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

(11) EP 3 336 239 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.06.2018 Bulletin 2018/25

(51) Int Cl.:
D06F 58/20 *(2006.01)* ***D06F 58/28*** *(2006.01)*

(21) Application number: **17206069.1**

(22) Date of filing: **08.12.2017**

(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:
MA MD TN

(30) Priority: **16.12.2016 KR 20160172574**

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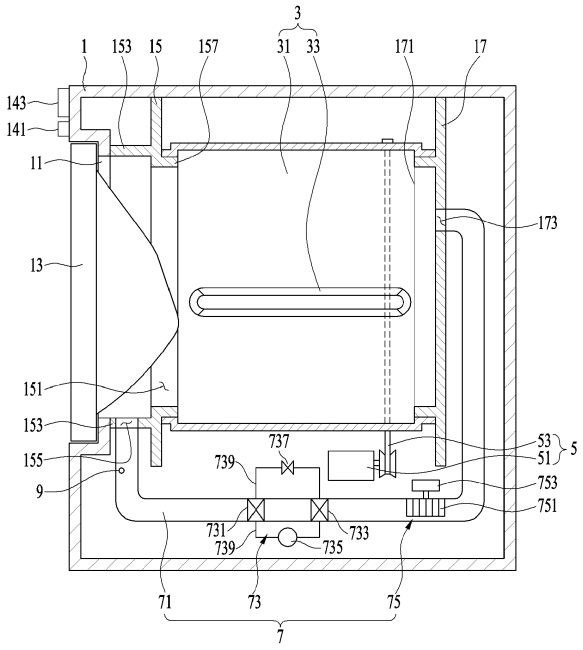
(54) LAUNDRY TREATMENT APPARATUS AND CONTROL METHOD OF LAUNDRY TREATMENT APPARATUS

(57) Disclosed is a control method of a laundry treatment apparatus including a drum (3) for storing laundry, a duct provided outside the drum for guiding air discharged from the drum (3) to the drum (3), a fan (75) provided in the duct (71), a heat pump (73) for performing heat exchange between air introduced into the duct (71) and a refrigerant to dehumidify and heat the air, and a temperature sensing unit for measuring the temperature of the air introduced into the duct (71), the control method including operating the fan and the heat pump (73) to supply heated air to the drum (a hot air supply step), measuring the temperature of the air discharged from the drum (3) through the temperature sensing unit (a temperature measurement step), when the temperature of the air measured by the temperature sensing unit (9) is equal to or higher than a predetermined reference temperature, measuring the amount of time for which the temperature of the air remains equal to or higher than the reference temperature (a time measurement step), and when the amount of time for which the temperature of the air remains equal to or higher than the reference temperature is equal to or greater than a reference amount of time, stopping the operation of the fan (75) and the heat pump (a hot air supply completion step).

FIG. 1



EP 3 336 239 A1

Description

[0001] This application claims the benefit of Korean Patent Application No. 10-2016-0172574, filed on December 16, 2016.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a laundry treatment apparatus and a control method thereof.

Discussion of the Related Art

[0003] A laundry treatment apparatus is an apparatus that is capable of washing laundry, drying laundry, or both washing and drying laundry.

[0004] A laundry treatment apparatus that is capable of drying laundry includes a drum for receiving laundry and a hot air supply device for supplying heated air to the drum. Conventional laundry treatment apparatuses include two types of hot air supply devices.

[0005] The first type of hot air supply device includes a supply duct for guiding external air to the drum, an exhaust duct for guiding the air in the drum out of the drum, a fan provided in any one of the supply duct and the exhaust duct, and a heater provided in the supply duct for heating air. The second type of hot air supply device includes a circulation duct for discharging the air in the drum out of the drum and resupplying the air to the drum, a cooling unit provided in the circulation duct for condensing air, and a heater provided in the circulation duct for heating dehumidified air.

[0006] In the second type of hot air supply device, a heat pump may be used to cool and heat air. However, a laundry treatment apparatus including a heat pump has a problem in that it is difficult to supply high-temperature air to the drum, whereby it is difficult to sterilize laundry.

[0007] That is, compared with a heater made of a heating wire (a resistance wire that generates heat when current is supplied thereto), the heat pump generates a small amount of heat. As a result, air having a temperature lower than the temperature of air supplied to the drum after being heated using the heating wire is supplied to the drum, whereby it is difficult to perform a sterilization course for supplying high-temperature air to the drum to kill bacteria in laundry.

SUMMARY OF THE INVENTION

[0008] Accordingly, the present invention is directed to a laundry treatment apparatus and a control method of a laundry treatment apparatus that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0009] An object of the present invention is to provide a laundry treatment apparatus and a control method of a laundry treatment apparatus that is configured such that air heated by a heat pump is supplied in order to perform a sterilization course.

[0010] Additional advantages, objects, and features 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. The objectives and other advantages may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0011] In accordance with an aspect, a control method of a laundry treatment apparatus, including a drum for storing laundry, a duct provided outside the drum for guiding air discharged from the drum to the drum, a fan provided in the duct, a heat pump for performing heat exchange between air introduced into the duct and a refrigerant to dehumidify and heat the air, and a temperature sensing unit for measuring the temperature of the air introduced into the duct, includes operating the fan and the heat pump to supply heated air to the drum (a hot air supply step), measuring the temperature of the air discharged from the drum through the temperature sensing unit (a temperature measurement step), when the temperature of the air measured by the temperature sensing unit is equal to or higher than a predetermined reference temperature, measuring the amount of time for which the temperature of the air remains equal to or higher than the reference temperature (a time measurement step), and when the amount of time for which the temperature of the air remains equal to or higher than the reference temperature is equal to or greater than a reference amount of time, stopping the operation of the fan and the heat pump (a hot air supply completion step). In accordance with another aspect, a laundry treatment apparatus includes a drum for storing laundry, a duct provided outside the drum for guiding air discharged from the drum to the drum, a fan provided in the duct, a heat pump for performing heat exchange between air introduced into the duct and a refrigerant to dehumidify and heat the air, a temperature sensing unit for measuring the temperature of the air introduced into the duct, and a controller being configured to perform a control method according to any one of the herein described embodiments.

[0012] The reference temperature and the reference amount of time may be uniform irrespective of the amount of laundry introduced into the drum.

[0013] The time measurement step may include comparing the accumulated value of the amount of time for which the temperature of the air measured by the temperature sensing unit is equal to or higher than the reference temperature with the reference amount of time.

[0014] The time measurement step may include comparing the amount of time for which the temperature of the air measured by the temperature sensing unit continuously remains equal to or higher than the reference temperature with the reference amount of time.

[0015] The reference temperature may be set to 60 °C

to 70 °C.

[0016] The reference amount of time may be set to 50 minutes to 60 minutes.

[0017] The hot air supply completion step may include stopping the operation of the heat pump and maintaining the operation of the fan for a predetermined amount of time (a cooling step) and stopping the operation of the fan after the completion of the cooling step (a fan operation completion step).

[0018] The control method may further include rotating the drum while the hot air supply step is being performed (a drum rotation step).

[0019] The hot air supply step, the temperature measurement step, and the time measurement step may be performed when a sterilization course is selected through an input unit.

[0020] 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 present invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, which are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the present invention and together with the description serve to explain the principle of the present invention. In the drawings:

FIG. 1 is a view showing an example of a laundry treatment apparatus according to the present invention; and

FIG. 2 is a flowchart showing an example of a control method of a laundry treatment apparatus according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Meanwhile, the construction or control method of an apparatus, which will be described hereinafter, are disclosed only to describe embodiments of the present invention, and therefore the scope of the present invention is not limited thereby. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0023] FIG. 1 is a view showing an example of a laundry treatment apparatus according to the present invention. A laundry treatment apparatus 100 according to the present invention includes a cabinet 1, a drum 3 rotatably provided in the cabinet, a hot air supply unit 7 for supplying heated air to the drum, and a temperature sensing unit 9 for measuring the temperature in the drum.

[0024] The cabinet 1 is provided with a cabinet introduction port 11, through which laundry is introduced into or removed from the drum. The cabinet introduction port 11 is opened and closed by a door 13, which is hinged to the cabinet 1

[0025] The drum 3 may include a cylindrical drum body 31 having an open front surface and an open rear surface and a lifter 33 protruding from the inner circumferential surface of the drum body toward the center of rotation of the drum body.

[0026] The drum 3 having the above structure is supported by a first support unit 15 and a second support unit 17 provided in the cabinet 1. The first support unit 15 is fixed in the cabinet 1 to rotatably support the front surface of the drum body 31, and the second support unit 17 is fixed in the cabinet 1 to rotatably support the rear surface of the drum body 31.

[0027] The first support unit 15 is provided with an introduction port 151, which communicates with the cabinet introduction port 11. Consequently, the interior of the drum body 31 communicates with the outside of the cabinet 1 through the introduction port 151 and the cabinet introduction port 11.

[0028] The first support unit 15 is provided with a front support unit 157 for rotatably supporting the open front surface of the drum body 31. The front support unit 157 may be formed in the shape of a ring that surrounds the introduction port 151.

[0029] Meanwhile, the first support unit 15 may be fixed to the front surface of the cabinet 1 via a connection unit 153. The connection unit 153 may be formed in the shape of a ring that surrounds the cabinet introduction port 11.

[0030] The second support unit 17 is provided with a rear support unit 171 for rotatably supporting the open rear surface of the drum body 31. The rear support unit 171 may be formed in the shape of a ring that is inserted into the open rear surface of the drum body 31.

[0031] The drum 3 having the above structure is rotated by a driving unit 5. The driving unit 5 may include a motor 51 provided in the cabinet 1 and a belt 53 for transmitting the rotary force of the motor to the drum body 31.

[0032] The hot air supply unit 7 may include a duct 71 provided outside the drum body 31 for guiding the air discharged from the drum body 31 to the drum body 31, a fan 75 provided in the duct 71, and a heat pump 73 for performing heat exchange between the air introduced into the duct 71 and a refrigerant to dehumidify and heat the air.

[0033] One end of the duct 71 may be connected to a first through-hole 155 formed through a connection part 153 of the first support unit, and the other end of the duct 71 may be connected to a second through-hole 173 formed through the second support unit 17.

[0034] The fan is a means for circulating the air in the drum body 31 through the duct 71. The fan may include an impeller 751 rotatably provided in the duct 71 and a fan motor 753 fixed to the outside of the duct 71 for rotating the impeller.

[0035] The heat pump 73 may include a refrigerant pipe 739 defining a circulation channel of the refrigerant, an evaporator 731 disposed in the duct 71 in the state of being fixed to the refrigerant pipe 739, a condenser 733 disposed in the duct 71 in the state of being fixed to the refrigerant pipe 739, a compressor 735 for compressing the refrigerant that has passed through the evaporator 731 and moving the compressed refrigerant to the condenser 733, and an expansion valve 737 for opening or closing the refrigerant pipe 739 (for controlling the flow rate of the refrigerant) to adjust the pressure of the refrigerant discharged from the condenser 733.

[0036] The evaporator 731 absorbs heat from the air introduced into the duct 71 to condense the moisture contained in the air. Consequently, the refrigerant passing through the evaporator 731 is evaporated in the refrigerant pipe 739. The condenser 733 emits heat to the air that has passed through the evaporator in order to heat the air. Consequently, the refrigerant passing through the condenser 733 is condensed in the refrigerant pipe 739. As a result, the air that has passed through the evaporator 731 is cooled, and the air that has passed through the condenser 733 is heated.

[0037] The temperature sensing unit 9 may be configured to sense the temperature in the drum body 31 or to sense the temperature of the air introduced into the duct 71. FIG. 1 shows an example in which the temperature sensing unit 9 is provided in the duct 71.

[0038] The laundry treatment apparatus 100 shown in FIG. 1 is configured as an apparatus that performs only drying of laundry. Alternatively, the laundry treatment apparatus according to the present invention may be configured as an apparatus that performs both washing and drying of laundry.

[0039] In this case, a tub (not shown) for storing water may be provided in the cabinet, and the drum 3 may be rotatably provided in the tub. In order to rotate the drum provided in the tub, the driving unit may include a stator fixed to the outside of the tub for generating a rotating field, a rotor configured to be rotated by the rotating field, generated by the stator, and a rotary shaft extending through the tub for interconnecting the drum and the rotor.

[0040] In the case in which the stator, the rotor, and the rotary shaft constitute the driving unit, the first support unit 15 and the second support unit 17 may be omitted. Meanwhile, the duct 71 may be configured to discharge the air in the tub out of the tub and to resupply the air to the tub.

[0041] FIG. 2 is a flowchart showing an example of a control method of the laundry treatment apparatus 100 having the above structure. The control method may be performed by a controller of the laundry treatment apparatus 100 for controlling the same. The control method according to the present invention includes a step (S10) of determining whether a sterilization course for removing bacteria that are harmful to humans, such as *Pseudomonas aeruginosa* or *Staphylococcus aureus*, has been selected.

[0042] The cabinet 1 may be provided with a display unit 143 for displaying control commands that can be selected by a user and the state of execution of the control command selected by the user and an input unit 141 for allowing the user to input one of the control commands.

[0043] Consequently, the user may select the sterilization course through the input unit 141, and a controller (not shown) may determine whether the sterilization course has been selected based on a control signal received from the input unit 141.

[0044] When a control command for requesting execution of the sterilization course is input, a hot air supply step (S20) of supplying heated air to the drum 3 is performed.

[0045] The hot air supply step (S20) may include a fan operation step (S21) and a heat pump operation step (S23).

[0046] The fan operation step (S21) is a step of supplying power to the fan motor 753 to rotate the impeller 751 under the control of the controller, and the heat pump operation step (S23) is a step of circulating the refrigerant through the compressor 735 and the expansion valve under the control of the controller.

[0047] Meanwhile, in the hot air supply step (S20), the fan operation step (S21) and the heat pump operation step (S23) may be sequentially performed in order to prevent a reduction in the efficiency of the heat pump.

[0048] In order to improve the efficiency of heat exchange between the laundry stored in the drum 3 and the air supplied to the drum at the hot air supply step (S20), a drum rotation step (S25) of rotating the drum 3 through the driving unit 5 under the control of the controller may be performed while the hot air supply step (S20) is being performed.

[0049] The drum rotation step (S25) may be set to rotate the drum in any one of the clockwise direction and the counterclockwise direction or to rotate the drum in alternating directions.

[0050] While the hot air supply step (S20) is being performed, a temperature measurement step (S30) of measuring the temperature of the air introduced into the duct 71 from the drum 3 through the temperature sensing unit 9 is performed.

[0051] When the temperature of the air measured at the temperature measurement step (S30) is equal to or higher than a predetermined reference temperature (S40), a time measurement step (S45) of measuring the amount of time for which the temperature of the air remains equal to or higher than the reference temperature is performed.

[0052] The controller determines the temperature of the air introduced into the duct 71 based on temperature data received from the temperature sensing unit 9 and compares the temperature data received from the temperature sensing unit 9 with reference temperature data stored in the controller or in a separate storage to determine whether the temperature of the air is equal to or higher than the reference temperature (S40).

[0053] When the amount of time for which the temperature of the air remains equal to or higher than the reference temperature is less than a predetermined reference amount of time, the temperature measurement step (S30), the temperature comparison step (S40), and the time measurement step (S45) are repeated.

[0054] When the amount of time for which the temperature of the air remains equal to or higher than the reference temperature is equal to or greater than the reference amount of time (S50), a hot air supply completion step (S60) of stopping the operation of the fan and the heat pump is performed.

[0055] Meanwhile, the time measurement step (S45) may be a step of comparing the accumulated value of the amount of time for which the temperature of the air measured by the temperature sensing unit 9 is equal to or higher than the reference temperature with the reference amount of time or a step of comparing the amount of time for which the temperature of the air measured by the temperature sensing unit 9 continuously remains equal to or higher than the reference temperature with the reference amount of time. In the latter step, the amount of time for which the sterilization course is performed may be increased. For this reason, the former step is performed as the time measurement step (S45).

[0056] According to experimentation, when the temperature of the air discharged from the drum is 60 °C to 70 °C and is maintained for 50 minutes to 60 minutes, it can be seen that 99% or more of bacteria harmful to humans are killed irrespective of the amount of the laundry stored in the drum (the laundry amount). Consequently, the reference temperature may be set to 60 °C to 70 °C, and the reference amount of time may be set to 50 minutes to 60 minutes.

[0057] The hot air supply completion step (S60) may include a cooling step (S61) of stopping the operation of the heat pump 73 and maintaining the operation of the fan for a predetermined amount of time and a fan operation completion step (S63) of stopping the operation of the fan after the completion of the cooling step (S61).

[0058] In the case in which the drum rotation step (S25) is performed while the hot air supply step (S20) is being performed, however, the drum rotation step (S25) may be completed after the completion of the cooling step (S61).

[0059] As can be seen from the above description, the control method according to the present invention is capable of performing a sterilization course in a drying machine including a heat pump and of sterilizing laundry stored in a drum within the same amount of time irrespective of the amount of laundry (a laundry amount).

[0060] As is apparent from the above description, the present invention has the effect of providing a control method of a laundry treatment apparatus that is configured such that air heated by a heat pump is supplied in order to perform a sterilization course.

[0061] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A laundry treatment apparatus comprising:

   a drum (3) for storing laundry,
   a duct (71) provided for reintroducing air discharged from the drum (3) into the drum (3),
   a fan (75) provided in the duct (71),
   a heat pump (73) for dehumidifying and heat air flowing in the duct (71),
   a temperature sensing unit (9) for measuring a temperature of air discharged from the drum (3), and
   a controller configured to determine an amount of time, for which the measured temperature of the discharged air remains equal to or higher than the reference temperature, and to stop operation of the fan (75) and of the heat pump (73), when the amount of time is equal to or greater than a reference amount of time.

2. The laundry treatment apparatus according to claim 1, wherein the reference temperature and the reference amount of time are independent from an amount of laundry introduced into the drum.

3. The laundry treatment apparatus according to any one of the preceding claims, wherein the controller is configured to compare an accumulated value of the amount of time, for which the measured temperature is equal to or higher than the reference temperature, with the reference amount of time.

4. The laundry treatment apparatus according to claim 1 or 2, wherein the controller is configured to compare the amount of time, for which the measured temperature continuously remains equal to or higher than the reference temperature, with the reference amount of time.

5. The laundry treatment apparatus according to any one of the preceding claims, wherein the reference temperature is 60 °C to 70 °C.

6. The laundry treatment apparatus according to any one of the preceding claims, wherein the reference amount of time is 50 minutes to 60 minutes.

7. The laundry treatment apparatus according to any one of the preceding claims, wherein the controller is configured to stop the operation of the heat pump

(73) and to maintain the operation of the fan (75) for a predetermined amount of time of a cooling step and to stop the operation of the fan (75) after completion of the cooling step.

8. The laundry treatment apparatus according to any one of the preceding claims, wherein the controller is configured to rotate the drum (3) while the fan (75) and the heat pump (73) are operated for supplying heated air into the drum (3) in a hot air supply step.

9. The laundry treatment apparatus according to any one of the preceding claims, wherein the controller is configured to determine the amount of time, for which the measured temperature of the discharged air remains equal to or higher than the reference temperature, when the measured temperature is equal to or higher than a predetermined reference temperature.

10. A control method of a laundry treatment apparatus, the control method comprising:

operating a fan and a heat pump to supply heated air to a drum of the laundry treatment apparatus in a hot air supply step;
measuring a temperature of air discharged from the drum in a temperature measurement step;
when the measured temperature of the air is equal to or higher than a predetermined reference temperature, measuring an amount of time for which the temperature of the air remains equal to or higher than the reference temperature in a time measurement step; and
when an amount of time, for which the temperature of the air remains equal to or higher than the reference temperature, is equal to or greater than a reference amount of time, stopping operation of the fan and the heat pump in a hot air supply completion step.

11. The control method according to claim 10, wherein the hot air supply step, the temperature measurement step, and the time measurement step are performed when a sterilization course is selected through an input unit.

12. The control method according to claim 10 or 11, wherein the reference temperature and the reference amount of time are uniform irrespective of an amount of laundry introduced into the drum (3), or wherein the time measurement step comprises comparing an accumulated value of the amount of time for which the measured temperature of the air is equal to or higher than the reference temperature with the reference amount of time.

13. The control method according to claim 10, 11, or 12, wherein the time measurement step comprises comparing the amount of time for which the measured temperature of the air continuously remains equal to or higher than the reference temperature with the reference amount of time.

14. The control method according to any one of claims 10 to 13, wherein the reference temperature is 60°C to 70°C, and/or wherein the reference amount of time is 50 minutes to 60 minutes.

15. The control method according to any one of claims 10 to 14, wherein the hot air supply completion step comprises:

stopping the operation of the heat pump and maintaining the operation of the fan for a predetermined amount of time in a cooling step; and
stopping the operation of the fan after completion of the cooling step in a fan operation completion step.

FIG. 1

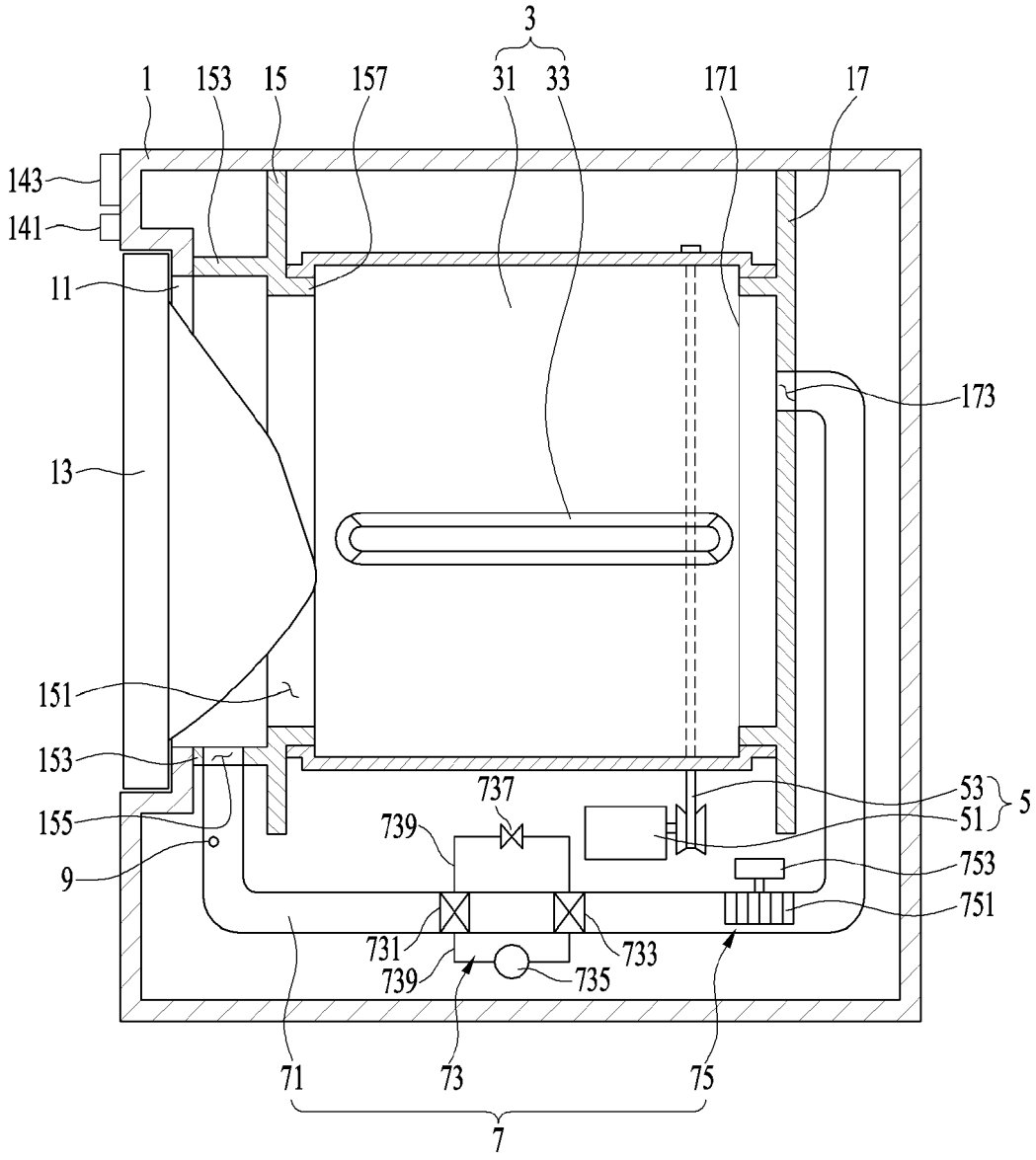

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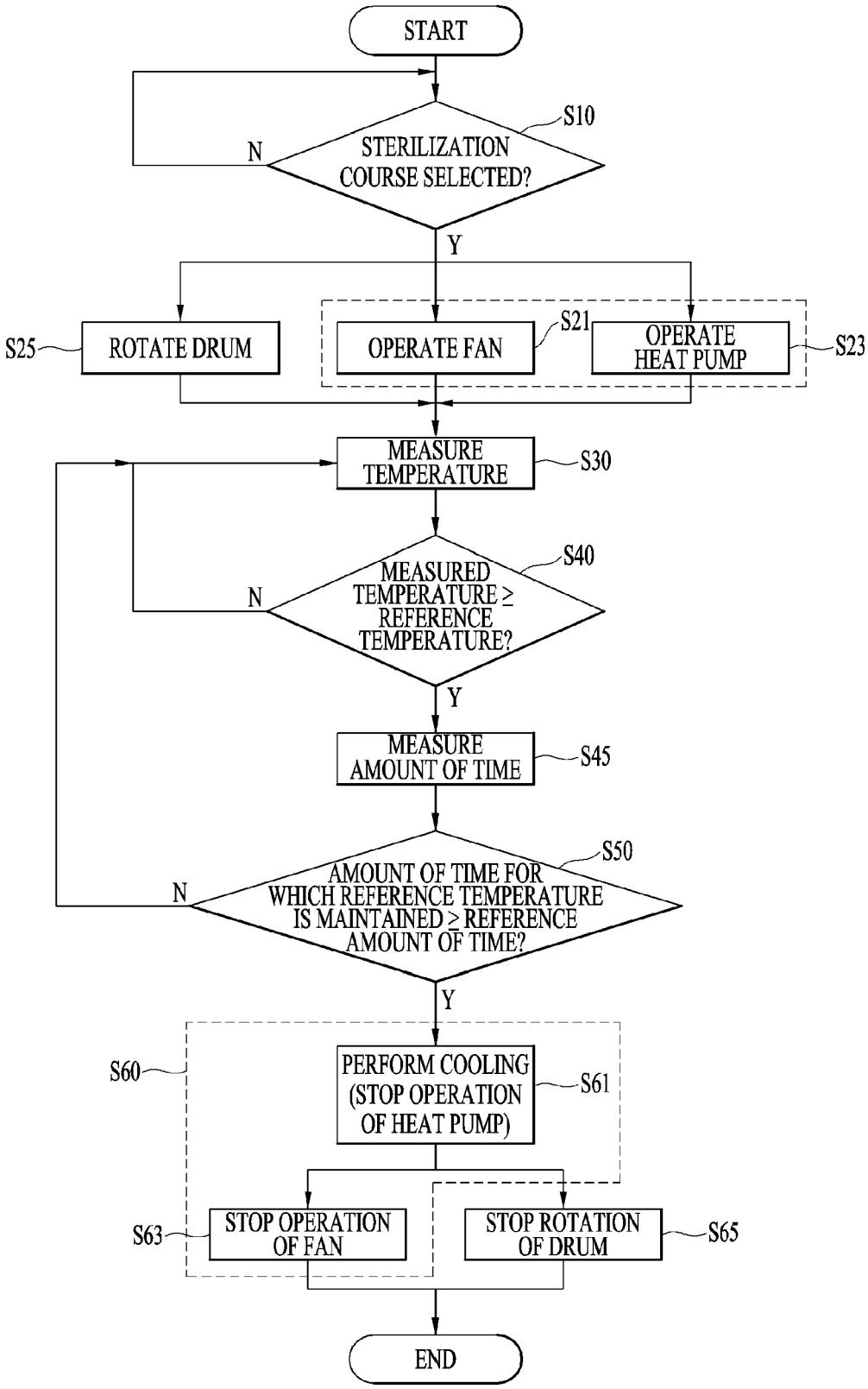
FIG. 2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S10
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S25
ROTATE DRUM
OPERATE FAN
S21
OPERATE HEAT PUMP
S23
MEASURE TEMPERATURE
S30
S40
MEASURED TEMPERATURE ≥ REFERENCE TEMPERATURE?
N
Y
MEASURE AMOUNT OF TIME
S45
S50
AMOUNT OF TIME FOR WHICH REFERENCE TEMPERATURE IS MAINTAINED ≥ REFERENCE AMOUNT OF TIME?
N
Y
S60
PERFORM COOLING (STOP OPERATION OF HEAT PUMP)
S61
S63
STOP OPERATION OF FAN
STOP ROTATION OF DRUM
S65
END

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 6069

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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	16 March 2018	Kising, Axel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 20 6069

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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