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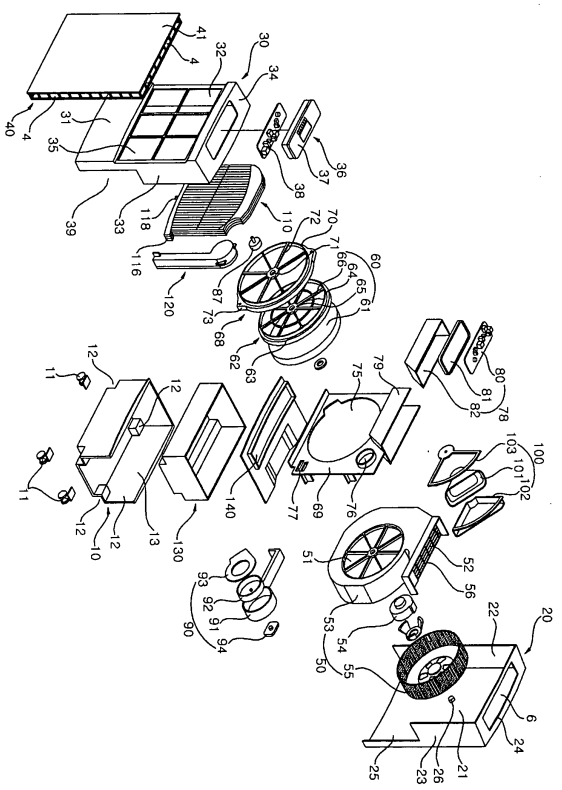
(54) Dehumidifier having dehimidifying rotor

(57) Disclosed herein is a dehumidifier having a dehumidifying rotor, the dehumidifier comprising a main body 2 including an air suction portion 4 and an air discharge portion 6; a blower 50 sucking indoor air through the air suction portion 4 such that the sucked indoor air passes through the main body 2 and is then discharged through the air discharge portion 6; a dehumidifying rotor 60 rotatably arranged in the main body 2 and including a desiccant 61 containing meso-silica and a desiccant wheel 62 surrounding the circumference of the desiccant 61 and connected to the desiccant 61; a dehumidifying rotor rotating device 84 rotating the dehumidifying rotor 60; and regeneration devices 90, 100, 110, and 120 regenerating the dehumidifying rotor 60, thus providing advantages such as high dehumidification performance and low power consumption.

Fig. 2



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Description

BACKGROUND

[0001] The present invention relates to a dehumidifier for dehumidifying indoor air and, more particularly, to a dehumidifier having a dehumidifying rotor that absorbs moisture from the indoor air and is regenerated at low temperature.

[0002] In general, a dehumidifier dehumidifies humid indoor air and, conventionally, the dehumidifier allows the indoor air to pass through a heat exchanger including a condenser in which refrigerant flows and an evaporator to reduce the humidity and discharges the dehumidified air to the room, thus reducing the indoor humidity.

[0003] That is, the dehumidifier absorbs heat from ambient air by evaporating the refrigerant in the evaporator. When the refrigerant is evaporated, the temperature of the evaporator is reduced, and thus the temperature of the air passing through the evaporator is also reduced.

[0004] Accordingly, as the temperature around the evaporator is reduced, the moisture contained in the air is condensed into dew on the surface of the evaporator, and the dew on the surface of the evaporator falls into a bucket.

[0005] However, the above-described dehumidifier using the heat exchanger including the condenser and the evaporator is problematic in that it requires a compressor for compressing the refrigerant, the manufacturing cost is increased, noise is generated according to the operation of the compressor, it requires a space in which the compressor is located, the volume of the dehumidifier is increased, and thus it cannot be easily moved due to the weight of the compressor.

[0006] Meanwhile, Korean Patent No. 10-0598214 discloses a humidification and dehumidification system using a desiccant, in which the moisture contained in air is absorbed by a desiccant while the air passes through the desiccant, and the desiccant is regenerated while the moisture adsorbed into the desiccant is evaporated by heat of a heater.

[0007] The above-described humidification and dehumidification system evaporates the moisture adsorbed into the desiccant while the indoor air heated by the heater passes through the desiccant by an indirect heating method, or evaporates the moisture of the desiccant integrated with an electric heater using the electric heater by a direct heating method, and the air (high temperature and high humidity) evaporated from the desiccant is discharged to the outside by a regeneration air blower.

[0008] However, the dehumidification system disclosed in Korean Patent No. 10-0598214 is problematic in that, if the high temperature and high humidity air evaporated from the desiccant is discharged to the room, the indoor dehumidification performance is reduced, and if the high temperature and high humidity air evaporated from the desiccant is discharged to the outside, a separate duct for guiding the high temperature and high humidity air to the outside is required, which complicates the structure, and it is not easy to move the dehumidification system.

SUMMARY OF THE INVENTION

[0009] The present invention has been made in an effort to address the above-described problems associated with prior art. Accordingly, it would be desirable to provide a dehumidifier having a dehumidifying rotor, which can improve indoor dehumidification performance and minimize power consumption required to regenerate the dehumidifying rotor since the dehumidifying rotor is regenerated at low temperature.

[0010] It would also be desirable to provide a dehumidifier having a dehumidifying rotor in which the condensation efficiency is improved, and regeneration performance and dehumidification performance of the dehumidifying rotor are improved.

[0011] Accordingly, the present invention provides a dehumidifier having a dehumidifying rotor, the dehumidifier comprising: a main body including an air suction portion and an air discharge portion; a blower sucking indoor air through the air suction portion such that the sucked indoor air passes through the main body and is then discharged through the air discharge portion; a dehumidifying rotor rotatably arranged in the main body and including a desiccant containing meso-silica and a desiccant wheel surrounding the circumference of the desiccant and connected to the desiccant; a dehumidifying rotor rotating device rotating the dehumidifying rotor; and regeneration devices regenerating the dehumidifying rotor.

[0012] The meso-silica may have a pore size of 2 nm to 50 nm.

[0013] The regeneration devices may comprise: a regeneration fan blowing air into the dehumidifying rotor; a regeneration heater heating the air blown to the dehumidifying rotor by the regeneration fan; and a condensing heat exchanger heat-exchanging the air that has regenerated the dehumidifying rotor with the air sucked into the blower such that the air that has regenerated the dehumidifying rotor is condensed.

[0014] The condensing heat exchanger may comprise: a condensing flow passage, through which the air that has regenerated the dehumidifying rotor passes; and a heat-absorbing flow passage, through which the air sucked into the blower passes, the condensing flow passage and the heat-absorbing flow passage intersecting each other.

[0015] The heat-absorbing flow passage may be located at a position between the condensing flow passages to penetrate the condensing heat exchanger.

[0016] The dehumidifier may further comprise a duct guiding the air condensed while passing through the condensing heat exchanger to the regeneration fan.

[0017] The condensing heat exchanger, the dehumidifying rotor, the regeneration heater, and the blower may be sequentially arranged in this order in the front and rear direction.

[0018] The dehumidifier may further comprise a bucket, located at the bottom of the condensing heat exchanger, into which condensed water generated in the condensing heat exchanger is put.

[0019] The dehumidifier may further comprise: a rotor frame dividing the inside of the main body into a rear space in which the blower is disposed and a front space in which the condensing heat exchanger is disposed; and a rotor supporter mounted on the rotor frame and rotatably supporting the dehumidifying rotor, wherein the rotor frame may include a bypass portion through which indoor air passing through the condensing heat exchanger bypasses the dehumidifying rotor.

[0020] The main body may comprise: a base; a rear case located at the rear top of the base and including an air discharge portion formed on an upper plate portion of the rear case; a front case disposed in front of the rear case and including an air suction hole; and a front panel disposed in front of the front case and including the air suction portion.

[0021] The dehumidifier having the dehumidifying rotor in accordance with the present invention has an advantage in that the desiccant containing meso-silica can minimize the power consumption of the regeneration devices compared to the desiccant containing zeolite and the like.

[0022] The dehumidifier having the dehumidifying rotor in accordance with the present invention has an advantage in that the regeneration air that regenerates the dehumidifying rotor is condensed by the condensing heat exchanger, and the heat exchange area of the condensing heat exchanger is maximized, thus improving condensation efficiency and improving regeneration performance of and dehumidification performance of the dehumidifying rotor.

[0023] The dehumidifier having the dehumidifying rotor in accordance with the present invention has an advantage in that the air passing through the condensing flow passage of the condensing heat exchanger is guided into the regeneration fan by the duct, and thus it is possible to design the condensing flow passage of the condensing heat exchanger such that the condensation efficiency is maximized.

[0024] The dehumidifier having the dehumidifying rotor in accordance with the present invention has an advantage in that with the use of the bypass portion through which indoor air passing through the condensing heat exchanger bypasses the dehumidifying rotor, it is possible to form the condensing heat exchanger to have a size greater than that of the dehumidifying rotor, thus improving the condensing efficiency of the condensing heat exchanger.

[0025] It is to be understood that both the foregoing explanation and the following detailed description of the present invention are exemplary and illustrative and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The above and other features of the present invention will now be described in detail with reference to certain exemplary embodiments thereof illustrated the accompanying drawings which are given hereinbelow by way of illustration only, and thus are not limitative of the present invention, and wherein:

FIG. 1 is a perspective view of a dehumidifier having a dehumidifying rotor in accordance with a preferred embodiment of the present invention;

FIG. 2 is an exploded perspective view of essential parts of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention;

FIG. 3 is a longitudinal cross-sectional view of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention;

FIG. 4 is a horizontal cross-sectional view of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention;

FIG. 5 is a schematic diagram showing the dehumidification and regeneration principle of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention;

FIG. 6 is a graph schematically showing a relationship between temperature and absolute humidity of air during dehumidification by the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention;

FIG. 7 is an enlarged cross-sectional view of a dehumidifying rotor and a heater shown in FIG. 2; and

FIG. 8 is a front view of the dehumidifying rotor and a rotor frame shown in FIG. 2.

DETAILED DESCRIPTION

[0027] Reference will now be made in detail to the preferred embodiment of the present invention, examples of which are illustrated in the accompanying drawings. Throughout the drawings, like elements are indicated using the same or

similar reference designations where possible.

[0028] FIG. 1 is a perspective view of a dehumidifier having a dehumidifying rotor in accordance with a preferred embodiment of the present invention, FIG. 2 is an exploded perspective view of essential parts of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention, FIG. 3 is a longitudinal cross-sectional view of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention, FIG. 4 is a horizontal cross-sectional view of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention, FIG. 5 is a schematic diagram showing the dehumidification and regeneration principle of the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention, and FIG. 6 is a graph schematically showing a relationship between temperature and absolute humidity of air during dehumidification by the dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment of the present invention.

[0029] As shown in FIG. 1, a dehumidifier in accordance with a preferred embodiment of the present invention sucks indoor air to absorb moisture and discharges the dehumidified indoor air and, for this purpose, an air suction portion 4 and an air discharge portion 6 are provided in a main body 2.

[0030] As shown in FIGS. 1 and 2, the main body 2 includes a base 10, a rear case 20 that forms a rear appearance and is located at the rear top of the base 10, a front case 30 connected to the front of the rear case 20, and a front panel 40 disposed in front of the front case 30.

[0031] A wheel assembly 11 including wheels to facilitate movement of the dehumidifier and a wheel support on which the wheels are rotatably supported is installed on the base 10.

[0032] The wheel support of the wheel assembly 11 is mounted on the base 10 by a fastening member such as a screw.

[0033] The base 10 includes a wheel assembly receiving portion 12, in which a portion of the wheel assembly 11 is inserted and received, formed at each of four corners.

[0034] The base 10 may be formed in a plate shape or into a box shape. A bucket entrance portion 13 is formed on one of the front, rear, left, and right surfaces of the base 10 to extract a bucket 130 therefrom, which will be described later, and an upper surface 14 of the base 10 is opened such that condensed water generated in a condensing heat exchanger 110, which will be described later, falls into the bucket 130.

[0035] The rear case 20 includes a rear plate portion 21, left and right side plate portions 22 and 23 formed in a bent shape on the left and right sides of the rear plate portion 21, and an upper plate portion 24 formed in a bent shape on the top side of the rear plate portion 21.

[0036] The air discharge portion 6 through which the indoor air dehumidified in the main body 2 is discharged to the outside of the main body 2 is provided in the rear case 20. The air discharge portion 6 is provided on the upper plate portion 24 of the rear case 20 such that the indoor air dehumidified in the main body 2 is discharged to the top of the dehumidifier.

[0037] A rear opening portion 25 for allowing the bucket 130 to be inserted into and extracted from the base 10 is provided in the rear case 20.

[0038] The front case 30 includes a front plate portion 31, left and right side plate portions 32 and 33 formed in a bent shape on the left and right sides of the front plate portion 31, and an upper plate portion 34 formed in a bent shape on the top side of the front plate portion 31.

[0039] An air suction hole 35 through which the indoor air is sucked into the main body 2 is provided in the front case 30. The air suction hole 35 is provided on the front plate portion 31 of the front case 30 such that the indoor air sucked into the main body 2 is introduced from the front of the dehumidifier in the front and rear direction.

[0040] A control unit 36 including a controller for operating the dehumidifier and a display for displaying information of the dehumidifier is installed on the front case 30, especially on the upper plate portion 34.

[0041] The control unit 36 includes a control panel 37 exposed to the outside and a control PCB 38 disposed on the control panel 37, on which various electrical components for the controller, the display, etc. are mounted.

[0042] A front opening portion 39 for allowing the bucket 130 to be inserted into and extracted from the base 10 is provided in the front case 30.

[0043] The front panel 40 forms a front appearance and includes the air suction portion 4 for allowing the indoor air to be sucked into the main body 2, especially into the air suction hole 35 of the front case 30.

[0044] That is, the indoor air sequentially passes through the air suction portion 4 of the front panel 40 and the air suction hole 35 of the front case 30 to be sucked into the main body 2. Then, the sucked indoor air is dehumidified in the main body 2 and discharged to the outside of the main body 2 through the air discharge portion 6 of the rear case 20.

[0045] The front surface of the front panel 40 is closed to improve the front appearance of the dehumidifier, and the air suction portion 4 is provided at a position other than the front surface. Accordingly, the front panel 40 includes a front plate portion 41 in a plate shape having no opening portion, and the air suction portion 4 is provided at the rear of the front plate portion 41. The air suction portion 4 is formed to project from the rear surface of the front plate portion 41 of the front panel 40 with a grill shape.

[0046] A blower 50, a dehumidifying rotor 60, and regeneration devices 90, 100, 110, and 120 are installed in the main

body 2.

[0047] The regeneration devices 90, 100, 110, and 120 regenerate the dehumidifying rotor 60 and include a regeneration fan 90, a regeneration heater 100, a condensing heat exchanger 110, and a duct 120. The configurations of the regeneration devices 90, 100, 110, and 120 will be described in detail later.

[0048] The blower 50 is a kind of dehumidifying fan that sucks the indoor air (I) through the air suction portion 4 to be passed through the main body 2 and discharged through the air discharge portion 6 such that the indoor air (I) is dehumidified by the dehumidifying rotor 60. The blower 50 includes a fan housing 53, a fan motor 54, and a fan 55. The rear surface of the fan housing 53 is opened to form a blow path along with the rear case 20, and the fan housing 53 includes an air suction hole 51 formed on the front surface and a discharge portion 52 formed on the top of the fan housing 53. The fan motor 54 is installed on the fan housing 53 or the rear case 20. The fan 55 is connected to a rotation axis of the fan motor 54 such that it is rotated between the fan housing 53 and the rear case 20.

[0049] A discharge grill 56 is installed on the discharge portion 52 of the fan housing 53.

[0050] The fan 55 is rotatably supported to a fan support 26 formed on the rear case 20.

[0051] The dehumidifying rotor 60 adsorbs moisture from the indoor air (I) sucked by the blower 50 and is regenerated at low temperature. The dehumidifying rotor 60 is located between the blower 50 and the condensing heat exchanger 110.

[0052] The dehumidifying rotor 60 includes a desiccant 61, which adsorbs moisture from the indoor air (I) while the indoor air (I) passes therethrough and is regenerated at low temperature, and a desiccant wheel 62, which surrounds the circumference of the desiccant 61, to which the desiccant 61 is fixed.

[0053] The desiccant 61 is generally formed in a circular plate shape and includes a fixing hole 63 formed in the middle of the desiccant 61 to be fixed with the desiccant wheel 62.

[0054] The desiccant 61 is formed in such a manner that ceramic fiber kraft paper and corrugated paper are alternately wound in a cylindrical shape and meso-silica (Si02) is coated thereon.

[0055] Here, the meso-silica is mesoporous silica having excellent absorption characteristics and capable of being regenerated, i.e., removing moisture at low temperature below 60°C, since porosity and surface area are developed.

[0056] The meso-silica is formed in such a manner that spherical silica particles having a particle size of 10 to 1000 nm, a silica precursor, and a surfactant are reacted in a solvent to form a shell containing silica and surfactant on the surface of each spherical silica particle, and when the resultant having the shells is heat-treated to remove the surfactant of the shells, silica shells are formed with pores having a size of 2 nm to 50 nm formed at positions where the surfactants are removed.

[Table 1]

Sample	Absorption rate (mL/g)	Regeneration temperature
Zeolite	0.37	153
Alumina	0.47	80
Meso-silica	0.63	48

[0057] Table 1 shows the results of testing the regeneration region and the like of the desiccant, in which meso-silica having a particle size of about 200 nm and a pore size of 2 nm to 50 nm was compared with those of zeolite and alumina. As shown in Table 1, the dehumidification performance of the meso-silica is higher than that of the zeolite and alumina since the meso-silica has a moisture absorption per gram of the sample greater than that of the zeolite and alumina, and the meso-silica can be regenerated at a relatively low temperature since the regeneration temperature of the meso-silica is lower than that of the zeolite and the alumina.

[0058] When the above-described desiccant 61 is rotated, a portion (hereinafter referred to as a dehumidification portion) at which the moisture is adsorbed while the indoor air (I) passes therethrough and a portion (hereinafter referred to as a regeneration portion) at which the moisture is evaporated while regeneration air (O) passes therethrough are alternately changed, and thus the moisture is adsorbed and evaporated. A portion facing the regeneration heater 100 corresponds to the regeneration portion through which the regeneration air (O) passes, and a portion other than the portion facing the regeneration heater 100 corresponds to the dehumidification portion through which the indoor air (I) passes.

[0059] The desiccant wheel 62 is a kind of desiccant case that protects the desiccant 61 and includes a ring-shaped circumferential portion 64 surrounding the circumference of the desiccant 61, a fixing portion 65 for fixing the desiccant 61, and a connection portion 66 radially disposed between the circumferential portion 64 and the fixing portion 65 to connect the circumferential portion 64 and the fixing portion 65.

[0060] A rotor supporter 68 rotatably supporting the dehumidifying rotor 60 and a rotor frame 69 on which the rotor supporter 68 is mounted are provided in the main body 2.

[0061] The rotor supporter 68 substantially supports the dehumidifying rotor 60 and includes a ring-shaped circumferential portion 70 surrounding the circumference of the dehumidifying rotor 60, a support axis 71 rotatably supporting the dehumidifying rotor 60, and a connection portion 72 radially disposed between the circumferential portion 70 and the support axis 71 to connect the circumferential portion 70 and the support axis 71.

[0062] A fastening portion 73 assembled to the rotor frame 69 by a fastening member such as a screw is formed to project from the circumferential portion 70.

[0063] The rotor supporter 68 is mounted on the rotor frame 69 by a fastening member such as a screw.

[0064] The rotor frame 69 is a kind of barrier, which divides the inside of the main body 2 into a rear space in which the blower 50 is installed and a front space in which the condensing heat exchanger 110 is installed, and is located between the blower 50 and the condensing heat exchanger 110.

[0065] The rotor frame 69 includes a penetrating portion 75 disposed in front of the air suction hole 51 of the blower 50 to allow the rotor supporter 68 to pass therethrough.

[0066] The rotor frame 69 further includes an opening portion 76 disposed in front of the regeneration fan 90 to connect the duct 120, which allows the air guided into the duct 120 to be introduced into the regeneration fan 90, to the regeneration fan 90.

[0067] It is preferable that the opening portion 76, which connects the duct 120 to the regeneration fan 90, be disposed most adjacent to the regeneration heater 100 such that the air passing through the duct 120 is rapidly sucked into the regeneration fan 90 and introduced into the regeneration heater 100.

[0068] For example, in the case where the regeneration heater 100 is disposed corresponding to the top of the dehumidifying rotor 60, it is preferable that the opening portion 76 be disposed at the top of the rotor frame 69. In the case where the regeneration heater 100 is disposed corresponding to the bottom of the dehumidifying rotor 60, it is preferable that the opening portion 76 be disposed at the bottom of the rotor frame 69.

[0069] The rotor frame 69 includes a bypass portion 77 through which the indoor air passing through the condensing heat exchanger 110 bypasses the dehumidifying rotor 60.

[0070] Here, the bypass portion 77 is provided such that the heat exchange region of the condensing heat exchanger 110 is not limited to the portion facing the dehumidifying rotor 60 but extends beyond the size of the dehumidifying rotor 60. Accordingly, the bypass portion 77 is located at a position facing a portion of the condensing heat exchanger 110, which does not face the dehumidifying rotor 60.

[0071] A part of the indoor air (I) sucked into the main body 2 passes through the portion of the condensing heat exchanger 110 facing the dehumidifying rotor 60 to condense the air passing through the condensing heat exchanger 110, and the rest of the indoor air (I) sucked into the main body 2 passes through the portion of the condensing heat exchanger 110, which does not face the dehumidifying rotor 60, to condense the air passing through the condensing heat exchanger 110.

[0072] That is, the entire size of the condensing heat exchanger 110 is greater than that of the dehumidifying rotor 60 such that the portion of the condensing heat exchanger 110, which does not face the dehumidifying rotor 60, can condense the regeneration air.

[0073] Meanwhile, the rotor frame 69 includes a controller installation portion 79 in which a controller 78 controlling the dehumidifier is installed.

[0074] The controller 78 includes a PCB 80 on which various electrical components are mounted, a PCB case 81 formed of a synthetic resin material, in which the PCB 80 is installed, and a control box 82 formed of a metal material, in which the PCB case 81 is installed.

[0075] The regeneration fan 90 allows the air for the regeneration of the dehumidifying rotor 60 (hereinafter referred to as the regeneration air) to be blown to the dehumidifying rotor 60 and includes a fan housing 91, a fan 92 rotatably disposed in the fan housing 91, an orifice 93 provided in the fan housing 91 such that it guides the air sucked by the fan 92, and a fan motor 94 mounted in the fan housing 91 and rotating the fan 92.

[0076] The regeneration fan 90 is located at the rear of the opening portion 76 of the rotor frame 69 such that the orifice 93 is connected to the opening portion 76 of the rotor frame 69.

[0077] The regeneration heater 100 heats the air blown to the dehumidifying rotor 60 by the regeneration fan 90 such that high temperature air is supplied to the dehumidifying rotor 60. The regeneration heater 100 is located between the dehumidifying rotor 60 and the blower 50.

[0078] The regeneration heater 100 includes an electric heater 101, a heater cover 102 covering the electric heater 101 and connected to the regeneration fan 90, and a blocking member 103 located between the heater cover 102 and the dehumidifying rotor 60 and connected to the heater cover 102.

[0079] The blocking member 103 is an air guide that prevents the air heated by the heater 101 from leaking between the heater 101 and the dehumidifying rotor 60 and guides the heated air toward the dehumidifying rotor 60. The blocking member 103 is formed in a substantially fan shape or in a semicircular shape and includes an opening portion formed on a surface facing the dehumidifying rotor 60.

[0080] The condensing heat exchanger 110 allows the regeneration air (O) that has regenerated the dehumidifying

rotor 60 to be condensed by exchanging heat with the indoor air (I) sucked toward the blower 50 and is located in front of the dehumidifying rotor 60 and the rotor frame 69.

[0081] The condensing heat exchanger 110 is also located at the rear of the front plate portion 31 of the front case 30.

[0082] That is, in the dehumidifier in accordance with the preferred embodiment, the condensing heat exchanger 110, the dehumidifying rotor 60, the regeneration heater 100, and the blower 50 are sequentially arranged in this order in the flow direction of the indoor air (I).

[0083] Meanwhile, the condensing heat exchanger 110 includes a condensing flow passage 112, through which the regeneration air (O) that has regenerated the dehumidifying rotor 60 passes, and a heat-absorbing flow passage 114, through which the indoor air (I) sucked by the blower 50 and introduced into the blower 50 passes before it passes through the dehumidifying rotor 60.

[0084] A plurality of condensing heat exchangers 110 are disposed in the flow direction of the indoor air (I).

[0085] The condensing flow passage 112 is provided in the condensing heat exchanger 110, and the heat-absorbing flow passage 114 penetrates the condensing heat exchanger 110.

[0086] The condensing flow passage 112 is provided between front and rear plates of the condensing heat exchanger 110, and the front and rear plates are formed of a synthetic resin material to facilitate the molding of the condensing flow passage 112 and the heat-absorbing flow passage 114 and reduce the weight thereof.

[0087] The condensing flow passage 112 includes a plurality of flow passages connected in parallel in the condensing heat exchanger 110, and each of the plurality of flow passages is arranged in the condensing heat exchanger 110 in the up and down direction.

[0088] The heat-absorbing flow passage 114 is formed at positions, where the flow passages of the condensing flow passage 112 are not formed, in the condensing heat exchanger 110 in the front and rear direction.

[0089] The heat-absorbing flow passage 114 is formed between the flow passages of the condensing flow passage 112 to penetrate the condensing heat exchanger 110 in a direction intersecting the condensing flow passage 112.

[0090] That is, the condensing flow passage 112 of the condensing heat exchanger 110 is divided into a plurality of flow passages by the heat-absorbing flow passage 114. When the regeneration air (O) moves in the up and down direction through the condensing flow passage 112 in the condensing heat exchanger 110, the indoor air (I) passes through the heat-absorbing flow passage 114 at the front of the condensing heat exchanger 110 in the front and rear direction to condense the regeneration air (O), and then moves to the rear of the heat-absorbing flow passage 114.

[0091] The condensing heat exchanger 110 includes a regeneration air inlet port formed at the top, through which the regeneration air (O) passing through the dehumidifying rotor 60 is introduced into the condensing heat exchanger 110, a regeneration air discharge port 116 formed at the bottom, through which the regeneration air (O) passing through the condensing flow passage 112 is discharged, and a condensed water discharge port 118 through which water condensed in the condensing flow passage 112 is discharged.

[0092] The generation air inlet port of the condensing heat exchanger 110 has substantially the same size and shape as the regeneration portion of the dehumidifying rotor 60.

[0093] When the regeneration heater 100 has an angular shape, the portion of the dehumidifying rotor 60 facing the regeneration heater 100 corresponds to the regeneration portion, and the regeneration air inlet port of the condensing heat exchanger 110 has the same angular shape as the regeneration heater 100.

[0094] On the contrary, when the regeneration heater 100 has a semicircular shape, the portion of the dehumidifying rotor 60 facing the regeneration heater 100 corresponds to the regeneration portion, and the regeneration air inlet port of the condensing heat exchanger 110 has the same semicircular shape as the regeneration heater 100.

[0095] The regeneration air discharge port 116 of the condensing heat exchanger 110 is formed to project from one side of the circumference of the condensing heat exchanger 110 such that the heat exchange region of the condensing heat exchanger 110 is maximized.

[0096] That is, when the regeneration air discharge port 116 is located on the front and rear surfaces of the condensing heat exchanger 110, i.e., on the air flow surface, the heat exchange region of the condensing heat exchanger 110 is reduced by the space that the regeneration air discharge port 116 occupies. Therefore, if the regeneration air discharge port 116 is formed to project from the side of the circumference of the condensing heat exchanger 110 in the above manner, the heat exchange region of the condensing heat exchanger 110 is increased.

[0097] Meanwhile, the condensed water discharge port 118 is formed to project from the bottom of the circumference of the condensing heat exchanger 110.

[0098] Since the respective flow passages of the condensing flow passage 112 are formed to be spaced apart from one another in the left and right direction of the condensing heat exchanger 110, it is preferable that the condensed water discharge port 118 be formed at the bottom, especially in the middle of the bottom, of the circumference of the condensing heat exchanger 110. Here, the bottom of the circumference of the condensing heat exchanger 110 is formed to be inclined toward the condensed water discharge port 118.

[0099] The duct 120 guides the air passing through the condensing flow passage 112 of the condensing heat exchanger 110 to the regeneration fan 90 such that a regeneration flow passage through which the regeneration air (O) passes in

the dehumidifier forms a closed circuit. One end of the duct 120 is connected to the regeneration air discharge port 116 and the other end is connected to the opening portion 76 of the rotor frame 69.

[0100] That is, in the dehumidifier in accordance with the preferred embodiment, the regeneration fan 90, the regeneration heater 100, the dehumidifying rotor 60, the condensing heat exchanger 110, and the duct 120 are sequentially arranged in this order in the flow direction of the indoor air (I). The regeneration fan 90 is disposed at the rear of the rotor frame 69, the regeneration heater 100 is disposed at the rear of the dehumidifying rotor 60, the condensing heat exchanger 110 is disposed in front of the dehumidifying rotor 60 and the rotor frame 69, and the duct 120 is disposed in front of the rotor frame 69.

[0101] In the above-described dehumidifier, the regeneration air (O) blown by the regeneration fan 90 sequentially passes through the regeneration heater 100 and the dehumidifying rotor 60, moves to the front of the dehumidifying rotor 60, moves downward in front of the dehumidifying rotor 60 along the condensing flow passage 112 of the condensing heat exchanger 110, moves to the side of the condensing heat exchanger 110, moves to the front top of the rotor frame 69 along the duct 120, passes through the rotor frame 69 in the front and rear direction to be moved to the rear thereof, and is then introduced into the regeneration fan 90.

[0102] The dehumidifier having the dehumidifying rotor in accordance with the preferred embodiment further includes the bucket 130 and a drain fan 140.

[0103] The bucket 130, into which the condensed water generated in a condensing heat exchanger 110 falls, is formed in a box shape with an opened top.

[0104] The bucket 130 is inserted into the bottom of the drain fan 140 through the opening portions 25 and 39 provided in the rear case 20 and the front case 30 of the main body 2 or extracted to the outside.

[0105] The drain fan 140 receives the condensed water falling from the condensing flow passage 112 of the condensing heat exchanger 110 to be put into the bucket 130, and is located in the main body 2, especially at the bottom of the condensing heat exchanger 110.

[0106] FIG. 7 is an enlarged cross-sectional view of the dehumidifying rotor and the heater shown in FIG. 2.

[0107] In the dehumidifier in accordance with the preferred embodiment, the rotor supporter 68 supports the desiccant 61 and the desiccant wheel 62 and is integrally assembled with the regeneration heater 100.

[0108] The fixing portion 65 of the desiccant wheel 62 is inserted into the fixing hole 63 formed in the middle of the desiccant 61 and fixed with the desiccant 61. The fixing portion 65 serves as a rotation axis of the dehumidifying rotor 60, and a support axis penetration hole 67 at which the support axis 71 of the rotor supporter 68 penetrates is provided.

[0109] The support axis 71 of the rotor supporter 68 projects to penetrate the support axis penetration hole 67 of the dehumidifying rotor 60.

[0110] The support axis 71 of the rotor supporter 68 includes a fastening hole 74 to which a fastening member 104 is fastened such that the regeneration heater 100 is fixed to the support axis 71.

[0111] The regeneration heater 100 includes a heater cover penetration portion 105, formed in the heater cover 102 such that the fastening member 104 penetrates the heater cover 102 and the blocking member 103 and is connected to the support axis 71, and a blocking member penetration portion 106 formed in the blocking member 103, at which the fastening member 104 penetrates.

[0112] That is, the fastening member 104 sequentially passes through the heater cover penetration portion 105 and the blocking member penetration portion 106 of the blocking member 103 and is connected to the fastening hole 74 formed in the support axis 71 of the rotor supporter 68 such that the support axis 71 of the rotor supporter 68 rotatably supports the desiccant 61 and the desiccant wheel 62 and supports the regeneration heater 100.

[0113] FIG. 8 is a front view of the dehumidifying rotor and the rotor frame shown in FIG. 2.

[0114] As shown in FIOG. 8, the dehumidifier in accordance with the preferred embodiment of the present invention further includes a dehumidifying rotor rotating device 84 rotating the dehumidifying rotor 60.

[0115] The dehumidifying rotor 60 includes a driven gear 85 provided on the outer circumference of the circumferential portion 64 of the desiccant wheel 62.

[0116] The dehumidifying rotor rotating device 84 rotates the desiccant wheel 62 of the dehumidifying rotor 60 and includes a driving gear 86 rotating the driven gear 85 and a motor 87 rotating the driving gear 86.

[0117] The motor 87 is fastened to one of the rotor supporter 68 and the rotor frame 69 by a fastening member such as a screw.

[0118] The motor 87 is disposed such that the driving gear 86 is located on one side of the circumference of the driven gear 86.

[0119] The operation of the dehumidifier having the above-described structure in accordance with the present invention will be described below.

[0120] First, when a command for operating the dehumidifier is input through the control unit 36, the controller 78 operates the blower 50 as the dehumidifying fan, the regeneration fan 90, and the dehumidifying rotor rotating device 84.

[0121] During operation of the dehumidifying fan 50, the indoor air (I) sucked into the main body 2 through the air suction portion 4 passes through the heat-absorbing flow passage 114 of the condensing heat exchanger 110 and then

passes through the dehumidifying rotor 60. Moisture of the indoor air (I) passing through the dehumidifying rotor 60 is absorbed by the desiccant 61, and thus the temperature of the indoor air (I) is increased. Then, the resulting indoor air (I) is discharged to the outside through the air discharge portion 6 (A→B→C→D).

[0122] Meanwhile, during the operation of the dehumidifying fan 50, the dehumidifying rotor rotating device 84 rotates the dehumidifying rotor 60. The portion of the dehumidifying rotor 60 to which the moisture is adsorbed while the indoor air (I) passes therethrough, i.e., the dehumidification portion, becomes the regeneration portion as it faces the regeneration heater 100, and is then returned to the dehumidification portion as it moves to the position, which does not face the regeneration heater 100.

[0123] During operation of the regeneration fan 90, the regeneration air (O) is moved to the regeneration heater 100 by the regeneration fan 90 and is heated to a high temperature by the regeneration heater 100. Subsequently, the regeneration air (O) heated to a high temperature by the regeneration heater 100 passes through the regeneration portion, which corresponds to the portion of the dehumidifying rotor 60 facing the regeneration heater 100, such that the moisture adsorbed to the regeneration portion of the dehumidifying rotor 60 is evaporated, and thus the regeneration air (O) becomes high temperature and high humidity air. Then, the high temperature and high humidity regeneration air (O) changed by the dehumidifying rotor 60 is introduced and passes through the condensing flow passage 112 of the condensing heat exchanger 110 such that the indoor air (I) passing through the condensing heat exchanger 110 absorbs the heat of the regeneration air (O), and thus the moisture is condensed as the temperature of the regeneration air (O) is reduced (E→F→G→H).

[0124] The regeneration air (O) passing through the condensing flow passage 112 passes through the duct 120 and is sucked into the regeneration fan 90. As such, the regeneration air (O) circulates the regeneration fan 90, the regeneration heater 100, the dehumidifying rotor 60, the condensing heat exchanger 110, and the duct 120 to continuously regenerate the dehumidifying rotor 60.

[0125] During the dehumidification of the indoor air and during the regeneration of the dehumidifying rotor 60, the condensed water is generated in the condensing flow passage 112 of the condensing heat exchanger 110 and falls down. The falling condensed water falls down to the drain fan 140 through the condensed water discharge port 118 of the condensing heat exchanger 110 and is then put into the bucket 130.

[0126] Meanwhile, according to the above-described dehumidifier, since the desiccant 61 of the dehumidifying rotor 60 contains the meso-silica, it is possible to regenerate the desiccant 61 at low temperature. Therefore, it is not necessary to increase the temperature of the regeneration heater 100 to a high temperature, it is possible to minimize the power consumption of the regeneration heater 100, and it is possible to increase the dehumidification capacity per unit time since the desiccant 61 is rapidly regenerated.

[0127] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A dehumidifier having a dehumidifying rotor, the dehumidifier comprising:

a main body 2 including an air suction portion 4 and an air discharge portion 6;
a blower 50 sucking indoor air through the air suction portion 4 such that the sucked indoor air passes through the main body 2 and is then discharged through the air discharge portion 6;
a dehumidifying rotor 60 rotatably arranged in the main body 2 and including a desiccant 61 containing meso-silica and a desiccant wheel 62 surrounding the circumference of the desiccant 61 and connected to the desiccant 61;
a dehumidifying rotor rotating device 84 rotating the dehumidifying rotor 60; and
regeneration devices 90, 100, 110, and 120 regenerating the dehumidifying rotor 60.

2. The dehumidifier of claim 1, wherein the meso-silica has a pore size of 2 nm to 50 nm.

3. The dehumidifier of claim 1 or 2, wherein the regeneration devices 90, 100, 110, and 120 comprise:

a regeneration fan 90 blowing air into the dehumidifying rotor 60;
a regeneration heater 100 heating the air blown to the dehumidifying rotor 60 by the regeneration fan 90; and
a condensing heat exchanger 110 heat-exchanging the air that has regenerated the dehumidifying rotor 60 with the air sucked into the blower 50 such that the air that has regenerated the dehumidifying rotor 60 is condensed.

4. The dehumidifier of claim 3, wherein the condensing heat exchanger 110 comprises:

a condensing flow passage 112, through which the air that has regenerated the dehumidifying rotor 60 passes; and
a heat-absorbing flow passage 114, through which the air sucked into the blower 50 passes,

wherein the condensing flow passage 112 and the heat-absorbing flow passage 114 intersect each other.

5. The dehumidifier of claim 3, wherein the heat-absorbing flow passage 114 is located at a position between the condensing flow passages 112 to penetrate the condensing heat exchanger 110.

6. The dehumidifier of claim 3, further comprising a duct 120 guiding the air condensed while passing through the condensing heat exchanger 110 to the regeneration fan 90.

7. The dehumidifier of claim 3, wherein the condensing heat exchanger 110, the dehumidifying rotor 60, the regeneration heater 100, and the blower 50 are sequentially arranged in this order in the front and rear direction.

8. The dehumidifier of claim 3, further comprising a bucket 130, located at the bottom of the condensing heat exchanger 110, into which condensed water generated in the condensing heat exchanger 110 is put.

9. The dehumidifier of claim 3, further comprising:

a rotor frame 69 dividing the inside of the main body 2 into a rear space in which the blower 50 is disposed and a front space in which the condensing heat exchanger 110 is disposed; and
a rotor supporter 68 mounted on the rotor frame 69 and rotatably supporting the dehumidifying rotor 60,

wherein the rotor frame 69 includes a bypass portion 77 through which indoor air passing through the condensing heat exchanger 110 bypasses the dehumidifying rotor 60.

10. The dehumidifier of claim 3, wherein the main body 2 comprises:

a base 10;
a rear case 20 located at the rear top of the base 10 and including an air discharge portion 6 formed on an upper plate portion of the rear case 20;
a front case 30 disposed in front of the rear case 20 and including an air suction hole 35; and
a front panel 40 disposed in front of the front case 30 and including the air suction portion 4.

Fig. 1

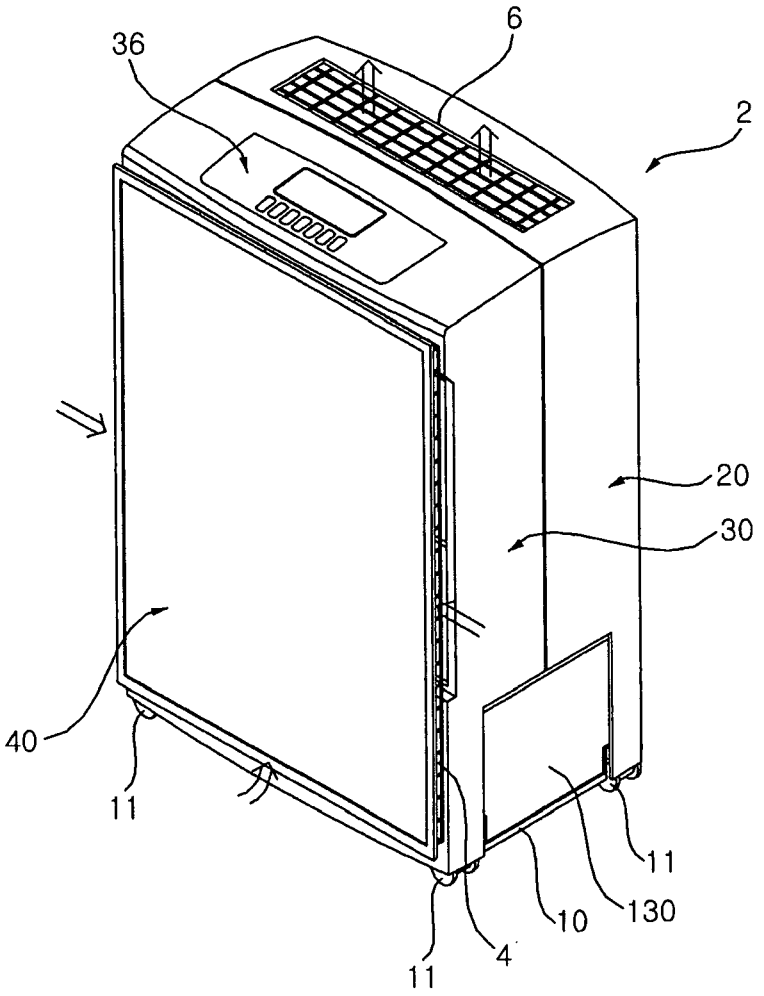

Fig. 2

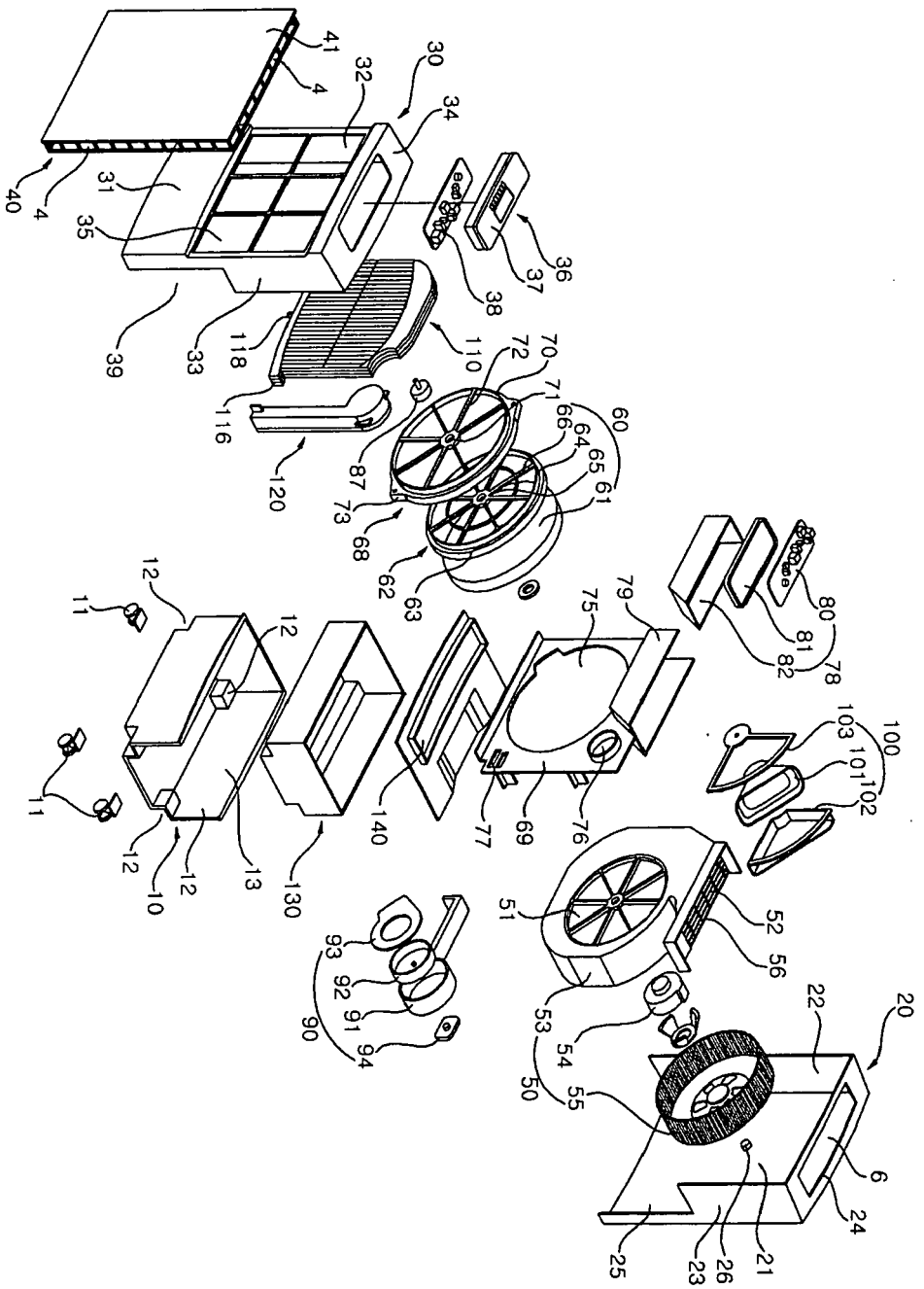
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Fig. 3

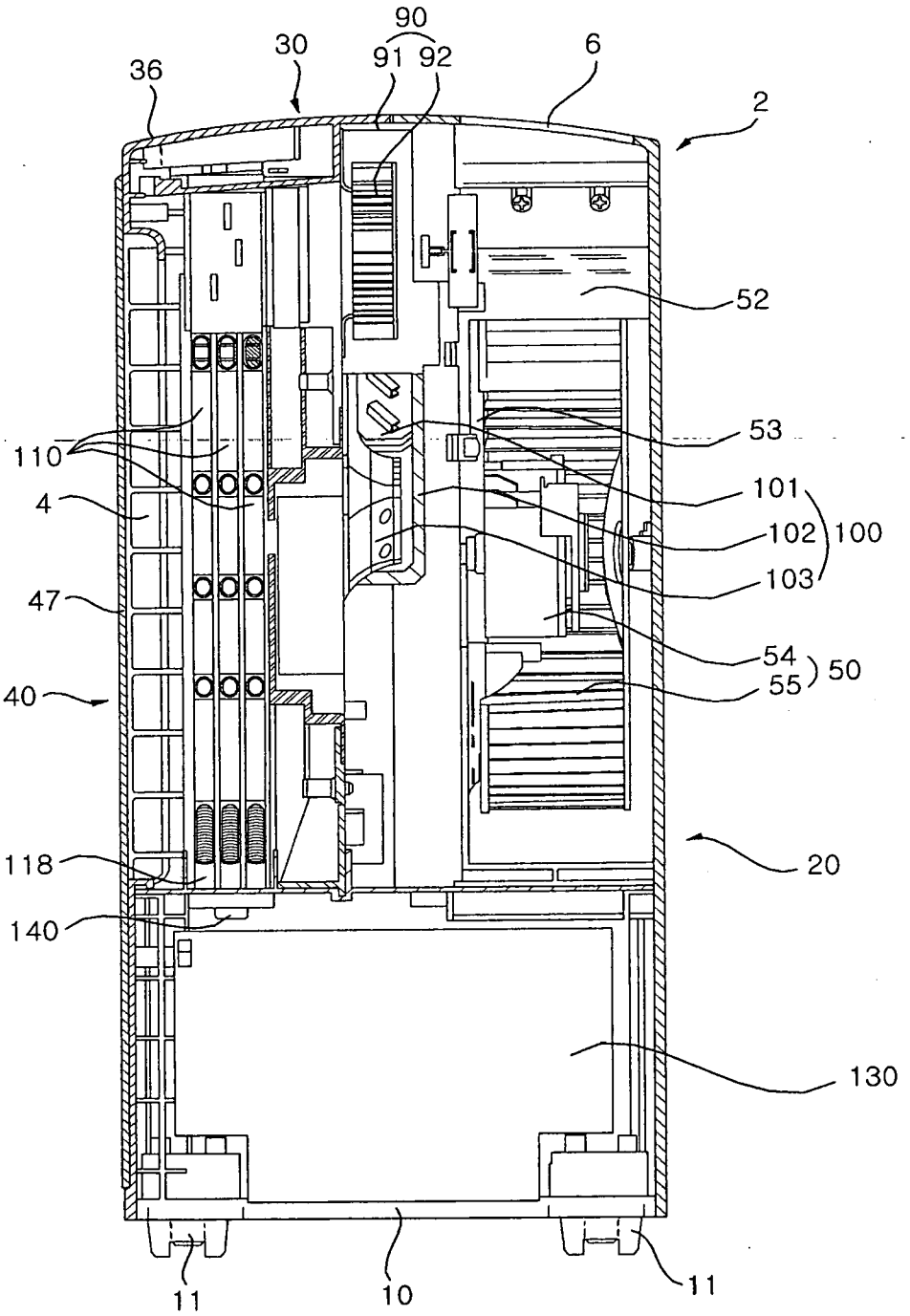
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Fig. 4

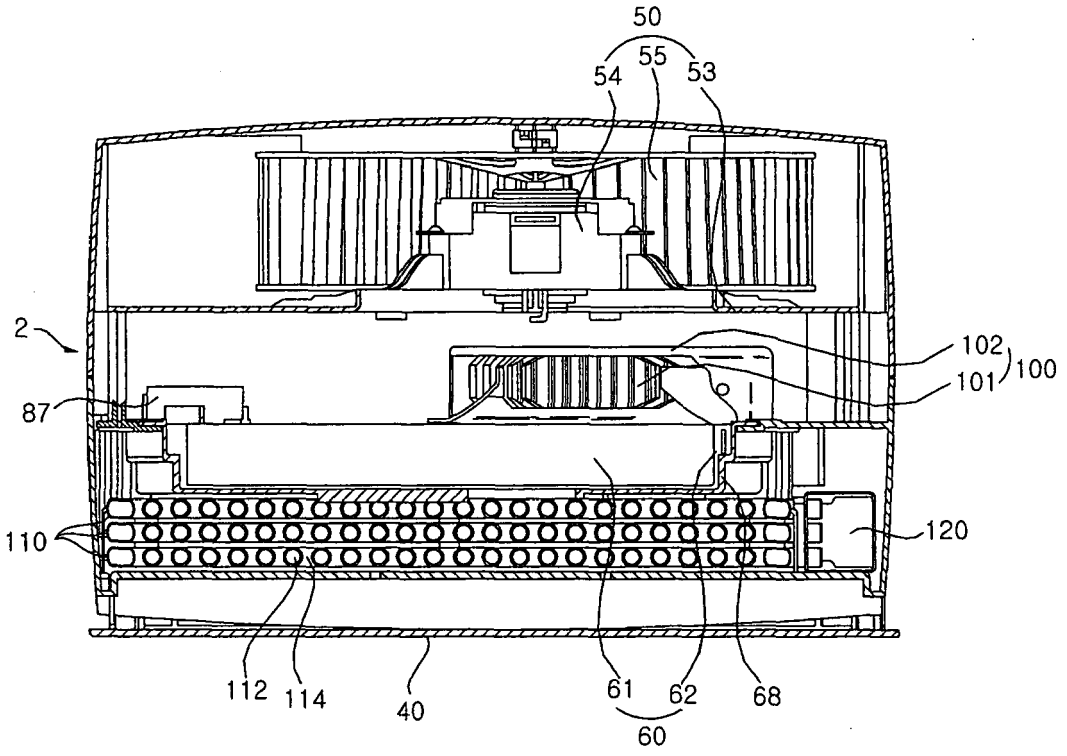


Fig. 5

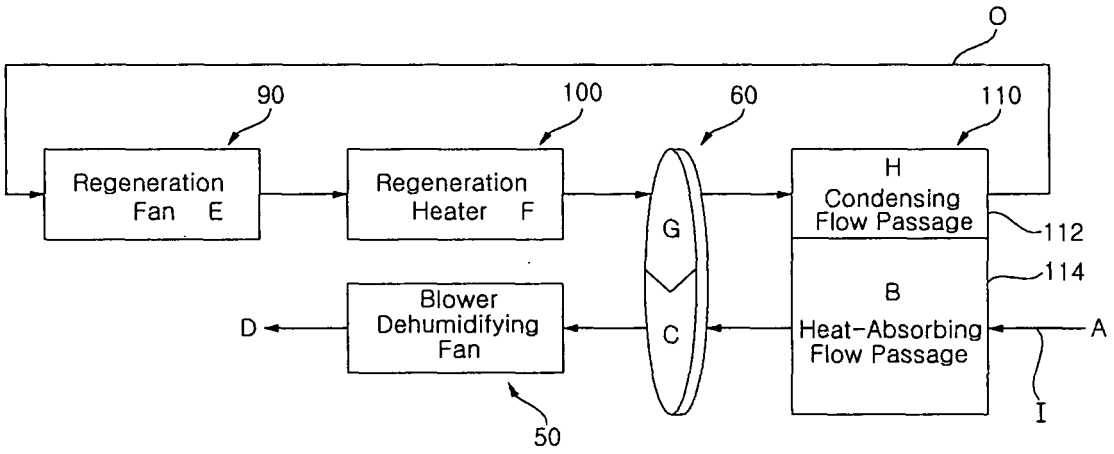
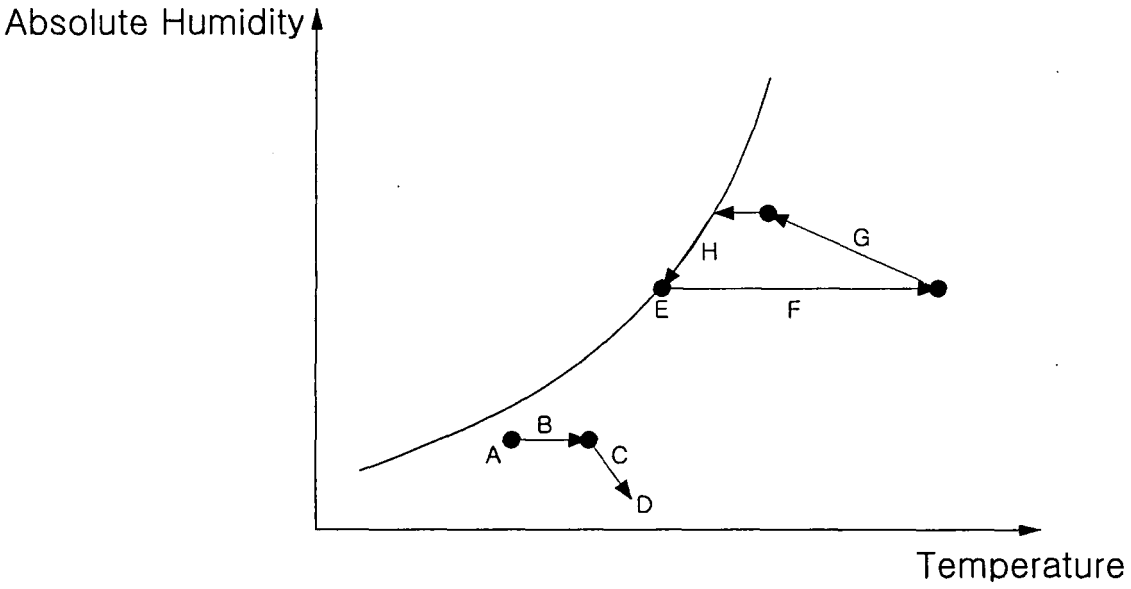

O
90
100
60
110
Regeneration Fan E
Regeneration Heater F
G
H
Condensing Flow Passage
112
114
B
Heat-Absorbing Flow Passage
A
I
C
Blower Dehumidifying Fan
D
50

Fig. 6


Absolute Humidity
H
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A
C
D
Temperature

Fig. 7

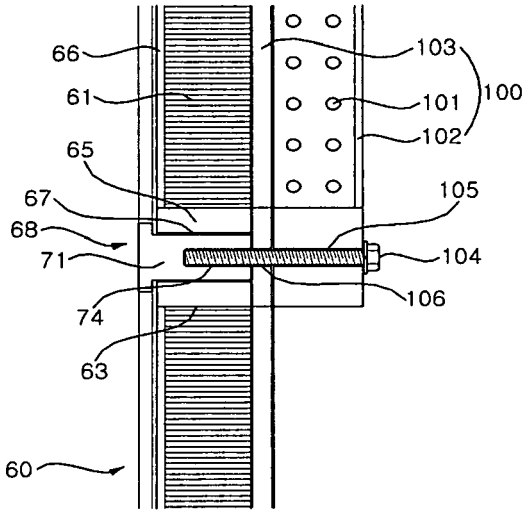
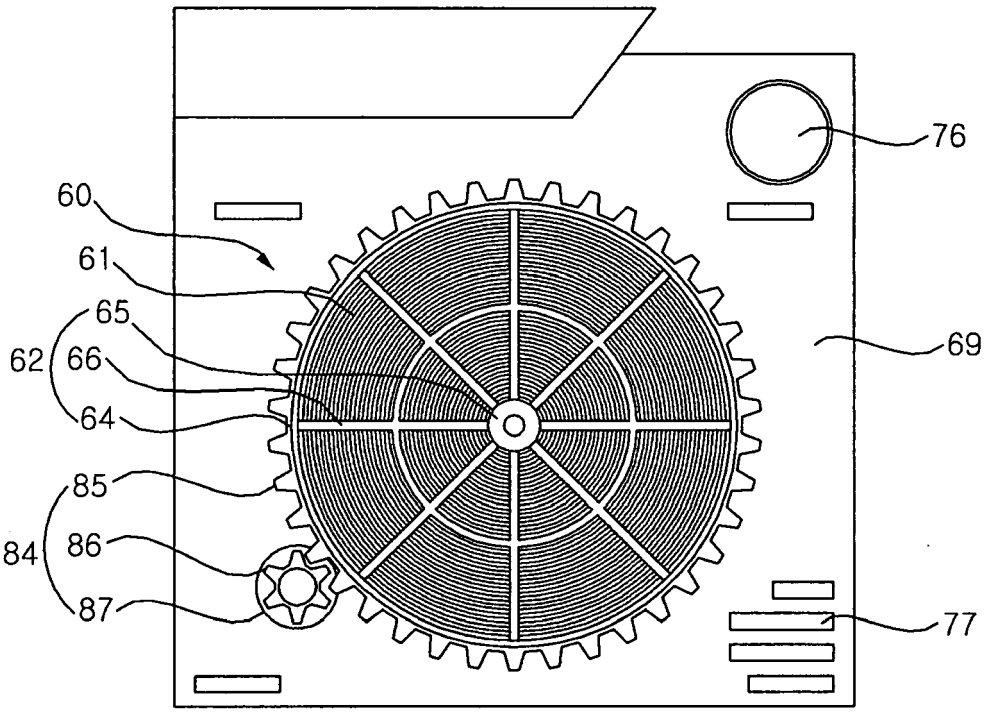


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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