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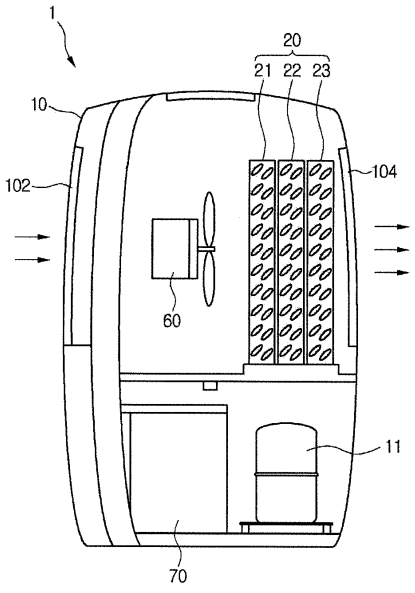
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## (54) Air conditioner

(57) An air conditioner is provided. The air conditioner includes an air conditioner includes: a main body including a suction hole for suctioning air and a discharge hole for discharging the air, a compressor disposed in the main body to compress a refrigerant, a heat exchanger receiving the refrigerant compressed by the compressor, the heat exchanger including a plurality of heat-exchange parts, an expander disposed in the main body to expand the refrigerant, and a valve for controlling a flow of the refrigerant into the heat exchanger. An operation mode of the air conditioner includes a cooling mode and a dehumidifying mode, the plurality of heat-exchange parts are disposed in series with respect to a flow direction of the air to allow the air to successively pass therethrough, and a portion of the plurality of heat-exchange parts acts as a condenser, and the other portion of the plurality of heat-exchange parts acts as an evaporator according to the flow of the refrigerant by an operation of the valve.

Fig.1




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## Description

### BACKGROUND

**[0001]** The present disclosure relates to an air conditioner.

**[0002]** Air conditioners are home appliances that maintain indoor air in the most proper state according to use and purpose thereof. For example, such an air conditioner controls indoor air into a cold state in summer and controls indoor air into a warm state in winter. Furthermore, the air conditioner controls humidity of the indoor air and purifies the indoor air to become to a pleasant and clean state. The air conditioner may have a refrigeration cycle constituted by a compressor, a condenser, an expansion device, and an evaporator.

**[0003]** An air conditioner according to the related art includes an indoor unit and an outdoor unit as disclosed in Korean Patent Publication No. 2007-0064077. Generally, the indoor unit is fixed at a predetermined indoor place, and the outdoor unit is disposed at an outdoor place.

**[0004]** The air conditioner according to the related art includes a plurality of indoor heat exchanger in the indoor unit to cool, heat, and dehumidify the indoor air.

**[0005]** However, as described above, since the indoor unit of the air conditioner according to the related art is fixedly installed, it is impossible to air-condition air within a space except for a specific space.

### SUMMARY

**[0006]** Embodiments provide an air conditioner that is movable to a desired position and is capable of dehumidifying and cooling air.

**[0007]** In one embodiment, an air conditioner includes: a main body including a suction hole for suctioning air and a discharge hole for discharging the air; a compressor disposed in the main body to compress a refrigerant; a heat exchanger receiving the refrigerant compressed by the compressor, the heat exchanger including a plurality of heat-exchange parts; an expander disposed in the main body to expand the refrigerant; and a valve for controlling a flow of the refrigerant into the heat exchanger, wherein an operation mode of the air conditioner includes a cooling mode and a dehumidifying mode, the plurality of heat-exchange parts are disposed in series with respect to a flow direction of the air to allow the air to successively pass therethrough, and a portion of the plurality of heat-exchange parts acts as a condenser, and the other portion of the plurality of heat-exchange parts acts as an evaporator according to the flow of the refrigerant by an operation of the valve.

**[0008]** The valve may control the flow of the refrigerant so that the air passes through the heat-exchange part that acts as the condenser to pass through the heat-exchange part that acts as the evaporator in the cooling mode of the air conditioner, and the valve may control the flow of the refrigerant so that the air passes through the heat-exchange part that acts the evaporator to pass through the heat-exchange part that acts as the condenser in the dehumidifying mode of the air conditioner.

**[0009]** The plurality of heat-exchange parts may include: a first heat-exchange part; a second heat-exchange part disposed at a downstream side of the first heat-exchange part; and a third heat-exchange part disposed at a downstream side of the second heat-exchange part, wherein the refrigerant compressed in the compressor may be supplied into the second heat-exchange part, and the valve may control the flow of the refrigerant so that the refrigerant discharged from the second heat-exchange part flows into at least one of the first heat-exchange part and the third heat-exchange part.

**[0010]** The cooling mode of the air conditioner may include a first mode and a second mode, wherein, in the first mode, the valve may control the flow of the refrigerant so that the refrigerant discharged from the expander flows into each of the first and third heat-exchange parts, and in the second mode, the valve may control the flow of the refrigerant so that the refrigerant discharged from the expander flows into the third heat-exchange part.

**[0011]** In the dehumidifying mode, the valve may control the flow of the refrigerant so that the refrigerant discharged from the expander to the first heat-exchange part.

**[0012]** The expander may be disposed in a tube through which the refrigerant discharged from the second heat-exchange part flows, and the valve is disposed at a downstream side of the expander in the tube.

**[0013]** The air conditioner may further include: a first connection tube connected to the valve and the first heat-exchange part; and a second connection tube connected to the valve and the second heat-exchange part.

**[0014]** At least one portion of the third heat-exchange part may vertically overlap the second heat-exchange part.

**[0015]** The plurality of heat-exchange parts may include: the first heat-exchange part; and the second heat-exchange part disposed at the downstream of the first heat-exchange part, wherein, in the dehumidifying mode of the air conditioner, the valve may control the flow of the refrigerant so that the refrigerant discharged from the compressor flows into the first heat-exchange part to allow the first heat-exchange part to act as the condenser.

**[0016]** In the cooling mode of the air conditioner, the valve may control the flow of the refrigerant so that the refrigerant discharged from the compressor flows into the second heat-exchange part to allow the second heat-exchange part to act as the condenser.

**[0017]** The expander may be disposed in a tube connecting the first heat-exchange part to the second heat-exchange part.

**[0018]** The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the de-

scription and drawings, and from the claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]**

Fig. 1 is schematic view illustrating an inner configuration of an air conditioner according to a first embodiment.

Fig. 2 is a view of the air conditioner according to the first embodiment.

Fig. 3 is a view illustrating a flow of a refrigerant when the air conditioner operates in a dehumidifying mode according to the first embodiment.

Fig. 4 is a view illustrating the flow of the refrigerant when the air conditioner operates in a cooling mode according to the first embodiment.

Fig. 5 is schematic view illustrating an inner configuration of an air conditioner according to a second embodiment.

Fig. 6 and Fig. 7 show views of an air conditioner according to a third embodiment.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0020]** Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

**[0021]** In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific preferred embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to practice the invention, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense.

**[0022]** Fig. 1 is schematic view illustrating an inner configuration of an air conditioner according to a first embodiment, and Fig. 2 is a view of the air conditioner according to the first embodiment.

**[0023]** Referring to Figs. 1 and 2, an air conditioner 1 according to a first embodiment includes a main body 10 defining an outer appearance thereof.

**[0024]** The main body 10 may includes a suction hole 102 for suctioning air, a discharge hole 104 for discharging the air, and a fan 60 for allowing the air to flow.

**[0025]** Also, the main body 10 may include a compressor 11 for compressing a refrigerant, a heat exchanger 20 for heat-exchanging the refrigerant flowing therethrough with the air, and an expander 30 for expanding the refrigerant.

**[0026]** In the current embodiment, the heat exchanger 20 includes a plurality of heat-exchanging parts. Here, a portion of the heat exchanging parts acts as a condenser, and the other portion of the heat exchanging parts acts as an evaporator.

**[0027]** Thus, in the current embodiment, since the main body 10 includes the compressor, the condenser, the expander, and the evaporator constituting a refrigerant cycle, the main body 10 may move to a desired position to dehydrate or cool the indoor air.

**[0028]** The plurality of heat-exchange parts may include a first heat-exchange part 21, a second heat-exchange part 22, and a third heat-exchange part 23. In the current embodiment, the plurality of heat-exchange parts 21, 22, and 23 may be integrated with each other to constitute one heat exchanger 20. Here, the plurality of heat-exchange parts 21, 22, and 23 may be distinguished from each other according to a flow of the refrigerant. Alternatively, the plurality of heat-exchange parts 21, 22, and 23 may be provided as separated modules and then be coupled to each other to constitute one heat exchanger 20. Alternatively, the plurality of heat-exchange parts 21, 22, and 23 may be provided as separated modules and then independently disposed in the main body 10. In this case, it may be understood that the main body 10 substantially includes three heat exchangers.

**[0029]** The second heat-exchange part 22 is disposed between the first heat-exchange part 21 and the third heat-exchange part 23. The second heat-exchange part 22 is disposed at a downstream side of the first heat-exchange part 21 with respect to a flow of the air. Also, the third heat-exchange part 23 is disposed at a downstream side of the second heat-exchange part 22. The discharge hole 104 is defined in a downstream side of the third heat-exchange part 23. That is, since the first to third heat-exchange parts 21, 22, and 23 are disposed in series with respect to a flow direction of the air, the air successively flows through the first, second, and third heat-exchange parts 21, 22, and 23 and then is discharged outside the main body 10 through the discharge hole 104.

**[0030]** For example, although the fan 60 is disposed at an upstream side of the first heat-exchange part 21 in Fig. 2, the present disclosure is not limited thereto. For example, the fan 60 may be disposed at the downstream side of the third heat-exchange part 23.

**[0031]** The compressor 11 may be connected to the second heat-exchange part 22 through a first tube 41. The second heat-exchange part 22 may be connected to a second tube 43. The expander 30 is disposed in the second tube 43. A valve 50 for controlling a flow direction of the refrigerant is disposed in a downstream-side tube of the expander 30 in the second tube 43. Although the valve 50 may be a three-way valve, the present disclosure is not limited thereto.

**[0032]** A first connection tube 45 and a second con-

nection tube 46 are connected to the valve 50. The first connection tube 45 is connected to the first heat-exchange part 21, and the second connection tube 46 is connected to the third heat-exchange part 23. Thus, the refrigerant may flow into one of the first heat-exchange part 21 and the third heat-exchange part 23 or may flow into each of the first heat-exchange part 21 and the third heat-exchange part 23 by the valve 50.

**[0033]** The discharge tubes of the first heat-exchange part 21 and the third heat-exchange part 23 may be combined with each other and then connected to the compressor 11.

**[0034]** As described above, since the heat exchanger 20 includes the plurality of heat-exchange parts 21, 22, and 23, the air conditioner 1 may include at least a cooling mode and a dehumidifying mode. Also, the main body 10 may further include a water tank 70 for storing condensate water in the dehumidifying mode.

**[0035]** The water tank 70 may be separably coupled to the main body 10. The condensate water stored in the water tank 70 may be drained in a state where the water tank 70 is separated from the main body 10.

**[0036]** Hereinafter, an operation of the air conditioner according to the current embodiment will be described.

**[0037]** Fig. 3 is a view illustrating a flow of a refrigerant when the air conditioner operates in a dehumidifying mode according to the first embodiment, and Fig. 4 is a view illustrating the flow of the refrigerant when the air conditioner operates in a cooling mode according to the first embodiment.

**[0038]** First, referring to Fig. 3, when the air conditioner 1 operates in the dehumidifying mode, the refrigerant compressed in the compressor 11 is introduced into the second heat-exchange part 22. The refrigerant introduced into the second heat-exchange part 22 is condensed while flowing into the second heat-exchange part 22. Thus, the second heat-exchange part 22 acts as a condenser in the dehumidifying mode. The refrigerant discharged from the second heat-exchange part 22 is expanded by the expander 30.

**[0039]** The refrigerant expanded in the expander 30 flows into the first heat-exchange part 21 by the valve 50. That is, in the dehumidifying mode, the valve 50 controls the flow of the refrigerant to allow the refrigerant to flow into only the first heat-exchange part 21 of the first and second heat-exchange parts 21 and 23.

**[0040]** The refrigerant is reintroduced into the compressor 11 after being evaporated while the refrigerant flows into the first heat-exchange part 21. Thus, the second heat-exchange part 21 acts as the evaporator in the dehumidifying mode.

**[0041]** In summary, in the dehumidifying mode, the first heat-exchange part 21 acts as the evaporator, the second heat-exchange part 22 acts as a condenser, and the refrigerant does not flow into the third heat-exchange part 23.

**[0042]** Thus, the air blown by the fan 60 is dehumidified while passing through the first heat-exchange part 21, and then is heated while passing through the second heat-exchange part 22. The heated air passes through the third heat-exchange part 23 and then is discharged from the main body 10 through the discharge hole 104. Here, since the refrigerant does not flow into the third heat-exchange part 23, the heated air does not substantially change in phase even though the heated air passing through the second heat-exchange part 22 passes through the third heat-exchange part 23.

**[0043]** Therefore, since the dehumidified heated air is discharged from the main body 10 finally, the dehumidifying operation may be performed.

**[0044]** Referring to Fig. 4, when the air conditioner 1 operates in the cooling mode, the refrigerant compressed in the compressor 11 is introduced into the second heat-exchange part 22. The refrigerant introduced into the second heat-exchange part 22 is condensed while flowing into the second heat-exchange part 22. Thus, the second heat-exchange part 22 acts as the condenser in the cooling mode. The refrigerant discharged from the second heat-exchange part 22 is expanded by the expander 30.

**[0045]** The refrigerant expanded in the expander 30 flows into the first and third heat-exchange parts 21 and 23 by the valve 50. That is, in the cooling mode, the valve 50 controls the flow of the refrigerant to allow the refrigerant to flow into each of the first heat-exchange part 21 and the third heat-exchange part 23.

**[0046]** The refrigerant is evaporated while flowing into the first and third heat-exchange parts 21 and 23 and then is reintroduced into the compressor 11. Thus, the first and third heat-exchange parts 21 and 23 act as the evaporator in the cooling mode.

**[0047]** In summary, in the cooling mode, the first heat-exchange part 21 acts as the evaporator, the second heat-exchange part 22 acts as the condenser, and the third heat-exchange part 23 acts as the evaporator.

**[0048]** Thus, the air blown by the fan 60 is dehumidified while passing through the first heat-exchange part 21, and then is heated while passing through the second heat-exchange part 22. Then, the heated air is cooled while passing through the third heat-exchange part 23. Thus, the cooled air is discharged from the main body 10 through the discharge hole 104.

**[0049]** Here, even though the air passing through the second heat-exchange part 22 is heated, the heated air has a temperature similar to room temperature. Also, since the heated air is cooled while passing through the third heat-exchange part 22 that acts as the evaporator. Finally, the cooled air is discharged from the main body 10, and thus the cooling operation may be performed.

**[0050]** In the current embodiment, although the valve 50 operates to allow the refrigerant to flow into the first heat-exchange part 21 and the third-heat-exchange part 23 in the cooling mode, the present disclosure is not limited thereto. For example, the valve 50 may operate to allow the refrigerant to flow into only the third heat-exchange part 23. In this case, since the air is finally cooled while flowing through the third heat-exchange part 23,

the cooling operation may be performed.

**[0051]** Alternatively, the cooling mode may be divided into two modes. In a first mode, the refrigerant may flow into each of the first and third heat-exchange parts 21 and 23. In a second mode, the refrigerant may flows into only the third heat-exchange part 23.

**[0052]** Here, since dehumidification performance for the air may be secured in the first mode, the first mode may be called a dehumidification-combined cooling mode, and the second mode may be called a cooling mode.

**[0053]** According to the proposed embodiment, the air conditioner 1 may operate in the dehumidifying mode or the cooling mode according to user's selection in a state where the main body 10 moves to a desired position.

**[0054]** Fig. 5 is schematic view illustrating an inner configuration of an air conditioner according to a second embodiment.

**[0055]** The current embodiment is the same as the first embodiment except for the heat exchanger. Thus, only specific portions of the current embodiment will be described below.

**[0056]** Referring to Fig. 5, a heat exchanger 20 according to a second embodiment may include a first heat-exchange part 21, a second heat-exchange part 22, and a third heat-exchange part 23.

**[0057]** In the current embodiment, the first to third heat-exchange parts 21, 22, and 23 may have the same function as those of the first embodiment, except for positions thereof.

**[0058]** In detail, the second and third heat-exchange parts 22 and 23 may be disposed at a downstream side of the first heat-exchange part 21. At least one portion of the third heat-exchange part 23 may be disposed above the second heat-exchange part 22.

**[0059]** Here, the at least one portion of the third heat-exchange part 23 may vertically overlap the second heat-exchange part 22 in Fig. 5.

**[0060]** Also, at least one portion of the third heat-exchange part 23 may be disposed at a downstream side of the second heat-exchange part 22. That is, the at least one portion of the third heat-exchange part 23 may horizontally overlap the second heat-exchange part 22 in Fig. 5.

**[0061]** Thus, according to the current embodiment, the condensate water generated in the third heat-exchange part while the third heat-exchange part 23 acts as an evaporator flows down into the second heat-exchange part 22, and thus the second heat-exchange part 22 acting as the condenser may be improved in condensation performance.

**[0062]** Figs. 6 and 7 are configurations of an air conditioner according to a third embodiment. Fig. 6 illustrates a flow of a refrigerant when the air conditioner operates in a cooling mode, and Fig. 7 illustrates a flow of the refrigerant when the air conditioner operates in a dehumidifying mode.

**[0063]** The current embodiment is the same as the first embodiment except for a heat exchanger and a flow of a refrigerant. Thus, only specific portions of the current embodiment will be described below.

**[0064]** Referring to Fig. 6, an air conditioner according to a third embodiment may include a compressor 11, a valve 80 for controlling a flow direction of a refrigerant discharged from the compressor 11, a heat exchanger 90 connected to the valve 80, and an expander 30 for expanding the refrigerant.

**[0065]** The heat exchanger 90 may include a first heat-exchange part 91 and a second heat-exchange part 92 disposed at a downstream side of the first heat-exchange part 91.

**[0066]** The valve 80 controls a flow of the refrigerant according to an operation mode of the air conditioner so that the refrigerant discharged from the compressor 11 flows into at least one of the first heat-exchange part 91 and the second heat-exchange part 92. In the current embodiment, the valve 80 may be a four-way valve.

**[0067]** The expander 30 may be disposed in a tube connecting the first heat-exchange part 91 to the second heat-exchange part 92 to each other.

**[0068]** First, when the air conditioner operates in a cooling mode, the refrigerant compressed in the compressor 11 flows into the first heat-exchange part 91 by the valve 80. The refrigerant is condensed while flowing in the first heat-exchange part 91 and is expanded in the expander 30 to flow into the second heat-exchange part 92. The refrigerant is evaporated while flowing in the second heat-exchange part 92 and is introduced into the compressor 11 by the valve 80.

**[0069]** The air blown by a fan 60 successively flows into the first and second heat-exchange parts 91 and 92. Since the air passes through the second heat-exchange part 92 that finally acts as an evaporator, cooling operation may be performed by the air conditioner.

**[0070]** Referring to Fig. 7, when the air conditioner operates in a dehumidifying mode, the refrigerant compressed in the compressor 11 flows into the second heat-exchange part 92 by the valve 80. The refrigerant is condensed while flowing in the second heat-exchange part 92 and is expanded in the expander 30 to flow into the first heat-exchange part 91. The refrigerant is evaporated while flowing in the first heat-exchange part 91 and is introduced into the compressor 11 by the valve 80.

**[0071]** The air blown by a fan 60 successively flows into the first and second heat-exchange parts 91 and 92. Therefore, since the air is dehumidified while passing through the first heat-exchange part 91 and is heated while passing through the second heat-exchange part 92, a dehumidifying operation may be performed by the air conditioner.

**[0072]** Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, var-

ious variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

## Claims

**1.** An air conditioner comprising:

a main body (10) comprising a suction hole (102) for suctioning air and a discharge hole (104) for discharging the air;
a compressor (11) disposed in the main body (10) to compress a refrigerant;
a heat exchanger (20) receiving the refrigerant compressed by the compressor (11), the heat exchanger comprising a plurality of heat-exchange parts (21, 22, 23);
an expander (30) disposed in the main body (10) to expand the refrigerant; and
a valve (50; 80) to control a flow of the refrigerant into the heat exchanger (20),
wherein an operation mode of the air conditioner comprises a cooling mode and a dehumidifying mode,
the plurality of heat-exchange parts (21, 22, 23; 91, 92) are disposed in series with respect to a flow direction of the air to allow the air to successively pass therethrough, and
a portion of the plurality of heat-exchange parts (21, 22, 23) acts as a condenser, and the other portion of the plurality of heat-exchange parts acts as an evaporator according to the flow of the refrigerant by an operation of the valve (50).

**2.** The air conditioner according to claim 1, wherein the valve (50; 80) controls the flow of the refrigerant so that the air passes through the heat-exchange part that acts as the evaporator after passing through the heat-exchange part that acts as the condenser in the cooling mode of the air conditioner, and
the valve (50; 80) controls the flow of the refrigerant so that the air passes through the heat-exchange part that acts as the condenser after passing through the heat-exchange part that acts the evaporator in the dehumidifying mode of the air conditioner.

**3.** The air conditioner according to claim 1 or 2, wherein the plurality of heat-exchange parts comprises:

a first heat-exchange part (21);
a second heat-exchange part (22) disposed at a downstream side of the first heat-exchange part; and
a third heat-exchange part (23) disposed at a downstream side of the second heat-exchange part,
wherein the refrigerant compressed in the compressor (11) is supplied into the second heat-exchange part (22), and
the valve (50) controls the flow of the refrigerant so that the refrigerant discharged from the second heat-exchange part (22) flows into at least one of the first heat-exchange part (21) and the third heat-exchange part (23).

**4.** The air conditioner according to claim 3, wherein the cooling mode of the air conditioner comprises a first mode and a second mode,
wherein, in the first mode, the valve (50) controls the flow of the refrigerant so that the refrigerant discharged from the expander (30) flows into each of the first and third heat-exchange parts (21, 23), and in the second mode, the valve (50) controls the flow of the refrigerant so that the refrigerant discharged from the expander (30) flows into the third heat-exchange part (23).

**5.** The air conditioner according to claim 3 or 4, wherein, in the dehumidifying mode, the valve (50) controls the flow of the refrigerant so that the refrigerant discharged from the expander (30) flows into the first heat-exchange part (21).

**6.** The air conditioner according to any one of claims 3 to 5, wherein the expander (30) is disposed in a tube through which the refrigerant discharged from the second heat-exchange part flows, and
the valve (50; 80) is disposed at a downstream side of the expander (30) in the tube.

**7.** The air conditioner according to claim 6, further comprising:

a first connection tube connected to the valve (50; 80) and the first heat-exchange part (21; 91); and
a second connection tube connected to the valve (50; 80) and the second heat-exchange part (22; 92).

**8.** The air conditioner according to any one of claims 3 to 7, wherein at least one portion of the third heat-exchange part (23) vertically overlaps the second heat-exchange part (22).

**9.** The air conditioner according to claim 2, wherein the plurality of heat-exchange parts comprises:

the first heat-exchange part (91); and
the second heat-exchange part (92) disposed at the downstream of the first heat-exchange

part (91),
wherein, in the dehumidifying mode of the air conditioner, the valve (80) controls the flow of the refrigerant so that the refrigerant discharged from the compressor (11) flows into the first heat-exchange part (91) to allow the first heat-exchange part (91) to act as the condenser.

**10.** The air conditioner according to claim 9, wherein, in the cooling mode of the air conditioner, the valve (80) controls the flow of the refrigerant so that the refrigerant discharged from the compressor (11) flows into the second heat-exchange part (92) to allow the second heat-exchange part (92) to act as the condenser.

**11.** The air conditioner according to claim 9 or 10, wherein the expander (30) is disposed in a tube connecting the first heat-exchange part (91) to the second heat-exchange part (92).

**12.** A method of operating an air conditioner according to any one of claims 1 to 11.

Fig.1

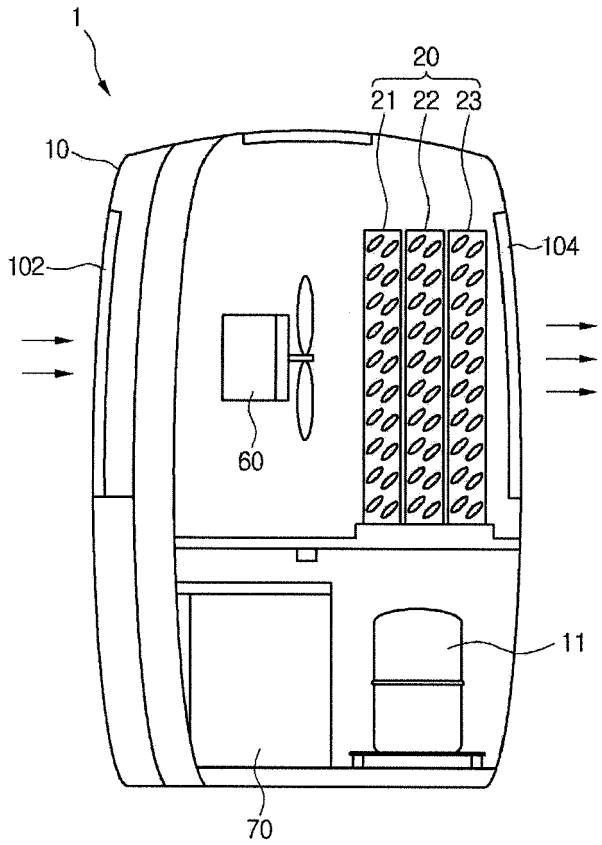


Fig.2

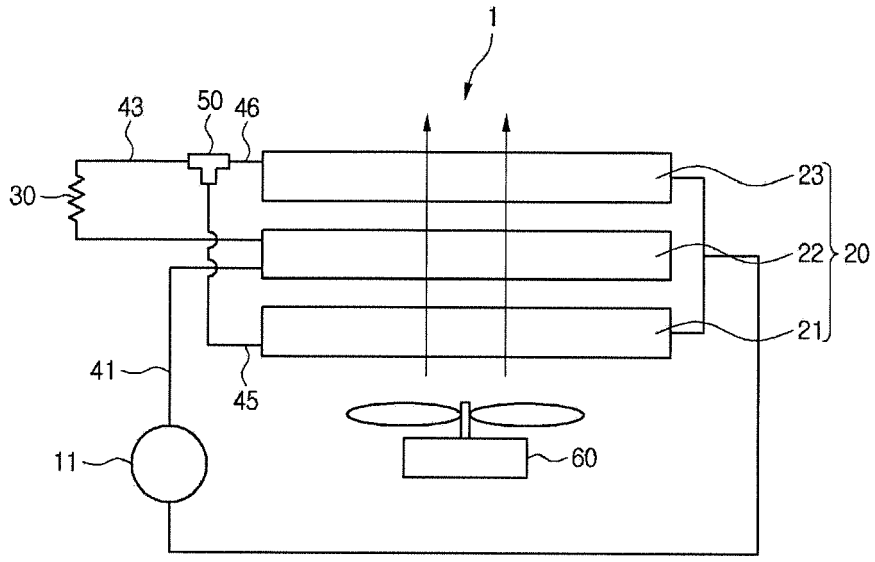


Fig.3

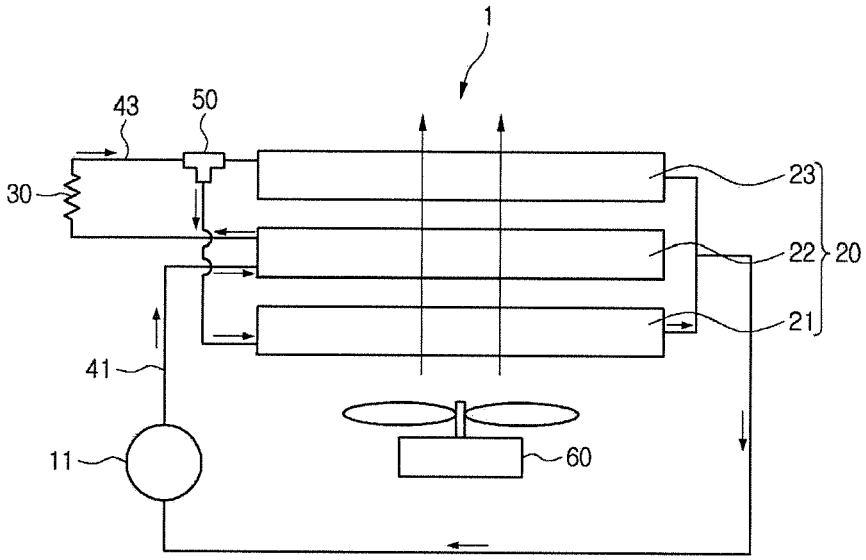


Fig.4

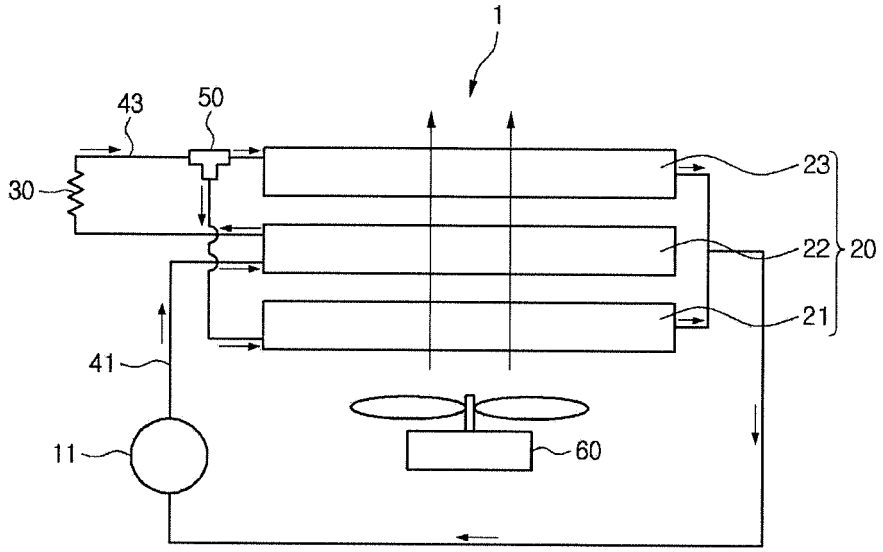


Fig.5

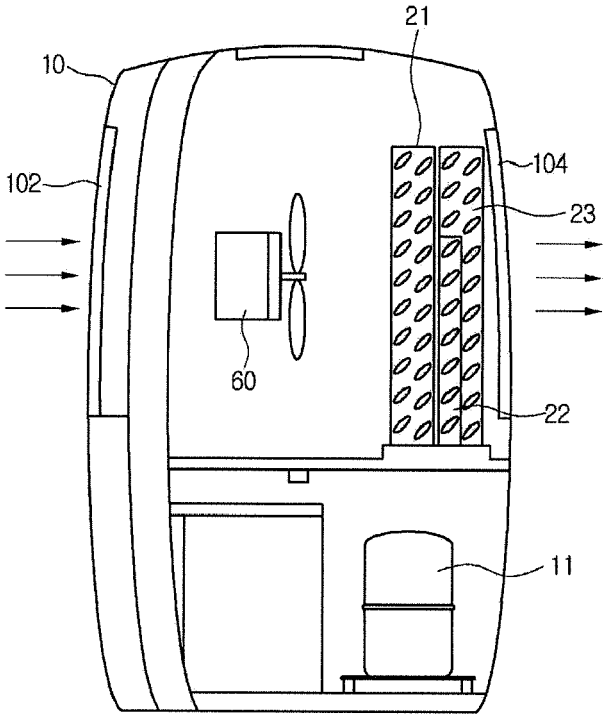


Fig.6

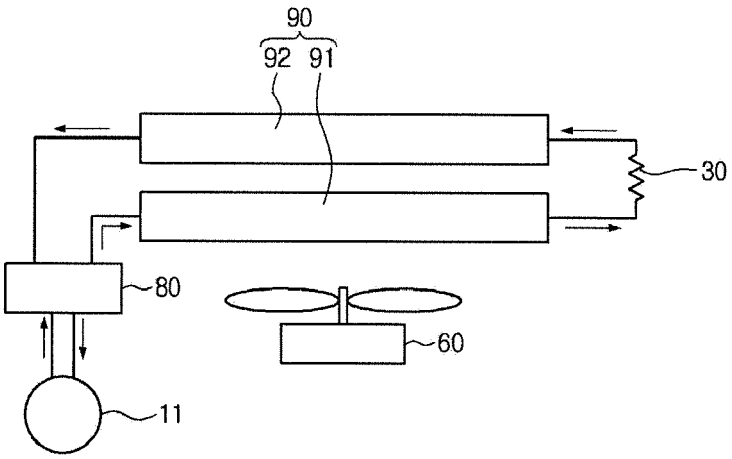
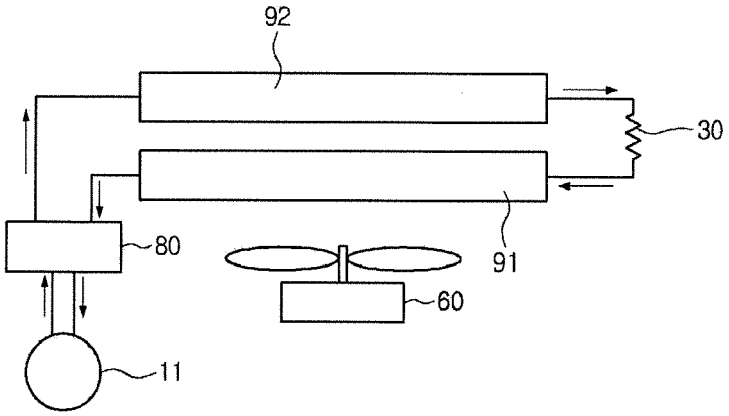


Fig.7



## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- KR 20070064077 **[0003]**