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(54) AIR CONDENSER AND CLOTHES-DRYING MACHINE

(57) Disclosed are an air condenser (1) and a clothes dryer. The air condenser includes condensing air ducts (j) and a cooling pipeline (i) arranged crosswise. The condensing air ducts (j) include a first group of condensing air ducts and a second group of condensing air ducts, wherein air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner. By arranging the first and the second groups of condensing air ducts which can partially perform heat exchange on the air condenser (1), heat exchange is performed between high-temperature and high-humidity air flowing out of a drum (3) of the clothes dryer and air condensed by the air condenser (1) to enter a heater (2), so that waste heat of high-temperature air in the condensing air ducts (j) can be effectively recycled, and loss of heat is reduced, thereby achieving a purpose of saving energy while increasing heat exchange efficiency.

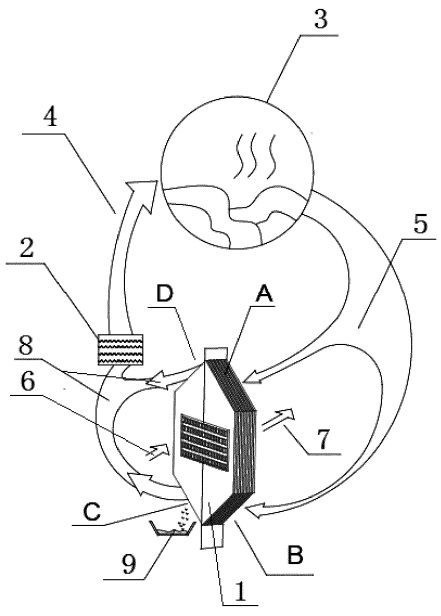

FIG. 7

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of clothes drying apparatuses, and particularly relates to an air condenser applied to a clothes dryer and a clothes dryer with the air condenser.

BACKGROUND

[0002] At present, a condenser adopted by a clothes dryer in a market is generally a cross-type air heat exchanger, and the cross-type air heat exchanger only has a single condensing air duct and a single cooling air duct arranged crosswise. For application in the clothes dryer, air inlet heat in the condensing air duct is not fully utilized, so heat efficiency is low, and energy loss is great.

[0003] Fig. 1 and Fig. 2 show schematic diagrams of a structure of the cross-type air heat exchanger and an internal air flowing direction of the cross-type air heat exchanger. An operating principle of a traditional condenser applied to the clothes dryer is as follows: in a using process of the clothes dryer, an air duct passing through a traditional condensation-type clothes dryer is divided into a condensing air duct j' and a cooling air duct i', the cooling air duct i' is a non-closed-loop duct; and air is sucked into the clothes dryer by a fan, subjected to heat exchange on an inner surface of an air condenser 1', heated after heat exchange and then discharged out of the air condenser 1' via an outlet of the cooling air duct. The condensing air duct j' is a closed air duct; the air is circularly operated in the condensing air duct j' formed among components such as a drum 3' of the clothes dryer, the air condenser 1', a heater 2' and the like; saturated hot air 5' in the drum 3' before passing through the air condenser is sucked into the air condenser 1' by the fan and is subjected to heat exchange on the inner surface of an air condenser 1'; moisture in the saturated hot air 5' before passing through the air condenser is condensed into condensate water 9' and discharged out of the air condenser 1'; unsaturated hot air 8' discharged out of the air condenser 1' is heated by the heater 2' to become hot dry air 4'; the hot dry air enters the drum 3' of the clothes dryer and is fully contacted with clothes; the moisture on surfaces of the clothes is evaporated into water vapor; and the water vapor is sucked into the air condenser 1' and condensed, thereby forming a closed-loop circulating process. A flowing direction of the air in the cooling air duct i' is as follows: room-temperature dry air 6' before passing through the air condenser enters the air condenser 1', performs heat exchange with the saturated hot air 5' before passing through the air condenser to become hot dry air 7', and is discharged out of the air condenser 1'. Since heat carried by the hot air discharged from the condenser in the cooling air duct i' of the clothes dryer adopting the traditional condenser above is lost, heat is greatly wasted.

[0004] Therefore, an air condenser applied to the clothes dryer and the clothes dryer with the air condenser are urgently needed in the market. The condenser can recycle the heat of the hot air with water vapor cooled by the condensing air duct for preheating low-temperature air discharged to a heating element and having no water vapor, thereby achieving an effect of saving energy.

SUMMARY

[0005] A purpose of the present invention is to propose an air condenser for solving problems in an existing art that heat of hot air is seriously wasted and heat exchange efficiency is low in a using process of a cross-type heat exchanger.

[0006] Another purpose of the present invention is to propose a clothes dryer. The air condenser above is arranged on the clothes dryer, so that the clothes dryer is small in energy loss and high in heat exchange efficiency in a using process.

[0007] In order to achieve the purposes, on one hand, a technical solution is adopted in the present invention as follows.

[0008] An air condenser includes condensing air ducts and a cooling pipeline arranged crosswise, wherein the condensing air ducts include a first group of condensing air ducts and a second group of condensing air ducts; air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner.

[0009] Further, the condensing air ducts include intermediate air ducts, wherein at least one part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the first group of condensing air ducts; at least another part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the second group of condensing air ducts; and the intermediate air ducts and the cooling pipeline are arranged crosswise to perform heat exchange.

[0010] Further, the first group of condensing air ducts include at least one first condensing sheet; and the first condensing sheet is formed with at least the air inlet ducts and the air outlet ducts of the first condensing air ducts; the second group of condensing air ducts include at least one second condensing sheet; and the second condensing sheet is formed with at least the air inlet ducts and the air outlet ducts of the second condensing air ducts; the first condensing sheet and the second condensing sheet are arranged at intervals, so that the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are at least partially over-

lapped; and the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are at least partially overlapped.

[0011] Further, the intermediate air ducts and the air inlet ducts and the air outlet ducts of the first group of condensing air ducts and the second group of condensing air ducts are formed integrally or separately.

[0012] Further, the cooling pipeline is used for introducing low-temperature gas or liquid.

[0013] Further, the air condenser further includes four interfaces, respectively connected with the air inlet ducts of the first group of condensing air ducts, the air outlet ducts of the first group of condensing air ducts, the air inlet ducts of the second group of condensing air ducts and the air outlet ducts of the second group of condensing air ducts.

[0014] On the other hand, a technical solution is adopted in the present invention as follows.

[0015] A clothes dryer includes a drum and a heater, wherein the above air condenser is arranged on the clothes dryer; and the drum is communicated with first air inlets and second air inlets of the air condenser.

[0016] The present invention has beneficial effects as follows: according to the air condenser in the present invention, the first group of condensing air ducts and the second group of condensing air ducts which can partially perform heat exchange are arranged, so that heat exchange is performed between high-temperature and high-humidity air flowing out of a drum of the clothes dryer and air condensed by the air condenser to enter the heater; the high-temperature and high-humidity air can be pre-cooled during preheating; waste heat of high-temperature air in the condensing air ducts can be effectively recycled; and loss of heat is reduced, thereby achieving a purpose of saving energy while increasing heat exchange efficiency.

[0017] The above air condenser is arranged on the clothes dryer in the present invention. Since the waste heat of the air in the condensing air ducts can be effectively recycled by the above air condenser, the heat exchange efficiency of the heater used for heating the air is increased by 14%-20%, energy consumption is effectively saved, and the heat exchange efficiency is increased. Therefore, the clothes dryer is low in energy consumption and more environmental-friendly in a using process, and market competitiveness of the clothes dryer is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

Fig. 1 is a schematic diagram illustrating a structure of an air condenser and directions of air ducts passing through the air condenser in an existing art;

Fig. 2 is a schematic diagram illustrating an air flowing direction inside a clothes dryer in an existing art;

Fig. 3 is a schematic structural diagram illustrating air ducts of an air condenser proposed in embodiment I of the present invention;

Fig. 4 is a schematic structural diagram illustrating a first condensing sheet proposed in embodiment I of the present invention;

Fig. 5 is a schematic structural diagram illustrating a second condensing sheet proposed in embodiment I of the present invention;

Fig. 6 is a schematic structural diagram illustrating a cooling package sheet proposed in embodiment I of the present invention;

Fig. 7 is a schematic diagram illustrating an internal air flowing direction of a condensation-type clothes dryer proposed in embodiment I of the present invention;

Fig. 8 is a schematic structural diagram illustrating a first condensing sheet proposed in embodiment II of the present invention;

Fig. 9 is a schematic structural diagram illustrating a second condensing sheet proposed in embodiment II of the present invention;

Fig. 10 is a schematic structural diagram illustrating a combination of a first condensing sheet and a second condensing sheet proposed in embodiment II of the present invention;

Fig. 11 is a schematic structural diagram illustrating an air direction in a direct discharging clothes dryer proposed in embodiment II of the present invention;

Fig. 12 is a schematic structural diagram illustrating an air condenser proposed in embodiment III of the present invention;

Fig. 13 is a schematic structural diagram illustrating an air direction in a heat-pump type clothes dryer proposed in embodiment III of the present invention.

List of reference numerals

[0019]

i': Cooling air duct; j': Condensing air duct; 1': Air condenser; 2': Heater; 3': Drum; 4': Hot dry air; 5': Saturated hot air before passing through the air condenser; 6': Room-temperature dry air before passing through the air condenser; 7': Hot dry air; 8': Unsaturated hot air after passing through the air condenser; 9': Condensate water;

1: Air condenser; 2: Heater; 3: Drum; 4: Hot dry air; 5: Saturated hot air; 6: Room-temperature dry air; 7: Hot dry air; 8: Unsaturated hot air; 9: Condensate water; 10: Heat exchange tube; 11: Cooling sheet; 111: Vent hole; 12: First condensing sheet; 121: First air guiding groove; 13: Second condensing sheet; 131: Second air guiding groove; 23: Overlap region; i: Cooling pipeline; j: Condensing air duct; A: First air inlet; B: Second air inlet; C: First air outlet; and D:

Second air outlet.

DETAILED DESCRIPTION

[0020] Technical solutions of the present invention are further described below in combination with drawings through specific embodiments.

[0021] The present invention proposes an air condenser, including condensing air ducts and a cooling pipeline arranged crosswise, wherein the condensing air ducts include a first group of condensing air ducts and a second group of condensing air ducts; air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner. The condensing air ducts include intermediate air ducts, wherein at least one part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the first group of condensing air ducts; at least another part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the second group of condensing air ducts; and the intermediate air ducts and the cooling pipeline are arranged crosswise, so that cold air or refrigerant liquid in the cooling pipeline can perform heat exchange with the intermediate air ducts of the condensing air ducts.

Embodiment I

[0022] Figs. 3-7 illustrate a structure of an air condenser of a condensation-type air clothes dryer proposed by the present embodiment and a flowing direction of air in the clothes dryer in the air condenser. The air condenser in the present embodiment includes condensing air ducts j and a cooling pipeline i arranged crosswise, wherein the condensing air ducts j include a first group of condensing air ducts and a second group of condensing air ducts; air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner. The cooling pipeline i is arranged between the first group of condensing air ducts and the second group of condensing air ducts and is used for enabling low-temperature gas or liquid to pass through. Hot air passing through the first group of condensing air ducts and the second group of condensing air ducts in the condensing air ducts j performs heat exchange with the low-temperature gas or liquid in the cooling pipeline i. As a further embodiment, the condensing air ducts further include intermediate air ducts, wherein at least one part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the first group of condensing air ducts; and at least another part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the second group of condensing air ducts. The hot air in the first group of condensing air ducts and the second group of condensing air ducts performs heat exchange with the low-temperature gas or liquid in the cooling pipeline i in the intermediate air ducts.

[0023] The cooling pipeline i is composed of cooling sheets 11, and the cooling sheets 11 are sequentially arranged to penetrate through a whole thickness direction of the condenser. Fig. 6 illustrates a structure of the cooling sheets 11 in the present embodiment. Vent holes 111 are formed in the cooling sheets 11, have turn-up structures and are used for enabling room-temperature dry air circulating in the cooling pipeline i to pass through. The vent holes 111 formed in the cooling sheets 11 can be in any shape as long as the air can be guaranteed to pass through the vent holes 111.

[0024] The first group of condensing air ducts of the condensing air ducts j include at least one first condensing sheet 12, and the first condensing sheet is formed with at least the air inlet ducts and the air outlet ducts of the first condensing air ducts; the second group of condensing air ducts include at least one second condensing sheet 13, and the air inlet ducts and the air outlet ducts of the second condensing air ducts are formed on the second condensing sheet 13. The first group of condensing air ducts is formed by sequentially arranging the first condensing sheets 12, and the second group of condensing air ducts is formed by sequentially arranging the second condensing sheets 13. The air inlet ducts and the air outlet ducts of the first group of condensing air ducts are formed by arranging air inlet ducts and air outlet ducts of first condensing air ducts of the first condensing sheets 12, and the air inlet ducts and the air outlet ducts of the second group of condensing air ducts are formed by arranging air inlet ducts and air outlet ducts of second condensing air ducts of the second condensing sheets 13. The first condensing sheets 12 and the second condensing sheets 13 are arranged at intervals, so that the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are at least partially overlapped. Similarly, the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are at least not overlapped. The first condensing sheets 12 and the second condensing sheets 13 are sequentially arranged at intervals and penetrate through a whole thickness direction of the air condenser. When the intermediate air ducts in the condensing air ducts are designed, the intermediate air ducts and the air inlet ducts and the air outlet ducts of the first group of condensing

air ducts and the second group of condensing air ducts may be formed integrally or separately.

[0025] In order to guarantee that gas passing through the condensing air ducts j can pass along a flowing direction of the air ducts, air guiding grooves are formed in the first condensing sheets 12 and the second condensing sheets 13 in the present embodiment. As a more specific embodiment, first air guiding grooves 121 are formed in the first condensing sheets 12, directions of the first air guiding grooves 121 extend from first air inlets A of the condenser to first air outlets C of the condenser, and the first air guiding grooves 121 are uniformly distributed along width directions of the first air inlets and the first air outlets. Second air guiding grooves 131 are formed in the second condensing sheets 13, directions of the second air guide guiding 131 extend from second air inlets B of the condenser to second air outlets D of the condenser, and the second air guiding grooves 131 are uniformly distributed along width directions of the second air inlets B and the second air outlets D.

[0026] The turn-up structures are arranged on the vent holes 111 of the cooling sheets 11 in the present embodiment, and are used for supporting the first condensing sheets 12 and the second condensing sheets 13 adjacent to each of the cooling sheets 11. Therefore, heights of the turn-up structures are equal to widths of the air guiding grooves formed in the first condensing sheets 12 and the second condensing sheets 13. As a further embodiment, in the present embodiment, one end of each of the first air guiding grooves 121 is fixed on the cooling sheets 11, and the other end of each of the first air guiding grooves 121 is fixed on the first condensing sheets 12; and one end of each of the second air guiding grooves 131 is fixed on the cooling sheets 11, and the other end of each of the second air guiding grooves 131 is fixed on the second condensing sheets 13.

[0027] As shown in Fig. 7, the present embodiment further proposes a clothes dryer. The clothes dryer includes an air condenser 1, a heater 2 and a drum 3 in the present embodiment. The drum 3 is configured to contain clothes and dry the clothes in the drum 3. In a process of drying the clothes by the clothes dryer in the present embodiment, an air flowing direction and air change in the clothes dryer are as follows. In the cooling pipeline, room-temperature dry air 6 before passing through the air condenser enters the air condenser from an inlet of the cooling pipeline, performs heat exchange with saturated hot air 5 entering the condensing air ducts from the drum 3 in the cooling pipeline before passing through the air condenser, and then becomes hot dry air 7. In the condensing air ducts, the saturated hot air 5 entering the air condenser 1 from the drum 3 enters the air condenser 1 from the first air inlets A and the second air inlets B of the air condenser 1 respectively for performing heat exchange and performs heat exchange to become the hot dry air 7 in the air condenser 1; and the hot dry air 7 is discharged from the air condenser from the first air outlets C and the second air outlets D, and is collected to enter the heater 2 together for heating. Heat exchange in two aspects needs to be performed in the air condenser 1. On one hand, heat exchange is performed between air in the condensing air ducts and air in the cooling pipeline; and on the other hand, heat exchange is performed between air in the first group of condensing air ducts and air in the second group of condensing air ducts. An air flow passing through the first air guiding grooves 121 in the first condensing sheets 12 and an air flow passing through the second air guiding grooves 131 in the first condensing sheets 13 flow together at overlap parts of the first condensing sheets 12 and the second condensing sheets 13 and perform heat exchange. The air flow passing through the first air guiding grooves in the first condensing sheets 12 is the saturated hot air 5 before passing through the air condenser, while the air flow passing through the second air guiding grooves 131 in the second condensing sheets 13 is unsaturated hot air 8. At the overlap parts of the first condensing sheets 12 and the second condensing sheets 13, heat of the saturated hot air 5 before passing through the air condenser is transferred to the unsaturated hot air 8, and then the unsaturated hot air 8 is preheated; and the unsaturated hot air 8 after passing through the air condenser pre-cools the saturated hot air 5, so that the saturated hot air 5 is further cooled by the room-temperature dry air 6 in the cooling pipeline i, and produced condensate water 9 is discharged out of the air condenser 1.

[0028] The unsaturated hot air 8 after passing through the air condenser enters the heater 2, becomes hot dry air 4 after heated by the heater 2, and the hot dry air 4 enters the drum 3 to dry the clothes; and saturated hot air 5 after drying enters a next air cycle.

[0029] The first condensing sheets 12, the second condensing sheets 13 and the cooling sheets 11 in the present embodiment are made of one of PVC, PET or aluminum sheets.

[0030] As a preferred embodiment, thicknesses of the first condensing sheets 12, the second condensing sheets 13 and the cooling sheets 11 in the present embodiment are 0.2mm-0.4mm.

[0031] The first group of condensing air ducts and the second group of condensing air ducts which can partially perform heat exchange are arranged on the air condenser 1 in the present embodiment, so that heat exchange is performed between high-temperature and high-humidity air flowing out of the drum 3 of the clothes dryer and air condensed by the air condenser 1 to enter the heater 2. The high-temperature and high-humidity air can also be pre-cooled while preheating. Waste heat of high-temperature air in the condensing air ducts can be effectively recycled, and loss of heat is reduced, thereby achieving a purpose of saving energy while increasing heat exchange efficiency.

Embodiment II

[0032] The present embodiment proposes an air condenser and a direct discharging clothes dryer. Figs. 8-10 illustrate a structure of the air condenser proposed in the present embodiment. Like embodiment I, the air condenser in the present embodiment includes condensing air ducts and a cooling pipeline arranged crosswise. The condensing air ducts include a first group of condensing air ducts and a second group of condensing air ducts, wherein air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner. The cooling pipeline is arranged between the first group of condensing air ducts and the second group of condensing air ducts and is used for enabling refrigerant gas or refrigerant liquid to pass through. Hot air passing through the first group of condensing air ducts and the second group of condensing air ducts in the condensing air ducts performs heat exchange with the refrigerant gas or refrigerant liquid in the cooling pipeline.

[0033] The cooling pipeline is composed of cooling sheets 11, and the cooling sheets 11 are sequentially arranged to penetrate through a whole thickness direction of the condenser. Vent holes are formed in the cooling sheets 11, have turn-up structures and are used for enabling room-temperature dry air circulating in the cooling pipeline to pass through. The vent holes formed in the cooling sheets 11 can be in any shape as long as the air can be guaranteed to pass through the vent holes. In the present embodiment, structures and arrangement manners of first condensing sheets in the first group of condensing air ducts and second condensing sheets in the second group of condensing air ducts are the same as those in embodiment I.

[0034] The first group of condensing air ducts of the condensing air ducts are formed by sequentially arranging first condensing sheets 12, and the second group of condensing air ducts are formed by sequentially arranging second condensing sheets 13. The first condensing sheets 12 and the second condensing sheets 13 are sequentially arranged at intervals and penetrate through a whole thickness direction of the air condenser. In order to guarantee that gas passing through the condensing air ducts can pass along a flowing direction of the air ducts, air guiding grooves are formed in the first condensing sheets 12 and the second condensing sheets 13 in the present embodiment. As a more specific embodiment, first air guiding grooves 121 are formed in the first condensing sheets 12. In combination with Fig. 11, directions of the first air guiding grooves 121 extend from first air inlets A of the condenser to first air outlets C of the condenser, and the first air guiding grooves 121 are uniformly distributed along width directions of the first air inlets A and the first air outlets C. Second air guiding grooves 131 are formed in the second condensing sheets 13, directions of the second air guiding grooves 131 extend from second air inlets B of the condenser to second air outlets D of the condenser, and the second air guiding grooves 131 are uniformly distributed along width directions of the second air inlets B and the second air outlets D.

[0035] The turn-up structures are arranged on the vent holes of the cooling sheets 11 in the present embodiment, and are used for supporting the first condensing sheets 12 and the second condensing sheets 13 adjacent to each of the cooling sheets 11. Therefore, heights of the turn-up structures are equal to widths of the air guiding grooves formed in the first condensing sheets 12 and the second condensing sheets 13. As a further embodiment, in the present embodiment, one end of each of the first air guiding grooves 121 is fixed on the cooling sheets 11, and the other end of each of the first air guiding grooves 121 is fixed on the first condensing sheets 12; and one end of each of the second air guiding grooves 131 is fixed on the cooling sheets 11, and the other end of each of the second air guiding grooves 131 is fixed on the second condensing sheets 13.

[0036] An overlap region 23 is formed between the first condensing sheets 12 and the second condensing sheets 13 in a process of forming the condensing air ducts. In the overlap region 23, since the air condenser in the present embodiment is applied to the direct discharging clothes dryer, saturated hot air 5 entering the air condenser from the first air guiding grooves 121 on the first condensing sheets 12 and the second air guiding grooves 131 on the second condensing sheets 13 respectively performs heat exchange with unsaturated hot air 8 in the second condensing sheets 13 and the first condensing sheets 12 in the overlap region 23.

[0037] Fig. 11 illustrates an air duct circulating system for internal air of the direct discharging clothes dryer proposed in the present embodiment, and the system includes a cooling pipeline and condensing air ducts. Room-temperature dry air 6 enters the cooling pipeline, performs heat exchange to become hot dry air 7 and then enters a heater 2, and the hot dry air 7 heated by the heater 2 becomes hot dry air 4 and enters a drum 3 to dry clothes. After the clothes are dried, the hot dry air 4 becomes the saturated hot air 5, and enters the air condenser 1 from the first air inlets A and the second air inlets B to perform heat exchange. In combination with Figs. 8-10, after performing heat exchange in the air condenser 1, the saturated hot air 5 becomes unsaturated hot air 8, and the unsaturated hot air 8 is discharged out of the air condenser 1 via the first air outlets C and the second air outlets D.

Embodiment III

[0038] The present embodiment proposes an air condenser applied to a heat-pump type clothes dryer, and a

heat-pump type clothes dryer using the heat-pump type air condenser. Fig. 12 and Fig. 13 illustrate a structure of the air condenser proposed in the present embodiment, and an air circulation path inside the heat-pump type clothes dryer.

[0039] The structure of the air condenser in the present embodiment is basically the same as structures of the air condensers in embodiment I and II. Differences are as follows: mounting holes are formed in the cooling sheets 11 in the present embodiment, and heat exchange tubes 10 used for introducing condensed gas or condensed liquid are mounted in the mounting holes.

[0040] A drum 3 on the heat-pump type clothes dryer in the present embodiment is communicated with the first air inlets A and the second air inlets B of the air condenser 1, and the heater 2 is communicated with the first air outlets C and the second air outlets D of the air condenser 1.

[0041] Saturated hot air 5 discharged out of the drum 3 enters the air condenser 1 from the first air inlets A and the second air inlets B, performs heat exchange with the condensed gas or condensed liquid introduced into the heat exchange tubes 10 to become unsaturated hot air 8, and the unsaturated hot air 8 is discharged out of the air condenser 1 from the first air outlets C and the second air outlets D. Meanwhile, condensate water 9 produced in the heat exchange process drips through the heat exchange tubes 10 and is discharged out of the air condenser 1. The unsaturated hot air 8 after passing through the air condenser enters the heater 2, is heated to become hot dry air 4 and then enters the drum 3 to continue to dry the clothes.

[0042] Then, the above air circulation path is repeated until the clothes are completely dried.

[0043] The above air condenser is arranged on the clothes dryer in the present invention. Since the above air condenser can effectively recycle waste heat of air in the condensing air ducts, heat exchange efficiency of the heater used for heating the air is increased by 14%-20%, energy consumption is effectively saved, and the heat exchange efficiency is increased. Therefore, the clothes dryer is low in energy consumption and more environmental-friendly in a using process, and market competitiveness of the clothes dryer is improved.

[0044] Apparently, above embodiments of the present invention are only for clearly describing examples made in the present invention rather than limiting embodiments in the present invention. Those ordinary skilled in the art may make other different forms of changes or modifications on the basis of the above description. Herein exhaustive illustrations of all embodiments are not needed and cannot be made. Any modification, equivalent replacements and improvements and the like made within spirits and principles of the present invention should be included in a protection scope of claims of the present invention.

Claims

1. An air condenser, comprising condensing air ducts and a cooling pipeline arranged crosswise, wherein the condensing air ducts comprise a first group of condensing air ducts and a second group of condensing air ducts; air inlet ducts of the first group of condensing air ducts and air outlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner; and air outlet ducts of the first group of condensing air ducts and air inlet ducts of the second group of condensing air ducts are at least partially arranged in a heat exchangeable manner.

2. The air condenser according to claim 1, wherein the condensing air ducts comprise intermediate air ducts;
at least one part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the first group of condensing air ducts;
at least another part of the intermediate air ducts is connected between the air inlet ducts and the air outlet ducts of the second group of condensing air ducts; and
the intermediate air ducts and the cooling pipeline are arranged crosswise to perform heat exchange.

3. The air condenser according to claim 2, wherein the first group of condensing air ducts comprise at least one first condensing sheet; and the first condensing sheet is formed with at least the air inlet ducts and the air outlet ducts of the first condensing air ducts; the second group of condensing air ducts comprise at least one second condensing sheet; and the second condensing sheet is formed with at least the air inlet ducts and the air outlet ducts of the second condensing air ducts;
the first condensing sheet (12) and the second condensing sheet (13) are arranged at intervals, so that the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air inlet ducts of the first condensing air ducts and the air outlet ducts of the second condensing air ducts are at least partially overlapped; and
the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are arranged adjacently, and projections of the air outlet ducts of the first condensing air ducts and the air inlet ducts of the second condensing air ducts are at least partially overlapped.

4. The air condenser according to claim 2, wherein the intermediate air ducts and the air inlet ducts and the air outlet ducts of the first group of condensing air ducts and the second group of condensing air ducts are formed integrally or separately.

5. The air condenser according to claim 1, wherein the cooling pipeline is used for introducing low-temperature gas or liquid.

6. The air condenser according to claim 1, further comprising four interfaces, respectively connected with the air inlet ducts of the first group of condensing air ducts, the air outlet ducts of the first group of condensing air ducts, the air inlet ducts of the second group of condensing air ducts and the air outlet ducts of the second group of condensing air ducts.

7. A clothes dryer, comprising a drum (3) and a heater (2), wherein an air condenser (1) according to any one of claims 1-6 is arranged on the clothes dryer; and
the drum (3) is communicated with first air inlets (A) and second air inlets (B) of the air condenser (1).

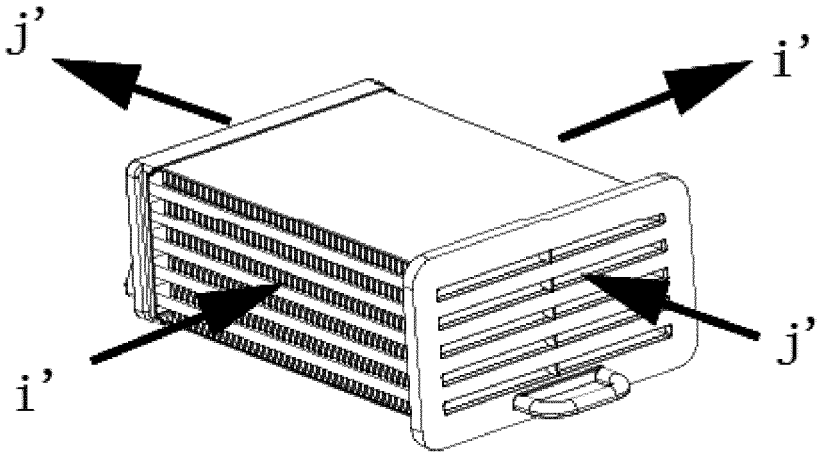

FIG. 1

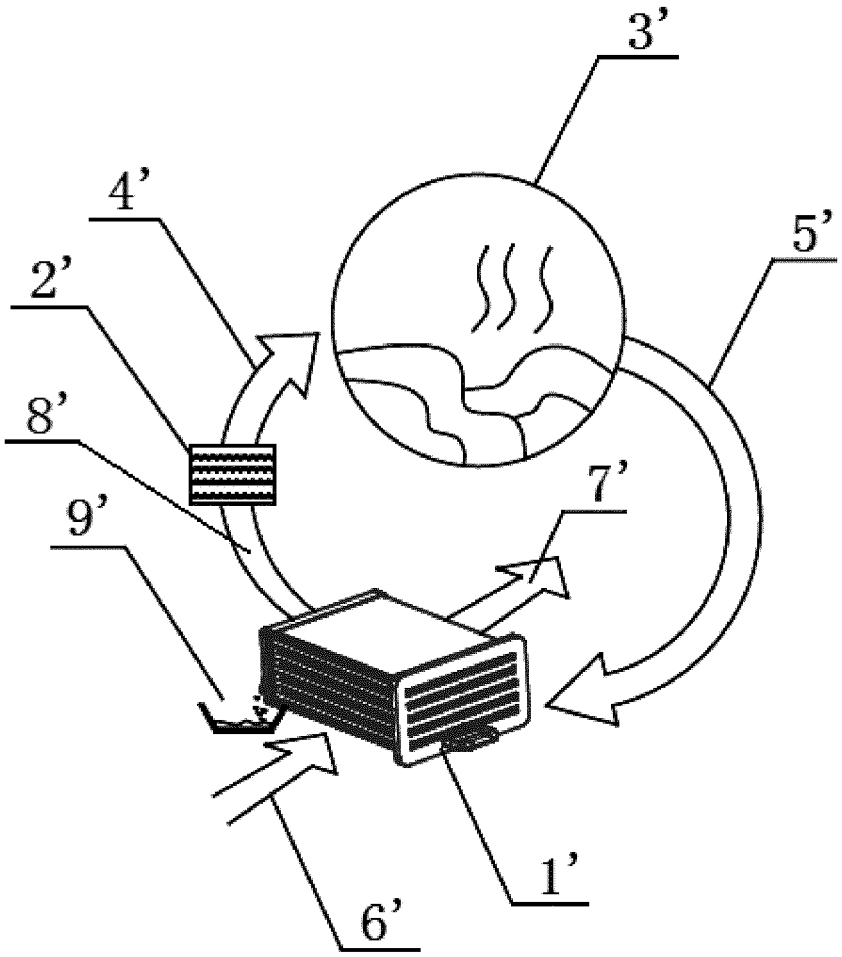

FIG. 2

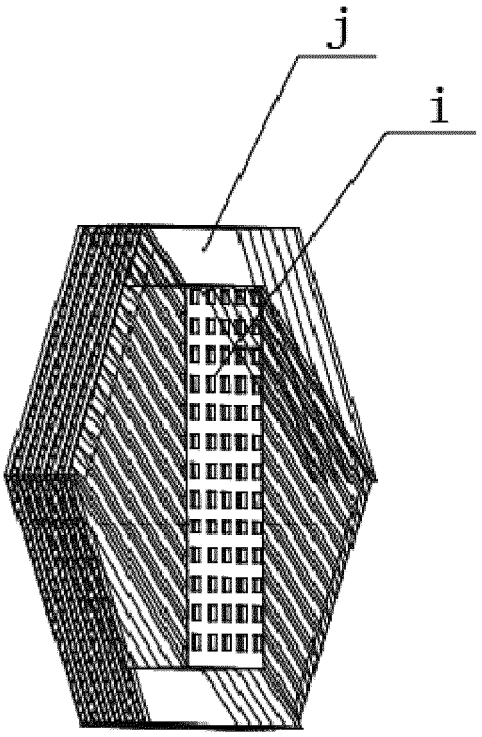

FIG. 3

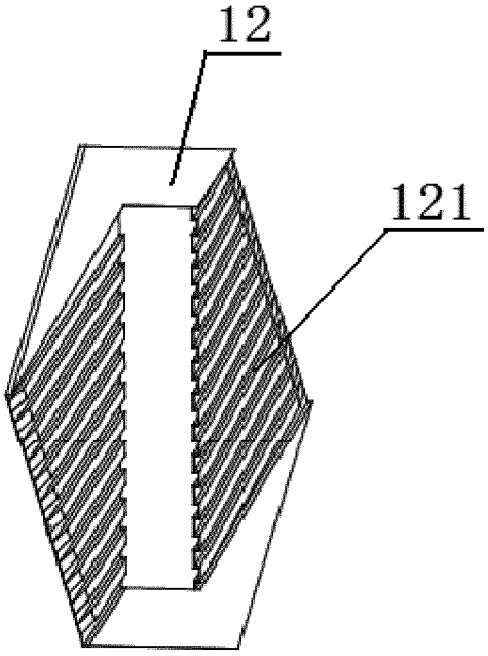

FIG. 4

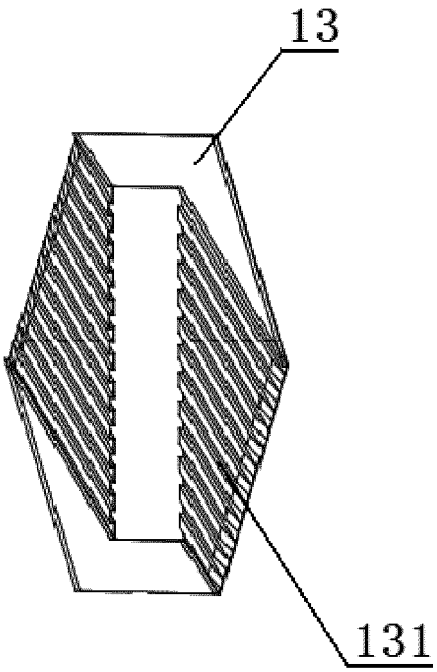

FIG. 5

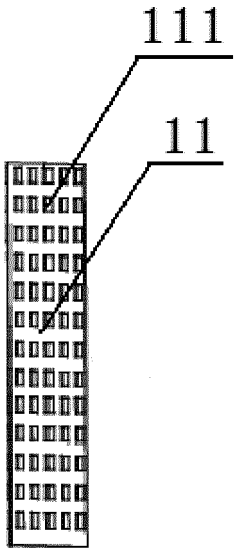

FIG. 6

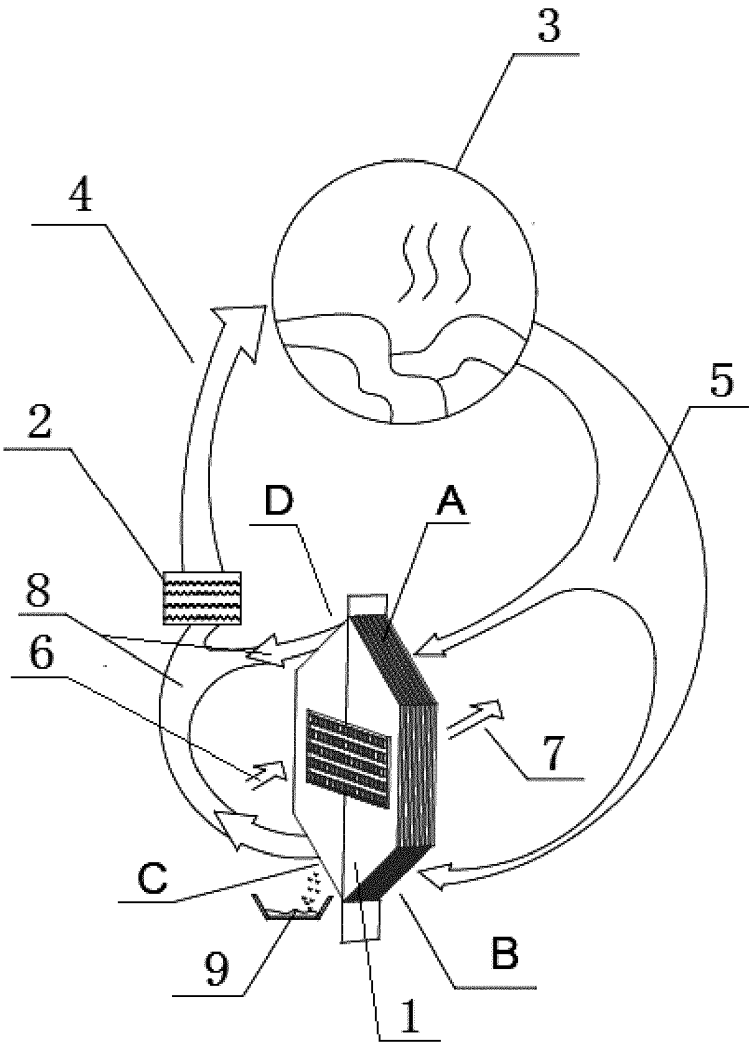

FIG. 7

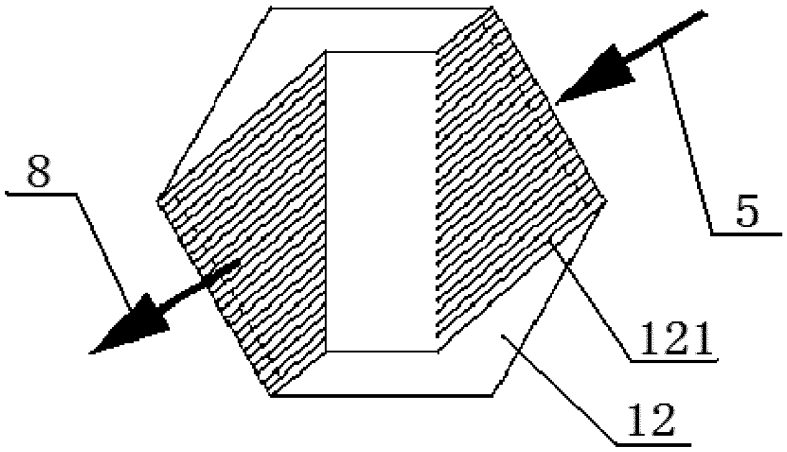

FIG. 8

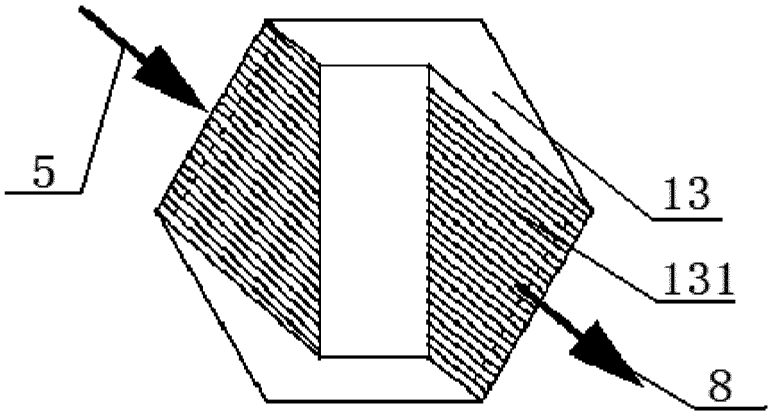

FIG. 9

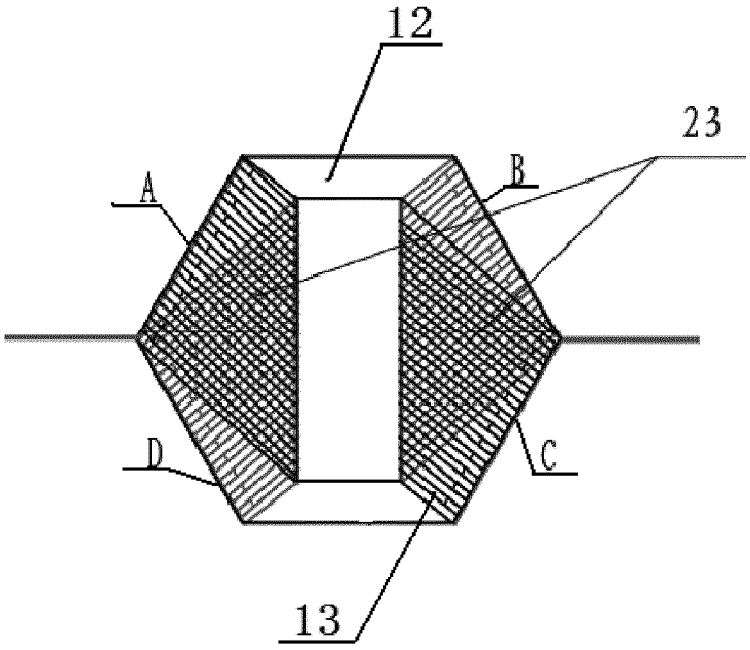

FIG. 10

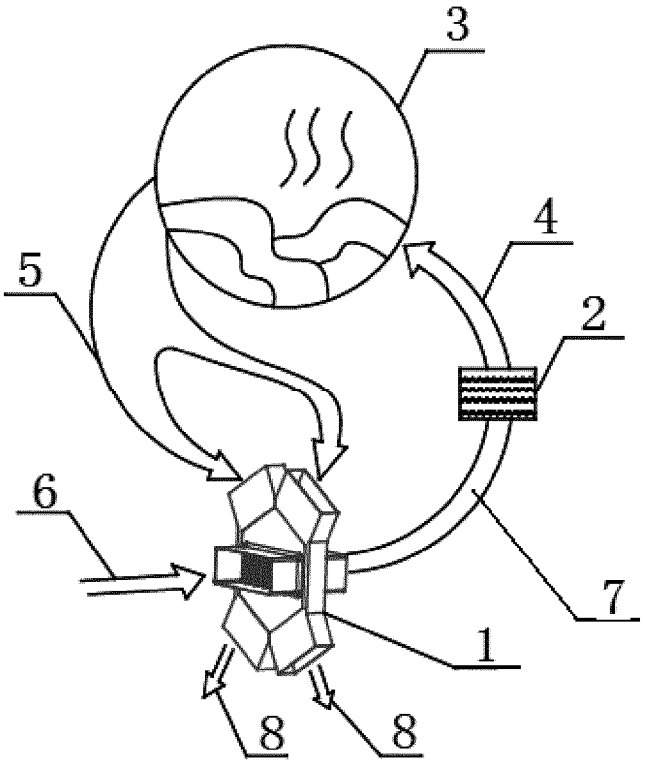

FIG. 11

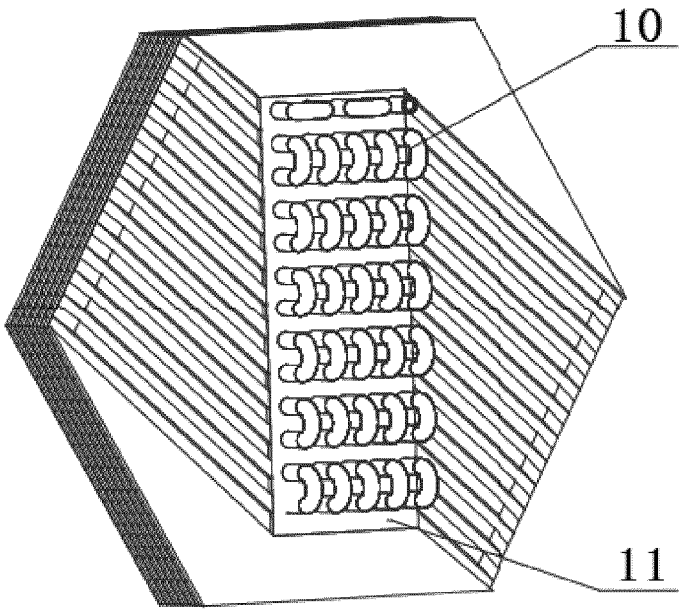

FIG. 12

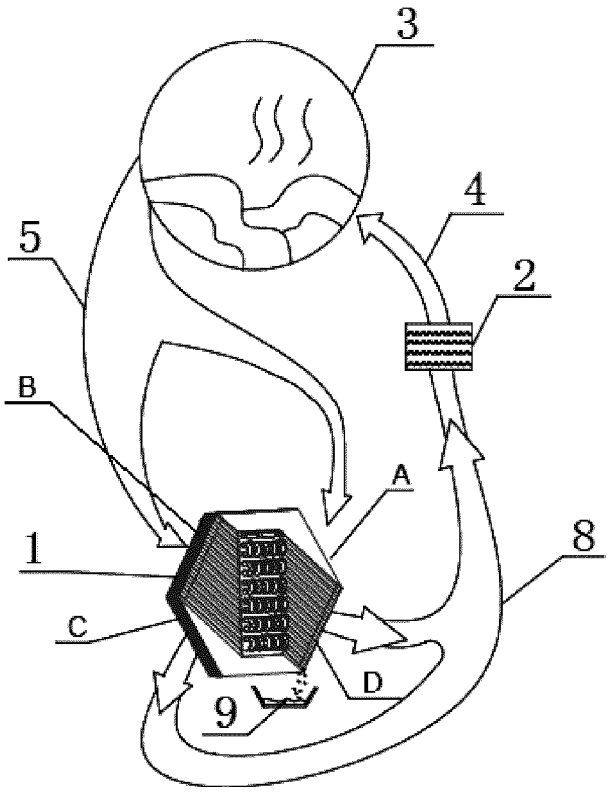

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/084070

A. CLASSIFICATION OF SUBJECT MATTER

D06F 58/20 (2006.01) i; D06F 58/24 (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, VEN: air condenser, air cooling, heat exchange, cooling, air channel, wind path, outlet air, inlet air, air, condenser, cooler, heat, exchanger, dehumidif+, radiator, preheat+, first, second, two, condensat+, path, passage, gallery, access, channel, outlet, vent, inlet, suction

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 102505437 A (HAIER ELECTRONICS GROUP CO., LTD. et al.), 20 June 2012 (20.06.2012), description, paragraphs 30-31, and figure 1	1-7
A	CN 102884239 A (BSH BOSCH UND SIEMENS HAUSGERAETE GMBH), 16 January 2013 (16.01.2013), description, paragraph 28, and figure 1	1-7
A	EP 1936022 A1 (ELECTROLUX HOME PROD CORP.), 25 June 2008 (25.06.2008), the whole document	1-7
A	EP 2735641 A1 (ELECTROLUX HOME PROD CORP.), 28 May 2014 (28.05.2014), the whole document	1-7

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

* Special categories of cited documents:

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"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

"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

"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	Date of mailing of the international search report
03 November 2015 (03.11.2015)	**18 November 2015 (18.11.2015)**
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**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/084070

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 102505437 A	20 June 2012	JP 2014534035 A	18 December 2014
		WO 2013067837 A1	16 May 2013
		EP 2778281 A1	17 September 2014
		US 2014298674 A1	09 October 2014
CN 102884239 A	16 January 2013	EP 2507425 A1	10 October 2012
		CN 201538898 U	04 August 2010
		WO 2011067287 A1	09 June 2011
		EP 2507425 B1	22 April 2015
		IN 201201102 P2	01 February 2013
EP 1936022 A1	25 June 2008	RU 2436879 C2	20 December 2011
EP 2735641 A1	28 May 2014	None	

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