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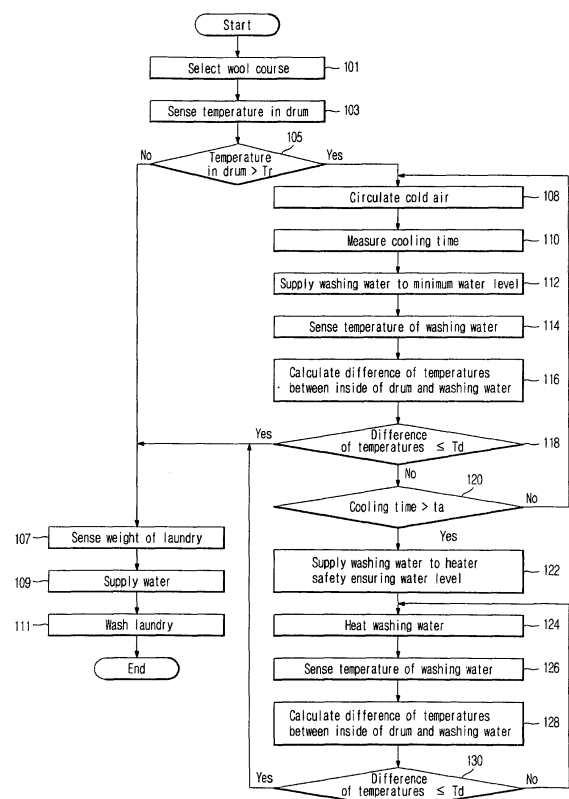
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(54) **Washing and drying machine and method for controlling the same**

(57) A washing machine having a drying device for generating an air current to dry laundry, includes a drum forming a washing space; a first temperature sensor for sensing the temperature of washing water; a second temperature sensor for sensing the temperature in the drum; and a controller for determining whether or not a washing condition for washing delicate fabrics is satisfied based on the temperature in the drum and the temperature of the washing water, and controlling the drying device, when it is determined that the washing condition is not satisfied, so that a washing operation of the delicate fabrics is performed after the washing condition is satisfied. The washing machine ensures the washing condition suitable to wash the delicate fabrics even when the temperature in the drum is elevated due to the earlier washing operation, and then performs the washing operation of the delicate fabrics, thereby preventing damage to the delicate fabrics due to shrinkage and deformation.

Fig.6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a washing machine for washing delicate fabrics, such as wool and silk, and a method for controlling the same.

2. Description of the Related Art

[0002] A drum washing machine vertically moves laundry together with washing water along the inner circumferential surface of a drum, which is horizontally disposed, according to the alternate rotation of the drum in the clockwise and counterclockwise directions, thereby washing the laundry.

[0003] Generally, drum washing machines also have a drying function. In the case that a drum washing machine has the drying function, the drum washing machine includes an electric heater for heating air, and a duct for circulating the heated air. Korean Patent Laid-open Publication No. 2005-0101788 (dated October 25, 2005) discloses such a drum washing machine.

[0004] Conventionally, a washing machine, which washes laundry using washing water heated by a heater, has been developed and used.

[0005] Korean Patent Laid-open Publication No. 2004-0085507 (dated October 8, 2004) discloses a drum washing machine, which washes laundry using washing water heated to a high temperature in a short period of time by supplying steam of a high temperature to the inside of a tub in order to increase washing capacity.

[0006] In a washing machine having at least one out of a function of drying laundry using an electric heater, a function of heating washing water so as to increase the temperature of the washing water, and a function of supplying steam of a high temperature, although one washing operation has been finished, the temperature in a drum may be considerably elevated, and thus, a long cooling time is required until the temperature in the drum is similar to the temperature of external air.

[0007] However, the above conventional washing machine does not consider the temperature in the drum after the earlier washing operation is completed.

[0008] As shown in FIG. 1, when the conventional washing machine washes woolen fabrics, a wool course is selected by a user through an input unit provided on a main body of the washing machine under the condition that laundry is placed into a drum (1). The drum is rotated and the weight of the laundry is sensed (2), and washing water is supplied to the drum in consideration of the weight of the laundry (3). Thereafter, the drum is rotated and the laundry in the drum is washed (4).

[0009] Although the temperature in the drum is elevated just after the earlier washing operation has been completed, the conventional washing machine does not con-

sider the temperature in the drum. When delicate fabrics, such as wool and silk, are placed into the drum under the condition that the temperature in the drum is elevated, and washing water is supplied from the outside of the washing machine to the drum, the delicate fabrics heated by air of a high temperature in the drum contacts the cold washing water. Thereafter, when the delicate fabrics are mechanically washed by the rotation of the drum, the delicate fabrics shrink or deform. Sizes and characteristics of the fabrics are changed due to the shrinkage or deformation of the delicate fabrics. Accordingly, the conventional washing machine has a limit in washing the delicate fabrics, such as wool and silk.

[0010] As a drying function for smoothing wrinkles of clothing is recently applied to washing machines, the drying function has become more frequently used. When woolen fabrics are washed after the above-described drying function is performed, the washing operation of the woolen fabrics must be performed after a designated waiting time has elapsed until the temperature in the drum is sufficiently lowered. However, it is difficult for some users to follow this point of the washing operation. Further, since many users determine a time to perform a new washing operation after the earlier washing operation has been completed dependent on experience, the washing of the woolen fabrics is often performed in an unsuitable condition. Accordingly, solutions to the above problems have been demanded.

SUMMARY OF THE INVENTION

[0011] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

[0012] Therefore, one aspect of the invention is to provide a washing machine, which satisfactorily washes delicate fabrics without the influence of an earlier washing operation, and a method for controlling the same.

[0013] Another aspect of the invention is to provide a washing machine, which performs a washing operation of delicate fabrics in an appropriate condition when the temperature in a drum is elevated, and a method for controlling the same.

[0014] In accordance with one aspect, the present invention provides a washing machine having a drying device for generating an air current to dry laundry, including: a drum forming a washing space; a first temperature sensor for sensing the temperature of washing water; a second temperature sensor for sensing the temperature in the drum; and a controller for determining whether or not a washing condition for washing delicate fabrics is satisfied based on the temperature in the drum and the temperature of the washing water, and controlling the drying device when it is determined that the washing condition is not satisfied, so that a washing operation of the delicate fabrics is performed after the washing condition is satisfied.

[0015] The controller may determine that the washing condition is satisfied when a difference of temperatures between the inside of the drum and the washing water is less than a predetermined temperature.

[0016] The controller may perform a cooling operation for lowering the temperature in the drum when the temperature in the drum is higher than a reference temperature in the determination of the washing condition.

[0017] The drying device may include an air blast fan for generating the air current; a duct for guiding the air current to the inside of the drum; a channel for supplying air, discharged from the inside of the drum, to the duct; and a cooling water spraying unit for spraying cooling water to the channel; and the controller may operate the air blast fan and supply the cooling water through the cooling water spraying unit, when the cooling operation is required.

[0018] The controller may include a counter for performing the cooling operation for a predetermined time.

[0019] The controller may perform the washing operation of the delicate fabrics when the washing condition is satisfied by the cooling operation.

[0020] The washing machine may further include a heater for heating the washing water, wherein the controller controls the heater so that the washing water is heated by the heater, when the washing condition is not satisfied by the cooling operation.

[0021] The controller may perform the washing operation of the delicate fabrics when the difference of temperatures between the inside of the drum and the washing water is less than the predetermined temperature.

[0022] The delicate fabrics may include wool and silk.

[0023] In accordance with another aspect, the present invention provides a method for controlling a washing machine having a drying device for generating an air current to dry laundry, including: selecting a washing course for washing delicate fabrics; sensing the temperature in a drum forming a washing space and the temperature of washing water; determining whether or not a washing condition for the delicate fabrics is satisfied; and controlling the drying device when it is determined that the washing condition is not satisfied, so that a washing operation of the delicate fabrics is performed after the washing condition is satisfied.

[0024] A cooling operation for lowering the temperature in the drum by circulating the air current generated by the drying device to the inside of the drum may be performed for a predetermined time when the temperature in the drum is higher than a reference temperature in the determination of the washing condition.

[0025] The reference temperature may be 35°C.

[0026] It may be determined that the washing condition is satisfied when a difference of temperatures between the inside of the drum and the washing water is less than a predetermined temperature.

[0027] The predetermined temperature may be 2°C.

[0028] The washing operation of the delicate fabrics may be performed when the washing condition is satisfied during the cooling operation.

fied during the cooling operation.

[0029] Preliminary washing water may be supplied and heated when the washing condition is not satisfied after the cooling operation is performed.

[0030] The preliminary washing water may be supplied to a heater safety ensuring water level to immerse a heater for heating the washing water.

[0031] Whether or not the washing condition is satisfied may be determined based on the temperature of the heated washing water and the temperature in the drum, and the washing operation of the delicate fabrics may be performed when the washing condition is satisfied.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a flow chart illustrating a method for washing laundry in a conventional wool course;

FIG. 2 is a sectional view of a washing machine in accordance with the present invention;

FIG. 3 is a perspective view of a tub of the washing machine in accordance with the present invention;

FIG. 4 is a block diagram of the washing machine in accordance with the present invention;

FIG. 5 is a sectional view of the tub for illustrating the minimum water level and a heater safety ensuring water level; and

FIG. 6 is a flow chart illustrating a method for washing woolen fabrics in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] Reference will now be made in detail to the embodiment of the present invention, an example of which is illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiment is described below to explain the present invention by referring to the annexed drawings.

[0034] As shown in FIG. 2, a washing machine in accordance with the present invention includes a main body 10 forming the external appearance of the washing machine, a tub 20 installed in the main body 10 for storing washing water, and a drum 30 rotatably installed in the tub 20 for containing laundry to be washed. A door 11 for opening and closing an opening, which allows a user to place the laundry into the washing machine, is hinged

to the front surface of the main body 10.

[0035] First and second water supply pipes 12a and 12b for supplying washing water to the tub 20 and a detergent supply device 13 for supplying a detergent to the tub 20 are installed in the upper portion of the inside of the main body 10. The first water supply pipe 12a supplies warm water, and the second water supply pipe 12b supplies cold water. First and second water supply valves 16 and 17 for controlling the water supply through the first and second water supply pipes 12a and 12b are respectively installed in the first and second water supply pipes 12a and 12b. Here, the first water supply valve 16 is a switching valve, and the second water supply valve 17 is a motor-operated three-way valve for selectively supplying the cold water to the detergent supply device 13 and a connection pipe 55.

[0036] A heater 22 for heating the washing water and a first temperature sensor 23 for sensing the temperature of the washing water are installed on the bottom of the tub 20.

[0037] A drain pump motor 14 and a drain pipe 15 for discharging the washing water contained in the tub 20 to the outside of the main body 10 are installed in the lower portion of the inside of the main body 10.

[0038] A washing motor 40 for rotating the drum 30 in regular and reverse directions is installed on the external surface of a rear plate 21 forming the rear surface of the tub 20, and a rotary shaft 41 for transmitting the rotary force of the washing motor to the drum 30 is installed between the drum 30 and the washing motor 40.

[0039] The drum washing machine in accordance with the present invention further includes a drying device 50 for drying the laundry contained in the drum 30 by supplying warm air to the drum 30. As shown in FIG. 2, the drying device 50 includes an air blast fan 51, a fan motor 51 a, a drying heater 52, a heating duct 53, and a condensation channel 54.

[0040] The air blast fan 51 is installed on the tub 20, and supplies driving force for circulating air. The heating duct 53 connects an outlet side of the air blast fan 51 to a front opening the drum 30, and guides an air current generated from the air blast fan 51 to the inside of the drum 30. The drying heater 52 for heating air so as to effectively dry the laundry is installed in the heating duct 53. The condensation channel 54 serves to remove moisture from air discharged from the drum 30 after the drying of the laundry is completed, and one end of the condensation channel 54 is connected to the rear surface of the drum 30 and the other end of the condensation channel 54 is connected to an inlet side of the air blast fan 51.

[0041] As shown in FIG. 3, a channel forming portion 21a, which is concaved to a designated depth to the rear plate 21, for forming the condensation channel 54 is formed on the rear plate 21 of the tub 20. A cooling water spraying unit 56 for spraying cooling water for cooling the air passing through the condensation channel 54 is installed in the condensation channel 54. The cooling

water spraying unit 56 is connected to the second water supply valve 17 through the connection pipe 55.

[0042] Although not shown in FIG. 2, the drum washing machine of the present invention further includes a water level sensor 61 installed in the tub 20 for sensing the level of the washing water in the tub 20, and a second temperature sensor 62 for sensing the temperature in the drum 30.

[0043] The drum washing machine of the present invention further includes a controller for controlling the overall operations of the washing machine including the washing operation of delicate fabrics. Hereinafter, the controller will be described with reference to FIG. 4.

[0044] An input unit 60 for inputting user's instructions to the controller 63, the water sensor 61 for sensing the level of the washing water, a first temperature sensor 23 for sensing the temperature of the washing water, and the second temperature sensor 62 for sensing the temperature in the drum 30 are electrically connected to an input side of the controller 63.

[0045] A valve driving unit 64 for controlling the operations of the first and second water supply valves 16 and 17, a heater driving unit 65 for controlling the operations of the heater 22 and the drying heater 52, and a motor driving unit 66 for controlling the operations of the washing motor 40, the drain pump motor 14, and the fan motor 51 a are electrically connected to an output side of the controller 63.

[0046] The controller 63 includes a counter 63-1 for measuring the washing time.

[0047] When a wool course for washing delicate fabrics, for example, wool, is selected, the controller 63 determines whether or not the washing machine satisfies a washing condition for washing the fabrics without shrinkage and damage. When it is determined that the washing condition is not satisfied, the controller 63 resets a washing condition suitable to wash the fabrics. That is, the controller 63 allows the washing machine to wash the delicate fabrics only when the washing condition for washing the woolen fabrics is satisfied.

[0048] The controller 63 determines that the washing condition for washing woolen fabrics is set when a difference of temperatures between the inside of the drum and washing water is not high. At this time, a water supply operation for sensing the temperature of the washing water is required. As shown in FIG. 5, water is supplied to the minimum water level to immerse the first temperature sensor 23.

[0049] When the temperature in the drum is excessively high and is not suitable to satisfy the washing condition for the woolen fabrics, the controller 63 turns the drying heater 52 off and operates the air blast fan 51. Then, the controller 63 circulates an air current generated from the air blast fan 51 in the drum 30, thereby performing a cooling operation for lowering the temperature in the drum 30.

[0050] Thereafter, the controller 63 senses the temperature of the washing water using the first temperature sensor 23 and the temperature in the drum 30 using the

second temperature sensor 62, and determines whether or not a difference of the sensed temperatures is in a predetermined range. When it is determined that the difference of the sensed temperatures is not in the predetermined range, the washing water is heated to a high temperature so that a difference of the temperatures between the washing water and the inside of the drum is lowered. Water, which is supplied to heat the washing water, serves as preliminary washing water. A suitable amount of the preliminary washing water is supplied prior to the supply of main washing water for washing the delicate fabrics. Here, the preliminary washing water is supplied to a heater safety ensuring water level to immerse the heater 22.

[0051] When it is determined that the difference of the sensed temperatures is in the predetermined range, the washing of the woolen fabrics is performed.

[0052] Hereinafter, the operation of the above-described washing machine of the present invention will be described.

[0053] As shown in FIG. 6, woolen fabrics are placed into the drum 30 of the washing machine, and a user selects a wool course through the input unit 60 provided on the main body 10 (101).

[0054] Then, the controller 63 senses the temperature in the drum 30 through the second temperature sensor 62 (103), and determines whether or not the temperature in the drum 30 is higher than a predetermined temperature T_r , for example, 35°C (105). When it is determined that the temperature in the drum 30 is not higher than the predetermined temperature T_r , the controller 63 recognizes that the washing machine satisfies a condition suitable to wash the woolen fabrics. Accordingly, the controller 63 rotates the drum 30 so as to sense the weight of the laundry contained in the drum 30 (107), supplies a designated amount of washing water according to the sensed weight of the laundry (109), and drives the washing motor 40 so as to wash the woolen fabrics (111).

[0055] When it is determined that the temperature in the drum 30 is higher than the predetermined temperature T_r , the controller 63 drives the fan motor 51 so as to operate the air blast fan 51 under the condition that the drying heater 52 is turned off, and an air current generated from the air blast fan 51 passes through the heating duct 53 and the drum 20 and is circulated into the condensation channel 54. Here, the controller 63 controls the second water supply valve 17 so that cold water passes through the connection pipe 55 and is sprayed into the condensation channel 54 through the cooling water spraying unit 56. Thereby, the circulating air current is cooled by exchanging heat with the cold water, thereby being changed into cold air. The temperature in the drum 30 is rapidly lowered by the cold air (108). During the above cooling operation, the counter 63-1 measures the cooling time (110).

[0056] Thereafter, the controller 63 supplies cold water to the minimum water level in the tub 20 through the second water supply valve 17 (112). The controller 63 senses

the temperature of the washing water through the first temperature sensor 23 (114), calculates a difference of temperatures between the inside of the drum 30 and the washing water (116), and determines whether or not the difference of the temperatures is less than a predetermined temperature T_d (118). When it is determined that the difference of the temperatures is less than the predetermined temperature T_d , the washing of the woolen fabrics is performed by steps 107, 109 and 111.

[0057] When it is determined that the difference of the temperatures is not less than the predetermined temperature T_d , the controller 63 determines whether or not the measured cooling time exceeds a predetermined time t_a (120). When it is determined the measured cooling time does not exceed the predetermined time t_a , step 108 is performed so as to continue the cooling operation.

[0058] When it is determined that the measured cooling time exceeds the predetermined time t_a , the controller 63 supplies cold water, serving as preliminary washing water, to the heater safety ensuring water level in the tub 20 through the second water supply valve 17 (122). Then, the controller 63 heats the washing water using the heater 22 (124), senses the temperature of the washing water through the first temperature sensor 23, calculates a difference of temperatures between the inside of the drum 30 and the washing water (128), and determines whether or not the difference of the temperatures is less than the predetermined temperature T_d (130). When it is determined that the difference of temperatures is not less than the predetermined temperature T_d , step 124 is performed so as to heat the washing water.

[0059] When it is determined that the difference of the temperature is less than the predetermined temperature T_d , the washing of the woolen fabrics is performed by operations 107, 109 and 111.

[0060] As apparent from the above description, the present invention provides a washing machine, which performs a cooling operation for lowering the temperature in a drum so that a difference of temperatures between the inside of the drum and washing water is less than a predetermined temperature, when the temperature in the drum is excessively elevated due to a drying function performed in an earlier washing operation and the washing machine is not suitable to wash delicate fabrics, such as wool and silk, and supplies preliminary washing water and heats the preliminary washing water, when the washing condition of the washing machine after the cooling operation is performed is not satisfied, thereby causing the washing condition to be satisfied. Accordingly, the washing machine of the present invention performs a washing operation only when the washing condition for delicate fabrics is satisfied, thereby preventing damage to the delicate fabrics due to shrinkage and deformation.

[0061] Although an embodiment of the invention has been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and

spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A washing machine having a drying device for generating an air current to dry laundry, comprising:

a drum forming a washing space;
a first temperature sensor for sensing the temperature of washing water;
a second temperature sensor for sensing the temperature in the drum; and
a controller for determining whether or not a washing condition for washing delicate fabrics is satisfied based on the temperature in the drum and the temperature of the washing water, and controlling the drying device when it is determined that the washing condition is not satisfied, so that a washing operation of the delicate fabrics is performed after the washing condition is satisfied.

2. The washing machine as set forth in claim 1, wherein the controller determines that the washing condition is satisfied when a difference of temperatures between the inside of the drum and the washing water is less than a predetermined temperature.

3. The washing machine as set forth in claim 2, wherein the controller performs a cooling operation for lowering the temperature in the drum when the temperature in the drum is higher than a reference temperature in the determination of the washing condition.

4. The washing machine as set forth in claim 3, wherein:
the drying device comprises:

an air blast fan for generating the air current;
a duct for guiding the air current to the inside of the drum;
a channel for supplying air, discharged from the inside of the drum, to the duct; and
a cooling water spraying unit for spraying cooling water to the channel; and
the controller operates the air blast fan and supplies the cooling water through the cooling water spraying unit, when the cooling operation is required.

5. The washing machine as set forth in claim 3, wherein the controller comprises a counter for performing the cooling operation for a predetermined time.

6. The washing machine as set forth in claim 3, wherein the controller performs the washing operation of the

delicate fabrics when the washing condition is satisfied by the cooling operation.

7. The washing machine as set forth in claim 3, further comprising a heater for heating the washing water, wherein the controller controls the heater so that the washing water is heated by the heater, when the washing condition is not satisfied by the cooling operation.

8. The washing machine as set forth in claim 7, wherein the controller performs the washing operation of the delicate fabrics when the difference of temperatures between the inside of the drum and the washing water is less the predetermined temperature.

9. The washing machine as set forth in claim 1, wherein the delicate fabrics comprise wool and silk.

10. A method for controlling a washing machine having a drying device for generating an air current to dry laundry, comprising:

selecting a washing course for washing delicate fabrics;
sensing the temperature in a drum forming a washing space and the temperature of washing water;
determining whether or not a washing condition for the delicate fabrics is satisfied; and
controlling the drying device when it is determined that the washing condition is not satisfied, so that a washing operation of the delicate fabrics is performed after the washing condition is satisfied.

11. The method as set forth in claim 10, wherein a cooling operation for lowering the temperature in the drum by circulating the air current generated by the drying device to the inside of the drum is performed for a predetermined time when the temperature in the drum is higher than a reference temperature in the determination of the washing condition.

12. The method as set forth in claim 11, wherein the reference temperature is 35 °C.

13. The method as set forth in claim 10, wherein it is determined that the washing condition is satisfied when a difference of temperatures between the inside of the drum and the washing water is less than a predetermined temperature.

14. The method as set forth in claim 13, wherein the predetermined temperature is 2°C.

15. The method as set forth in claim 11, wherein the washing operation of the delicate fabrics is per-

formed when the washing condition is satisfied during the cooling operation.

- 16.** The method as set forth in claim 15, wherein preliminary washing water is supplied and is heated when the washing condition is not satisfied after the cooling operation is performed. 5
- 17.** The method as set forth in claim 16, wherein the preliminary washing water is supplied to a heater safety ensuring water level to immerse a heater for heating the washing water. 10
- 18.** The method as set forth in claim 16, wherein whether or not the washing condition is satisfied is determined based on the temperature of the heated washing water and the temperature in the drum, and the washing operation of the delicate fabrics is performed when the washing condition is satisfied. 15
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- 19.** A method for washing delicate fabrics in a drum type washing machine including a drying device for generating an air current to dry laundry, the method comprising: 25
- selecting a delicate fabric course;
 - sensing a temperature in the drum;
 - circulating cold air in the drum if the temperature in the drum is above a reference temperature;
 - supplying washing water to the drum to a predetermined minimum water level; 30
 - sensing a temperature of the washing water;
 - calculating a difference of temperatures between the temperature in the drum and the temperature of the washing water; and 35
 - washing the delicate fabrics if the difference of temperatures between the drum and washing water is less than a predetermined temperature difference. 40
- 20.** The method of claim 19, further comprising:
- supplying warm water to the drum to if the difference of temperatures between the drum and washing water is more than a predetermined temperature difference; 45
 - calculating a difference of temperatures between the temperature in the drum and the temperature of the washing water; and
 - washing the delicate fabrics when the difference of temperatures between the drum and washing water is less than a predetermined temperature difference. 50
55

Fig.1

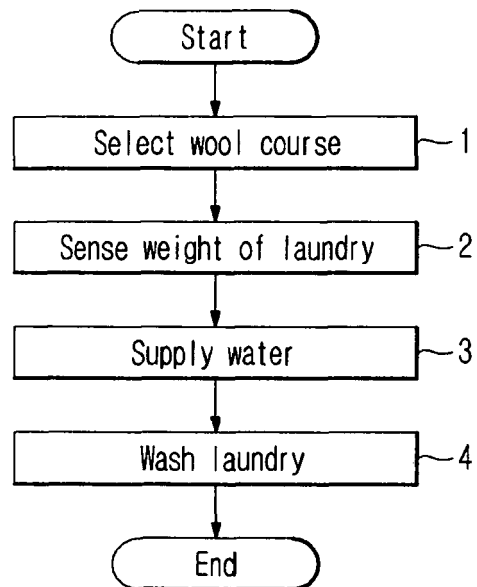


Fig.2

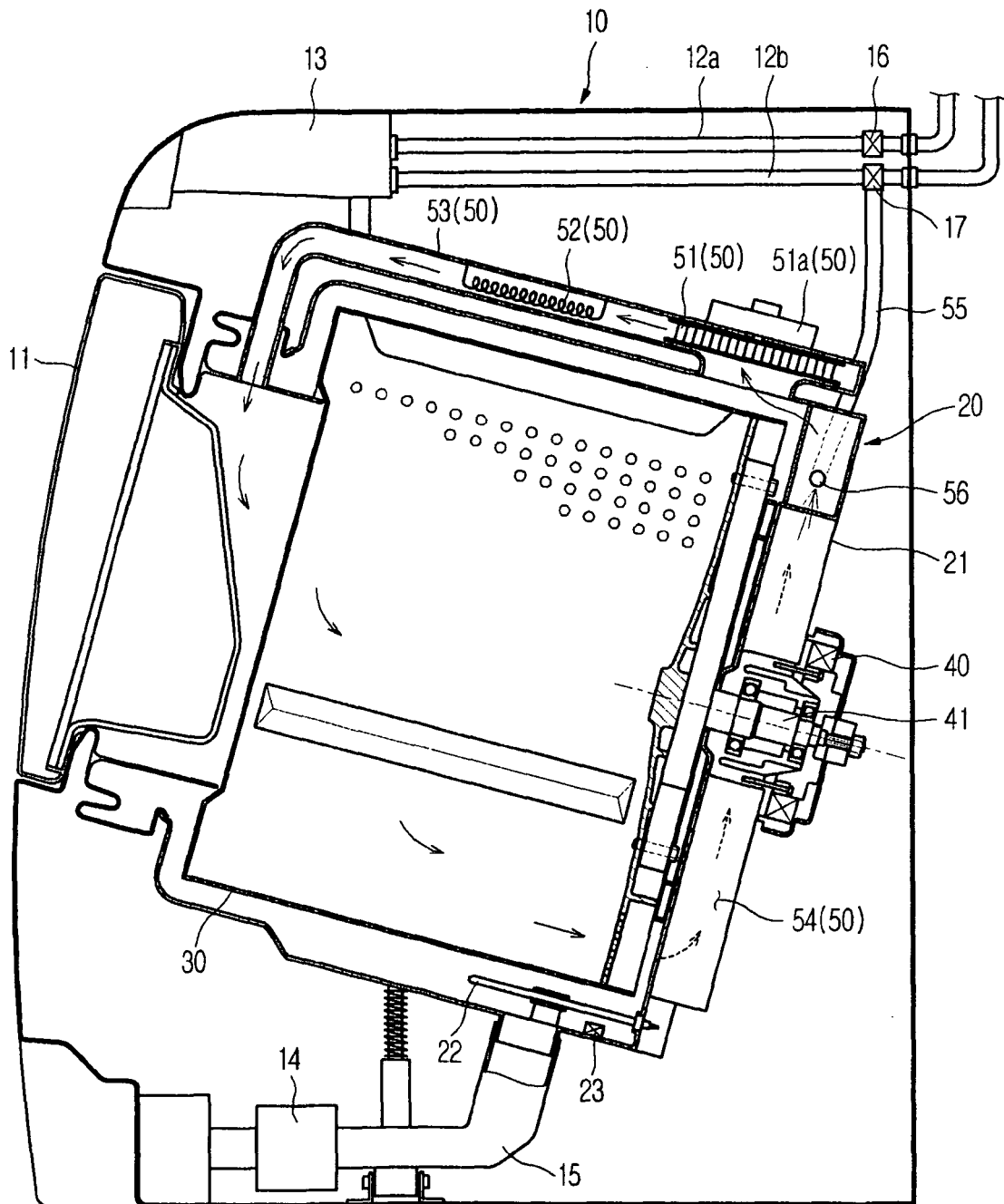


Fig.3

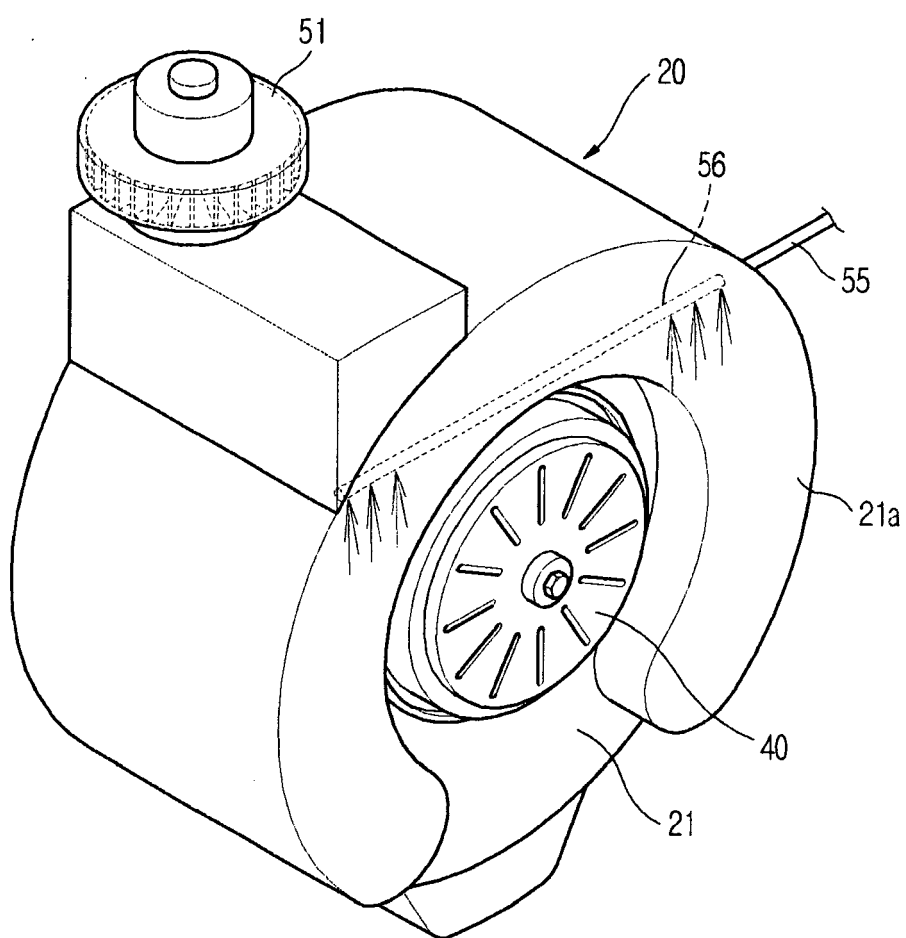


Fig.4

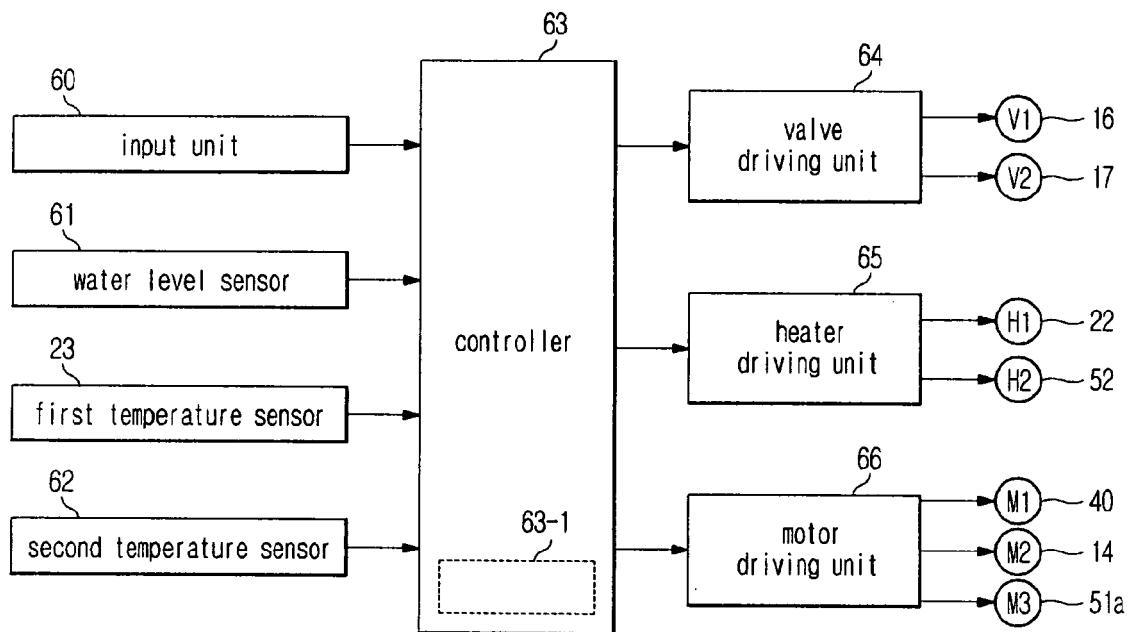


Fig.5

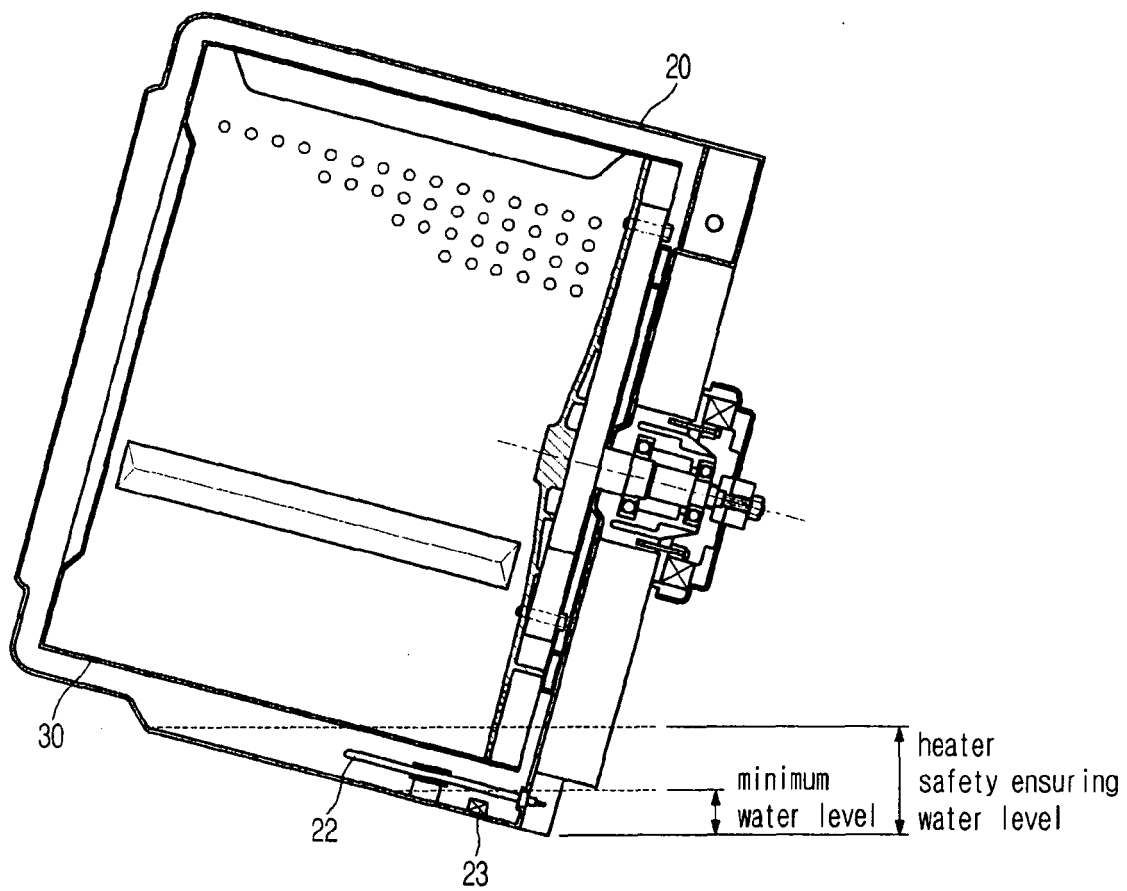
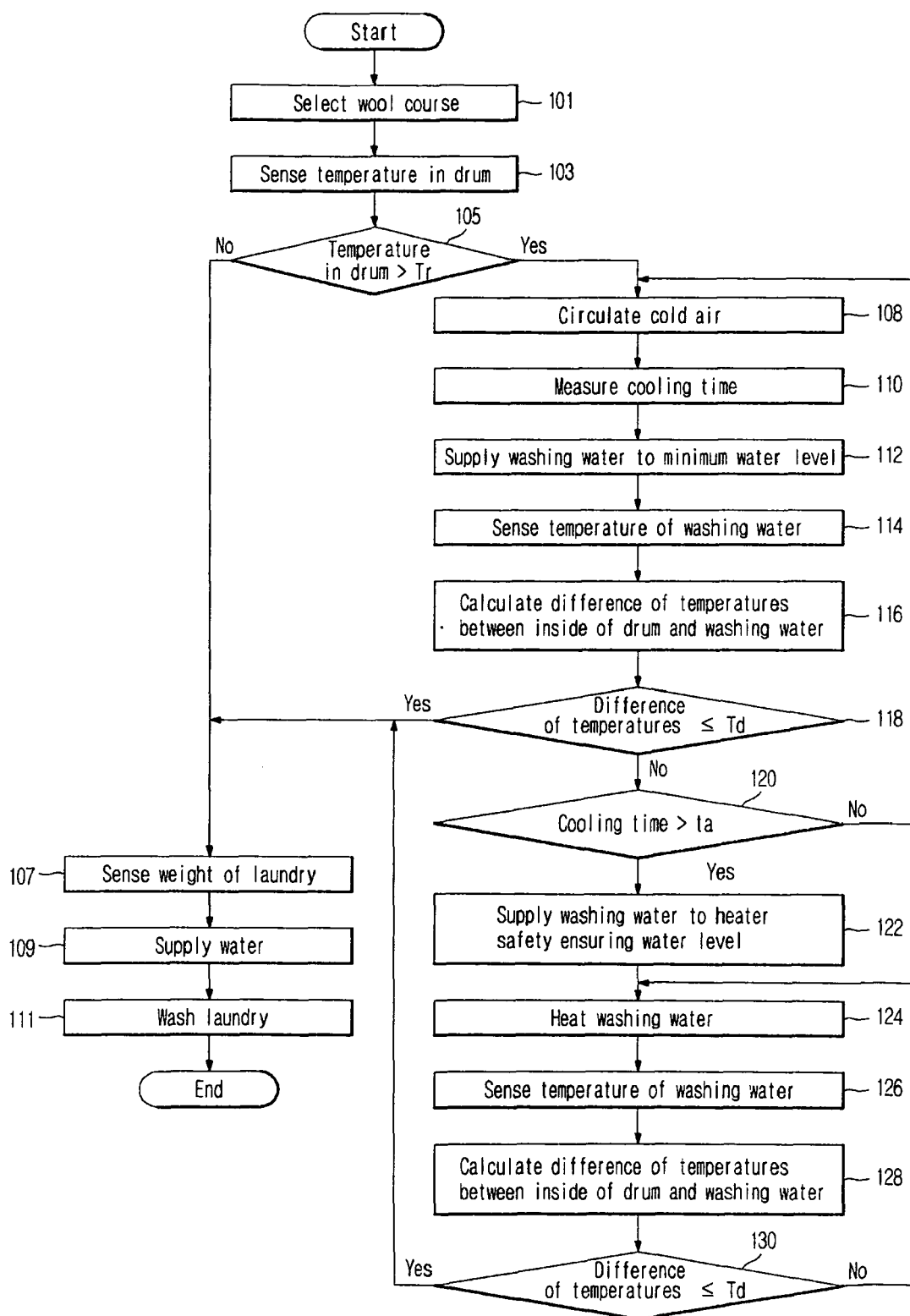


Fig.6





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Munich		15 June 2007	Lodato, Alessandra
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
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