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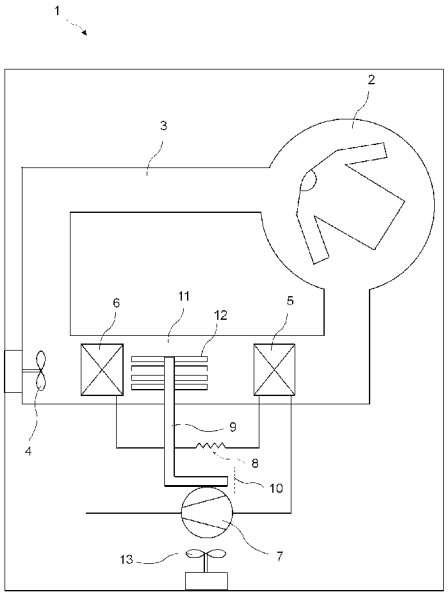
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(54) Title: A HEAT PUMP TYPE DRYER

Figure 1



(57) Abstract: The present invention relates to a heat pump type clothes dryer (1) that comprises a tub (2) wherein the laundry to be dried is emplaced, an air circulation duct (3) wherein the drying cycle air is circulated, an evaporator (5) disposed in the air circulation duct (3), cooling and reducing the humidity of the warm and humid air that comes from the tub (2) and passes through it, a condenser (6) heating the low-humid air coming through the evaporator (5), a compressor (7) increasing the temperature and pressure of the refrigerant; and wherein the waste heat discharged from the compressor (7) is utilized in order to heat the drying air in the air circulation duct (3).

Description

A HEAT PUMP TYPE DRYER

[0001] The present invention relates to a heat pump type clothes dryer wherein the waste heat discharged from the compressor is utilized.

[0002] In heat pump type clothes dryers, in order to dehumidify the drying air and to send warm and dry air over the laundry, heat pumps thermodynamically operating with the method of reverse Rankine cycle or vapour compression cycle are used. The drying cycle air passed through the elements such as evaporator and condenser forming the heat pump is dehumidified and heated.

[0003] The compressor being among the heat pump elements is substantially heated due to the friction loss of the elements operating therein. As the temperature of the compressor increases, the efficiency of the compressor decreases and the compressor is tried to be cooled by using fan. Furthermore, embodiments are provided wherein the waste heat discharged from the compressor is utilized in order to heat the drying air; however, there are no practical solutions to utilize this heat effectively.

[0004] In the Japanese Patent Application No JP2007082864 and in a heat pump dryer consisting of elements such as compressor, condenser and evaporator fastened to each other by a conduit that joins these elements and wherein the refrigerant circulates, the compressor is disposed near the feed air port used for the drying cycle, thus the heating of the drying air is provided by taking advantage of the waste heat discharged from the compressor.

[0005] The aim of the present invention is the realization of a heat pump type clothes dryer wherein the waste heat discharged from the compressor is utilized for the drying process.

[0006] The heat pump type clothes dryer realized in order to attain the aim of the present invention is explicated in the claims.

[0007] In the heat pump type clothes dryer of the present invention, the humidity of the drying air is decreased and heated by using the cooling cycle realized by the elements such as compressor, evaporator and condenser, furthermore, the waste heat discharged from the compressor is utilized by

means of a heat transfer device with one end contacting the compressor casing and the other end extending into the air circulation duct. The heat transfer device also contributes to the cooling of the compressor and thus to the increasing of the performance.

[0008] In the preferred embodiment of the present invention, a heat pipe as known in the state of the art is used as the heat transfer device in the heat pump dryer. The heat pipe comprises an evaporating section located at the end, which contacts the compressor and enabling the compressor to be cooled by absorbing the heat in the compressor as a result of the evaporation effect of the fluid therein, and a condensing section located at the end, which extends into the air circulation duct and enabling the absorbed heat to be transferred to the air circulation duct and the drying air to be heated as a result of the condensation effect of the fluid therein.

[0009] In an embodiment of the present invention, the condensing section of the heat transfer device extending into the air circulation duct is located between the evaporator and the condenser in the air circulation duct.

[0010] In another embodiment of the present invention, heat dissipation fins are mounted to the end of the heat transfer device that extends into the air circulation duct.

[0011] In another embodiment of the present invention, the end of the heat transfer device contacting the compressor is in a suitable geometry with the shape of the outer surface of the compressor casing and the heat transfer device contacts at least one part of the outer surface of the compressor casing from the surface.

[0012] In another embodiment of the present invention, the heat pump type clothes dryer comprises a cooling fan providing the compressor to be cooled and the heat transfer device is positioned in the air flow line blown by the cooling fan and sweeping the compressor casing, thus the forced heat convection created by the air blown by the cooling fan is also utilized.

[0013] The heat pump type dryer realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0014] Figure 1 - is the schematic view of a heat pump type dryer.

[0015] The elements illustrated in the figures are numbered as follows:

[0016] 1 - Heat pump type dryer

[0017] 2 - Tub

[0018] 3 - Air circulation duct

[0019] 4 - Fan

[0020] 5 - Evaporator

[0021] 6 - Condenser

[0022] 7 - Compressor

[0023] 8 - Capillary tube

[0024] 9 - Heat transfer device

[0025] 10 - Evaporating section

[0026] 11 - Condensing section

[0027] 12 - Heat dissipation fins

[0028] 13 - Cooling fan

[0029] The heat pump type dryer (1) comprises a tub (2) wherein the laundry to be dried is emplaced, an air circulation duct (3) wherein the drying cycle air is circulated, a fan (4) providing the continuity of the air flow in the air circulation duct (3) and the tub (2) throughout the drying cycle, an evaporator (5) disposed in the air circulation duct (3), cooling and reducing the humidity of the warm and humid air that comes from the tub (2) and passes through the said evaporator (5), a condenser (6) disposed in the air circulation duct (3), heating the low-humid air coming through the evaporator (5), a compressor (7) increasing the temperature and pressure of the refrigerant and a capillary tube (8) or a reducing valve disposed between the evaporator (5) and the condenser (6) and enabling the pressure and temperature of the refrigerant flowing therein to be decreased.

[0030] The cycle wherein the refrigerant is circulated by means of the compressor (7) is named as the cooling cycle. In the cooling cycle, the refrigerant, the pressure and temperature of which is increased in the compressor (7), is first sent to the condenser (6), where the refrigerant changes from the vapor phase to the liquid phase and the condenser (6) releases heat to the outside. The refrigerant, the pressure and temperature of which is decreased while passing through the capillary tube (8), enables the heat

absorption from the outside by changing from the liquid phase to the vapor phase in the evaporator (5).

[0031] The air flow provided by means of the fan (4) in the air circulation duct (3) is named as the drying cycle. In the drying cycle, the air leaving the tub (2) from the tub (2) outlet passes through the evaporator (5) and the condenser (6) respectively in the air circulation duct (3) and re-enters the tub (2) by means of the tub (2) inlet. The drying air is provided to be condensed by being cooled while passing through the evaporator (5) and to be heated while passing through the condenser (6), thus warm and dry air is sent over the laundry in the tub (3).

[0032] The heat pump type dryer (1) of the present invention comprises a heat transfer device (9) with one end contacting the compressor (7) casing and the other end extending into the air circulation duct (3), providing the waste heat discharged from the compressor (7) to be transferred to the air circulation duct (3).

[0033] The end of the heat transfer device (9) remaining in the air circulation duct (3) serves as a heater and during the operation of the heat pump dryer (1), the temperature of the drying air and hence the drying efficiency is increased as a result of the heat taken from the compressor (7) by means of the heat transfer device (9) being transferred to the air circulation duct (3). The heat transfer device (9) also contributes to the cooling of the compressor (7) and thus increase in efficiency of the compressor (7) is provided.

[0034] In the heat pump type dryer (1) of the present invention, disposing the compressor (7) neither near the air circulation duct (3) nor in the air circulation duct (3) is required for taking advantage of the waste heat discharged from the compressor (7); the heat of the compressor (7) is transferred to the air circulation duct (3) only by means of the heat transfer device (9) extending from the compressor (7) to the air circulation duct (3) regardless of the position of the compressor (7) with regards to the air circulation duct (3).

[0035] In the preferred embodiment of the present invention, a heat pipe is used as the heat transfer device (9) in the heat pump type dryer (1). In the state

of the art the heat pipe is identified as a device providing heat transfer between two locations by the utilization of the evaporation and condensation features of a fluid therein.

[0036] In this embodiment, the heat transfer device (9) comprises an evaporating section (10) located at the end which contacts the compressor (7) and enabling the compressor (7) to be cooled by absorbing the heat in the compressor (7) as a result of the evaporation effect of the fluid therein and a condensing section (11) located at the end which extends into the air circulation duct (3) and enabling the absorbed heat to be transferred to the air circulation duct (3) and the drying air to be heated as a result of the condensation effect of the fluid therein.

[0037] In an embodiment of the present invention, the condensing section (11) of the heat transfer device (9) extending into the air circulation duct (3) is located between the evaporator (5) and the condenser (6). In this embodiment, in the air circulation duct (3) the pre-heating of the low-humid and cooled drying air coming through the evaporator (5) prior to the condenser (6) is enabled and energy saving is provided by decreasing the drying duration.

[0038] In another embodiment of the present invention, the heat pump type dryer (1) comprises more than one heat dissipation fin (12) mounted to the end of the heat transfer device (9) that is in the air circulation duct (3). In this embodiment, the surface area enabling the heat transfer from the end of the heat transfer device (9) that is in the air circulation duct (3) to the drying air is increased by means of the heat dissipation fins (12) and the drying air is heated efficiently.

[0039] In another embodiment of the present invention, the end of the heat transfer device (9) contacts the compressor (7) in a suitable geometry with the shape of the outer surface of the compressor (7) casing. Thus the heat transfer device (9) wraps at least one part of the outer surface of the compressor (7) casing and the ability of the heat transfer device (9) of absorbing the heat of the compressor (7) is increased.

[0040] In another embodiment of the present invention, the heat pump type dryer (1) comprises a cooling fan (13) enabling the compressor (7) to be cooled

and the heat transfer device (9) is disposed in the air flow line blown by the cooling fan (13) and sweeping the compressor (7) casing. Thus, the forced heat convection created by the air blown by the cooling fan (13) is utilized and the transfer efficiency of the heat of the compressor (7) to the heat transfer device (9) is increased.

[0041] In the heat pump type dryer (1) of the present invention, the compressor (7) is cooled by transferring the heat of the compressor (7) to the air circulation duct (3) wherein the drying air is circulated by means of the heat transfer device (9), for example by means of a heat pipe and the performance of the compressor (7) is increased.

[0042] The heat absorbed from the compressor (7) by means of the heat transfer device (9) is used for the heating of the drying air in the air circulation duct (3), thus energy savings is provided as a result of decreasing the drying duration.

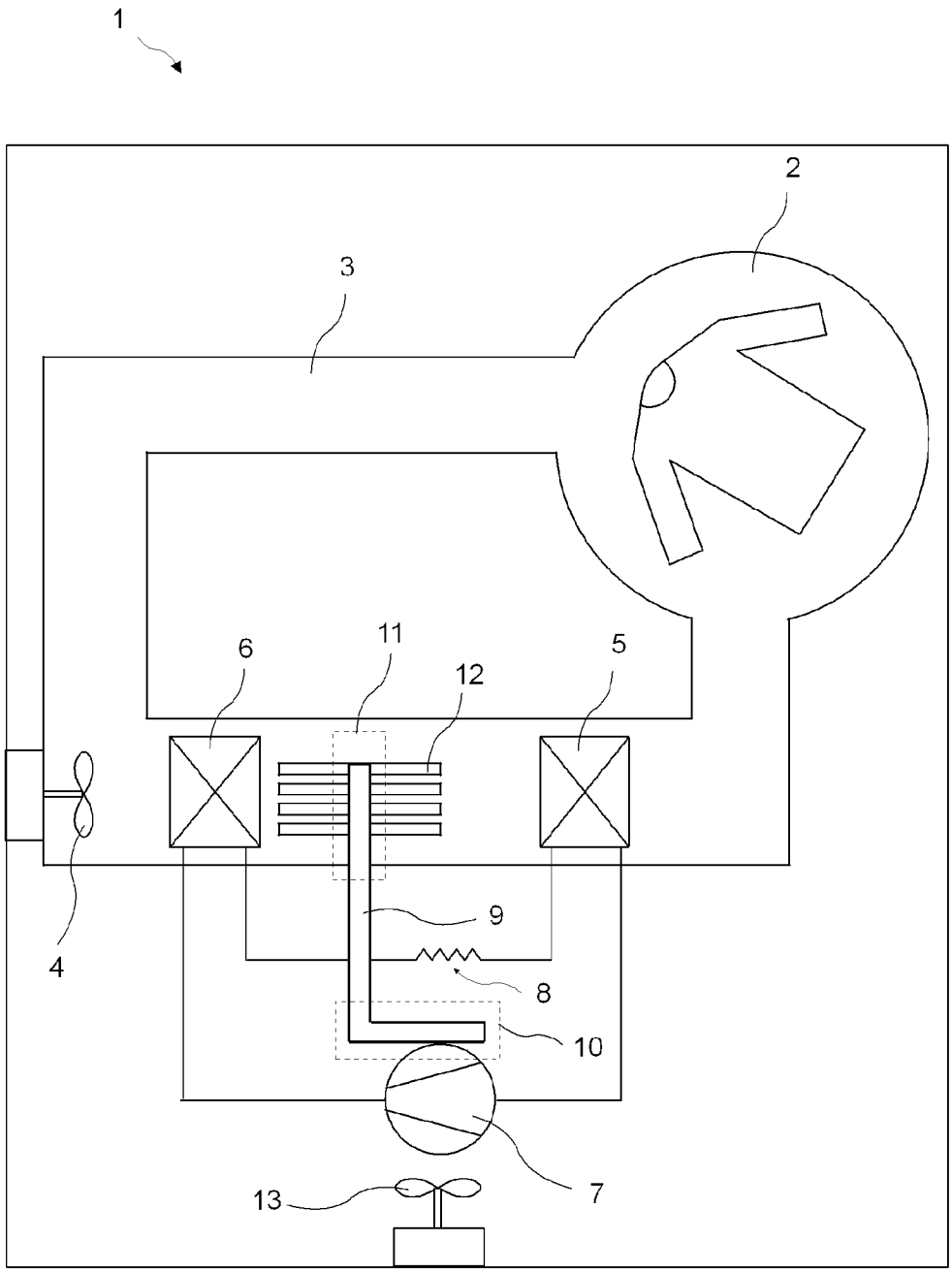
[0043] Disposing the compressor (7) neither near nor in the air circulation duct (3) is required for taking advantage of the waste heat discharged from the compressor (7); the heat is efficiently transferred to the drying air in the air circulation duct (3) by means of the heat transfer device (9) extending from the compressor (7) to the air circulation duct (3) regardless of the position of the compressor (7) with regards to the air circulation duct (3).

Claims

1. A heat pump type dryer (1) comprising a tub (2) wherein the laundry to be dried is emplaced, an air circulation duct (3) wherein the drying cycle air is circulated, a fan (4) providing the continuity of the air flow in the air circulation duct (3) and the tub (2) throughout the drying cycle, an evaporator (5) disposed in the air circulation duct (3), cooling and reducing the humidity of the warm and humid air that comes from the tub (2) and passes through the said evaporator (5), a condenser (6) disposed in the air circulation duct (3), heating the low-humid air coming through the evaporator (5) and a compressor (7) increasing the temperature and pressure of the refrigerant, characterized by a heat transfer device (9) with one end contacting the compressor (7) casing and the other end extending into the air circulation duct (3), and providing the waste heat discharged from the compressor (7) to be transferred to the air circulation duct (3).
2. A heat pump type dryer (1) as in Claim 1, characterized by the heat transfer device (9) being a heat pipe.
3. A heat pump type dryer (1) as in Claim 2, characterized by the heat transfer device (9) comprising an evaporating section (10) located at the end which contacts the compressor (7) and enabling the compressor (7) to be cooled by absorbing the heat in the compressor (7) as a result of the evaporation effect of the fluid therein and a condensing section (11) located at the end which extends into the air circulation duct (3) and enabling the absorbed heat to be transferred to the air circulation duct (3) and the drying air to be heated as a result of the condensation effect of the fluid therein.
4. A heat pump dryer (1) as in Claim 3, characterized by the heat transfer device (9), wherein the condensing section (11) extending into the air circulation duct (3) is located between the evaporator (5) and the condenser (6).
5. A heat pump dryer (1) as in any one of the above Claims, characterized by more than one heat dissipation fin (12) mounted to the end of the heat transfer device (9) that extends into the air circulation duct (3).
6. A heat pump dryer (1) as in any one of the above Claims, characterized by the heat transfer device (9) wrapping at least one part of the outer surface of the compressor (7) casing.

7. A heat pump dryer (1) as in any one of the above Claims, characterized by a cooling fan (13) providing the compressor (7) to be cooled and a heat transfer device (9) positioned in the air flow line blown by the cooling fan (13) and sweeping the compressor (7) casing.

Figure 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/058555

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F58/24 D06F58/26 D06F58/28

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2007 082864 A (MITSUBISHI ELECTRIC CORP; NIPPON KENTETSU CO LTD) 5 April 2007 (2007-04-05) cited in the application the whole document	1-7
X	EP 1 811 076 A (SANYO ELECTRIC CO [JP]) 25 July 2007 (2007-07-25) the whole document	1-7
X	JP 2008 080023 A (SANYO ELECTRIC CO) 10 April 2008 (2008-04-10) the whole document	1-7
X	JP 2007 143720 A (MITSUBISHI ELECTRIC CORP; NIPPON KENTETSU CO LTD) 14 June 2007 (2007-06-14) the whole document	1-7

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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/EP2009/058555

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2007082864 A	05-04-2007	NONE	
EP 1811076 A	25-07-2007	CN 101012618 A	08-08-2007
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