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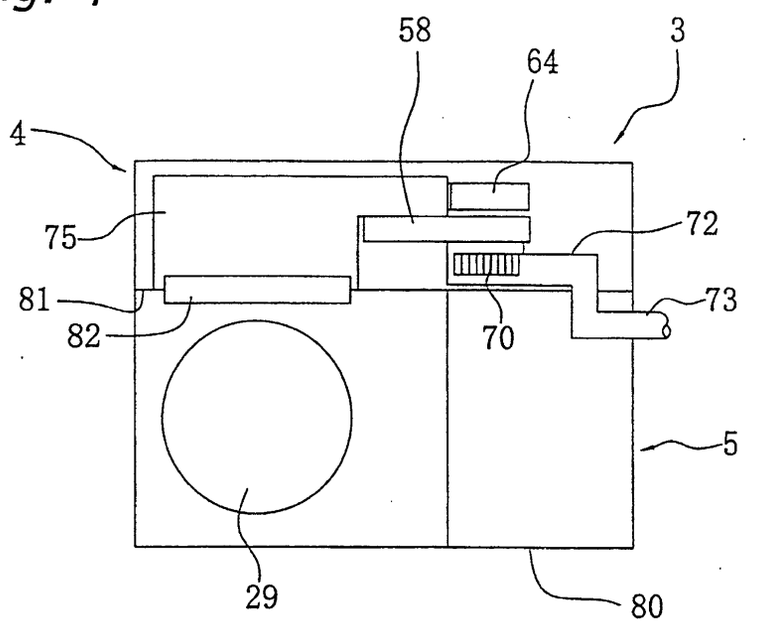
(54) AIR CONDITIONER

(57) An air conditioner comprised of a humidification unit consumes less energy when operating, the size of the outdoor unit is reduced, and the cost of the air conditioner is reduced. A flow path opening and closing means 82 is provided in a divider 81 that divides a humidification unit 4 from an outdoor air conditioning unit 5 that are in an outdoor unit casing 80. By opening the flow path opening and closing means 82, an absorption flow path is formed that passes through a humidification rotor 58 and discharges air through the front surface of an outdoor fan 29 via an absorption discharge path 75.

Fig. 4



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Description

Technical Field

[0001] The present invention relates to an air conditioner that is capable of transporting humidified air from a humidification unit attached to an outdoor unit to an indoor unit, and regulating the humidity of indoor air.

Background Art

[0002] In a separate type of air conditioner, an outdoor heat exchanger disposed in an outdoor unit is connected to an indoor heat exchanger disposed in an indoor unit via a refrigerant line. This type of air conditioner is structured so that cooling and heating operations are conducted by controlling each heat exchanger so that they act as a refrigerant condenser and vaporizer.

[0003] An outdoor fan for generating air flow is disposed in the outdoor unit. This outdoor air fan introduces outdoor air, and heat exchange occurs between the refrigerant that passes through the interior of the outdoor heat exchanger and this air.

[0004] Likewise, an indoor fan for generating air flow inside the casing of the indoor unit is disposed in the indoor unit. This indoor air fan draws in indoor air, and heat exchange occurs between the refrigerant that passes through the interior of the indoor heat exchanger and this air.

[0005] Generally speaking, there are many times when the indoor relative humidity is extremely low when heating operations are being conducted by the air conditioner. This is because the temperature of the indoor air is simply raised without supplying additional moisture. Because of this, it has been proposed to provide a humidification unit in the air conditioner for the purpose of supplying humidified air indoors. The humidification unit, for example, absorbs moisture from the air, and includes a disk shaped rotor made of a porous hygroscopic material such as zeolite or the like in which the moisture absorbed thereby can be removed by heating the same and which is rotatably supported on the humidification unit. The humidification unit also includes an absorption fan for introducing outdoor air therein so that the rotor can absorb moisture from the air and for producing an air flow that passes through a portion of the rotor, and a humidification fan that generates an air flow for transporting air humidified by the moisture removed from the rotor to the indoor unit. The air flow from the absorption fan and the air flow from the humidification fan passes through the rotor at different locations along the rotational direction thereof. A heater for heating the rotor is disposed at the position of the rotor in which air flow from the humidification fan passes therethrough.

[0006] The moisture in the air flow from the absorption fan is absorbed by the hygroscopic material of the rotor. The rotor is rotatively driven by a motor, the position on the rotor in which the moisture has been absorbed is then heated by the heater, and thus moisture can be added to the air flow from the humidification fan.

[0007] The humidification unit described above can either be disposed on top of the outdoor unit or in the vicinity thereof, the rotor therein absorbs moisture in the outdoor air drawn into the humidification unit by the humidification fan, and the moisture absorbed by the rotor is repeatedly removed and transported to the indoor unit as humidified air.

[0008] Accordingly, the outdoor fan provided in the outdoor unit generates an air flow for exchanging heat between it and the refrigerant that passes through the interior of the outdoor heat exchanger. In addition, the absorption fan in the humidification unit generates an air flow for absorbing moisture by the rotor. The outdoor fan and the absorption fan introduce outdoor air into the casing, and discharge this air from the casing after it has passed through the outdoor heat exchanger or the absorption fan.

[0009] If this outdoor air conditioning unit and humidification unit could be stored together in the outdoor unit casing, and the outdoor fan and absorption fan could be combined into one fan, the number of parts could be reduced, cost reductions could be achieved, and a reduction in both the energy consumed during operations and the size of the outdoor unit could be provided.

[0010] It is an object of the present invention to provide an air conditioner comprised of a humidification unit in which the energy consumed thereby during operations is reduced, the size of the outdoor unit is reduced, and cost reductions are achieved.

Disclosure Of The Invention

[0011] An air conditioner according to the present invention is comprised of an outdoor unit casing, an outdoor air conditioning unit, an indoor unit casing, an indoor air conditioning unit, a humidification unit, and a flow path opening and closing means. The outdoor air conditioning unit includes an outdoor heat exchanger that is stored inside the outdoor unit casing, and an outdoor fan that is stored inside the outdoor unit casing and which serves to generate an air flow that exchanges heat between it and the outdoor heat exchanger. The indoor air conditioning unit includes an indoor heat exchanger that is stored inside the indoor unit casing. The humidification unit is rotatively disposed inside the outdoor casing, and includes a hygroscopic member that is comprised of a hygroscopic material that absorbs moisture from the air and releases this absorbed moisture when it is heated, a drive means for rotatively driving the hygroscopic member, a heating means which heats a portion of the hygroscopic member, and a humidified air transport means that mixes the moisture removed from the portion of the hygroscopic member heated by the heating means with air and transports this mixture into the indoor unit casing. The flow path opening and closing means opens and closes an air flow path

that extends from the exterior of the outdoor unit casing to the portion of the hygroscopic member in which the heating means is not positioned, and discharges air to the outside by means of the outdoor fan.

[0012] Here, the introduction of air from the outside when the humidification unit absorbs moisture can be accomplished by means of the outdoor fan of the outdoor air conditioning unit, thus allowing the number of parts to be reduced, the size of the air conditioner to be reduced, the amount of energy consumed to be reduced, and cost reductions to be achieved.

[0013] In this configuration, the outdoor heat exchanger is positioned at least on the rear side of the outdoor unit casing, the outdoor fan is provided on the front side of the outdoor heat exchanger, and the humidification unit is provided on the upper portion of the outdoor heat exchanger and the outdoor fan inside the outdoor unit casing.

[0014] Here, the outdoor heat exchanger is positioned on the negative pressure side of the outdoor fan, the air flow path is constructed such that the air that passed through the hygroscopic member is directed toward and passes through the negative pressure portion between the outdoor heat exchanger and the outdoor fan, and thus this air can be efficiently used when the hygroscopic member absorbs moisture.

[0015] In addition, the hygroscopic member can be constructed such that it is disk shaped and rotatable about a rotation shaft that extends in the vertical direction.

[0016] Here, uneven rotation of the hygroscopic member can be eliminated, and thus reliable humidification can be obtained thereby.

[0017] Furthermore, the humidified air transport means can be constructed such that it comprises a humidification fan that sends air to the portion of the hygroscopic member that is heated by the heating means, and a humidified air line for transporting air flow that passed through the heated portion of the hygroscopic member to the indoor unit casing.

[0018] Here, by rotatively driving the hygroscopic member, the portion thereof that has absorbed moisture in the air flow path generated by the outdoor fan moves to the heated position, and humidified air can be supplied to the indoor unit through the humidified air line by means of the air flow from the humidification fan.

[0019] The outdoor unit casing is comprised of an divider that separates, in an airtight manner, an outdoor fan storage unit that stores the outdoor heat exchanger and the outdoor fan from a humidification unit storage unit that stores the humidification unit. The flow path opening and closing means can be provided in this divider.

[0020] Here, the divider can reliably isolate the outdoor fan storage unit from the humidification unit storage unit when the humidification unit is not operating, and an air flow path that passes through the hygroscopic member can be created by opening the flow path opening and closing means when the humidification unit is operating.

Brief Description Of The Drawings

[0021]

Fig. 1 is a perspective view showing the exterior structure of an air conditioner in which a first embodiment of the present invention is adopted.
Fig. 2 shows a refrigerant circuit.
Fig. 3 is an exploded perspective view of an outdoor unit.
Fig. 4 is a cross-sectional view showing a summary of the outdoor unit.
Fig. 5 is a cross-sectional view showing a summary of the outdoor unit.
Fig. 6 shows one example of a flow path opening and closing means.
Fig. 7 is a longitudinal cross-section of Fig. 6.
Fig. 8 shows another example of a flow path opening and closing means.
Fig. 9 describes the control of the aperture of the flow opening and closing means in operational modes.
Fig. 10 is a flowchart for controlling the humidification operation by controlling the outdoor fan.
Fig. 11 is a flowchart for controlling the humidification operation by regulating the aperture of the flow path opening and closing means.

Best Mode For Carrying Out The Invention

[Exterior appearance of the air conditioner]

[0022] The exterior appearance of an air conditioner in which a first embodiment of the present invention is adapted is shown in Fig. 1.

[0023] The air conditioner 1 is comprised of an indoor unit 2 installed on a wall surface or the like of an indoor space, and an outdoor unit 3 disposed outdoors. The outdoor unit 3 is comprised of an outdoor air conditioning unit 5 that stores such things as an outdoor heat exchanger and an outdoor fan, and a humidification unit 4 that transports humidified air to the indoor unit 2.

[0024] An indoor heat exchanger is stored in the indoor unit 2, an outdoor heat exchanger is stored in the outdoor unit 3, and a refrigerant circuit is formed by connecting each heat exchanger with a refrigerant line 6. In addition, a humidified air line 7 for supplying humidified air from the humidification unit 4 to the indoor unit 2 is provided between the humidification unit 4 and the indoor unit 2.

[Outline of the structure of the refrigerant circuit]

[0025] An example of the refrigerant circuit that is employed in the air conditioner 1 is shown in Fig. 2

[0026] An indoor heat exchanger 11 is provided inside the indoor heat exchanger 2. The indoor heat exchanger 11 is comprised of heat conduction pipe that has a plurality of bends in both ends thereof in the lengthwise direction, and a plurality of fins that are interposed between the heat conduction pipe, and exchanges heat between it and air that comes into contact therewith.

[0027] In addition, a cross flow fan 12 is provided inside the indoor unit 2, which discharges air into an interior space after that air has been taken in from outdoors and heat has been exchanged between it the indoor heat exchanger 11. The cross flow fan 12 is cylindrical in shape, blades are provided on the peripheral surface thereof in the direction which it axially rotates, and produces an air flow in the direction at which the axis of rotation is crossed. The cross flow fan 12 is rotatively driven by a fan motor 13 that is provided inside the indoor unit 2.

[0028] A compressor 21, a four way directional control valve 22 that is connected to the discharge side of the compressor 21, an accumulator 23 that is connected to the intake side of the compressor 21, an outdoor heat exchanger 24 that is connected to the four way directional control valve 22, and a decompressor 25 that is an electric expansion valve connected to the outdoor heat exchanger 24, are provided in the outdoor air conditioning unit 5. The decompressor 25 is connected to a local line 31 via a filter 26 and a liquid shut-off valve 27, and is connected to one end of the indoor heat exchanger 11 via this local line 31. In addition the four way directional control valve 22 is connected to a local line 32 via a gas shut-off valve 28, and is connected to the other end of the indoor heat exchanger 11 via this local line 32. The local lines 31, 32 correspond to the refrigerant line 6 shown in Fig. 1.

[0029] A propeller fan 29 for discharging air to the outside after it has exchanged heat with the outdoor heat exchanger 24 is provided inside the outdoor air conditioning unit 5. The propeller fan 29 is rotatively driven by a fan motor 30.

[Structure of the outdoor unit]

[0030] The structure of the outdoor unit 3 will be described with the exploded perspective view thereof shown in Fig. 3.

[0031] The outdoor unit 3 is comprised an outdoor casing that includes such things as a bottom plate 41, a right side plate 42, a left side plate 43, a front plate 44, a protective metal net 46, a top plate 47, and a humidification unit casing 48.

[0032] A fan intake port 45 and a divider 49 are installed behind the front plate 44. In addition, the outdoor heat exchanger 24 is installed in front of the protective metal net 46 that is positioned in the rear of the outdoor unit casing, and is approximately L-(shaped) when viewed from above.

[0033] A fan motor mount 50 is installed in front of the outdoor heat exchanger 24, and the fan motor 30 is fixed thereto. The outdoor fan 29 is installed on the outdoor fan motor 30. The outdoor fan 29 is driven by the outdoor fan motor 30, and thereby creates a negative pressure in the space formed by the fan intake port 45, the divider 49, the left side plate 43, the outdoor heat exchanger 24, and the bottom plate of the humidification unit casing 48. After the air introduced from the rear surface and the left surface comes into contact with the outdoor heat exchanger 24, it is discharged through the front surface of the front plate 44.

[0034] The components that form the refrigerant circuit, such as the compressor 21, the four way directional control valve 22, the electric valve 25, the liquid shut-off valve 27, and the gas shut-off valve 28, and a thermistor 51 for detecting the temperature of each component thereof, are disposed between the divider 49 and the right side plate 42. A shut-off valve cover 52 for protecting the liquid shut-off valve 27 and the gas shut-off valve 28 is installed on the right side of the right side plate 42.

[0035] An electric component box 53 is installed above the outdoor fan 29. A printed wiring board 54 on which electric components for controlling each portion of the air conditioner are mounted is stored in the electric component box 53, and heat dissipating fins 55 for dissipating heat produced by the electric components are installed on the electric component box 53.

[0036] In addition, a fire-proof plate 56 for preventing fire from spreading in the rare instance one breaks out, and a drip-proof plate 57 for preventing the intrusion of drops of water from the humidification unit, are provided in the upper portion of the space in which refrigerant circuit components such as the compressor 21 are stored.

[0037] A humidification rotor 58 is disposed inside the humidification unit casing 48. The humidification rotor 58 absorbs moisture from the air that comes into contact therewith, and is a disk shaped member that is made of a porous material such as zeolite and the like that has the ability to release moisture absorbed thereby when it is heated. The humidification rotor 58 is rotatively supported by a support shaft 59 that is provided on the humidification unit casing 48. Gear teeth are formed on the peripheral surface of the humidification rotor 58, and mesh with a rotor drive gear 62 installed on a drive shaft of a rotor drive motor 61.

[0038] A heater assembly 64 is disposed on the upper surface of the humidification rotor 58 such that it covers approximately half thereof. The heater assembly 64 is comprised of a heater main body 66, an upper cover 65 that covers the heater main body 66, and a lower cover 69 that has an intake port 67 for drawing in air and a discharge port 68 that discharges air heated by the heater main body 66. The heater assembly 64 is installed above the humidification rotor 58 via a heater fixing plate 63.

[0039] A humidification fan 70 is disposed below the humidification rotor 58 and in a position that faces the heater assembly 64. The humidification fan 70 is a cen-

trifugal fan that is disposed inside a casing that links to a humidification connecting duct 72, and is formed to be integral with a humidification fan intake port 71 that is installed below the humidification rotor 58. The humidification fan 70 discharges air that passed through the humidification rotor 58 to the humidification connecting duct 72, and sends out humidified air to the indoor unit 2 via a humidification hose 73 and a humidified air line 7.

[0040] An absorption connecting duct 74 is provided on the upper surface of the humidification rotor 58 such that it covers the portion thereof that is not covered by the heater assembly 64. The absorption connecting duct 74 forms an air flow path that extends from the lower portion of the humidification rotor 58, passes through the humidification rotor 58, and ends in an absorption discharge path 75 that is adjacent to the area in which the humidification rotor 58 is stored.

[0041] An electric component casing that is composed of the electric component box 76 in which the printed wiring board is stored and an electric component box lid 77 is disposed inside the humidification unit casing 48 together with an electric power source board 79

[Air flow path of the humidification unit]

[0042] Figs. 4 and 5 show a simplified cross-sectional view of the outdoor unit 3.

[0043] The humidification unit 4 is disposed in the upper portion of the outdoor air conditioner 5, and is integrally stored inside the outdoor unit casing 80. A divider 81 that divides the humidification unit 4 from the outdoor air conditioning unit 5 is disposed inside the outdoor unit casing 80.

[0044] The absorption discharge path 75 of the humidification unit 4 is disposed above the outdoor fan 29. A flow path opening and closing means 82 is provided in the divider 81 positioned between the established space of the outdoor fan 29 and the absorption discharge path 75. The flow path opening and closing means 82 is constructed such that it is capable of opening and closing the absorption discharge path 75 and the established space of the outdoor fan 29.

[0045] If the flow path opening and closing means 82 is in the open state, the absorption discharge path 75 will be open to the negative pressure space generated by the outdoor fan 29, air will flow from the exterior of the outdoor unit casing 80 through the humidification rotor 58, and an air flow will be generated that is discharged through the front surface of the outdoor air conditioning unit 5 via the absorption discharge path 75.

[0046] In addition, by driving the humidification fan 70, heated air will pass through the humidification rotor 58 via the heater assembly 64, and an air flow will be generated that is discharged through the humidification connection duct 72 and the humidification hose 73.

[0047] In this way, the air heated by the heating assembly 64 is mixed with the moisture removed from the humidification rotor 58 to become humidified air, and is then transported to the indoor unit 2.

[Flow path opening and closing means]

[0048] An example of the flow path opening and closing means 82 is shown in Figs. 6 and 7.

[0049] Here, a slide plate 92 is provided that is capable of closing a port 91 provided in the divider 81. The slide plate 92 is supported such that it is horizontally moveable in Fig. 6 by means of guide members 93, 93.

[0050] A threaded shaft 94 is fixed to one end of the slide plate 92. A nut member 96 is provided on a central portion of the threaded shaft 94 that regulates the horizontal movement of the slide plate 92, meshes with the threaded shaft 94, and is supported by the threaded shaft 94 such that it is freely rotatable therewith. The peripheral surface of the nut member 96 has a gear formed thereon which meshes with a gear 97 fixed to a rotation shaft of a drive motor 98.

[0051] By rotatively driving the drive motor 98 in a first direction, the nut member 96 rotates via the gear 97, and moves the threaded shaft 94 in the first direction. When this occurs, the slide plate 92 fixed to one end of the threaded shaft 94 is guided by the guide members 93, 93 to move it, for example, from the position which closes the port 91 to the position which opens it. Likewise, by rotatively driving the drive motor in a second direction, the threaded shaft 94 will move in the (second) direction. When this occurs, the slide plate 92 fixed to one end of the threaded shaft 94 moves together with the threaded shaft 94 and will move from the position in which the port 91 is open to the position in which it is closed.

[Other examples of the flow path opening and closing means]

[0052]

(A) Another example of the flow path opening and closing means 82 is shown in Fig. 8.

Here, a slide plate 101 that is capable of opening and closing the port 91 provided in the divider 81 is supported by a rotation shaft 102 such that it is freely rotatable therewith.

A lever 103 is provided on the slide plate 101. An actuator 105 of a solenoid 104 is fixed to the lever 103. In addition, an elastic member 106 such as a coil spring or the like which serves to return the slide plate 101 to the position which closes the port 91 when the solenoid 104 is turned off is provided on the slide plate 101.

When the solenoid 104 is turned off, the actuator 105 is in the free state, and the slide plate 101 moves to the position which closes the port 91 due to the biasing force of the elastic member 106.

When the solenoid 104 is turned on, the actuator 105 is retracted, the slide plate 101 rotates in

the clockwise direction in Fig. 8, and moves to the position which opens the port 91.

(B) A gear that rotates integrally with the slide plate of Fig. 8 can be installed on the rotation shaft 102, and this gear and the gear fixed to the rotation shaft of the drive motor can be constructed so that they mesh.

[0053] Here, it becomes possible to regulate the amount that the slide plate 101 opens the port 91 by regulating the amount of drive of the drive motor.

[Control of the humidification operation]

(A) Aperture control of the flow path opening and closing means according to mode

[0054] If a flow path opening and closing means 82 capable of regulating the aperture is used, then the operational mode can be controlled by regulating the aperture.

[0055] As shown in Fig. 9, if the operational mode is cooling or heating, the flow path opening and closing means 82 will be completely closed. When this occurs, the air flow through the humidification rotor 58 will be cut off, and thus the air flow produced by the outdoor fan 29 is only for the outdoor heat exchanger 24.

[0056] In addition, if the operational mode is heating and humidification, the flow path opening and closing means 82 will be half open. Here, the air flow through the humidification rotor 58 will be restricted by half that when in the fully open state, and thus the air flow to the outdoor heat exchanger 24 will be maintained, the efficiency during heating operations will not be damaged, and humidification operations can be conducted by means of the humidification unit 3.

[0057] Furthermore, if the operational mode is humidification, the flow path opening and closing means 82 will be fully open. Here, the air flow through the humidification flow path will be maximized, and the absorption of moisture during humidification operations can be performed more efficiently.

(B) Control of humidification operations by controlling the outdoor fan

[0058] In the humidification operation mode, the rotational frequency of the outdoor fan 29 will be controlled in response to the outdoor humidity, and the amount of moisture absorbed from the air introduced into the air conditioner 1 will be regulated. This situation is shown in the flowchart of Fig. 10.

[0059] The outdoor humidity is detected in Step S11. If a humidity sensor is provided in the outdoor unit 3, the outdoor humidity can be detected by this humidity sensor. In addition, if an outdoor temperature sensor for detecting the outdoor temperature is provided together with a post-rotor pass through temperature sensor that detects the air temperature after the air has passed through the humidification rotor, the outdoor humidity can be detected from the detected values from the outdoor temperature sensor and the post-rotor pass through temperature sensor.

[0060] In Step S12, it is determined whether or not the outdoor humidity is lower than a first predetermined value. If the outdoor humidity is lower than the first predetermined value, the process moves to Step S13. In Step S13, the rotational frequency of the outdoor fan 29 is set to high. Here, the outdoor fan motor 30 that drives the outdoor fan 29 is a DC motor, and thus the rotational frequency thereof can be increased by increasing the frequency of the power supplied to the outdoor fan motor 30.

[0061] In Step S14, it is determined whether or not the outdoor humidity is higher than a second predetermined value. This second predetermined value is higher than the first predetermined value, and if the outdoor humidity detected is higher than the second predetermined value, then the process moves to Step S15. At Step S15, the rotational frequency of the outdoor fan 29 is set to low. Here, the rotational frequency thereof can be lowered by lowering the frequency of the power supplied to the outdoor fan motor 30.

(C) Control of humidification operations by regulating the aperture of the flow path opening and closing means

[0062] If the aperture of the flow path opening and closing means 82 can be regulated, then when in the humidification operation mode, the aperture can be regulated in response to the outdoor humidity, the amount of air introduced into the air conditioner 1 can be changed, and the amount of moisture absorbed can be regulated. This situation is shown in the flowchart of Fig. 11.

[0063] In Step S21, the outdoor humidity is detected. Like noted above, if a humidity sensor is provided in the outdoor unit 3, the outdoor humidity can be detected by this humidity sensor, and the outdoor humidity can also be detected from the detected values from an outdoor temperature sensor and a post-rotor pass through temperature sensor.

[0064] In Step S22, it is determined whether or not the outdoor humidity is lower than a first predetermined value. If the outdoor humidity is lower than the first predetermined value, the process moves to Step S23. In Step S23, the aperture of the flow path opening and closing means 82 is set to high.

[0065] In Step S24, it is determined whether or not the outdoor humidity is higher than a second predetermined value. This second predetermined value is higher than the first predetermined value, and if the outdoor humidity detected is higher than the second predetermined value, then the process moves to Step S25. At Step S25, the aperture of the flow path opening and closing means 82 is set to low.

[Tourmaline]

[0066] Tourmaline powder can be mixed into the synthetic resin used to form the casing members around the vicinity of the air discharge ports in the indoor unit 2 and each structural element thereof. In addition, a paint containing tourmaline powder can be applied to the casing member and each structural element. Furthermore, the interior of the humidified air line 7 from the humidification unit 4 to the indoor unit 2, as well as each structural element of the humidification unit 4, can be formed from a synthetic resin containing tourmaline powder, or a paint containing tourmaline powder can be applied thereto.

[0067] Tourmaline discharges electricity and generates negative ions when moisture comes into contact therewith. Thus, the air discharged from the indoor unit 2 can contain a large quantity of negative ions, and thus the generation of oxygen radicals that are deleterious to human health can be reduced and adult diseases such as high blood pressure and the like can be prevented.

Industrial Applicability

[0068] In the air conditioner according to claim 1 of the present invention, the outdoor fan provided in the outdoor air conditioning unit is used to produce an air flow so that the humidification unit can absorb moisture, which makes it possible to reduce the amount of noise generated when compared to providing an absorption fan in the humidification unit. In addition, the number of parts such as motors and the like can be reduced, the size of the air conditioner can be reduced, the amount of energy consumed can be reduced, and cost reductions can be achieved.

[0069] In the air conditioner according to claim 2, the outdoor heat exchanger is positioned on the side of the outdoor fan that produces negative pressure, the air flow path is constructed such that the air that passed through the hygroscopic member is directed toward and passes through the negative pressure portion between the outdoor heat exchanger and the outdoor fan, and thus this air can be efficiently used when the hygroscopic member absorbs moisture.

[0070] In the air conditioner according to claim 3, nonuniform rotation of the hygroscopic member can be eliminated, and thus reliable humidification can be obtained thereby.

[0071] In the air conditioner according to claim 4, by rotatively driving the hygroscopic member, the portion thereof that has absorbed moisture in the air flow path generated by the outdoor fan moves to the heated position, and humidified air can be supplied to the indoor unit through the humidified air line by means of the air flow from the humidification fan.

[0072] In the air conditioner according to claim 5, the divider can reliably isolate the outdoor fan storage unit from the humidification unit storage unit when the humidification unit is not operating, and an air flow path that passes through the hygroscopic member can be produced by opening the flow path opening and closing means when the humidification unit is operating.

Claims

1. An air conditioner, comprising:

an outdoor unit casing (80);
an outdoor air conditioning unit (5) that comprises an outdoor heat exchanger (24) that is stored inside the outdoor unit casing (80), and an outdoor fan (29) that is stored inside the outdoor unit casing (80) and serves to generate an air flow that exchanges heat between it and the outdoor heat exchanger (24);
an indoor unit casing that is disposed in an interior space;
an indoor air conditioning unit (2) that comprises an indoor heat exchanger (11) that is stored inside the indoor unit casing;
a humidification unit (4) that is rotatively stored inside the outdoor unit casing (80), and which comprises a hygroscopic member (58) that is formed from a hygroscopic material that absorbs moisture from the air and releases this absorbed moisture when it is heated, a drive means (61) for rotatively driving the hygroscopic member (58), a heating means (64) which heats a portion of the hygroscopic member (58), and a humidified air transport means (70, 72, 73) that mixes the moisture removed from the portion of the hygroscopic member (58) heated by the heating means (64) with air and transports this mixture into the indoor unit casing; and
a flow path opening and closing means (82) that extends from the exterior of the outdoor unit casing (80) to a portion of the hygroscopic member (58) in which the heating means (64) is not positioned, and which opens and closes the air flow path that discharges air to the outside by means of the outdoor fan (29).

2. The air conditioner set forth in claim 1, wherein the outdoor heat exchanger (24) is positioned at least on a rear surface of the outdoor unit casing (80), the outdoor fan (29) is provided on a front surface of the outdoor heat exchanger (24), and the humidification unit (4) is provided on an upper portion of the outdoor heat exchanger (24) and the outdoor fan (29) inside the outdoor unit casing (80).

3. The air conditioner set forth in claim 1 or claim 2, wherein the hygroscopic member (58) can be constructed such that it is disk shaped and rotatable

about a rotation shaft (59) that extends in a vertical direction.

4. The air conditioner set forth in claims 1 to 3, wherein the humidified air transport means comprises a humidification fan (70) that sends air to a portion of the hygroscopic member (58) that is heated by the heating means (64), and humidified air lines (72, 73) for transporting air flow that passed through the heated portion of the hygroscopic member (58) to the indoor unit casing.

5. The air conditioner set forth in any of claims 1 to 4, wherein the outdoor unit casing (80) is comprised of a divider (81) that separates, in an airtight manner, an outdoor fan storage unit that stores the outdoor heat exchanger (24) and the outdoor fan (29) from a humidification unit storage unit that stores the humidification unit; and

the flow path opening and closing means (82) can be provided in the divider (81).

Fig. 1

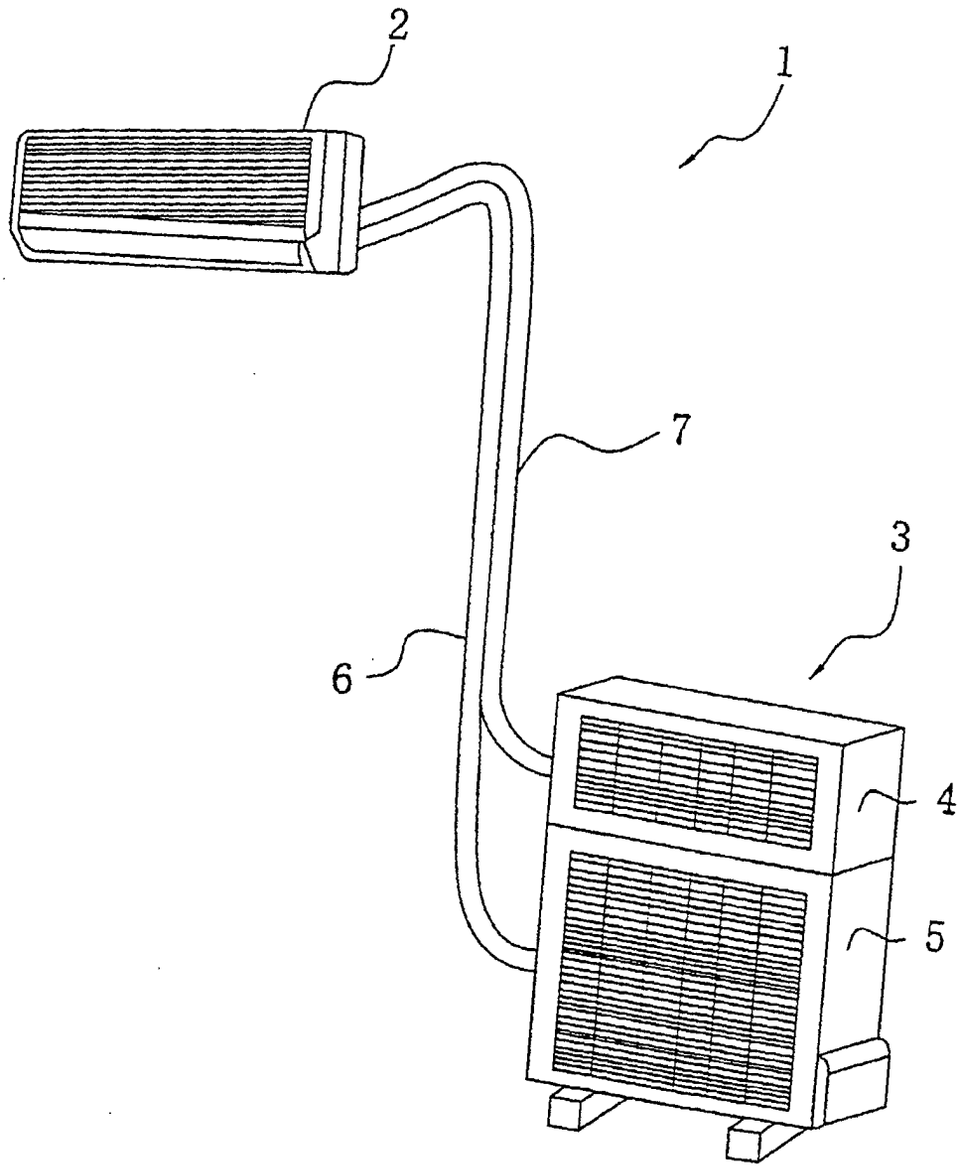

Fig. 2

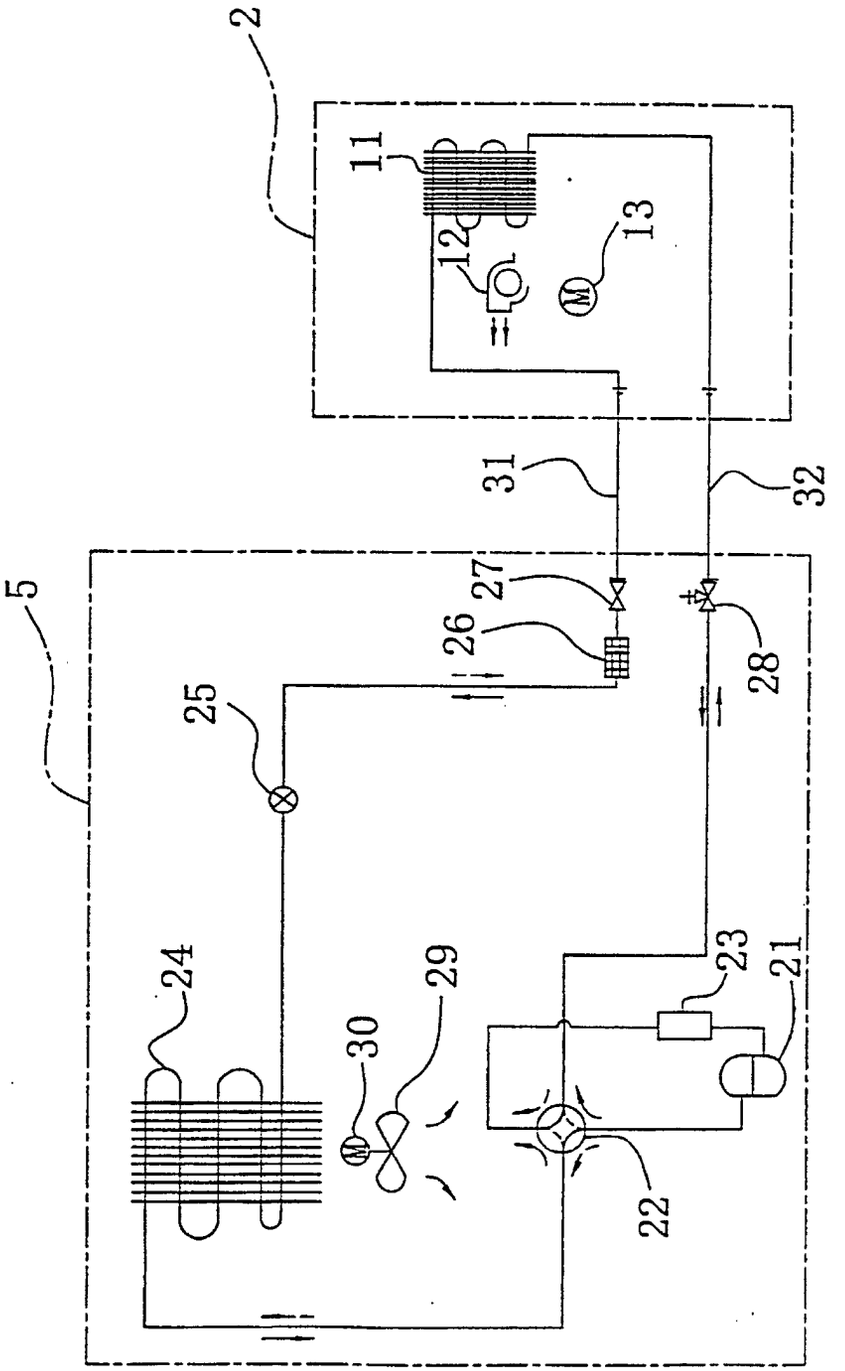

Fig. 3

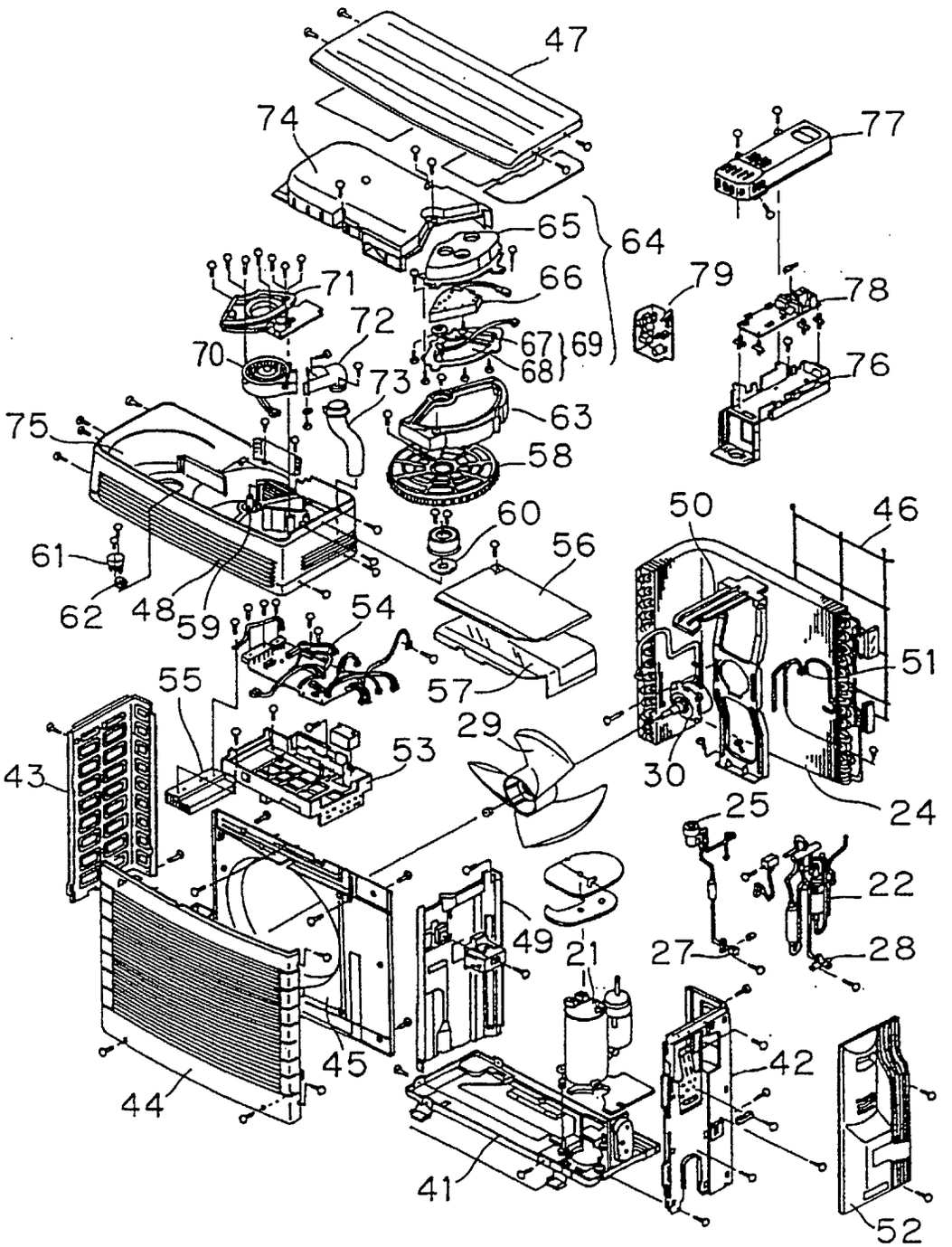
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Fig. 4

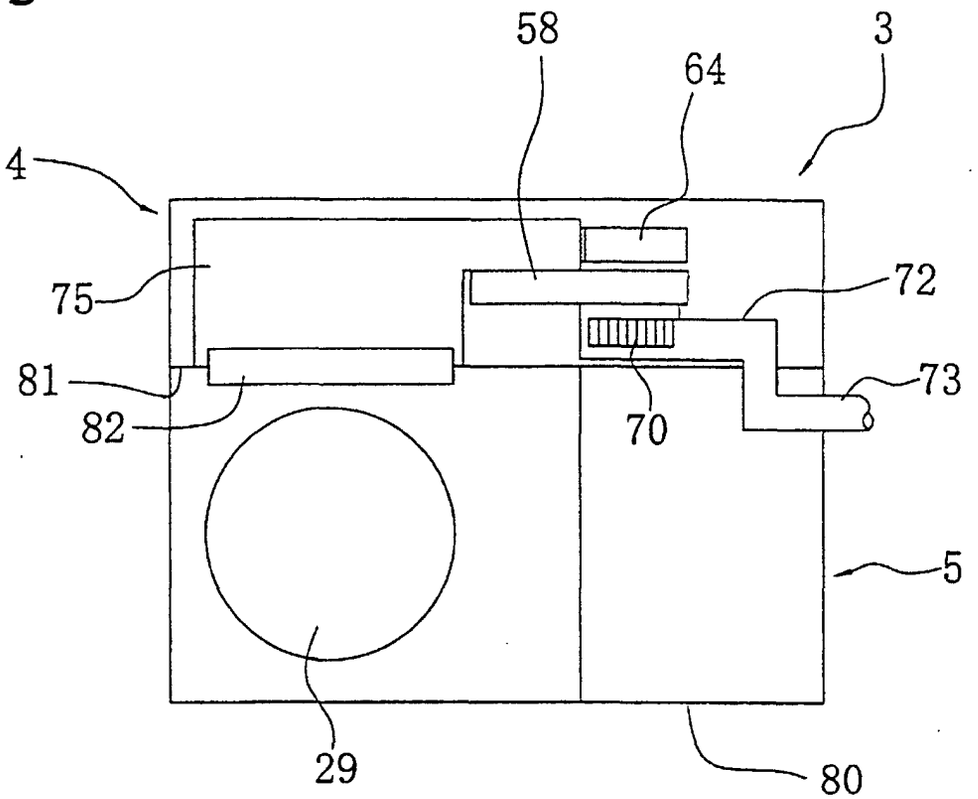


Fig. 5

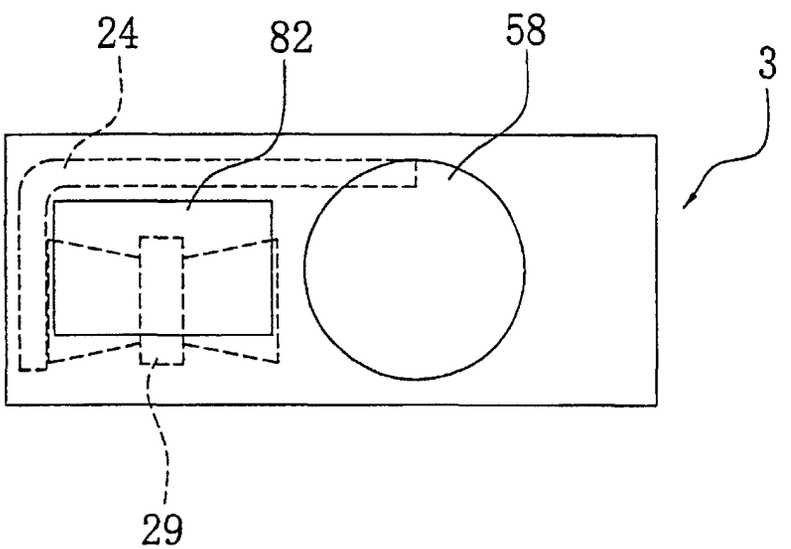


Fig. 6

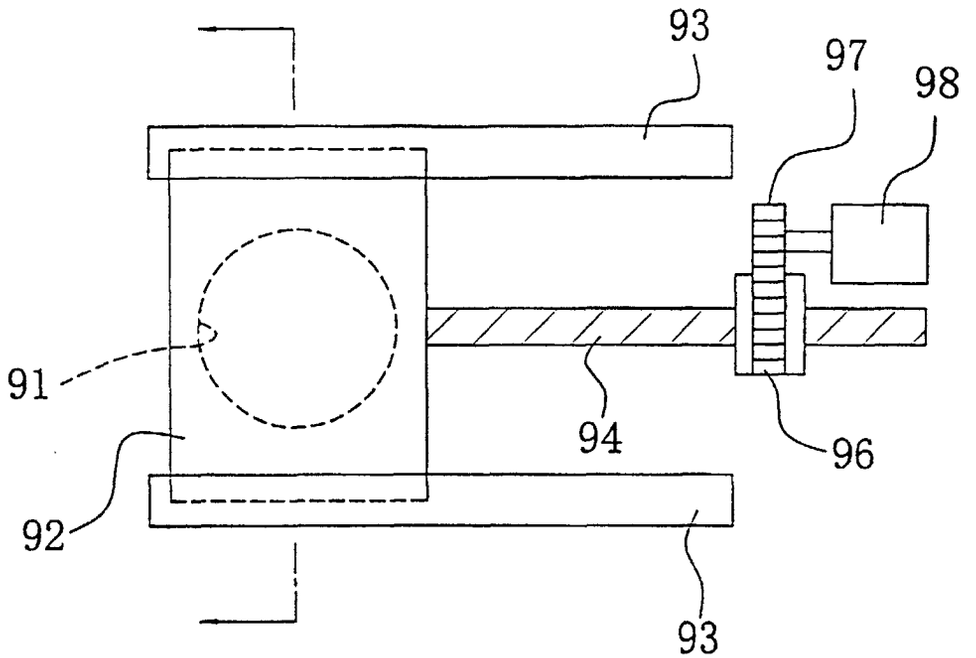


Fig. 7

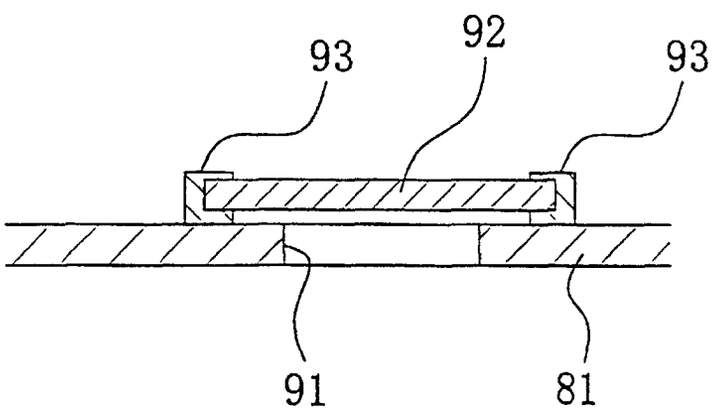


Fig. 8

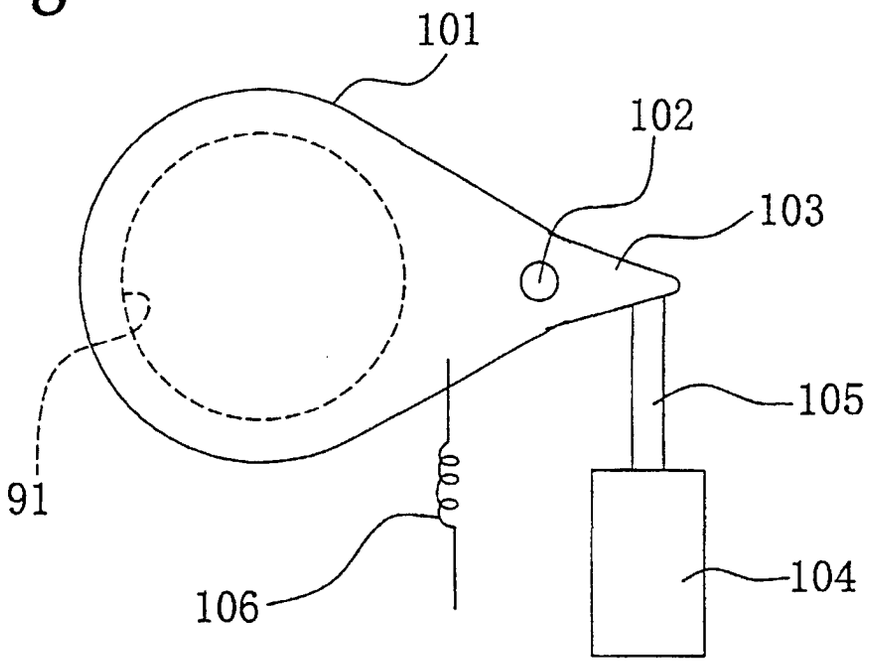


Fig. 9

Operational mode	Flow path opening and closing
Heating and cooling	Fully closed
Heating and humidification	Half open
Humidification	Fully open

Fig. 10

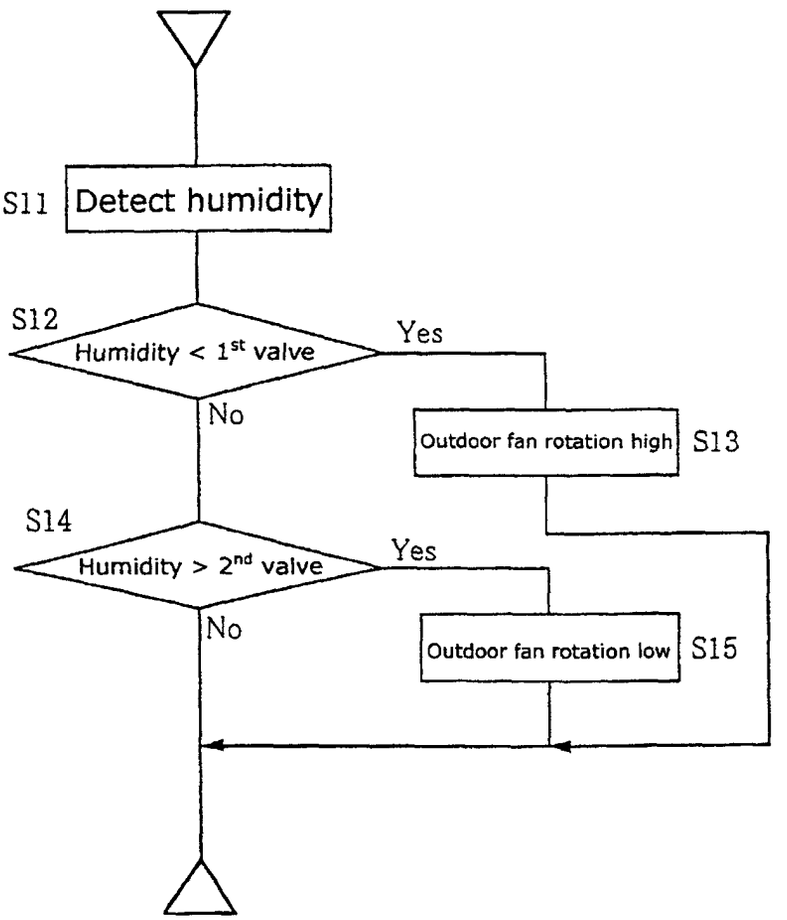
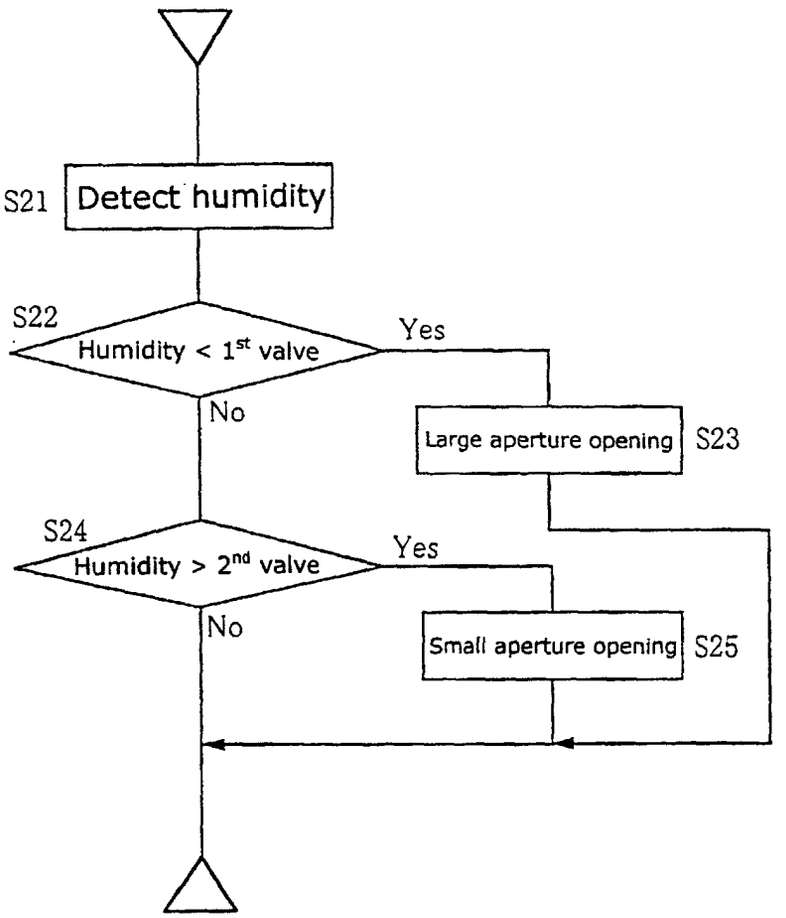

S11
Detect humidity
S12
Humidity < 1st valve
Yes
No
Outdoor fan rotation high
S13
S14
Humidity > 2nd valve
Yes
No
Outdoor fan rotation low
S15

Fig. 11


S21
Detect humidity
S22
Humidity < 1st valve
Yes
No
Large aperture opening
S23
S24
Humidity > 2nd valve
Yes
No
Small aperture opening
S25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/06569

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F24F6/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] F24F6/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-128681 A (Sharp Corporation), 21 May, 1996 (21.05.96), Full text; all drawings (Family: none)	1-5
Y	JP 6-257805 A (Matsushita Electric Ind. Co., Ltd.), 16 September, 1994 (16.09.94), Full text; Figs. 4, 5 (Family: none)	1-5
A	JP 8-270980 A (Sharp Corporation), 18 October, 1996 (18.10.96), Full text; all drawings (Family: none)	1-5
EA	JP 2001-82773 A (Samsung Electron Co., Ltd.), 30 March, 2001 (30.03.01), Full text; all drawings (Family: none)	1-5
A	JP 7-19546 A (Sharp Corporation), 20 January, 1995 (20.01.95), Full text; all drawings (Family: none)	1-5

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 September, 2001 (13.09.01)	25 September, 2001 (25.09.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/06569

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-171056 A (Daikin Industries, Ltd.), 23 June, 2000 (23.06.00), Full text; all drawings (Family: none)	1-5

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