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(54) Title: LAUNDRY PROCESSING APPLIANCE HAVING DRYING FUNCTION AND CONTROL METHOD THEREOF

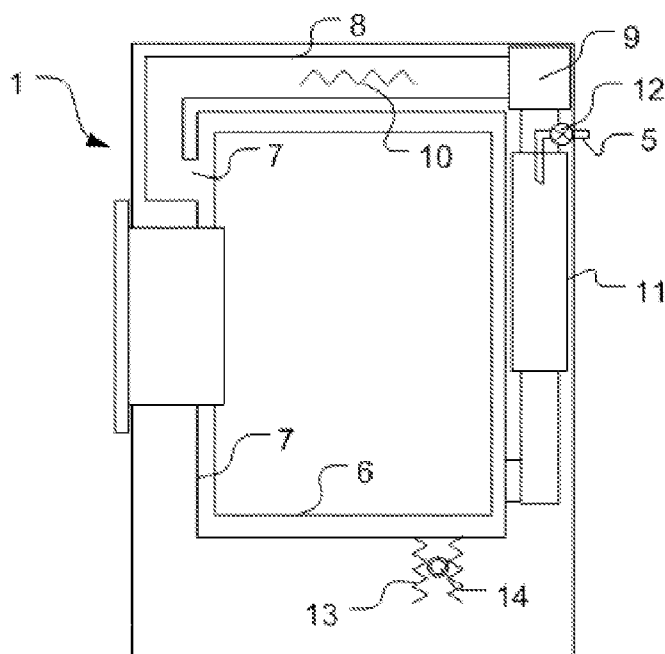


FIG. 2

(57) Abstract: A laundry processing appliance 1 having a drying function and a control method thereof are provided. The laundry processing appliance 1 comprises a drying system 2 performing a drying operation on laundry, wherein the drying system 2 comprises an air circulation system 3, 9 for promoting heat exchange between circulating air and the laundry, a condensing system 5, 11 for condensing humidity from the air after the heat exchange, and a cooling water supply system 5, 12 to supply cooling water for the condensing system 5, 11. Further, the appliance comprises 1 control means 15 for controlling the cooling water supply system 5, 12 according to a temperature of a condensed water formed by the condensing system 5, 11 and a temperature detecting device 14 for detecting the temperature of the condensed water, thereby ensuring a desirable drying effect and avoiding unnecessary waste of water resources.



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LAUNDRY PROCESSING APPLIANCE HAVING DRYING FUNCTION AND CONTROL METHOD THEREOF

The present invention relates to a laundry processing appliance and a control method thereof, in particular, to a laundry processing appliance having a drying function and a control method thereof.

Most of known laundry processing appliances embodied as washer-dryers or dryers currently available on the market use a water-cooling drying technology. In such appliance a heater is used to heat process air flowing through an appropriate guide. The high-temperature and dry air thus formed enters a rotating drum and exchanges heat with wet laundry put into the drum by a user, so that the moisture carried in the laundry evaporates, and the humidity of the process air after heat exchange with the wet laundry is increased while the temperature thereof is reduced, thus forming moist warm air. The moist warm air enters a condenser and exchanges heat with cooling water supplied from the outside, the moist warm air is cooled to a dew point and the moisture carried in the air is condensed and then drained. The process air after cooling and condensation forms low-temperature and dry air, and then the low-temperature and dry air is heated by the heater again to repeat the above procedure, and finally, the moisture in the laundry is all taken away, achieving the objective of drying the laundry to a desired dryness thereby. The circulation of the process air is driven through the operation of a blower.

In the above drying procedure, the water inflow of the cooling water entering the washer-dryer is a constant value at present. However, it is found through analysis that different stages of a drying process, different laundry conditions and different external environments require different quantities of the cooling water to perform the drying process as desired. First, different stages of the drying process require different quantities of the cooling water. At the beginning stage of drying, as the heater just starts to operate, the process air temperature is low and the evaporation efficiency is low, so that the moisture content of the process air after exchange with the laundry is low, and accordingly a small quantity of the cooling water is required only. When the process air temperature has been heated to a certain temperature, the evaporation efficiency is increased, and the moisture content of the process air is increased, so that the required quantity of the

cooling water is increased. Finally, as the laundry is gradually dried, the evaporation efficiency is reduced and the moisture content of the process air turns low again, so that the required quantity of the cooling water is reduced. Next, the amount and type of laundry affects the required quantity of the cooling water. As the weight, texture and initial
5 moisture content of the laundry to be dried are different, the evaporation efficiency in the drying procedure is also different, so that the requirement on the condensing quantity is different, and accordingly the quantity of the cooling water is also different. In addition, the initial temperature of the cooling water also affects the required quantity of the cooling water. The cooling water with different temperatures has different capabilities of
10 condensing the vapour in the moist hot air, so the initial temperature of the cooling water also affects the required quantity of the cooling water even if the requirement on the condensing quantity is the same.

It can be seen from the above that, the supply of the cooling water at a constant flow rate
15 fails to inlet water according to actual requirements. Either the supply of the cooling water is excessive, thus causing the waste of water, or the supply of the cooling water is insufficient, so that a desirable drying effect cannot be achieved, or the drying effect can only be achieved by prolonging the drying duration which increases the power consumption.

20 Accordingly, an objective of the present invention is to provide a control method of a laundry processing appliance having a drying function, so as to control the water inflow of the cooling water according to actual requirements, thereby ensuring a desirable drying effect and avoiding the waste of water resources.

25 The above objective is achieved by a control method of a laundry processing appliance, and a laundry processing appliance, in accordance with the respective independent claim. Preferred embodiments of the method and the appliance are subjects of dependent claims and the subsequent description, with each preferred embodiment of the method
30 corresponding to a preferred embodiment of the appliance and vice versa, even if not specified so herein in detail.

According to the invention, the problem is solved by a control method of a laundry processing appliance having a drying function, comprising: performing a drying operation

on laundry by circulating process air; and supplying a cooling water, so as to condense moisture carried in the process air to condensed water, wherein the method further comprises controlling a water inflow of the cooling water according a temperature of the condensed water.

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As a preferred embodiment of the present invention, when the temperature of the condensed water is lower than a preset temperature, the water inflow of the cooling water is decreased; and when the temperature of the condensed water is higher than the preset temperature, the water inflow of the cooling water is increased.

10

As another preferred embodiment of the present invention, the water inflow of the cooling water is controlled by adjusting an open and close rhythm of an inlet valve of the cooling water.

15 As another preferred embodiment of the present invention, the open and close rhythm of the inlet valve of the cooling water is controlled through an open or close duration of the inlet valve.

As another preferred embodiment of the present invention, the control method further includes: determining the corresponding open or close duration of the inlet valve of the
20 cooling water according to the temperature of the condensed water.

As another preferred embodiment of the present invention, when a determined open duration of the inlet valve of the cooling water is smaller than a first set open duration, the
25 open duration of the inlet valve of the cooling water is modified to the first set open duration, and when the determined open duration of the inlet valve of the cooling water is larger than a second set open duration, the open duration of the inlet valve of the cooling water is the actually determined open duration.

30 As another preferred embodiment of the present invention, the first set open duration is 20 seconds, and the second set open duration is 60 seconds.

Another objective of the present invention is to provide a laundry processing appliance having a drying function, so that when the laundry processing appliance performs a drying

operation, the cooling water can be supplied according to actual requirements, and thus the consumption of the cooling water in the drying procedure is reduced while ensuring a desirable drying effect, thereby saving water resources.

- 5 The above objective is achieved by a laundry processing appliance having a drying function, comprising a drying system performing a drying operation on laundry, wherein the drying system comprises an air circulation system for promoting heat exchange between circulating air and the laundry, a condensing system for condensing humidity from the air after the heat exchange, and a cooling water supply system to supply cooling
- 10 water for the condensing system, wherein control means for controlling the cooling water supply according to a temperature of a condensed water formed by the condensing system and a temperature detecting device for detecting the temperature of the condensed water are provided.
- 15 As another preferred embodiment of the present invention, the temperature detecting device is disposed in a drainage pipe of the laundry processing appliance.

As another preferred embodiment of the present invention, the laundry processing appliance further includes a preset relation table of the temperature of the condensed

20 water and a parameter of controlling the water inflow of the cooling water.

As another preferred embodiment of the present invention, the parameter of controlling the water inflow of the cooling water is a time parameter controlling the inlet valve of the cooling water to open or close.

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The beneficial effects of the present invention include those specified as follows. The temperature of the cooling water is detected by the temperature detecting device, and then the water inflow of the cooling water is accurately controlled according to the detected temperature, which implements a technology for controlling the water inflow of

30 the cooling water, achieves the water supply according to actual requirements, and technically optimizes the water-cooling drying technology, thereby saving water resources and reducing the power consumption of the appliance while ensuring a desirable drying effect of the appliance.

It is noted that the embodiments described are merely preferred embodiments of the present invention, and the present invention may also have other embodiments, for example, the present invention is also applicable to a laundry processing appliance having a drying function that uses a mixture of air and water or uses air for condensation. It should be understood by persons of ordinary skill in the art that any equivalent modification made based on the teachings of the present invention shall fall within the scope of the present invention as defined by the appended claims.

Preferred embodiments of the invention are now described in detail with reference to the appended drawing, wherein:

FIG. 1 is a schematic system view of a laundry processing appliance having a drying function according to an embodiment of the present invention;

FIG. 2 is a schematic view of a laundry processing appliance having a drying function according to an embodiment of the present invention; and

FIG. 3 is a flow chart of a control method of the laundry processing appliance shown in FIG. 2.

Referring to FIG. 1, according to an embodiment of the present invention, a laundry processing appliance having a drying function 1 includes a drying system 2 performing a drying operation on laundry. The drying system 2 includes an air heating and circulation system 3 for heating air and promoting heat exchange between the air and the laundry, and a condensing system 4 for condensing the air after the heat exchange. The laundry processing appliance 1 further includes a cooling water supply system 5 controlled according to a temperature of a condensed water formed by the condensing system 4 to supply a cooling water for the condensing system 4. It is noted that the laundry processing appliance 1 having a drying function according to the present embodiment may be a washer-dryer, or a dryer only having the drying function.

Referring to FIGs. 1 and 2, the air heating and circulation system 3 includes a drum 6 capable of rotating at a high rate about a horizontal shaft or a rotating shaft inclined at an angle when driven by an electric motor, a tub 7 receiving the drum 6, a heating pipe component 8 disposed on the top of the tub 7, and a blower device 9 for promoting the air circulation. A heating device 10 for heating the process air is disposed in the heating pipe

component 8, and the condensing system 4 includes a condensing device 11 disposed behind the tub 7. One end of the heating pipe component 8 is connected to the tub 7, and the other end is connected to the condensing device 11 through the blower device 9. Thus, the heating pipe component 8, the tub 7, the drum 6, the condensing device 11 and the blower device 9 form a closed air circulation loop.

In order to supply the required cooling water to the condensing device 11, the cooling water supply system 5 is disposed between the condensing device 11 and the blower device 9, so that the cooling water is supplied to the condensing system 4, and the cooling water supply system 5 is controlled by opening and closing an inlet valve 12 in a given rhythm. When a drying program is started, the process air is first heated by the heating device 10 to form hot dry air with a high temperature, and then is supplied to the drum 6 to fully contact and exchange heat with the wet laundry put by a user into the drum 6 so as to form hot air with high moisture and low temperature. Through the circulation of the process air and the rotation of the drum 6, the process air is fully mingled with the laundry, and thus the moisture in the laundry is absorbed by the process air and then is drained into the condensing system 4 through an air vent on the tub 7 for condensation by the condensing device 11. In the condensing system 4, the hot air with high moisture and low temperature exchanges heat with the cooling water supplied by the cooling water supply system 5 to form hot air with low moisture and low temperature, which is heated again by the heating device 10 under the action of the blower device 9 to enter a next circulation, and the circulation is repeated to dry the moisture carried in the laundry, and finally the drying procedure is achieved.

The moisture carried in the hot air with low moisture and low temperature is cooled to a dew point to form condensed water under the action of the cooling water, and then the condensed water is drained out from a corrugated drainage pipe 13 out of the appliance 1. In order to accurately control the water inflow of the cooling water, a temperature detecting device 14 is disposed on an appropriate position of the corrugated drainage pipe 13. During the execution of the drying program, the temperature detecting device 14 detects a temperature of the condensed water flowing through the corrugated drainage pipe 13, and the temperature of the condensed water to reflect the condensing effect. The higher the temperature of the condensed water is, the higher the condensing efficiency is, which indicates that the cooling water is fully utilized or is slightly insufficient, and

accordingly the supply of the cooling water may be properly increased; otherwise, the lower the temperature of the condensed water is, the lower the condensing efficiency is, which indicates that the cooling water fails to be fully utilized, and accordingly the supply of the cooling water may be properly reduced.

5

The supply of the cooling water is controlled through the inlet valve 12, when it is required to increase the supply of the cooling water, the inlet valve 12 is opened to inlet the water, and when it is required to reduce the supply of the cooling water, the inlet valve 12 is closed or partly closed. As a preferred embodiment, a corresponding relation exists
10 between the temperature of the condensed water and the water inflow of the cooling water, and therefore, a corresponding relation table between the temperature of the condensed water and a control rhythm of the inlet valve of the cooling water can be obtained according to experimental results (as shown in FIG. 1) and stored in the control means 15 provided in the appliance 1 for interfacing with the user and process control. In
15 this way, during the execution of the drying program, the control means 15 directly obtains the control rhythm of the inlet valve 12 from the corresponding relation table according to the temperature of the condensed water detected by the temperature detecting device 14, that is, required open/close duration of the inlet valve 12. In addition, in order to prevent the inlet valve 12 drive from becoming too hot due to too short close duration of the inlet
20 valve 12, when the determined open duration of the inlet valve 12 is smaller than a first set open duration, for example, 20 seconds, the open duration of the inlet valve 12 is modified to the first set open duration, that is, the open duration is 20 seconds, and when the determined open duration of the inlet valve 12 is larger than a second set open duration, for example, 60 seconds, the open duration of the inlet valve 12 is the actually
25 determined open duration.

FIG. 3 illustrates a control method of the laundry processing appliance 1 having a drying function according to the embodiment shown the Figures described above. As shown in FIG. 3, when a user selects a certain drying program, it is first judged whether the
30 selected program is a program of timed 15-minute drying, and if yes, the cooling stage is directly entered; otherwise, a timed drying program is entered. The temperature detecting device 14 continuously detects the temperature of the condensed water in the drainage pipe 13, and then a corresponding open/close duration of the inlet valve 12 is determined in the relation table between the temperature of the condensed water and the control

rhythm of the inlet valve 12 according to the detected temperature value, so as to control the rhythm of the inlet valve 12. The above procedure is repeated until the cooling procedure is entered. Through the real-time detection of the temperature of the condensed water, the water inflow of the cooling water is accurately controlled, thereby
5 avoiding the drawback of low drying efficiency and increased energy consumption due to insufficient supply of the cooling water, and avoiding unnecessary waste of water resources due to excessive supply of the cooling water.

LIST OF REFERENCE NUMERALS

- 1 Laundry processing appliance
- 2 Drying system
- 5 3 Air heating and circulation system
- 4 Condensing system
- 5 Cooling water supply system
- 6 Drum
- 7 Tub
- 10 8 Heating pipe component
- 9 Blower device
- 10 Heating device
- 11 Condensing device
- 12 Inlet valve
- 15 13 Drainage pipe
- 14 Temperature detecting device
- 15 Control means

CLAIMS

- 5 1. A control method of a laundry processing appliance (1) having a drying function, comprising: performing a drying operation on laundry by circulating process air; and supplying cooling water, so as to condense moisture carried in the process air to condensed water; **characterized in that** the method further comprises controlling a water inflow of the cooling water according a temperature of the
10 condensed water.
2. The control method according to claim 1, wherein, when the temperature of the condensed water is lower than a preset temperature, the water inflow of the cooling water is decreased; and when the temperature of the condensed water is
15 higher than the preset temperature, the water inflow of the cooling water is increased.
3. The control method according to one of claims 1 and 2, wherein the water inflow of the cooling water is controlled by adjusting an open and close rhythm of an inlet
20 valve (12) of the cooling water.
4. The control method according to claim 3, wherein the open and close rhythm of the inlet valve (12) of the cooling water is controlled through an open or close duration of the inlet valve.
25
5. The control method according to claim 4, further comprising determining the corresponding open or close duration of the inlet valve (12) of the cooling water according to the temperature of the condensed water.
- 30 6. The control method according to claim 5, wherein when a determined open duration of the inlet valve (12) of the cooling water is smaller than a first set open duration, the open duration of the inlet valve (12) of the cooling water is modified to the first set open duration, and when the determined open duration of the inlet

valve of the cooling water is larger than a second set open duration, the open duration of the inlet valve (12) of the cooling water is the actually determined open duration.

- 5 7. The control method according to claim 6, wherein the first set open duration is 20 seconds, and the second set open duration is 60 seconds.
- 10 8. A laundry processing appliance (1) having a drying function, comprising a drying system (2) performing a drying operation on laundry, wherein the drying system (2) comprises an air circulation system (3, 9) for promoting heat exchange between circulating air and the laundry, a condensing system (4, 11) for condensing humidity from the air after the heat exchange, and a cooling water supply system (5, 12) to supply cooling water for the condensing system, **characterized by** control means (15) for controlling the cooling water supply according to a temperature of a condensed water formed by the condensing system and a temperature detecting device (14) for detecting the temperature of the condensed water.
- 15 9. The laundry processing appliance (1) according to claim 8, wherein the temperature detecting device (14) is disposed in a drainage pipe (13) of the laundry processing appliance (1).
- 20 10. The laundry processing appliance (1) according to one of claims 8 and 9, further comprising a preset relation table of the temperature of the condensed water and a parameter of controlling the water inflow of the cooling water.
- 25 11. The laundry processing appliance (1) according to claim 10, wherein the parameter of controlling the water inflow of the cooling water is a time parameter controlling the inlet valve (12) of the cooling water to open or close.

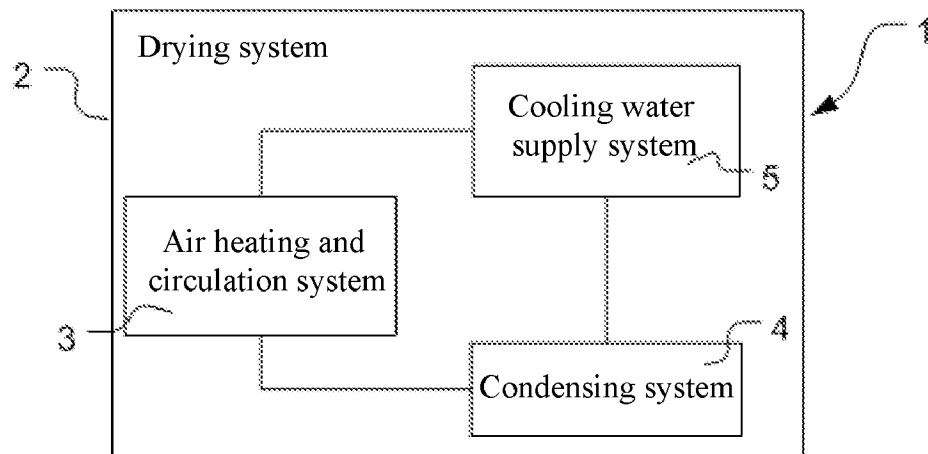


FIG. 1

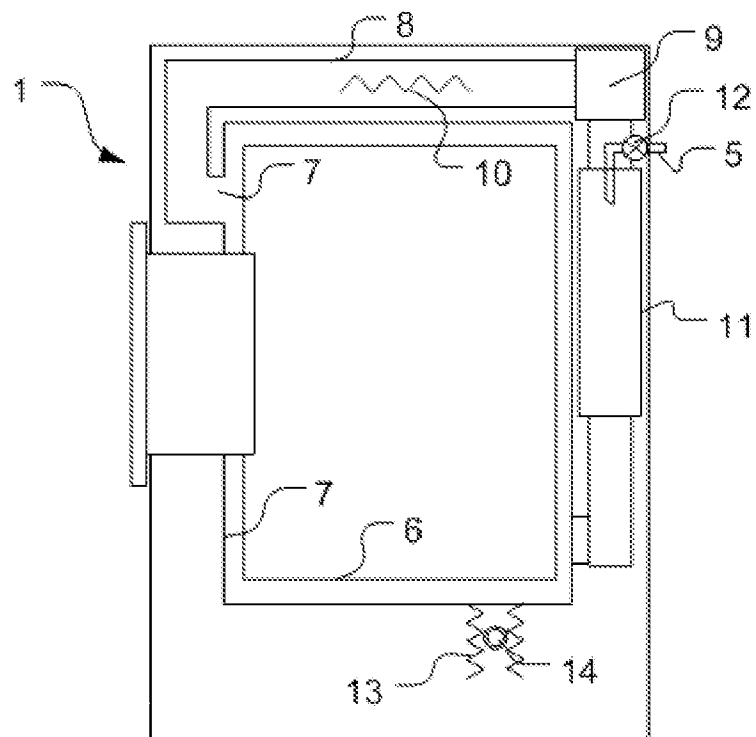


FIG. 2

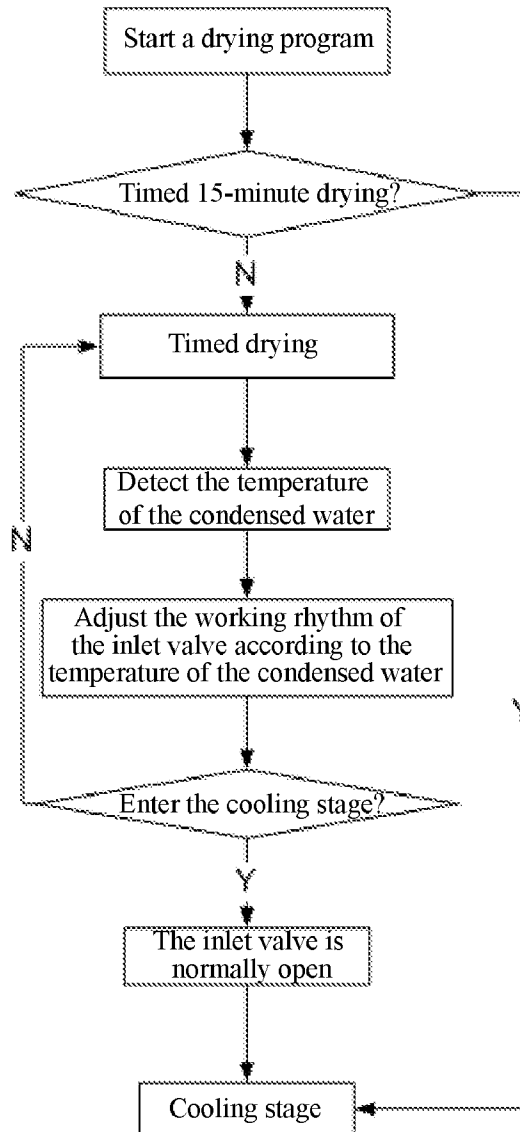


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/068641

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F58/24
ADD.

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	----- EP 1 698 722 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 6 September 2006 (2006-09-06) paragraph [0034] - paragraph [0050]; figures 1,3	1,8
A	----- EP 0 829 569 A2 (TOSHIBA KK [JP]) 18 March 1998 (1998-03-18) column 8, line 24 - line 35 column 9, line 10 - line 30; figures 3,5 ----- -/--	1,8



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/068641

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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