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(54) PORTABLE AIR CONDITIONER

TRAGBARE KLIMAANLAGE

CONDITIONNEUR D'AIR PORTABLE

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(73) Proprietor: **LG Electronics, Inc.**
Seoul 150-010 (KR)

(72) Inventor: **LEE, Sung-Hwa,**
Towol-Sungwon Apt. 503-402
641-010 Kyungsangnam-Do (KR)

(74) Representative: **Schmitt, Armand et al**
Office Ernest T. Freylinger S.A.
234, route d'Arlon,
B.P. 48
8001 Strassen (LU)

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Description

TECHNICAL FIELD

[0001] The present invention relates to a portable air conditioner, and more particularly to, a portable air conditioner which can individually provide a cool air current to each user and which can be easily moved due to a small size.

BACKGROUND ART

[0002] In general, an air conditioner pleasantly cools an indoor space such as a residential area, restaurant or office by using a refrigerating cycle. The operation of the conventional air conditioner using the refrigerating cycle will now be explained with reference to Fig. 1.

[0003] The conventional air conditioner using the refrigerating cycle includes a compressor 2 for compressing refrigerants into high temperature high pressure gas refrigerants, a condenser 4 for condensing the refrigerants from the compressor 2 into high temperature high pressure liquid refrigerants, an expansion means 6 for decompressing the refrigerants from the condenser 4 into low temperature low pressure refrigerants, such as a capillary tube or electronic expansion valve, and an evaporator 8 for evaporating the refrigerants from the expansion means 6 into low temperature low pressure gas refrigerants. The aforementioned elements are connected to each other through refrigerant pipe lines.

[0004] And it includes an outdoor air blowing means (not shown) having a radiation fan 12 and a motor (not shown) for forcibly blowing outdoor air to the condenser 4 and disposed in one side of the condenser 4, and an indoor air blowing means (not shown) having a cooling fan 14 and a motor (not shown) for forcibly blowing indoor air to the evaporator 8 and disposed in one side of the evaporator 8.

[0005] Here, the refrigerants passing through the condenser 4 are heat-exchanged with outdoor air and condensed, and the refrigerants passing through the evaporator 8 are heat-exchanged with indoor air and evaporated, to cool indoor air.

[0006] The operations of the motors for driving the compressor 2, the radiation fan 12 and the cooling fan 14 are controlled by a control unit (not shown). According to a size of the indoor space to be cooled, each capacity of the compressor 2, the radiation fan 12 and the cooling fan 14 is determined and the operations thereof are controlled by the control unit.

[0007] In the air conditioner, the compressor 2, the condenser 4, the expansion means 6, the evaporator 8, the outdoor air blowing means and the indoor air blowing means are incorporated into one unit and fixed to a wall or window, or the compressor 2, the condenser 4, the expansion means 6 and the outdoor air blowing means are incorporated into one outdoor unit and fixed to the outdoor space, and the evaporator 8 and the indoor air blowing means are incorporated into one indoor unit and fixed to the indoor space.

[0008] In the air conditioner, the compressor 2 is operated to circulate the refrigerants through the refrigerating cycle, and the radiation fan 12 and the cooling fan 14 are driven to forcibly blow outdoor air and indoor air to the condenser 4 and the evaporator 8, respectively.

[0009] In more detail, when the compressor 2 is operated, the refrigerants are compressed into high temperature high pressure gas refrigerants. The refrigerants passing through the compressor 2 are heat-exchanged with outdoor air and condensed into high temperature high pressure liquid refrigerants through the condenser 4. The refrigerants passing through the condenser 4 are expanded and decompressed into low temperature low pressure refrigerants through the expansion means 6. The refrigerants passing through the expansion means 6 are heat-exchanged with indoor air and evaporated into low temperature low pressure gas refrigerants through the evaporator 8, thereby cooling indoor air.

[0010] In addition, when the radiation fan 12 is operated, outdoor air is forcibly blown to the condenser 4, and thus efficiently heat-exchanged with the refrigerants passing through the condenser 4, and when the cooling fan 14 is operated, indoor air is forcibly blown to the evaporator 8, and thus efficiently heat-exchanged with the refrigerants passing through the evaporator 8.

[0011] However, in the conventional air conditioner, because the refrigerants are compressed under a high pressure, the compressor and the refrigerant pipe lines in which the high pressure refrigerants are circulated require high pressure resistance. Accordingly, a weight and size of the compressor and the refrigerant pipe lines increase. Moreover, the elements are connected to each other through the refrigerant pipe lines, and thus not easily installed or moved. When the user moves to a different space, the cooling effects are useless.

[0012] In the conventional air conditioner, the compressor is connected to the other elements through the refrigerant pipe lines, and thus vibrations and noises of the compressor are transmitted to the indoor space, which may irritate the users. Freon-based refrigerants of the air conditioner cause environmental pollution.

[0013] The conventional air conditioner cools the whole indoor space, and thus fails to satisfy all the users in the space. Furthermore, the air conditioner cools the part of the indoor space in which any of the users does not stay, which reduces cooling efficiency

[0014] UK patent application GB 2 267 338 discloses a device for thermoelectic air conditioning using a semiconductor thermoelectric cooler based on the Peltier effect and thereby eliminates the problem of noisy operation since no compressor is used.

[0015] United States Patent US 6,058.712 discloses all the features of the preamble of claim 1, thereby disclosing a system for conditioning air, which includes thermoelectric devices. Among others, this system comprises a thermoelectric module having a heat absorption unit for absorbing peripheral heat and a radiation unit for radiating heat to the periphery and performing heat absorption and radiation at the same time when receiving electric current. Furthermore, an air blowing means is installed near the heat absorption unit for blowing air to exchange heat between the heat absorption unit and the air and a radiation means is installed near the radiation unit for cooling the radiation unit. The system also includes a control unit for controlling the thermoelectric module, the air blowing means and the radiation means.

DISCLOSURE OF THE INVENTION

[0016] An object of the present invention is to provide a portable air conditioner, which despite being small and light for the user to use when he/she moves, has increased cooling efficiency.

[0017] Another object of the present invention is to provide a portable air conditioner which can guarantee a pleasant environment by preventing noises and vibrations and removing refrigerants.

[0018] Yet another object of the present invention is to provide a portable air conditioner which can improve users' satisfaction by controlling cooling for each user.

[0019] In order to achieve the above-described objects of the invention, there is provided a portable air conditioner including: a thermoelectric module having a heat absorption unit for absorbing peripheral heat and a radiation unit for radiating heat to the periphery in the facing portions, and performing heat absorption and radiation at the same time when receiving electric current; an air blowing means installed near the heat absorption unit, for blowing air to exchange heat between the heat absorption unit and the air, a radiation means installed near the radiation unit, for cooling the radiation unit; and a control unit for controlling the thermoelectric module, the air blowing means and the radiation means. The radiation means comprises a spray nozzle for spraying water to the radiation unit so that water sprayed from the spray nozzle to the radiation unit can be evaporatated to cool the radiation unit.

[0020] According to one aspect of the invention, the thermoelectric module includes P-type semiconductors and N-type semiconductors in pairs, and the heat absorption unit and the radiation unit are formed in both ends of the P-type semiconductors and the N-type semiconductors.

[0021] Preferably, the plurality of thermoelectric modules are connected in series.

[0022] More preferably, a plurality of heat absorption fins are installed in the heat absorption unit, and a plurality of radiation fins are installed in the radiation unit, for widening a heat transfer area.

[0023] According to another aspect of the invention, the air blowing means includes a heat absorption passage guide having a suction hole and a discharge hole for sucking and discharging air, having the heat absorption unit or heat absorption fins built in between the suction hole and the discharge hole, and guiding air, and a cooling fan and a motor installed inside the heat absorption passage guide, for blowing air along the heat absorption passage guide.

[0024] Preferably, in the heat absorption passage guide, the suction hole is formed in the lower portion, the discharge hole is formed in the upper portion, and the cooling fan is installed inside the discharge hole.

[0025] More preferably, the cooling fan is a cross flow fan.

[0026] According to yet another aspect of the invention, the radiation means includes a radiation fan and a motor for blowing air to the radiation unit, so that water sprayed from the spray nozzle to the radiation unit can be evaporated to cool the radiation unit.

[0027] Preferably, the radiation means further includes a radiation passage guide having a suction hole and a discharge hole for sucking and discharging air, having the radiation unit built in between the suction hole and the discharge hole, and guiding air.

[0028] Preferably, in the radiation passage guide, the suction hole is formed in the upper portion, the discharge hole is formed in the lower portion, and the radiation fan is installed inside the suction hole.

[0029] Preferably, the radiation means further includes a water storage tank installed in the lower portion of the radiation passage guide, for collecting water sprayed from the spray nozzle and storing water, and a pump for pumping water stored in the water storage tank to the spray nozzle.

[0030] Preferably, the spray nozzle is installed inside the suction hole of the radiation passage guide, for spraying water from the upper portion of the radiation unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein:

Fig. 1 is an operation state view illustrating a general air conditioner using a refrigerating cycle;
Fig. 2 is a structure view illustrating a portable air conditioner in accordance with the present invention;
Fig. 3 is a side-sectional view illustrating major elements of the portable air conditioner in accordance with the present invention;
Fig. 4 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to a thermoelectric module, when the portable air conditioner is operated in the optimum state in accordance with the present invention;
Fig. 5 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to a pump, when the portable air conditioner is operated in the optimum state in accordance with the present invention;
Fig. 6 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to a cooling fan, when the portable air conditioner is operated in the optimum state in accordance with the present invention;
Fig. 7 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to a radiation fan, when the portable air conditioner is operated in the optimum state in accordance with the present invention;
Fig. 8 is a graph showing a cooling quantity and a performance factor according to a humidity of air, when the portable air conditioner is operated in the optimum state in accordance with the present invention; and
Fig. 9 is a graph showing a cooling quantity and a performance factor according to a temperature of air, when the portable air conditioner is operated in the optimum state in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0032] Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

[0033] Fig. 2 is a structure view illustrating a portable air conditioner in accordance with the p resent invention, a nd Fig. 3 is a side-sectional view illustrating major elements of the portable air conditioner in accordance with the present invention.

[0034] Referring to Figs. 2 and 3, the portable air conditioner includes a thermoelectric module 50 having a heat absorption unit 52 and a radiation unit 54 in the facing portions, and performing heat absorption for absorbing peripheral heat in the heat absorption unit 52 and radiation for radiating heat to the periphery in the radiation unit 54 at the same time when receiving electric current, an air blowing means 60 installed near the heat absorption unit 52, for blowing air to the heat absorption unit 52 to exchange heat between the heat absorption unit 52 and the air, a radiation means 70 installed near the radiation unit 54, for spaying water to the radiation unit 54 for evaporation and cooling, and a control unit 80 for controlling the thermoelectric module 50, the air blowing means 60 and the radiation means 70.

[0035] In detail, the thermoelectric module 50 is a chip-type electronic cooling material using a thermoelectric semiconductor which is an energy conversion material as a basic material. The thermoelectric module 50 is comprised of P-type semiconductors P having deficient electrons and N-type semiconductors N having excessive electrons in pairs. The plurality of P-type semiconductors P and the plurality of N-type semiconductors N are installed to have their one side ends alternately electrically connected in series by a metal electrode. When receiving a DC voltage, electrons move heat to the same direction In the different semiconductors. The heat absorption unit 52 for performing heat absorption is formed in one side ends of the P-type semiconductors P and the N-type semiconductors N, and the radiation unit 54 for performing radiation is formed in the other side ends thereof.

[0036] Here, heat transfer plates 52a and 54a for directly transferring heat to both ends of the P-type semiconductors P and the N-type semiconductors N, such as ceramics are connected to the thermoelectric module 50. A plurality of heat absorption fins 52b for widening a heat absorption area are formed on the heat transfer plate (heat absorption plate 52a) of the heat absorption unit 52, and a plurality of radiation fins 54b for widening a radiation area are formed on the heat transfer plate (radiation plate 54a) of the radiation unit 54. The electrodes for connecting the P-type semiconductors P a nd the N -type semiconductors N are fixed to the heat transfer plates 52a and 54a by soldering, etc.

[0037] In the thermoelectric module 50, an insulating wall 56 is partially inserted between the heat absorption unit 52 and the radiation unit 54, and the P-type semiconductors P and the N-type semiconductors N are built in a partition wall 57. The insulating wall 56 delays transferring heat from the radiation unit 54 to the heat absorption unit 52 by conduction, and the partition wall 57 partitions the spaces of the heat absorption unit 52 and the radiation unit 54 and prevents heat transfer of air flowing through each space by convection, thereby improving heat exchange efficiency.

[0038] A DC power supply 58 is connected to the metal electrode, for supplying a set voltage. Here, the set voltage must be determined to improve cooling performance. That is, when the set voltage is supplied to the thermoelectric module 50, the set voltage must lower a temperature of the heat absorption unit 52 below a predetermined value and prevent a temperature of the radiation unit 54 from increasing over a predetermined value.

[0039] The thermoelectric module 50 employs the Peltier effect discovered by the French physicist Athahase Peltier (1785-1845). According to the Peltier effect, when a loop is formed by using two kinds of metals, if electric current is applied to the middle of the loop, one junction generates heat and the other junction absorbs heat.

[0040] The air blowing means 60 includes a heat absorption passage guide 62 fixedly installed in one side of the partition wall 57 to have the heat absorption plate 52a and the heat absorption fins 52b of the heat absorption unit 52 built in, for forming a passage for flowing air between a suction hote 62a and a discharge hole 62b, and a cooling fan 64 and a motor (not shown) installed inside the heat absorption passage guide 62, for blowing air along the heat absorption passage guide 62.

[0041] In the heat absorption passage guide 62, the suction hole 62a is formed in the lower portion so that relatively light hot air can be sucked from the lower portion, upwardly transferred and actively heat-exchanged with the heat absorption plate 52a and the heat absorption fins 52b, and the discharge hole 62b is formed in the upper portion so that heat-exchanged and thus relatively heavy cool air can be discharged from the upper portion and easily downwardly transferred. The passage between the suction hole 62a and the discharge hole 62b is vertically formed to minimize flow loss of air.

[0042] Preferably, the cooling fan 64 and the motor are installed inside the discharge hole 62b and controlled by the control unit 80, to increase a volume of cool air discharged to the user. More preferably, the cooling fan 64 is a cross flow fan for increasing an air volume and decreasing noises.

[0043] Moreover, a flow meter 66 and a psychrometer 68 are connected near the discharge hole 62b of the heat absorption passage guide 62, for measuring a volume, temperature and humidity of cool air discharged to the user. The control unit 80 controls the whole elements according to the data.

[0044] The radiation means 70 includes a radiation passage guide 72 fixedly installed in the other side of the partition wall 57 to have the radiation plate 54a and the radiation fins 54b of the radiation unit 54 built in, for forming a passage for flowing air between a suction hole 72a and a discharge hole (not shown), a spray nozzle 74 for spraying water to the radiation plate 54a and the radiation fins 54b, and a radiation fan 76 and a motor (not shown) for blowing air to the radiation plate 54a and the radiation fins 54b, so that water sprayed from the spray nozzle 74 to the radiation plate 54a and the radiation fins 54b can be evaporated to cool the radiation plate 54a and the radiation fins 54b.

[0045] In the radiation passage guide 72, the suction hole 72a is formed in the upper portion, the discharge hole is formed in the lower portion, the radiation fan 76 and the motor are installed inside the suction hole 72a, and the spray nozzle 74 is installed in the lower portion of the radiation fan 76 and the motor so that water can be sprayed from the upper portion of the radiation plate 54a and the radiation fins 54b. Preferably, a hole 74h for spraying water is installed toward the upper portion of the radiation plate 54a and the radiation fins 54b.

[0046] Here, the operations of the radiation fan 76 and the motor are controlled by the control unit 80. Preferably, the radiation fan 76 is a cross flow fan for increasing an air volume and decreasing noises.

[0047] The radiation means 70 further includes a water storage tank 77 installed in the lower portion of the radiation passage guide 72, for collecting and storing water sprayed from the spray nozzle 74, and a pump 78 for pumping water stored in the water storage tank 77 to the spray nozzle 74. The operation of the pump 78 is also controlled by the control unit 80.

[0048] The control unit 80 is divided into a data input unit 82 for acquiring volume, temperature and humidity data of cool air discharged to the discharge hole 62b of the heat absorption passage guide 62, and an operation control unit 84 connected to the data input unit 82, for comparing the data with user-set values or previously-stored reference values to control the operations of the elements.

[0049] The control unit 80 controls a DC voltage inputted to the motors for driving the cooling fan 64 and the radiation fan 76, or a DC voltage inputted to the pump 78. Here, the control unit 80 controls the DC voltages inputted to each element in consideration of a cooling quantity Q_c and a performance factor COP.

[0050] The thermoelectric module 50 can be connected directly to the DC power supply 58, for receiving the set voltage. It is also possible to control a size of the voltage from the DC power supply 58 by the control unit 80 and then input the controlled voltage to the thermoelectric module 50.

[0051] The cooling quantity Q_c is a heat quantity absorbed by the heat absorption unit 52 of the thermoelectric module 50, and represented by the following Formula 1, and the performance factor COP is a rate of the cooling quantity Q_c to power inputted to the thermoelectric module 50, the cooling fan 64, the radiation fan 76 and the pump 78, and represented by the following Formula 2:

<Formula 1>

$$Q_c = m\, C_p \Delta T$$

[0052] Here, Q_c denotes a cooling quantity, m denotes a discharge of cool air, C_p denotes a specific heat of air, and ΔT denotes a temperature difference of air before/after passing through the heat absorption unit 52 of the thermoelectric

module 50.

<Formula 2>

$$COP = \frac{Q_c}{W_t + W_p + W_{f1} + W_{f2}}$$

[0053] Here, COP denotes a performance factor, Q_c denotes a cooling quantity of the above Formula 1, and W_t, W_p, W_{f1} and W_{f2} denote power supplied to the thermoelectric module 50, the pump 78, the cooling fan 64 and the radiation fan 76, respectively.

[0054] As described above, in consideration of the cooling quantity Q_c, the control unit 80 raises the DC voltages supplied to the cooling fan 64, the radiation fan 76 and the pump 78 in order to improve heat exchange by increasing a volume of air and sprayed water, and in consideration of both the cooling quantity Q_c and the performance factor COP, the control unit 80 inputs the optimum DC voltages to each element in order to obtain the appropriate cooling quantity Q_c, reduce the power inputted to each element and obtain the cooling quantity Q_c over a predetermined value.

[0055] Fig. 4 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to the thermoelectric module, when the portable air conditioner is operated in the optimum state in accordance with the present invention, Fig. 5 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to the pump, when the portable air conditioner is operated in the optimum state in accordance with the present invention, Fig. 6 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to the cooling fan, when the portable air conditioner is operated in the optimum state in accordance with the present invention, and Fig. 7 is a graph showing a cooling quantity and a performance factor according to a voltage inputted to the radiation fan, when the portable air conditioner is operated in the optimum state in accordance with the present invention.

[0056] When the optimum state of the portable air conditioner is detected based on the test data considering the cooling quantity Q_c and the performance factor COP, the voltages inputted to the thermoelectric module 50, the pump 78, the cooling fan 64 and the radiation fan 76 are V_t=18V, V_p=6V, V_{f1}=24V and V_{f2}=24V, the relative humidity of air is RH=60%, and the temperature of air is Ta=30°C.

[0057] In detail, in the case that the portable air conditioner is operated in the optimum state by changing the voltage V_t inputted to the thermoelectric module 50, as shown in Fig. 4, when the voltage V_t inputted to the thermoelectric module 50 ranges from 15 to 20V, the cooling quantity Q_c and the performance factor COP are high and have the optimum values in 18V.

[0058] When the voltage V_t inputted to the thermoelectric module 50 is too low, the heat absorption unit 52 is rarely maintained below a set temperature, and thus the cooling quantity Q_c and the performance factor COP have low values. When the voltage V_t inputted to the thermoelectric module 50 is too high, the radiation unit 54 is overheated to transfer heat to the heat absorption unit 52 by conduction, and thus the cooling quantity Q_c and the performance factor COP have low values. Accordingly, it is preferable to control the voltage V_t inputted to the thermoelectric module 50 within an appropriate voltage range.

[0059] That is, the voltage V_t inputted to the thermoelectric module 50 is controlled to have the highest value within the voltage range for preventing heat transfer from the radiation unit 54 to the heat absorption unit 52 by conduction during the operation of the thermoelectric module 50.

[0060] In the case that the portable air conditioner is operated in the optimum state by changing the voltage V_p inputted to the pump 78, as shown In Fig. 5, when the voltage V_p inputted to the pump 78 ranges from 6 to 9V, the cooling quantity Q_c and the performance factor COP are high and have the optimum values in 6V.

[0061] When the voltage V_p inputted to the pump 78 is 9V, the cooling quantity Q_c has the highest value. However, as the voltage V_p inputted to the pump 78 decreases, the performance factor COP increases. Therefore, it is also preferable to control the voltage V_p inputted to the pump 78 within an appropriate voltage range.

[0062] The voltage V_p inputted to the pump 78 is controlled within the appropriate range determined according to the size of the thermoelectric module 50 and the number of the spray nozzles 74.

[0063] In the case that the portable air conditioner is operated in the optimum state by changing the voltage V_{f1} inputted to the cooling fan 64, as shown in Fig. 6, when the voltage V_{f1} inputted to the cooling fan 64 ranges from 23 to 24V, the cooling quantity Q_c and the performance factor COP are high and have the optimum values in 24V.

[0064] When the voltage V_{f1} inputted to the cooling fan 64 is too low, the air volume of the cooling fan 64 is small, air is not sufficiently heat-exchanged with the heat absorption unit 52, and thus the cooling quantity Q_c and the performance factor COP are low. When the voltage V_{f1} inputted to the cooling fan 64 is too high, the power W_{f1} inputted to the cooling

fan 64 increases, and thus the performance factor COP is low. It is therefore preferable to control the voltage V_{f1} inputted to the cooling fan 64 within an appropriate voltage range.

[0065] In the case that the portable air conditioner is operated in the optimum state by changing the voltage V_{f2} inputted to the radiation fan 76, as shown in Fig. 7, when the voltage V_{f2} inputted to the radiation fan 76 ranges from 23 to 24V, the cooling quantity Q_c and the performance factor COP are high and have the optimum values in 24V.

[0066] When the voltage V_{f2} inputted to the radiation fan 76 is too low, the air volume of the radiation fan 76 is small, air does not sufficiently evaporate and cool the radiation unit 54, and thus the cooling quantity Q_c and the performance factor COP are low. When the voltage V_{f2} inputted to the radiation fan 76 is too high, the power W_{f2} inputted to the radiation fan 76 increases, and thus the performance factor COP is low. Accordingly, it is preferable to control the voltage V_{f2} inputted to the radiation fan 76 within an appropriate voltage range.

[0067] The control unit 80 controls the voltages inputted to the thermoelectric module 50, the pump 78, the cooling fan 64 and the radiation fan 76 within the appropriate voltage ranges. When the flow meter 66 and the psychrometer 68 measure the volume, temperature and humidity of cool air discharged through the discharge hole 62b of the heat absorption passage guide 62, the data input unit 82 acquires the data, and the operation control unit 84 compares and operates the data to control the voltages inputted to each element.

[0068] Fig. 8 is a graph showing a cooling quantity and a performance factor according to a humidity of air, when the portable air conditioner is operated in the optimum state in accordance with the present invention, and Fig. 9 is a graph showing a cooling quantity and a performance factor according to a temperature of air, when the portable air conditioner is operated in the optimum state in accordance with the present invention.

[0069] In the case that the portable air conditioner is operated in the optimum state by changing the relative humidity RH of air, as shown in Fig. 8, when the relative humidity RH of air is lower than 60%, the cooling quantity Q_c and the performance factor COP are high.

[0070] When the portable air conditioner is used in the place having a very high relative humidity RH of air, evaporation and cooling are not efficient in the radiation unit 54 of the thermoelectric module 50. Therefore, the cooling quantity Q_c and the performance factor COP have low values. Preferably, the portable air conditioner is used in the place having a relative humidity RH of air lower than a predetermined value (for example, RH=60%).

[0071] In the case that the portable air conditioner is operated in the optimum state by changing the temperature of air Ta, as shown in Fig. 9, when the temperature of air Ta is higher than 30°C, the cooling quantity Q_c and the performance factor COP are high.

[0072] When the portable air conditioner is used in the place having a very low temperature of air Ta, a temperature difference is small between the heat absorption unit 52 of the thermoelectric module 50 and the air, which prevents active heat transfer. In addition, evaporation and cooling are not efficient in the radiation unit 54 of the thermoelectric module 50, and thus the cooling quantity Q_c and the performance factor COP decrease. Preferably, the portable air conditioner is used in the place having a temperature of air Ta higher than a predetermined value (for example, Ta=30°C).

[0073] The operation of the portable air conditioner in accordance with the present invention will now be explained.

[0074] When the set DC voltage is supplied to the thermoelectric module 50, the electrons move to the same direction in the P-type semiconductors P and the N-type semiconductors N of the thermoelectric module 50. Accordingly, the heat absorption unit 52 formed in one side ends of the P-type semiconductors P and the N-type semiconductors N maintains a low temperature to perform heat absorption, and the radiation unit 54 formed in the other side ends of the P-type semiconductors P and the N-type semiconductors N maintains a high temperature to perform radiation.

[0075] In the heat absorption unit 52 side, when the cooling fan 64 is driven, air sucked through the suction hole 62a of the heat absorption passage guide 62 upwardly moves along the heat absorption passage guide 62, passes through the heat absorption plate 52a and the heat absorption fins 52b, and is discharged to the discharge hole 62b of the heat absorption passage guide 62. Because air is heat-exchanged with the absorption plate 52a and the heat absorption fins 52b, cool air is discharged.

[0076] Here, the heat absorption plate 52a and the heat absorption fins 52b have a large air contact area, to sufficiently perform heat exchange in the heat absorption unit 52. Moreover, the discharge hole 62b of the heat absorption passage guide 62 is formed in the upper portion, and thus cool air is discharged from the upper portion and evenly transferred to the lower portion.

[0077] In the radiation unit 54 side, when the radiation fan 76 is driven, air sucked through the suction hole 72a of the radiation passage guide 72 downwardly moves along the radiation passage guide 72, passes through the radiation plate 54a and the radiation fins 54b, and is discharged to the discharge hole of the radiation passage guide 72. Air is heat-exchanged with the radiation plate 54a and the radiation fins 54.

[0078] At the same time, when the pump 78 is driven, water stored in the water storage tank 77 is pumped and sprayed to the radiation plate 54a and the radiation fins 54b through the spray nozzle 74, and air blown by the radiation fan 76 evaporates water sprayed to the surfaces of the radiation plate 54a and the radiation fins 54b. Water sprayed to the surfaces of the radiation plate 54a and the radiation fins 54b absorbs heat of vaporization during the evaporation, and thus evaporation and cooling are performed in the radiation unit 54.

[0079] Here, water sprayed to the radiation plate 54a and the radiation fins 54b is evaporated or collected by the water storage tank 77.

[0080] In the thermoelectric module 50, the insulating wall 56 is installed between the heat absorption unit 52 and the radiation unit 54, radiation is actively performed due to evaporation and cooling of the radiation unit 54, and thus a temperature difference increases between the heat absorption unit 52 and the radiation unit 54, thereby preventing heat transfer by conduction. As a result, cooling efficiency is more improved.

[0081] The flow meter 66 and the psychrometer 68 measure the volume, temperature and humidity of cool air discharged through the discharge hole 62b of the heat absorption passage guide 62. In the control unit 80, the data input unit 82 acquires the volume, temperature and humidity data measured by the flow meter 66 and the psychrometer 68, and the operation control unit 84 compares the data with the user-set values or the previously-stored reference values, to control the DC voltages supplied to the thermoelectric module 50, the pump 78, the cooling fan 64 and the radiation fan 76, respectively.

[0082] The portable air conditioner in accordance with the present invention has the following advantages.

[0083] First, the portable air conditioner generates cool air by exchanging heat of air in the heat absorption unit for performing heat absorption by using the thermoelectric module. The weight and size of the air conditioner are so reduced that the user can use the air conditioner when he/or she moves.

[0084] Second, the portable air conditioner composes the refrigerating cycle of the thermoelectric process by using the thermoelectric module. Therefore, the compressor is not used to prevent noises and vibrations, so that the user can pleasantly use the portable air conditioner. Furthermore, special refrigerants are not used to reduce environmental pollution.

[0085] Third, the portable air conditioner individually cools the part of the indoor space in which the user stays. Accordingly, cooling can be controlled for each user, to improve users' satisfaction. In addition, the radiation unit of the thermoelectric module is evaporated and cooled, and thus rapidly radiated. The portable air conditioner interrupts heat transfer by conduction between the heat absorption unit and the radiation unit, thereby improving cooling efficiency.

[0086] Although the preferred embodiments of the present invention have been described, it is understood that the present invention should not be limited to the preferred embodiment but various changes and modifications can be made by one skilled in the art within the scope of the present invention as hereinafter claimed.

Claims

1. A portable air conditioner, comprising:

a thermoelectric module (50) having a heat absorption unit (52) for absorbing peripheral heat and a radiation unit (54) for radiating heat to the periphery in the facing portions, and performing heat absorption and radiation at the same time when receiving electric current;
an air blowing means (60) installed near the heat absorption unit, for blowing air to exchange heat between the heat absorption unit and the air,
a radiation means (70) installed near the radiation unit, for cooling the radiation unit; and
a control unit (80) for controlling the thermoelectric module, the air blowing means and the radiation means

characterized in that
the radiation means (70) comprises a spray nozzle (74) for spraying water to the radiation unit so that water sprayed from the spray nozzle to the radiation unit can be evaporated to cool the radiation unit.

2. The portable air conditioner of claim 1, wherein the thermoelectric module comprises P-type semiconductors (P) and N-type semiconductors (N) in pairs, and the heat absorption unit and the radiation unit are formed in both ends of the P-type semiconductors and the N-type semiconductors.

3. The portable air conditioner of claim 2, wherein the plurality of thermoelectric modules are connected in series.

4. The portable air conditioner of any one of claims 1 to 3, wherein a plurality of heat absorption fins (52b) are installed in the heat absorption unit, for widening a heat transfer area.

5. The portable air conditioner of any one of claims 1 to 3, wherein a plurality of radiation fins (54b) are installed in the radiation unit, for widening a heat transfer area.

6. The portable air conditioner of any one of claims 1 to 5, wherein the air blowing means comprises a heat absorption

passage guide (62) having a suction hole (62a) and a discharge hole (62b) for sucking and discharging air, having the heat absorption unit or heat absorption fins built in between the suction hole and the discharge hole, and guiding air, and a cooling fan (64) and a motor installed inside the heat absorption passage guide, for blowing air along the heat absorption passage guide.

7. The portable air conditioner of claim 6, wherein, in the heat absorption passage guide (62), the suction hole (62a) is formed in the lower portion, the discharge hole (62b) is formed in the upper portion, and the cooling fan (64) is installed inside the discharge hole.

8. The portable air conditioner of claim 7, wherein the cooling fan (64) is a cross flow fan.

9. The portable air conditioner of any one of claims 1 to 5, wherein the radiation means (70) comprises a radiation fan (76) and a motor for blowing air to the radiation unit.

10. The portable air conditioner of claim 9, wherein the radiation means further comprises a radiation passage guide (72) having a suction hole (72a) and a discharge hole (72b) for sucking and discharging air, having the radiation unit built in between the suction hole and the discharge hole, and guiding air.

11. The portable air conditioner of claim 10, wherein, in the radiation passage guide (72), the suction hole (72a) is formed in the upper portion, the discharge hole (72b) is formed in the lower portion, and the radiation fan (76) is installed inside the suction hole.

12. The portable air conditioner of claim 10, wherein the radiation means further comprises a water storage tank (77) installed in the lower portion of the radiation passage guide (72), for collecting water sprayed from the spray nozzle (74) and storing water, and a pump (78) for pumping water stored in the water storage tank to the spray nozzle.

13. The portable air conditioner of claim 12, wherein the spray nozzle (74) is installed inside the suction hole (72a) of the radiation passage guide, for spraying water from the upper portion of the radiation unit.

Patentansprüche

1. Tragbare Klimaanlage, umfassend:

ein thermoelektrisches Modul (50), das eine Wärmeaufnahmeeinheit (52) zur Aufnahme von Randwärme und eine Abstrahleinheit (54) zur Abstrahlung von Wärme auf den Rand in den einander zugewandten Abschnitten aufweist und die Wärmeaufnahme und Abstrahlung zur gleichen Zeit durchführt, wenn es elektrischen Strom erhält;
ein Luftblasmittel (60), das nahe der Wärmeaufnahmeeinheit eingebaut ist, zum Blasen von Luft, um Wärme zwischen der Wärmeaufnahmeeinheit und der Luft auszutauschen;
ein Abstrahlmittel (70), das nahe der Abstrahleinheit eingebaut ist, zum Kühlen der Abstrahleinheit; und
ein Steuergerät (80) zur Steuerung des thermoelektrischen Moduls, des Luftblasmittels und des Abstrahlmittels,

dadurch gekennzeichnet, dass
das Abstrahlmittel (70) eine Sprühdüse (74) zum Sprühen von Wasser auf die Abstrahleinheit umfasst, so dass Wasser, das von der Sprühdüse auf die Abstrahleinheit gesprüht wird, verdampft werden kann, um die Abstrahleinheit zu kühlen.

2. Tragbare Klimaanlage nach Anspruch 1, wobei das thermoelektrische Modul p-Halbleiter (P) und n-Halbleiter (N) in Paaren umfasst und die Wärmeaufnahmeeinheit und die Abstrahleinheit in beiden Enden der p-Halbleiter und n-Halbleiter ausgebildet sind.

3. Tragbare Klimaanlage nach Anspruch 2, wobei die mehreren thermoelektrischen Module in Reihe angeschlossen sind

4. Tragbare Klimaanlage nach irgendeinem der Ansprüche 1 bis 3, wobei mehrere Wärmeaufnahmerippen (52b) in der Wärmeaufnahmeeinheit eingebaut sind, um eine Wärmeübertragungsfläche zu verbreitern.

5. Tragbare Klimaanlage nach irgendeinem der Ansprüche 1 bis 3, wobei mehrere Abstrahlrippen (54b) in der Abstrahleinheit eingebaut sind, um eine Wärmeübertragungsfläche zu verbreitern.

6. Tragbare Klimaanlage nach irgendeinem der Ansprüche 1 bis 5, wobei das Luftblasmittel Folgendes umfasst eine Wärmeaufnahme-Durchlassführung (62), die eine Ansaugöffnung (62a) und eine Abblasöffnung (62b) aufweist, um Luft anzusaugen und abzublasen, wobei die Wärmeaufnahmeeinheit oder die Wärmeaufnahmerippen zwischen der Ansaugöffnung und der Abblasöffnung eingebaut sind, und Luft zu führen; und einen Kühlventilator (64) und einen Motor, die in der Wärmeaufnahme-Durchlassführung eingebaut sind, um Luft entlang der Wärmeaufnahme-Durchlassführung zu blasen.

7. Tragbare Klimaanlage nach Anspruch 6, wobei in der Wärmeaufnahme-Durchlassführung (62) die Ansaugöffnung (62a) im unteren Abschnitt ausgebildet ist, die Abblasöffnung (62b) im oberen Abschnitt ausgebildet ist und der Kühlventilator (64) in der Abblasöffnung eingebaut ist

8. Tragbare Klimaanlage nach Anspruch 7, wobei der Kühlventilator (64) ein Querstromventilator ist

9. Tragbare Klimaanlage nach irgendeinem der Ansprüche 1 bis 5, wobei das Abstrahlmittel (70) einen Abstrahlventilator (76) und einen Motor umfasst, um der Abstrahleinheit Luft zuzublasen

10. Tragbare Klimaanlage nach Anspruch 9, wobei das Abstrahlmittel ferner eine Abstrahl-Durchlassführung (72) umfasst, die eine Ansaugöffnung (72a) und eine Abblasöffnung (72b) aufweist, um Luft anzusaugen und abzublasen, wobei die Abstrahleinheit zwischen der Ansaugöffnung und der Abblasöffnung eingebaut ist, und Luft zu führen.

11. Tragbare Klimaanlage nach Anspruch 10, wobei in der Abstrahl-Durchlassführung (72) die Ansaugöffnung (72a) im oberen Abschnitt ausgebildet ist, die Abblasöffnung (72b) im unteren Abschnitt ausgebildet ist und der Abstrahlventilator (76) in der Ansaugöffnung eingebaut ist

12. Tragbare Klimaanlage nach Anspruch 10, wobei das Abstrahlmittel ferner Folgendes umfasst: einen im unteren Abschnitt der Abstrahl-Durchlassführung (72) eingebauten Wasservorratsbehälter (77), um Wasser, das von der Sprühdüse (74) gesprüht wird, zu sammeln und Wasser zu speichern; und eine Pumpe (78), um Wasser, das im Wasservorratsbehälter gespeichert ist, zur Sprühdüse zu pumpen

13. Tragbare Klimaanlage nach Anspruch 12, wobei die Sprühdüse (74) in der Ansaugöffnung (72a) der Abstrahl-Durchlassführung eingebaut ist, um Wasser vom oberen Abschnitt der Abstrahleinheit zu sprühen

Revendications

1. Climatiseur portable, comprenant

   un module thermoélectrique (50) ayant une unité d'absorption de chaleur (52) pour absorber la chaleur périphérique et une unité de rayonnement (54) pour faire rayonner la chaleur vers la périphérie dans les parties se faisant face, et effectuant l'absorption et le rayonnement de la chaleur en même temps à réception d'un courant électrique ;
   un moyen de soufflage d'air (60) installé près de l'unité d'absorption de chaleur, pour souffler de l'air afin d'échanger de la chaleur entre l'unité d'absorption de chaleur et l'air ;
   un moyen de rayonnement (70) installé près de l'unité de rayonnement, pour refroidir l'unité de rayonnement ; et une unité de commande (80) pour commander le module thermoélectrique, le moyen de soufflage d'air et le moyen de rayonnement

   caractérisé en ce que
   le moyen de rayonnement (70) comprend une buse de pulvérisation (74) pour pulvériser de l'eau sur l'unité de rayonnement de manière à ce que l'eau pulvérisée à partir de la buse de pulvérisation sur l'unité de rayonnement puisse être évaporée pour refroidir l'unité de rayonnement

2. Climatiseur portable selon la revendication 1, dans lequel le module thermoélectrique comprend des semi-conducteurs de type P (P) et des semi-conducteurs de type N (N) par paires, et l'unité d'absorption de chaleur et l'unité de rayonnement sont formées aux deux extrémités des semi-conducteurs de type P et des semi-conducteurs de type N.

3. Climatiseur portable selon la revendication 2, dans lequel la pluralité de modules thermoélectriques sont connectés en série

4. Climatiseur portable selon l'une quelconque des revendications 1 à 3, dans lequel une pluralité d'ailettes d'absorption de chaleur (52b) sont installées dans l'unité d'absorption de chaleur, pour élargir une zone de transfert de chaleur.

5. Climatiseur portable selon l'une quelconque des revendications 1 à 3, dans lequel une pluralité d'ailettes de rayonnement (54b) sont installées dans l'unité de rayonnement, pour élargir une zone de transfert de chaleur

6. Climatiseur portable selon l'une quelconque des revendications 1 à 5, dans lequel le moyen de soufflage d'air comprend un guide de passage d'absorption de chaleur (62) ayant un orifice d'aspiration (62a) et un orifice de décharge (62b) pour aspirer et décharger de l'air, ayant l'unité d'absorption de chaleur ou les ailettes d'absorption de chaleur intégrée(s) entre l'orifice d'aspiration et l'orifice de décharge, et guidant l'air, et un ventilateur de refroidissement (64) et un moteur installés à l'intérieur du guide de passage d'absorption de chaleur, pour souffler l'air le long du guide de passage d'absorption de chaleur

7. Climatiseur portable selon la revendication 6, dans lequel, dans le guide de passage d'absorption de chaleur (62), l'orifice d'aspiration (62a) est formé dans la partie inférieure, l'orifice de décharge (62b) est formé dans la partie supérieure, et le ventilateur de refroidissement (64) est installé à l'intérieur de l'orifice de décharge

8. Climatiseur portable selon la revendication 7, dans lequel le ventilateur de refroidissement (64) est un ventilateur tangentiel

9. Climatiseur portable selon l'une quelconque des revendications 1 à 5, dans lequel le moyen de rayonnement (70) comprend un ventilateur de rayonnement (76) et un moteur pour souffler de l'air sur l'unité de rayonnement

10. Climatiseur portable selon la revendication 9, dans lequel le moyen de rayonnement comprend en outre un guide de passage de rayonnement (72) ayant un orifice d'aspiration (72a) et un orifice de décharge (72b) pour aspirer et décharger de l'air, ayant l'unité de rayonnement intégrée entre l'orifice d'aspiration et l'orifice de décharge, et guidant l'air

11. Climatiseur portable selon la revendication 10, dans lequel, dans le guide de passage de rayonnement (72), l'orifice d'aspiration (72a) est formé dans la partie supérieure, l'orifice de décharge (72b) est formé dans la partie inférieure, et le ventilateur de rayonnement (76) est installé à l'intérieur de l'orifice d'aspiration.

12. Climatiseur portable selon la revendication 10, dans lequel le moyen de rayonnement comprend en outre un réservoir de stockage d'eau (77) installé dans la partie inférieure du guide de passage de rayonnement (72), pour récupérer l'eau pulvérisée à partir de la buse de pulvérisation (74) et stocker l'eau, et une pompe (78) pour pomper l'eau stockée dans le réservoir de stockage d'eau vers la buse de pulvérisation

13. Climatiseur portable selon la revendication 12, dans lequel la buse de pulvérisation (74) est installée à l'intérieur de l'orifice d'aspiration (72a) du guide de passage de rayonnement, pour pulvériser l'eau à partir de la partie supérieure de l'unité de rayonnement

FIG.1

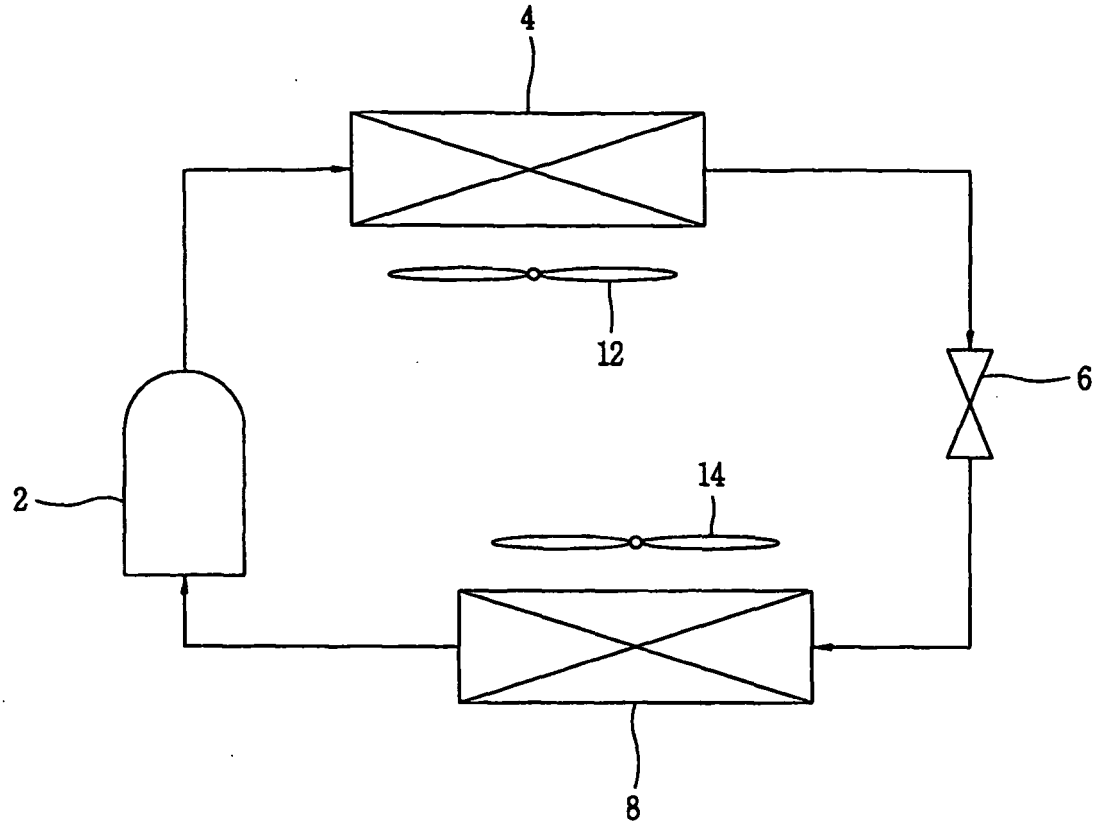


FIG.2

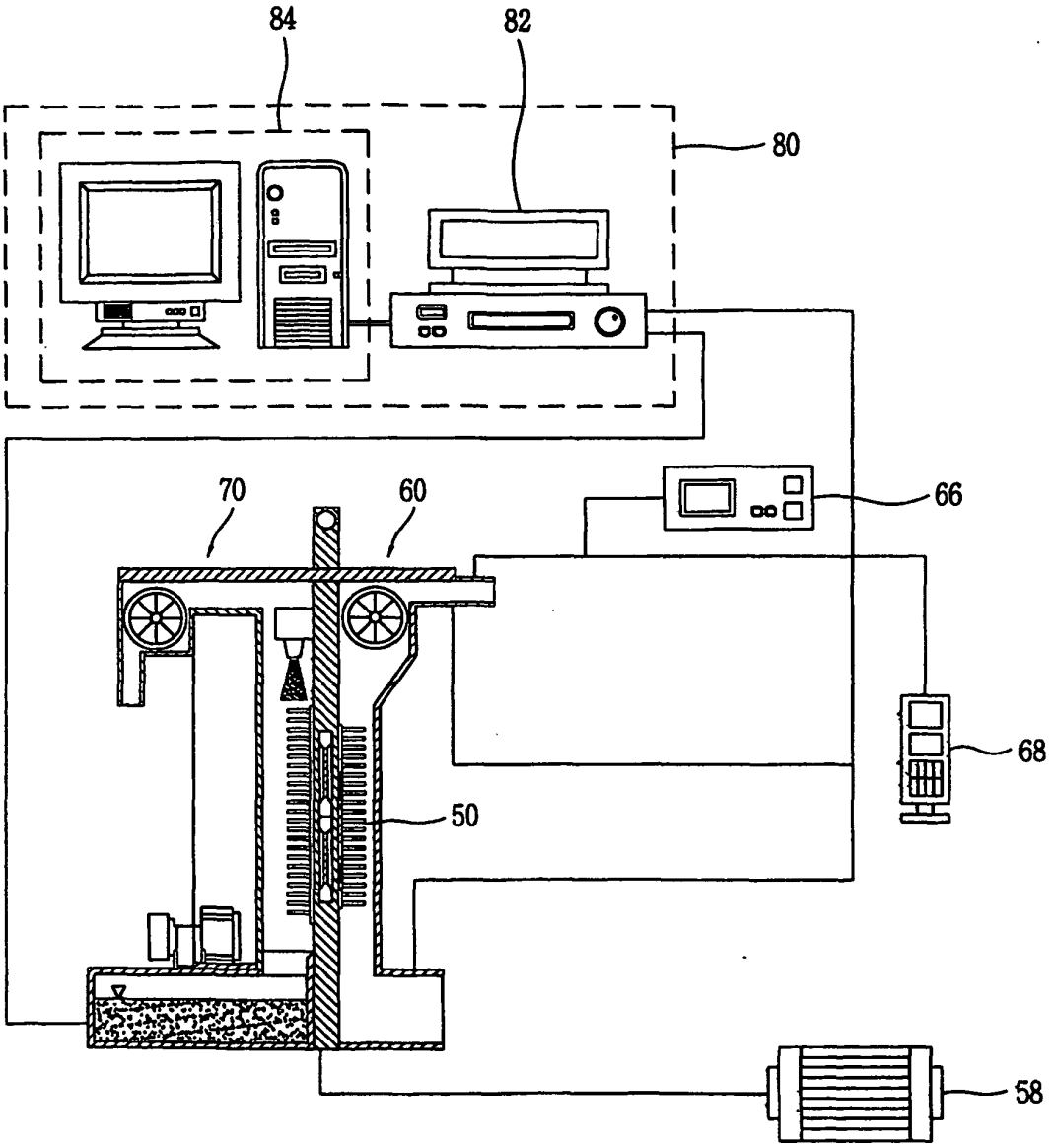


FIG.3

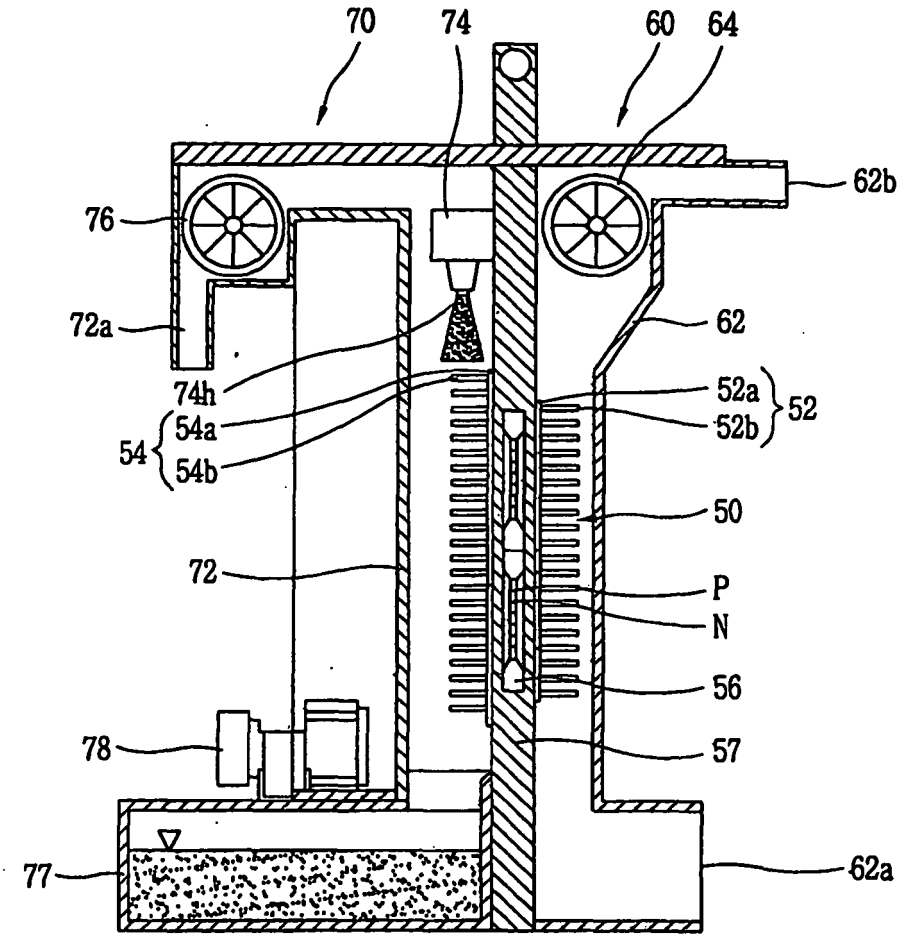

70
74
60
64
62b
76
72a
62
74h
52a
52
54a
52b
54
54b
50
72
P
N
56
78
57
77
62a

FIG.4

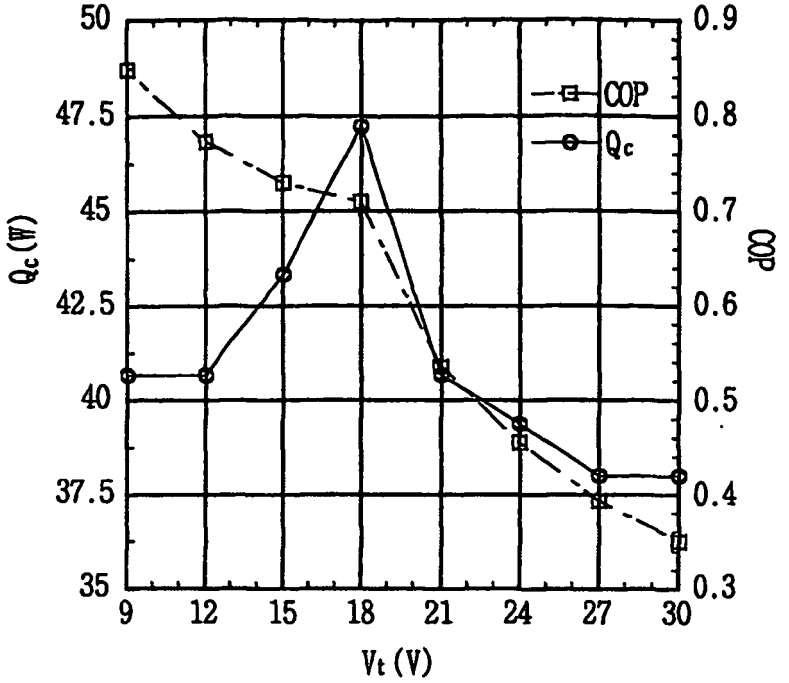

50
47.5
45
42.5
40
37.5
35
Qc (W)
9
12
15
18
21
24
27
30
Vt (V)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
COP
COP
Qc

FIG.5

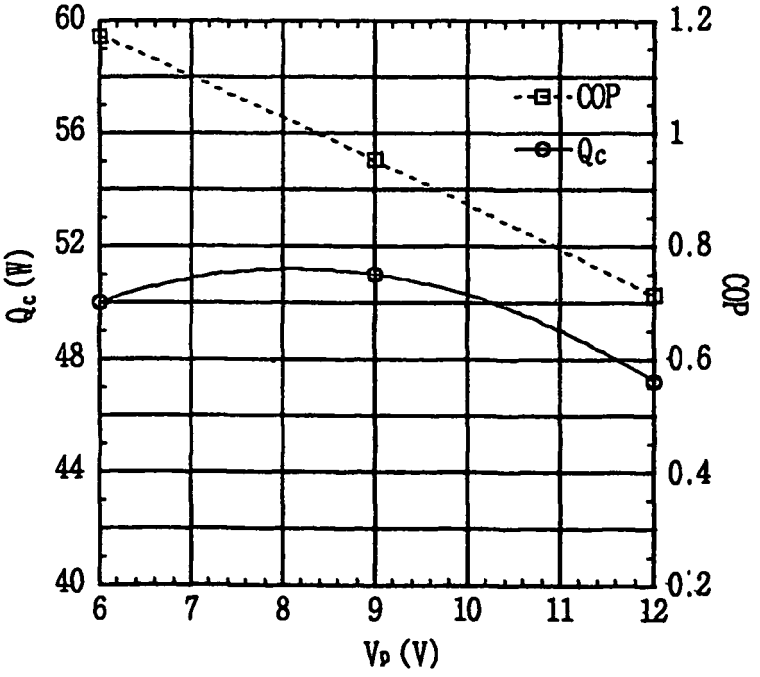

60
56
52
48
44
40
Qc (W)
6
7
8
9
10
11
12
Vp (V)
1.2
1
0.8
0.6
0.4
0.2
COP
COP
Qc

FIG.6

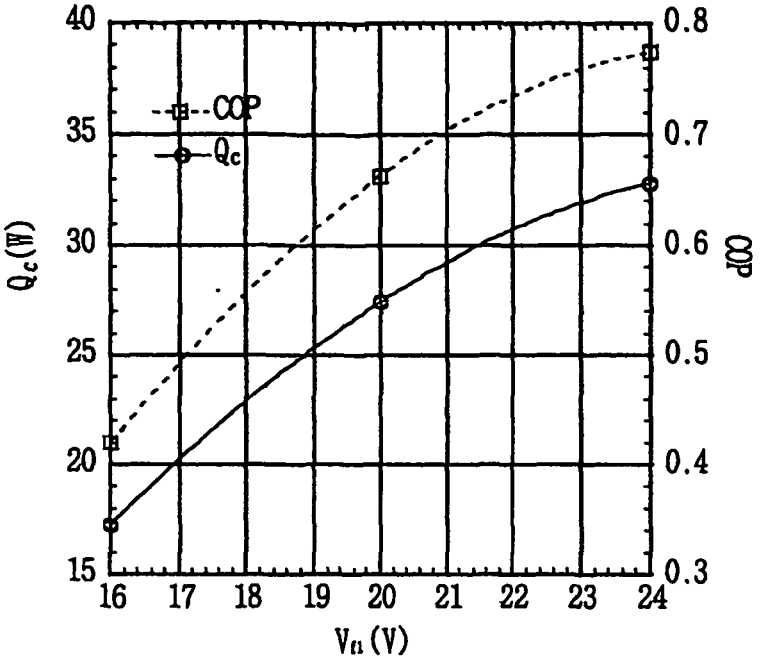

COP
Qc
Qc(W)
COP
40
35
30
25
20
15
0.8
0.7
0.6
0.5
0.4
0.3
16 17 18 19 20 21 22 23 24
Vf1 (V)

FIG.7

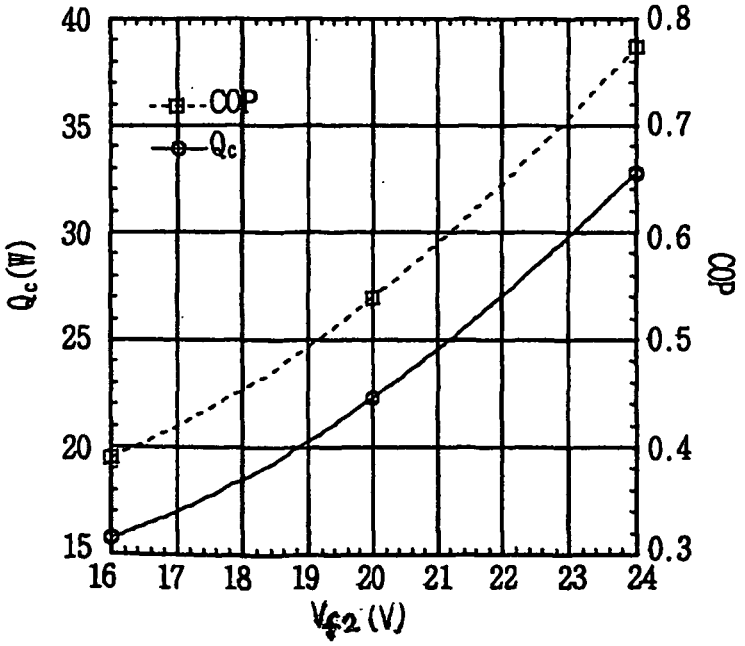

COP
Qc
Qc(W)
COP
40
35
30
25
20
15
0.8
0.7
0.6
0.5
0.4
0.3
16 17 18 19 20 21 22 23 24
Vf2 (V)

FIG.8

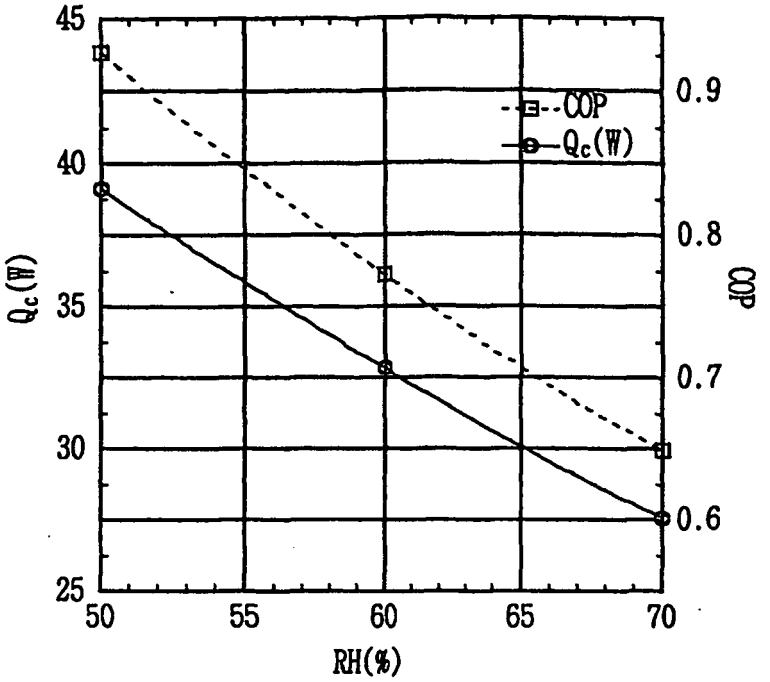
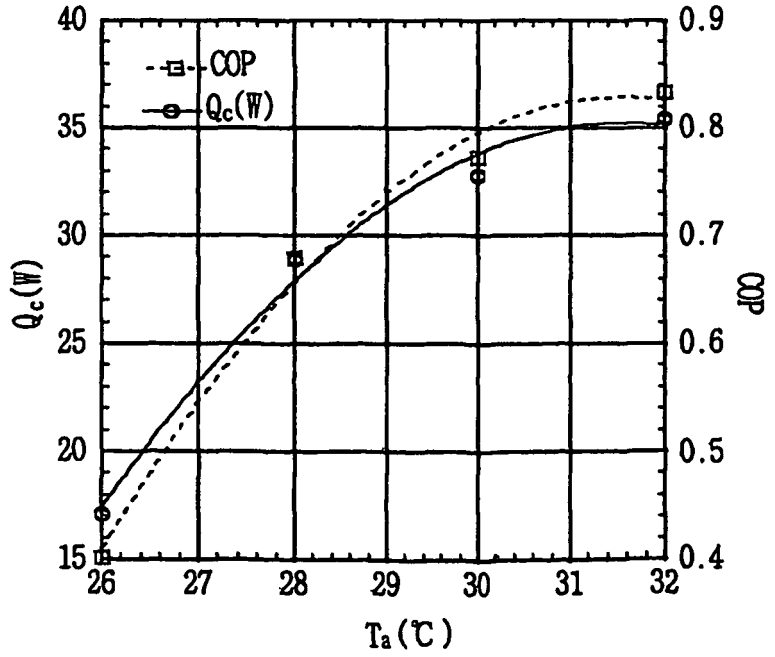

45
40
35
30
25
Qc(W)
0.9
0.8
0.7
0.6
COP
COP
Qc(W)
50
55
60
65
70
RH(%)

FIG.9


40
35
30
25
20
15
Qc(W)
0.9
0.8
0.7
0.6
0.5
0.4
COP
COP
Qc(W)
26
27
28
29
30
31
32
Ta(℃)

REFERENCES CITED IN THE DESCRIPTION

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