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(54) **DEHUMIDIFIER SYSTEM**

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EP 3 483 515 B1

Description

(a) Technical Field of the Invention

[0001] The present invention generally relates to the field of dehumidification of air, and more particularly to a dehumidifier system.

(b) Description of the Prior Art

[0002] Dehumidification devices that have been commonly used heretofore are rotary wheel dehumidifiers and compressor dehumidifiers. The compressor dehumidifier comprises, as major components thereof, a compressor, an evaporator, a condenser, a capillary tube, copper tubes connected among these components, and an air blower system. The compressor dehumidifier makes use of phase change of a refrigerant to lower the temperature of surrounding air to dew point for formation of condensate water. When the surrounding temperature is relatively low (less than 15-16 degrees Celsius), the temperature of the evaporator might become lower than 0 degree Celsius. Under this condition, the surrounding air, when entering the evaporator, gets frosting directly. With continuous operation of the compressor dehumidifier, the frost formed on the evaporator becomes thicker and thicker so that it becomes necessary for the dehumidifier to start an automatic defrosting operation. A commonly adopted defrosting operation is to shut down the compressor and the compressor would only be re-started after the frost turns into water. Further, in a low temperature environment, due to the defrosting so carried out, there would be more idle time of the compressor dehumidifier that is spent in defrosting. Since no dehumidification is carried out during the idle time, the amount of moisture that the compressor dehumidifier may remove from air is only a small fraction of that in a standard environment condition (26.7° and 60%). For a dehumidification capacity of 12L achievable in an operation carried out in the condition of 26.7° and 60%, only 1.5L capacity may be available for a low temperature environment (10° and 60%). Thus, the dehumidification capacity of the compressor dehumidifier gets lowered at a low temperature and this leads to a lower operation efficiency of the compressor dehumidifier.

[0003] Prior art patent documents are known, such as US 2012/085112 A1 and US 5 816 065 A. Both US 2012/085112 A1 and US 5 816 065 A provide a dehumidification system that includes a heat-pump sub-system and an air-conditioning sub-system that are set up in a split arrangement including outdoor heat dissipating and indoor air conditioning, and separate and independent airflow channels are required. This makes it impossible to have the sub-system integrated in a compact arrangement.

SUMMARY OF THE INVENTION

[0004] An objective of the present invention is to provide a dehumidifier system, which aims to overcome the issue of low operation efficiency of a compressor dehumidifier caused by reduced dehumidification performance in a low temperature environment and frosting on an evaporator.

[0005] To overcome the above technical problems, a technical solution adopted in this invention provides the following:

A dehumidifier system comprises a main enclosure that has an air inlet opening and an air outlet opening, characterized by further comprising a compressor based dehumidification assembly, a rotary wheel based humidification assembly, and an air blower that are arranged in an interior of the main enclosure, wherein the compressor based dehumidification assembly comprises an evaporator, a condenser, a compressor, and a throttle element; wherein the rotary wheel based humidification assembly comprises a dehumidification roller, a regeneration air blower, a heating element and a heat exchanger that includes a first heat exchange passage and a second heat exchange passage that are not in communication with each other; wherein the first heat exchange passage, the regeneration air blower, the heating element, and the dehumidification roller are arranged, in a circulative and communicating configuration, to form a regeneration circulation airflow channel, in which air moves in a closed loop as being driven by the regeneration air blower through the heating element, the dehumidification roller to further pass through the first heat exchange passage of the heat exchanger to return to the regeneration air blower; and wherein the air inlet opening, the second heat exchange passage, the evaporator, the air blower, and the air outlet opening, are arranged, in a circulative and communicating configuration, to form a first airflow channel, in which air moves in an open loop by first moving from the air inlet opening through the second heat exchange passage of the heat exchanger and the evaporator to be driven by the air blower to discharge through the air outlet opening, wherein a second airflow channel is formed of the air inlet opening, the condenser, the dehumidification roller, the air blower, and the air outlet opening that are arranged to communicate with each other.

[0006] Preferably, the first airflow channel further comprises a part of airflow channel that is in communication with the condenser, wherein the air inlet opening, the second heat exchange passage, the evaporator, the condenser, the air blower, and the air outlet opening are arranged to communicate in sequence with each other.

[0007] The first airflow channel may further comprise

a part of airflow channel that is in communication with the dehumidification roller, wherein the air inlet opening, the second heat exchange passage, the evaporator, the condenser, the dehumidification roller, the air blower, and the air outlet opening are arranged to communicate in sequence with each other.

[0008] Preferably, the heat exchanger, the evaporator, the condenser, and the dehumidification roller are arranged side by side in an interior of the main enclosure and the evaporator has an exit facing the condenser and the condenser has an exit facing the dehumidification roller.

[0009] Beneficial efficacy of the present invention is as follows:

In the present invention, a compressor based dehumidification assembly and a rotary wheel based humidification assembly are combined with each other. The rotary wheel based humidification assembly comprises a heat exchanger that generates, through heat exchange, air of a relatively high temperature. The compressor based dehumidification assembly comprises an evaporator, which is susceptible to frosting in an operation in a low temperature. With an arrangement of a first airflow channel to guide air from the heat exchanger to the evaporator, the temperature of air entering the evaporator is increased so that the evaporator does not readily get frosting in the operation thereof and thus dehumidification capability of the compressor based dehumidification assembly can be improved for operation in a low temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG 1 is a schematic view showing a structure of a first embodiment of the present invention.

FIG 2 is a schematic view showing a structure of a second embodiment of the present invention.

FIG 3 is a schematic view showing a structure of a third embodiment of the present invention.

FIG 4 is a schematic view showing a structure of a fourth embodiment of the present invention.

FIG 5 is a schematic view showing a structure of the fourth embodiment of the present invention in an example including an additional second airflow channel.

FIG 6 is a schematic view showing a structure of the fourth embodiment of the present invention in an example including an additional third airflow channel.

FIG 7 is a schematic view showing a structure of the fourth embodiment of the present invention in an example including additional second, third, and fourth airflow channels.

FIG 8 is a schematic view showing a structure of the fourth embodiment of the present invention in an example including an additional control valve, however not showing the regeneration circulation airflow channel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] To more clearly expound the purposes, technical solutions, and advantages of the present invention, a more detailed description of the present invention will be given, with reference to the attached drawings and embodiments thereof. It is appreciated that the embodiments described herein are provided only for explanation of the present invention and are not intended to impose undue limitations to the scope of the present invention which is defined in the claims.

[0012] It is noted here that when an element is referred to as "being fixed to" or "being mounted on" another element, it can be directly located on said another element or it can be indirectly located on said another element. When an element is referred to as "being connected to" another element, it can be directly connected to said another element or indirectly connected to said another element.

[0013] It is also noted that terminology concerning directions, such as left, right, up, and down, as used in the description of the embodiments are provided as being in a relative sense or with reference to a condition of normal use of a product and should not be construed as being limitative.

[0014] As shown in FIG. 1, a dehumidifier system according to the instant embodiment comprises a main enclosure 10 that has an air inlet opening 11 and an air outlet opening 12 and also comprises, arranged in an interior of the main enclosure 10 a compressor based dehumidification assembly, a rotary wheel based humidification assembly, and an air blower 40 that causes air to flow through the compressor based dehumidification assembly and the rotary wheel based humidification assembly to be discharged out of the main enclosure 10.

[0015] The compressor based dehumidification assembly comprises an evaporator 21, a condenser 22, a compressor 23, and a throttle element.

[0016] The rotary wheel based humidification assembly comprises a dehumidification roller 31, a regeneration air blower 32, a heating element 33 and a heat exchanger 34 that includes a first heat exchange passage (not shown in the drawings) and a second heat exchange passage (not shown in the drawings) that are not in communication with each other.

[0017] The evaporator 21, the condenser 22, the compressor 23, and the throttle element are arranged, in a circulative and communicating configuration, to form a heat pump circulation.

[0018] The first heat exchange passage, the regeneration air blower 32, the heating element 33, and the dehumidification roller 31 are arranged, in a circulative and communicating configuration, to form a regeneration circulation airflow channel A.

[0019] The air inlet opening 11, the second heat exchange passage, the evaporator 21, the air blower 40, and the air outlet opening 12 are arranged, in a circulative

and communicating configuration, to form a first airflow channel B.

[0020] When a surrounding temperature is low temperature (less than 15°C), during operation, a temperature of the evaporator 21 readily becomes lower than or approaching 0° and the evaporator 21 gets frosting in an interior structure thereof. Combining the rotary wheel based humidification assembly as an additive means with the compressor based dehumidification assembly would allow air in the first airflow channel B to first undergo heat exchange with the heat exchanger 34. Under such a condition, due to the dehumidification roller 31 being operable to release moisture after being heated, the air that enters the first heat exchange passage of the heat exchanger 34 has a temperature and humidity that are higher than a temperature and humidity of air entering the second heat exchange passage and an absolute temperature of the first heat exchange passage is higher than an absolute temperature of the second heat exchange passage. Under this condition, the air of the first airflow channel B passing through the heat exchanger 34 would cause the air in the first heat exchange passage to reach a temperature condition of dew point and thus turn into condensate water on an inside surface of the first heat exchange passage. Further, the air of the first heat exchange passage is also increased in temperature (becoming higher than the original 15°C) due to exchange heat with the heat exchanger 34 so that with the increase of temperature of the first airflow channel B, the evaporator 21 would not get frosting due to the temperature of the air moving therein. This would resolve the issue of frosting that might occur in the compressor based dehumidification assembly due to a low temperature. The compressor based dehumidification assembly can now continuously operate in a low temperature and an idle operation for the purpose of defrosting can be prevented. Compared to the prior art, the capability of dehumidification is increased and the efficiency of dehumidification is improved.

[0021] In the present invention, the compressor based dehumidification assembly and the rotary wheel based humidification assembly are combined with each other so that air having a high temperature is generated due to heat exchange with the heat exchanger 34 of the rotary wheel based humidification assembly, while although the evaporator 21 of the compressor based dehumidification assembly readily gets frosting in air of a low temperature, the arrangement of the first airflow channel B brings air from the heat exchanger 34 to the evaporator 21 to increase the temperature of air that enters the evaporator 21 thereby making the evaporator 21 not so easy to get frosting and thus effectively improving the dehumidification capacity of the compressor based dehumidification assembly in the low temperature.

[0022] In a high temperature, the rotary wheel based humidification assembly has a low dehumidification efficiency and the rotary wheel based humidification assembly could be shut down to allow the compressor based

dehumidification assembly to operate alone in order to improve the overall dehumidification efficiency of the entire system of this invention.

[0023] Detailed descriptions will be given to specific embodiments of the present invention, with reference being had to the attached drawings.

EMBODIMENT 1

[0024] The instant embodiment is shown in FIG. 1. The instant embodiment comprises a first airflow channel B that is made up of the air inlet opening 11, the second heat exchange passage, the evaporator 21, the air blower 40 and the air outlet opening 12 arranged in communication with each other and a second airflow channel C made up of the air inlet opening 11, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 arranged in communication with each other. Air of the second airflow channel C enters the condenser 22 and undergoes heat exchange with the condenser 22 to bring away heat from the condenser 22. The air of the second airflow channel C, after leaving the condenser 22, enters the dehumidification roller 31 and subjected to dehumidification by the dehumidification roller 31 to be discharged by the air blower 40 through the air outlet opening 12.

[0025] The heat exchanger 34, the evaporator 21, the condenser 22, and the dehumidification roller 31 are arranged side by side, in a parallel arrangement, inside the main enclosure 10 with an exit of the evaporator 21 facing the condenser 22 and an air exit of the condenser 22 facing the dehumidification roller 31. Air of the first airflow channel B moves straightforward from the air inlet opening toward the evaporator 21, and is directly guided, after passing through the evaporator 21, toward the air outlet opening, while air of the second airflow channel C, after passing through the condenser, is directly towards the air blower 40. Such arrangements of the first airflow channel B and the second airflow channel C feature shortened lengths and reduced bends. The above-described arrangement of the four components is advantageous for shortening the lengths of the first airflow channel B and the second airflow channel C and reducing bends of these channels so that the internal arrangement of the main enclosure 10 is made neat and is easy for setting up the airflow channels. Further, the air blower 40 is arranged at an outer side of the dehumidification roller 31.

[0026] The main enclosure 10 is configured with an upper chamber and a lower chamber. The heat exchanger 34, the evaporator 21, the condenser 22, and the dehumidification roller 31 are arranged in the upper chamber of the main enclosure 10. The instant embodiment further comprises a water accumulation tank 60 for collecting and holding therein condensate water from the heat exchanger 34 and the evaporator 21. The compressor 23 and the water accumulation tank 60 are arranged in the lower chamber, and the water accumulation tank 60 is located under the heat exchanger 34 and the evap-

erator 21.

[0027] In the first airflow channel B, air that enters the second heat exchange passage of the heat exchanger 34 undergoes heat exchange with high-temperature and high-humidity air in the first heat exchange passage and causes the air in the first heat exchange passage to carry out first condensation and dewing of the instant embodiment. The air of the first airflow channel B, after having been increased in temperature in the second heat exchange passage, subsequently enters the evaporator 21 to carry out second condensation and dewing of the instant embodiment, and is then discharged, through the air blower 40 and the air outlet opening 12, to outside of the main enclosure 10. The first airflow channel B functions to cause condensation and dewing of the high-temperature and high-humidity air of the circulation airflow channel A, allowing for normal circulation inside the circulation airflow channel A, while air of its own is subjected to condensation and dewing in the evaporator 21 to transfer heat to the evaporator 21 to maintain normal operation of the heat pump circulation of the compressor based dehumidification assembly.

[0028] In this case, the first airflow channel B functions as a channel for heating the evaporator 21 and for moisture removing and water condensing and since it undergoes one round of water condensation, it would reduce humidity of air of the dehumidification roller 31 if allowed to pass through the dehumidification roller 31 so as to lower the dehumidification efficiency of the dehumidification roller 31, whereby a preferred way is to let it discharged to the outside directly, while the dehumidification roller 31 can be used to filter air having higher humidity to improve the dehumidification efficiency thereof.

[0029] The dehumidification roller 31 is operable to absorb moisture from air located therein and the dehumidification roller 31 is kept in continuous rotation as being driven by a rotary electrical machine (not shown in the drawings) and continuously absorb moisture, wherein a portion of the dehumidification roller 31 that has absorbed therein moisture is rotated to a position corresponding to and facing the heating element 33. In the regeneration circulation airflow channel A, the regeneration air blower 32 draws dry air into the heating element 33 and the heating element 33 heats up the air, which then enters the portion of the dehumidification roller 31 corresponding to and facing the heating element 33 so that the heated, and thus high-temperature, dry air is allowed to dry the dehumidification roller 31, the air of the regeneration circulation airflow channel A, after passing the dehumidification roller 31, is turned into high-temperature and high-humidity air, which then enters the first heat exchange passage of the heat exchanger 34 to undergo heat exchange with air in the second heat exchange passage so that the air in the first heat exchange passage undergoes condensation and dewing. After passing through the heat exchanger 34, the air in the regeneration circulation airflow channel A is turned into dry air again for re-entry into the regeneration air blower 32 for the

next circulation cycle.

[0030] The instant embodiment combines the two dehumidification assemblies so as to possess the dehumidification capabilities of the two dehumidification assemblies and also eliminate the deficiency of the compressor based dehumidification assembly for operation in a low temperature to make the compressor based dehumidification assembly not ready to frost in the low temperature thereby effectively improving the dehumidification capability the dehumidifier system in a low temperature. The airflow channels of this embodiment have a simple and overall compact arrangement.

EMBODIMENT 2

[0031] Compared to EMBODIMENT 1, a difference of the instant embodiment is that, as shown in FIG. 2, a second airflow channel C made up of the air inlet opening 11, the condenser 22, the air blower 40, and the air outlet opening 12 that are arranged in communication with each other and a third airflow channel D made up of the air inlet opening 11, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 that are arranged in communication with each other are included. In the instant embodiment, the second airflow channel of EMBODIMENT 1 is replaced with the second airflow channel C and the third airflow channel D of this embodiment.

[0032] In the instant embodiment, air of the second airflow channel C enters from the air inlet opening 11, moves through the condenser 22 to exchange heat with the condenser 22 so as to dissipate heat from and thus cool down the condenser 22, and then discharges to the outside through the air blower 40 and the air outlet opening 12. High-humidity air of the third airflow channel D is drawn, through the air inlet opening 11, into the dehumidification roller 31 with moisture thereof being absorbed by the dehumidification roller 31 and then discharged to the outside through the air blower 40 and the air outlet opening 12. Compared to EMBODIMENT 1, an additional airflow channel is included, yet in the instant embodiment, high-temperature air of the condenser 22 is directly charged to the outside so that the high-temperature air is prevented from heating the dehumidification roller 31 to thereby avoid lowering the dehumidification efficiency of the dehumidification roller 31. Compared to EMBODIMENT 1, in the instant embodiment, the dehumidification roller 31 demonstrates even higher dehumidification efficiency.

EMBODIMENT 3

[0033] Compared to EMBODIMENT 1, a difference of the instant embodiment is that, as shown in FIG. 3, the first airflow channel B further comprises a part of airflow channel that is connected to the condenser 22 and thus, in an overall arrangement, the air inlet opening 11, the second heat exchange passage, the evaporator 21, the condenser 22, the air blower 40, and the air outlet open-

ing 12 are set in communication with each other in such a sequence. Air of the first airflow channel B moves, in sequence, through the air inlet opening 11, the second heat exchange passage, the evaporator 21, the condenser 22, the air blower 40, and the air outlet opening 12. In EMBODIMENT 1, the condenser 22 is included in the second airflow channel C, while in the instant embodiment, the condenser 22 is included in the first airflow channel B, wherein high-temperature air generated after passing through the condenser 22 is directly discharged outside the main enclosure 10 to prevent entry into the dehumidification roller 31 so as to help increase the dehumidification efficiency of the dehumidification roller 31.

[0034] The instant embodiment also comprises a second airflow channel C, wherein the air inlet opening 11, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 are arranged in communication with each other to form the second airflow channel C. Air entering the second airflow channel C is directly guided into the dehumidification roller 31, and air that passes through the dehumidification roller 31 is normal-temperature and high-humidity air and has not been heated by the condenser 22. Compared to EMBODIMENT 1, in the instant embodiment, air that passes through the dehumidification roller 31 may be of the same humidity, but the temperature is lower so that in the instant embodiment, the dehumidification roller 31 shows higher dehumidification efficiency.

EMBODIMENT 4

[0035] Compared to EMBODIMENT 1, a difference of the instant embodiment is that as shown in FIG. 4, the first airflow channel B further comprises an airflow channel in communication with the condenser 22 and the dehumidification roller 31 and, specifically, the air inlet opening 11, the second heat exchange passage, the evaporator 21, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 are arranged in communication with each other in such a sequence. The above basic configuration of the instant embodiment provides a structural arrangement of the simplest airflow channel and the simplest main enclosure 10.

[0036] In the basic configuration of the instant embodiment, air of the first airflow channel B moves, in sequence, through the heat exchanger 34, the evaporator 21, the condenser 22, and the dehumidification roller 31. Since air has to move through all the components, the overall air resistance is relatively large.

[0037] In the basic configuration of the instant embodiment, the main enclosure 10 is provided therein with airflow channels for replenishment of air to allow air external of the main enclosure 10 to directly enter the evaporator 21, or to directly enter the condenser 22, or to directly enter the dehumidification roller 31, so as to increase airflow channels for intake of air, allowing a part of the external air to detour round the heat exchanger 34

for direct entry into the evaporator 21, or to simultaneously detour round the heat exchanger 34 and the evaporator 21 for direct entry into the condenser 22, or to simultaneously detour round the heat exchanger 34, the evaporator 21, and the condenser 22 for direct entry into the dehumidification roller 31.

[0038] Various modifications can be made on the basic configuration of the instant embodiment in order to for example increase the airflow channels for replenishment of air. Such airflow channels may be provided in various alternative ways and examples are to selectively add three airflow channels for replenishment of air, which could respectively be a second airflow channel C, a third airflow channel D, and a fourth airflow channel E. The air inlet opening 11, the evaporator 21, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 are selectively set in communication with each other to form the second airflow channel C; the air inlet opening 11, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 are selectively in communication with each other to form the third airflow channel D; and the air inlet opening 11, the dehumidification roller 31, the air blower 40, and the air outlet opening 12 are selectively set in communication with each other to form the fourth airflow channel E.

[0039] As shown in FIG. 5, the first alternative way of embodiment includes adding only the second airflow channel C, wherein specifically, air flows along the second airflow channel C to move, in sequence, through the air inlet opening 11, the evaporator 21, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12. High-humidity air of the second airflow channel C makes direct entry into the evaporator 21, and thus, two airflows enter the evaporator 21 together. Due to the second airflow channel C, total humidity of air passing through the evaporator 21 is increased, wherein in the case where only the first airflow channel B is put in operation under the same condition, the addition of the second airflow channel C would effectively increase the total amount of water condensed by the evaporator 21.

[0040] As shown in FIG. 6, the second alternative way of embodiment includes adding only the third airflow channel D, wherein specifically, air flows along the third airflow channel D to move, in sequence, through the air inlet opening 11, the condenser 22, the dehumidification roller 31, the air blower 40, and the air outlet opening 12. Since air of the first airflow channel B moves through all the components, the overall air resistance is relatively large and this makes it harder for air to reach the condenser 22 and thus, head dissipation of the condenser 22 becomes difficult. Air in the third airflow channel D may make direct entry into the condenser 22 to exchange heat with the condenser 22 to improve heat exchange with the condenser 22 and also increase the total humidity of air passing the dehumidification roller 31.

[0041] As shown in FIG. 7, the third alternative way of embodiment includes adding the second airflow channel

C, the third airflow channel D, and the fourth airflow channel E, and thus, as compared to the above two alternative ways, air flow through the evaporator 21, the condenser 22, and the dehumidification roller 31 is increased, wherein among the three components, the dehumidification roller 31 receives the largest amount of increase of air so that the dehumidification roller 31 demonstrate a high dehumidification efficiency. Further, the air flow through the condenser 22 is larger than that of the evaporator 21 so as to provide higher heat dissipation efficiency. Simultaneously adding the three airflow channels allows for selectively and individually setting up the air flows of the three airflow channels so that air flow could be set at a large value for components showing insufficiency of air flow, while airflow cross-sectional area of an airflow channel that passes through a component where the demand for air flow is small can be properly reduced.

[0042] In each of the above three alternative ways of embodiment, a control valve 50 could be provided for controlling the air flow level or state of closing/opening of the second airflow channel C, the third airflow channel D, or the fourth airflow channel E. The instant embodiment further comprises an electric control module (not shown in the drawings) for controlling the operation of the compressor based dehumidification assembly, the rotary wheel based humidification assembly, and each individual control valve 50. Specifically, the electric control module functions to control opening and closing of the control valve 50 and an opening angle thereof and may respond to demand of functionality as instructed and input by a user to control opening time, closing time, and opening angle adjusting time of each individual control valve 50. Additional operation may be available for control starting time and shutdown time of the compressor based dehumidification assembly and the rotary wheel based humidification assembly.

[0043] In the instant embodiment, it is preferred to include three control valves 50 in the third alternative way to respectively associated with the second airflow channel C, the third airflow channel D, the fourth airflow channel E. As shown in FIG. 8, the three control valves 50 respectively control the second airflow channel C, the third airflow channel D, the fourth airflow channel E.

[0044] Specifically, in the instant embodiment, the heat exchanger 34, the evaporator 21, the condenser 22, the dehumidification roller 31 are arranged side by side in the interior of the main enclosure 10 such that a gap is provided between the heat exchanger 34 and the evaporator 21 and forms a part of the second airflow channel C and the control valve 50 associated with the second airflow channel C is set up at an entry site of the gap to control air flow through the gap be. A gap is provided between the heat exchanger 34 and the condenser 22 and forms a part of the third airflow channel D and the control valve 50 associated with the third airflow channel D is set up at an entry site of the gap to control air flow through the gap between the evaporator 21 and the condenser 22. A gap is provided between the condenser 22

and the dehumidification roller 31 and forms a part of the fourth airflow channel E and the control valve 50 associated with the fourth airflow channel E is set up at an entry site of the gap to control air flow through the gap between the condenser 22 and the dehumidification roller 31.

[0045] By using the electric control module to control each individual control valve 50 to open or close, it is possible to individually open any one of the second airflow channel C, the third airflow channel D, and the fourth airflow channel E, such as individually opening the control valve 50 associated with the second airflow channel C to allow direct entry of air into the evaporator 21, or individually opening the control valve 50 associated with the fourth airflow channel E to allow direct entry of air into the dehumidification roller 31. Alternatively, any two of the control valves 50 can be combined or an operation of simultaneously opening all the control valves 50 can be made. Further, the electric control module may adjust the opening angle of the control valve 50 to achieve control of air flow through each of the gaps, meaning controlling the air flow through each of the second airflow channel C, the third airflow channel D, and the fourth airflow channel E so that in use, it is possible to control the control valves 50 according to different operation environments or different user requirements for opening and closing or opening to a desired angle to allow the compressor based dehumidification assembly and the rotary wheel based humidification assembly to achieve the greatest performance thereof. The seventh example includes the arrangement of the control valve(s) 50 and the electric control module so that the electric control module is operable to control the opening and closing of each of the control valves 50 to achieve all the functions available for the basic configuration and the alternative seven embodiments and thus the addition of the control valve(s) 50 and the electric control module provide diversified functionality of this invention.

[0046] The present invention is applicable to suit the needs of complicated operations. For example, in case of drying clothing indoors, the control module of the present invention may make adjustment of the operation conditions of the two sets of dehumidification assembly and the control status of the three control valves so that the present invention can be used in a clothing drying mode.

[0047] The rotary wheel based humidification assembly comprises a heating element 33 and the compressor based dehumidification assembly comprises a condenser 22. The two components are components that release heat. Thus, air, when passing through the heat exchanger 34, generates an effect of temperature increasing and causes temperature drop when subsequently passes through the evaporator 21 of the system associated with the compressor 23, with a portion of moisture being condensed on the evaporator 21, and then causes temperature increase again in subsequent pass through the condenser 22, and finally causes temperature increase further again in passing through the dehumidification roller

31 with a part of moisture being further absorbed by the dehumidification roller 31. Air fed out of the system would have an increased temperature and a reduced level of humidity, as compared to surrounding air, providing hot dry air that is best suit for drying clothing.

[0048] Since the moisture contained in the clothing may evaporate fast at a high temperature, the system of the present invention, due to combination of the compressor based dehumidification assembly and the rotary wheel based humidification assembly, is operable in a clothing drying process by selectively activating one of the dehumidification assemblies or both, with the electric control module, in response to the temperature and humidity of a clothing drying environment, plus message concerning the amount of clothing and the size of the clothing drying environment supplied and input by a user in order to achieve the most efficient result of clothing drying, such as the time period for drying clothing being the shortest or the clothing drying operation being carried out in a most energy-saving manner.

[0049] During a clothing drying process, the water content of the clothing is the greatest just before the dehumidifier is activated. At this moment, a dry hot airflow having the highest available temperature applied to blow toward the clothing would quickly evaporate and remove the water. With the water content in the clothing getting lowered, a clothing drying efficiency ratio (g/kW.h) between the amount of water evaporated and the amount of hot dry air generated by the dehumidifier system is getting lowered and at this moment, the electric control module may be operated to shut down one of the dehumidification assemblies to reduce energy consumption in order to increase the clothing drying efficiency ratio. Since the clothing drying efficiency of individual ones of the two dehumidification assemblies may be different according to the temperature and humidity of the clothing drying environment, electrical control operation may be such that a determination may be made to activate one of the devices according to result of researches conducted in laboratories.

[0050] In the clothing drying mode, the electric control module may make a combined determination according to the clothing drying process and temperature and humidity of the environment and may be operated to simultaneously activate the two dehumidification assemblies or activate/deactivate one of the dehumidification assemblies to achieve the highest clothing drying efficiency (g/kW.h).

[0051] In a practical operation, in a low temperature environment (10°, 60%), an individual operation of the dehumidification roller 31 provide a dehumidification capacity of 5L with a power consumption of 600W, so that the dehumidification efficiency, which is dehumidification capacity/power consumption, is equal to $5L/(600W*24H)=5L/14.4kW=0.347L/1kW$. Individual operation of the compressor 23 for dehumidification, the dehumidification capacity is 1.5L with a power consumption of 200W, so that the dehumidification efficiency is

equal to $1.5L/(200W*24H)=1.5L/4.8kW=0.313L/1kW$. When both devices are activated, the dehumidification capacity is 8L with a power consumption of 800W, so that the dehumidification efficiency is equal to $8L/(800W*24H)=8L/19.2kW=0.417L/1kW$. These three sets of data clearly reveal that the present invention may effectively improve overall dehumidification efficiency.

[0052] The above provides preferred embodiments of the present invention and is not intended to limit the present invention, the protection scope of the present invention being defined in the appended claims.

Claims

1. A dehumidifier system, comprising a main enclosure (10) that has an air inlet opening (11) and an air outlet opening (12), comprising a compressor based dehumidification assembly, a rotary wheel based humidification assembly, and an air blower (40) that are arranged in an interior of the main enclosure (10),

wherein the compressor based dehumidification assembly comprises an evaporator (21), a condenser (22), a compressor (23), and a throttle element;

wherein the rotary wheel based humidification assembly comprises a dehumidification roller (31), a regeneration air blower (32), a heating element (33) and a heat exchanger (34) that includes a first heat exchange passage and a second heat exchange passage that are not in communication with each other;

wherein the first heat exchange passage, the regeneration air blower (32), the heating element (33), and the dehumidification roller (31) are arranged, in a circulative and communicating configuration, to form a regeneration circulation airflow channel (A), in which air moves in a closed loop as being driven by the regeneration air blower (32) through the heating element (33), the dehumidification roller (31) to further pass through the first heat exchange passage of the heat exchanger (34) to return to the regeneration air blower (32); and

wherein the air inlet opening (11), the second heat exchange passage, the evaporator (21), the air blower (40), and the air outlet opening (12), are arranged, in a circulative and communicating configuration, to form a first airflow channel (B), in which air moves in an open loop by first moving from the air inlet opening (11) through the second heat exchange passage of the heat exchanger (34) and the evaporator (21) to be driven by the air blower (40) to discharge through the air outlet opening (12),

and wherein a second airflow channel (C) is formed of the air inlet opening (11), the condens-

er (22), the dehumidification roller (31), the air blower (40), and the air outlet opening (12) that are arranged to communicate with each other.

2. The dehumidifier system according to claim 1, **characterized in that** the first airflow channel (B) further comprises a part of airflow channel that is in communication with the condenser (22), wherein the air inlet opening (11), the second heat exchange passage, the evaporator (21), the condenser (22), the air blower (40), and the air outlet opening (12) are arranged to communicate in sequence with each other.
3. The dehumidifier system according to claim 2, **characterized in that** the first airflow channel (B) further comprises a part of airflow channel that is in communication with the dehumidification roller (31), wherein the air inlet opening (11), the second heat exchange passage, the evaporator (21), the condenser (22), the dehumidification roller (31), the air blower (40), and the air outlet opening (12) are arranged to communicate in sequence with each other.
4. The dehumidifier system according to any one of claims 1-3, **characterized in that** the heat exchanger (34), the evaporator (21), the condenser (22), and the dehumidification roller (31) are arranged side by side in an interior of the main enclosure (10) and the evaporator (21) has an exit facing the condenser (22) and the condenser (22) has an exit facing the dehumidification roller (31).

Patentansprüche

1. Entfeuchtungssystem, das ein Hauptgehäuse (10) umfasst, das eine Lufteinlassöffnung (11) und eine Luftauslassöffnung (12) aufweist, das eine Entfeuchtungsanordnung auf Kompressorbasis, eine Befeuchtungsanordnung auf Drehradbasis und ein Luftgebläse (40) umfasst, die im Inneren des Hauptgehäuses (10) angeordnet sind,

wobei die Entfeuchtungsanordnung auf Kompressorbasis einen Verdampfer (21), einen Kondensator (22), einen Kompressor (23) und ein Drosselement umfasst;

wobei die Befeuchtungsanordnung auf Drehradbasis eine Entfeuchtungsrolle (31), ein Regenerationsluftgebläse (32), ein Heizelement (33) und einen Wärmetauscher (34) umfasst, der einen ersten WärmetauschkDurchgang und einen zweiten WärmetauschkDurchgang enthält, die nicht in Verbindung miteinander stehen;

wobei der erste WärmetauschkDurchgang, das Regenerationsluftgebläse (32), das Heizelement (33) und die Entfeuchtungsrolle (31) in ei-

ner zirkulierenden und kommunizierenden Konfiguration angeordnet sind, um einen Regenerationszirkulationsluftstromkanal (A) zu bilden, in dem sich Luft in einer geschlossenen Schleife bewegt, während sie von dem Regenerationsluftgebläse (32) durch das Heizelement (33) und die Entfeuchtungsrolle (31) angetrieben wird, um weiter durch den ersten WärmetauschkDurchgang des Wärmetauschers (34) zu strömen, um zu dem Regenerationsluftgebläse (32) zurückzukehren; und

wobei die Lufteinlassöffnung (11), der zweite WärmetauschkDurchgang, der Verdampfer (21), das Luftgebläse (40) und die Luftauslassöffnung (12) in einer zirkulierenden und kommunizierenden Konfiguration angeordnet sind, um einen ersten Luftstromkanal (B) zu bilden, in dem sich Luft in einer offenen Schleife bewegt, indem sie sich zuerst von der Lufteinlassöffnung (11) durch den zweiten WärmetauschkDurchgang des Wärmetauschers (34) und den Verdampfer (21) bewegt, um durch das Luftgebläse (40) angetrieben zu werden, um durch die Luftauslassöffnung (12) auszuströmen, und

wobei ein zweiter Luftstromkanal (C) aus der Lufteinlassöffnung (11), dem Kondensator (22), der Entfeuchtungsrolle (31), dem Luftgebläse (40) und der Luftauslassöffnung (12) gebildet wird, die angeordnet sind, um miteinander zu kommunizieren.

2. Entfeuchtungssystem nach Anspruch 1, **gekennzeichnet dadurch, dass** der erste Luftstromkanal (B) ferner einen Teil des Luftstromkanals umfasst, der in Verbindung mit dem Kondensator (22) steht, wobei die Lufteinlassöffnung (11), der zweite WärmetauschkDurchgang, der Verdampfer (21), der Kondensator (22), das Luftgebläse (40) und die Luftauslassöffnung (12) angeordnet sind, um nacheinander miteinander zu kommunizieren.
3. Entfeuchtungssystem nach Anspruch 2, **gekennzeichnet dadurch, dass** der erste Luftstromkanal (B) ferner einen Teil des Luftstromkanals umfasst, der in Verbindung mit der Entfeuchtungsrolle (31) steht, wobei die Lufteinlassöffnung (11), der zweite WärmetauschkDurchgang, der Verdampfer (21), der Kondensator (22), die Entfeuchtungsrolle (31), das Luftgebläse (40) und die Luftauslassöffnung (12) angeordnet sind, um nacheinander miteinander zu kommunizieren.
4. Entfeuchtungssystem nach einem der Ansprüche 1-3, **gekennzeichnet dadurch, dass** der Wärmetauscher (34), der Verdampfer (21), der Kondensator (22) und die Entfeuchtungsrolle (31) nebeneinander im Inneren des Hauptgehäuses (10) angeordnet sind und der Verdampfer (21) einen Ausgang

aufweist, der dem Kondensator (22) zugewandt ist, und der Kondensator (22) einen Ausgang aufweist, der der Entfeuchtungsrolle (31) zugewandt ist.

Revendications

1. Système déshumidificateur, comprenant une enceinte principale (10) qui a une ouverture d'entrée d'air (11) et une ouverture de sortie d'air (12),

comprenant un ensemble de déshumidification basé sur un compresseur, un ensemble d'humidification basé sur une roue rotative et un souffleur d'air (40) qui sont agencés à l'intérieur de l'enceinte principale (10),

où l'ensemble de déshumidification basé sur le compresseur comprend un évaporateur (21), un condenseur (22), un compresseur (23) et un élément d'étranglement ;

où l'ensemble d'humidification basé sur une roue rotative comprend un rouleau de déshumidification (31), un souffleur d'air de régénération (32), un élément chauffant (33) et un échangeur de chaleur (34) qui comprend un premier passage d'échange de chaleur et un deuxième passage d'échange de chaleur qui ne sont pas en communication l'un avec l'autre ;

où le premier passage d'échange de chaleur, le souffleur d'air de régénération (32), l'élément chauffant (33) et le rouleau de déshumidification (31) sont agencés, dans une configuration de circulation et de communication, pour former un canal d'écoulement d'air de circulation de régénération (A), où l'air se déplace dans une boucle fermée en étant entraîné par le ventilateur d'air de régénération (32) à travers l'élément chauffant (33), le rouleau de déshumidification (31) pour continuer à traverser le premier passage d'échange de chaleur de l'échangeur de chaleur (34) pour retourner au souffleur d'air de régénération (32) ; et

où l'ouverture d'entrée d'air (11), le deuxième passage d'échange de chaleur, l'évaporateur (21), le souffleur d'air (40) et l'ouverture de sortie d'air (12) sont agencés, dans une configuration de circulation et de communication, pour former un premier canal d'écoulement d'air (B), où l'air se déplace en boucle ouverte en se déplaçant d'abord depuis l'ouverture d'entrée d'air (11) à travers le deuxième passage d'échange de chaleur de l'échangeur de chaleur (34) et de l'évaporateur (21) pour être entraîné par le souffleur d'air (40) pour décharger à travers l'ouverture de sortie d'air (12), et

où un deuxième canal d'écoulement d'air (C) est formé de l'ouverture d'entrée d'air (11), du condenseur (22), du rouleau de déshumidification

(31), du souffleur d'air (40) et de l'ouverture de sortie d'air (12) qui sont agencés pour communiquer les uns

2. Système déshumidificateur selon la revendication 1, **caractérisé en ce que** le premier canal d'écoulement d'air (B) comprend en outre une partie de canal d'écoulement d'air qui est en communication avec le condenseur (22), où l'ouverture d'entrée d'air (11), le deuxième canal d'échange de chaleur, l'évaporateur (21), le condenseur (22), le souffleur d'air (40) et l'ouverture de sortie d'air (12) sont agencés pour communiquer en séquence les uns avec les autres.
3. Système déshumidificateur selon la revendication 2, **caractérisé en ce que** le premier canal d'écoulement d'air (B) comprend en outre une partie de canal d'écoulement d'air qui est en communication avec le rouleau de déshumidification (31), où l'ouverture d'entrée d'air (11), le deuxième passage d'échange de chaleur, l'évaporateur (21), le condenseur (22), le rouleau de déshumidification (31), le souffleur d'air (40) et l'ouverture de sortie d'air (12) sont agencés pour communiquer en séquence les uns avec les autres.
4. Système déshumidificateur selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** l'échangeur de chaleur (34), l'évaporateur (21), le condenseur (22) et le rouleau de déshumidification (31) sont disposés côte à côte à l'intérieur de l'enceinte principale (10) et l'évaporateur (21) a une sortie tournée vers le condenseur (22) et le condenseur (22) a une sortie tournée vers le rouleau de déshumidification (31).

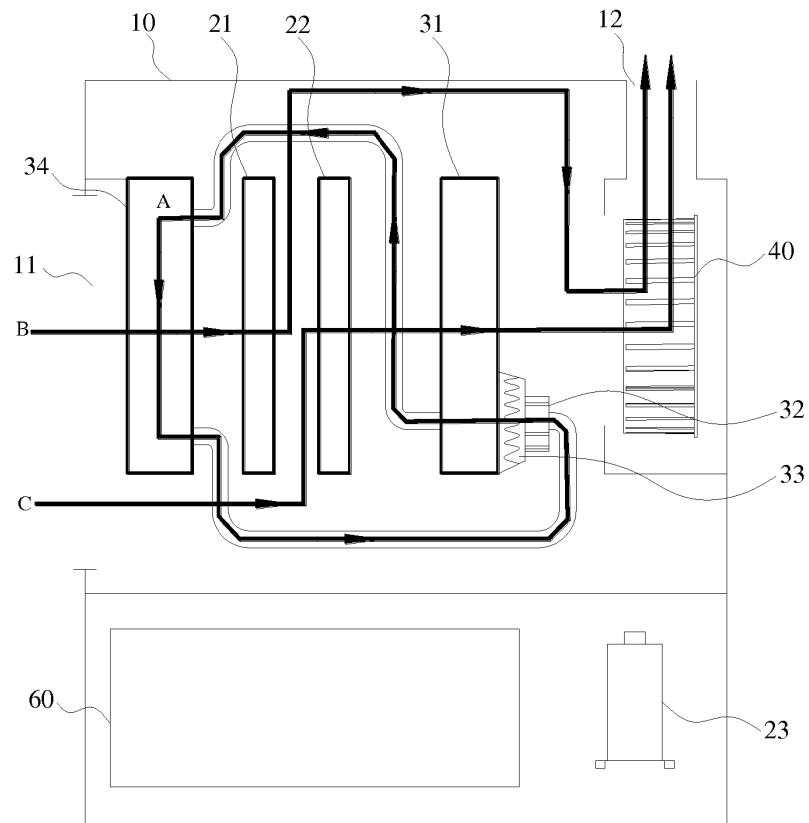


FIG. 1

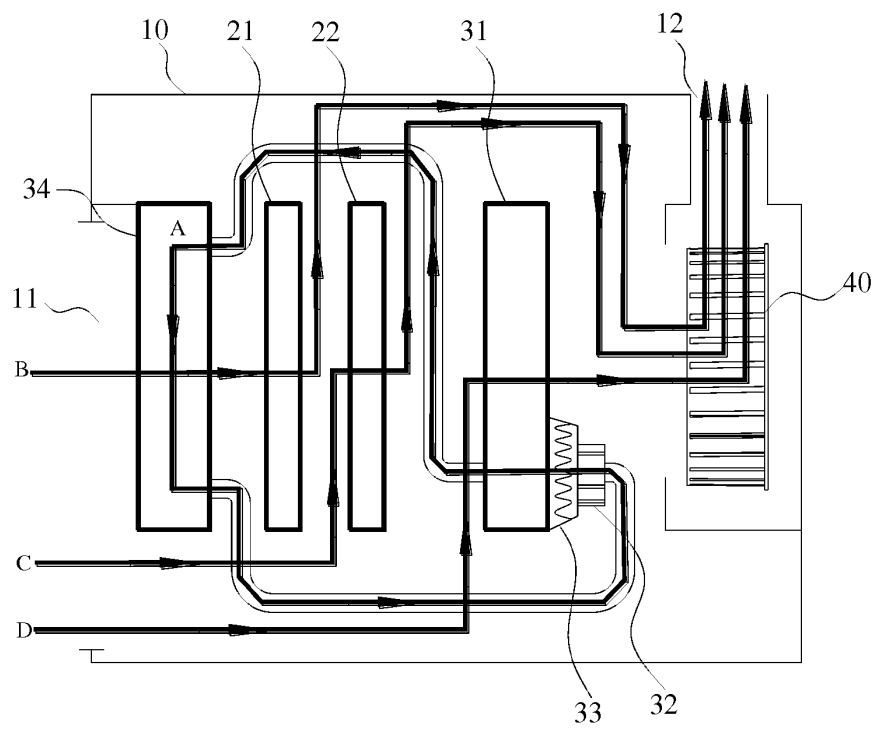


FIG. 2

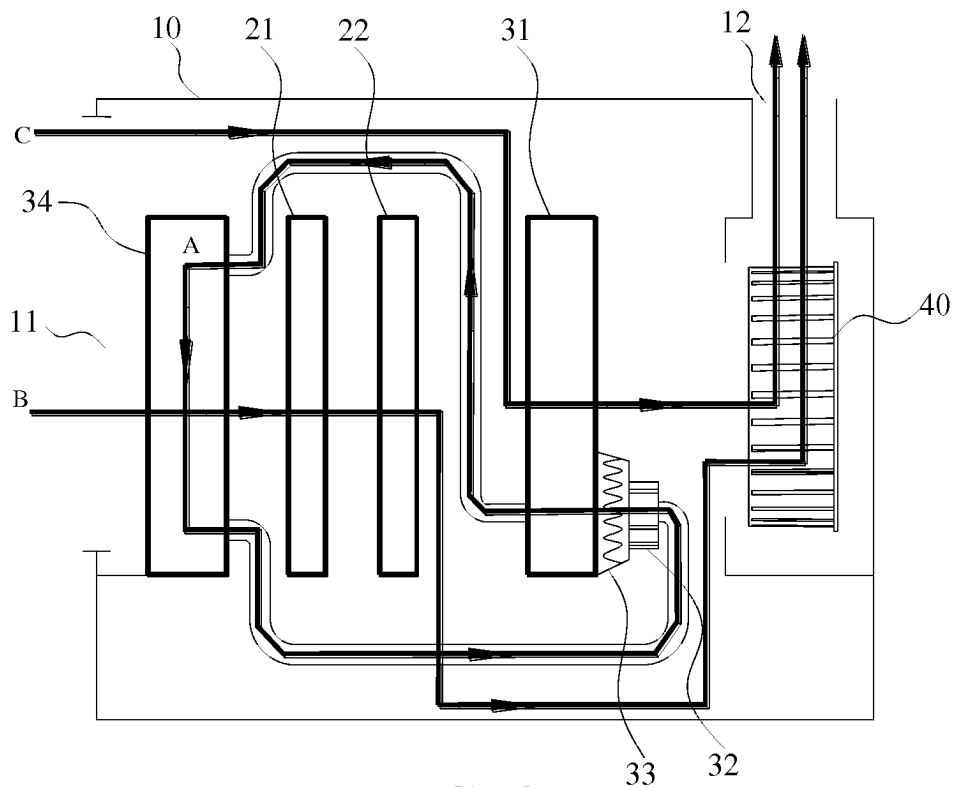


FIG. 3

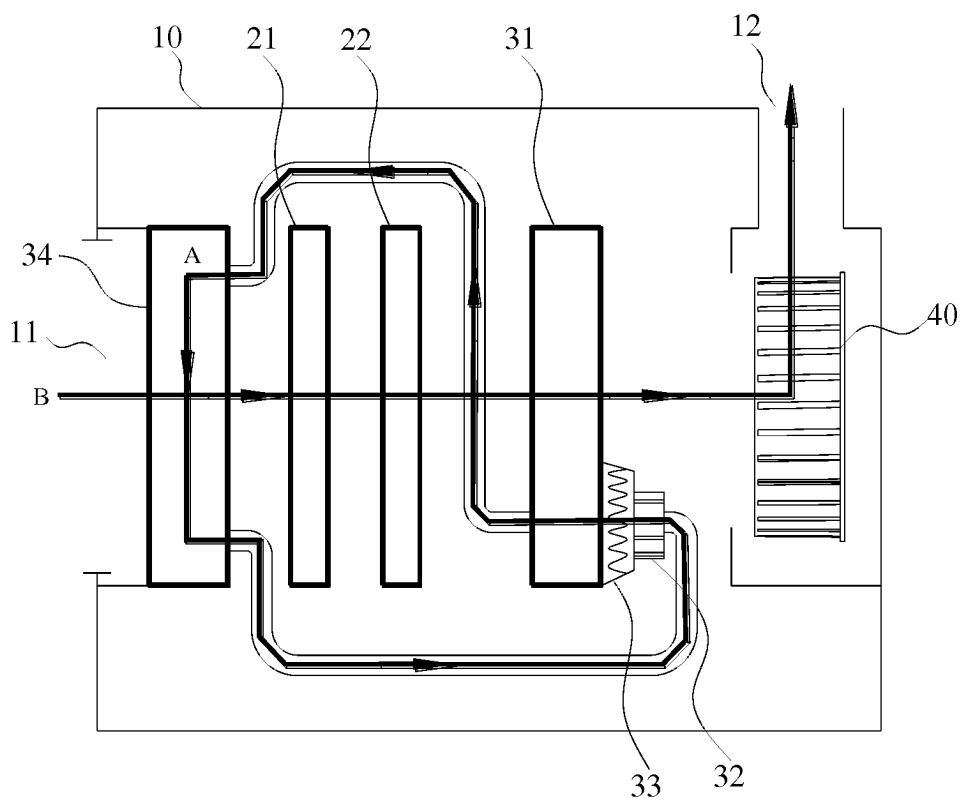


FIG. 4

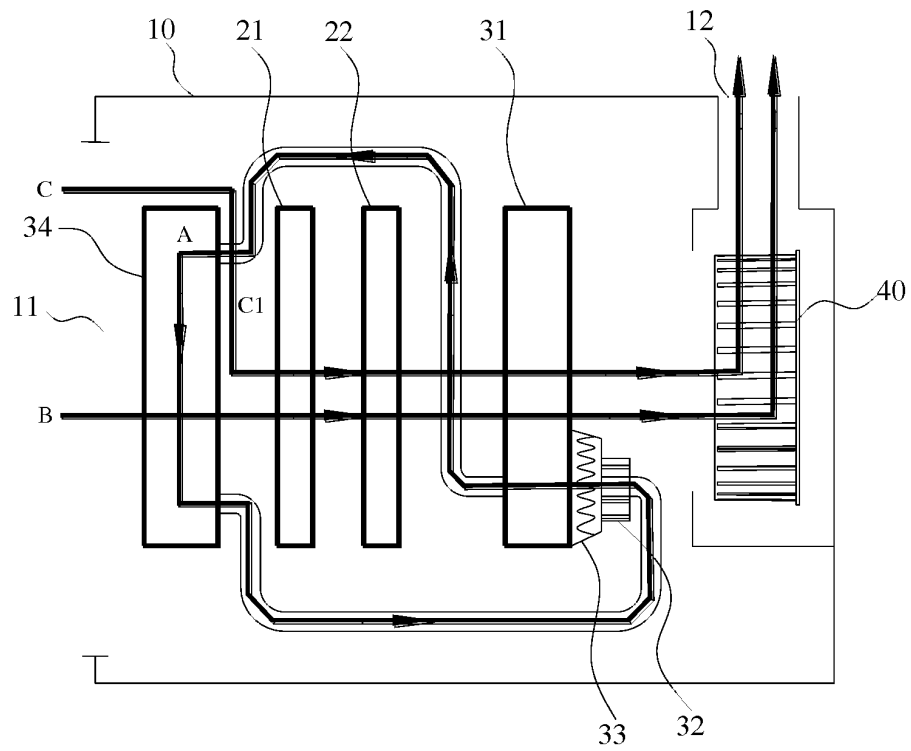


FIG. 5

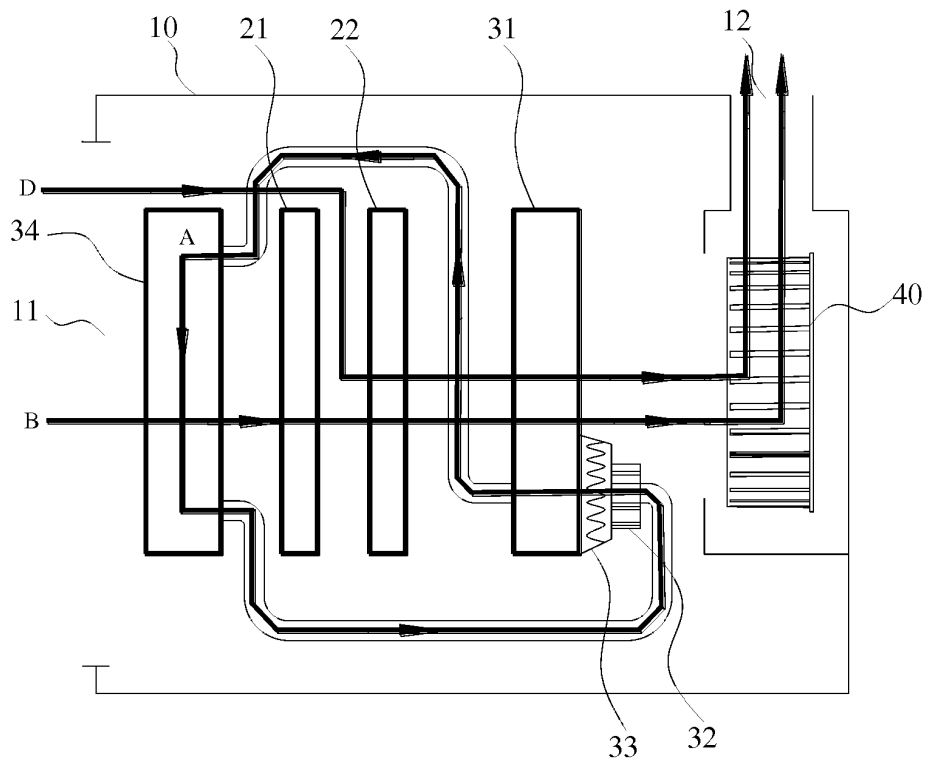


FIG. 6

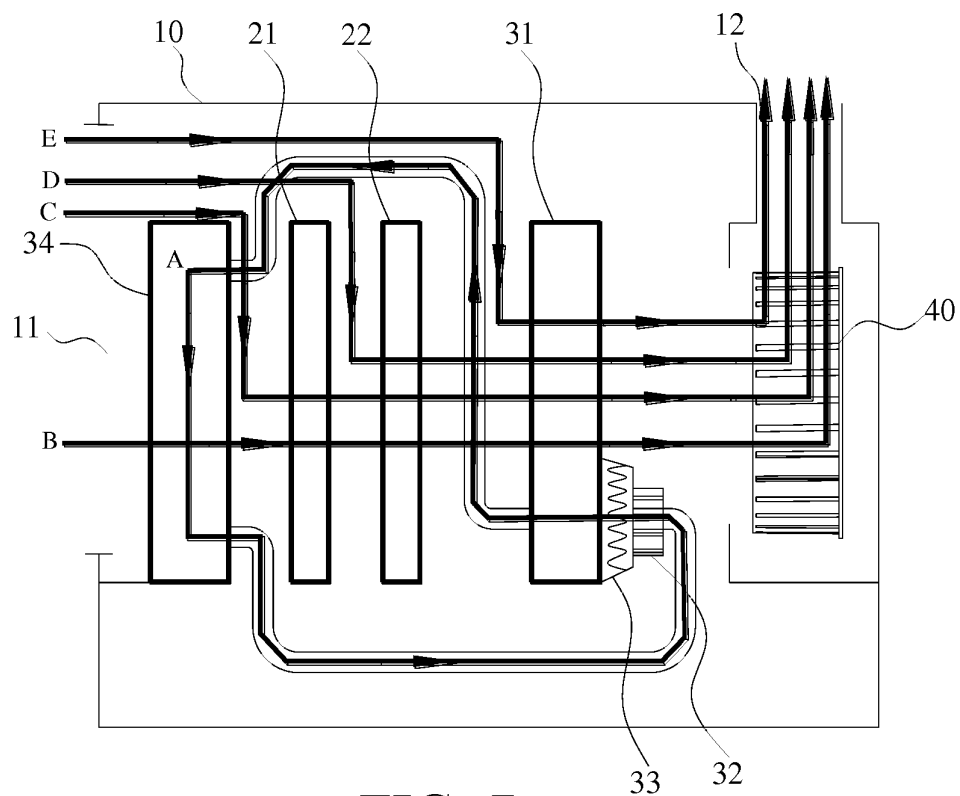


FIG. 7

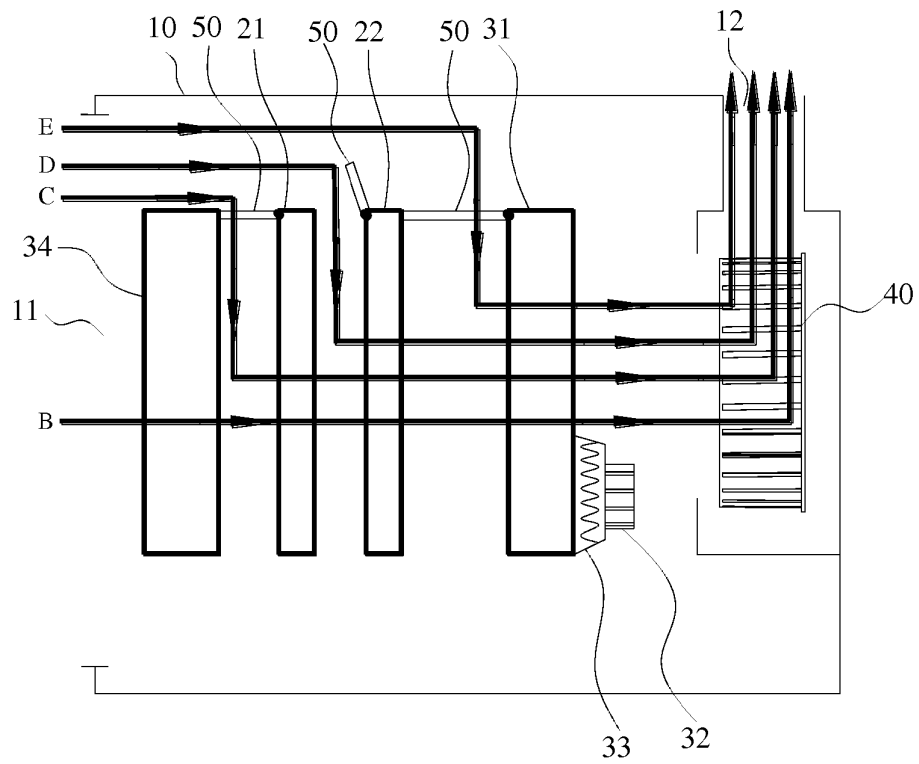


FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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