A method for controlling a washing machine having a drying function is disclosed. The method for controlling the washing machine having a drying function includes: a) dehydrating laundry if a command for performing a drying operation is inputted by a user; and b) drying the laundry after the dehydrating step. The dehydrating step a) includes: measuring time until a rotational velocity of a drum reaches a predetermined velocity; calculating an amount of the laundry based on the measured time; determining a dehydration velocity and dehydration time according to the calculated amount of the laundry; and rotating the drum at the dehydration velocity for the dehydration time. The drying step b) includes: hot-air drying the laundry by operating a heater and a blower fan to supply hot air into the drum until dryness of the laundry reaches a predetermined target dryness; and if the dryness of the laundry reaches the predetermined target dryness, cool-air drying the laundry by stopping operation of the heater while keeping operation of the blower fan to supply air of low temperature into the drum for a predetermined time.
FIG. 2

control panel

dryness sensor

laundry volume sensor

control unit

water supply valve

drain pump

motor

heater

fan motor

condensed water valve
FIG. 3

Start

S1: Input command for independent drying?

S2: Dehydrating

S3: Terminate dehydrating

S4: Laundry disentangling

S5: Hot-air drying

S6: Dryness ≥ target value?

S7: Terminate hot-air drying

S8: Cool-air drying

S9: Predetermined time expired?

S10: Terminate cool-air drying

End
METHOD FOR CONTROLLING WASHING MACHINE HAVING DRYING FUNCTION

[0001] This application claims the benefit of Korean Patent Application Nos. 10-2005-0115485 filed on Nov. 30, 2005, and 10-2005-0118253 filed on Dec. 6, 2005, which are hereby incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a washing machine having a drying function, and more particularly to a method for controlling a washing machine having a drying function which can reduce operating time of a drying operation and further improve a drying performance.

[0004] 2. Discussion of the Related Art

[0005] Generally, washing machines are electric home appliances that remove contaminants from laundry, such as clothes or bedclothes, using emulsification of detergent, friction of washing water motion generated by the rotation, and impact applied to the laundry. The washing machines perform a washing operation, a rinsing operation and a dehydrating operation.

[0006] Washing machines equipped with a drying device perform a drying operation for automatically drying wet clothes, as well as washing, rinsing and dehydrating operations.

[0007] The washing, rinsing, dehydrating and drying operations may be performed sequentially by a predetermined washing program, or may be performed independently according to a user's demand.

[0008] Normally, a washing operation is a course of supplying detergent and washing water to laundry to be washed such that contaminants can be removed from the laundry by a chemical action of the detergent contained in the washing water and a physical action of a drum. A rinsing operation is a course of supplying washing water containing no detergent to laundry such that the detergent and contaminants can be rinsed out of the laundry.

[0009] A dehydrating operation is a course of rotating a drum at high speed after the completion of the rinsing operation such that moisture can be removed from the laundry. And, a drying operation is a course of circulating hot air through the drum such that the wet laundry can be dried.

[0010] A washing machine having a drying function is equipped with a drying device for drying laundry in a drum. The drying device includes a blower fan which forcibly sucks external air and blows the air into the drum, a heater which heats the air sucked by the blower fan to supply hot dry air into the drum, and a blow duct which forms an air passage through which the external air sucked by the blower fan flows into the drum via the heater.

[0011] In other words, the drying operation is performed in such a manner that external air is sucked into the blow duct by the operation of the blower fan while the heater is heating heat, and the sucked air is heated by the heater and enters the rotated drum. While the drying operation is being performed, when dryness of objects to be dried reaches a target value, a control unit determines that the drying is completed and terminates the drying operation.

[0012] Generally, if a user selects a specific operation, time required to perform the user-selected operation is displayed on display means to inform the user of the necessary time. However, because the drying operation is controlled to be continuously performed until dryness of objects to be dried reaches a target value, it is troublesome to calculate accurate time required to perform the drying operation.

[0013] Therefore, when the drying operation is performed, a washing machine is configured to display tentative drying time according to the amount of laundry. The tentative drying time refers to time which is determined by repeated experiments of measuring time until dryness of various groups of the laundry classified by volumes reaches a target value.

[0014] For example, the tentative drying time is 120 minutes, 90 minutes and 60 minutes with respect to a large amount (over 5 kg), a middle amount (2 to 5 kg) and a small amount (below 2 kg) of laundry, respectively. When the drying operation is performed, one of the above exemplary tentative drying times, corresponding to the detected amount of laundry to be dried, is displayed.

[0015] However, when the dehydrating of laundry is low and so the laundry to be dried contains a large amount of moisture, it takes much more time than the tentative drying time determined by the amount of laundry to finish the actual drying operation. Thus, it is troublesome to estimate the accurate time required to perform the drying operation.

[0016] Also, when the user manually inputs the drying operation time, it happens frequently that the laundry of low dehydration, i.e., the laundry containing a large amount of moisture cannot be dried to the extent of a target dryness within the manually inputted time, thereby deteriorating the drying performance of the washing machine.

SUMMARY OF THE INVENTION

[0017] Accordingly, the present invention is directed to a method for controlling a washing machine having a drying function that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0018] An object of the present invention is to provide a method for controlling a washing machine having a drying function which can reduce operating time of a drying operation and further improve a drying performance.

[0019] 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.

[0020] To achieve the object and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a method for controlling a washing machine having a drying function which includes a drum and a drying device for drying laundry by supplying
hot dry air into the drum, comprises: a) dehydrating the laundry if a command for performing a drying operation is inputted by a user; and b) drying the laundry after the dehydrating step a).

[0021] Preferably, the command may be a command for independently performing only the drying operation.

[0022] Preferably, the dehydrating step a) may include: rotating the drum at a predetermined velocity (V1) for a predetermined time (T1).

[0023] Preferably, the dehydrating step a) may include: measuring time until a rotational velocity of the drum reaches a predetermined velocity (V2); calculating an amount of the laundry based on the measured time; determining a dehydration velocity (V3) and dehydration time (T2) according to the calculated amount of the laundry; and rotating the drum at the dehydration velocity (V3) for the dehydration time (T2).

[0024] Preferably, the dehydrating step a) may include: rotating the drum while the drying device is in a non-operating state.

[0025] Preferably, the dehydrating step a) may include: rotating the drum and driving the drying device at the same time.

[0026] Preferably, the drying device may include a blower fan which forcibly sucks external air and blows the air into the drum, and a heater which heats the air sucked by the blower fan to supply hot air into the drum. The drying step b) may include: hot-air drying the laundry by operating the heater and the blower fan to supply the hot air into the drum until dryness of the laundry reaches a predetermined target dryness; and if the dryness of the laundry reaches the predetermined target dryness, cool-air drying the laundry by stopping operation of the heater while keeping operation of the blower fan to supply air of low temperature into the drum for a predetermined time (T3).

[0027] In another aspect of the present invention, there is provided a method for controlling a washing machine having a drying function which includes a drum and a drying device for drying laundry by supplying hot dry air into the drum, comprising: a) dehydrating the laundry if a command for performing a drying operation is inputted by a user; b) disentangling the laundry tangled during the dehydrating step a); and c) drying the laundry after the disentangling step b).

[0028] Preferably, the command may be a command for independently performing only the drying operation.

[0029] Preferably, the dehydrating step a) may include: rotating the drum at a predetermined velocity (V1) for a predetermined time (T1).

[0030] Preferably, the dehydrating step a) may include: measuring time until a rotational velocity of the drum reaches a predetermined velocity (V2); calculating an amount of the laundry based on the measured time; determining a dehydration velocity (V3) and dehydration time (T2) according to the calculated amount of the laundry; and rotating the drum at the dehydration velocity (V3) for the dehydration time (T2).

[0031] Preferably, the dehydrating step a) may include: rotating the drum while the drying device is in a non-operating state.

[0032] Preferably, the dehydrating step a) may include: rotating the drum and driving the drying device at the same time.

[0033] Preferably, the disentangling step b) may include: dispensing the laundry by alternately rotating the drum in a given rotation direction and in a reverse direction.

[0034] Preferably, the drying device may include a blower fan which forcibly sucks external air and blows the air into the drum, and a heater which heats the air sucked by the blower fan to supply hot air into the drum. The drying step c) may include: hot-air drying the laundry by operating the heater and the blower fan to supply the hot air into the drum until dryness of the laundry reaches a predetermined target dryness; and if the dryness of the laundry reaches the predetermined target dryness, cool-air drying the laundry by stopping operation of the heater while keeping operation of the blower fan to supply air of low temperature into the drum for a predetermined time (T3).

[0035] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0037] FIG. 1 is a side-sectional view showing an overall constitution of a washing machine having a drying function to which a control method in accordance with the present invention is applied;

[0038] FIG. 2 is a constitutional block diagram of a washing machine depicted in FIG. 1; and

[0039] FIG. 3 is a flow chart illustrating a method for controlling a washing machine having a drying function in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0040] Reference will now be made in detail to the preferred embodiments of the present invention associated with a method for controlling a washing machine having a drying function, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0041] FIG. 1 is a side-sectional view showing an overall constitution of a washing machine having a drying function to which a control method in accordance with the present invention is applied, and FIG. 2 is a constitutional block diagram of a washing machine depicted in FIG. 1.

[0042] As shown in FIGS. 1 and 2, a washing machine having a drying function according to the present invention comprises a cabinet 2, a tub 10, a drum 30, a motor 40, and a drying device 50.
The cabinet 2 is formed with a laundry input hole 4 at its front surface, and a door 6 is hingedly coupled to the front surface of the cabinet 2 to open and close the laundry input hole 4.

Also, the cabinet 2 is provided with a control panel 7 at its front upper portion or upper surface, by which a user inputs an automatic washing course for sequentially performing washing, rinsing, dehydrating and drying operations, or inputs independently the washing operation, the rinsing operation, the dehydrating operation and the drying operation.

The tub 10 is shock-absorably mounted in the cabinet 2 by a spring 11 and a damper 12.

The tub 10 is formed with a water supply hole 15 at its upper portion to which a water supply device 14 including a water supply valve 13 is connected, and a drain hole 18 at its lower portion to which a drain device 17 including a drain pump 16 is connected.

The tub 10 is formed with an opening 19 at its front surface, through which a user puts or pulls laundry in/out of the drum 30, while opposing the laundry input hole 4 of the cabinet 2.

The tub 10 is formed with an air outlet hole 21 at its rear surface, which communicates with the drying device 50 such that air in the tub 10 can flow into the drying device 50.

The tub 10 is formed with an air inlet hole 22 at its front upper surface, which communicates with the drying device 50 such that air passing through the drying device 50 can flow into the drum 30 through the tub 10.

The drum 30 is rotatably mounted in the tub 10, and functions as an accommodating part for accommodating the laundry m to perform the washing, rinsing, dehydrating and drying operations. The drum 30 is disposed horizontally or slantly with a predetermined angle in the tub 10. And, the drum 30 is formed with a laundry input hole 31 at its front surface, while opposing the laundry input hole 4 of the cabinet 2.

The drum 30 is formed with a plurality of through-holes 32, through which washing water gathered on an inner lower portion of the tub 10 flows into the drum 30 at the washing or rinsing operation, water removed from the laundry m is exhausted outside from the drum 30 at the dehydrating operation, and hot air passing through the drying device 50 flows into the drum 30 at the drying operation.

A lift 33 for lifting up and subsequently dropping the laundry m by the rotation of the drum 30 is mounted in the drum 30, thereby increasing the agitation of the laundry m and improving the washing and rinsing performance.

The motor 40 includes a stator (not shown) which is mounted to a rear portion of the tub 10, and a rotor 42 which is rotated by interaction with the stator, thereby transferring a rotating force to the drum 30.

The drying device 50 includes a drying duct 56 mounted above the tub 10, in which a heater 52 and a blower fan 54 are disposed to supply hot air into the drum 30, a condensation duct 58, one end of which is connected to the air outlet hole 21 of the tub 10 and the other end of which is connected to the drying duct 56 to condense air flowing toward the drying duct 56 from the tub 10 by a water-cooling method, and a condensed water supplying device 60 which supplies condensed water C into the condensation duct 58.

A fan motor 55 for rotating the blower fan 54 is mounted to the drying duct 56.

The condensed water supplying device 60 includes a condensed water valve 62 which is connected to an external hose 61 to regulate the distribution of the condensed water, and a condensed water hose 64 which guides the condensed water passing through the condensed water valve 62 into the condensation duct 58.

A non-descriptive reference numeral 66 refers to a dryness sensor which is mounted to an inner front lower portion of the drum 30 to detect the dryness of the laundry m.

Preferably, the dryness sensor 66 may be embodied by an electrode sensor that has a pair of metal plates which are arranged in parallel with each other, which will now be described.

The electrode sensor outputs a voltage signal by using a difference between impedances generated at both ends electrodes according to the amount of moisture contained in the laundry when the laundry comes into contact with the pair of metal plates at the same time. By such an electrode sensor, the dryness of the laundry can be detected.

The washing machine of the present invention further comprises a laundry volume sensor 68 for measuring the amount of the laundry in the drum 30 during the respective operations.

Preferably, the laundry volume sensor 68 may be embodied by a hall sensor for measuring an RPM of the motor 40. The amount of laundry is calculated by measuring time until the rotational velocity of the drum 30 measured by the hall sensor reaches a predetermined target value.

In other words, as the amount of laundry is larger, it takes longer time for the rotational velocity of the drum 30 to reach the target value. Based on this principle, the amount of laundry can be measured.

The washing machine having a drying function according to the present invention further comprises a control unit 70 which controls the operations of the water supply valve 13, the drain pump 16, the motor 40 and the drying device 50 in response to at least one signal from the control panel 7, the dryness sensor 60 and the laundry volume sensor 68.

Hereinafter, a method for controlling the washing machine having a drying function structured as above when independently performing the drying operation will be described.

FIG. 3 is a flow chart illustrating a method for controlling the washing machine having a drying function in accordance with the present invention.

If a user puts the laundry m into the drum 30 and inputs a command for independently performing only the drying operation through the control panel 7 at step S1, the control unit 70 does not immediately initiate the drying operation but first performs the dehydrating operation at step S2.
[0067] This is for effectively drying the laundry m within shorter time at the drying operation by performing the dehydrating operation before the drying operation to remove moisture from the laundry m in advance.

[0068] The dehydrating operation is performed in such a manner that the motor 40 is driven at a predetermined RPM (for example, 1000 rpm) for a predetermined time T1 (for example, 5 minutes). At this time, it is preferable that the above predetermined RPM is a maximum RPM which can be adapted to the dehydrating operation.

[0069] Alternatively, the dehydrating operation may be performed based upon dehydrating velocity and dehydrating time which are determined according to the amount of laundry measured by the laundry volume sensor 68.

[0070] Because a large amount of moisture is removed from the laundry m by a centrifugal force due to the rotation of the drum 30 at the dehydrating operation, the laundry m can be more easily dried at the following drying operation.

[0071] At the dehydrating operation, a normal dehydrating program or a hot air dehydrating program may be performed. The normal program is made such that only the drum 30 is rotated and the heater 52 and the blower fan 54 are not driven. The hot air dehydrating program is made such that the drum 30 is rotated and at the same time the heater 52 and the blower fan 54 are driven to supply hot air into the drum 30.

[0072] In the case of performing the hot air dehydrating program of driving the drying device including the heater 52 and the blower fan 54, a preliminary drying effect can be obtained at the dehydrating operation. Accordingly, the hot air dehydrating program can further shorten drying time, as compared to the normal dehydrating program.

[0073] If the operating time at the dehydrating operation elapses beyond the predetermined time T1 or the dehydrating time determined by the amount of laundry m, the control unit 70 terminates the dehydrating operation at step S3.

[0074] After the completion of the dehydrating operation, the control unit 70 performs a laundry disentangling operation to disentangle the laundry m tangled during the dehydrating operation at step S4. The laundry disentangling operation is performed by alternately rotating the drum 30 in a given rotation direction (e.g., clockwise) and in a reverse direction (e.g., counterclockwise) for a predetermined time T2.

[0075] The laundry disentangling operation is for increasing drying efficiency at the following drying operation by dispersing the laundry m tangled or stuck to a wall of the drum 30 during the dehydrating operation.

[0076] When the predetermined time T2 has expired, the control unit 70 terminates the laundry disentangling operation. Then, the control unit 70 measures the amount of laundry through the laundry volume sensor 68, and determines the time required to perform the drying operation, i.e., the tentative drying time according to the measured laundry volume. And, the tentative drying time is displayed on display means.

[0077] Afterward, the drying operation for drying the laundry m will be performed.

[0078] During the drying operation, the motor 40 is driven at a lower rpm than during the dehydrating operation, so that the laundry m can freely move in the drum 30.

[0079] Also, during the drying operation, the control unit 70 drives the heater 52 and the blower fan 54 and opens the condensed water valve 62, thereby hot-air drying the laundry m at step S5.

[0080] By the rotation of the blower fan 54, the air A in the drum 30 comes into contact with the laundry m, and becomes humid by absorbing moisture from the laundry m. The humid air A flows toward a space between the tub 10 and the drum 30 through the through-holes 32 of the drum 30, and passes through the condensation duct 58. While passing through the condensation duct 58, the humid air A exchanges heat with the condensed water supplied into the condensation duct 58. The moisture contained in the air A is condensed by the condensed water, and the air A is dried. The dry air is blown into the drying duct 56 by the blower fan 54.

[0081] The air blown into the drying duct 56 is heated by the heater 52 to be transformed into the hot dry air. The hot dry air flows into the drum 30 through the tub 10.

[0082] As described above, the laundry m is dried by the air A in the drum 30 which circulates while being repeatedly condensed and heated.

[0083] Further, because the laundry m has been sufficiently dehydrated at the dehydrating operation, the drying time is shortened and the drying performance is increased.

[0084] During the drying operation, the control unit 70 detects periodically the dryness of the laundry through the dryness sensor 66, and determines whether the dryness of the laundry reaches the predetermined target value at step S6.

[0085] If the control unit 70 determines that the dryness of the laundry does not reach the predetermined target value, the control unit 70 continues the above-described drying operation.

[0086] On the other hand, if the control unit 70 determines that the dryness of the laundry reaches the predetermined target value, the control unit 70 turns off the heater 52 to terminate the drying operation at step S7.

[0087] After the completion of the drying operation, the control unit 70 closes the condensed water valve 62, and cool-air dries the laundry m for a predetermined time T3 at step S8.

[0088] The cool-air drying operation is performed by operating only the blower fan 54 while turning off the heater 52 and closing the condensed water valve 62. During the cool-air drying operation, external air circulates through the tub 10, the drum 30, the condensation duct 58 and the drying duct 56, thereby lowering the temperature of the laundry m gradually.

[0089] The control unit 70 determines whether the predetermined time T3 has expired or not at step S9. If the control unit 70 determines that the predetermined time T3 has expired, the control unit 70 terminates the cool-air drying operation at step S10. As a result, the independent drying operation is completed.

[0090] As apparent from the above description, the method for controlling the washing machine having a drying function according to the present invention has the following effects.

[0091] Because moisture is sufficiently removed from the laundry by performing the dehydrating operation before the
drying operation, the operating time required to perform the drying operation can be shortened, and the energy consumption can be reduced.

[0092] Also, by performing the laundry disentangling operation to evenly disperse the laundry in the drum after the dehydrating operation before the drying operation, the drying performance can be increased.

[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 spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:
1. A method for controlling a washing machine having a drying function which includes a drum and a drying device for drying laundry by supplying hot dry air into the drum, the method comprising:
   a) dehydrating the laundry if a command for performing a drying operation is inputted by a user; and
   b) drying the laundry after the dehydrating step a).
2. The method according to claim 1, wherein the command is a command for independently performing only the drying operation.
3. The method according to claim 1, wherein the dehydrating step a) includes: rotating the drum at a predetermined velocity (V1) for a predetermined time (T1).
4. The method according to claim 1, wherein the dehydrating step a) includes:
   measuring time until a rotational velocity of the drum reaches a predetermined velocity (V2);
   calculating an amount of the laundry based on the measured time;
   determining a dehydration velocity (V3) and dehydration time (T2) according to the calculated amount of the laundry; and
   rotating the drum at the dehydration velocity (V3) for the dehydration time (T2).
5. The method according to claim 1, wherein the dehydrating step a) includes: rotating the drum while the drying device is in a non-operating state.
6. The method according to claim 1, wherein the dehydrating step a) includes: rotating the drum and driving the drying device at the same time.
7. The method according to claim 1, wherein the drying device includes a blower fan which forcibly sucks external air and blows the air into the drum, and a heater which heats the air sucked by the blower fan to supply hot air into the drum,
   whereby the drying step b) includes:
   hot-air drying the laundry by operating the heater and the blower fan to supply the hot air into the drum until dryness of the laundry reaches a predetermined target dryness; and
   if the dryness of the laundry reaches the predetermined target dryness, cool-air drying the laundry by stopping operation of the heater while keeping operation of the blower fan to supply air of low temperature into the drum for a predetermined time (T3).
8. A method for controlling a washing machine having a drying function which includes a drum and a drying device for drying laundry by supplying hot dry air into the drum, the method comprising:
   a) dehydrating the laundry if a command for performing a drying operation is inputted by a user;
   b) disentangling the laundry tangled during the dehydrating step a); and
   c) drying the laundry after the disentangling step b).
9. The method according to claim 8, wherein the command is a command for independently performing only the drying operation.
10. The method according to claim 8, wherein the dehydrating step a) includes: rotating the drum at a predetermined velocity (V1) for a predetermined time (T1).
11. The method according to claim 8, wherein the dehydrating step a) includes:
   measuring time until a rotational velocity of the drum reaches a predetermined velocity (V2);
   calculating an amount of the laundry based on the measured time;
   determining a dehydration velocity (V3) and dehydration time (T2) according to the calculated amount of the laundry; and
   rotating the drum at the dehydration velocity (V3) for the dehydration time (T2).
12. The method according to claim 8, wherein the dehydrating step a) includes: rotating the drum while the drying device is in a non-operating state.
13. The method according to claim 8, wherein the dehydrating step a) includes: rotating the drum and driving the drying device at the same time.
14. The method according to claim 8, wherein the disentangling step b) includes: dispersing the laundry by alternately rotating the drum in a given rotation direction and in a reverse direction.
15. The method according to claim 8, wherein the drying device includes a blower fan which forcibly sucks external air and blows the air into the drum, and a heater which heats the air sucked by the blower fan to supply hot air into the drum,
   whereby the drying step c) includes:
   hot-air drying the laundry by operating the heater and the blower fan to supply the hot air into the drum until dryness of the laundry reaches a predetermined target dryness; and
   if the dryness of the laundry reaches the predetermined target dryness, cool-air drying the laundry by stopping operation of the heater while keeping operation of the blower fan to supply air of low temperature into the drum for a predetermined time (T3).

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