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(54) **DRYER**

(57) Provided is a clothes dryer, which is capable of lowering a temperature of clothes during the latter half of an operation regardless of the type and the amount of the clothes and uniformly drying all the clothes while fully reducing damages to the clothes caused by overheating. The clothes dryer (1) of the present invention includes a drum (20), an air supply and exhaust unit (4) for supplying and discharging the air for drying to and from the drum (20), a burner (30) for heating the air for drying, a temperature sensor (31) for detecting the exhaust temperature, and a heating control unit (55) for performing a temperature adjustment processing. The temperature adjustment processing enables the burner (30) to stop when the exhaust temperature reaches an upper limit temperature and enables the burner (30) to re-operate when the exhaust temperature is lowered to a specified re-ignition temperature. The heating control unit (55) is provided with a re-ignition temperature adjustment part that performs an adjustment to lower the re-ignition temperature, and the re-ignition temperature is gradually lowered through the re-ignition temperature adjustment part every time when the temperature adjustment processing is repeated and intermittently to perform the re-ignition.

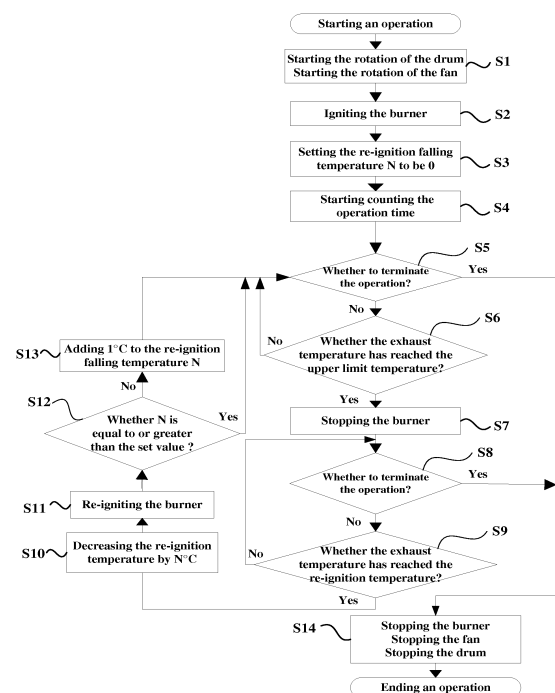


FIG. 3

Description

upper limit temperature, the process returns to step T4.

TECHNICAL FIELD

<Step T6>

[0001] The present invention relates to a clothes dryer capable of reducing damages to clothes by lowering a temperature of the clothes during overdrying regardless of the type and the amount of the clothes.

5 **[0009]** In step T6, the control unit stops the burner. As a result, air for drying of a substantially normal temperature which is not heated is supplied into the drum, and the temperature inside the drum is lowered.

BACKGROUND

10 <Step T7>

[0002] Conventionally, a clothes dryer is known in which air for drying heated by a burner is blown into a drum into which clothes to be dried is introduced by a fan, and an exhaust is performed from a back side of a main body (see, for example, Patent Document 1).

15 **[0010]** In step T7, the control unit determines whether or not the operation time has reached the end time, and determines whether or not to end the operation. When it is determined that the operation is to be ended, the process proceeds to step T10, and when it is determined not to end the operation, the process proceeds to step T8.

[0003] FIG. 5 is a flowchart showing a processing procedure in which a conventional clothes dryer carries out a drying operation. Regarding the clothes dryer disclosed in Patent Document 1, the control unit generally is configured to perform a processing shown in FIG. 5, and when a start button is pressed, the operation is started and proceeds to step T1.

20 <Step T8>

<Step T1>

25 **[0011]** In step T8, the control unit determines whether or not the exhaust temperature has reached a re-ignition temperature. When it is determined that the re-ignition temperature has been reached, the process proceeds to step T9, and when it is determined that the re-ignition temperature has not been reached, the process returns to step T7.

[0004] In step T1, the control unit starts rotations of the drum and the fan. As a result, a supply and exhaust of the air for drying to and from the drum is started.

30 <Step T9>

<Step T2>

35 **[0012]** In step T9, the control unit re-ignites the burner, and the process proceeds to step T4. As a result, the supply of high-temperature air for drying to the drum is resumed, and the temperature inside the drum rises again.

[0005] In step T2, the control unit ignites the burner. As a result, a supply of high-temperature air for drying to the drum is started.

<Step T3>

<Step T10>

[0006] In step T3, the control unit starts counting operation time.

40 **[0013]** In step T10, the control unit stops the burner and stops the rotations of the fan and the drum, respectively. As a result, this flow is ended.

<Step T4>

45 **[0014]** As described above, a conventional clothes dryer suppresses an abnormal rise in the temperature inside the drum and the damage of the clothes due to overheating by repeating the following processes: when the exhaust temperature from the drum reaches the predetermined upper limit temperature, the burner (heat source) is stopped to lower the temperature inside the drum, and thereafter, when the exhaust temperature reaches the predetermined re-ignition temperature, the burner is re-ignited.

[0007] In step T4, the control unit determines whether or not the operation time has reached the end time and determines whether or not to end the operation. When it is determined that the operation is to be terminated, the process proceeds to step T10, and when it is determined not to end the operation, the process proceeds to step T5.

50 **[0015]** However, in the above-described drying operation, even after the exhaust temperature reaches the upper limit temperature, that is, moisture contained in the clothes decreases, at least a portion of the clothes have almost been dried and become excessively dried, and when the exhaust temperature reaches the re-ignition temperature, the burner is re-ignited at once so that the

<Step T5>

[0008] In step T5, the control unit determines whether or not the exhaust temperature has reached an upper limit temperature. When it is determined that the exhaust temperature has reached the upper limit temperature, the process proceeds to step T6, and when it is not determined that the exhaust temperature has reached the

temperature inside the drum is kept high and the surface temperature of the clothes keeps rising all the time. Such a state leads to a bruise of clothes, and the clothes dryer performing the conventional drying operation has room for improvement concerning a reduction of the damages of the clothes caused by overheating.

[0016] To solve this problem, such a control is considered as follows: the upper limit temperature is lowered in the latter half of the operation in which fire extinguishing and ignition of the burner are repeated, and the burner is stopped before the temperature inside the drum rises excessively. However, the clothes dryer cannot distinguish the type, weight, etc. of the clothes accommodated in the drum, due to the characteristics of the clothes dryer suitably used particularly for a laundromat, and it is difficult to determine at what point the latter half of the operation is. Therefore, it is difficult to adopt such a control.

Current Technical Literature

Patent Literature

[0017] Patent Literature 1: Japanese Laid-Open Patent Publication No. 9-290095

SUMMARY

The technical problem to be solved by the present invention

[0018] An object of the present invention is to effectively solve such a problem, and it is an object of the present invention to provide a clothes dryer capable of lowering the temperature in the latter half of the operation regardless of the type and the amount of clothes and sufficiently reducing damages to the clothes due to overheating and drying the entire clothes uniformly.

The technical solution for solving the technical problem

[0019] In view of the above problems, the present invention adopts following technical solutions.

[0020] That is, a clothes dryer according to the present invention includes a drum capable of accommodating clothes, an air supply and exhaust unit for supplying and discharging air for drying to and from the drum, a heating unit for heating the air for drying supplied to the drum, an exhaust temperature detection unit for detecting the temperature of the air for drying that is discharged from drum, and a heating control unit for performing a temperature adjustment processing, the heating unit is stopped when an exhaust temperature detected by the exhaust temperature detection unit reaches a predetermined upper limit temperature, and it is re-operated when the exhaust temperature is lowered to a predetermined re-ignition temperature to perform a re-ignition. The heating control unit is provided with a re-ignition temperature adjustment part that performs an adjustment to lower the re-ignition

temperature and the re-ignition temperature is gradually lowered through the re-ignition temperature adjustment part every time when the temperature adjustment processing is repeated intermittently to perform the re-ignition.

[0021] In particular, it is preferable that the re-ignition temperature adjustment part lowers the re-ignition temperature in stages by a predetermined temperature to determine a new re-ignition temperature every time when the temperature adjustment processing is performed.

[0022] Furthermore, the re-ignition temperature adjustment part pre-sets a lower limit value for the re-ignition temperature. When the temperature adjustment processing is repeated to enable the re-ignition temperature to reach the lower limit value, the re-ignition temperature adjustment part keeps the re-ignition temperature at the lower limit value, and the heating control unit performs a re-ignition at the re-ignition temperature thereafter.

[0023] In these cases, it is also preferable that the re-ignition temperature adjustment part acquires an elapsed time from the re-ignition until the exhaust temperature reaches a predetermined upper limit temperature, and adds a correction value to the predetermined temperature based on the elapsed time.

[0024] In addition, it is preferable that the heating unit is a non-adjustable burner having no thermal power adjustment function.

The effect of the present invention

[0025] According to the present invention described above, the air for drying heated by the heating unit is supplied into the drum by an air supply and exhaust unit to dry the clothes, and the point of time at which the exhaust temperature detected by the exhaust temperature detection unit exceeds the upper limit temperature is set to be a substantial boundary between the former half and the latter half of the drying operation. The point of time at which the exhaust temperature has reached the upper limit temperature is not taken as a reference point, but the point of time at which the exhaust temperature has dropped to the re-ignition temperature is taken as the reference point of the reheating operation of the heating unit. It is possible to perform the temperature adjustment processing by the heating control unit in the latter half of the drying operation without strictly estimating the type and the amount of the clothes to be dried. Every time this temperature adjustment processing is repeated intermittently, the heating control unit gradually reduces the re-ignition temperature down to the required temperature through the re-ignition temperature adjustment part, so that the unheated air for drying is used to dry the clothes, and the temperature inside the drum can be reliably lowered to a temperature lower than the temperature during the previous temperature adjustment processing. Consequently, regardless of the type and the amount of the clothes to be dried, the peak temperature in the drum for

each temperature adjustment processing can be gradually reduced in the latter half of the drying operation to lower the temperature of the clothes in the overdrying condition, and it is possible to uniformly dry the whole clothes while sufficiently reducing the damage of clothes by overheating.

[0026] Particularly, according to the present invention in which a re-ignition temperature adjustment part gradually lowers the re-ignition temperature in stages by a predetermined temperature, it is possible to easily and gently control the above-described control in which the whole clothes can be dried uniformly while sufficiently reducing the damage of clothes by overheating.

[0027] Furthermore, according to the present invention in which the re-ignition temperature adjustment part sets the lower limit value for the re-ignition temperature, it is possible to prevent the temperature of the clothes from dropping excessively in the latter half of the drying operation and ensure necessary drying performance without causing insufficient drying.

[0028] Furthermore, according to the present invention in which a correction value is added to the re-ignition temperature in accordance with the elapsed time from the re-ignition to the stop of the heating, the presence or absence of the effect generated through the reduction in the re-ignition temperature is fed back, and a function of stably reducing temperature inside the drum is achieved.

[0029] In addition, according to the present invention in which the heating unit is a non-adjustable burner, the manufacturing cost can be reduced compared with the case of using the adjustable burner.

BRIEF DESCRIPTION OF DRAWINGS

[0030]

FIG. 1 is a schematic view showing a clothes dryer according to an embodiment of the present invention;

FIG. 2 is a block diagram showing structures of the same clothes dryer;

FIG. 3 is a flowchart showing a processing procedure of a drying operation of the same clothes dryer;

FIG. 4 is a flowchart of FIG. 3 corresponding to a modified example of the present invention; and

FIG. 5 is a flowchart showing a processing procedure in a drying operation of a conventional clothes dryer.

DETAILED DESCRIPTION

[0031] Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

[0032] FIG. 1 is a schematic view showing a clothes dryer 1 according to an embodiment of the present invention. FIG. 1(A) is a front view of a clothes dryer 1, and FIG. 1(B) is a side view of a clothes dryer 1 according to an embodiment of the present invention. FIG. 2 is a block diagram showing structures of the clothes dryer 1.

[0033] The clothes dryer 1 of the present embodiment includes a device main body 10, a drum 20 and a drum case 21, a drum motor 23, a burner 30, an air supply and exhaust unit 4, a temperature sensor (thermistor) 31, a control unit 5 (see FIG. 2), and is particularly suitably used in a laundromat.

[0034] The interior of the device main body 10 is isolated by an upper partition plate 11 and a lower partition plate 12. A combustion chamber 13 is formed at the upper portion thereof, a drying chamber 14 is formed in the middle portion thereof, and a ventilation chamber 15 and a fan motor chamber 16 are formed at the lower portion thereof, respectively.

[0035] The drum 20 is provided in the cylindrical drum case 21 in the drying chamber 14, and the drum 20 is arranged concentrically with the drum case 21 with its axis being the front-rear direction of the clothes dryer main body 1. Further, the drum 20 has a slightly smaller diameter than the drum case 21 and a large number of small holes (not shown) provided on its circumferential surface so that it can repeatedly rotate in the forward direction and the reverse direction to loosen the clothes. Such a drum 20 can accommodate the clothes L to be dried.

[0036] An intake port 21a (see FIG. 1 (A)) is formed at the upper left position of the drum case 21, and the intake port 21a communicates with a combustion chamber 13 to be described later via a short ventilation duct 17. An exhaust port 21b (see FIG. 1 (A)) is formed at the lower right position of the drum case 21. The front side opening of the drum 20 can be tightly closed by the door 22 so as to freely open and close.

[0037] The drum motor 23 is attached to the upper portion on the rear surface side of the device main body 10.

The drum 20 is rotatably driven by the rotational force of the drum motor 23.

[0038] A burner 30, as a heating unit, is provided in the combustion chamber 13 and heats the air for drying supplied into the drum 20 through the small holes. In addition, the burner 30 is a non-adjustable type burner having no heating power adjusting function. Gas supply and gas interruption to the burner 30 are performed by the gas valve 30b shown in FIG. 2. Besides, an igniter 30a (see FIG. 2) is provided in the vicinity of the burner 30.

[0039] The air supply and exhaust unit 4 supplies and exhausts the air for drying to and from the drum 20, and has a supply and discharge passage 40, a discharge fan 48a, and a fan motor 48b.

[0040] The supply and discharge passage 40 is constituted by the combustion chamber 13, the ventilation duct 17, the drum case 21, the ventilation port 40b formed in the lower partition plate 12 so as to face the exhaust port 21b, the ventilation chamber 15 and the fan motor chamber 16.

[0041] The ventilation chamber 15 is formed below the lower partition plate 12 and is isolated from the fan motor chamber 16 by a partition plate 44 arranged substantially vertically. Further, an air filter 45 is disposed so as to

straddle the lower end portion of the shielding plate 42 whose upper end portion is fixed to the lower partition plate 12 and the lower end portion of the partition plate 44, and a vent hole 44a is formed at the right position of the partition plate 44 (see FIG. 1 (A)).

[0042] In the fan motor chamber 16, an exhaust fan 48a on the front side of the fan partition plate 47 and a fan motor 48b on the rear side of the fan partition plate 47 for rotating the exhaust fan 48a are disposed. A ventilation opening 47a (see FIG. 1(A)) is formed in the upper left portion of the fan partition plate 47.

[0043] The temperature sensor 31, as the exhaust temperature detection unit, detects the temperature (exhaust temperature) of the air for drying discharged from the drum 20, and is disposed in the vicinity of the exhaust fan 48a, that is, the ventilation opening 47a of the fan partition plate 47. It is difficult to measure the temperature inside the drum 20 during operation in real time, but the temperature inside the drum 20 can be indirectly measured in real time by using the temperature sensor 31.

[0044] The operation of such a clothes dryer 1 is controlled by a control unit 5 (see FIG. 2) including a microcomputer. The control unit 5 includes a heating control unit 55, a timer 51, a ROM 53, and a RAM 54. By executing a program (such as a temperature adjustment processing to be described later) stored in the ROM 53 by a microcomputer, a pre-set operation is performed. In the RAM 54, data (such as a re-ignition falling temperature N to be described later) to be used for executing the above program is temporarily stored.

[0045] The control unit 5 is capable of outputting a fan motor drive signal to the fan motor 48b and can output a drum motor drive signal to the drum motor 23.

[0046] The heating control unit 55 is capable of outputting an ignition signal to the igniter 30a and outputting a gas supply signal to the gas valve 30b.

[0047] The heating control unit 55 performs the following temperature adjustment processing as follows: stopping the burner 30 when the exhaust temperature detected by the temperature sensor 31 reaches a predetermined upper limit temperature, and re-operating the burner 30 to perform a re-ignition when the exhaust temperature drops to a predetermined re-ignition temperature. In the present embodiment, for example, the upper limit temperature is set to be about 70 °C, and the re-ignition temperature is set to be in a range of 40 to 45°C in advance.

[0048] Furthermore, the heating control unit 55 has a re-ignition temperature adjustment part 56 for performing an adjustment to lower the re-ignition temperature. The re-ignition temperature is gradually lowered by the re-ignition temperature adjustment part 56 every time when the temperature adjustment processing is repeated intermittently to perform the re-ignition.

[0049] As described above, a clothes dryer in the present embodiment includes: a drum 20 capable of accommodating clothes L, an air supply and exhaust unit 4 for supplying and discharging air for drying to and from

the drum 20, a burner 30, as a heating unit, for heating the air for drying supplied to the drum 20, a temperature sensor 31, as an exhaust temperature detection unit, for detecting the temperature of the air for drying that is discharged from drum 20, and a heating control unit 55 for performing a temperature adjustment processing as follows: stopping the burner 30 when an exhaust temperature detected by the temperature sensor 31 reaches a predetermined upper limit temperature, and re-operating the burner 30 to perform a re-ignition when the exhaust temperature drops to a predetermined re-ignition temperature. The heating control unit 55 is provided with a re-ignition temperature adjustment part 56 that performs an adjustment to lower the re-ignition temperature, and the re-ignition temperature is gradually lowered through the re-ignition temperature adjustment part 56 every time when the temperature adjustment processing is repeated intermittently to perform the re-ignition.

[0050] With such a configuration, the air for drying heated by the burner 30 is supplied into the drum 20 by the air supply and exhaust unit 4 to dry the clothes L, and the point of time at which the exhaust temperature exceeds the upper limit temperature is set to be a substantial boundary between the former half and the latter half of the drying operation. The point of time at which the exhaust temperature has reached the upper limit temperature is not taken as the reference point, but the point of time at which the exhaust temperature has dropped to the re-ignition temperature is taken as the reference point of the reheating operation of the burner 30. Thus, it is possible to perform the temperature adjustment processing by the heating control unit 55 in the latter half of the drying operation without strictly estimating the kind and the amount of the clothes L to be dried inside the drum 20. Every time this temperature adjustment processing is repeated intermittently, the heating control unit 55 gradually reduces the re-ignition temperature down to the required temperature through the re-ignition temperature adjustment part 56, so that the unheated air for drying continues to dry the clothes L, and the temperature inside the drum 20 can be reliably lowered to a temperature lower than the temperature during the previous temperature adjustment processing. Consequently, regardless of the type and the amount of clothes L to be dried, the peak temperature in the drum 20 for every temperature adjustment processing can be gradually reduced in the latter half of the drying operation to stably lower the temperature of the clothes L in the overdrying condition, and it is possible to uniformly dry the whole clothes while sufficiently reducing the damage of the clothes L by overheating compared with the current method of keeping a continuous high-temperature operation.

[0051] Furthermore, in making such an effect, new sensors are unnecessary, and the conventional mechanical configuration can be adopted without costs.

[0052] It should be noted that, as another method for lowering the temperature of the clothes with a boundary as the upper limit temperature is reached, it is conceivable

able to lower the upper limit temperature itself from the time when the exhaust temperature reaches the upper limit temperature. However, since this method is carried out after the burner 30 is re-ignited, the time for the exhaust temperature to reach the upper limit temperature again is advanced. Thus, the number of times of ignition and extinction of the burner 30 increases throughout the operation, which is disadvantageous in terms of the durability of the machine.

[0053] In the present invention, the number of times of ignition and extinction of the burner 30 is reduced as compared with the above-described method, which is advantageous also from the aspect of durability of the machine.

[0054] Also, as described above, when the exhaust temperature reaches the upper limit temperature for the first time, the surface of the clothes L is in a substantially dried state, and the dried portions are more easily damaged by heat compared with the wetted portion. This point is not noted in the prior art, and the following idea is also not mentioned: the temperature in the drum 20 is lowered by lowering the re-ignition temperature in a state where an undried portion possibly remains.

[0055] FIG. 3 is a flowchart showing the processing procedure in the drying operation of the clothes dryer 1. Hereinafter, the processing procedure of the drying operation will be specifically described with reference to FIG. 3. In this case, the initial value of the re-ignition temperature is set to be 45°C., the subtraction value (a predetermined value) to decrease the re-ignition temperature step by step is set to be 1°C., the cumulative value of the subtraction value is set to be the re-ignition fall temperature N, and the lower limit of the re-ignition value is set to be 40°C.

[0056] When the clothes L to be dried is thrown into the drum 20 by opening the door 22, and the door 22 is closed and a start button (not shown) is pushed, this flow starts.

<Step S1>

[0057] In step S1, the control unit 5 outputs a drum motor drive signal to the drum motor 23 to start the rotation of the drum 20, and outputs a fan motor drive signal to the fan motor 48b to start the rotation of the exhaust fan 48a. As a result, the air in the fan motor chamber 16 is discharged to the outside of the device, the air flows from the combustion chamber 13 toward the fan motor chamber 16 to flow to the supply and discharge passage 40, and supply and exhaust of the air for drying to and from the drum 20 is started.

<Step S2>

[0058] In step S2, the heating control unit 55 outputs a gas supply signal to the gas valve 30b to turn on the gas valve 30b, and also outputs an ignition signal to the igniter 30a to ignite the burner 30. As a result, a supply of high-temperature air for drying to the drum 20 is start-

ed.

<Step S3>

[0059] In step S3, the control unit 5 sets the initial value of the re-ignition falling temperature N to be 0 (°C).

<Step S4>

[0060] In step S4, the control unit 5 causes the timer 51 to start counting the operation time.

<Step S5>

[0061] In step S5, the control unit 5 determines whether or not the operation time has reached the end time based on the count value of the timer 51, and determines whether or not to end the operation. When it is determined that the operation is to be terminated, the process proceeds to step S14, and when it is not determined to end the operation, the process proceeds to step S6.

<Step S6>

[0062] In step S6, the control unit 5 determines whether or not the exhaust temperature detected by the temperature sensor 31 has reached the upper limit temperature. When it is determined that the exhaust temperature has reached the upper limit temperature, the process proceeds to step S7, and when it is determined that the exhaust temperature has not reached the upper limit temperature, the process returns to step S5. It should be noted that, when the amount of moisture in the drum 20 is large, even if the high-temperature air for drying is supplied, the amount of heat is utilized for the evaporation of water, and the temperature inside the drum 20 is hard to rise. The more the amount of clothes and the amount of moisture contained in the clothes are, the more time it takes for the exhaust temperature to reach the upper limit temperature. The time depends on the fabric and the amount of the clothes L and the like. However, when the exhaust temperature reaches the upper limit temperature for the first time, even if the surface of the clothes L is dried, the interior still is in a wet state.

<Step S7>

[0063] In step S7, the heating control unit 55 stops the supply of the gas to the burner 30 by the gas valve 30b and stops (extinguishes) the burner 30.

<Step S8>

[0064] In step S8, based on the count value of the timer 51, the control unit 5 determines whether or not the operation time has reached the end time and determines whether or not to end the operation. When it is determined that the operation is to be terminated, the process pro-

ceeds to step S14, and when it is determined not to end the operation, the process proceeds to step S9.

<Step S9>

[0065] In step S9, the control unit 5 determines whether or not the exhaust temperature detected by the temperature sensor 31 has decreased to the re-ignition temperature. When it is determined that the exhaust temperature has decreased to the re-ignition temperature, the process proceeds to step S10, and when it is determined that the exhaust temperature has not dropped to the re-ignition temperature, the process returns to step S8.

<Step S10>

[0066] In step S10, the re-ignition temperature of the gas supply signal and the ignition signal is lowered by the re-ignition falling temperature N°C through the re-ignition temperature adjuster 56.

<Step S11>

[0067] In step S11, the heating control unit 55 outputs a gas supply signal to the gas valve 30b and outputs an ignition signal to the igniter 30a to re-ignite the burner 30.

<Step S12>

[0068] In step S12, the heating control unit 55 determines whether or not the re-ignition temperature has reached the lower limit value by determining whether or not the re-ignition falling temperature N has reached the set value (for example, 5°C). When it is determined that the re-ignition falling temperature N is equal to or higher than 5°C, the process proceeds to step S5, and when it is determined that the re-ignition falling temperature N is not 5°C or higher, the process proceeds to step S13.

[0069] That is, when the re-ignition temperature reaches the lower limit value, the re-ignition temperature adjustment part 56 keeps the re-ignition temperature at the lower limit value (40°C) by keeping the re-ignition falling temperature N at a set value. The heating control unit 55 performs a subsequent temperature adjustment processing at the re-ignition temperature. For this reason, the temperature of the clothes is prevented from being excessively lowered, and the required drying performance is ensured without causing insufficient drying. It should be noted that, the lower limit of the re-ignition temperature, that is, the set value of the re-ignition falling temperature N, is not limited to 5°C as long as the effect of the present invention can be exerted.

<Step S13>

[0070] In step S13, the control unit 5 adds 1°C to the re-ignition falling temperature N as a predetermined value. As a result, the re-ignition falling temperature N in-

creases by 1°C at a time (each time the re-ignition temperature is lowered by 1°C) for each temperature adjustment processing until the re-ignition falling temperature N reaches the set value (for example, 5°C). As described above, with respect to the initial value of the re-ignition temperature, each time the temperature adjustment processing is performed, the re-ignition falling temperature N is added incrementally, and thus, the re-ignition temperature is lowered stage by stage to perform a re-ignition. Therefore, it is possible to easily realize the above-described control capable of uniformly drying the entire clothes L while sufficiently reducing the damage to the clothes L by overheating. Further, the predetermined value is generally set to be about 1°C, and thus, the peak temperature in the drum 20 for each temperature adjustment processing can be reduced in a manner of reducing damages to the clothes L and ensuring an appropriate temperature difference that can dry the undried portion in the latter half of the operation. Further, even if the upper limit arrival time point of the exhaust temperature deviates from the boundary between the former half and the latter half of the actual drying operation, since the re-ignition falling temperature N is added little by little, the peak temperature in the drum 20 for each temperature adjustment processing is gradually reduced so that it does not have a large influence on the drying performance. Of course, the predetermined value is not limited to 1 °C.

<Step S14>

[0071] In step S14, the heating control unit 55 stops the burner 30, and the control unit 5 stops the rotations of the exhaust air fan 48a and the drum 20, respectively, thereby terminating the present flow.

[0072] As described above, the clothes dryer 1 in the present embodiment has an operation course capable of reducing damages to the clothes by lowering the temperature of the clothes during overdrying of the clothes L. It should be noted that, regarding the clothes dryer 1 in an experiment, the upper limit temperature is set to be about 70 °C, the re-ignition temperature is set to be at about 40 to 45°C, and the additional time A is set to be at 5 seconds. When the above experiment is compared with the case shown in Fig. 5, which indicates the current drying operation, the peak temperature in the drum 20 during the drying operation could be reduced by about 10°C. The experimental values are obtained from the Thermo Label (registered trademark) capable of measuring the highest temperature in the drum 20.

[0073] It should be noted that, as another method of lowering the clothes temperature during overdrying, it is considered to use a thermal power adjustment type burner capable of adjusting the thermal power in a plurality of stages and adjust the fire power of the burner to a small value after the exhaust temperature reaches the upper limit temperature, thereby lowering the temperature of the clothes.

[0074] In this case, it is considered possible that the number of times of ignition and extinguishment is suppressed after the fire power of the burner is adjusted and that there are few problems in terms of durability of the machine. However, when an adjustable burner is used, the manufacturing cost of the device rises. In the present invention, the temperature in the drum 20 is adjusted by updating the re-ignition falling temperature, and only the ON/OFF control is enough for the heating unit. Thus, it is possible to use the non-adjustable burner 30 as the heating unit, and it is particularly advantageous in terms of the manufacturing cost of device.

[0075] Although one embodiment of the present invention has been described above, the specific configuration of each part is not limited to the above-described embodiment.

[0076] For example, the re-ignition temperature adjustment unit 56 is used to acquire the elapsed time T from the re-ignition until the exhaust temperature reaches the predetermined upper limit temperature, and it is effective that the correction value is added to the re-ignition falling temperature based on the elapsed time T.

[0077] FIG. 4 is a flow chart corresponding to FIG. 3 showing the procedure. Common parts are denoted by the same reference numerals, and the explanations thereof are omitted. Next, the added steps are described below.

<Step S13a>

[0078] In step S13a, counting is started for the elapsed time (the re-ignition elapsed time) since the re-ignition.

<Step S7a>

[0079] In step S7a, the elapsed time for the exhaust temperature reaching the upper limit temperature is acquired.

<Step S9a>

[0080] In step S9a, a correction value α is added to the re-ignition falling temperature N according to the elapsed time. That is, when the re-ignition falling temperature N is decreased, the elapsed time until the predetermined upper limit temperature is reached after the re-ignition is extended, but the elapsed time may hardly change depending on the amount of the laundry or the outside air temperature. Therefore, the re-ignition falling temperature N will be corrected to $N+\alpha$. If both N and α are 1 °C, the re-ignition temperature will be lowered by 2 °C in steps S9a and S10. Whether or not the elapsed time has changed is determined depending on whether or not it has been changed into a threshold value (for example, 5 seconds). Conversely, in the case where the elapsed time is greatly extended even by lowering by 1 °C in step S10, α may be configured to take a negative value depending on the situation.

[0081] By doing so, it is possible to provide a feedback on whether the effect is good or bad by lowering the re-ignition falling temperature, and more accurately, the temperature is stably reduced in the drum.

[0082] In the present embodiment, the burner 30 is used as the heating unit, but other burners may also be used as long as the drying air can be heated.

[0083] Furthermore, in the above-described embodiment, the re-ignition temperature in the subsequent temperature adjustment processing is determined by adding a predetermined value to the re-ignition falling temperature N. However, it is not limited to this, and the next re-ignition temperature can be determined by setting the re-ignition temperature to be a predetermined variable with $t=0$ as an initial value or by multiplying the re-ignition temperature by a predetermined coefficient. In addition, a new re-ignition temperature may be determined based on a table in which the number of repetitions of the temperature adjustment processing and the re-ignition temperature are associated with each other.

[0084] Various modifications are possible in other configurations without departing from the technical spirits of the present invention.

Description of the symbols

[0085] 1: Clothes dryer; 4: Air supply and exhaust unit; 20: Drum; 30: Burner (heating unit); 31: Temperature sensor (exhaust temperature detection unit); 55: Heating control unit; 56: Re-ignition temperature adjustment portion; L: Clothes; N: Re-ignition falling temperature.

Claims

1. A clothes dryer, comprising:

a drum capable of accommodating clothes,
an air supply and exhaust unit for supplying and discharging air for drying to and from the drum,
a heating unit for heating the air for drying supplied to the drum,
an exhaust temperature detection unit for detecting the temperature of the air for drying that is discharged from the drum, and
a heating control unit for performing a temperature adjustment processing as follows: stopping the heating unit when an exhaust temperature detected by the exhaust temperature detection unit reaches a predetermined upper limit temperature, and re-operating the heating unit to perform a re-ignition when the exhaust temperature drops to a predetermined re-ignition temperature, wherein
the heating control unit is provided with a re-ignition temperature adjustment part that performs an adjustment to lower the re-ignition temperature, and the re-ignition temperature is

gradually lowered through the re-ignition temperature adjustment part every time when the temperature adjustment processing is repeated intermittently to perform the re-ignition.

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2. The clothes dryer according to claim 1, wherein the re-ignition temperature adjustment part lowers the re-ignition temperature in stages by a predetermined temperature to determine a new re-ignition temperature every time when the temperature adjustment processing is performed. 10

3. The clothes dryer according to claim 2, wherein the re-ignition temperature adjustment part pre-sets a lower limit value for the re-ignition temperature, and when the temperature adjustment processing is repeated to enable the re-ignition temperature to reach the lower limit value, the re-ignition temperature adjustment part keeps the re-ignition temperature at the lower limit value, and the heating control unit performs the re-ignition at the re-ignition temperature thereafter. 15
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4. The clothes dryer according to claim 2 or claim 3, wherein the re-ignition temperature adjustment part acquires an elapsed time from the re-ignition until the exhaust temperature reaches a predetermined upper limit temperature, and adds a correction value to the predetermined temperature based on the elapsed time. 25
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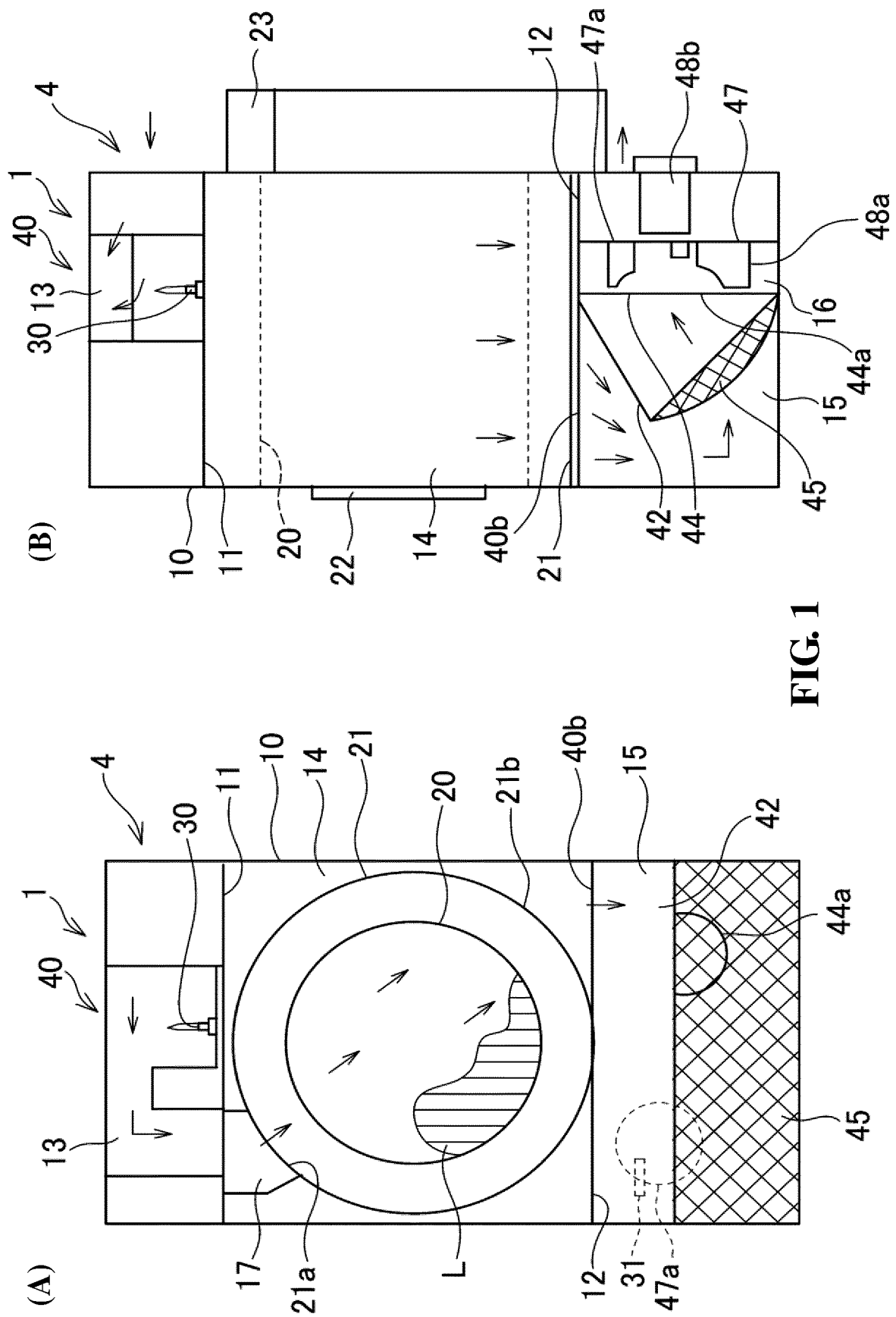
5. The clothes dryer according to any one of claims 1 to 4, wherein the heating unit is a non-adjustable burner having no thermal power adjustment function. 35

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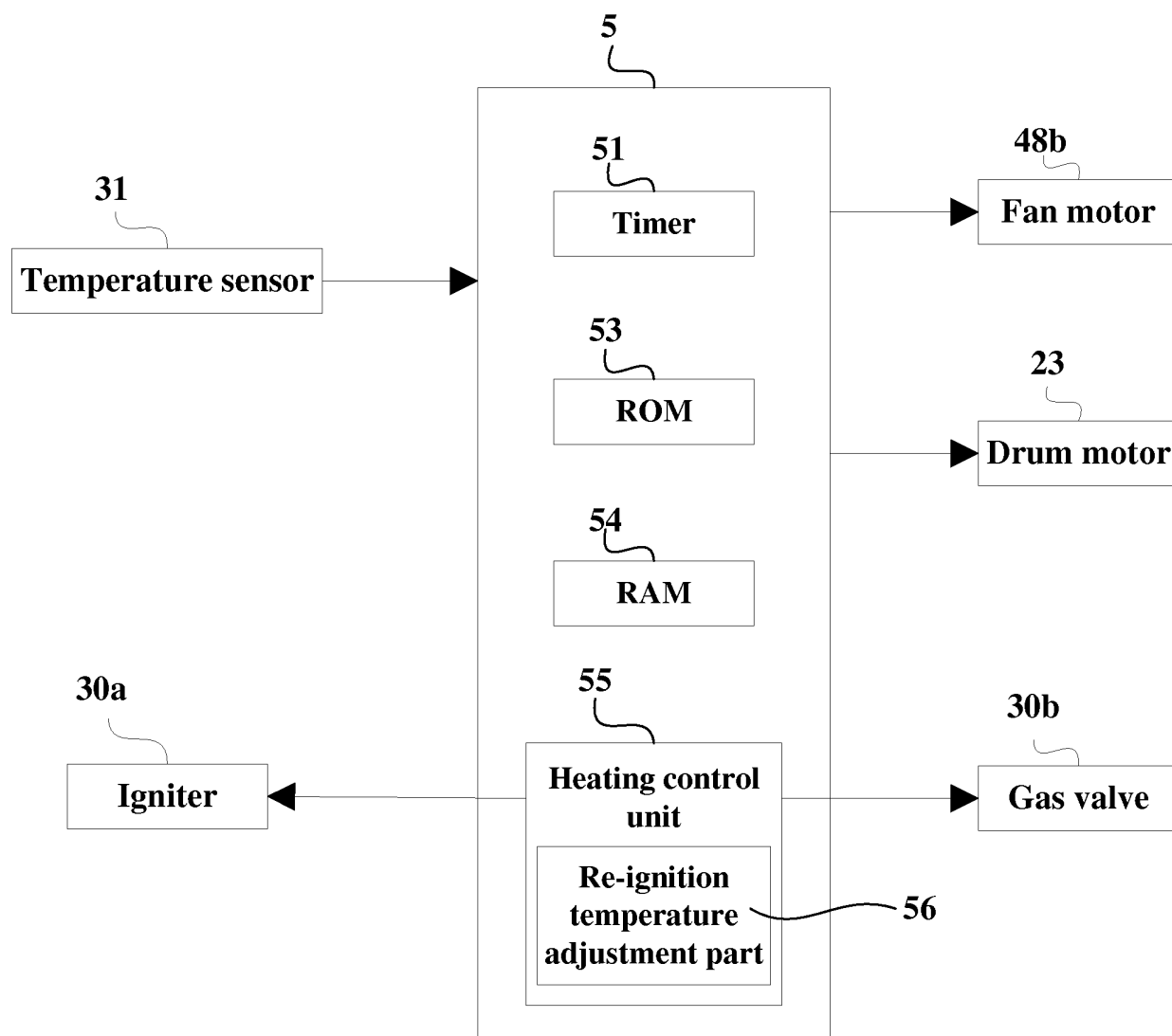


FIG. 2

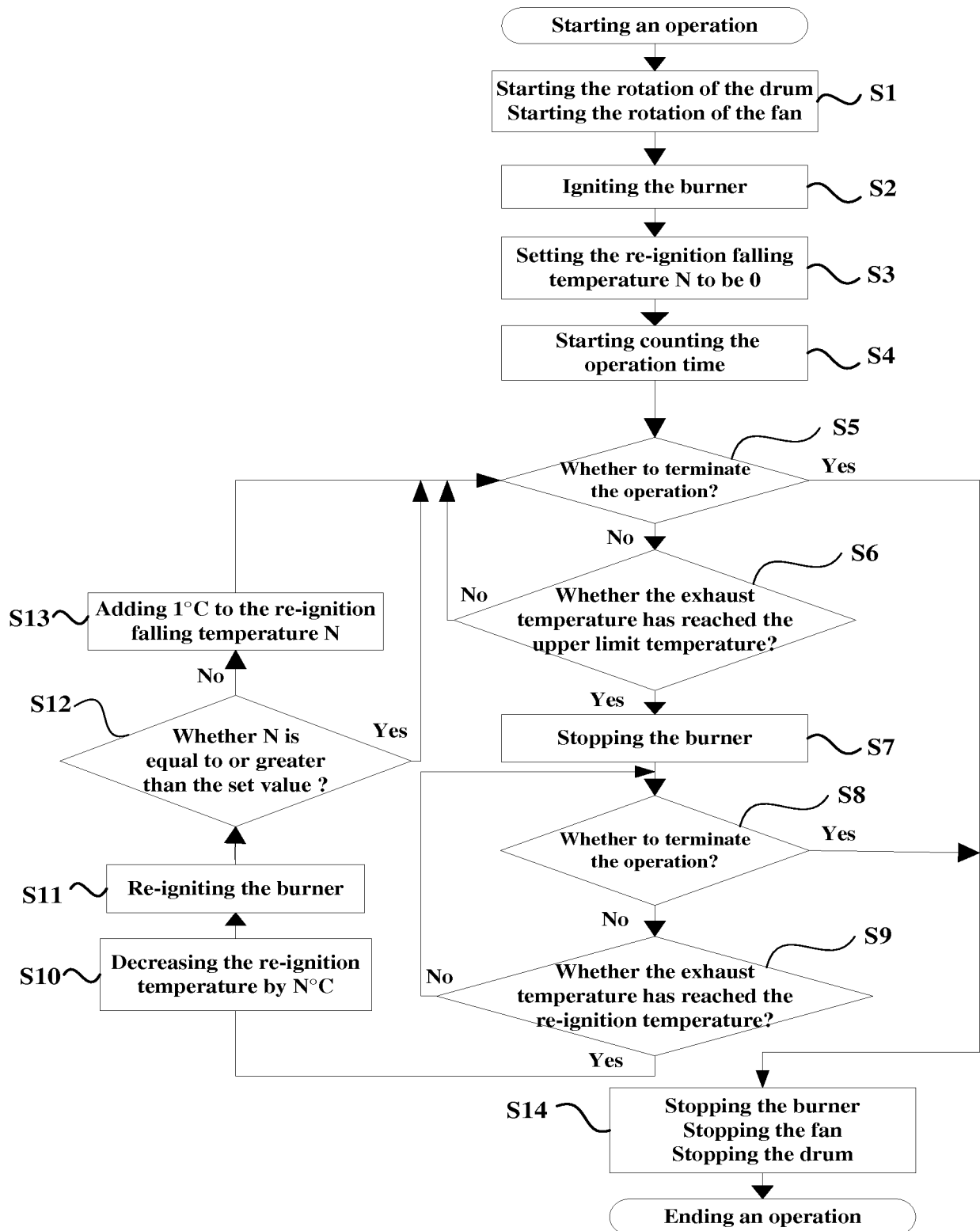


FIG. 3

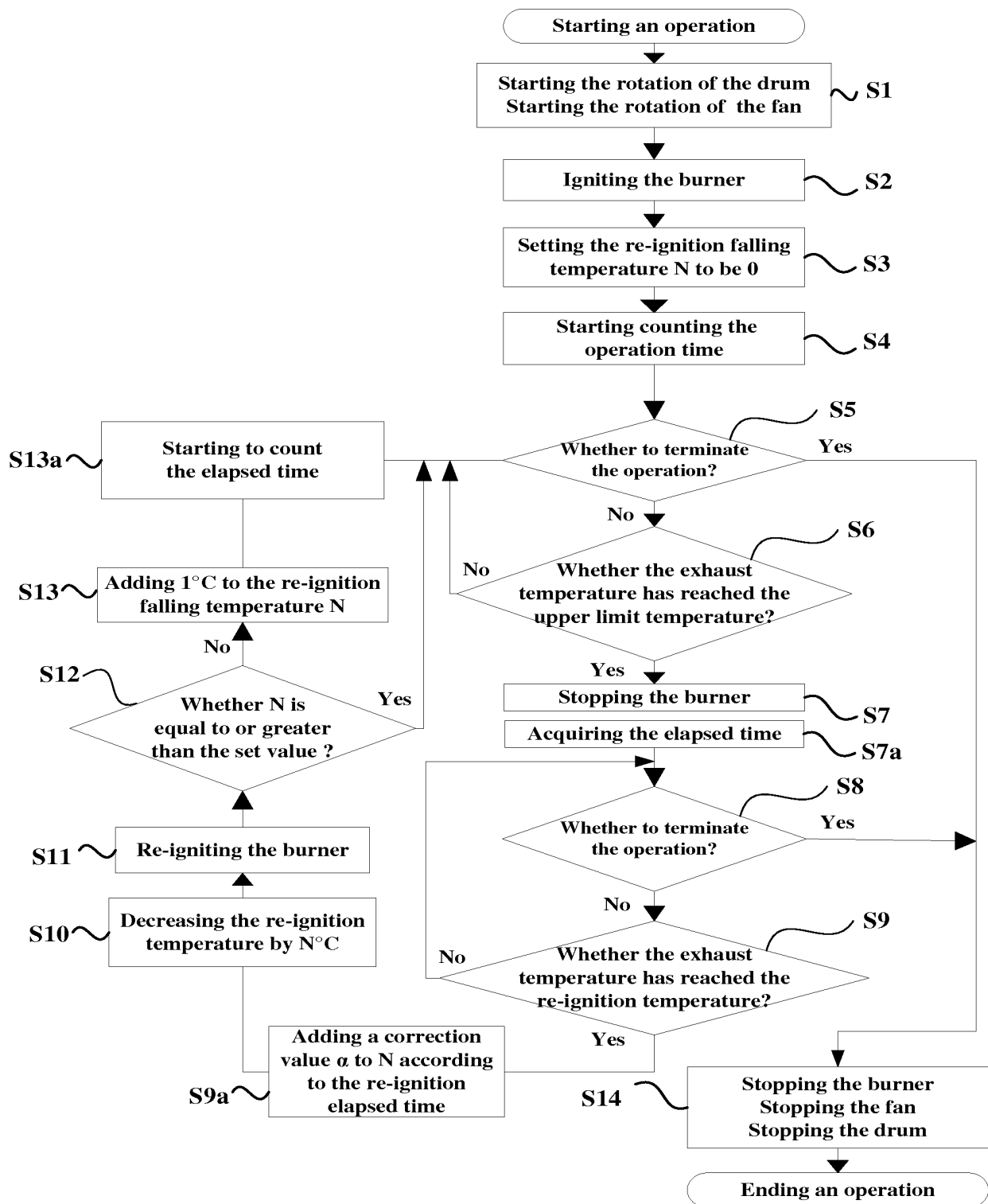


FIG. 4

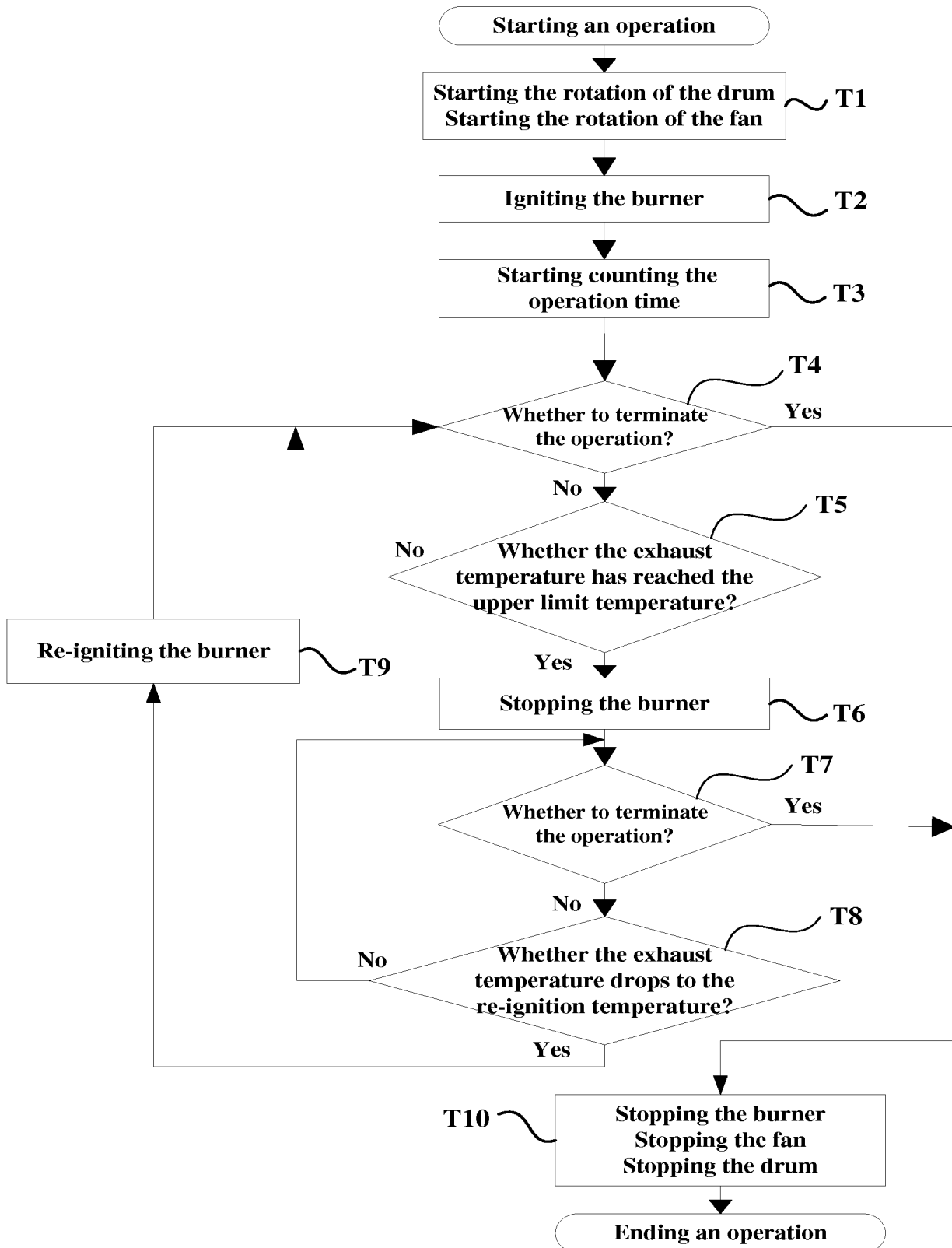


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/110375

A. CLASSIFICATION OF SUBJECT MATTER

D06F 58/26 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, EPODOC, DWPI: air temperature, air out, adjust+, set+, regulat+, fire, temperature, fuel, gas, exhaust, vent, discharge

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP H09290095 A (SANYO ELECTRIC CO), 11 November 1997 (11.11.1997), description, paragraphs 26-38, and figures 1, 2 and 5	1-5
A	CN 2479048 Y (GUANGDONG WANJIALE GAS IMPLEMENT CO., LTD.), 27 February 2002 (27.02.2002), the whole document	1-5
A	CN 1510205 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 07 July 2004 (07.07.2004), the whole document	1-5
A	US 6715216 B1 (CISSELL MFG COMPANY), 06 April 2004 (06.04.2004), the whole document	1-5

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 15 March 2017 (15.03.2017)	Date of mailing of the international search report 22 March 2017 (22.03.2017)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer GUO, Xu Telephone No.: (86-10) 62084600

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/110375

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP H09290095 A	11 November 1997	None	
CN 2479048 Y	27 February 2002	None	
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US 6715216 B1	06 April 2004	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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