(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 808 886 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.04.2021 Bulletin 2021/16

(21) Application number: **20190801.9**

(22) Date of filing: **13.08.2020**

(51) Int Cl.:
D06F 34/18 *(2020.01)* *D06F 35/00* *(2006.01)*
D06F 37/22 *(2006.01)* *D06F 37/24* *(2006.01)*
D06F 103/04 *(2020.01)* *D06F 103/24* *(2020.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **15.10.2019 KR 20190127724**

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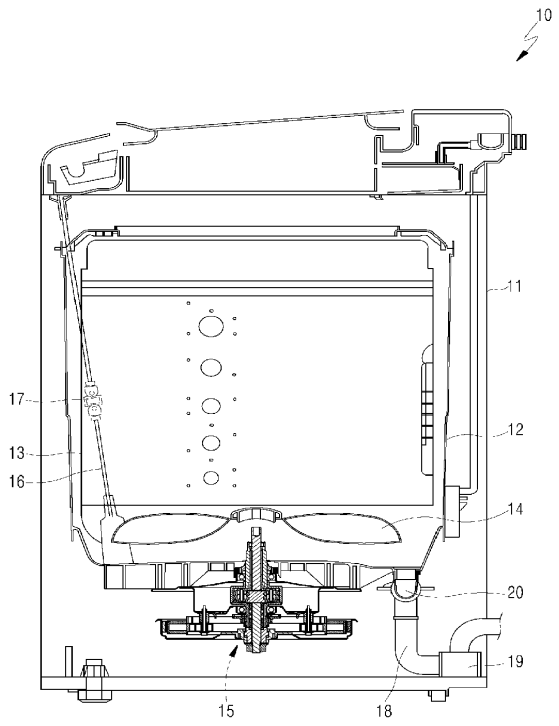
Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) METHOD FOR CONTROLLING WASHING MACHINE

(57) Disclosed is a method for controlling a washing machine (10). A weight sensor (17) configured to detect a weight of laundry is installed on a suspension bar (16) configured to suspend an outer tub (12) of the washing machine. In the method for controlling the washing machine according to the present disclosure, while the driver (15) is rotating the washing tub to spin-dry the laundry, the weight sensor measures the weight of the laundry, and spin-drying of the laundry is ended based on a weight measurement value obtained as a result of the measurement.

FIG. 1



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit of priority to Korean Patent Application No. 10-2019-0127724, entitled "METHOD FOR CONTROLLING WASHING MACHINE" and filed on October 15, 2019, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a method for controlling a washing machine, and, more particularly, to a method for controlling a washing machine that spin-dries laundry that has been washed.

2. Background

[0003] When an amount of laundry exceeds a capacity of a washing machine, the laundry may not be properly spin-dried. In addition, when the laundry is inclined to one side within a washing tub, normal spin-drying may not be achieved. Recently, in order to prevent damage to the laundry and optimally spin-dry the laundry, there is a tendency to lower a rotational force of the washing tub within a predetermined range. However, when the rotational force of the washing tub is lowered, a large amount of water may remain in the laundry without being removed from the laundry. In such a case, drying time may increase, and water may drip from the laundry during drying, which in turn may increase user dissatisfaction.

[0004] In this regard, in Korean Patent Application Publication No. 10-2000-0025011 (published on May 06, 2000; hereinafter referred to as "related art 1"), disclosed is a method for controlling spin-drying time in a washing machine. In related art 1, a weight W1 of dry laundry is obtained by performing a first weight detection at a beginning of washing. After the first weight detection is performed, washing and rinsing is performed. Then, a weight W2 of the laundry is obtained by performing a second weight detection prior to spin-drying.

[0005] In related art 1, a type of the laundry is recognized based on W2/W1. When $W2/W1<K1$, the laundry is determined to be chemical fiber-based laundry. In such a case, a spin-drying time is set to 5 minutes or less based on a result of the determination. When $K1 \leq W2/W1 \leq K2$, chemical fiber-based laundry and natural fiber-based laundry are determined to be mixed. In such a case, the spin-drying time is set to between 5 and 9 minutes based on a result of the determination. When $K2<W2/W1$, the laundry is determined to be natural fiber-based laundry. In such a case, the spin-drying time is set to 9 minutes or more based on a result of the determination.

[0006] In related art 1, a proper spin-drying time may be calculated according to a type of laundry, such as chemical fiber-type laundry, natural fiber-type laundry, and blended fiber-type laundry. Accordingly, the laundry may not be damaged, or may be spin-dried properly.

[0007] However, in related art 1, when new laundry is added or some of the previously loaded laundry is removed just before the spin-drying starts, it may not be possible to detect such a situation. When some of the previously loaded laundry is removed before the spin-drying starts, the spin-drying time should be reduced to ensure proper spin-drying. In addition, when new laundry is added before the spin-drying starts, the spin-drying time should be increased to ensure proper spin-drying. In particular, when a large amount of laundry, such as jeans or towels, which requires a long time to spin-dry, is added, it is difficult to ensure proper spin-drying.

[0008] In addition, as mentioned above, in related art 1, only W2/W1 is used to recognize the type of laundry. However, it is difficult to accurately recognize the type of laundry using only W2/W1. Accordingly, there is a need for a technology for accurately recognizing laundry without installing additional devices.

[0009] Nevertheless, even if the type of laundry is accurately recognized by using W2/W1, since a degree of spin-drying of the laundry varies depending on a degree to which the laundry gets inter-tangled or inclined to a certain side, it is difficult to ensure proper spin-drying.

[0010] Recently, an electric dryer is becoming popular. The electric dryer requires a long drying time. In particular, when an atmospheric temperature is low, the drying time becomes longer. In order to reduce the drying time, as much moisture as possible should be removed from laundry before loading the laundry into the electric dryer.

[0011] On the other hand, even if the degree of the spin-drying of the laundry is low, the laundry taken out of the washing machine is quickly dried naturally in sunny or dry weather. However, even if the degree of the spin-drying of the laundry is high, natural drying is slow in cloudy or humid weather.

SUMMARY

[0012] The present disclosure is directed to providing a method for controlling a washing machine that is capable of accurately recognizing laundry.

[0013] The present disclosure is further directed to a method for controlling a washing machine that may cause laundry to be spin-dried to a certain degree of spin-drying.

[0014] The present disclosure is still further directed to providing a method for controlling a washing machine that is capable of facilitating use of a dryer after spin-drying is finished.

[0015] The present disclosure is still further directed to providing a method for controlling a washing machine that allows a user to predict a natural drying time for spin-dried laundry.

[0016] In a method for controlling the washing machine

according to an embodiment of the present disclosure, while a driver is rotating a washing tub to spin-dry laundry, a weight sensor measures a weight of the laundry, and spin-drying of the laundry is ended based on a weight measurement value obtained as a result of the measurement.

[0017] The washing machine may include a washing tub, an outer tub, the driver, a suspension bar, and the weight sensor.

[0018] The outer tub may be configured to accommodate the washing tub. The laundry may be loaded into the washing tub.

[0019] The driver may be configured to rotate the washing tub.

[0020] The suspension bar may be configured to suspend the outer tub.

[0021] The weight sensor may be configured to detect the weight of the laundry. The weight sensor may be installed on the suspension bar.

[0022] The weight sensor may measure the weight of the laundry while the driver is rotating the washing tub constantly at a first speed to spin-dry the laundry.

[0023] The weight sensor may measure the weight of the laundry multiple times. The spin-drying of the laundry may be ended based on a reduction rate of the weight measurement value being less than a first reference value.

[0024] Accordingly, accuracy in recognizing the laundry may be improved without installing additional devices necessary for recognizing the laundry.

[0025] A weight of dry laundry may be measured before the laundry is washed.

[0026] The spin-drying of the laundry may be ended based on the reduction rate of the weight measurement value being less than the first reference value and a ratio of the weight measurement value to the weight of the dry laundry being less than or equal to a second reference value.

[0027] The first speed may be set to be inversely proportional to the weight of the laundry.

[0028] When the ratio of the weight measurement value to the weight of the dry laundry exceeds the second reference value, the first speed may be adjusted according to the weight measurement value.

[0029] Accordingly, the laundry may be spin-dried to a certain degree of spin-drying even when new laundry is added or some of the previously loaded laundry is removed just before the spin-drying starts. In addition, the laundry may be spin-dried to the certain degree of spin-drying regardless of a degree to which the laundry gets inter-tangled or inclined to a certain side.

[0030] A weight of wet laundry may be measured before the laundry is spin-dried.

[0031] The spin-drying of the laundry may be ended based on the reduction rate of the weight measurement value being less than the first reference value and a ratio of a reduction amount of the weight measurement value to the weight of the wet laundry being less than a third reference value.

[0032] The first speed may be set to be inversely proportional to the weight of the laundry.

[0033] When the ratio of the reduction amount of the weight measurement value to the weight of the wet laundry exceeds the third reference value, the first speed may be adjusted according to the weight measurement value.

[0034] Accordingly, the laundry may be spin-dried to the certain degree of spin-drying even when new laundry is added or some of the previously loaded laundry is removed just before the spin-drying starts. In addition, the laundry may be spin-dried to the certain degree of spin-drying regardless of the degree to which the laundry gets inter-tangled or inclined to the certain side.

[0035] The weight of the dry laundry may be measured before the laundry is washed.

[0036] The spin-drying of the laundry may be ended based on the ratio of the weight measurement value to the weight of the dry laundry being less than or equal to the second reference value.

[0037] The weight of the wet laundry may be measured before the laundry is spin-dried.

[0038] The spin-drying of the laundry may be ended based on the ratio of the reduction amount of the weight measurement value to the weight of the wet laundry being less than the third reference value.

[0039] The weight of the dry laundry may be measured before the laundry is washed.

[0040] When the spin-drying of the laundry is ended, the weight of the spin-dried laundry is measured, and then first information may be transmitted to a terminal or a dryer of a user.

[0041] Accordingly, the user may predict a natural drying time for the spin-dried laundry. In addition, after the spin-drying is finished, the dryer may be conveniently used and the use time of the dryer may be shortened.

[0042] The first information may include a ratio of the weight of the spin-dried laundry to the weight of the dry laundry.

[0043] The weight of the wet laundry may be measured before the laundry is spin-dried.

[0044] When the spin-drying of the laundry is ended, the weight of the spin-dried laundry is measured, and then second information may be transmitted to the terminal or the dryer of the user.

[0045] Accordingly, the user may predict a natural drying time for the spin-dried laundry.

[0046] In addition, after the spin-drying is finished, the dryer may be conveniently used and the use time of the dryer may be shortened.

[0047] The second information may include the ratio of the weight of the spin-dried laundry to the weight of the wet laundry.

[0048] The weight sensor may measure the weight of the laundry multiple times.

[0049] The spin-drying of the laundry may be ended after the washing tub is rotated at a maximum spin-drying rotation speed.

[0050] The maximum spin-drying rotation speed may be set to be inversely proportional to the reduction rate of the weight measurement value.

[0051] Accordingly, the laundry may be spin-dried to the certain degree of spin-drying even when new laundry is added or some of the previously loaded laundry is removed just before the spin-drying starts. In addition, the laundry may be spin-dried to the certain degree of spin-drying regardless of the degree to which the laundry gets inter-tangled or inclined to the certain side.

[0052] The weight sensor may measure the weight of the laundry multiple times.

[0053] A fabric quality of the laundry may be determined based on the reduction rate of the weight measurement value.

[0054] Accordingly, the accuracy in recognizing the laundry may be improved without installing additional devices necessary for recognizing the laundry.

[0055] According to embodiments of the present disclosure, since, while the driver is rotating the washing tub to spin-dry the laundry, the weight sensor measures the weight of the laundry, and spin-drying of the laundry is ended based on a weight measurement value obtained as a result of the measurement, the accuracy in recognizing the laundry may be improved without installing additional devices necessary for recognizing the laundry.

[0056] In addition, according to embodiments of the present disclosure, since the spin-drying of the laundry is ended based on the reduction rate of the weight measurement value being less than the first reference value, the laundry may be spin-dried to the certain degree of spin-drying even when new laundry is added or some previously loaded laundry is removed just before the spin-drying starts. In addition, the laundry may be spin-dried to the certain degree of spin-drying regardless of the degree to which the laundry gets inter-tangled or inclined to the certain side.

[0057] Further, according to embodiments of the present disclosure, since, when the spin-drying of the laundry is ended, the weight of the spin-dried laundry is measured and then the first information or the second information is transmitted to the dryer, the dryer may be conveniently used and the use time of the dryer after the spin-drying is finished may be shortened.

[0058] In addition, according to embodiments of the present disclosure, since, when the spin-drying of the laundry is ended, the weight of the spin-dried laundry is measured and then the first information or the second information is transmitted to the terminal of the user, the user may numerically confirm a spin-drying completion time, thereby predicting a natural drying time for the spin-dried laundry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059]

FIG. 1 is a cross-sectional view illustrating a washing machine.

FIG. 2 is a flow chart illustrating a method for controlling a washing machine, according to a first embodiment of the present disclosure.

FIG. 3 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 2.

FIG. 4 is a flow chart illustrating a method for controlling a washing machine, according to a second embodiment of the present disclosure.

FIG. 5 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 4.

FIG. 6 is a flow chart illustrating a method for controlling a washing machine, according to a third embodiment of the present disclosure.

FIG. 7 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 6.

FIG. 8 is a flow chart illustrating a method for controlling a washing machine, according to a fourth embodiment of the present disclosure.

FIG. 9 is a diagram illustrating an exchange of information between a washing machine, a dryer, and a terminal, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0060] Hereinbelow, preferred embodiments of the present disclosure will be described in greater detail with reference to the accompanying drawings. However, in describing the present disclosure, descriptions of already known functions or configurations will be omitted to clarify the subject matter of the present disclosure.

[0061] FIG. 1 is a cross-sectional view illustrating a top loader washing machine 10.

[0062] As illustrated in FIG. 1, the top loader washing machine 10 includes a case 11, an outer tub 12, an inner tub (washing tub) 13, a pulsator 14, a driver 15, a suspension bar 16, and a weight sensor 17.

[0063] The washing tub 13, into which laundry is loaded, is located inside the outer tub 12. The driver 15 is configured to rotate the washing tub 13. The suspension bar 16 is configured to suspend the outer tub 12. The weight sensor 17 configured to detect a weight of the laundry is installed on the suspension bar 16. The weight sensor 17 is provided as a load cell.

[0064] The load cell may be manufactured using a strain gauge. As disclosed in Korean Patent Registration No. 10-1729577, the suspension bar 16 which suspends the outer tub 12 and the weight sensor 17 installed on the suspension bar 16 are well-known technologies, so a detailed description thereof will be omitted.

[0065] Water contained in the outer tub 12 and the in-

ner tub 13 before spin-drying is discharged through a drain passage 18 to the outside. A drain pump 19 configured to discharge the water to the outside is installed on the drain passage 18. The drain passage 18 is opened or closed by a drain valve 20. A method for controlling a washing machine (S100, S200, S300, S400) according to an embodiment of the present disclosure, as described below, may be set in a controller (not shown) of the top loader washing machine 10.

First embodiment

[0066] FIG. 2 is a flow chart illustrating a method for controlling a washing machine, according to a first embodiment of the present disclosure. FIG. 3 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 2.

[0067] As illustrated in FIG. 2, the method for controlling the washing machine (S100) according to the first embodiment of the present disclosure includes a step of measuring a weight of dry laundry (S110), a washing step (S120), a step of measuring a weight of wet laundry (S130), a step of rotating a washing tub at a first speed (VM) (S141), a step of measuring a weight of the laundry (S143), and a step of determining whether to end spin-drying (S144).

[0068] The step of measuring the weight of the dry laundry (S110) is a step of measuring the weight of the dry laundry loaded into the washing tub 13. The weight of the dry laundry represents a weight of laundry (an amount of laundry to be washed) before water is supplied to the washing tub 13.

[0069] The laundry is made of natural and/or synthetic fibers. As disclosed in the related art 1 mentioned above, the fibers have different water absorption properties depending on their type. Accordingly, a spin-drying speed and a spin-drying time are to be adjusted differently according to the type of the laundry so as to achieve a certain degree of spin-drying.

[0070] As an existing method for detecting a weight of laundry, there is a method for converting, by a hall sensor, a change in magnetic flux generated as a gear installed on a motor shaft is rotated, into a square wave, which is an electrical signal, and detecting the weight of the laundry based on the square wave. That is, there is a method for detecting the weight of the laundry by using the number of pulses obtained by detecting a rotational force that depends on the weight of the laundry.

[0071] There is also another method for detecting a weight of laundry, the method including causing a square wave to be generated when a signal generated by a back electromotive force of a motor is greater than or equal to a predetermined voltage, and detecting the weight of the laundry based on the number of pulses of the square wave, the number of pulses being generated by a rotational force that depends on the weight of the laundry. Alternatively, the weight of laundry may be detected using a separate weight sensor. The method for detecting the weight of laundry is a well-known technology, so a detailed description thereof will be omitted.

[0072] As illustrated in FIG. 2, when the step of measuring the weight of the dry laundry (S110) is completed, the washing step (S120) starts. The washing step (S120) may be a step of supplying water to the washing tub 13, and washing and rinsing the laundry. Alternatively, the washing step (S120) may be a step of supplying water to the washing tub 13 and washing or rinsing the laundry.

[0073] When the washing step (S120) is completed, a step of measuring the weight of the wet laundry (S130) starts. The step of measuring the weight of the wet laundry (S130) is a step of discharging water contained in the washing tub 13 and then measuring the weight of the wet laundry. A controller of the washing machine 10 opens the drain valve 20 and operates the drain pump 19, before measuring the weight of the wet laundry.

[0074] The weight of the wet laundry represents a weight of laundry to be measured (an amount of laundry to be spin-dried) after the water contained in the washing tub 13 is discharged. As illustrated in FIG. 3, the weight of the wet laundry is measured by the method for detecting the weight of the laundry as described above while repeating acceleration and deceleration of the washing tub 13.

[0075] When the step of measuring the weight of the wet laundry (S130) is completed, the spin-drying starts (S140). As illustrated in FIG. 3, after the spin-drying starts (S140), the washing tub 13 is gradually accelerated to rotate at the first speed (VM) (S141).

[0076] As illustrated in FIG. 2, the step of rotating the washing tub 13 at the first speed (VM) (S141) is a step of rotating the washing tub 13 at a maximum rotation speed. The maximum rotation speed may represent a maximum rotation speed of the washing tub 13 that is set as a default for specific washing courses (such as standard course, wool course, and duvet course). The washing tub 13 is rotated constantly at the first speed (VM) for a predetermined period of time so as to spin-dry the laundry (S142).

[0077] While the washing tub 13 is being rotated constantly at the first speed (VM) (S142), the water absorbed in the laundry is gradually removed from the laundry. The step of measuring the weight of the laundry (S143) is a step of measuring the weight of the laundry by the weight sensor 17 while the washing tub 13 is being rotated at the first speed (VM).

[0078] The step of determining whether to end the spin-drying (S144) is a step of ending spin-drying of laundry based on a weight measurement value.

[0079] When, in the step of determining whether to end the spin-drying (S144), a ratio of the weight measurement value to the weight of the dry laundry is equal to or less than a second reference value, the spin-drying of the laundry may be ended. The above condition is expressed by Equation 1 as follows:

$$\frac{C_0}{A} \leq X_2 \qquad \text{Equation 1}$$

where A: weight of dry laundry; Co: weight measurement value; X_2: second reference value.

[0080] The second reference value is as follows: X_2 = 1.8

[0081] That is, when, assuming that the weight of the dry laundry is 100%, the weight measurement value is 180% or less, the spin-drying of the laundry may be ended. In other words, when, assuming that the weight of the dry laundry is 100%, the weight measurement value is 180% or less, the laundry is determined to have been sufficiently spin-dried. Accordingly, when the above condition is satisfied, the spin-drying of the laundry is ended.

[0082] As illustrated in FIG. 2, when, in the step of determining whether to end the spin-drying (S144), the ratio of the weight measurement value to the weight of the dry laundry is determined to exceed the second reference value, the washing tub 13 is rotated again at the first speed (VM) for a predetermined period of time (S142). Then, the step of measuring the weight of the laundry (S143) and the step of determining whether to end the spin-drying (S144) are performed again.

[0083] However, when, in the step of determining whether to end the spin-drying (S144), a ratio of a reduction amount of the weight measurement value to the weight of the wet laundry is determined to be less than a third reference value, the spin-drying of the laundry may be ended. The weight sensor 17 measures the weight of the laundry multiple times, once at each time (t). The above condition is expressed by Equation 2 as follows:

$$\frac{C_0 - C_t}{B} < X_3 \qquad \text{Equation 2}$$

where B: weight of wet laundry; Co: weight measurement value; Ct: weight measurement value after time t has elapsed since Co was measured; X_3: third reference value.

[0084] The third reference value and the time t are as follows:

X_3 = 0.01
t = 1 minute

[0085] The above equation 2 is an equation that determines whether, assuming that the weight of the wet laundry is 100%, the reduction amount of the weight measurement value for 1 minute is less than 1%. When, assuming that the weight of the wet laundry is 100%, the reduction amount of the weight measurement value for 1 minute is less than 1%, the laundry is determined to have been sufficiently spin-dried. When the above condition is satisfied, the spin-drying of the laundry is ended.

[0086] As illustrated in FIG. 2, when, assuming that the weight of the wet laundry is 100%, the reduction amount of the weight measurement value for 1 minute is 1% or more, the washing tub 13 is rotated again at the first speed (VM) for a predetermined period of time (S142). Then, the step of measuring the weight of the laundry (S143) and the step of determining whether to end the spin-drying (S144) are performed again.

Second embodiment

[0087] FIG. 4 is a flow chart illustrating a method for controlling a washing machine according to a second embodiment of the present disclosure. FIG. 5 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 4.

[0088] As illustrated in FIG. 5, the method for controlling the washing machine (S200) according to the second embodiment of the present disclosure includes a step of measuring a weight of dry laundry (S210), a washing step (S220), a step of measuring a weight of wet laundry (S230), a step of rotating a washing tub at a first speed (VM1) (S241), a step of measuring a weight of laundry (S243), a step of determining whether to end spin-drying (S244), and a step of determining whether to end secondary spin-drying (S245).

[0089] The step of measuring the weight of the dry laundry (S210) is a step of measuring the weight of the dry laundry loaded into the washing tub 13. The weight of the dry laundry represents a weight of laundry (an amount of laundry to be washed) before water is supplied to the washing tub 13.

[0090] As illustrated in FIG. 4, when the step of measuring the weight of the dry laundry (S210) is completed, the washing step (S220) starts. The washing step (S220) may be a step of supplying water to the washing tub 13, and washing and rinsing the laundry. Alternatively, the washing step (S220) may be a step of supplying water to the washing tub 13 and washing or rinsing the laundry.

[0091] When the washing step (S220) is completed, a step of measuring the weight of the wet laundry (S230) starts. The step of measuring the weight of the wet laundry (S230) is a step of discharging water contained in the washing tub 13 and measuring the weight of the wet laundry. A controller of the washing machine 10 opens the drain valve 20 and operates the drain pump 19, before measuring the weight of the wet laundry.

[0092] The weight of the wet laundry represents a weight of laundry to be measured (an amount of laundry to be spin-dried) after the water contained in the washing tub 13 is discharged. As illustrated in FIG. 5, the weight of the wet laundry is measured by the method for detecting the weight of the laundry as described above while repeating acceleration and deceleration of the washing tub 13.

[0093] When the step of measuring the weight of the wet laundry (S230) is completed, spin-drying starts (S240). As illustrated in FIG. 5, after spin-drying starts (S240), the washing tub 13 is gradually accelerated to rotate at a first speed (VM1) (S241).

[0094] As illustrated in FIG. 4, the step of rotating the washing tub 13 at the first speed (VM1) (S241) is a step of rotating the washing tub 13 at a maximum rotation speed. The maximum rotation speed may represent a maximum rotation speed of the washing tub 13 that is set as a default for specific washing courses (such as standard course, wool course, and duvet course). The washing tub 13 is rotated at a first speed (VM1) for a predetermined period of time to spin-dry the laundry (S242).

[0095] While the washing tub 13 is being rotated at the first speed (VM1) for a predetermined period of time (S242), the water absorbed in the laundry is gradually removed from the laundry. The step of measuring the weight of the laundry (S243) represents a step of measuring the weight of the laundry by the weight sensor 17 at the first speed (VM1). The weight sensor 17 measures the weight of the laundry multiple times, once at each time (t).

[0096] The spin-drying of the laundry is ended when, in the step of determining whether to end the spin-drying (S244), a reduction rate of a weight measurement value is determined to be less than a first reference value. Whether or not to end the spin-drying is determined by using two or more of the weight measurement values as variables without using the weight of the dry laundry and the weight of the wet laundry as variables. The above condition is expressed by Equation 3 as follows:

$$\frac{C_0 - C_t}{C_0} < X_1 \qquad \text{Equation 3}$$

where Co: weight measurement value; Ct: weight measurement value after time t has elapsed since Co was measured; X_1: first reference value.

[0097] The first reference value and the time t are as follows:

$X_1 = 0.01$
t = 1 minute

[0098] When, in the step of determining whether to end the spin-drying (S244), the reduction rate of the weight measurement value is determined to be greater than or equal to the first reference value, the washing tub 13 is again rotated at a first speed (VM1) for a predetermined period of time (S242). Then, the step of measuring the weight of the laundry (S243) and the step of determining whether to end the spin-drying (S244) are performed again.

[0099] When the reduction rate of the weight measurement value is less than 1% per minute, the step of determining whether to end the secondary spin-drying (S245) starts.

[0100] When, in the step of determining whether to end the secondary spin-drying (S245), the ratio of the weight measurement value to the weight of the dry laundry is equal to or less than a second reference value, the spin-drying of the laundry may be ended. The above condition is expressed by Equation 4 as follows:

$$\frac{C_0}{A} \leq X_2 \qquad \text{Equation 4}$$

where A: weight of dry laundry; Co: weight measurement value; X_2: second reference value. The second reference value is as follows.

$X_2 = 1.8$

[0101] That is, when, assuming that the weight of the dry laundry is 100%, the weight measurement value is 180% or less, the spin-drying of the laundry may be ended. In other words, when, assuming that the weight of the dry laundry is 100%, the weight measurement value is 180% or less, the laundry is determined to have been sufficiently spin-dried. When the above condition is satisfied, the spin-drying of the laundry is ended.

[0102] In addition, when, in the step of determining whether to end the secondary spin-drying (S245), a ratio of a reduction amount of the weight measurement value to the weight of the wet laundry is less than a third reference value, the spin-drying of the laundry may be ended. The weight sensor 17 measures the weight of the laundry multiple times, once at each time (t). The above condition is expressed by Equation 5 as follows:

$$\frac{C_0 - C_t}{B} < X_3 \qquad \text{Equation 5}$$

where B: weight of wet laundry; Co: weight measurement value; Ct: weight measurement value after time t has elapsed since Co was measured; X_3: third reference value.

[0103] The third reference value and the time t are as follows:

$X_3 = 0.01$
t = 1 minute

[0104] That is, the above equation 5 is an equation that determines whether, assuming that the weight of the wet laundry is 100%, the reduction amount of the weight measurement value for 1 minute is less than 1%. When, assuming that the weight of the wet laundry is 100%, the reduction amount of the weight measurement value for 1 minute is less than 1%, the laundry is determined to

have been sufficiently spin-dried. When the above condition is satisfied, the spin-drying of the laundry is ended.

[0105] As illustrated in FIG. 4, when the Equation 4 or the Equation 5 is not satisfied, the first speed (VM1) is adjusted according to the weight measurement value (S246, S247). First, a step of determining whether the current first speed (VM1) is the maximum rotation speed with respect to the weight measurement value (S246) starts.

[0106] When the current first speed (VM1) is determined to be the maximum rotation speed with respect to the weight measurement value, the washing tub 13 is again rotated at the first speed (VM1) for a predetermined period of time (S242). Then, the step of measuring the weight of the laundry (S243), the step of determining whether to end the spin-drying (S244), and the step of determining whether to end the secondary spin-drying (S245) is performed again.

[0107] The first speed (VM1) may be set in the step of measuring the weight of the wet laundry (S230). That is, the first speed (VM1) may be a value corresponding to the weight of the wet laundry. The first speed (VM1) is set to a value inversely proportional to the weight of the laundry in the controller of the washing machine 10. In general, the weight measurement value is smaller than the weight of the wet laundry since it is the weight of the laundry measured after the spin-drying starts.

[0108] When the current first speed (VM1) is determined not to be the maximum rotation speed with respect to the weight measurement value, a step of resetting the first speed (VM1) (S247) starts. The first speed (VM1) is increased according to the weight measurement value.

[0109] Then, the washing tub 13 is rotated at the changed first speed (VM2) for a predetermined period of time (S242). Then, the step of measuring the weight of the laundry (S243), the step of determining whether to end the spin-drying (S244) and the step of determining whether to end the secondary spin-drying (S245) is performed again.

Third embodiment

[0110] FIG. 6 is a flow chart illustrating a method for controlling a washing machine, according to a third embodiment of the present disclosure. FIG. 7 is a graph illustrating a relationship between a time and a rotation speed, according to the method for controlling the washing machine illustrated in FIG. 6.

[0111] As illustrated in FIG. 6, the method for controlling the washing machine (S300) according to the third embodiment of the present disclosure includes a step of measuring a weight of dry laundry (S310), a washing step (S320), a step of measuring a weight of wet laundry (S330), a step of rotating a washing tub at a first speed (VD) (S341), a step of measuring a weight of laundry (S342), a step of determining a fabric quality of the laundry (S343), a step of setting a maximum spin-drying rotation speed (S344), and a step of rotating the washing tub at the maximum spin-drying rotation speed (S345).

[0112] The step of measuring the weight of the dry laundry (S310) is a step of measuring a weight of dry laundry loaded into the washing tub 13. The weight of the dry laundry represents a weight of laundry (an amount of laundry to be washed) before water is supplied to the washing tub 13.

[0113] As illustrated in FIG. 6, when the step of measuring the weight of the dry laundry (S310) is completed, the washing step (S320) starts. The washing step (S320) may be a step of supplying water to the washing tub 13, and washing and rinsing the laundry. Alternatively, the washing step (S320) may be a step of supplying water to the washing tub 13, and washing or rinsing the laundry.

[0114] When the washing step (S320) is completed, a step of measuring the weight of the wet laundry (S330) starts. The step of measuring the weight of the wet laundry (S330) is a step of discharging water contained in the washing tub 13 and measuring the weight of the wet laundry. A controller of the washing machine 10 opens the drain valve 20 and operates the drain pump 19, before measuring the weight of the wet laundry.

[0115] The weight of the wet laundry represents a weight of laundry to be measured (an amount of laundry to be spin-dried) after the water contained in the washing tub 13 is discharged. As illustrated in FIG. 7, the weight of the wet laundry is measured by the method for detecting the weight of the laundry as described above while repeating acceleration and deceleration of the washing tub 13.

[0116] When the step of measuring the weight of the wet laundry (S330) is completed, the spin-drying starts (S340). As illustrated in FIG. 7, after the spin-drying starts (S340), the washing tub 13 is gradually accelerated to rotate at the first speed VD (S341).

[0117] As illustrated in FIG. 6, the step of rotating the washing tub 13 at the first speed (VD) (S341) is a step of rotating the washing tub 13 at a detecting rotation speed that is slower than a resonance generation speed. The detecting rotation speed may be around 400 RPM. Alternatively, the detecting rotation speed may be, for example, 120 RPM, 250 RPM, or 400 RPM.

[0118] When the step of rotating the washing tub at the first speed (VD) (S341) is completed, the weight sensor 17 measures the weight of the laundry (S342) and then determines the fabric quality of the laundry (S343).

[0119] In the step of determining the fabric quality of the laundry (S343), the fabric quality of the laundry may be determined based on a reduction rate of the weight measurement value. The weight sensor 17 measures the weight of the laundry multiple times, once at each time (t).

[0120] The fabric quality of the laundry may be determined by a result of Equation 6 below.

$$\frac{C_0 - C_t}{C_0} \qquad \text{Equation 6}$$

where Co: weight measurement value; Ct: weight measurement value after time t has elapsed since Co was measured.

[0121] That is, the fabric quality of the laundry may be determined based on a reduction rate of the weight measurement value. As centrifugal force acts on the laundry, a rate at which water is removed from the laundry varies depending on a material of the laundry. Data about the spin-drying speed for each laundry material that depends on the rotation speed of the washing tub 13 is stored in the controller in advance.

[0122] The controller of the washing machine 10 stores a time elapsed from the step of starting the spin-drying (S340) to the step of determining the fabric quality of laundry (S343), and the rotation speed of the washing tub 13. Accordingly, the controller may determine the fabric quality of the laundry based on the reduction rate of the weight measurement value.

[0123] When the fabric quality of the laundry is determined (S343), the maximum spin-drying rotation speed (VM1) is reset according to the determined fabric quality of the laundry (S344). The washing tub is rotated at the reset maximum spin-drying rotation speed (VM2) (S345). As illustrated in FIG. 7, when a predetermined period of time has elapsed (S346) after the washing tub 13 was rotated at the maximum spin-drying rotation speed (VM2) (S345), the spin-drying of the laundry is ended.

Fourth embodiment

[0124] FIG. 8 is a flow chart illustrating a method for controlling a washing machine (S400), according to a fourth embodiment of the present disclosure. FIG. 9 is a diagram illustrating an exchange of information between a washing machine 10, a dryer 20, and a terminal 30.

[0125] As illustrated in FIG. 8, the method for controlling the washing machine according (S400) to the fourth embodiment of the present disclosure includes a step of measuring a weight of dry laundry (S410), a washing step (S420), a step of measuring a weight of wet laundry (S430), a step of starting spin-drying (S440), a step of ending spin-drying (S441), a step of measuring a weight of the spin-dried laundry (S442), a step of transmitting first information to the terminal (S443), and a step of transmitting second information to the dryer (S444).

[0126] The measuring the weight of the dry laundry (S410) is a step of measuring a weight of dry laundry loaded into the washing tub 13. The weight of the dry laundry represents a weight of laundry (an amount of laundry to be washed) before water is supplied to the washing tub 13.

[0127] As illustrated in FIG. 8, when the step of measuring the weight of the dry laundry (S410) is completed, the washing step (S420) starts. The washing step (S420) may be a step of supplying water to the washing tub 13, and washing and rinsing the laundry. Alternatively, the washing step (S420) may be a step of supplying water to the washing tub 13 and washing or rinsing the laundry.

[0128] When the washing step (S420) is completed, the step of measuring the weight of the wet laundry (S430) starts. The step of measuring the weight of the wet laundry (S430) is a step of discharging water contained in the washing tub 13 and measuring the weight of the wet laundry. A controller of the washing machine 10 opens the drain valve 20 and operates the drain pump 19, before measuring the weight of the wet laundry.

[0129] The weight of the wet laundry represents a weight of laundry to be measured (an amount of laundry to be spin-dried) after the water contained in the washing tub 13 is discharged. The weight of the wet laundry is measured by the method for detecting the weight of the laundry as described above while repeating acceleration and deceleration of the washing tub 13.

[0130] When the step of measuring the weight of the wet laundry (S430) is completed, the spin-drying starts (S440). While the spin-drying is performed, the washing tub 13 is gradually accelerated to rotate at a maximum rotation speed, thereby spin-drying the laundry. The processes from the step of starting the spin-drying (S440) to the step of ending the spin-drying (S441) proceed in the order of the processes from the step of starting the spin-drying (S140, S240, S340) to the step of ending the spin-drying, according to any one of the first to third embodiments of the present disclosure.

[0131] When the spin-drying of the laundry is ended (S441), the step of measuring the weight of the spin-dried laundry (S442) starts. The weight of the spin-dried laundry represents a weight of laundry to be measured after the spin-drying is ended. The weight of the spin-dried laundry is measured by the method for detecting the weight of the laundry as described above while repeating acceleration and deceleration of the washing tub 13.

[0132] When the step of measuring the weight of the spin-dried laundry (S442) is completed, the step of transmitting the first information to the terminal 30 of a user (S443) and the step of transmitting the second information to the dryer 20 (S444) starts. Alternatively, the first information may be transmitted to the dryer 20. The second information may be transmitted to the terminal 30 of the user.

[0133] The first information may include the ratio of the weight of the spin-dried laundry to the weight of the dry laundry. The second information may include the ratio of the weight of the spin-dried laundry to the weight of the dry laundry.

[0134] As illustrated in FIG. 9, a dedicated application that allows the terminal 30 of the user to exchange information with the washing machine 10 and the dryer 20 is installed in the terminal 30 of the user. When the terminal 30 of the user receives the first information or the second information, the dedicated application of the terminal 30 is automatically executed. The dedicated application may display the ratio of the weight of the spin-dried laundry to the weight of the dry laundry (hereinafter referred to as a first degree of spin-drying), the ratio of the weight of the spin-dried laundry to the weight of the wet laundry

(hereinafter referred to as a second degree of spin-drying), and an predicted natural drying time determined by comparing the first degree of spin-drying with a current humidity. Accordingly, the user may recognize the natural drying time of the laundry when the spin-drying is ended.

[0135] As illustrated in FIG. 9, the washing machine 10 and the dryer 20 may exchange information with each other via any type of wired or wireless communication. The dryer 20 receives the first degree of spin-drying, the second degree of spin-drying, and information on a fabric quality of laundry. The dryer 20 automatically sets a drying temperature or a drying time based on the first degree of spin-drying, the second degree of spin-drying, and the information on the fabric quality of laundry. The user may load laundry into the dryer 20 and then immediately press a "start" button to quickly dry the laundry.

[0136] In the foregoing, while specific embodiments of the present disclosure have been described and illustrated, the present disclosure is not limited to the described embodiments. It is obvious to those skilled in the art that various variations and modifications may be made to the specific embodiments without departing from the spirit and scope of the present disclosure. Accordingly, such modifications or variations should not be individually understood from the technical spirit or viewpoint of the present disclosure, and the modified embodiments are within the scope of the claims of the present disclosure.

Claims

1. A method for controlling a washing machine, the washing machine comprising:

a washing tub (13) for lading laundry therein;
an outer tub (12) accommodating the washing tub;
a driver (15) configured to rotate the washing tub;
a suspension bar (16) suspending the outer tub; and
a weight sensor (17) installed on the suspension bar and configured to detect a weight of the laundry,
the method comprising:
measuring weight of the laundry by the weight sensor (17) while the driver (15) rotates the washing tub (13) to spin-dry the laundry; and
ending the spin-drying of the laundry based on a weight measurement value obtained as a result of the measurement.

2. The method of claim 1, wherein the laundry weight-measuring by the weight sensor (17) is carried out while the driver (15) rotates the washing tub (13) constantly at a first speed to spin-dry the laundry.

3. The method of claim 1 or 2, wherein the laundry weight-measuring by the weight sensor (17) is carried out multiple times, and
wherein the spin-drying of the laundry is ended if a reduction rate of the weight measurement value is determined to be less than a first reference value.

4. The method of claim 3, further comprising: measuring weight of dry laundry before the laundry is washed, and
wherein the spin-drying of the laundry is ended if the reduction rate of the weight measurement value is less than the first reference value and a ratio of the weight measurement value to the weight of dry laundry is less than or equal to a second reference value.

5. The method of claim 4, insofar as dependent upon claim 2, wherein the first speed is set to be inversely proportional to the weight of the laundry, and
wherein when the ratio of the weight measurement value to the weight of dry laundry exceeds the second reference value, the first speed is adjusted according to the weight measurement value.

6. The method of claim 3, further comprising: measuring weight of wet laundry before the laundry is spin-dried, and
wherein the spin-drying of the laundry is ended if the reduction rate of the weight measurement value is less than the first reference value and a ratio of a reduction amount of the weight measurement value to the weight of wet laundry is less than a third reference value.

7. The method of claim 6, insofar as dependent upon claim 2, wherein the first speed is set to be inversely proportional to the weight of the laundry, and
wherein when the ratio of the reduction amount of the weight measurement value to the weight of wet laundry exceeds the third reference value, the first speed is adjusted according to the weight measurement value.

8. The method of claim 1 or 2, further comprising: measuring weight of dry laundry before the laundry is washed, and
wherein the spin-drying of the laundry is ended if a ratio of the weight measurement value to the weight of dry laundry is less than or equal to a second reference value.

9. The method of claim 1 or 2, further comprising: measuring weight of wet laundry before the laundry is spin-dried, and
wherein the spin-drying of the laundry is ended if a ratio of a reduction amount of the weight measurement value to the weight of wet laundry is less than a third reference value.

10. The method of any one of claims 1 to 3 and 6 to 9, further comprising: measuring weight of dry laundry before the laundry is washed;
measuring, when the spin-drying of the laundry is ended, weight of the spin-dried laundry; and
transmitting first information to an external terminal or a dryer,
wherein the first information includes a ratio of the weight of the spin-dried laundry to the weight of dry laundry.

11. The method of any one of claims 1 to 5 and 8 to 10, further comprising: measuring weight of wet laundry before the laundry is spin-dried;
measuring, when the spin-drying of the laundry is ended, weight of the spin-dried laundry; and
transmitting second information to an external terminal or a dryer,
wherein the second information includes a ratio of the weight of the spin-dried laundry to the weight of wet laundry.

12. The method of claim 1 or 2, wherein the laundry weight-measuring by the weight sensor (17) is carried out multiple times,
wherein the spin-drying of the laundry is ended after the washing tub (13) is rotated at a maximum spin-drying rotation speed, and
wherein the maximum spin-drying rotation speed is set to be inversely proportional to a reduction rate of the weight measurement value.

13. The method of any one of claims 1, 2, 8, 9 and 12, wherein the laundry weight-measuring by the weight sensor (17) is carried out multiple times, and
wherein the method further comprises: determining a fabric quality of the laundry based on a reduction rate of the weight measurement value.

Amended claims in accordance with Rule 137(2) EPC.

1. A method for controlling a washing machine, the washing machine comprising:

a washing tub (13) for loading laundry therein;
an outer tub (12) accommodating the washing tub;
a driver (15) configured to rotate the washing tub;
a suspension bar (16) suspending the outer tub; and
a weight sensor (17) installed on the suspension bar and configured to detect a weight of the laundry,
the method comprising:

measuring weight of the laundry by the weight sensor (17) while the driver (15) rotates the washing tub (13) to spin-dry the laundry;
ending the spin-drying of the laundry based on a weight measurement value obtained as a result of the measurement,
wherein the laundry weight-measuring by the weight sensor (17) is carried out multiple times while the driver (15) rotates the washing tub (13) constantly at a first speed to spin-dry the laundry,
wherein the method further comprising determining a fabric quality of the laundry based on a reduction rate of the weight measurement value,
wherein the spin-drying of the laundry is ended after the washing tub (13) is rotated at a maximum spin-drying rotation speed, and
wherein the maximum spin-drying rotation speed is set to be inversely proportional to a reduction rate of the weight measurement value.

2. The method of claim 1, wherein the laundry weight-measuring by the weight sensor (17) is carried out multiple times, and
wherein the spin-drying of the laundry is ended if a reduction rate of the weight measurement value is determined to be less than a first reference value.

3. The method of claim 2, further comprising: measuring weight of dry laundry before the laundry is washed, and
wherein the spin-drying of the laundry is ended if the reduction rate of the weight measurement value is less than the first reference value and a ratio of the weight measurement value to the weight of dry laundry is less than or equal to a second reference value.

4. The method of claim 3, wherein the first speed is set to be inversely proportional to the weight of the laundry, and
wherein when the ratio of the weight measurement value to the weight of dry laundry exceeds the second reference value, the first speed is adjusted according to the weight measurement value.

5. The method of claim 2, further comprising: measuring weight of wet laundry before the laundry is spin-dried, and
wherein the spin-drying of the laundry is ended if the reduction rate of the weight measurement value is less than the first reference value and a ratio of a reduction amount of the weight measurement value to the weight of wet laundry is less than a third reference value.

6. The method of claim 5, wherein the first speed is set to be inversely proportional to the weight of the laundry, and
wherein when the ratio of the reduction amount of the weight measurement value to the weight of wet laundry exceeds the third reference value, the first speed is adjusted according to the weight measurement value.

7. The method of claim 1, further comprising: measuring weight of dry laundry before the laundry is washed, and
wherein the spin-drying of the laundry is ended if a ratio of the weight measurement value to the weight of dry laundry is less than or equal to a second reference value.

8. The method of claim 1, further comprising: measuring weight of wet laundry before the laundry is spin-dried, and
wherein the spin-drying of the laundry is ended if a ratio of a reduction amount of the weight measurement value to the weight of wet laundry is less than a third reference value.

9. The method of any one of claims 1, 2 and 5 to 8, further comprising:

measuring weight of dry laundry before the laundry is washed;
measuring, when the spin-drying of the laundry is ended, weight of the spin-dried laundry; and
transmitting first information to an external terminal or a dryer,
wherein the first information includes a ratio of the weight of the spin-dried laundry to the weight of dry laundry.

10. The method of any one of claims 1 to 4 and 7 to 9, further comprising:

measuring weight of wet laundry before the laundry is spin-dried;
measuring, when the spin-drying of the laundry is ended, weight of the spin-dried laundry; and
transmitting second information to an external terminal or a dryer,
wherein the second information includes a ratio of the weight of the spin-dried laundry to the weight of wet laundry.

FIG. 1

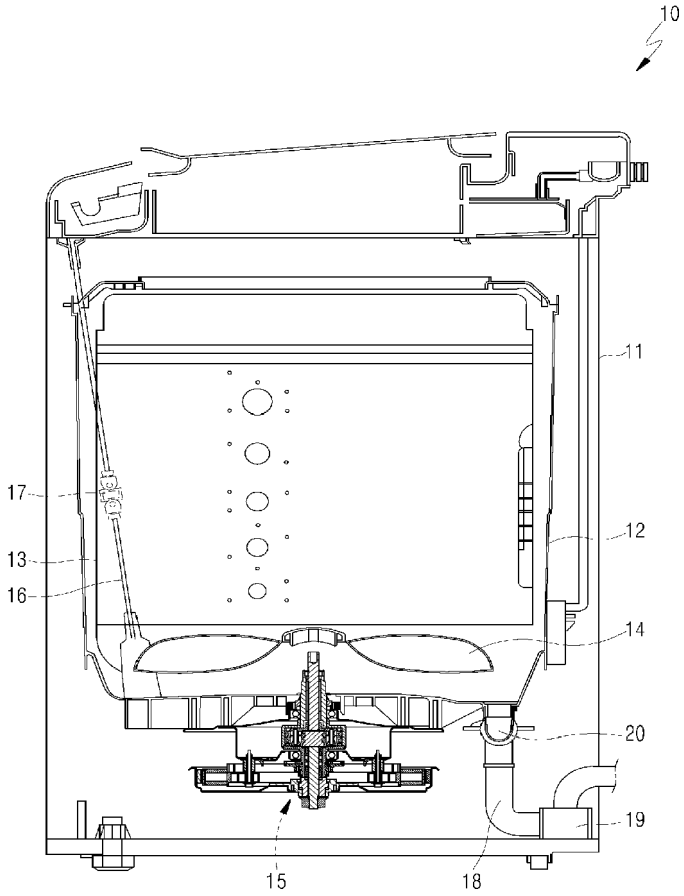


FIG. 2

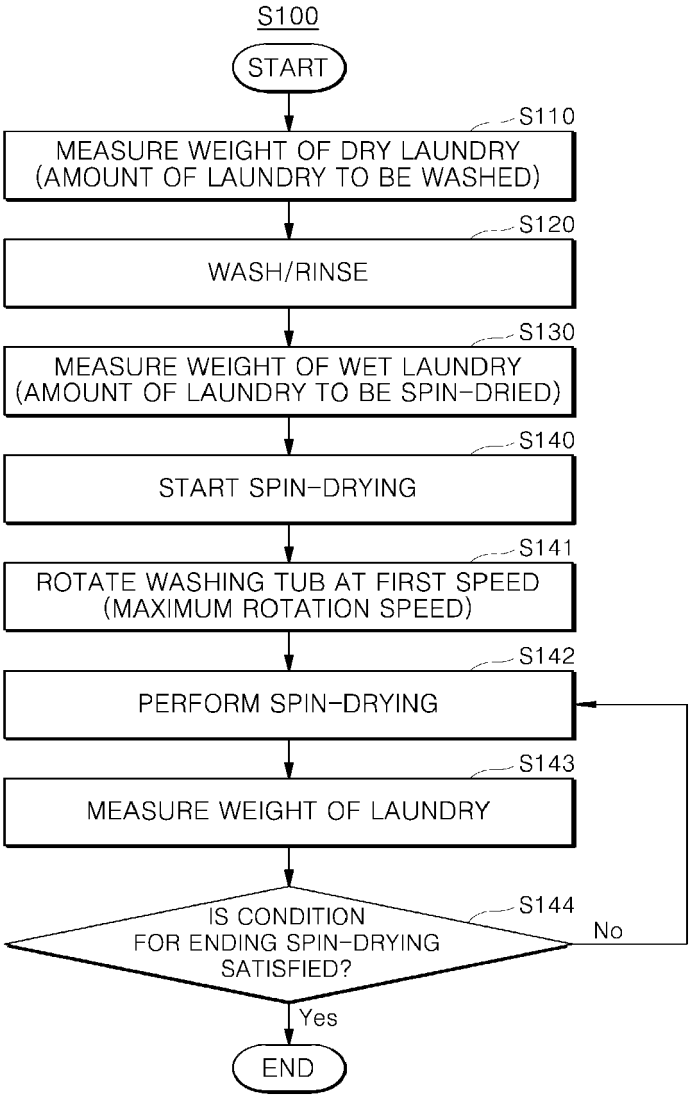

S100
START
S110
MEASURE WEIGHT OF DRY LAUNDRY (AMOUNT OF LAUNDRY TO BE WASHED)
S120
WASH/RINSE
S130
MEASURE WEIGHT OF WET LAUNDRY (AMOUNT OF LAUNDRY TO BE SPIN-DRIED)
S140
START SPIN-DRYING
S141
ROTATE WASHING TUB AT FIRST SPEED (MAXIMUM ROTATION SPEED)
S142
PERFORM SPIN-DRYING
S143
MEASURE WEIGHT OF LAUNDRY
S144
IS CONDITION FOR ENDING SPIN-DRYING SATISFIED?
No
Yes
END

FIG. 3

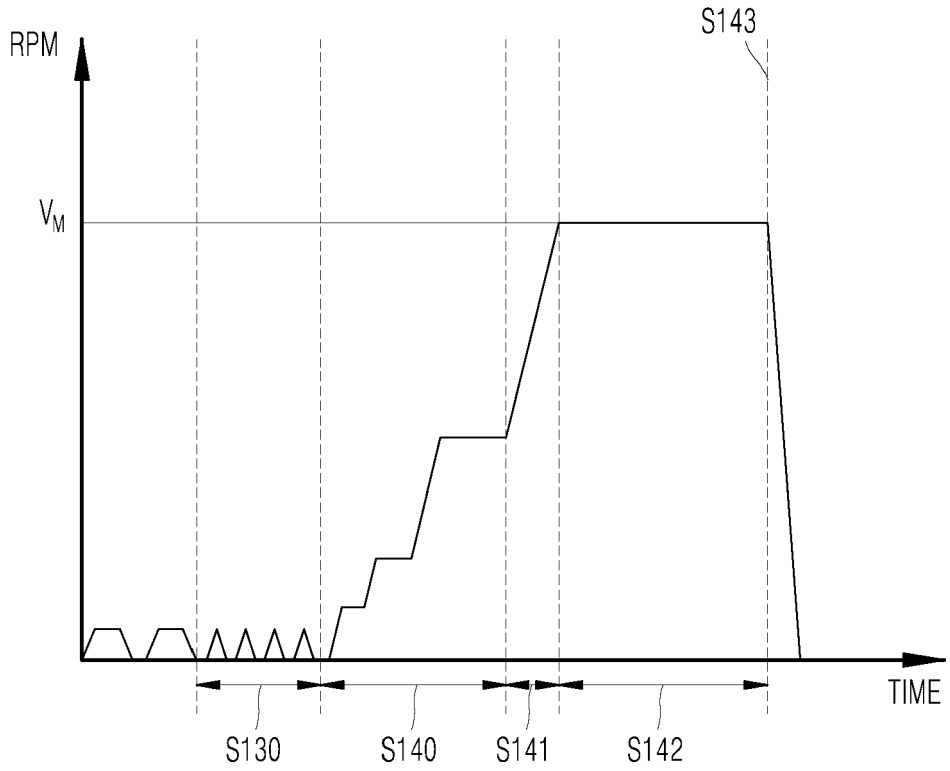


FIG. 4

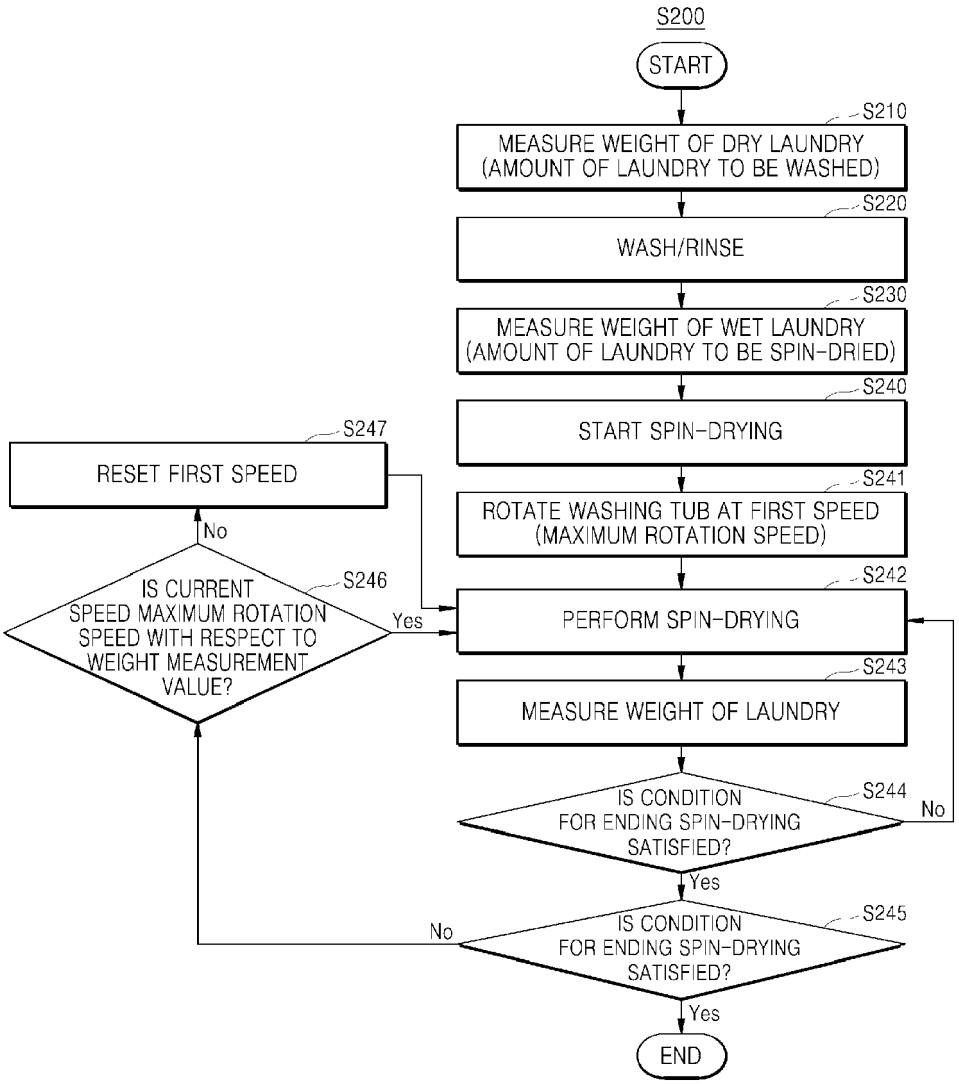

S200
START
S210
MEASURE WEIGHT OF DRY LAUNDRY (AMOUNT OF LAUNDRY TO BE WASHED)
S220
WASH/RINSE
S230
MEASURE WEIGHT OF WET LAUNDRY (AMOUNT OF LAUNDRY TO BE SPIN-DRIED)
S240
START SPIN-DRYING
S241
ROTATE WASHING TUB AT FIRST SPEED (MAXIMUM ROTATION SPEED)
S242
PERFORM SPIN-DRYING
S243
MEASURE WEIGHT OF LAUNDRY
S244
IS CONDITION FOR ENDING SPIN-DRYING SATISFIED?
No
Yes
S245
IS CONDITION FOR ENDING SPIN-DRYING SATISFIED?
No
Yes
END
S246
IS CURRENT SPEED MAXIMUM ROTATION SPEED WITH RESPECT TO WEIGHT MEASUREMENT VALUE?
Yes
No
S247
RESET FIRST SPEED

FIG. 5

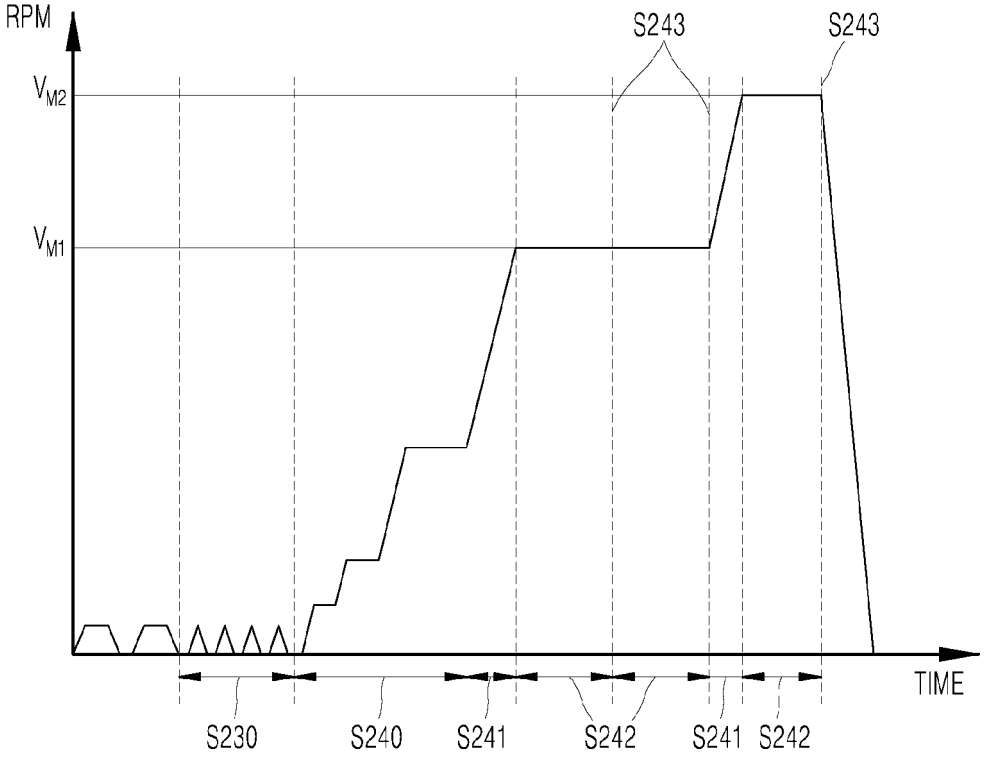


FIG. 6

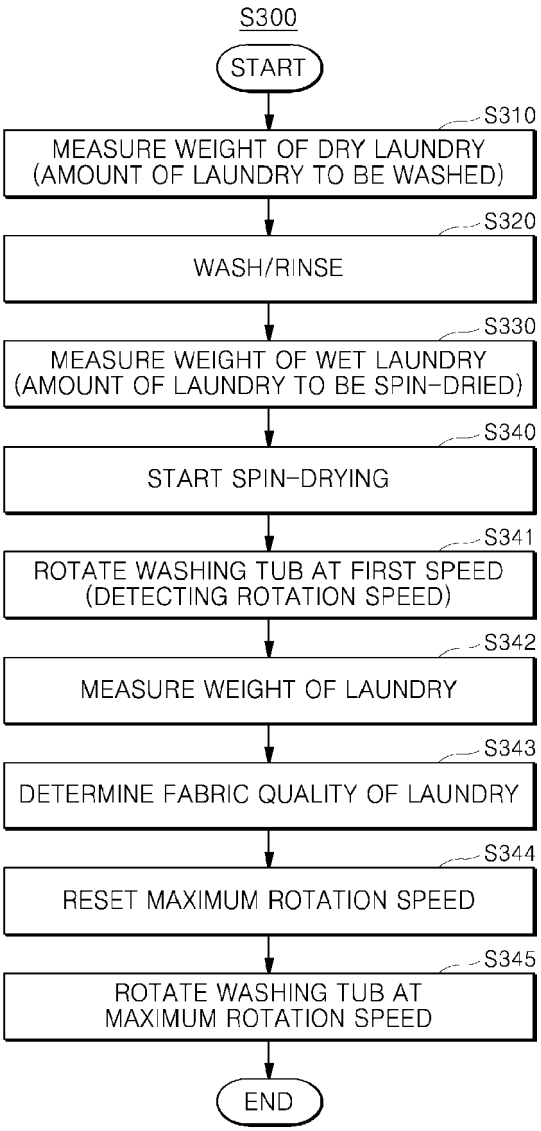

S300
START
S310
MEASURE WEIGHT OF DRY LAUNDRY (AMOUNT OF LAUNDRY TO BE WASHED)
S320
WASH/RINSE
S330
MEASURE WEIGHT OF WET LAUNDRY (AMOUNT OF LAUNDRY TO BE SPIN-DRIED)
S340
START SPIN-DRYING
S341
ROTATE WASHING TUB AT FIRST SPEED (DETECTING ROTATION SPEED)
S342
MEASURE WEIGHT OF LAUNDRY
S343
DETERMINE FABRIC QUALITY OF LAUNDRY
S344
RESET MAXIMUM ROTATION SPEED
S345
ROTATE WASHING TUB AT MAXIMUM ROTATION SPEED
END

FIG. 7

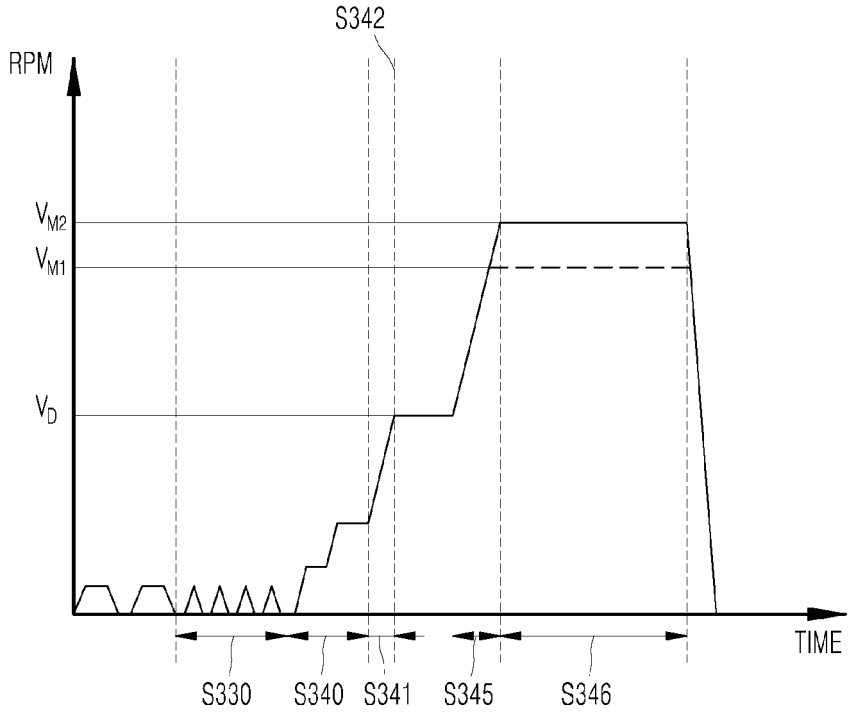


FIG. 8

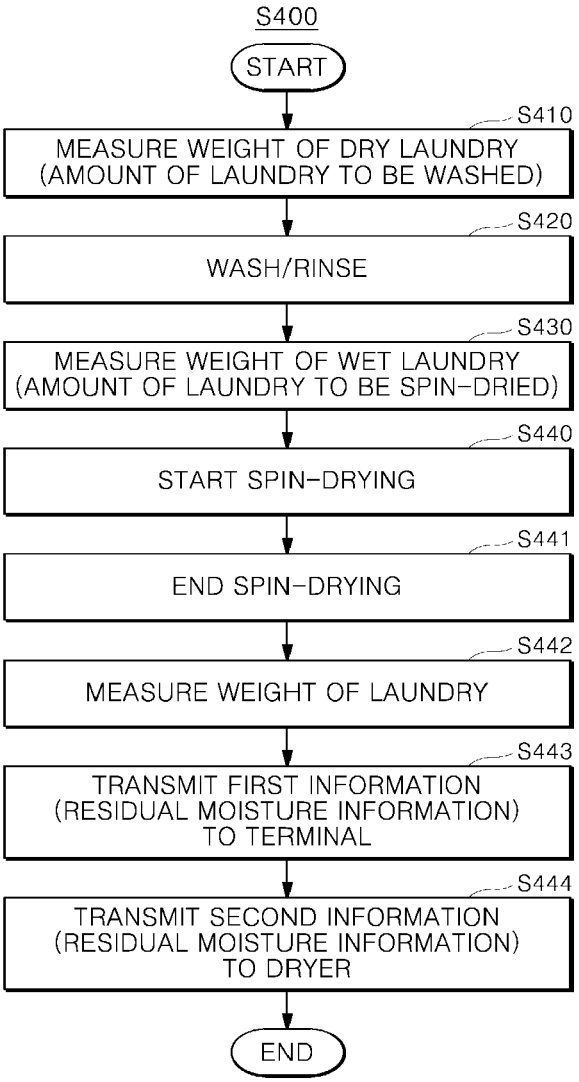
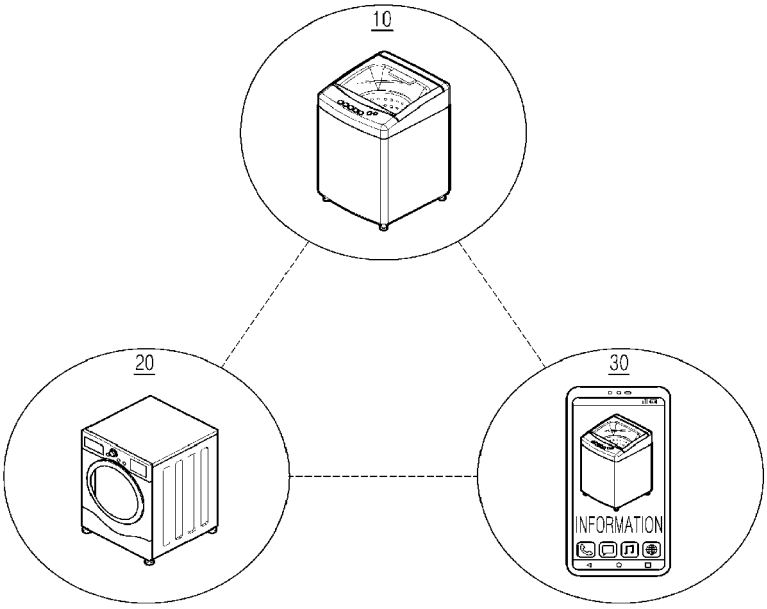

S400
START
S410
MEASURE WEIGHT OF DRY LAUNDRY (AMOUNT OF LAUNDRY TO BE WASHED)
S420
WASH/RINSE
S430
MEASURE WEIGHT OF WET LAUNDRY (AMOUNT OF LAUNDRY TO BE SPIN-DRIED)
S440
START SPIN-DRYING
S441
END SPIN-DRYING
S442
MEASURE WEIGHT OF LAUNDRY
S443
TRANSMIT FIRST INFORMATION (RESIDUAL MOISTURE INFORMATION) TO TERMINAL
S444
TRANSMIT SECOND INFORMATION (RESIDUAL MOISTURE INFORMATION) TO DRYER
END

FIG. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 0801

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2012/060299 A1 (KIM YOUNGJONG [KR] ET AL) 15 March 2012 (2012-03-15) * paragraph [0270] - paragraph [0280]; figures 31-34 * -----	1,3,4,8	INV. D06F34/18 ADD. D06F35/00
A	US 2010/293722 A1 (MUNHOZ ERICO DE OLIVEIRA [BR] ET AL) 25 November 2010 (2010-11-25) * paragraph [0033] - paragraph [0040] * -----	1-13	D06F37/22 D06F37/24 D06F103/04 D06F103/24
A	GB 2 202 646 A (TI CREDA MFG) 28 September 1988 (1988-09-28) * the whole document * -----	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 December 2020	Diaz y Diaz-Caneja

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 19 0801

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03-12-2020

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		WO 2012036422 A2	22-03-2012
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

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- KR 1020000025011 **[0004]**
- KR 101729577 **[0064]**