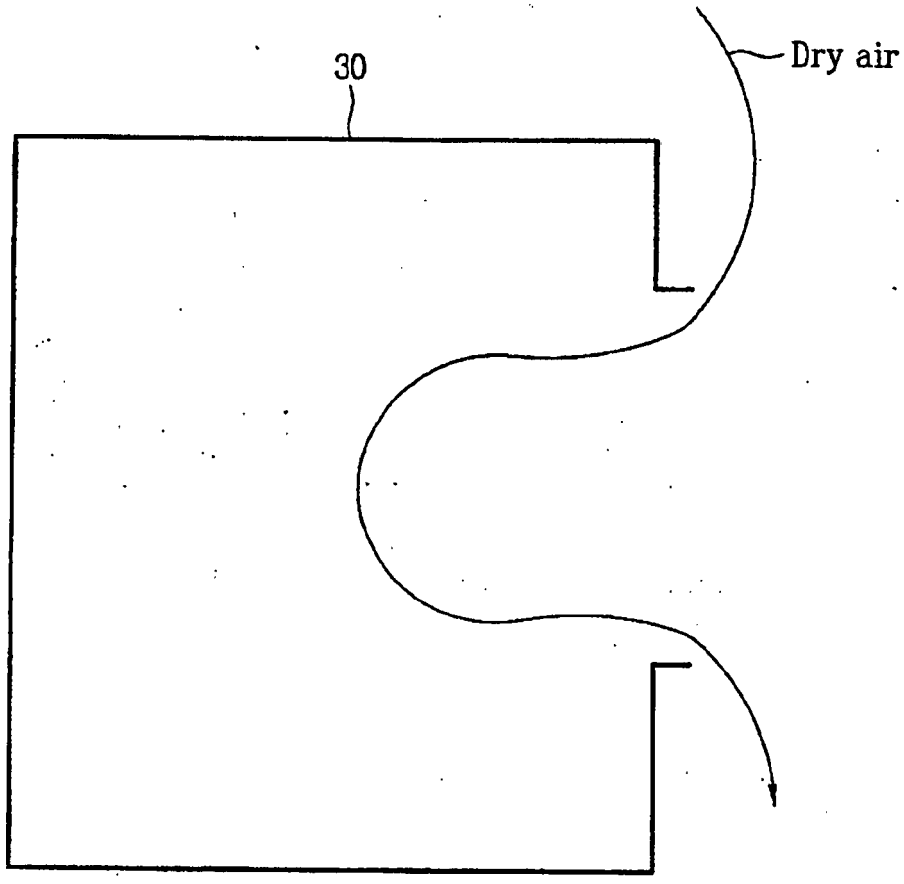


FIG. 4

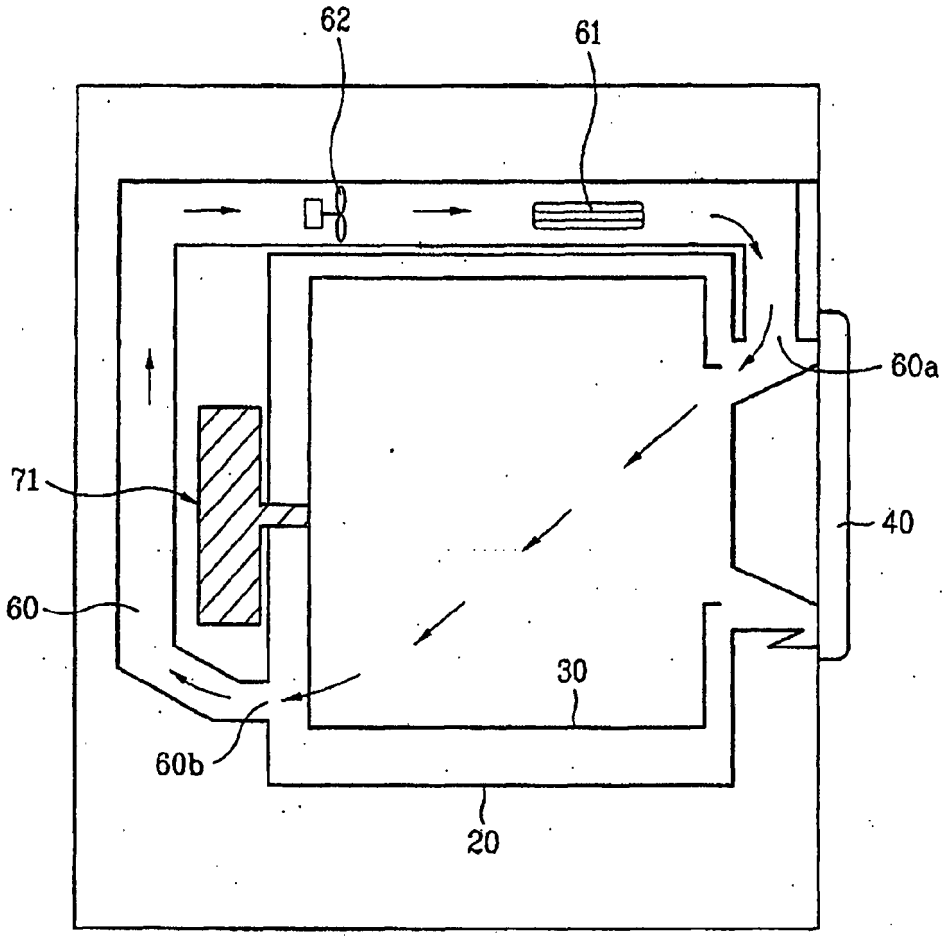


FIG. 5

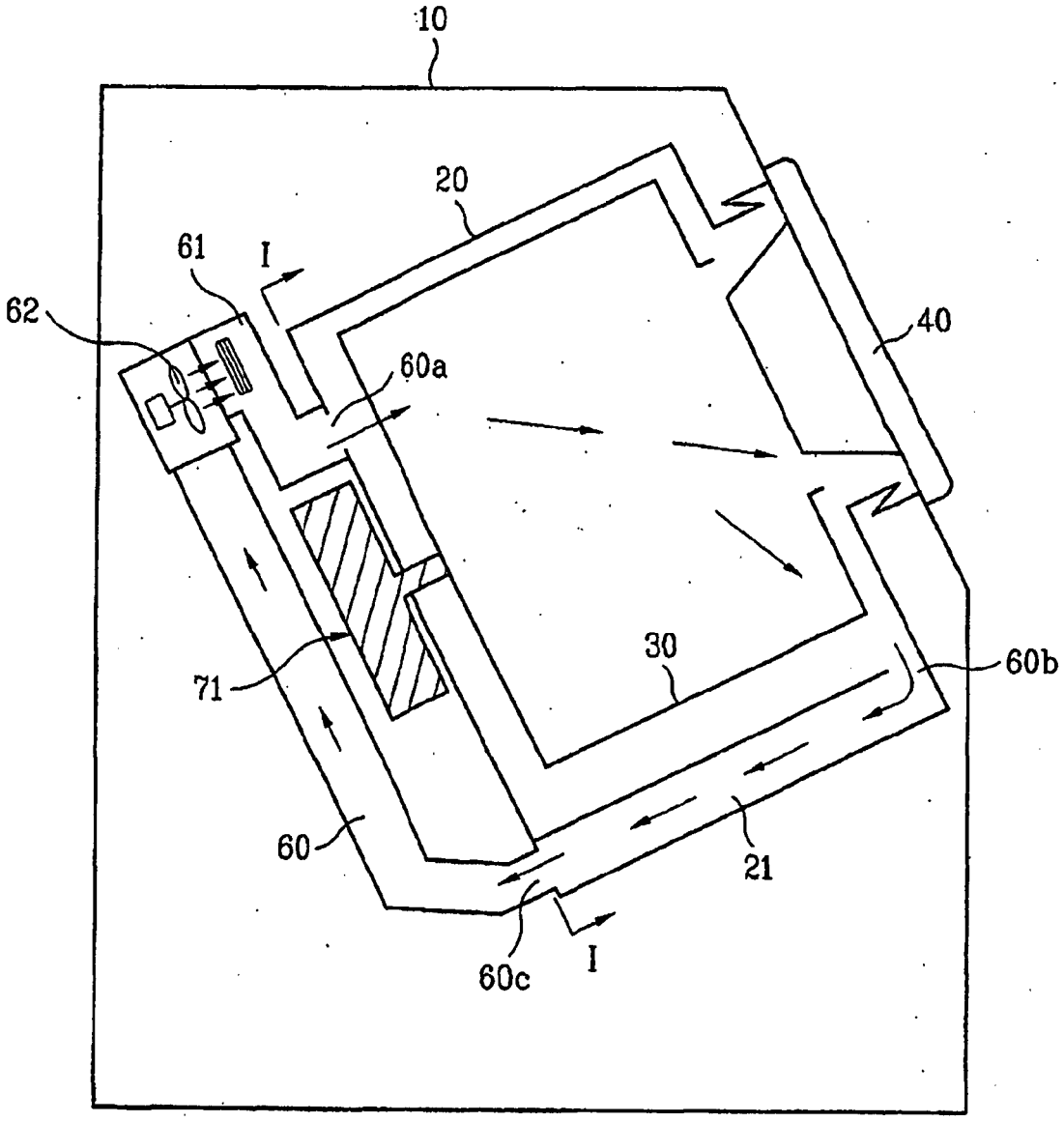


FIG. 6

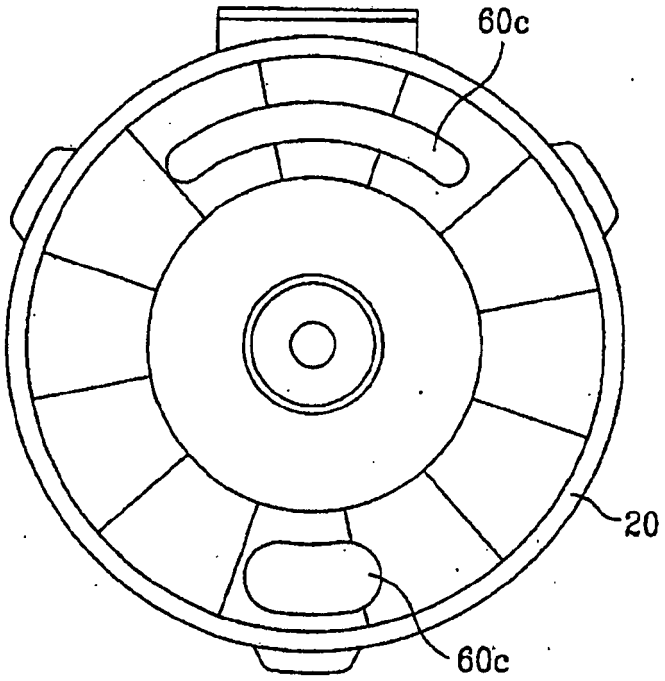


FIG. 7

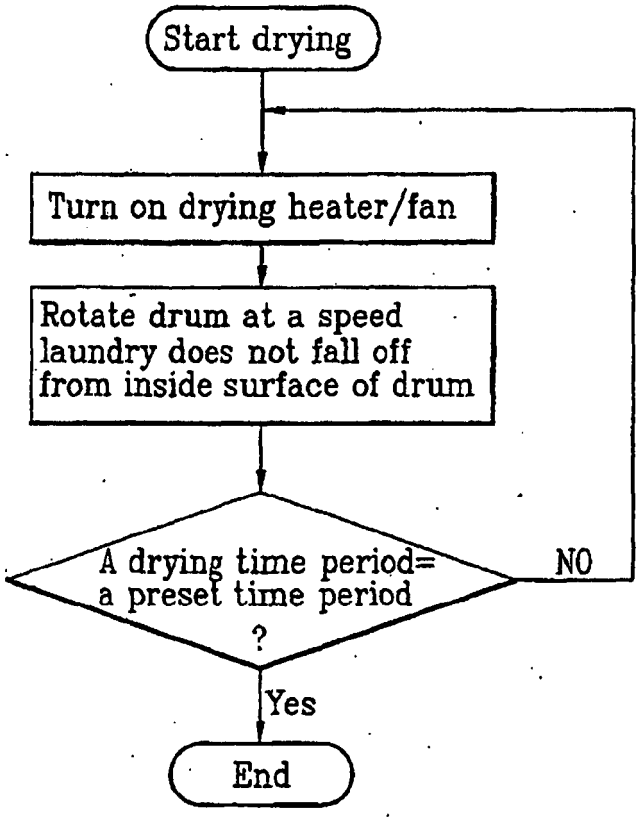

Start drying
Turn on drying heater/fan
Rotate drum at a speed laundry does not fall off from inside surface of drum
A drying time period= a preset time period ?
NO
Yes
End

FIG. 8

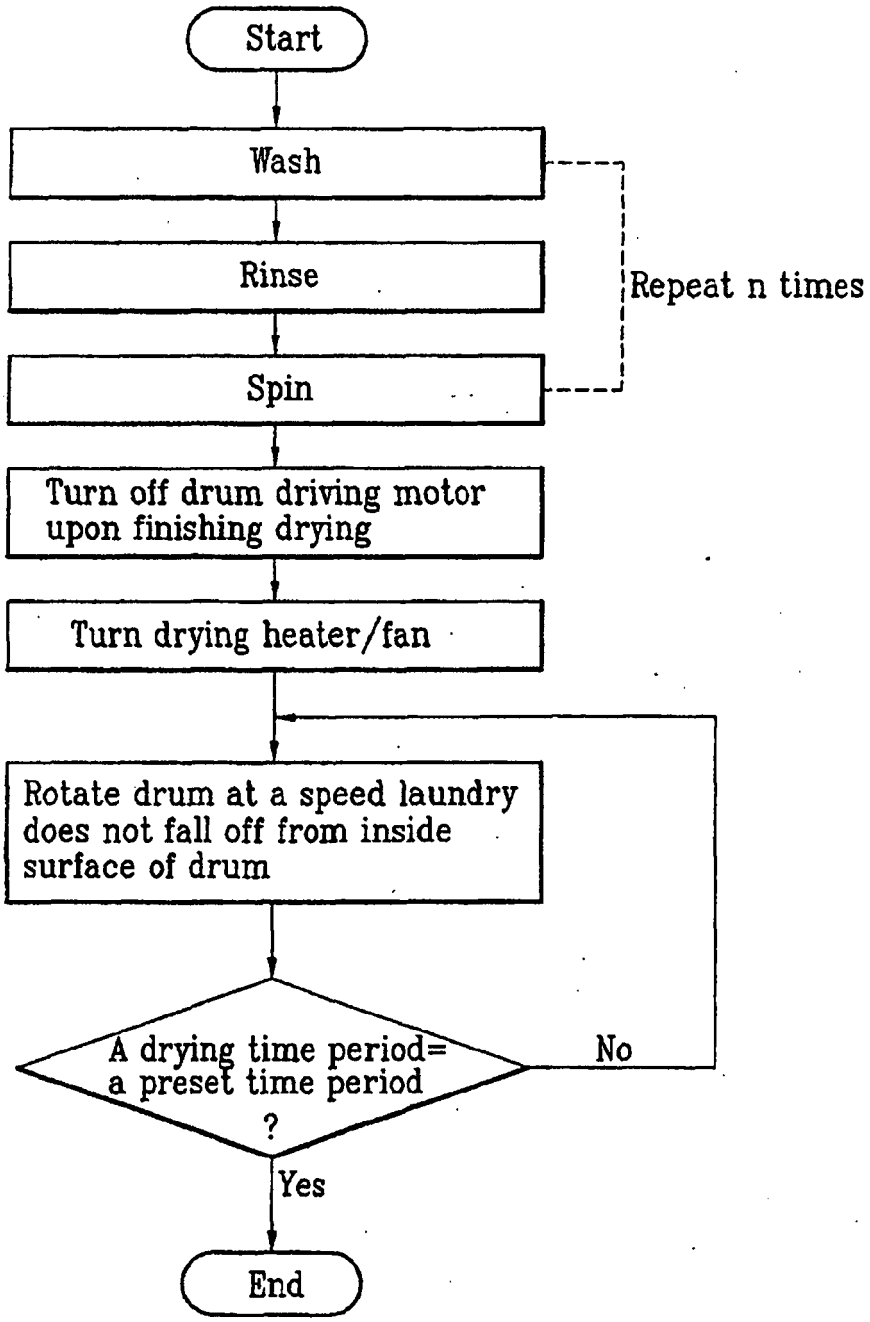

Start
Wash
Rinse
Spin
Repeat n times
Turn off drum driving motor upon finishing drying
Turn drying heater/fan
Rotate drum at a speed laundry does not fall off from inside surface of drum
A drying time period= a preset time period ?
No
Yes
End

FIG. 9

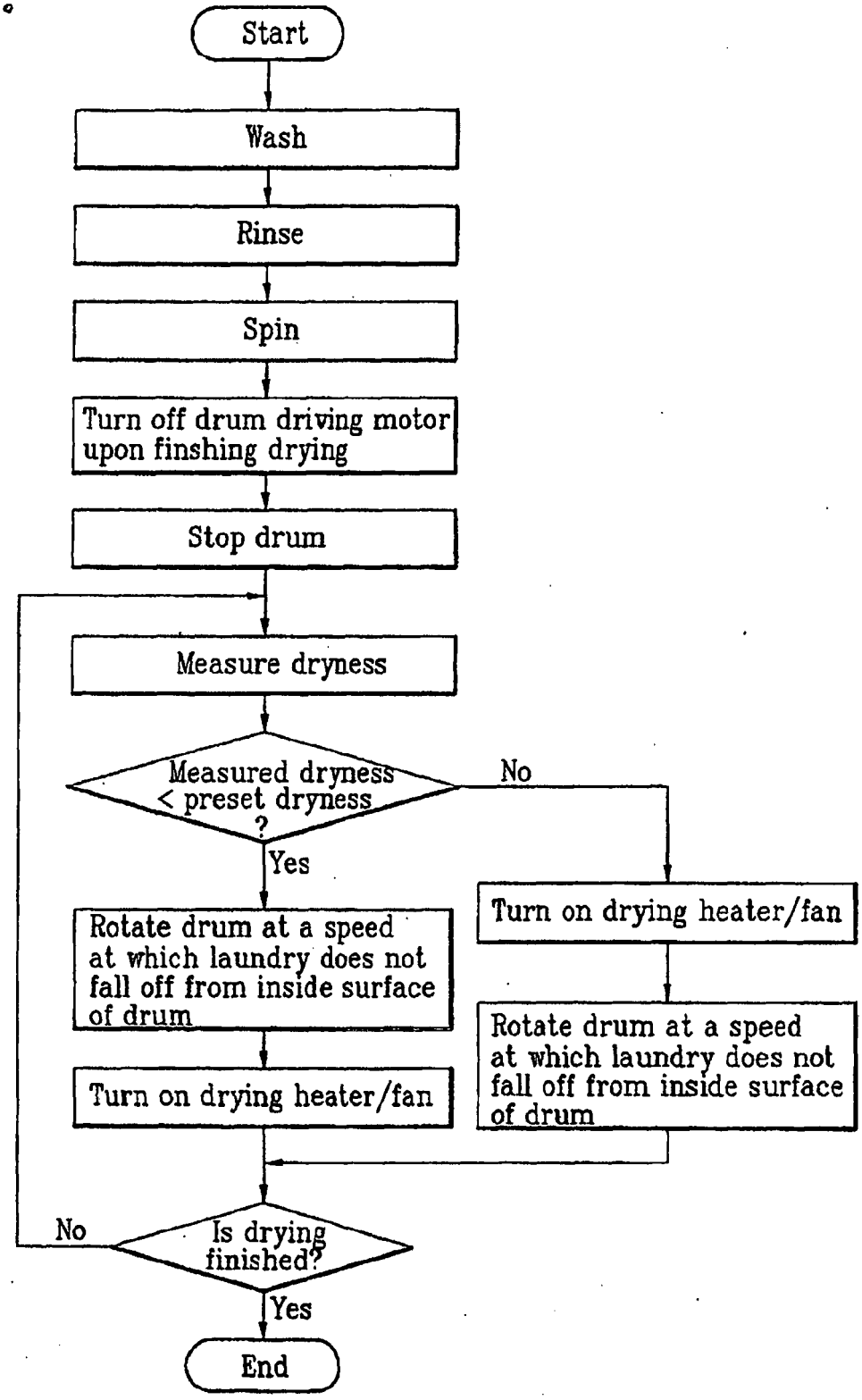

Start
Wash
Rinse
Spin
Turn off drum driving motor upon finshing drying
Stop drum
Measure dryness
Measured dryness < preset dryness ?
No
Yes
Rotate drum at a speed at which laundry does not fall off from inside surface of drum
Turn on drying heater/fan
Turn on drying heater/fan
Rotate drum at a speed at which laundry does not fall off from inside surface of drum
No
Is drying finished?
Yes
End

FIG. 10

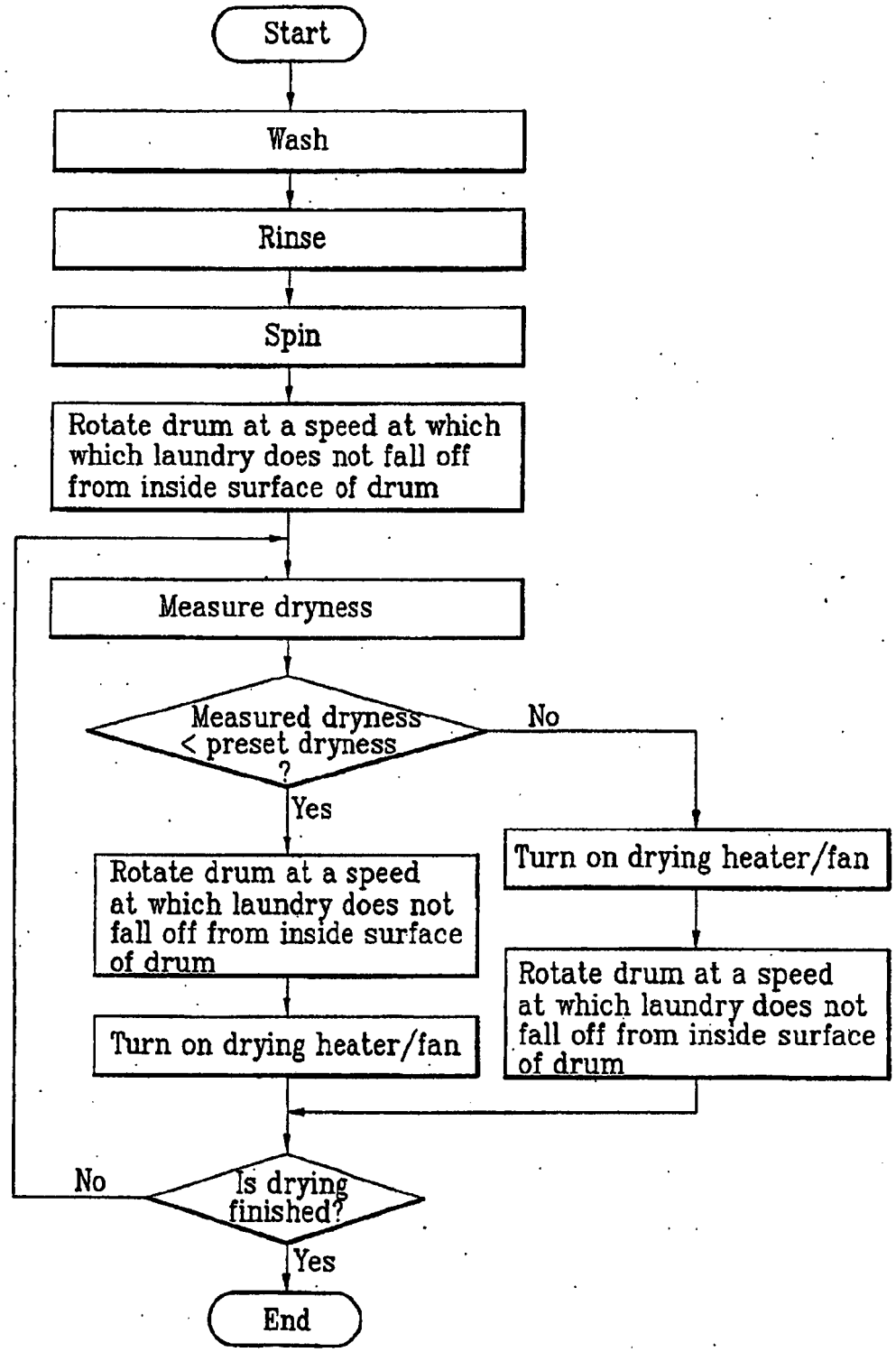
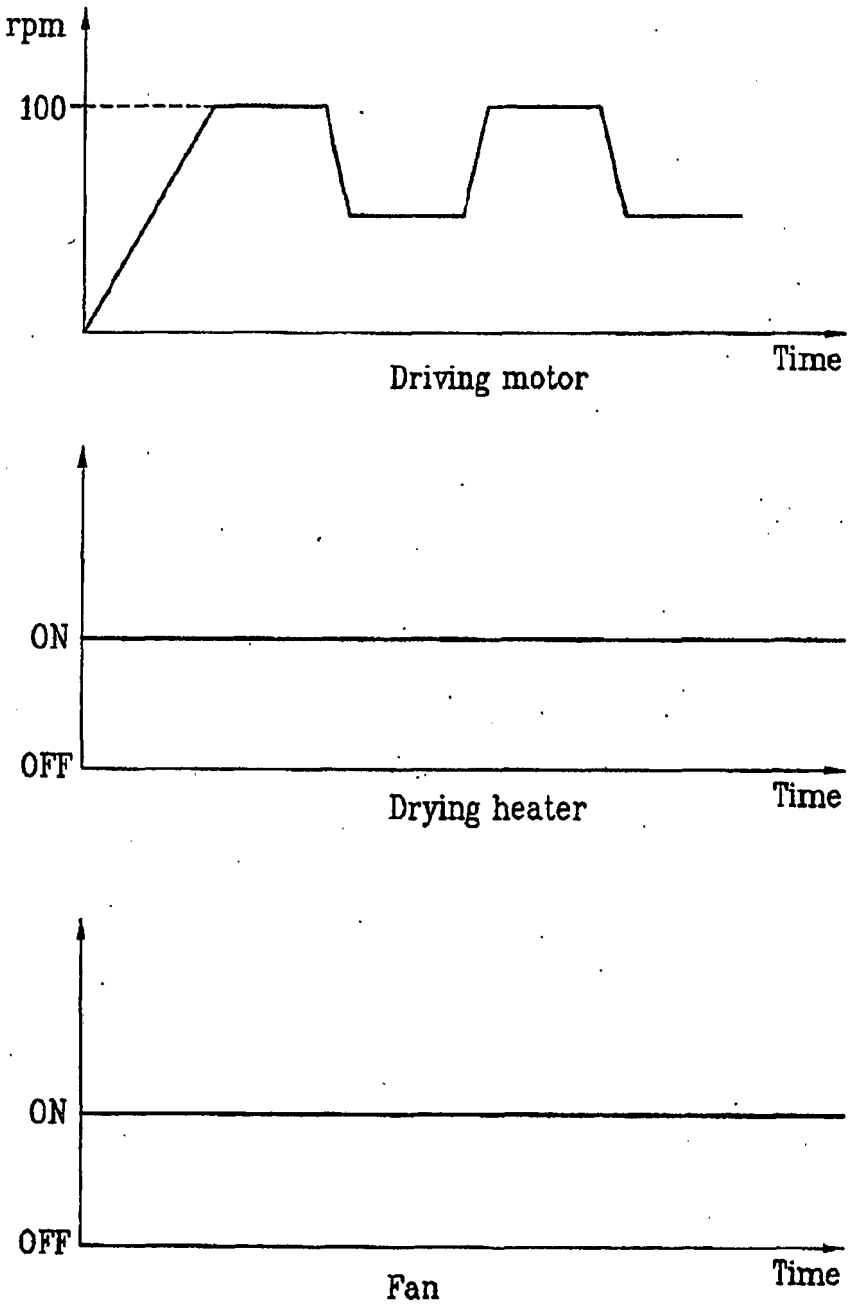

Start
Wash
Rinse
Spin
Rotate drum at a speed at which which laundry does not fall off from inside surface of drum
Measure dryness
Measured dryness < preset dryness ?
No
Yes
Turn on drying heater/fan
Rotate drum at a speed at which laundry does not fall off from inside surface of drum
Rotate drum at a speed at which laundry does not fall off from inside surface of drum
Turn on drying heater/fan
No
Is drying finished?
Yes
End

FIG. 11


rpm
100
Time
Driving motor
ON
OFF
Time
Drying heater
ON
OFF
Time
Fan

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0816549 A **[0021]**
- JP 0833669 A **[0022]**
- EP 0761864 A **[0023]**
- JP 2002035468 A **[0024]**