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(54) Washing / drying machine

(57) A washing machine includes a drum, a condensing duct to condense air which flows in from the drum, a cooling water supplying unit to supply cooling water to the inside of the condensing duct so that the air flowing into the condensing duct from the drum is condensed and a control unit to control the cooling water supplying unit so that the cooling water is supplied intermittently. Thus, a washing machine is provided that is capable of reducing the amount of cooling water consumed, increasing an efficiency of drying laundry and shortening the time for drying the laundry.

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Description

[0001] The present invention relates to a washing and/or drying machine comprising a drum, a condensing duct in communication with the drum for the circulation of air therethrough and, a spray means configured to spray coolant within the duct to condense moisture in the air circulating therethrough and a method of controlling such a washing and/or drying machine.

[0002] Known drum-type washing machines may have various functions such as rinsing, dehydrating/spinning and drying in addition to a standard washing function.

[0003] When a drying function of a drum-type washing machine is performed, heated air is supplied to the inside of a drum to heat the laundry therein and the resulting air at high temperature and high humidity within the drum undergoes a condensing process to enhance the drying efficiency of the washing machine and its drying process.

[0004] As illustrated in Figure 1, a conventional drum-type washing machine comprises a drum 1, a blowing fan 2 and a blowing fan duct 3 disposed on the outside of the drum 1, a condensing duct 4 connecting an outlet of the drum 1 to the blowing fan 3, a jetting nozzle 5 mounted internally in an upper part of the condensing duct 4 and a cooling water supply tube 6 connected to the jetting nozzle 5 for supplying cooling water thereto.

[0005] In operation of the above-described washing machine, air at high temperature and high humidity resulting from a drying process is drawn into the condensing duct 4 through an air outlet 1a in the lower side of the drum 1. The air then encounters cooling water jetted vertically downward within the condensing duct 4 by the jetting nozzle 5 as it flows upwards towards the blowing fan duct 3 thereby condensing the water contained in the air.

[0006] A conventional drum-type washing machine continuously supplies cooling water during the whole drying process so as to increase the condensing efficiency but this has the result of consuming a large amount of cooling water.

[0007] Therefore, there is a need for a drum type washing machine capable of reducing the amount of cooling water consumed whilst also maintaining an increased drying efficiency and short drying time.

[0008] Accordingly, the present invention is characterised by control means configured to control the spray means to spray the coolant intermittently within the duct.

[0009] The washing and/or drying machine preferably includes means to draw air from the drum into the duct and circulate it back into the drum and also preferably includes means to heat air drawn from the drum before it is circulated back into the drum

[0010] A preferred embodiment includes a temperature sensor to measure the temperature of the condensed water within the condensing duct, wherein the control unit is configured to permit intermittent supply of the coolant within the duct until the condensed water reaches a predetermined temperature.

[0011] Preferably, the control unit is configured to permit continuous supply of the coolant within the duct after the condensed water reaches a predetermined temperature and conveniently, the coolant is cooling water.

[0012] A method of the present invention is characterised by the step of spraying coolant intermittently within the duct.

[0013] A preferred method further comprises the steps of measuring the temperature of the condensed water within the condensing duct and, intermittently supplying the coolant within the duct until the condensed water reaches a predetermined temperature.

[0014] Preferably, the method also comprises the steps of continuously supplying the coolant within the duct after the condensed water reaches a predetermined temperature.

[0015] The foregoing and/or other aspects of the present invention can be achieved by providing a washing machine comprising a drum, a condensing duct, which communicates with the drum to condense air which flows in from the drum, a cooling water supplying unit to supply cooling water to the inside of the condensing duct so that the air flowing into the condensing duct from the drum is condensed, and a control unit to control the cooling water supplying unit so that the cooling water is supplied intermittently.

[0016] According to an aspect of the present invention, the washing machine further comprises a temperature sensor to measure a temperature of condensed water condensed inside the condensing duct by the cooling water of the cooling water supplying unit wherein the control unit controls the cooling water supplying unit so that the cooling water is intermittently supplied until a temperature of the condensed water measured by the temperature sensor reaches an established temperature.

[0017] According to an aspect of the present invention, the control unit controls the cooling water supplying unit so that the cooling water is continuously supplied, after the temperature of the condensed water measured by the temperature sensor has reached the established temperature.

[0018] According to an aspect of the present invention, the temperature sensor measures a temperature of the condensed water discharged from the condensing duct.

[0019] Preferred embodiments of the present invention will now be described, by way of example only, with reference to Figures 2 - 7 of the accompanying drawings, in which:

Figure 1 is a perspective view illustrating a structure of a condensing duct of a conventional drum type machine;

Figure 2 is a perspective view illustrating a drum type washing machine consistent with the present invention;

Figure 3 is a sectional view schematically illustrating the drum type washing machine consistent with the present invention;

Figure 4 is a schematic control block diagram of the

drum type washing machine consistent with the present invention;

Figure 5 is a control flow diagram of the drum type washing machine consistent with the present invention;

Figure 6 is a graph illustrating temperature of condensed water and a control state of a cooling water supplying unit; and

Figure 7 is a perspective view of a condensing duct according to another embodiment of the present invention.

[0020] Referring to Figures 2 and 3, a drum-type washing machine according to the present invention comprises a square-framed main casing 10, a cylinder type drum 20 installed inside the main casing 10 with a cylinder type washing tank 22 rotatably installed inside the cylinder type drum 20 and having dehydrating/draining holes through a wall face thereof. A driving motor 23 is provided below the drum 20 and is operable to rotate the washing tank 22 in either direction to perform washing, rinsing and dehydrating/spin-drying operations. A door 24 is installed in front of the main casing 10 opening and closing the main casing 10.

[0021] A water supplying unit is provided above the drum 20 which supplies the water for washing into the drum 20 and dissolves detergent in the supplied water. The water supplying unit comprises a water supplying valve 24, a water supplying tube 26 and a detergent dissolving unit 27.

[0022] A drying unit is also provided above the drum 20 to dry the laundry after a dehydrating/spin drying operation has been completed. The drying unit comprises a blowing fan 70 and a blowing fan duct 72 mounted on the top of the drum 20, and a discharging duct 80 mounted between the blowing fan duct 72 and an air inlet 21a of the drum 20 communicating them with each other. A heater 60 is mounted inside the discharging duct 80 and a condensing duct 30 is mounted between an air outlet 21b of the drum 20 and the blowing fan duct 72 communicating them with each other. A cooling water supplying unit 43 is provided to supply cooling water into the condensing duct 30 to condense air which flows into the condensing duct 30 from the inside of the drum 20.

[0023] The cooling water supplying unit 43 comprises a cooling water supplying tube 42 branched from the water supplying valve 25 and a cooling water jetting member 40 for jetting the cooling water from the cooling water supplying tube 42 to the inside of the condensing duct 30.

[0024] In operation, air blown through the blowing fan 70 is heated by the heater 60 as it passes through the discharging duct 80 and is then supplied to the inside of the drum 20 through the air inlet 21 a to heat and dry the laundry. The air at high temperature and high humidity generated in the course of drying the laundry flows out of the air outlet 21b of the drum 20 and into the inside of the condensing duct 30 and water contained in the high temperature and humidity air is condensed by the cooling water jetted vertically downward through the cooling water jetting member 40.

[0025] An elevation limiting projection 50 and a condensed water collecting projection 51 are provided inside the condensing duct 30 whose shapes and installation positions may be modified in various ways, as necessary.

[0026] A draining unit, including a draining tube 28 and a draining pump 29 is provided below the drum 20 so as to drain the water from the drum 20 after a washing cycle has finished.

[0027] As illustrated in Figure 4, the drum type washing machine according to the present invention comprises a temperature sensor 91 for measuring the temperature of the water from the air expelled from the drum 20 and a control unit 90 for controlling the supply of the cooling water dependent upon the temperature of the condensed water measured by the temperature sensor 91.

[0028] It is preferable, but not necessary, that the temperature sensor 91 is provided in a lower portion of the condensing duct 30 so as to measure the temperature of the condensed water as it is discharged to a discharging unit (not shown) from the bottom of the condensing duct 30.

[0029] A reference or "established" temperature is stored in the control unit 90 against which a temperature measured by the temperature sensor 91 is to be compared.

The reference temperature is represented by the highest temperature of the condensed water depicted in Figure 6.

[0030] The control unit 90 controls the cooling water supplying unit 43 so that the cooling water is supplied intermittently until the temperature measured by the temperature sensor 91 reaches the reference temperature and also controls the cooling water supplying unit 43 so that supply of the cooling water is continued after the temperature measured by the temperature sensor 91 has reached the reference temperature.

[0031] A drying operation of the drum type washing machine as described above, will now be described.

[0032] Referring to Figure 3, it can be seen that air blown from the blowing fan 70 is heated by the heater 60 as it passes through the discharging duct 80 and is then supplied into the inside of the drum 20 through the air inlet 21a. Accordingly, the laundry within the drum 20 is heated and dried.

[0033] The high temperature and high humidity air generated in the course of drying the laundry flows into the condensing duct 30 through the air outlet 21b of the drum 20 and is drawn through the condensing duct 30 into the blowing fan duct 72.

[0034] When the air passes through the condensing duct 30, the water contained in the air is condensed by the cooling water supplied through the cooling water supplying unit 43. Referring to Figure 5, the cooling water is intermittently supplied through the cooling water supplying unit 43 as controlled by the control unit 90 at operation S1.

[0035] As illustrated in Figure 6, the control unit 90 con-

trols the cooling water supplying unit 43 so that intermittent supply of the cooling water can continue until the temperature of the condensed water measured by the temperature sensor 91 reaches the reference temperature (see region A).

[0036] It is to be noted that condensation forms inside the condensing duct 30 even during intermittent supply of the cooling water shown in region A of Figure 6.

[0037] The condensed water rises up within the condensing duct 30 by the air current therein but its elevation is limited by colliding against the elevation limiting projection 50 and forming water drops thereon. Having formed on the elevation limiting projection 50, the water drops are dropped and collected in the condensed water collecting projection 51 and are then scattered and elevated again by the upward air current, and then again collided against the elevation limiting projection 50. This cycle of processes is repeated. Since contact of the air current elevated with water is extended through these processes, condensation occurs within the condensing duct 30 even during the stages of intermittent supply of the cooling water when the cooling water is not being discharged through the jetting member 40.

[0038] Next, the temperature of the condensed water measured by the temperature sensor 91 is compared with the reference temperature at operation S3. When the cooling water temperature measured by the temperature sensor 91 reaches the reference temperature as shown in Figure 6, the control unit 90 controls the cooling water supplying unit 43 at operation S5 so that the cooling water is supplied continuously instead of intermittently. This causes the temperature of the condensed water to lower as shown in region B of Figure 6.

[0039] Thereafter, the control unit 90 ascertains whether the drying operation is completed and if it is ascertained that the drying operation has been completed, the control unit 90 stops supply of the cooling water.

[0040] In the washing machine of the present invention, if the cooling water is supplied to the condensing duct 30 intermittently, the temperature of the condensed water increases as the drying time is increased. Accordingly, the temperature of the air returned to the inside of the drum 20 through the condensing duct 30 is also increased, thereby increasing the internal temperature of the drum 20. As the internal temperature of the drum 20 is increased, the efficiency of vaporising the water in the laundry can be improved and the drying time can be shortened. In addition, the amount of the cooling water consumed can be reduced.

[0041] In the above-described embodiment, the present invention has been applied to the condensing duct 30 as illustrated in Figure 3. However, the present invention is not limited to this embodiment, but can be applied to various types of condensing ducts. For example, the present invention may also be applied to a condensing duct 130 as illustrated in Figure 7.

[0042] The condensing duct 130 illustrated in Figure 7 comprises an air inlet 132 through which air flows from the drum, a condensing unit 134 through which the air flowing through the air inlet 132 passes, and an air outlet 136 through which the air having passed through the condensing unit 134 is discharged.

[0043] The present invention has been described with reference to a drum-type washing machine but can also be applied to a drying machine.

[0044] As described above, in a washing machine according to the present invention, the amount of cooling water consumed can be reduced, the laundry drying efficiency can be improved and the laundry drying time can be shortened.

[0045] Although a few embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the appended claims and their equivalents.

Claims

1. A washing and/or drying machine comprising a drum, a condensing duct in communication with the drum for the circulation of air therethrough and, a spray means configured to spray coolant within the duct to condense moisture in the air circulating therethrough, **characterised by** control means configured to control the spray means to spray the coolant intermittently within the duct.

2. A washing and/or drying machine according to claim 1 including means to draw air from the drum into the duct and circulate it back into the drum.

3. A washing and/or drying machine according to claim 2 including means to heat air drawn from the drum before it is circulated back into the drum

4. A washing and/or drying machine according to any preceding claim including a temperature sensor to measure the temperature of the condensed water within the condensing duct, wherein the control unit is configured to permit intermittent supply of the coolant within the duct until the condensed water reaches a predetermined temperature.

5. A washing and/or drying machine according to claim 4 wherein the control unit is configured to permit continuous supply of the coolant within the duct after the condensed water reaches a predetermined temperature.

6. A washing and/or drying machine according to any preceding claim wherein the coolant is cooling water.

7. A method of controlling a washing and/or drying machine comprising a drum, a condensing duct in com-

munication with the drum for the circulation of air therethrough and, a spray means configured to spray coolant within the duct to condense moisture in the air circulating therethrough, **characterised by** the step of spraying coolant intermittently within the duct.

8. A method of controlling a washing and/or drying machine according to claim 7, further comprising the steps of measuring the temperature of the condensed water within the condensing duct and, intermittently supplying the coolant within the duct until the condensed water reaches a predetermined temperature.

9. A method of controlling a washing and/or drying machine according to claim 8, further comprising the steps of continuously supplying the coolant within the duct after the condensed water reaches a predetermined temperature.

10. A washing machine comprising a drum, a condensing duct, which communicates with the drum to condense air which flows in from the drum, a cooling water supplying unit to supply cooling water to the inside of the condensing duct so that the air flowing into the condensing duct from the drum is condensed, and a control unit to control the cooling water supplying unit so that the cooling water is supplied intermittently.

11. The washing machine as claimed in claim 10 further comprising a temperature sensor to measure a temperature of condensed water condensed inside the condensing duct by the cooling water of the cooling water supplying unit wherein the control unit controls the cooling water supplying unit so that the cooling water is intermittently supplied until a temperature of the condensed water measured by the temperature sensor reaches an established temperature.

12. The washing machine as claimed in claim 11 wherein the control unit controls the cooling water supplying unit so that the cooling water is continuously supplied after the temperature of the condensed water measured by the temperature sensor has reached the established temperature.

13. The washing machine as claimed in claim 12 wherein the temperature sensor measures a temperature of the condensed water discharged from the condensing duct.

14. The washing machine as claimed in claim 11 wherein the temperature sensor measures a temperature of the condensed water discharged from the condensing duct

FIG. 1

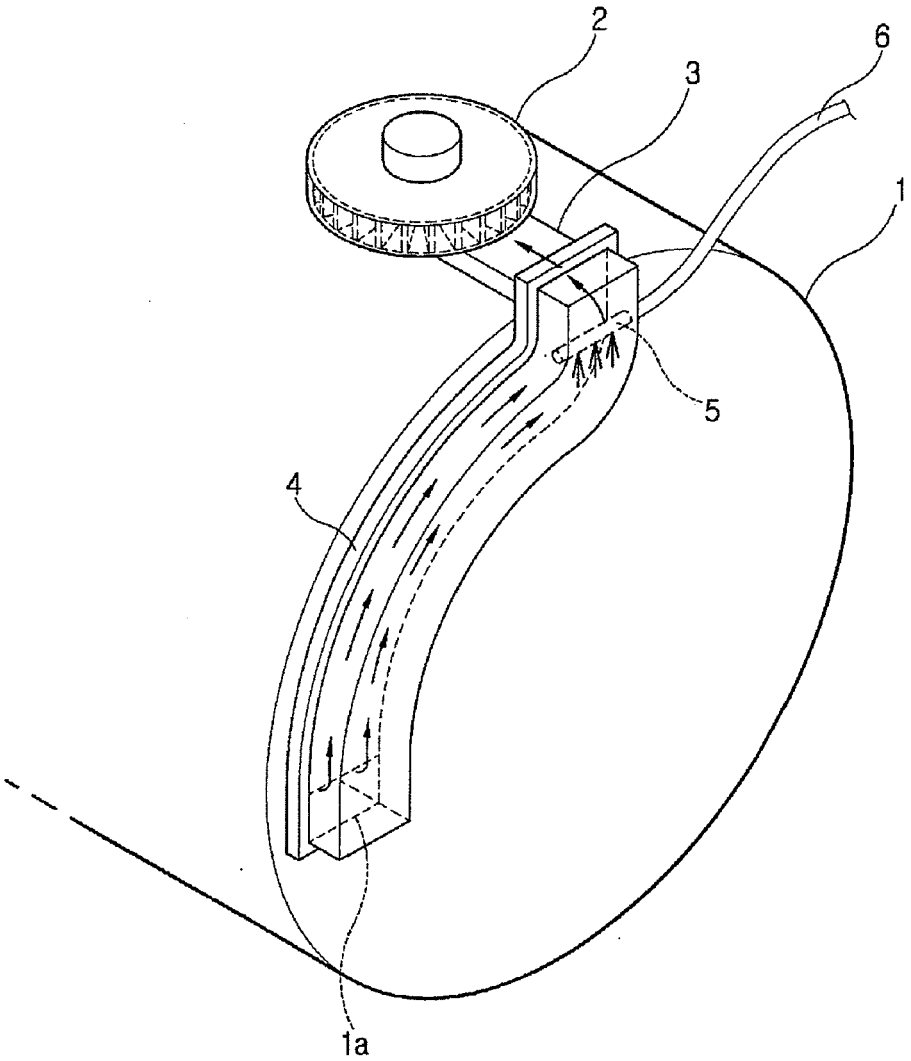


FIG. 2

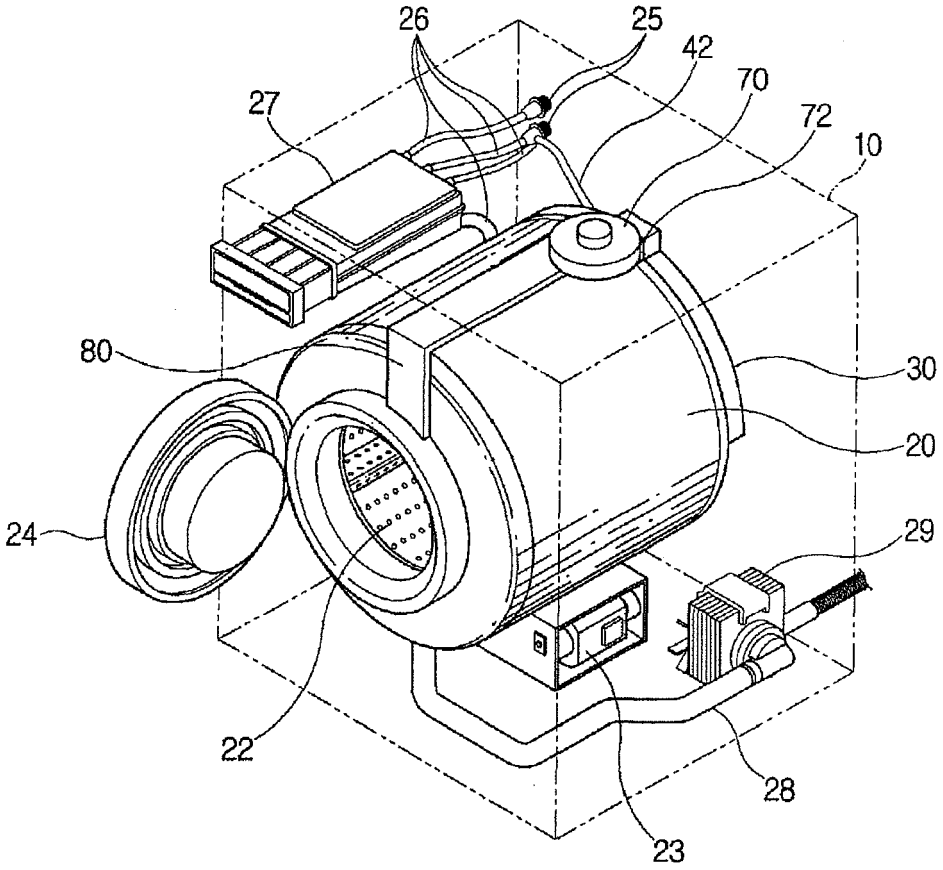


FIG. 3

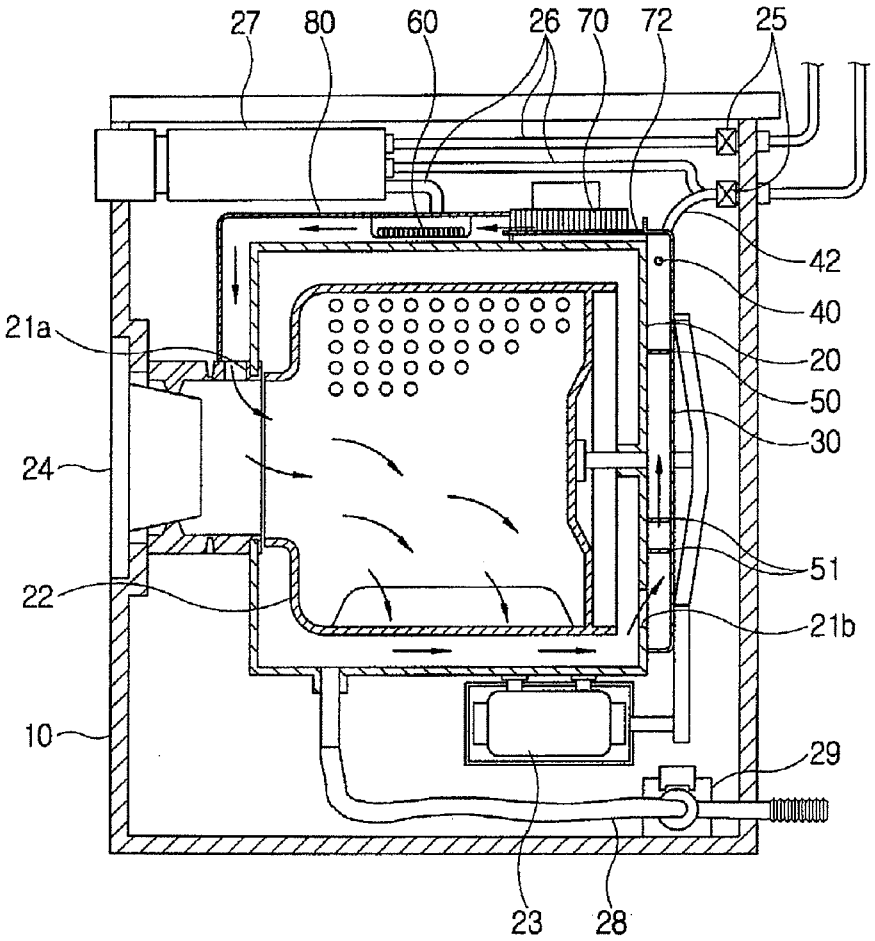


FIG. 4

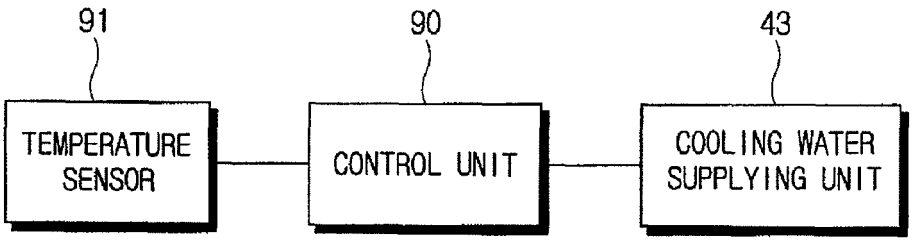

91
90
43
TEMPERATURE SENSOR
CONTROL UNIT
COOLING WATER SUPPLYING UNIT

FIG. 5

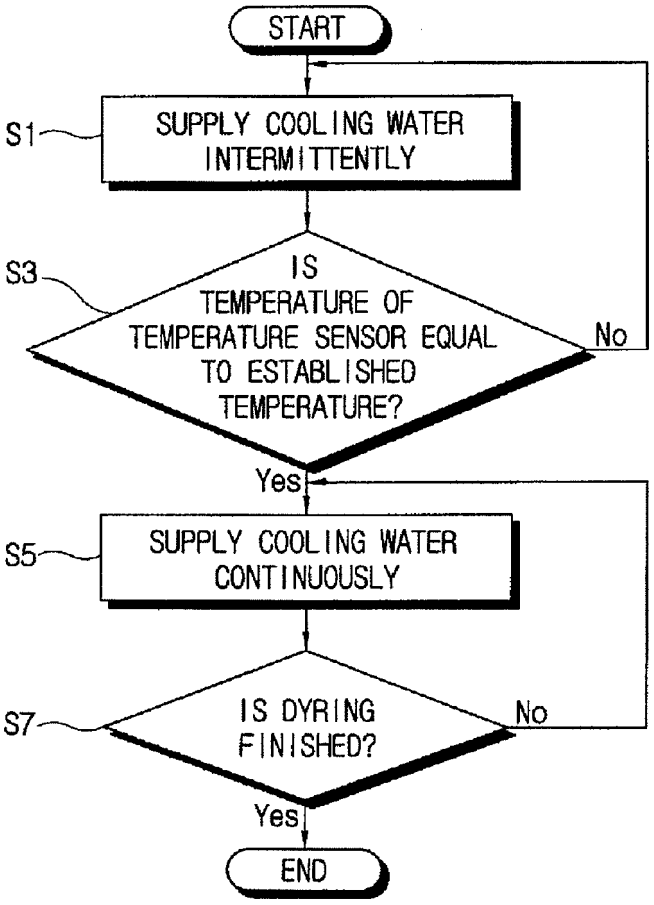

START
S1
SUPPLY COOLING WATER INTERMITTENTLY
S3
IS TEMPERATURE OF TEMPERATURE SENSOR EQUAL TO ESTABLISHED TEMPERATURE?
No
Yes
S5
SUPPLY COOLING WATER CONTINUOUSLY
S7
IS DYRING FINISHED?
No
Yes
END

FIG. 6

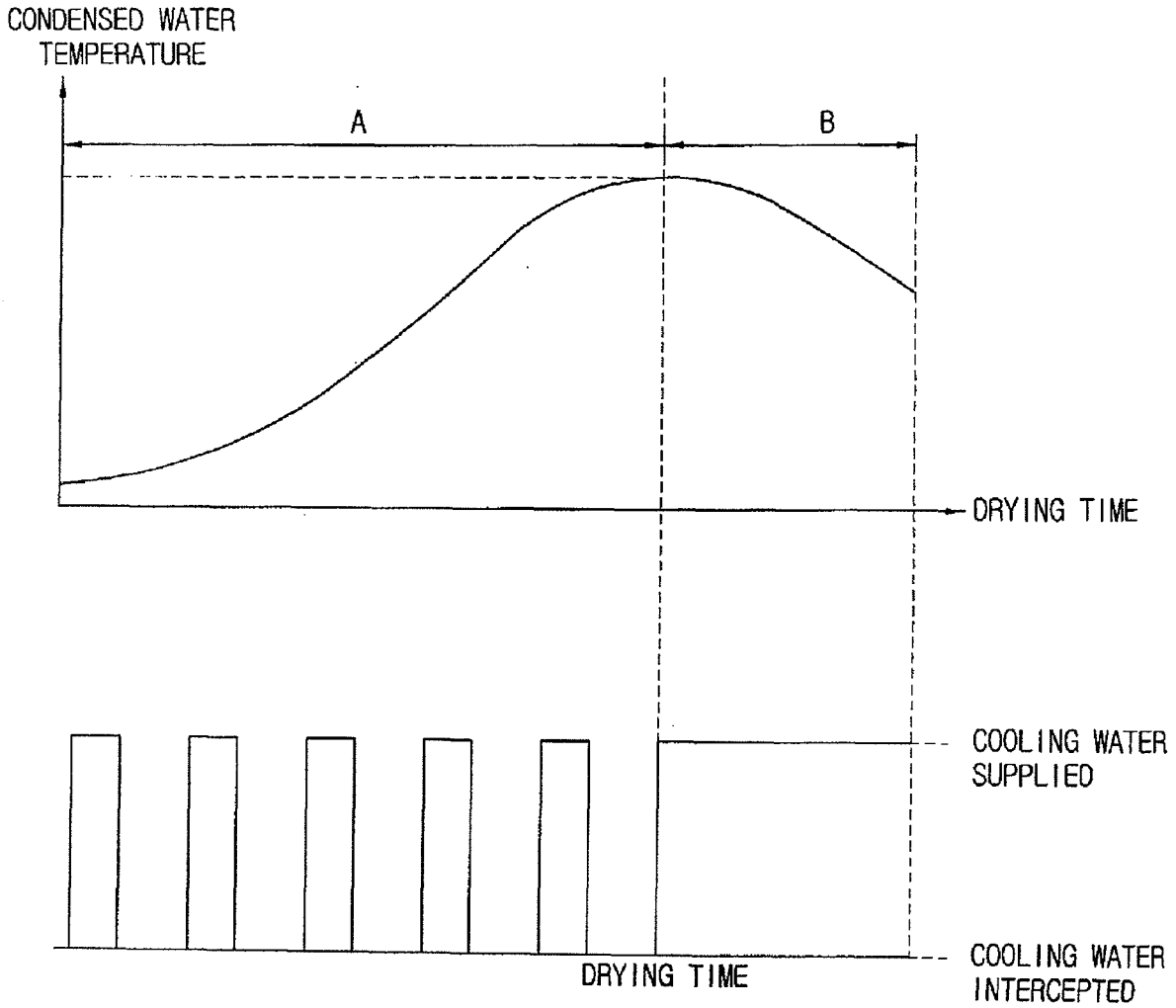
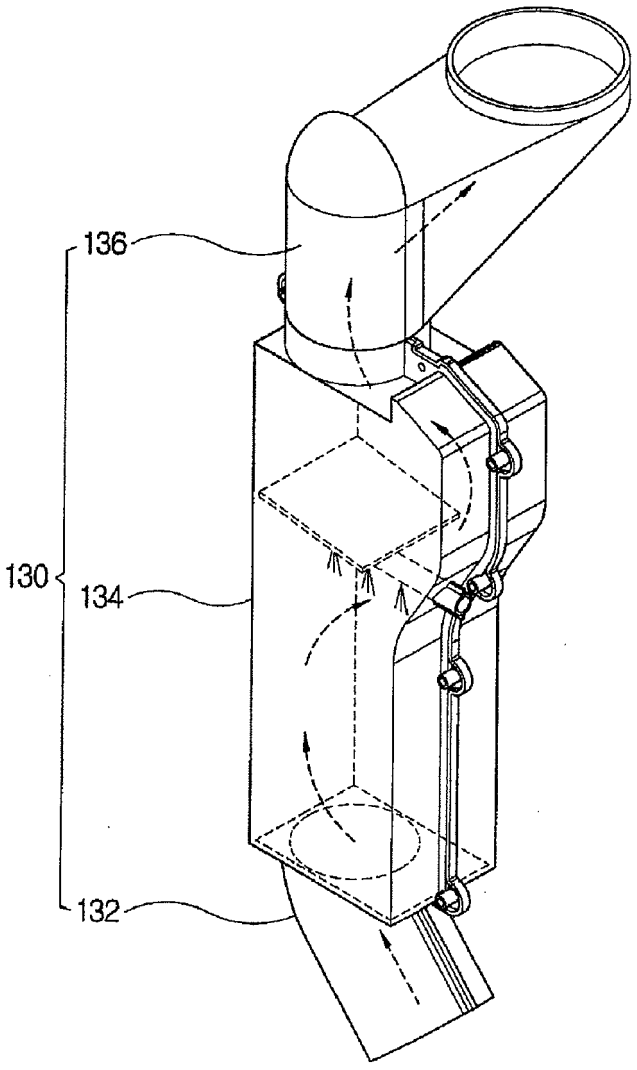

CONDENSED WATER TEMPERATURE
A
B
DRYING TIME
COOLING WATER SUPPLIED
COOLING WATER INTERCEPTED
DRYING TIME

FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 9028

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	US 2002/178765 A1 (MATSUDA EIJI ET AL) 5 December 2002 (2002-12-05) * paragraphs [0014] - [0018] * * paragraphs [0055], [0056] * * paragraphs [0083], [0084] * * figure 1 *	1-3,6,7, 10	TECHNICAL FIELDS SEARCHED (IPC) D06F

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 March 2006	Weinberg, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

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A	-----	1-3,5-7, 9,10,12, 13	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons
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& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 10 9028

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