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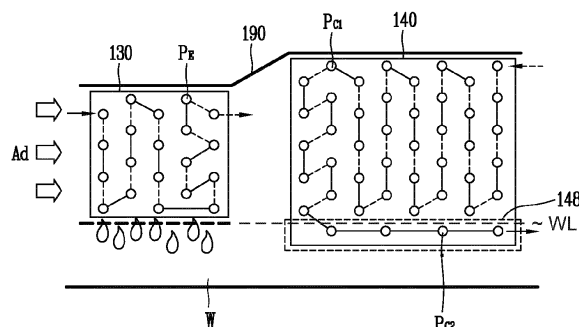
(54) **Laundry machine**

(57) The present disclosure relates to a heat pump type clothes dryer for enhancing extra-cooling performance using condensation water, and relates to a clothes dryer in which a second condenser 141 is added to a first condenser 140 in the clothes dryer employing a heat pump to maximize a condensation effect so as to enhance heat exchange efficiency, and moreover, condensation water generated from the heat exchanger unit is used for the cooling of the second condenser 141 to improve the condensation effect.

Accordingly, the clothes dryer of the present disclosure may be a circulation type heat pump clothes dryer including a cabinet 100, a drum 110, a drying duct 190

configured to circulate dry air by resupplying it thereto, an evaporator 130 having a heat pump, a condenser 140, a compressor 150 and an expansion apparatus 160, wherein the condenser includes a first condenser 140 configured to liquefy a high-temperature and high-pressure refrigerant circulated from the compressor 150; and a second condenser 141 configured to condense the refrigerant condensed from the first condenser 140 again, and the second condenser 141 is formed below a condensation water surface accumulated at a lower portion of the drying duct 190 at a lower portion of the first condenser 140 to cool the second condenser 141 using condensation water generated by the evaporator 130.

FIG. 6



Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The present disclosure relates to a heat pump type laundry machine, such as a combined washing and drying machine or a clothes dryer, and more particularly, to a heat pump type laundry machine for enhancing dehumidifying power in an evaporator using condensation water.

2. Description of the related art

[0002] In general, a laundry machine includes a clothes treating apparatus, such as a washing machine, a washer, a combined washing and drying machine or a dryer. The laundry machine having a drying function, such as a combined washer or a dryer is a device wherein the laundry is in the drum in a state that the washing is completed and a dehydration process is performed, supplying hot air into the drum to evaporate moisture of the laundry, thereby drying the laundry.

[0003] For an example of a dryer of them, the foregoing dryer may include a drum rotatably provided within a cabinet to put the laundry thereinto, a drive motor configured to drive the drum, a blower fan configured to blow air into the drum, and a heating means configured to heat air brought into the drum. Furthermore, the heating means may use high-temperature electric resistance heat generated using an electric resistance, or combustion heat generated by combusting gas.

[0004] On the other hand, air discharged from the drum contains the moisture of the laundry, and thus becomes high temperature and humid air.

[0005] Here, the dryer may be classified according to a method for processing the high temperature and humid air, and thus divided into a condensation (circulation) type dryer for condensing moisture contained in the high temperature and humid air by cooling the air below the dew point temperature through a condenser while being circulated without discharging the high temperature and humid air out of the dryer, and an exhaustion type dryer for directly discharging the high temperature and humid air having passed through the drum to the outside.

[0006] In case of the condensation type dryer, in order to condense air discharged from the drum, the process of cooling the air below the dew point temperature should be carried out to heat the air through the heating means prior to being supplied to the drum again. Here, the loss of heat energy contained in the air is generated while being cooled down during the condensation process, and an additional heater or the like is required to heat the air to a temperature required for drying.

[0007] Even in case of the exhaustion type dryer, it is required to discharge high temperature and humid air to the outside and receive outside air at normal tempera-

ture, thereby heating the air up to a required temperature level through the heating means. In particular, thermal energy transferred by the heating means is contained in high temperature air being discharged to the outside but it is discharged and wasted to the outside, thereby reducing the thermal efficiency.

[0008] Accordingly, in recent years, clothes treating apparatuses for collecting energy required to generate hot air and energy being discharged to the outside without being used have been introduced to increase energy efficiency, and a clothes treating apparatus having a heat pump system has been introduced as an example of the clothes treating apparatus. The heat pump system may include two heat exchangers, a compressor and an expansion apparatus, and energy contained in the discharged hot air is reused in heating up air being supplied to the drum, thereby increasing energy efficiency.

[0009] Specifically, in the heat pump system, an evaporator is provided at the exhaust side, and a condenser at an inlet side of the drum, and thus thermal energy is transferred to refrigerant through the evaporator and then thermal energy contained in the refrigerant is transferred to air brought into the drum, thereby generating hot air using waste energy. However, in a dryer using such a typical heat pump, the size of the condenser may be restricted due to a lack of space within which the condenser is installed, thereby causing difficulty in achieving its condensation effect.

[0010] Accordingly, heat exchange efficiency may be reduced in the heat exchanger and the cooling of refrigerant may not be properly carried out, thereby reducing dehumidifying capability.

SUMMARY OF THE INVENTION

[0011] The present disclosure is to solve the foregoing problems in the related art, and an object of the present disclosure is to provide a clothes dryer employing a circulation type heat pump in which a second condenser is added to a first condenser to maximize a condensation effect, thereby enhancing heat exchange efficiency.

[0012] Another object of the present disclosure is to provide a clothes dryer employing a heat pump structure in which refrigerant is extra-cooled, e.g. supercooled, for the cooling of the second condenser during the refrigerant cycle using condensation water generated from the heat exchanger unit, thereby enhancing dehumidifying capability.

[0013] Still another object of the present disclosure is to provide a clothes dryer employing a heat pump structure in which the second condenser itself has a separate independent condenser structure being submerged under condensation water, thereby removing a cooling fan that has been required for the use of an extra-cooling period.

[0014] According to an embodiment of the present disclosure, a clothes dryer of the present disclosure may include a cabinet; a drum rotatably provided within the

cabinet; a drying duct provided in the cabinet to circulate air discharged from the drum by resupplying it thereto; an evaporator and a condenser sequentially provided on a flow path formed by the drying duct; and a compressor and an expansion apparatus configured to form a refrigerant cycle along with the evaporator and the condenser, wherein a part of the condenser is arranged below a condensation water line of the drying duct.

[0015] Furthermore, the condenser may include a first condenser part or first condenser configured to liquefy a high-temperature and high-pressure refrigerant circulated from the compressor. A second condenser part or second condenser may be further provided and configured to condense the refrigerant condensed from the first condenser part again to extra-cool refrigerant during the refrigerant cycle, thereby enhancing dehumidifying capability in the evaporator.

[0016] A lower portion of the drying duct may be configured to accumulate condensation water from the evaporator up to a condensation water line for cooling the second condenser. Preferably, the second condenser is formed at the lower portion of the drying duct below the condensation water line. Accordingly, the second condenser may be formed below a condensation water line at a lower portion of the drying duct and/or at a lower portion of the first condenser to cool the second condenser using condensation water generated by the evaporator. The second condenser may be formed as a refrigerant line extended from the first condenser and integrally formed therewith. For instance, the refrigerant pipe of the second condenser may be formed to be extended from the refrigerant pipe of the first condenser. The condensation water line refers to a level in the drying duct, to which condensation water normally fills up.

[0017] The refrigerant pipe of the first condenser and the refrigerant pipe of the second condenser may be intrusively formed in the same heat dissipation fins, e.g. penetrating the same heat dissipation fins.

[0018] Furthermore, the refrigerant pipe of the first condenser may be vertically arranged, e.g. in a meandering pattern or in a zigzag pattern. Here, the lowest end portions or lower bends of the refrigerant pipe of the first condenser may be disposed on the condensation water line. Alternatively, the refrigerant pipe of the first condenser may be horizontally arranged, e.g. in a meandering pattern or in a zigzag pattern. Then, the lowest column or level of the refrigerant pipe of the first condenser may be disposed on the condensation water line

[0019] The refrigerant pipe of the second condenser may be horizontally arranged, e.g. in a meandering pattern or in a zigzag pattern, below the condensation water line. The refrigerant pipe of the second condenser may be disposed below the condensation water line, e.g. extended from the lowest end portion or lowest column of the refrigerant pipe of the first condenser to be arranged below the condensation water line.

[0020] According to another embodiment of the present disclosure, the second condenser may include

an independent refrigerant line separated from the first condenser. This independent refrigerant line of the second condenser may be disposed below a condensation water line at a lower portion of the drying duct to cool the second condenser using condensation water condensed by the evaporator.

[0021] In the foregoing embodiment, at least one heat dissipation fin of the first condenser may be configured as an independent heat dissipation fin separated from the heat dissipation fin(s) of the second condenser. Preferably, the heat dissipation fins of the first condenser and the heat dissipation fin of the second condenser are formed separately from each other, respectively.

[0022] In addition, the refrigerant pipe of the first condenser may be vertically arranged in a zigzag pattern, and the lowest end portion of the refrigerant pipe of the first condenser may be disposed on the condensation water line, and the refrigerant pipe of the second condenser may be horizontally arranged in a zigzag pattern below the condensation water line.

[0023] The first condenser and the second condenser may be connected by a refrigerant circulation line as a whole.

[0024] Here, a heater for reheating air that has been heated up while passing through the evaporator may be additionally provided therein. The heater may be included in an intake duct for providing heated air to the drum.

[0025] As described above, according to the present disclosure, the following effects can be promoted by the foregoing task solving means, and the configurations, combinations, and working relations which will be described later.

[0026] According to the present disclosure, a second condenser may be added to a first condenser in a clothes dryer employing a circulation type heat pump to maximize a condensation effect, thereby enhancing heat exchange efficiency.

[0027] Moreover, according to the present disclosure, refrigerant may be extra-cooled for the cooling of the second condenser during the refrigerant cycle using condensation water generated from the heat exchanger unit, thereby enhancing dehumidifying capability.

[0028] According to the present disclosure, furthermore, the second condenser itself may have a separate independent condenser structure configured to be submerged under condensation water. By these means, a cooling fan can be removed that has been required for the use of a extra-cooling period, thus saving an additional space for the cooling fan, and increasing space efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles

of the invention.

[0030] In the drawings:

FIG. 1 is a schematic view illustrating the internal structure of a laundry machine of the present invention;

FIG. 2 is a partial detail view illustrating a circulation type heat pump within a laundry machine of the present invention;

FIG. 3 is a structural view illustrating the drying method of the heat pump;

FIG. 4 is a structural view illustrating the circulation path of a refrigerant using a second condenser according to the present disclosure;

FIG. 5 is a view illustrating dryer air passing through the evaporator and condenser according to the related art;

FIG. 6 is a view illustrating a second condenser according to another embodiment of the present disclosure; and

FIG. 7 is a view illustrating a second condenser according to still another embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Hereinafter, a heat pump type dryer according to preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. The dryer is only one example of a laundry machine according to the present invention. The same can be applied to a combined washing and drying machine and the like.

[0032] Prior to the description, it should be noted that terms and words used in the description and claims must not be limited and interpreted to be typical or literal, and should be construed as the meaning and concept conforming to the technical concept of the invention on the basis that the inventor can define the concept of the terms and words to describe the invention in a best way.

[0033] Accordingly, since the embodiments described in the present disclosure and configurations shown the drawings are the most preferred embodiments only and do not represent all of technical concept of the invention, it should be understood that there may be various equivalents and modification examples that may replace them at the time of application of present disclosure.

[0034] Hereinafter, the configurations and working relations of a clothes dryer as an example for a laundry machine according to the present disclosure will be described in detail with reference to the accompanying drawings.

[0035] FIGS. 1 and 2 are views illustrating the internal structure of a heat pump type dryer, and FIG. 3 is a block diagram illustrating the drying method of the heat pump. Furthermore, FIG. 4 is a view illustrating the circulation path of a refrigerant using a second condenser according to the present disclosure, and FIG. 5 is a view illustrating

dryer air passing through the evaporator and condenser according to the related art.

[0036] Furthermore, FIGS. 6 and 7 are views illustrating a second condenser according to other embodiments of the present disclosure.

[0037] Referring to FIGS. 1 through 3, the present disclosure may include a cabinet 100 forming the outside of the clothes dryer, and a drum 110 rotatably provided within the cabinet. The drum is rotatably supported by a supporter (not shown) at the front and rear sides thereof and may be driven by a motor 10.

[0038] An intake duct 170 provided in the cabinet to inhale outside air and supply the air to an inner portion of the drum is provided in the vertical direction of the drum at the rear side of the drum. An intake flow path through which the air inhaled into the drum flows is formed by the intake duct. According to the present disclosure, the air inhaled through the intake duct may be brought in from the outside of the cabinet separately from the drying duct 190.

[0039] On the other hand, a heater 180 for heating the inhaled air to become high temperature air required for drying the laundry may be provided within the intake duct 170. The heater 180 receives electrical energy to sufficiently and quickly heat air to be supplied to the drum, and further supplies heating such that the refrigerant cycle is stably managed in a normal state. By these means, power efficiency of a heat pump type laundry machine can be improved and overload of the heat pump can be avoided.

[0040] According to the foregoing structure, heating required for drying can be sufficiently supplied in a short period of time, thereby having an effect of reducing dry time. In other words, additional heating can be supplied in a short period of time since the heating cannot be sufficiently supplied in a short period of time using only air on the circulation flow path with the drying duct.

[0041] The air brought into the drum may be supplied through a circulation flow path formed in the drying duct 190 separately from the air through the intake flow path. The drying duct 190 is provided in the cabinet to circulate air discharged from the drum by resupplying it thereto.

[0042] The air brought into the drum dries the laundry and then is brought into a front surface duct (not shown) located at a lower front side of the drum and supplied to the drum again through the drying duct by way of a lint filter (not shown) or discharged to the outside of the cabinet through an exhaust duct which will be described later.

[0043] A blower fan 120 for inhaling air within the drum to forcibly blow it to the outside of the dryer may be provided on the circulation flow path of the drying duct.

[0044] Here, an evaporator 130 and a condenser 140 are sequentially provided on a flow path formed by the drying duct. The evaporator 130 and condenser 140 as a kind of heat exchanger, according to the present disclosure, form a refrigerant cycle of the heat pump, thereby achieving heat exchange with air (Ad) on the circulation flow path by refrigerant flowing therein.

[0045] The air brought into the drum is heated by the heater 180 on the intake flow path or the condenser 140 on the circulation flow to become high-temperature dry air at about 150-250 °C when being brought into the drum. The high-temperature air is brought into contact with an object to be dried to evaporate the moisture of the object to be dried. The evaporated moisture is to be contained in middle-temperature air and exhausted out of the drum. At this time, in order to circulate the middle temperature and humid air and reuse it, the moisture should be removed. Since the moisture content in the air is affected by the temperature, the moisture can be removed when cooling the air. Accordingly, the air on the circulation flow path is cooled by heat exchange with the evaporator 130.

[0046] In order to supply the air cooled by the evaporator 130 again to the drum, it should be heated by high temperature air, and the heating of the air is carried out by the condenser 140.

[0047] A refrigerant cycle performs heat exchange with the environment using the phase change of refrigerant flowing through the inside thereof. Briefly described, refrigerant is transformed into a low-temperature and low-pressure gas by absorbing heat from the environment in the evaporator, compressed into a high-temperature and high-pressure gas in the compressor, transformed into a high-temperature and high-pressure liquid by dissipating heat to the environment in the condenser, transformed into a low-temperature and low-pressure liquid by dropping its pressure in the expansion apparatus, and brought into the evaporator again. Due to the circulation of refrigerant, heat is absorbed from the environment in the evaporator and heat is supplied to the environment in the condenser. The refrigerant cycle may be also referred to as a heat pump.

[0048] According to the present disclosure, the refrigerant cycle may include the compressor 150 and expansion apparatus 160 along with the evaporator 130 and condenser 140.

[0049] The flow path of air in heat exchange with the refrigerant cycle is illustrated in FIGS. 2 and 3. In other words, an arrow passing through the evaporator and condenser and a line connecting between the evaporator and condenser does not indicate the flow path of the refrigerant but indicate the flow path of the air in FIGS. 2 and 3, and the air is sequentially brought into contact with the evaporator and the like to perform heat exchange.

[0050] For the configuration in more detail, as illustrated in FIG. 3, it is seen that the evaporator 130 and condenser 140 are sequentially disposed, respectively, on the circulation flow path (a large circulation line formed along a bold arrow in FIG. 3) formed by the drying duct 190.

[0051] As illustrated in FIG. 3, the air (Ad) on the circulation flow path performs heat exchange with the heat pump during the refrigerant cycle, specifically the air (Ad) on the circulation flow path dissipates heat in heat exchange with the evaporator, and absorbs heat in heat exchange with the condenser. As a result, the air on the

circulation flow path absorbs heat dissipated by itself again.

[0052] In general, the evaporator and condenser are mainly in charge of heat exchange during the refrigerant cycle, and the air from which heat is taken in the evaporator liquefies moisture contained therein to exhaust it as condensation water, and dry air is heated by the compressor and condenser to be changed into high temperature and dry air.

[0053] In this manner, the air changed into high-temperature air in heat exchange with the refrigerant cycle through the circulation flow path is brought into the drum along with the air into the intake flow path to participate in the drying process.

[0054] Here, part of the air brought into the drum and used in the drying process is exhausted to the outside of the dryer, and part thereof is reused, and supplied to the air reused by absorbing only part of waste heat using the refrigerant cycle. However, the embodiments of the present invention may also be employed in a circulation type dryer without exhausting air or in an exhaustion type dryer, in which all of the air is exhausted to the outside of the dryer.

[0055] In the heat pump type clothes dryer, waste heat is typically collected using the refrigerant cycle, and the present disclosure provides an optimization means not to cause a overload during the refrigerant cycle. In other words, in case of a refrigerant cycle, the heat exchange of refrigerant should be carried out by phase change at the optimal operating temperature and pressure, and to this end, an heat exchanger such as an evaporator and a condenser, a compressor, an expansion apparatus and the like are used. Accordingly, in order to collect more heat, the size of the heat exchanger or compressor is inevitably increased. However, in case of a typical clothes dryer, it has a spatial restriction and thus the heat exchanger, compressor or the like is limited in their size.

[0056] Accordingly, according to the present disclosure, the heater 180 for heating the inhaled air to become high-temperature air required for drying the laundry is provided within the intake duct to continuously replenish the inhaled air with heating.

[0057] According to the present disclosure, heating may be replenished through the heater 180 to sufficiently supply the heating required for drying, thereby reducing dry time. Furthermore, in case of a refrigerant cycle, the heat exchange of refrigerant should be carried out by a phase change at the optimal operating temperature and pressure, and to this end, heating should be sufficiently supplied. Otherwise, it may cause a problem such as refrigerant being supplied to the compressor in a liquid phase or the like, and thus the cycle cannot be stably operated, thereby reducing the reliability of the cycle. Accordingly, as disclosed herein, the air brought into the drum may be additionally replenished with heating by the heater 180, and thus it is preferable that the refrigerant cycle can be stably operated in a normal state.

[0058] In addition, an additional blower fan 120 may

be provided on the intake flow path to provide more air-flow. Furthermore, the additional blower fan provides more airflow and thus the heater 180 is not overheated on the intake flow path. The configuration provided with the additional blower fan 120 is illustrated in FIGS. 2 through 4.

[0059] On the other hand, the present disclosure may be configured such that part of the air is exhausted to the outside of the cabinet at the upstream of the evaporator on the circulation flow path. Accordingly, as illustrated in FIG. 1, the present disclosure may further include an exhaust duct 15 branched from the upstream of the evaporator 130 in the drying duct 190, and the exhaust duct is configured to exhaust part of the air to the outside of the cabinet at the upstream of the evaporator on the circulation flow path. The exhaust duct forms an exhaust flow path for discharging hot air coming out of the drum to exhaust part of the air to the outside of the cabinet.

[0060] According to the foregoing configuration, waste heat is absorbed from part of the middle temperature and humid air coming out of the drum only within a range that can be processed by the refrigerant cycle, and the rest of the air is exhausted. Accordingly, it may be possible to reduce energy waste as well as not to cause an overload during the refrigerant cycle. Furthermore, it may be possible to reduce power consumption as well as enhance reliability for the operation of the refrigerant cycle.

[0061] Hereinafter, a heat pump type clothes dryer for maximizing a condensation effect using a second condenser according to the present disclosure to enhance dehumidifying capability will be described with reference to FIGS. 4 through 7.

[0062] Referring to FIG. 4, a clothes dryer according to the present disclosure may include an evaporator 130, a condenser 140, a compressor 150 and an expansion apparatus 160 as a heat pump type dryer. It has been sufficiently described in the above, and thus the description thereof will be omitted below.

[0063] According to the present disclosure, the condenser 140 may include a first condenser part or first condenser 140 configured to liquefy a high-temperature and high-pressure refrigerant circulated from the compressor; and a second condenser or second condensing unit 141 configured to condense the refrigerant condensed from the first condenser again to extra-cool refrigerant during the refrigerant cycle, thereby enhancing dehumidifying capability in the evaporator.

[0064] Typically, refrigerant passes through the compressor 150 to follow the path of the condenser 140, expansion apparatus 160 and evaporator 130, and according to the present disclosure, a separate second condensing unit 141 may be included therein when refrigerant that has passed through the compressor 150 is condensed in the condenser 140, thereby enhancing the condensation effect.

[0065] As described above, the level of extra-cooling may be further increased through the first condenser 140 and second condensing unit 141 in the condenser to en-

hance dehumidifying capability in the evaporator, thereby increasing the efficiency of the heat pump.

[0066] Furthermore, the second condensing unit 141 may further include a cooling fan 146 for enhancing the extra-cooling performance of a second condenser 143 in addition to the second condenser 143 separately provided therein. The cooling fan 146 may inhale external air at ambient temperature to cool the second condenser 143.

[0067] Here, for the refrigerant cycle of the heat pump dryer, refrigerant flowing into the pipe from the outlet of the condenser passes through the second condenser before passing through the expansion apparatus (or expansion valve) to enhance dehumidifying capability in the evaporator for removing moisture in the dry flow path. Accordingly, it has a structure in which refrigerant in the second condenser 143 is further extra-cooled and brought into the evaporator in a low refrigerant dryness state through the expansion apparatus (e.g. an expansion valve), thereby enhancing dehumidifying capability.

[0068] However, according to the foregoing embodiment, a separate cooling fan as well as the second condenser and connecting pipe should be additionally provided to increase the extra-cooling of refrigerant, thereby causing an increase in the raw material cost of the product.

[0069] Consequently, according to another embodiment of the present disclosure, as illustrated in FIG. 6, the second condenser 148 is formed below a condensation water line at a lower portion of the drying duct as a refrigerant line extended from the first condenser and integrally formed therein. Furthermore, the second condenser is cooled using condensation water condensed by the evaporator.

[0070] In FIG. 5, a conventional heat pump structure comprising an evaporator 130 and a condenser 140 in a drying duct is shown. The evaporator 130 and the condenser 140 are arranged at the same height and above the condensation water line WL of the drying duct, up to which condensation water W is collected. The refrigerant lines or refrigerant pipes P_E and P_C of the evaporator 130 and the condenser 140 are connected to each other via the compressor 150.

[0071] Referring to FIG. 6, according to an embodiment of the present disclosure, the refrigerant pipe of the first condenser 140 and the refrigerant pipe of the second condenser are intrusively formed in the same heat dissipation fins.

[0072] Here, considering the arrangement of the first condenser and second condenser inserted into the one or more heat dissipation fins, the refrigerant pipe P_{C1} of the first condenser is vertically arranged in a zigzag or meandering pattern, and the lowest end portion of the refrigerant pipe thereof is arranged on a condensation water line WL, and the refrigerant pipe P_{C2} of the second condenser 148 is horizontally arranged below the condensation water line. Vertically or horizontally arranged respectively refers to a plurality of subsequent bends of

the refrigerant pipe of the condenser being arranged in a vertical or horizontal plane with respect to the installed condenser.

[0073] Accordingly, the condenser 140 may not be required to be cooled with a separate cooling fan for the cooling of the condenser, and space utilization is enhanced, thereby promoting economical efficiency.

[0074] According to the foregoing embodiment, the second condenser 148 can be considered as a partial lower portion of the condenser 140 being submerged under condensation water (W), and the relevant lower portion of the condenser exhibits a structure for enhancing the extra-cooling efficiency of the condenser using the condensation water. Accordingly, a rear end portion at the outlet side of the pipe coming out of the condenser 148 should be submerged under condensation water to achieve extra-cooling without reducing the performance of the condenser.

[0075] Considering another embodiment of the present disclosure with reference to FIG. 7, the second condenser 148 is disposed below a condensation water line at a lower portion of the drying duct as an independent refrigerant line separated from the first condenser 140 to cool the second condenser using condensation water generated by the evaporator.

[0076] As illustrated in FIG. 7, the at least one heat dissipation fin of the first condenser 140 and the at least one heat dissipation fin of the second condenser 149 may be configured as independent heat dissipation fins separated from each other, respectively.

[0077] According to an embodiment in FIG. 7, the refrigerant circulation line (Pc1) in the first condenser and the refrigerant circulation line (Pc2) in the second condenser may be preferably connected by a separate refrigerant circulation line that does not penetrate the heat dissipation fin.

[0078] Accordingly, referring to FIG. 7, refrigerant (Pc1) circulated from the compressor (not shown in the drawing) is all circulated through the condenser 140, and then circulated again through the second condenser 149 via a separate refrigerant circulation path.

[0079] Here, the refrigerant circulation (Pc2) of the second condenser 149 may be submerged under the surface of condensation water (W), i.e. below the condensation water line (WL) of the drying duct. According to the present configuration, an additional cooling fan according to the foregoing embodiment may be provided to one or both of the condenser parts in order to maximize cooling efficiency. However, a cooling function can already be promoted through condensation water (W) generated by the evaporator 130 without having an additional cooling fan according to the present embodiment, thereby avoiding an additional configuration as well as maximizing space utilization.

[0080] Accordingly, it is preferable that the refrigerant pipe P_{c1} of the first condenser 140 is vertically arranged, e.g. in a zigzag pattern, and the lowest end portion of the refrigerant pipe P_{c1} is disposed not to be brought into

contact with condensation water on the condensation water line WL, and the refrigerant pipe P_{c2} of the second condenser is horizontally arranged below the condensation water line, e.g. in a zigzag pattern, to be submerged under condensation water.

[0081] Consequently, according to the present embodiment, the second condenser itself has a separate independent condenser structure and the second condenser has a structure being submerged under condensation water. Accordingly, refrigerant that has passed through the condenser may be extra-cooled while being circulated through the second condenser submerged under condensation water, and as a result, a cooling fan that has been required for the use of an extra-cooling period in the foregoing embodiment is not required, and the cost is reduced and an additional space is not occupied, thereby increasing space efficiency.

[0082] The aforementioned embodiments are merely preferred embodiments of the present disclosure to allow persons having ordinary skill in the art to which the present disclosure pertains (hereinafter, referred to as "those skilled in the art") to easily implement a heat pump type clothes dryer for enhancing extra-cooling performance using condensation water according to the present disclosure, and the present disclosure is not limited to the foregoing embodiments and the accompanying drawings, and thus the rights scope of the present disclosure is not limited thereto. Accordingly, it should be understood by those skilled in the art that various substitutions, modifications and changes can be made without departing from the technical concept of the invention, and it should be also clearly understood that portions which can be easily changed by those skilled in the art will fall in the rights scope of the invention.

Claims

1. A clothes dryer, comprising:

- a rotatable drum;
 - a drying duct configured to circulate air discharged from the drum by resupplying it thereto;
 - an evaporator and a condenser sequentially provided on a flow path formed by the drying duct; and
 - a compressor and an expansion apparatus configured to form a refrigerant cycle along with the evaporator and the condenser,
- wherein the condenser comprises a first condenser part configured to liquefy a high-temperature and high-pressure refrigerant circulated from the compressor; and a second condenser part configured to condense the refrigerant condensed from the first condenser part again, and wherein the second condenser part is arranged below a condensation water line at a lower portion of the drying duct for cooling the second

- condenser using condensation water.
2. The clothes dryer of claim 1, further the second condenser part is arranged at a lower portion of the first condenser part.
 3. The clothes dryer of claim 1 or 2, wherein the lower portion of the drying duct is configured to accumulate condensation water from the evaporator for cooling the second condenser part.
 4. The clothes dryer according to any one of the preceding claims, wherein the refrigerant pipe of the first condenser part is vertically and/or horizontally arranged in a zigzag pattern.
 5. The clothes dryer according to any one of the preceding claims, wherein the refrigerant pipe of the second condenser part is horizontal arranged in a zigzag pattern.
 6. The clothes dryer according to any one of the preceding claims, wherein a lowest end portion of the refrigerant pipe of the first condenser part is arranged on a condensation water line.
 7. The clothes dryer according to any one of the preceding claims, wherein the refrigerant pipe of the second condenser part is disposed below a condensation water line.
 8. The clothes dryer according to any one of the preceding claims, wherein the refrigerant pipe of the second condenser part is extended from a lowest end portion of the refrigerant pipe of the first condenser part.
 9. The clothes dryer according to any one of the preceding claims, wherein the second condenser part comprises a refrigerant line extended from the first condenser part and/or integrally formed with the first condenser part.
 10. The clothes dryer according to any one of the preceding claims, wherein the refrigerant pipe of the first condenser part and the refrigerant pipe of the second condenser part are formed in the same heat dissipation fins.
 11. The clothes dryer according to any one of the preceding claims 1 to 8, wherein the second condenser part comprises an independent refrigerant line separated from the first condenser part.
 12. The clothes dryer of claim 11, wherein the second condenser part comprises at least one heat dissipation fin separated from heat dissipation fins of the first condenser part.
 13. The clothes dryer of claim 11 or 12, wherein the first condenser part and the second condenser part are connected by a refrigerant circulation line.
 14. The clothes dryer according to any one of the preceding claims, further comprising a heater for heating air to be supplied to the drum.
 15. The clothes dryer of claim 14, wherein the heater is provided in an intake duct for supplying air into the drum.

FIG. 1

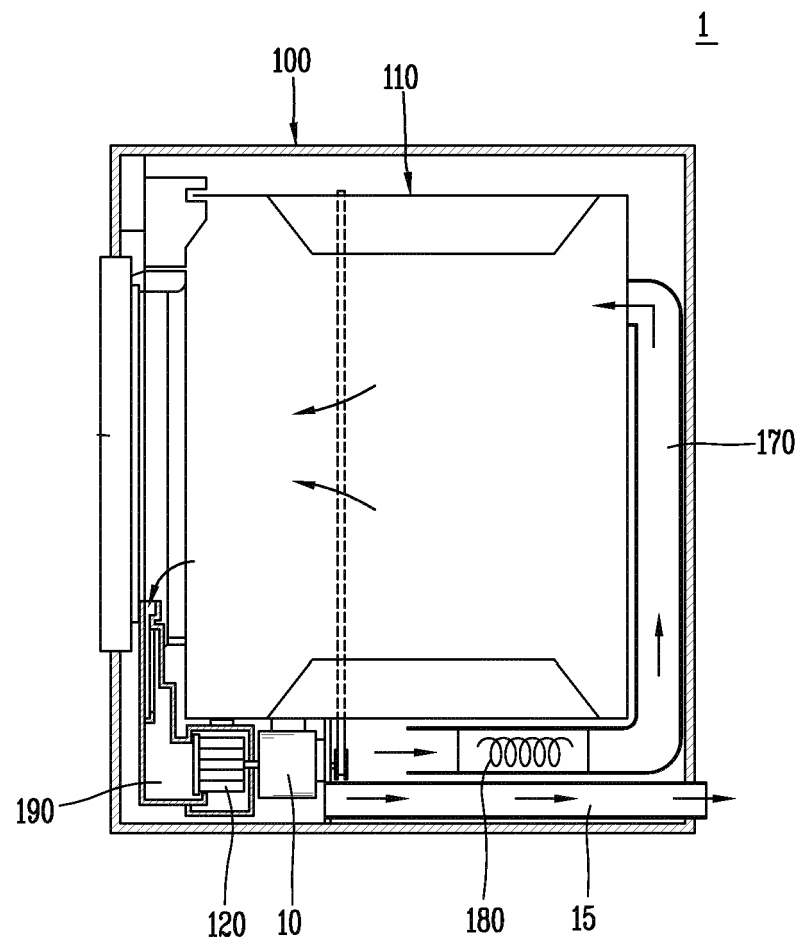


FIG. 2

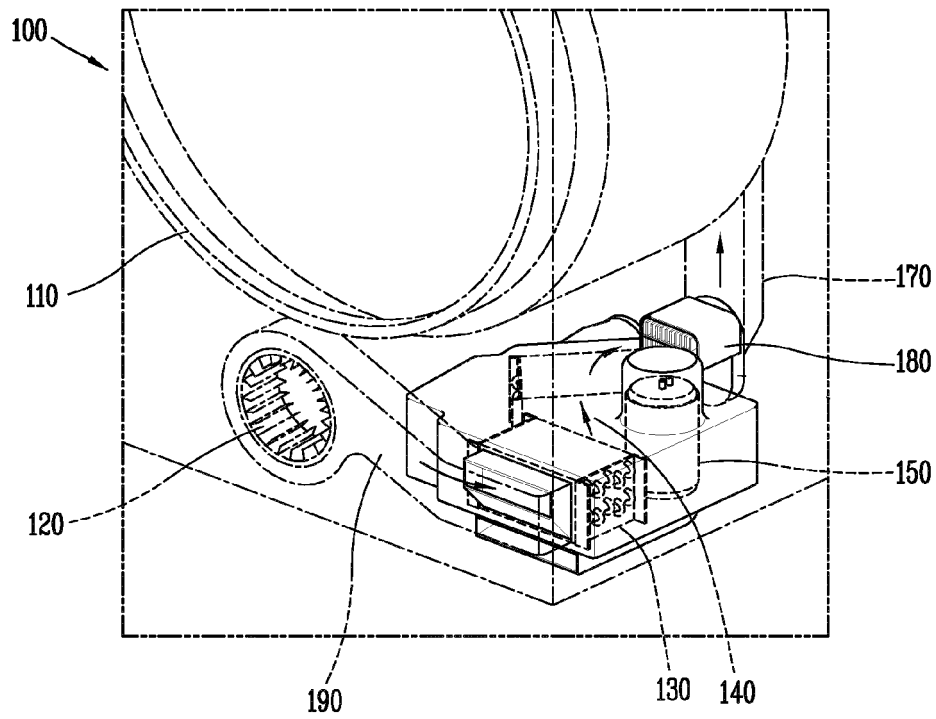


FIG. 3

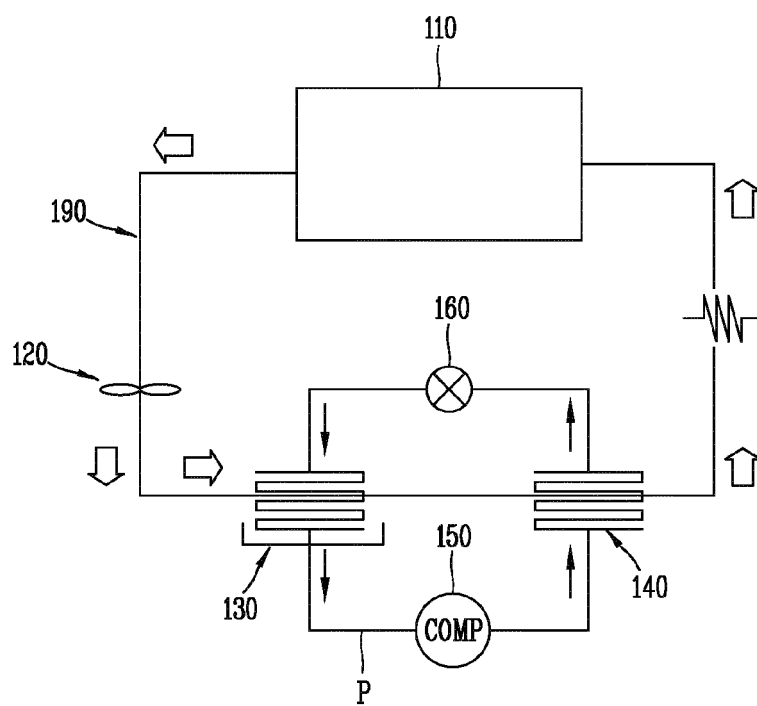


FIG. 4

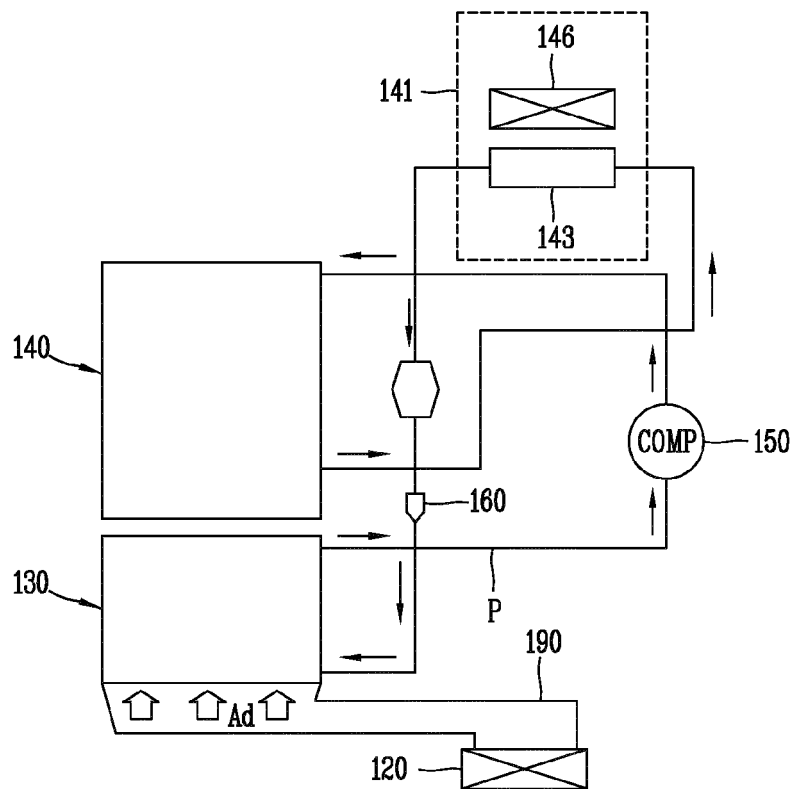


FIG. 5

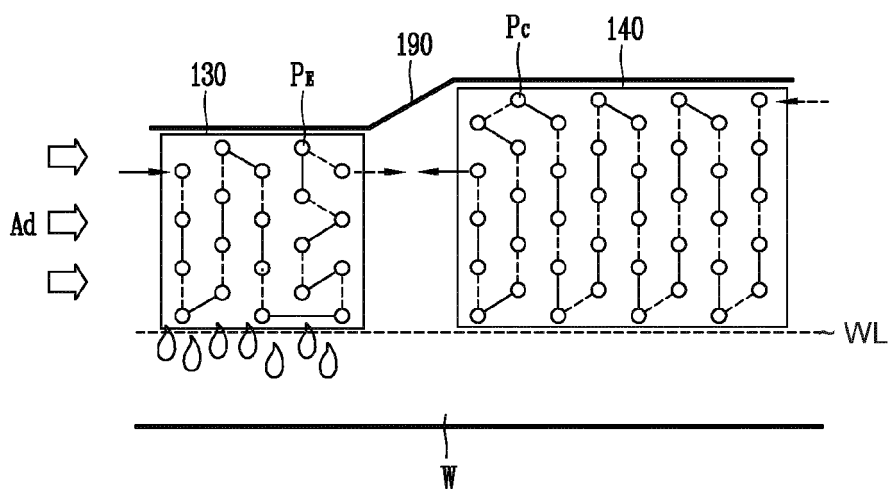


FIG. 6

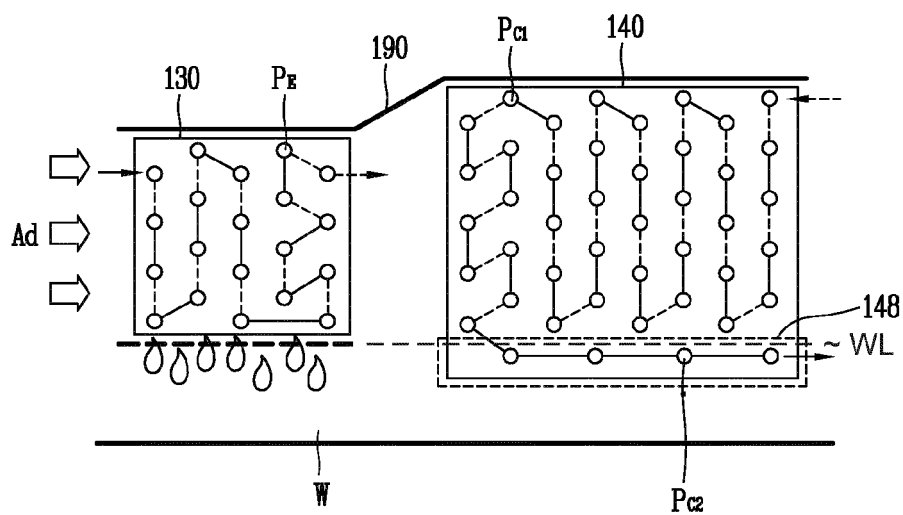


FIG. 7

