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(54) **DEHUMIDIFIER**

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Description

Technical Field

[0001] The present invention relates to a dehumidifier, and more particularly, to a dehumidifier that allows a portion of external air to be introduced to a flow path of air circulating through a plurality of heat exchangers.

Background Art

[0002] Generally, a dehumidifier is an appliance that sucks damp air into a case, allows the sucked damp air to pass through a heat exchanger to remove moisture from the sucked air, and discharge the air from which the moisture is removed to an indoor space, thereby lowering the humidity in the indoor space.

[0003] The dehumidifier of the related art uses only one heat exchanger to remove the moisture from the air and thus the dehumidifying efficiency is relatively low. Further, when the air passing through the single heat exchanger flows only in a direction from an inlet to an outlet, the dehumidifying reliability is deteriorated.

[0004] JP 2002-326012 discloses a dehumidifier having reduced power consumption by comprising a circulation channel arranged so that at least a portion of the recirculating air at an adsorption side of adsorbent passes after passing through a heat exchanger, and the recirculating air passes through a heating means after taking heat contained in the adsorbent.

Disclosure of Invention

Technical Problem

[0005] An object of the present invention is to provide a dehumidifier allowing a passage of circulating air flowing through a plurality of heat exchangers to constitute one closed circuit to exchange heat with external air.

[0006] Another object of the present invention is to provide a dehumidifier including an adsorption member that can adsorb moisture in air constantly to remove moisture adsorbed by the adsorption member using a heater.

[0007] Still another object of the present invention is to provide a dehumidifier having higher efficiency by allowing external heated air to flow into a heater assembly.

Technical Solution

[0008] The present invention provides a dehumidifier as set out in claim 1.

[0009] There is provided a dehumidifier including: a main body case having an inner space and having an external air inlet formed on one side; a barrier dividing the inner space; a plurality of heat exchangers disposed on one side of the barrier to allow heat to be exchanged between circulating air flowing through the heat exchangers and external air flowing from an outside; an absorption member provided on one side of the barrier to adsorb moisture contained in air while rotating in low speed; a heater assembly provided on one side of the adsorption member to heat the circulating air flowing through the heat exchangers; and a high temperature duct provided on one side of the heater assembly to guide a portion of air that has passed through the adsorption member to an inside of the heater assembly.

Advantageous Effects

[0010] According to a dehumidifier of the present invention, moisture contained in air is removed constantly by adsorption, and moisture contained in air is condensed and drained by a temperature difference between inside air and external air, so that dehumidification can be efficiently performed.

[0011] Also, a high temperature duct for guiding air to allow a portion of heated air that has flowed from an outside and passed through an adsorption member to flow into a heater assembly is further provided on the rear side of the heater assembly. Therefore, a load applied to the heater assembly relatively reduces, and dehumidification efficiency improves.

[0012] Since external air of high temperature directly flows to a heater assembly and circulates, heating of air is more easily performed to improve performance of a de- humidifier.

Brief Description of the Drawings

[0013]

FIG. 1 is a perspective view illustrating the appearance of a dehumidifier according to the present invention;

FIG. 2 is a first side exploded perspective view of the dehumidifier of FIG. 1 ;

FIG. 3 is a second side exploded perspective view of the dehumidifier of FIG. 1 ;

FIG. 4 is a front perspective view illustrating the inner construction of a dehumidifier according to the present invention;

FIG. 5 is a rear perspective view illustrating the inner construction of a dehumidifier according to the present invention;

FIG. 6 is an exploded perspective view of a main body case and a top panel of a dehumidifier according to the present invention;

FIG. 7 is a rear perspective view of an inner heat exchanger of a dehumidifier according to the present invention;

FIG. 8 is a perspective view illustrating the construction of a barrier according to an embodiment of the present invention;

FIG. 9 is a perspective view of an adsorption motor assembly according to an embodiment of the present invention;

FIG. 10 is a perspective view illustrating an adsorption motor assembly and an inner heat exchanger are mounted on a barrier according to an embodiment of the present invention;

FIG. 11 is a perspective view of a high temperature duct according to an embodiment of the present invention;

FIGS. 12 and 13 are front and rear perspective views, respectively, illustrating a hot air guide, a heater assembly, and a high temperature duct are mounted on an adsorption frame according to an embodiment of the present invention;

FIG. 14 is a perspective view of a side heat exchanger according to an embodiment of the present invention;

FIG. 15 is an exploded perspective view of the side heat exchanger illustrated in FIG. 14;

FIG. 16 is an exploded perspective view of the side heat exchanger illustrated in FIG. 14 seed from other direction;

FIG. 17 is a view illustrating an airflow in which external air flows according to an embodiment of the present invention;

FIG. 18 is a view illustrating an airflow in which air flows in the rear side of a barrier according to an embodiment of the present invention;

FIG. 19 is a view illustrating a movement path of circulating air in FIG. 2;

FIG. 20 is a view illustrating a movement path of circulating air in FIG. 3; and

FIG. 21 is a view illustrating a high temperature duct according to another embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0014] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to accompanying drawings.

[0015] The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art.

[0016] FIG. 1 is a perspective view of a dehumidifier according to an embodiment of the present invention.

[0017] Referring to FIG. 1, a dehumidifier of this embodiment includes a main body 100 for receiving a plurality of major components and a water container 300 and a support 310 that are disposed under the main body 100.

[0018] The main body 100 includes a main body case 110 formed in a rectangular container having opened top and bottom and a top panel 120 mounted on the top of the main body case 110.

[0019] The main body case 110 defines front, rear, left, and right sides of the main body 100. That is, the main body case 110 includes a front panel 112 defining the front side, a rear panel 114 (refer to FIG. 6) defining the rear side, a right panel 116 defining the right side, and a left panel 118 defining the left side.

[0020] The front, rear, left, and right panels 112, 114, 118, and 116 are integrally formed with each other such that the top and bottom of the main body case 110 are opened. Accordingly, the bottom of the main body case 110 is closed by a main body base 150 that will be described hereinafter, and the top panel 120 is mounted on the top of the main body case 110.

[0021] FIG. 2 is a first side exploded perspective view of the dehumidifier of FIG. 1, FIG. 3 is a second side exploded perspective view of the dehumidifier of FIG. 1, FIG. 4 is a front perspective view of an internal structure of the dehumidifier according to an embodiment of the present invention, and FIG. 5 is a rear perspective view of the internal structure of the dehumidifier of FIG. 4. In addition, FIG. 6 is an exploded perspective view of a main body case and top panel of the dehumidifier according to an embodiment of the present invention and FIG. 7 is a rear perspective view of an inner heat exchanger of the humidifier according to an embodiment of the present invention.

[0022] Referring to FIGS. 2 through 7, the top panel 120 defines an outer appearance of the top of the main body 100. The top panel 120 is installed to be spaced apart from an upper end of the main body case 110 with a predetermined gap.

[0023] Accordingly, the gap between the top panel 120 and the upper end of the main body case 110 functions as an air outlet 122 through which the air is discharged.

[0024] In more detail, an edge of the top panel 120 is installed to be spaced apart from the upper end of the main body case 110 with a predetermined gap. That is, as shown in the drawings, a predetermined gap is formed between the edge of the top panel 120 and the front, rear, left and, right panels 112, 114, 118, and 116. That is, as described above, the predetermined gap functions as the air outlet 122 through which the dehumidified air is discharged is formed.

[0025] For descriptive convenience, air that is introduced from an external side (an indoor space) of the dehumidifier into an interior side of the dehumidifier and subsequently discharged into the indoor space will be referred to as 'air'. On the other hand, air circulating through a plurality of heat exchangers 200, 210, and 220, a recovery assembly 160, and a heater assembly, which will be described later, will be referred to as 'circulating air'.

[0026] Spacing projections 124 are provided between the top panel 120 and the main body case 110 to form the gap between the top panel 120 and the main body case 110. The spacing projections 124 are formed to have a predetermined height to support the top panel 120, thereby allowing the top panel 110 to maintain a predetermined space from the upper end of the main body case 110.

[0027] The spacing projections 124 protrude upward from the upper end of the main body case 110. In more detail, the spacing projections 124 are formed on respective corners of the upper end of the main body case 110. Each of the spacing projections 124 is formed in a thin circular bar shape. That is, the top panel 120 is provided at four corners of the bottom surface with projection grooves 126 corresponding to the spacing projections 124. The spacing projections 124 are fixedly inserted in the corresponding projection grooves 126.

[0028] The main body case 110 is provided at one surface (right surface) with air inlets 128 through which the air is introduced. That is, the plurality of air inlets 128 are formed at the right panel 116. The air inlets 128 define passages through which the air is introduced into the main body case 110. Each of the air inlets 128 may be formed in a slit shape extending in a horizontal direction.

[0029] Alternatively, each of the air inlets 128 may be formed in a slit shape extending in a vertical direction. Instead of forming the air inlets in the right panel 116, a separate air inlet grille may be detachably mounted in the right panel 116.

[0030] A barrier 130 dividing an interior space of the main body 100 into front and rear spaces is provided in the main body 100. The barrier 130 has a plurality of bent portions. That is, as shown in the drawings, when viewed from the top, the barrier 130 is formed in a'
' shape to divide the interior space of the main body 100 into the front and rear spaces.

[0031] In more detail, the right end of the barrier 130 formed horizontally is bent vertically toward the rear side and extended to form a rear extension surface 130a. The rear end of the rear extension surface 130a is bent vertically toward the right side to form a right extension surface 130b. Also, the right end of the right extension surface 130b is bent by a predetermined angle to the rear side to form an extended inclination end 130c.

[0032] The inclination end 130c is formed to have an acute angle with respect to an extension line of the right extension surface 130b, and contacts the rear end of the right panel 116, and the right end of the rear panel 114 of the main body case 110. Therefore, the inclination end 130c guides external air such that the external air introduced through the air inlet 128 of the right panel 116 is all easily introduced to the front of the barrier 130.

[0033] The barrier 130 is configured to have a height that is same as or less than a height of the main body case 110. Accordingly, a gap is formed between an upper end of the barrier 130 and the top panel 120. The reason for forming the gap between the upper end of the barrier 130 and the top panel 120 is to allow the dehumidified air to flow upward at a rear side of the barrier 130 and subsequently flows to the front side of the barrier 130 through the gap between the barrier 130 and the top panel 120. Therefore, the dehumidified air can be discharged to an external side through the gap between the top panel 120 and the front panel 112.

[0034] A rearward recess 132 having a predetermined size is formed on the barrier 130. The rearward recess 132 is formed at a center of the barrier 130 and recessed rearward. A heater assembly 170, a blower fan 246, and an inner heat exchanger 200 are installed in the rearward recess 132.

[0035] The rearward recess 132 is provided at a center with a central through hole 134. The central through hole 134 functions as a passage through which the air flows from the front side of the barrier 130 to the rear side of the barrier 130.

[0036] A motor support 136 is formed on the central portion of the central through hole 134. The motor support 136 is a portion on which the blower motor 240, the blower fan 246, and the heater assembly 170 are mounted.

[0037] The motor support 136 is formed at the central portion of the central through hole 134. The motor support 136 includes a plurality (four) of support guides 136' radially formed to support the motor support 136. Therefore, the motor support 136 is integrally formed with the barrier 130.

[0038] An adsorption motor receiving portion 138 is further formed on a side of the motor support 136. That is, the cylindrical adsorption motor receiving portion 138 is formed on a left-upper half of the central through hole 134. The adsorption motor receiving portion 138 is a portion on which an adsorption motor 176 is mounted. The adsorption motor receiving portion 138 is formed in a cylindrical shape opened frontward. The adsorption motor receiving portion 138 is integrally formed with the rearward recess 132, and schematically located at the central portion of the barrier 130.

[0039] The rearward recess 132 is provided with a heater receiving portion 140. The heater receiving portion 140 is a portion on which the heater assembly 170 is mounted. The heater receiving portion 140 is formed on a left portion of the rearward recess 132. Heater guides for supporting upper and lower ends of the heater assembly 170 is formed to extend frontward from the rearward recess 132.

[0040] A recovery receiving portion 144 is further formed above the heater receiving portion 140. A predetermined space is defined above the heater guide 142 of the barrier 130 to form the recovery receiving portion 144. The recovery assembly 160 is installed in the recovery receiving portion 144.

[0041] The barrier 130 is provided with an air outlet 146 opened frontward. The air outlet 146 is a portion through which the circulating air is discharged. The air outlet 146 is formed on a right lower end of the rearward recess 132 of the barrier 130. Therefore, the circulating air discharged to the front side through the air outlet 146 is introduced into the inner heat exchanger 200.

[0042] A cylindrical air inlet 146' protrudes from a right portion of the barrier 130. That is, as shown in the drawing, the cylindrical air inlet 146 protrudes rightward from the right lower end of the barrier 130. The air inlet 146' is a portion for guiding the circulating air discharged from a side heat exchanger 220, which will be described later,

to an interior side of the barrier 130.

[0043] The air inlet 146' and the air outlet 146 communicate with each other. Therefore, the circulating air introduced into the barrier 130 through the air inlet 146' is discharged again through the air outlet 146.

[0044] An airflow guide 148 is formed on a rear surface of the barrier 130. The airflow guide 148 guides the flow of the air that is forcedly directed by the blower fan 246. That is, airflow guide 148 allows the air discharged in a circumferential direction by the blower fan 246 to flow toward the left upper portion. The blower fan 246 protrudes to the rear from the rear side of the barrier 130, and is integrally formed with the barrier 130.

[0045] The airflow guide 148 includes a circular guide portion 148' enclosing an outer side of the blower fan 246 and an upper guide portion 148" extending upward from the circular guide portion 148'. The circular guide portion 148 is a portion for primarily guiding the air discharged in the circumferential direction by the blower fan 246. The upper guide portion 148" is a portion for allowing the air guided leftward by the circular guide portion 148' to flow upward.

[0046] A main body base 150 is provided on a lower end of the barrier 130. The main body base 150 is formed in a rectangular plate shape to define a bottom appearance of the main body 100 and support a plurality of components including the barrier 130.

[0047] A drain pan receiving portion 152 is formed on the main body base 150. That is, the drain pan receiving portion 152 protrudes upward from a portion near a right end of the main body base 150. A drain pan that will be described later is received in the drain pan receiving portion 152.

[0048] The drain pan receiving portion 152 is provided with a plurality of insertion holes 154, 156, and 158. The insertion holes 154, 156, and 158 are portions in which a plurality of water guide members 206, 216, 222', 224', and 226' formed on lower ends of the heat exchangers 200, 210, and 220 are inserted.

[0049] In more detail, the side insertion holes 154 are formed in a right top surface of the drain pan receiving portion 152. The side water guide members 222', 224', and 226' are inserted in the respective sideward insertion holes 154. The side insertion holes 154 include first, second, and third insertion holes 154a, 154b, and 154c. The first, second, and third water guide members 222', 224', and 226' are respectively inserted in the first, second, and third insertion holes 154a, 154b, and 154c.

[0050] The front insertion hole 156 is formed at the left side of the side insertion hole 154. The front water guide member 216 of the front heat exchanger 210 is inserted in the front insertion hole 156.

[0051] The inner insertion hole 158 is further formed in the left side of the front insertion hole 156. That is, the drain pan receiving portion 152 has a height difference such that the left side is relatively lower than the right side. The inner insertion hole 158 is formed in the left side of the drain pan receiving portion 152. The inner water guide member 206 of the inner heat exchanger is inserted in the inner insertion hole 158.

[0052] A recovery assembly 160 is mounted on the front surface of the barrier 130. That is, the recovery assembly 160 is inserted from a front side into the recovery receiving portion 144 formed near the upper end of the barrier 130.

[0053] The recovery assembly 160 is enclosed by the case. Although not shown in the drawings, the recovery assembly 160 includes a recovery fan and a recovery motor. A recovery inlet 162 is formed on a front surface of the recovery assembly 160 and a recovery outlet 164 is formed on the left side.

[0054] The recovery inlet 162 is formed in a circular shape corresponding to the inner outlet 204 formed on the inner heat exchanger 200. The recovery outlet 164 protrudes and extends left-downward from the recovery assembly 160. The recovery outlet 164 is formed in a rectangular pillar shape such that it can be inserted into a heater inlet 174.

[0055] A fan-shaped heater assembly 170 is mounted on the front surface of the barrier 130. The heater assembly 170 functions to heat the air circulating through the heat exchangers 200, 210, and 220. Accordingly, the heater assembly 170 includes a heater (not shown) that generates hot air using electricity supplied from the external side. The circulating air heated by the heater assembly 170 is supplied to an adsorption member 182 to evaporate the moisture adsorbed by the adsorption member 182.

[0056] A heater outlet 172 is formed on the front surface of the heater assembly 170. A heater inlet 174 is formed on the rear surface of the heater assembly 170. The heater outlet 172 is a portion through which the high temperature circulating air, which is heated while it passes through the heater assembly, is discharged frontward of the heater assembly 170. The heater inlet 174 is a portion to which the recovery outlet 164 of the recovery assembly 160 is coupled. The heater outlet 172 is formed in a fan-shape.

[0057] An adsorption motor 176 is mounted on a rear side of the right end of the heater assembly 170. The adsorption motor 176 provides rotational power to the adsorption assembly 180 and is received in the adsorption motor receiving portion 138 of the barrier 130. An adsorption shaft 176 that is a rotational shaft of the adsorption motor 176 is installed to protrude frontward after passing through the right end of the heater assembly 170. Accordingly, the adsorption assembly 180 is fixedly mounted at the front end of the adsorption shaft 176'.

[0058] A high temperature duct 178 is installed on the rear side of the heater assembly 170. The high temperature duct 178 allows relatively hot air of external air that has passed through the adsorption member 182 that is around the heater assembly 170 to flow to the heater assembly 170. The construction of the high temperature duct 178 is described below in detail.

[0059] The adsorption assembly 180 is installed in front

of the barrier 130. The adsorption assembly 180 includes an adsorption member 182 for adsorbing the moisture contained in the air and an adsorption case 184 for fixing and supporting the adsorption member 182.

[0060] The adsorption member 182 may be formed of paper. That is, the adsorption member 182 is formed in a circular shape as a whole. An internal structure is formed in a honeycomb shape such that a plurality of through holes are horizontally formed.

[0061] In more detail, the adsorption member 182 is formed by rolling a two-folded paper in a honeycomb shape so that the through holes can be formed. Subsequently, the rolled paper is dipped in the adsorption solution so that the adsorption solution is coated on a surface of the rolled paper. As described above, since the adsorption solution on which moisture can be easily adsorbed is coated on the surface of the adsorption member 182, the moisture contained in the air is adsorbed by the adsorption member 182 and thus the moisture is removed from the air.

[0062] The adsorption case 184 includes an edge portion 184a enclosing the outer portion of the circular adsorption member 182, a central portion 184b supporting a central portion of the adsorption member 182, and a plurality of connecting portions 184c connecting the edge portion 184a to the central portion 184b.

[0063] A front end of the adsorption shaft 176' of the adsorption motor 176 is fixedly connected to the central portion 184b. Therefore, the adsorption case 184 and the adsorption member 182 can rotate with a constant speed in accordance with a torque of the adsorption motor 176.

[0064] The adsorption member 182 and the adsorption case 184 are fixedly mounted on the front surface of the barrier 130 by an adsorption frame 190. The adsorption frame 190 is fixed on the front surface of the barrier 130 by, for example, a screw, with the adsorption member 182 and the adsorption case 184 received inside the adsorption frame 190.

[0065] A hot air guide 192 is formed on a left portion of the adsorption frame 190. The hot air guide 192 is formed in a fan-shape corresponding to the heater assembly 170. The hot air guide 192 protrudes further to the front from the front surface of the adsorption frame 190.

[0066] The hot air guide 192 functions to guide the circulating air heated by the heater assembly 170 while it passes through the heater assembly 170 to the front heater exchanger 210. Therefore, the hot air guide 192 is opened rearward so that the circulating air can be introduced therein. The hot air guide 192 has an opened right side and an opened lower end so that the heated circulating air can be introduced into a front air inlet 212 of the front heat exchanger 210.

[0067] Sealing members 194 are respectively provided on upper and lower ends of the hot air guide 192. That is, the sealing members 194 are formed of an elastic material such as rubber and provided on respective rear surfaces of the upper and lower ends of the hot air guide 192.

[0068] The sealing member 194 functions to block a gap defined between the adsorption frame 190 and the adsorption member 182. Therefore, the high temperature circulating air flowing through the hot air guide 192 is not leaked through the gap defined between the adsorption frame 190 and the adsorption member 182.

[0069] The inner heat exchanger 200 is further installed on the barrier 130. That is, the inner heat exchanger 200 is vertically installed on a right portion of the rearward recess of the barrier 130. The inner heat exchanger 200 allows the circulating air in the inner heat exchanger 200 and the air flowing rearward through the central through hole 134 to heat-exchange with each other. The inner heat exchanger 200 is provided with a plurality of air through holes allowing air flowing and formed in a slit shape vertically.

[0070] The inner heat exchanger 200 is provided at a rear surface with an inner inlet 202 and an inner outlet 204 through which the air is introduced and discharged.

[0071] The inner inlet 202 is formed on a rear-lower end of the inner heat exchanger 200. The inner inlet 202 is coupled to the air outlet 146 formed on the barrier 130. Accordingly, the inner inlet 202 has a corresponding size to that of the air outlet 146. The circulating air discharged through the air outlet 146 is guided into the inner heat exchanger 200 through the inner inlet 202.

[0072] The inner outlet 204 is formed in a rear-upper end of the inner heat exchanger 200. The inner outlet 204 allows the circulating air in the inner heater exchanger 200 to be introduced through the recovery inlet 162 of the recovery assembly 160. Accordingly, the inner inlet 204 and the recovery inlet 162 are formed in sizes and shapes corresponding to each other and coupled to each other.

[0073] An inner water guide member 206 is further formed on a lower end of the inner heat exchanger 200. That is, the inner water guide member 206 formed in a thin cylindrical shape protrudes downward from the lower end right side of the inner heat exchanger 200. The outer diameter of the inner water guide member 206 has a corresponding side to an outer diameter of the inner insertion hole 158 of the drain receiving portion 152. Therefore, the inner water guide member 206 is inserted and mounted in the inner insertion hole 158.

[0074] The front heat exchanger 210 is further installed in front of the barrier 130. The front heat exchanger 210 is installed in front of the adsorption frame 190 to enclose the right side of the adsorption frame 190. Accordingly, the external air introduced into the adsorption assembly 180 heat-exchanges while it passes through the front heat exchanger 210.

[0075] The front heat exchanger 210 is vertically bent to the rear side at its right end so that it has a ㄱ-shape when viewed from the top. A plurality of air passing holes provided in the form of slits are formed in left and right sides of the front heat exchanger 210.

[0076] A left central portion of the front heat exchanger 210 is partly recessed rightward. The front inlet 212 is formed through the left central portion of the front heat exchanger 210. The front inlet 212 corresponds to right and lower ends of the hot air guide 192. Therefore, the front inlet 212 closely contacts the right and lower ends of the hot air guide 192 of the adsorption frame 190 so that the circulating air heated by the hot air guide 192 is guided into the front heat exchanger 210.

[0077] A front outlet 214 is formed on a right upper end of the front heat exchanger 210. That is, a right end of the front heat exchanger 210 is bent rearward. The front outlet 214 is formed on a right side upper end of the bent portion of the front heat exchanger 210. The circulating air introduced into the front heat exchanger 210 through the front inlet 212 is discharged through the front outlet 214. The air discharged through the front outlet 214 is introduced into the side heat exchanger 220.

[0078] A front water guide member 216 protrudes downward from a right-lower end of the front heat exchanger 210. The front water guide member 216 functions to guide the condensed water generated in the front heat exchanger 210 downward. The front water guide member 216 is inserted in the front insertion hole 156 of the drain pan receiving portion 152. Accordingly, the front water guide member 216 is formed in a thin cylindrical shape having an outer diameter corresponding to an inner diameter of the front insertion hole 156.

[0079] The side heat exchanger 220 is installed on a front-right portion of the barrier 130. That is, the side heat exchanger 220 is installed at the right side of the front heat exchanger 210. Like the inner and front heat exchangers 220 and 200, the side heat exchanger 220 functions to allow the interior and exterior airs to heat-exchange with each other.

[0080] The side heat exchanger 220 is a portion at which the air introduced through the inlet 128 of the right panel 116 primarily heat-exchanges. The side heat exchanger 220 includes three heat exchange units. That is, the side heat exchanger 220 includes first, second, and third heat exchange units 222, 224, and 226 that are vertically installed in a line.

[0081] The first heat exchange unit 222 is a portion where the external air introduced through the air inlet 128 heat-exchanges primarily. As shown in the drawing, the first heat exchange unit 222 is formed in a rectangular shape and provided at a left side rear-lower end with a first outlet 222a.

[0082] The first outlet 222a is a portion through which the circulating air is discharged. The circulating air discharged through the first outlet 222a is introduced through the air inlet 146 of the barrier 130. Accordingly, the first outlet 222a and the air inlet 146 are formed in sizes and shapes corresponding to each other and coupled to each other.

[0083] A first inlet 222b is formed on a front end upper portion of a left side of the first heat exchange unit 222. That is, the first inlet 222b is formed on the diagonal of the first outlet 222a. The first inlet 222b functions as an inlet through which the circulating air is introduced into the first heat exchange unit 222.

[0084] The second heat exchange unit 224 is provided at a left side of the first exchange unit 222. The air passing through the first heat exchange unit 222 further exchanges heat at the second heat exchange unit 224. A second outlet 224a is formed on an upper-front end of the right side of the second heat exchange unit 224.

[0085] The circulating air in the second heat exchange unit 224 is discharged through the second outlet 224a. The second outlet 224a and the first inlet 222b are formed in sizes and shapes corresponding to each other and coupled to each other. Therefore, the circulating air discharged through the second outlet 224a is introduced into the first heat exchange unit 222 through the first inlet 222b.

[0086] A second inlet 224b is formed on a rear-upper end of a left side of the second heat exchanger 224. The second inlet 224b is formed to correspond to a third outlet 226a to allow the circulating air to be introduced into the second heat exchange unit 224.

[0087] The third heat exchange unit 226 is provided at a left side of the second heat exchange unit 224. The air passing through the first and second heat exchange units 222 and 224 exchanges heat thirdly with the third heat exchange unit 226. The third heat exchange unit 226 has a shape corresponding to the second heat exchange unit 224 and is provided at a rear-upper end of a left side with a third outlet 226a.

[0088] The third outlet 226a and the second inlet 224b are formed in sizes and shapes corresponding to each other and coupled to each other. Accordingly, the circulating air discharged through the third outlet 226a is introduced into the second heat exchange unit 224 through the second inlet 224b.

[0089] A third inlet 226b is formed on a front upper end of a left side of the third heat exchange unit 226. The third inlet 226b is a portion through which the circulating air is introduced into the third heat exchange unit 226. The third inlet 226b and the front outlet 214 of the front heat exchanger 210 are formed in sizes and shapes corresponding to each other and coupled to each other.

[0090] Thin cylindrical shaped side water guide members 222', 224', and 226' are respectively protrude downward from the respective first, second, and third heat exchange units 222, 224, and 226. That is, the first, second, and third heat exchange units 222, 224, and 226 are respectively provided at front-lower ends with the side water guide members 222', 224', and 226' extending downward by a predetermined length.

[0091] The side water guide members 222', 224', and 226' are provided to guide the condensed water in the side heat exchanger 220 downward. The side water guide members 222', 224', and 226' are respectively inserted in the side insertion holes 154 formed thorough the drain pan receiving portion 152 of the main body base 150. Therefore, outer diameters of the side water guide

members 222', 224', and 226' correspond to the respective diameters of the first, second, and third insertion holes 154a, 154b, and 154c.

[0092] The side water guide members 222', 224', and 226' include a first side water guide member 222', a second side water guide member 224', and a third side water guide member 226'. The first side water guide member 222' protrudes downward from the lower end of the first heat exchange unit 222 and is inserted in the first insertion holes 154a. The second side water guide member 224' protrudes downward from the lower end of the second heat exchange unit 224 and is inserted in the second insertion hole 154b. The third water guide member 226' protrudes downward from the lower end of the third heat exchange unit 226 and is inserted in the third insertion hole 154c.

[0093] A shielding plate 230 for dividing the space into upper and lower spaces is provided in front of the barrier. As illustrated, the shielding plate 230 is formed with a flat plate to divide the front space of the barrier into the upper and lower spaces.

[0094] The shielding plate 230 blocks a gap between the front panel 112 and the barrier 130 and a gap between the right panel 116 and the barrier 130 to prevent the intake air from being mixed with the discharged air. That is, the shielding plate 130 functions to prevent the external air introduced through the air inlet 128 from being mixed with the air discharged to the external side (indoor space) through the air outlet 122.

[0095] The blower motor 240 is installed in rear of the barrier 130. The blower motor 240 provides rotational power to the blower fan 246 using electricity supplied from the external side. The blower motor 240 is installed on a rear side of the motor support 136 of the barrier 130. The blower motor 240 is provided with a motor shaft 242 transmitting the rotational power and protruding rearward.

[0096] The blower motor 240 is supported by a motor mount 244. That is, the cylindrical blower motor 240 is fixed on a rear side of the barrier 130 by the motor mount 244. The motor mount 244 is formed to enclose the blower motor 240 and fixed on the rear surface of the barrier 130 by, for example, a screw. Accordingly, the blower motor 240 is fixed on the rear side of the barrier 130 with being received inside the motor mount 244.

[0097] A blower fan 246 is installed on an outer portion of the blower motor 240. The blower fan rotates using the rotational power of the blower motor 240 to forcibly generate an air current. That is, the blower fan 246 is fixedly mounted on a rear end of the motor shaft 242 protruding rearward of the blower motor 240 and is rotated together with the rotation of the motor shaft 242.

[0098] The drain pan 250 is received in the lower portion of the drain pan receiving portion 152. The drain pan 250 temporally collects the condensed water falling downward through the water guide members 206, 216, 222', 224', and 226'. The drain pan 250 has a corresponding shape to that of the drain pan receiving portion 152.

[0099] The drain pan 250 is provided at the rear side with a drain hole 252 through which the collected water is drained to the water tank 300. The drain hole 252 is selectively opened by a drain lever 254.

[0100] The drain lever 254 is provided in the form of a cantilever to open the drain hole 252 when the water tank 300 is installed on the support 310 and close the drain hole 252 when the water tank 300 is not installed on the support 310.

[0101] The water tank 300 and the support 310 are provided under the main body base 150.

[0102] The water tank 300 stores the water (condensed water) generated in the heat exchangers 200, 210, and 220. That is, the water drops condensed in the heat exchangers 200, 210, and 220 fall into the water tank 300 through the drain pan 250 and are stored therein.

[0103] The water tank 300 is installed between front and rear supporting portions 314' and 314" of the support 310. The water tank 300 may be installed to be drawn out sideward (leftward or rightward). The water tank 300 is formed in a rectangular box shape having an opened top.

[0104] The support 310 supports the main body 100, and includes the support base 312 and the supporting portion 314. The support base 312 is a portion that directly contacts a floor of a building. The support base 312 is formed in a rectangular flat plate.

[0105] The supporting portion 314 includes a front end supporting portion 314' protruding upward from a front end of the support base 312 and a rear end supporting portion 314" protruding upward from a rear end of the support base 312.

[0106] The drain pan 250 is provided on the upper end of the support 310. In detail, the drain pan 250 is provided on the right end of the front end supporting portion 314' to guide the water discharged from the heat exchangers 200, 210, and 220 to the water tank 300.

[0107] That is, the water falling from the water guide members 206, 216, 222', 224', and 226' formed on the lower ends of the heat exchangers 200, 210, and 220 is collected in the drain pan 250 and subsequently falls to the water tank 300.

[0108] FIG. 8 is a perspective view illustrating the construction of a barrier according to an embodiment of the present invention.

[0109] Referring to FIG. 8, upper and lower coupling guides 320 and 322 for fixing the side heat exchanger 220 are formed long horizontally at front upper and lower ends of the right extension surface 130b of the barrier 130, respectively. That is, the upper coupling guide 320 is formed long horizontally at the vicinity of the upper end of the right extension surface 130b, and the lower coupling guide 322 is formed long horizontally at the vicinity of the lower end of the right extension surface 130b.

[0110] Also, an upper couplin groove 320' and a lower coupling groove 322" are formed in right sides of the upper coupling guide 320' and the lower coupling guide

322. Coupling members 334 and 336 are inserted and coupled in the upper coupling groove 320' and the lower coupling groove 322" respectively. Therefore, the insides of the upper and lower coupling grooves 320' and 322" are threaded to receive screws.

[0111] Meanwhile, coupling supports 139 for fixing the adsorption motor assembly 176 are further formed in the adsorption motor receiving portion 138. That is, coupling supports 139 for coupling to screws protrude to an upper side and a lower side at the upper and lower ends of the adsorption motor receiving portion 138. Also, the coupling supports 139 include a pair of coupling holes 139' for receiving screws.

[0112] FIG. 9 is a perspective view of an adsorption motor assembly according to an embodiment of the present invention.

[0113] Referring to FIG. 9, the adsorption motor assembly 176 is formed in a circular shape, and an adsorption motor (not shown) is surrounded by an outer case.

[0114] The adsorption shaft 176' for delivering rotational power to the adsorption assembly 180 protrudes to the front of the outer case, and the end of the adsorption shaft 176' is coupled to a center 184b of the adsorption case 184. Therefore, when the adsorption shaft 176 rotates, the adsorption assembly 180 rotates in its entirety.

[0115] The adsorption shaft 176' is located at a position separated a predetermined distance from the center of the adsorption motor assembly 176. That is, referring to FIG. 9, the adsorption shaft 176' protrudes to the front from a position separated a predetermined distance to the left from the center of the adsorption motor assembly 176. The reason the adsorption motor 176 is not located at the center, though not shown in detail, is because a plurality of gears are combined inside the adsorption assembly 180 to speed down rotation of the adsorption shaft 176'.

[0116] The adsorption motor assembly 176 includes a motor power terminal 176" to which power is applied. That is, the motor power terminal 176" is attached on the right side of the adsorption motor assembly 176. Therefore, external power is applied to the adsorption motor assembly 176 via the motor power terminal 176".

[0117] The adsorption motor assembly 176 further includes coupling portions 177 for fixing the adsorption assembly 180. That is, the coupling portions 177 protrude to the upper side and lower side at the upper and lower ends of the adsorption assembly 180. The coupling portions 177 include a pair of screw through holes 177' for receiving screws.

[0118] The coupling portions 177 contact the coupling supports 139 of the adsorption motor receiving portion 138. Therefore, the coupling portions 177 and the coupling supports 139 are formed in shapes corresponding to each other. Also, the screw through holes 177 and the coupling holes 139' have shapes corresponding to each other.

[0119] FIG. 10 is a perspective view illustrating an adsorption motor assembly and an inner heat exchanger are mounted on a barrier according to an embodiment of the present invention.

[0120] Referring to FIG. 10, the adsorption motor assembly 176 and the inner heat exchanger 200 are mounted on the barrier 130. That is, FIG. 10 illustrates the adsorption motor assembly 176 is inserted and mounted in the adsorption motor receiving portion 138, and the inner heat exchanger 200 is closely fixed at the right portion of the rearward recess 132.

[0121] The adsorption motor assembly 176 is inserted and mounted on the center of the barrier 130. Therefore, the adsorption motor assembly 176 applies rotational power to the center of the adsorption assembly 180. Also, the inner heat exchanger 200 is mounted on the rearward recess 132 of the barrier 130 using a plurality of screws.

[0122] FIG. 11 is a perspective view of a high temperature duct according to the present invention, and FIGS. 12 and 13 are front and rear perspective views, respectively, illustrating a hot air guide, a heater assembly, and a high temperature duct are mounted on an adsorption frame according to the present invention.

[0123] Referring to FIGS. 11 to 13, a passage through which high temperature air can flow is formed inside the high temperature duct 178. A high temperature inlet 178' and a high temperature outlet 178" are formed at the lower and upper ends of the high temperature duct 178, respectively.

[0124] A high temperature inlet 178' and a high temperature outlet 178" are formed at the lower and upper ends of the high temperature duct 178.

[0125] The high temperature inlet 178' contacts the rear side of the adsorption member 182.

In more detail, the high temperature inlet 178' is fixedly installed at the lower end of the heater assembly 170 in the rear side of the adsorption member 182 (refer to FIG. 12B).

[0126] The reason the high temperature inlet 178' needs to be installed to contact the lower end of the heater assembly 170 is for allowing hot air to flow through the high temperature duct 178. That is, referring to FIG. 12B, when the adsorption member 182 rotates in low speed clockwise, external air passes through the adsorption member 182 (to the rear side from the front side in FIG. 12B). The external air that has passed through the adsorption member 182 maintains high temperature to some extent. Therefore, when the hot air enters the inside of the heater assembly 170 through the high temperature duct 178, the air in the heater assembly 170 can be more effectively performed.

[0127] The high temperature outlet 178" is installed to communicate with the heater inlet 174 formed at the upper end of the heater assembly 170. Therefore, external air that has passed through the adsorption member 182 located at the vicinity of the lower end of the heater assembly 170 is introduced into the heater assembly 170 through the high temperature duct 178.

[0128] The high temperature inlet 178' is formed relatively larger than the high temperature outlet 178". That

is, referring to FIG. 11, the high temperature duct 178 has a width that gradually increases from the upper end to the lower end. This is because the high temperature outlet 176" should be inserted to the right end (in FIG. 12B) of the heater inlet 174 of the heater assembly 170, and the high temperature inlet 178' may have a size corresponding to the lower end length of the heater assembly 170.

[0129] The adsorption member 182 and the adsorption case 184 are received in the inner side of the adsorption frame 190. The heater assembly 170 is mounted on the rear side of the adsorption frame 190, and the hot air guide 192 is formed on the front side of the adsorption frame 190.

[0130] A first overheating prevention member H1 is provided on the surface of the heater assembly 170. That is, referring to FIG. 13, the first overheating prevention member H1 is formed on the rear side of the heater assembly 170 to control power supplied to the heater (not shown) provided to the heater assembly 170. That is, the first overheating prevention member H1 measures the temperature of the surface of the heater assembly 170 to turn on/off power supplied to the heater.

[0131] The first overheating prevention member H1 includes an automatic temperature control unit having bi-metal. Therefore, the first overheating prevention member H1 turns off power supplied to the heater assembly 170 when the temperature of the surface of the heater assembly 170 is greater than a predetermined temperature, and controls power to be supplied to the heater assembly 170 when the temperature of the surface of the heater assembly 170 is smaller than the predetermined temperature.

[0132] The first overheating prevention member H1 is mounted on the outer surface of the heater assembly 170 using the attaching bracket H1 as illustrated. That is, the first ove rheating prevention member H1 is fixedly mounted on the outer surface of the heater assembly 170 using the attaching bracket H1' coupled with screws.

[0133] The hot air guide 192 is provided on the front left portion of the adsorption frame 190 as illustrated, and may be integrally formed on the front side of the adsorption frame 190. Also, the hot air guide 192 includes a second overheating prevention member H2 for cutting off power supplied to the heater assembly 170.

[0134] The second overheating prevention member H2 is attached on the surface of the hot air guide 192 to measure the temperature of circulating air that passes through the hot air guide 192 and control power supplied to the heater assembly 170. Therefore, the second overheating prevention member H2 can be installed on the inner surface as well as the outer surface of the hot air guide 192, for course.

[0135] The second overheating prevention member H2 includes a temperature disk H2' and a temperature fuse H2".

[0136] The temperature disk H2' is turned off when the temperature of the hot air guide 192 is greater than a set temperature, and turned on when the temperature of the hot air guide 192 is smaller than the set temperature. That is, like the above-described first overheating prevention member H1, the second overheating prevention member H2 includes an automatic temperature control unit having bi-metal.

[0137] The temperature disk H2' is configured to operate at a relatively lower temperature than an operating temperature of the first overheating prevention member H1. That is, since the hot air guide 192 emits a relatively small amount of heat compared to the heater assembly 170, metal used for a bi-metal of the temperature disk H2' is formed of a material more sensitive to heat compared to the material used for a bi-metal of the first overheating prevention member H1.

[0138] The temperature fuse H2" performs the same function as that of a general fuse. That is, the temperature fuse H2" is permanently cut when the measured temperature of the hot air guide 192 is greater than the set temperature to cut off power supplied to the heater assembly 170.

[0139] Unlike the temperature disk H2', since the temperature fuse H2" cannot be used and should be replaced once cut, the temperature disk H2 operates on the first place, and then the temperature fuse H2" additionally operates. Therefore, the temperature fuse H2" is configured to operate at a relatively high temperature compared to the temperature disk H2'.

[0140] FIG. 14 is a perspective view of a side heat exchanger according to an embodiment of the present invention, FIG. 15 is an exploded perspective view of the side heat exchanger illustrated in FIG. 14, and FIG. 16 is an exploded perspective view of the side heat exchanger illustrated in FIG. 14 seed from other direction.

[0141] Referring to FIGS. 14 and 16, FIG. 14 illustrates the side heat exchanger 220 is assembled, and FIGS. 15 and 16 are exploded perspective views of the first heat exchange unit 222, second heat exchange unit 224, and third heat exchange unit 226 constituting the side heat exchanger 220 seen from the right and left sides, respectively.

[0142] The first, second, and third heat exchange units 222, 224, and 226 are coupled to each other using coupling members 340 and 342. At least one of the first, second, and third heat exchange units 222, 224, and 226 is fixedly mounted on the barrier 130.

[0143] In more detail, the upper end of at least one of the first, second, and third heat exchange units 222, 224, and 226 can be fixed in the barrier 130 using coupling members 224 and 336.

[0144] As illustrated, the rear upper end of the first heat exchange unit 222 extends upward to form an upper coupling portion 330, and the rear lower end of the first heat exchange unit 222 extends downward to form a lower end coupling portion 332.

[0145] Also, an upper through hole 330' is formed in the upper coupling portion 330, and a lower through hole 332' is formed in the lower coupling portion 332. The

coupling members 334 and 336 pass through the upper through hole 330' and the lower through hole 332'.

[0146] The side heat exchanger 220 is fixedly mounted on the barrier 130 using the coupling members 334 and 336. That is, as illustrated, the side heat exchanger 220 is fixed on the barrier 130 using the coupling members 334 and 336 such as screws. The coupling members 334 and 336 are not limited to screws, but other coupling members can be used.

[0147] The coupling members 334 and 336 include the upper coupling member 334 inserted and coupled in the upper coupling groove 320' of the upper coupling guide 320, and the lower coupling member 336 inserted and coupled in the lower coupling groove 322' of the lower coupling guide 322. Also, the upper coupling member 334 and the lower coupling member 336 pass through the upper through hole 330' and the lower through hole 332' of the first heat exchange unit 222, respectively, and are coupled to the upper coupling groove 320' and the lower coupling groove 322', respectively.

[0148] Meanwhile, the first, second, and third heat exchange units 222, 224, and 226 are coupled to each other using coupling members 340 and 342.

[0149] The coupling members 340 and 342 include coupling protrusions 340 and protrusion coupling pipes 342 formed on one sides of the heat exchangers 222, 224, and 226 to correspond to each other. That is, the protrusion coupling pipe 342 and the coupling protrusion 340 are formed on the left side of the first heat exchange unit 222 and the right side of the second heat exchange unit 224, respectively, to correspond to each other and are coupled to each other. Also, the protrusion coupling pipe 342 and the coupling protrusion 340 corresponding to each other are formed on the left side of the second heat exchange unit 224 and the right side of the third heat exchange unit 226, respectively, and coupled to each other. Also, the protrusion coupling pipe 342 and the coupling protrusion 340 are formed on each corner of one sides of the heat exchangers 222, 224, and 226.

[0150] In more detail, the protrusion coupling pipe 342 protrudes to the left from the rear upper left side of the first heat exchange unit 222. The protrusion coupling pipe 342 is formed in a thin cylindrical shape as illustrated. Therefore, the coupling protrusion 340 is inserted and coupled in a forcibly fitting manner into a circular groove formed inside the protrusion coupling pipe 342.

[0151] Therefore, the inner diameter of the protrusion coupling pipe 342 and the outer diameter of the coupling protrusion 340 are the same in their size, or the outer diameter of the coupling protrusion 340 may be slightly greater than the inner diameter of the protrusion coupling pipe 342.

[0152] The protrusion coupling pipe 342 protrudes to the left from the front lower end on the left side of the first heat exchange unit 222. The protrusion coupling pipe 342 is the same as the protrusion coupling pipe formed at the rear upper end on the left side of the above-described first heat exchange unit 222.

[0153] Also, the protrusion coupling pipe 342 is formed also at the rear left side of the first heat exchange unit 222. That is, the protrusion coupling pipe 342 is formed on the upper side of the first outlet 222a. On the other hand, the protrusion coupling pipe 342 is not formed at the front upper end on the left side of the first heat exchange unit 222 because the first inlet 222b is formed at the front upper end on the left side of the first heat exchange unit 222 and coupled to the second outlet 224a formed on the right side of the second heat exchange unit 224, serving as a coupling means.

[0154] The coupling protrusion 340 protrudes to the right from the corner on the right side of the second heat exchange unit 224. The coupling protrusions 340 have a circular thin bar shape as illustrated, and are formed at positions corresponding to the protrusion coupling pipes 342, respectively, on the left side of the first heat exchange unit 222. That is, the coupling protrusions 340 are formed at the rear upper and lower ends on the right side, and the front lower end on the right side of the second heat exchange unit 224. The protrusion coupling pipe 342 is formed also at the corner on the left side of the second heat exchange unit 224. That is, the protrusion coupling pipes 342 are formed on the lower and upper ends and rear lower end on the left side of the second heat exchange unit 224, respectively.

[0155] Also, the protrusion coupling pipe 342 is not formed at a rear upper end on the left side of the second heat exchange unit 224 because the second inlet 224b is coupled to the third outlet 226a of the third heat exchange unit 226 to serve as a coupling means. Accordingly, the protrusion coupling pipe 342 does not need to be formed.

[0156] The coupling protrusion 340 is formed at the corner on the right side of the third heat exchange unit 226. The coupling protrusion 340 formed on the right side of the third heat exchange unit 226 is formed at a position corresponding to the protrusion coupling pipe 342 formed on the left side of the second heat exchange unit 224.

[0157] FIG. 17 is a schematic view of an external air flow state in the humidifier according to an embodiment of the present invention, FIG. 18 is a schematic view of an air flow state in rear of a barrier of the humidifier according to an embodiment of the present invention, FIG. 19 is a view illustrating an circulating air flow path in FIG. 2, and FIG. 20 is a view illustrating a circulating air flow path in FIG. 3.

[0158] An operation of the above-described dehumidifier of the present invention will be described hereinafter with reference to FIGS. 17 to 20.

[0159] Referring first to FIG. 17, external (indoor space) air is introduced into the dehumidifier through a side surface (right surface) of the dehumidifier. The air dehumidified in the dehumidifier is discharged to the external side (indoor space) through an upper end of the dehumidifier. That is, the dehumidified air is discharged through the gap between the top panel 120 and other panels.

[0160] In more detail, when the blower motor 240 is driven, the blower fan 246 rotates by the rotational force of the blower motor 240.

[0161] Also, the adsorption motor 176 is driven by electricity supplied from an outside to rotate the adsorption assembly 180. That is, when power is supplied via a motor power terminal 176" of the adsorption motor assembly 176, gears (not shown) mounted inside the adsorption motor assembly 176 rotate, and thus the adsorption shaft 176' rotates.

[0162] When the adsorption shaft 176' rotates, the adsorption assembly 180 coupled to the front end of the adsorption shaft 176' rotates. At this point, the rotational force generated by the adsorption motor 176 is lower than the rotational force generated by the recovery motor (not shown) or the blower motor 240. Therefore, the adsorption assembly 180 rotates with a relatively low speed.

[0163] Also, a recovery fan (not shown) provided inside the recovery assembly 160 rotates to generate flowing of circulating air in the inside of the heat exchangers 200, 210, and 220. At this same time, the heater (not shown) provided inside the heater assembly 170 is also driven by the external power to emit hot air.

[0164] Meanwhile, as the blower fan 246 rotates, sucking force is generated in the dehumidifier and thus the external air (air in the indoor space) is introduced into the main body case 110 through the air inlet 128 of the right panel 116 (refer to ① in FIG. 17).

[0165] The external air introduced into the main body case 110 passes through the side heat exchanger 220 as indicated by ② in FIG. 17. That is, the air passes successively through the air passing holes provided in the form of slits on the first, second, and third heat exchange units 222, 224, 226.

[0166] At this point, the air outside the side heat exchanger 220 exchanges heat with the air inside the side heat exchanger 220. Accordingly, a temperature of the relatively cool air outside the side heat exchanger 220 increases by the hot circulating air inside the side heat exchanger 220.

[0167] The air that has passed through the side heat exchanger 220 passes through the front heat exchanger 210 as shown in FIG. 17. That is, the external air flows from the right and front sides of the front heat exchanger 210 to the rear side of the front heat exchanger 210. At this point, the airs inside and outside the front heat exchanger 210 exchange heat with each other.

[0168] The air that has passed through the front heat exchanger 210 passes through the adsorption member 182 as indicated by ④ in FIG. 17. Therefore, the moisture contained in the air is adsorbed on a surface of the adsorption member 182. Therefore, the air becomes more dry air.

[0169] The external air that has passed through the adsorption assembly 180 passes through the inner heat exchanger 200 as indicated by ⑤ of FIG. 17. Likewise, the airs inside and outside the inner heat exchanger 200 exchange heat with each other, so that the air becomes more high temperature.

[0170] The air that has passed through the inner heat exchanger 200 flows to the rear side of the barrier 130 through the central through hole 134 of the barrier 130 as indicated by ⑥ of FIG. 17. The air directed to the rear side of the barrier 130 is discharged in a radial direction by the blower fan 246 and guide by the airflow guide 148.

[0171] The airflow guide 148 encloses the outer side of the blower fan 246 and has a left end extending upward. Thus, the air discharged by the blower fan 246 flows toward the left upper portion of the barrier 130 as indicated by ⑦ of FIG. 17.

[0172] The airflow by the airflow guide 148 is described in more detail with reference to FIG. 18. The air discharged in the circumferential direction by the blower fan 246 is guided by the circular guide portion 148" and directed leftward (rightward in FIG. 18) as indicated by (7a).

[0173] Subsequently, the air flows upward by the upward guide portion 148", and as indicated by (7b), the air passes through the gap between the upper end of the upward guide portion 148" and the left panel 118.

[0174] A portion of the air that has passes through the gap between the upper end of the upward guide portion 148" and the left panel 118 is directed even to a front side of the barrier 130 through the gap between the upper end of the barrier 130 and the top panel 120. That is, since the gap is formed between the top panel 120 and the upper end of the barrier 130, as indicated by (7c), the air in rear of the barrier 130 flows toward even the front side of the barrier 130.

[0175] As described above, the air ascended by the airflow guide 148 flows to even the front side of the barrier 130. At this point, the shielding plate 230 in front of the barrier 130 blocks the downward flow of the air so that the air guided upward by the airflow guide 148 is not introduced again into the adsorption assembly 180. That is, the air directed upward by the airflow guide 148 flows to the lower side of the shielding plate 230 so as not to be mixed with the air that is being introduced from the external side.

[0176] The air directed upward is dispersed toward the edges of the top panel 120 and discharged through the air outlet 122. That is, as indicated by ⑧ of FIG. 17, the air is discharged to the external side through the air outlet 122 defined by the gap between the top panel 120 and the main body case 110. The method for discharging the air through the air outlet 122 defined by the gap provided in the form of slits is also called a line diffuser method.

[0177] Next, the flow of the circulating air in the heat exchangers 200, 210, and 220 will now be described with reference to FIGS. 19 and 20.

[0178] A passage of the circulating air flowing through the heat exchangers 200, 210, and 220 constitutes a closed circuit. That is, unlike the above-described air (i.e., air introduced from the indoor space to the dehumidifier), the circulating air in the heat exchangers 200, 210, and 220 is not replaced but continuously circulate through the closed passage to exchange heat with the external

air.

[0179] Describing in more detail, the circulating air directed from the recovery assembly 160 is, as indicated by □, introduced into the heater assembly 170 through the heater inlet 174 connected to the recovery outlet 164.

[0180] The circulating air introduced into the heater assembly 170 is heated by a heater (not shown), becomes a high temperature, and is directed frontward as indicated by □ by the heater outlet 172. The circulating air directed frontward through the heater outlet 172 passes through the adsorption member 182. At this point, the high temperature circulating air discharged through the heater outlet 172 evaporates the moisture adsorbed on the adsorption member 182.

[0181] That is, as the adsorption member 182 is rotated with a low speed by the adsorption motor 176, the moisture contained in the air passing through the adsorption member 182 is adsorbed on the adsorption member 182. At this point, as the high temperature circulating air passes through the adsorption member 182 as described above, the moisture adsorbed in the adsorption member 182 is evaporated and thus removed from the adsorption member 182.

[0182] In addition, since the heater outlet 172 is formed in the fan-shape, the adsorption member 182 affected by the high temperature circulating air discharged through the heater outlet 172 becomes a range (fan-shape) corresponding to the heat outlet 172. However, since the adsorption member 182 keeps rotating with the low speed by the adsorption motor 176, the adsorption member 182 entirely contacts the high temperature circulating air discharged through the heater outlet 172 when a predetermined time has elapsed.

[0183] The circulating air that has passed through the adsorption member 182 is introduced into the hot air guide 192 of the adsorption frame 190 and subsequently directed into the front heat exchanger 210 through the front inlet 212 of the front heat exchanger 210 as indicated by □.

[0184] The circulating air directed into the front heat exchanger 210 exchanges heat with the external air. That is, as described above, the circulating air exchanges heat with the external air which is introduced through the air inlet 128 and flows along an external side of the front heat exchanger 210.

[0185] In more detail, since the circulating air in the front heat exchanger 210 is higher in a temperature than the external air, the external air flowing along an outer side of the front heat exchanger 210 takes the heat of the circulating air in the front heat exchanger 210. Therefore, the temperature of the circulating air in the front heat exchanger 210 is lowered and thus the moisture contained in the circulating air is condensed and flows downward.

[0186] The circulating air that has passed through the front heat exchanger 210 is, as indicated by □, introduced into the side heat exchanger 220. That is, the circulating air in the front heat exchanger 210 is directed to the third heat exchange unit 226 through the front outlet 214 and subsequently introduced into the third heat exchanger 226 through the third inlet 226b. Subsequently, the circulating air passes through the second heat exchanger 224 and then to the first exchange unit. At this point, the external air outside the side heat exchanger 220 takes the heat from the circulating air and thus the moisture contained in the circulating air is condensed.

[0187] The air that has passed through the side heat exchanger 220 is introduced into the inner heat exchanger 200. In more detail, the circulating air discharged through the first outlet 222a of the first heat exchanger 222 is, as indicated by □, introduced into the barrier 130 through the air inlet 146 formed on the barrier 130. The circulating air is, as indicated by □, introduced into the inner heat exchanger 200 through the air outlet 146 and the inner inlet 202.

[0188] Like the side and front heat exchangers 220 and 210, the circulating air introduced into the inner heat exchanger 200 exchanges heat with the external air. That is, after passing through the adsorption member 182, the circulating air exchanges heat with the air directed to a rear side of the barrier 130 through the central through hole 134 of the barrier 130.

[0189] Accordingly, the circulating air in the inner heat exchanger 200 is cooled and thus the moisture contained in the circulating air is condensed and discharged downward.

[0190] The circulating air that has passed through the inner heat exchanger 200 is, as indicated by □, introduced into the recovery assembly 160. That is, since the inner inlet 204 of the inner heat exchanger 200 is coupled to the recovery inlet 162 of the recovery assembly 160, the circulating air in the inner heat exchanger 200 is introduced into the recovery assembly 160.

[0191] The circulating air introduced into the recovery assembly 160 is forcibly directed by the recovery fan (not shown) into the heater assembly 170 through the recovery outlet 164 as indicated by □. Through the above-described process, the circulating air circulates through the closed passage in which the heat exchangers 200, 210, and 220 are arranged, thereby completing one cycle.

[0192] Meanwhile, a portion of external air besides the flowing in a passage is introduced into the heater assembly 170 to circulate through the plurality of heat exchangers 200, 210, and 220. That is, since the high temperature duct 178 is installed on the rear side of the heater assembly 170, a portion of external air that has passed through the adsorption member 182 is introduced into the heater assembly 170 along the high temperature duct 178.

[0193] In other words, in the case where the recovery assembly 160 forcibly blows circulating air to the heater inlet 174 of the heater assembly 170, air flowing generated at the recovery assembly 160 allows air to be introduced also through the high temperature duct 178 and to flow into the heater assembly 170.

[0194] In more detail, referring to FIG. 13, when the adsorption member 182 is rotated clockwise in low speed by rotational force of the adsorption motor assembly 176, portions of the adsorption member 182 sequentially passes through the inside of the heater assembly 170, so that moisture on the adsorption member 182 evaporates.

[0195] When the adsorption member 182 passes through the inside of the heater assembly 170, circulating air heated by heat generated at the heater assembly 170 passes through the adsorption member 182 to remove moisture on the adsorption member 182. At this point, the moisture on the adsorption member 182 is removed, and simultaneously, the temperature of the adsorption member 182 increases by hot circulating air.

[0196] Therefore, since a portion of the adsorption member 182 that has passed through the lower end of the heater assembly 170 has a higher temperature than that of the other portions, a portion of external air that passes through the portion of the adsorption member 182 that has the higher temperature is raised in its temperature by the hot portion of the adsorption member 182. Accordingly, hot air flows into the high temperature duct 178 through the high temperature inlet 178', and subsequently, flows into the heater assembly 170 through the high temperature outlet 178".

[0197] A portion of external air introduced through the high temperature duct 178 as well as circulating air that has passed through the plurality of heat exchangers 200, 210, and 220 are introduced into and mixed in the heater assembly 170. Accordingly, the temperature of mixed air introduced to the heater assembly 170 is raised to some extent.

[0198] The condensed water generated by the heat exchange between the external air and the circulating air must be removed frequently by the user.

[0199] The above-described process is described in more detail. The condensed water generated by the temperature difference in the heat exchangers 200, 210, and 220 falls down along the inner walls of the heat exchangers 200, 210, and 220 and is collected in the drain pan 250. That is, since the water guide members 206, 216, 222', 224', and 226' protruding downward are formed on the lower ends of the heat exchangers 200, 210, and 220 and communicate with the inside of the drain pan 250 by being inserted in the insertion holes 154, 156, and 158 of the drain pan receiving portion 152, the condensed water generated in the heat exchangers 200, 210, and 220 is collected in the drain pan 250 through the water guide members 206, 216, 222', 224', and 226'.

[0200] The condensed water collected in the drain pan 250 falls into the water tank 300. That is, the condensed water that is temporarily collected in the drain pan 250 falls into the water tank 300 through a hole formed to pass through a side of the drain pan 250.

[0201] When a predetermined amount of condensed water is collected in the water tank 300 through the above-described process, the user takes the water tank 300 out in a side direction and empties the water tank.

[0202] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. 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.

[0203] For example, a separate unit for forcing external hot air flow introduced through the high temperature duct 178 can be provided. Also, a separate unit for airflow flowing through the high temperature duct 178 can be provided.

[0204] FIG. 21 is a view illustrating a high temperature duct according to another embodiment of the present invention.

[0205] FIG. 21 illustrates the cross-section of a construction for forcing airflow flowing through the high temperature duct 178 according to an embodiment of the present invention.

[0206] Referring to FIG. 21, a high temperature fan 178a for forcing air introduced through the high temperature inlet 178' to flow upward is provided inside the high temperature duct 178. A high temperature motor 178a is provided to the left side of the high temperature fan 178a to provide rotational power to the high temperature fan 178a.

[0207] Therefore, a portion of external air that has passed through the adsorption member 182 is introduced into the high temperature duct 178 by rotation of the high temperature fan 178a and forced to flow into the heater assembly 170 through the high temperature outlet 178".

Industrial Applicability

[0208] According to a dehumidifier having the above-described construction, a heater assembly is provided at its rear side with a high temperature duct for allowing a portion of heated air that has been introduced from the outside and passed through an adsorption member to be introduced into the heater assembly. Therefore, dehumidifying efficiency improves.

Claims

1. A dehumidifier comprising:

a main body case (110) having an inner space and having an external air inlet (128) formed on one side;
a barrier (130) dividing the inner space;
a plurality of heat exchangers (200, 210,220) disposed on one side of the barrier (130) to allow heat to be exchanged between circulating air flowing through the heat exchangers (200, 210, 220) and external air flowing from an outside;
an adsorption member (180) provided on one side of the barrier (130) to adsorb moisture con-

tained in air while rotating in low speed; and
a heater assembly (170) provided on one side of the adsorption member (180) to heat the circulating air flowing through the heat exchangers (200, 210, 220);
characterised in that the dehumidifier further comprises:

a high temperature duct (178) provided on one side of the heater assembly (170) to guide a portion of the external air that has passed through the adsorption member (180) to an inside of the heater assembly (170),
wherein the portion of external air introduced through the high temperature duct (178) as well as circulating air that has passed through the plurality of heat exchangers (200, 210, 220) are introduced into and mixed in the heater assembly (170).

2. The dehumidifier according to claim 1, further comprising a top panel (120) installed such that a separated space through which heat-exchanged air is discharged is formed on an upper surface of the main body case (110).

3. The dehumidifier according to claim 1, wherein the plurality of heat exchangers (200, 210, 220) comprise:

a side heat exchanger (220) installed on a lateral side of the barrier (130);
an inner heat exchanger (200) installed on one side of the barrier (130); and
a front heat exchanger (210) installed on a front of the inner heat exchanger (200).

4. The dehumidifier according to claim 1, further comprising a recovery assembly (160) provided in the inner space to force flowing of circulating air.

5. The dehumidifier according to claim 1, wherein one of the plurality of heat exchangers (200, 210, 220) is disposed on a position corresponding to the air inlet (128) to primarily exchange heat with the air flowing from the outside.

6. The dehumidifier according to claim 1, further comprising a drain pan (250) provided on one side of the barrier (130) to collect condensed water generated when circulating air exchanges heat with external air.

7. The dehumidifier according to claim 1, wherein the plurality of heat exchangers (200, 210, 220) comprise a water guide member (206, 216, 222', 224', 226') coupled to correspond to a receiving hole of the drain pan (250) formed on one side of the barrier (130).

8. The dehumidifier according to claim 1, wherein one of the plurality of heat exchangers (200, 210, 220) is disposed on a position corresponding to the air inlet (128), and first, second, and third heat exchange units (222, 224, 226) through which external air sequentially circulates are provided.

9. The dehumidifier according to claim 1, wherein a high temperature inlet (178') for guiding air that has passed through the adsorption member (180) to an inside of the dehumidifier is formed at one end of the high temperature duct (178), and a high temperature outlet (178") for guiding air in an inside of the high temperature duct (178) to the heater assembly (170) is formed at the other end of the high temperature duct (178).

10. The dehumidifier according to claim 9, wherein the high temperature inlet (178') is located on a lower end of the heater assembly (170), and the high temperature outlet (178") is located at an upper end of the heater assembly (170).

11. The dehumidifier according to claim 1, wherein the high temperature duct (178) has a width that increases toward one side.

12. The dehumidifier according to claim 1, wherein a high temperature fan (178a) for forcibly flowing air is provided inside the high temperature duct (178).

Patentansprüche

1. Luftentfeuchter, der Folgendes aufweist:

ein Grundgehäuse (110), das einen inneren Raum und einen an einer Seite ausgebildeten Einlass (128) für Außenluft aufweist;
eine Trennwand (130), die den inneren Raum unterteilt;
mehrere Wärmetauscher (200, 210, 220), die an einer Seite der Trennwand (130) angeordnet sind, um einen Wärmeaustausch zwischen einer durch die Wärmetauscher (200, 210, 220) strömenden Umluft und einer von außen einströmenden Außenluft zu ermöglichen;
ein Adsorptionselement (180), das an einer Seite der Trennwand (130) vorgesehen ist, um in der Luft enthaltene Feuchtigkeit zu adsorbieren, während es mit geringer Geschwindigkeit rotiert;
und
eine Heizungsanordnung (170), die an einer Seite des Adsorptionselements (180) angeordnet ist, um die durch die Wärmetauscher (200,

210, 220) strömende Umluft zu erwärmen;
dadurch gekennzeichnet, dass der Luftentfeuchter ferner Folgendes aufweist:

eine Hochtemperaturleitung (178), die an einer Seite der Heizungsanordnung (170) vorgesehen ist, um einen Teil der Außenluft, die durch das Adsorptionselement (180) hindurchgeströmt ist, zu einer Innenseite der Heizungsanordnung (170) zu leiten, wobei sowohl der durch die Hochtemperaturleitung (178) eingeleitete Teil der Außenluft, als auch durch die mehreren Wärmetauscher (200, 210, 220) geströmte Umluft in die Heizungsanordnung (170) eingeleitet und darin gemischt werden.

2. Luftentfeuchter nach Anspruch 1, der ferner eine obere Platte (120) aufweist, die so installiert ist, dass an einer oberen Oberfläche des Grundgehäuses (110) ein separater Raum gebildet wird, durch den eine einem Wärmeaustausch unterzogene Luft ausströmt.

3. Luftentfeuchter nach Anspruch 1, worin die mehreren Wärmetauscher (200, 210, 220) Folgendes aufweisen:

einen seitlichen Wärmetauscher (220), der an einer lateralen Seite der Trennwand (130) installiert ist;
einen inneren Wärmetauscher (200), der an einer Seite der Trennwand (130) installiert ist; und
einen vorderen Wärmetauscher (210), der an einer Vorderseite des inneren Wärmetauschers (200) installiert ist.

4. Luftentfeuchter nach Anspruch 1, der ferner eine Regenerierungsanordnung (160) aufweist, die in dem inneren Raum zum Umwälzen der Umluft vorgesehen ist.

5. Luftentfeuchter nach Anspruch 1, worin einer der mehreren Wärmetauscher (200, 210, 220) zum anfänglichen Wärmeaustausch mit der von außen zuströmenden Luft an einer mit dem Lufteinlass (128) in Kontakt stehenden Position angeordnet ist.

6. Luftentfeuchter nach Anspruch 1, der ferner eine Kondensatwanne (250) aufweist, die an einer Seite der Trennwand (130) zum Auffangen von Kondenswasser angeordnet ist, das beim Wärmeaustausch zwischen Umluft und Außenluft erzeugt wird.

7. Luftentfeuchter nach Anspruch 1, worin die mehreren Wärmetauscher (200, 210, 220) ein Wasserleitungselement (206, 216, 222', 224', 226') aufweisen, das passend zu einem Aufnahmeloch der an einer Seite der Trennwand (130) ausgebildeten Kondensatwanne (250) angebunden ist.

8. Luftentfeuchter nach Anspruch 1, worin einer der mehreren Wärmetauscher (200, 210, 220) an einer mit dem Lufteinlass (128) in Kontakt stehenden Position angeordnet ist, wobei erste, zweite und dritte Wärmetauschereinheiten (222, 224,226), durch die Außenluft nacheinander zirkuliert, vorgesehen sind.

9. Luftentfeuchter nach Anspruch 1, worin auf einer Seite der Hochtemperaturleitung (178) ein Hochtemperatureinlass (178') ausgebildet ist, um durch das Adsorptionselement (180) hindurchgeströmte Luft zu einer Innenseite des Luftentfeuchters zu führen, und am anderen Ende der Hochtemperaturleitung (178) ein Hochtemperaturauslass (178") ausgebildet ist, um Luft von einem Inneren der Hochtemperaturleitung (178) zur Heizungsanordnung (170) zu leiten.

10. Luftentfeuchter nach Anspruch 9, worin der Hochtemperatureinlass (178') an einem unteren Ende der Heizungsanordnung (170) und der Hochtemperaturauslass (178") an einem oberen Ende der Heizungsanordnung (170) angeordnet ist.

11. Luftentfeuchter nach Anspruch 1, worin die Hochtemperaturleitung (178) eine sich zu einer Seite vergrößernde Breite aufweist.

12. Luftentfeuchter nach Anspruch 1, worin innerhalb der Hochtemperaturleitung (178) ein Hochtemperaturgebläse (178a) zum Umwälzen von Luft vorgesehen ist.

Revendications

1. Déshumidificateur comprenant :

un boîtier de corps principal (110) ayant un espace intérieur et ayant une entrée d'air extérieur (128) formée sur un côté ;
une barrière (130) divisant l'espace intérieur ;
une pluralité d'échangeurs de chaleur (200, 210, 220) disposés sur un côté de la barrière (130) pour permettre l'échange de chaleur entre l'air circulant qui circule à travers les échangeurs de chaleur (200, 210, 220) et l'air extérieur qui circule de l'extérieur ;
un élément d'adsorption (180) prévu sur un côté de la barrière (130) pour adsorber l'humidité contenue dans l'air tout en tournant à faible vitesse ; et
un ensemble de chauffage (170) prévu sur un côté de l'élément d'adsorption (180) pour chauffer l'air circulant qui circule à travers les échan-

geurs de chaleur (200, 210, 220) ;
caractérisé en ce que le déshumidificateur comprend en outre :

un conduit à haute température (178) prévu sur un côté de l'ensemble de chauffage (170) pour guider une partie de l'air extérieur qui a traversé l'élément d'adsorption (180) à l'intérieur de l'ensemble de chauffage (170),
où la partie de l'air extérieur introduit à travers le conduit à haute température (178) ainsi que l'air circulant qui a traversé la pluralité d'échangeurs de chaleur (200, 210, 220) sont introduits dans l'ensemble de chauffage (170) et mélangés dans ce dernier.

2. Déshumidificateur selon la revendication 1, comprenant en outre un panneau supérieur (120) installé de sorte qu'un espace séparé, à travers lequel l'air ayant subi un échange de chaleur est évacué, soit formé sur une surface supérieure du boîtier de corps principal (110).

3. Déshumidificateur selon la revendication 1, dans lequel la pluralité d'échangeurs de chaleur (200, 210, 220) comprennent :

un échangeur de chaleur latéral (220) installé sur un côté latéral de la barrière (130) ;
un échangeur de chaleur interne (200) installé sur un côté de la barrière (130) ; et
un échangeur de chaleur avant (210) installé sur un côté avant de l'échangeur de chaleur interne (200).

4. Déshumidificateur selon la revendication 1, comprenant en outre un ensemble de récupération (160) prévu dans l'espace intérieur pour forcer la circulation de l'air circulant.

5. Déshumidificateur selon la revendication 1, dans lequel l'un de la pluralité d'échangeurs de chaleur (200, 210, 220) est disposé à une position correspondant à l'entrée d'air (128) pour échanger principalement de la chaleur avec l'air qui circule de l'extérieur.

6. Déshumidificateur selon la revendication 1, comprenant en outre un plateau de récupération (250) prévu sur un côté de la barrière (130) pour collecter l'eau condensée générée lorsque l'air circulant échange de la chaleur avec l'air extérieur.

7. Déshumidificateur selon la revendication 1, dans lequel la pluralité d'échangeurs de chaleur (200, 210, 220) comprennent un élément de guidage d'eau (206, 216, 222', 224', 226') couplé de manière à correspondre à un trou de réception du plateau de récupération (250) formé sur un côté de la barrière (130).

8. Déshumidificateur selon la revendication 1, dans lequel l'un de la pluralité d'échangeurs de chaleur (200, 210, 220) est disposé à une position correspondant à l'entrée d'air (128), et des première, deuxième, et troisième unités d'échange de chaleur (222, 224, 226), à travers lesquelles l'air extérieur circule successivement, sont prévues.

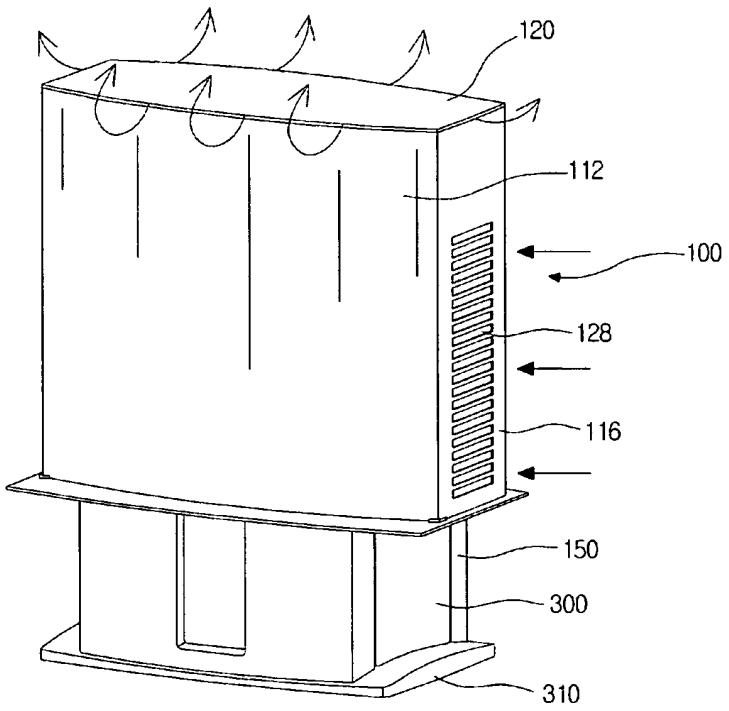
9. Déshumidificateur selon la revendication 1, dans lequel une entrée haute température (178') destinée à guider l'air qui a traversé l'élément d'adsorption (180) à l'intérieur du déshumidificateur est formée au niveau d'une extrémité du conduit à haute température (178), et une sortie haute température (178") destinée à guider l'air, à l'intérieur du conduit à haute température (178), à l'ensemble de chauffage (170) est formée au niveau de l'autre extrémité du conduit à haute température (178).

10. Déshumidificateur selon la revendication 9, dans lequel l'entrée haute température (178') est située sur une extrémité inférieure de l'ensemble de chauffage (170), et la sortie haute température (178") est située au niveau d'une extrémité supérieure de l'ensemble de chauffage (170).

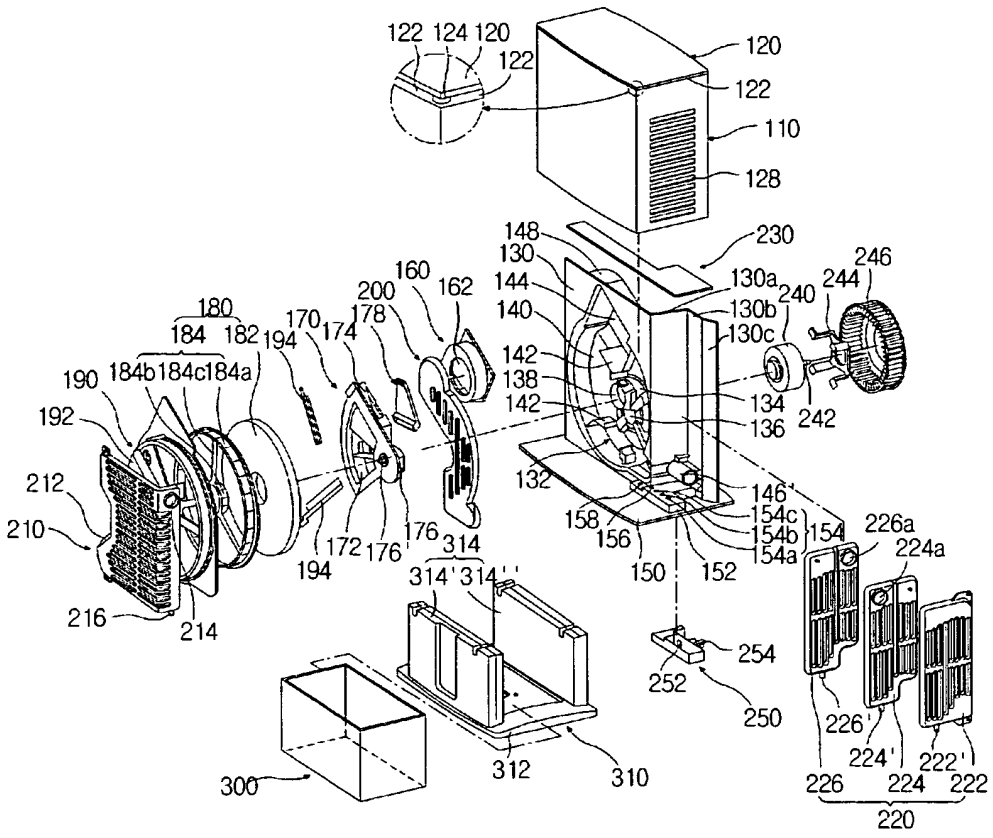
11. Déshumidificateur selon la revendication 1, dans lequel le conduit à haute température (178) présente une largeur qui augmente vers un côté.

12. Déshumidificateur selon la revendication 1, dans lequel un ventilateur à haute température (178a) permettant de circuler de manière forcée l'air, est prévu à l'intérieur du conduit à haute température (178).

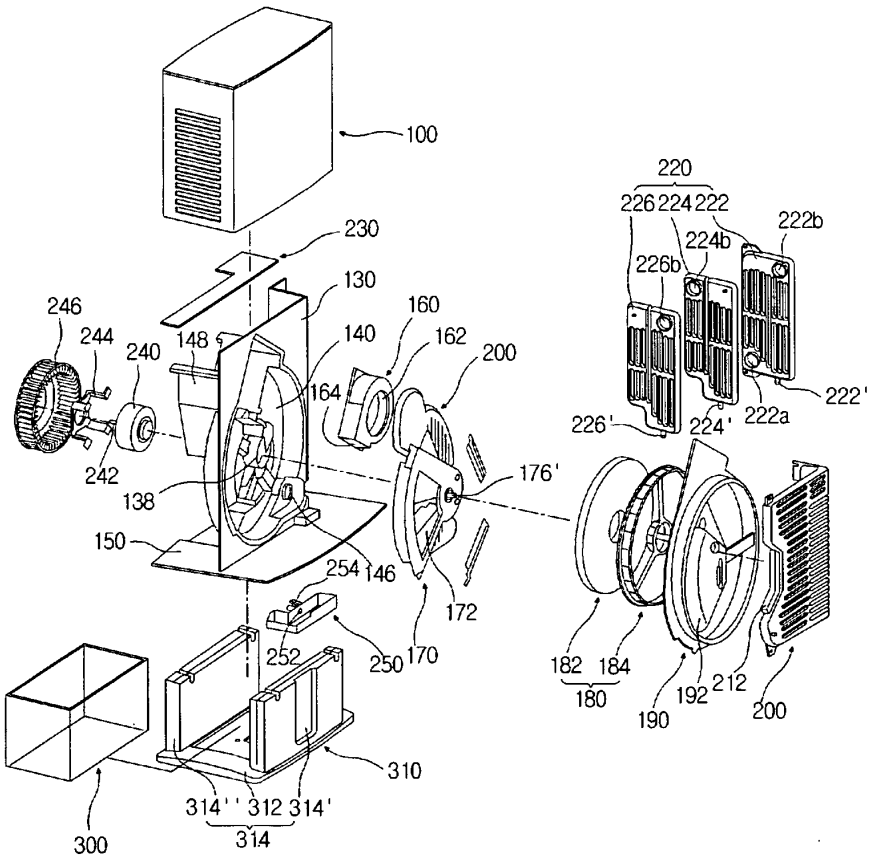
[Fig. 1]


120
112
100
128
116
150
300
310

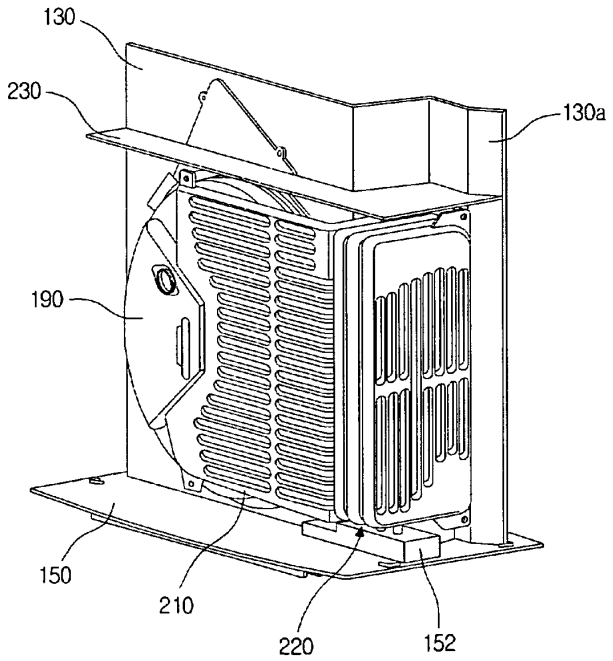
[Fig. 2]


122 124 120
122
120
122
110
128
148
130
230
246
144
130a
244
140
130b
240
130c
160
162
200
178
180
184
182
194
170
174
142
138
142
134
136
242
190
184b
184c
184a
192
212
210
216
214
132
146'
154c
154b
154a
154
226a
224a
158
156
150
152
172
176
176'
314
314'
314''
194
254
252
250
312
310
300
226'
224'
222'
226
224
222
220

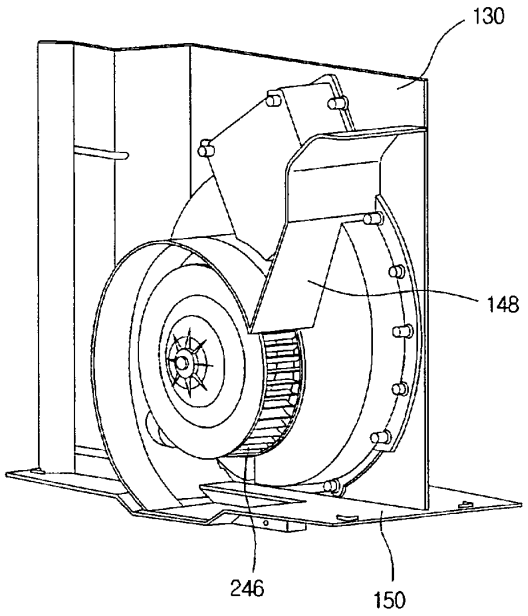
[Fig. 3]


100
230
130
246
244
240
148
140
160
162
200
164
242
138
176'
150
254
146
172
252
250
170
220
226 224 222
222b
224b
226b
222'
226'
224'
222a
182
184
180
192
212
190
200
310
314''
312
314'
314
300

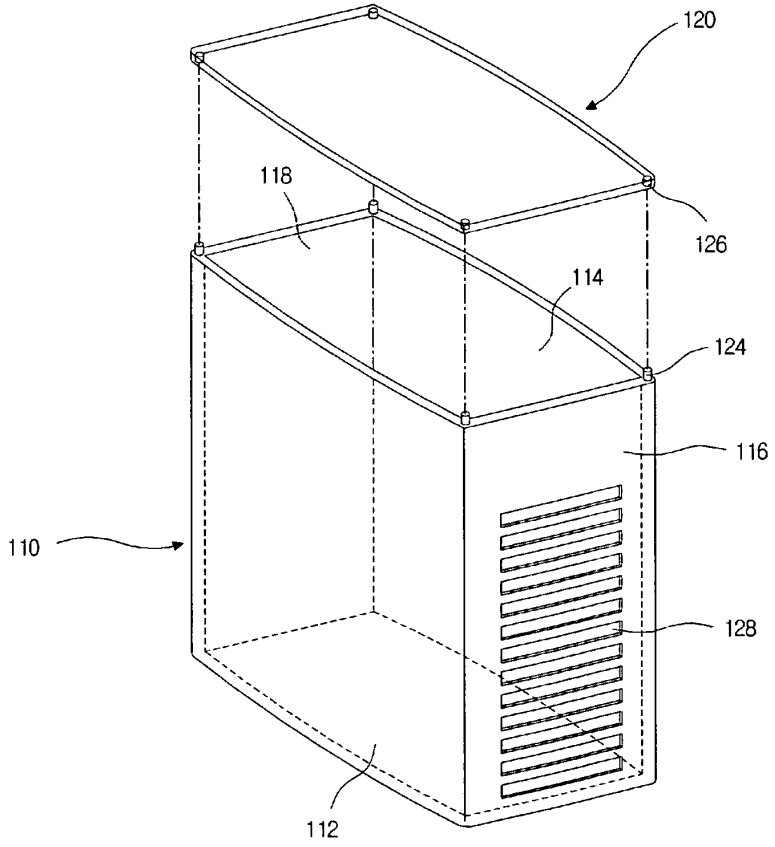
[Fig. 4]


130
230
130a
190
150
210
220
152

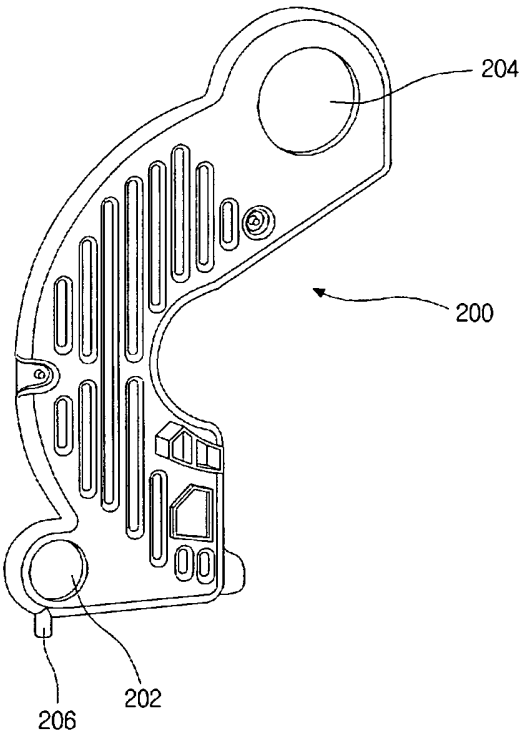
[Fig. 5]



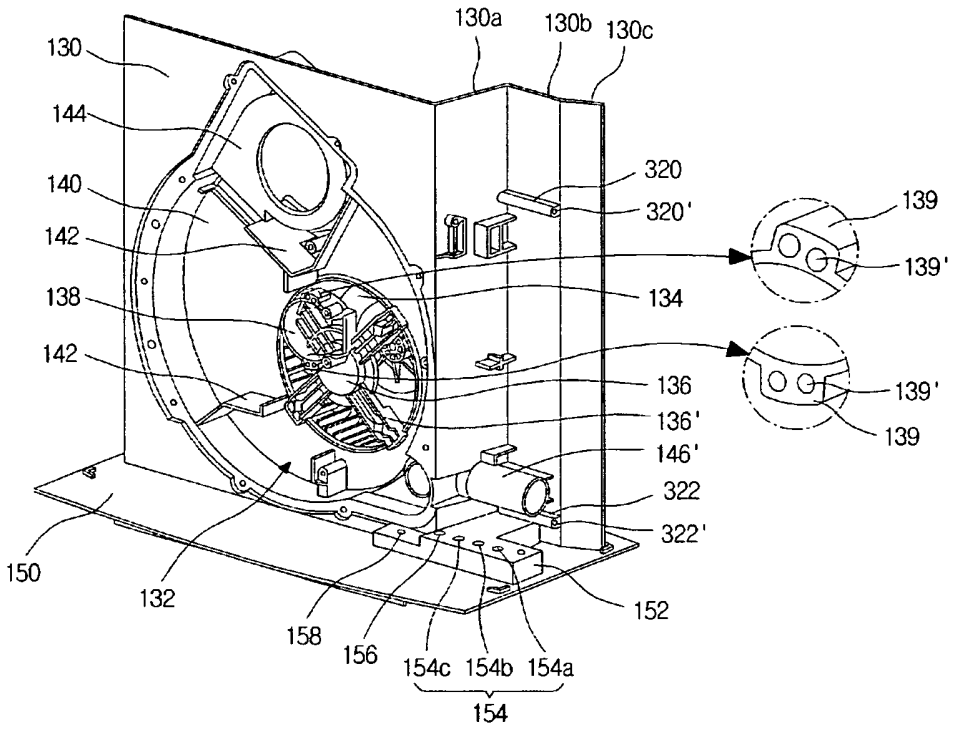
[Fig. 6]



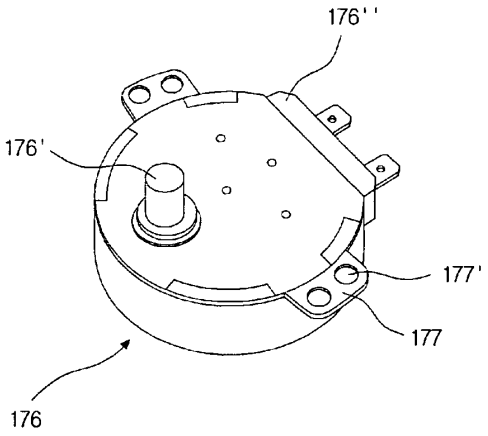
[Fig. 7]


204
200
202
206

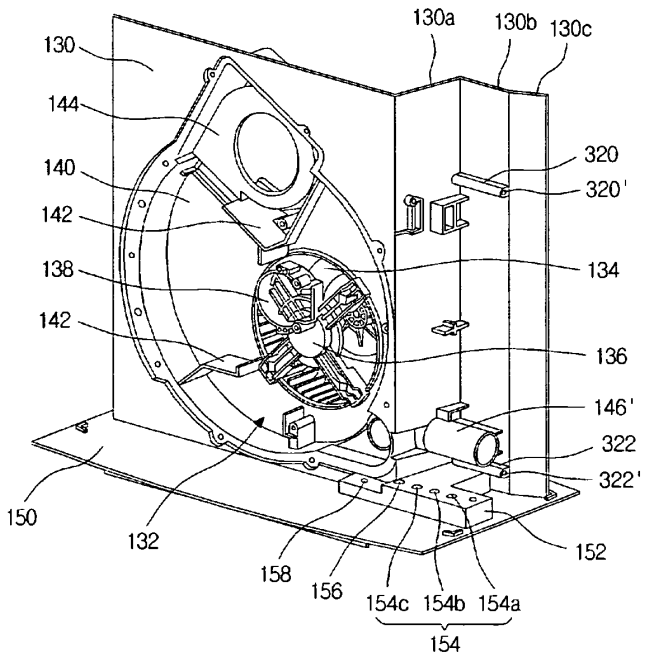
[Fig. 8]


130a
130b
130c
130
144
140
142
138
142
320
320'
139
139'
134
136
136'
146'
322
322'
139'
139
150
132
158
156
154c
154b
154a
154
152

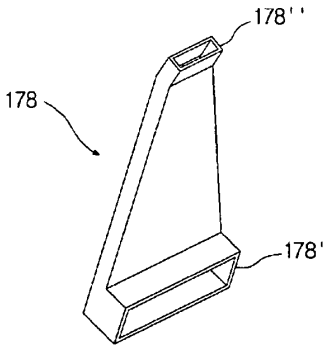
[Fig. 9]



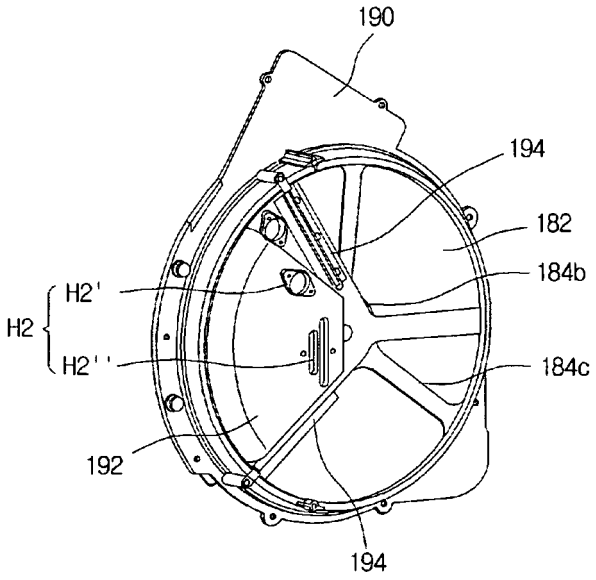
[Fig. 10]



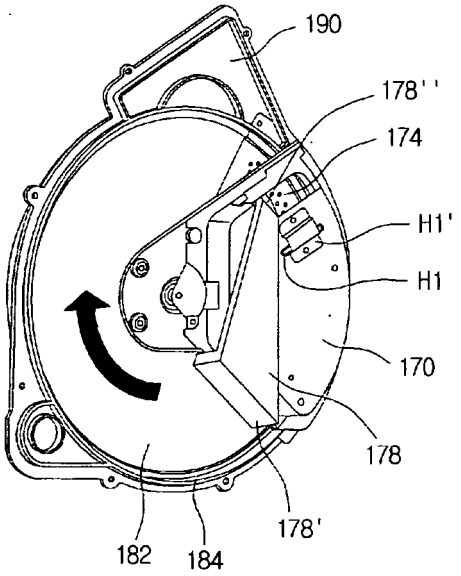
[Fig. 11]



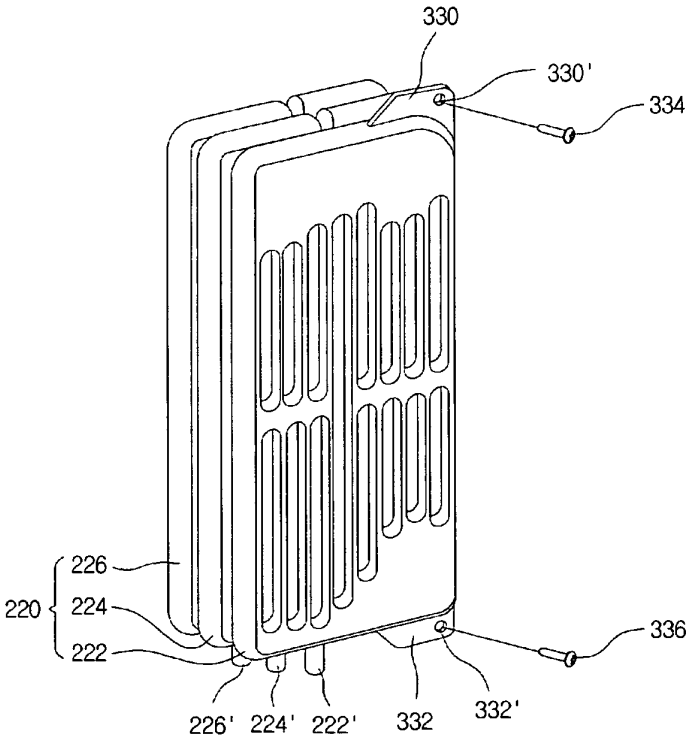
[Fig. 12]


190
194
182
184b
H2
H2'
H2''
184c
192
194

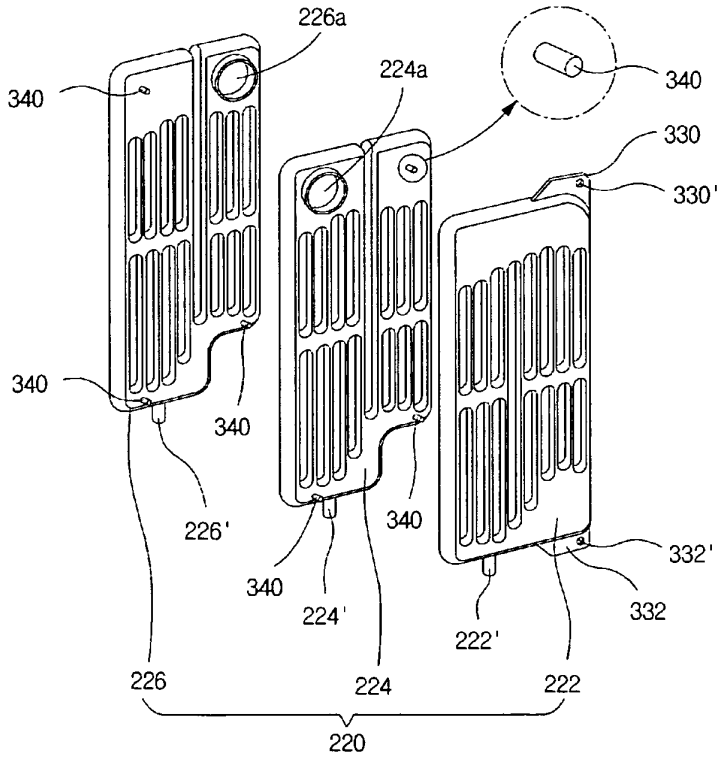
[Fig. 13]


190
178''
174
H1'
H1
170
178
178'
182
184

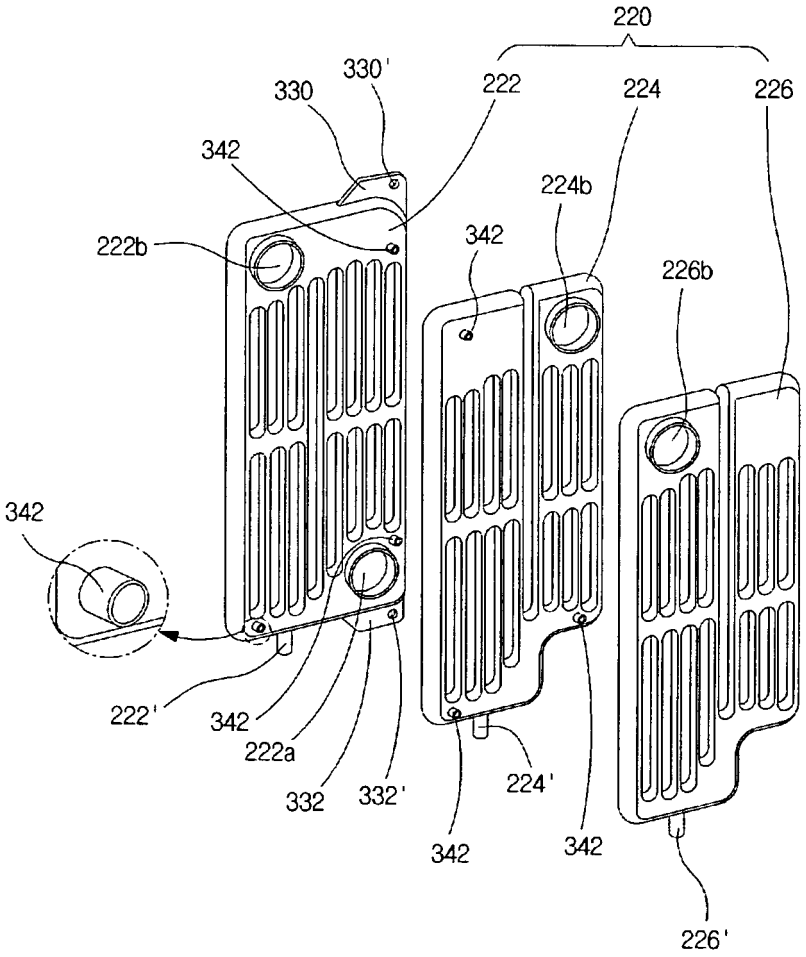
[Fig. 14]


330
330'
334
226
220
224
222
336
226'
224'
222'
332
332'

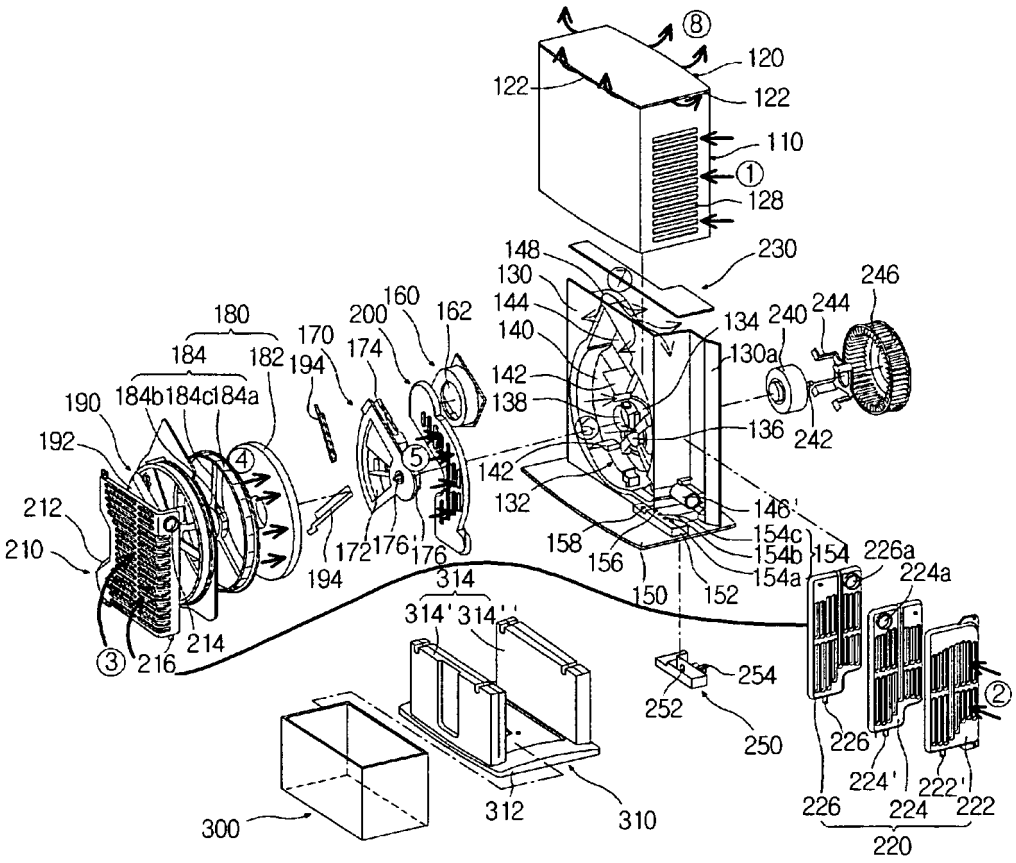
[Fig. 15]


226a
224a
340
340
330
330'
340
340
226'
340
340
224'
332'
332
222'
226
224
222
220

[Fig. 16]


220
330'
330
222
224
226
342
224b
222b
342
226b
342
222'
342
222a
332
332'
224'
342
342
226'

[Fig. 17]


⑧
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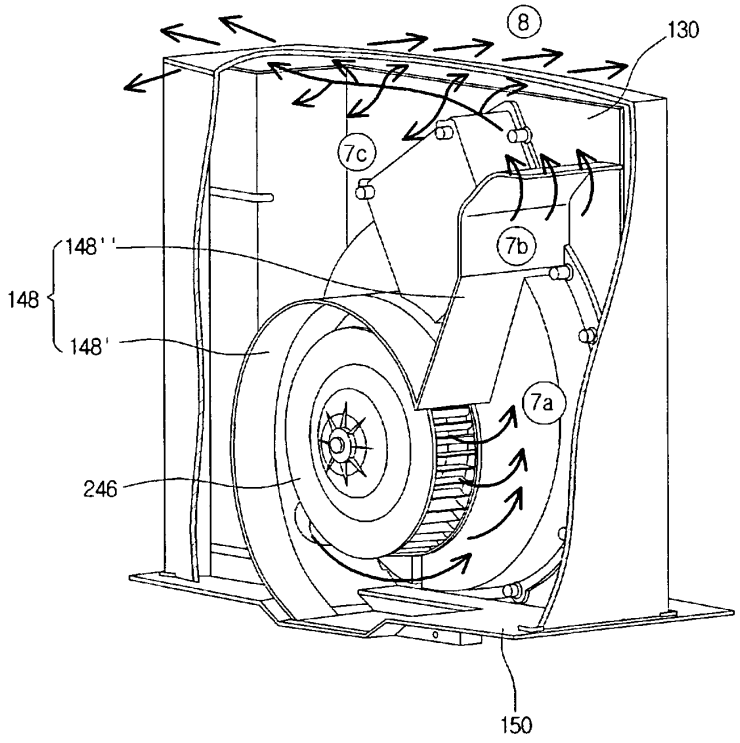
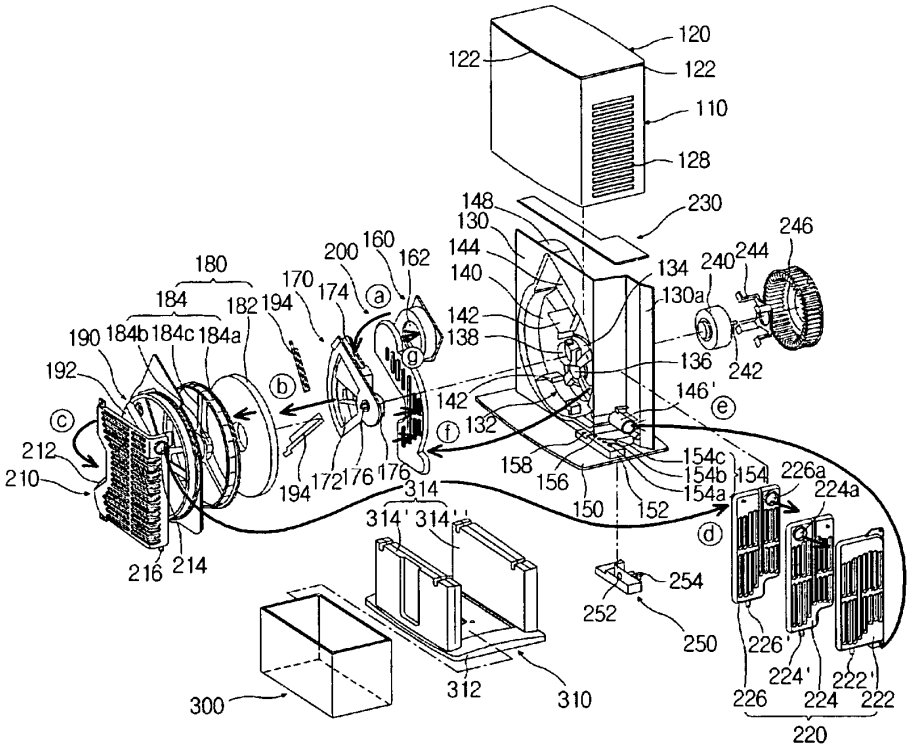
122
122
110
①
128
148
130
144
140
142
138
132
158
156
150
152
154c
154b
154
154a
230
246
244
240
134
130a
136
242
142
146'
226a
224a
180
184
182
170
194
174
200
160
162
190
184b
184c
184a
192
212
210
214
216
③
④
⑤
⑦
172
176'
176
194
314
314'
314''
254
252
250
226
224'
222'
226
224
222
220
300
312
310
②

[Fig. 18]


8
130
7c
7b
148''
148
148'
7a
246
150

[Fig. 19]


120
122
122
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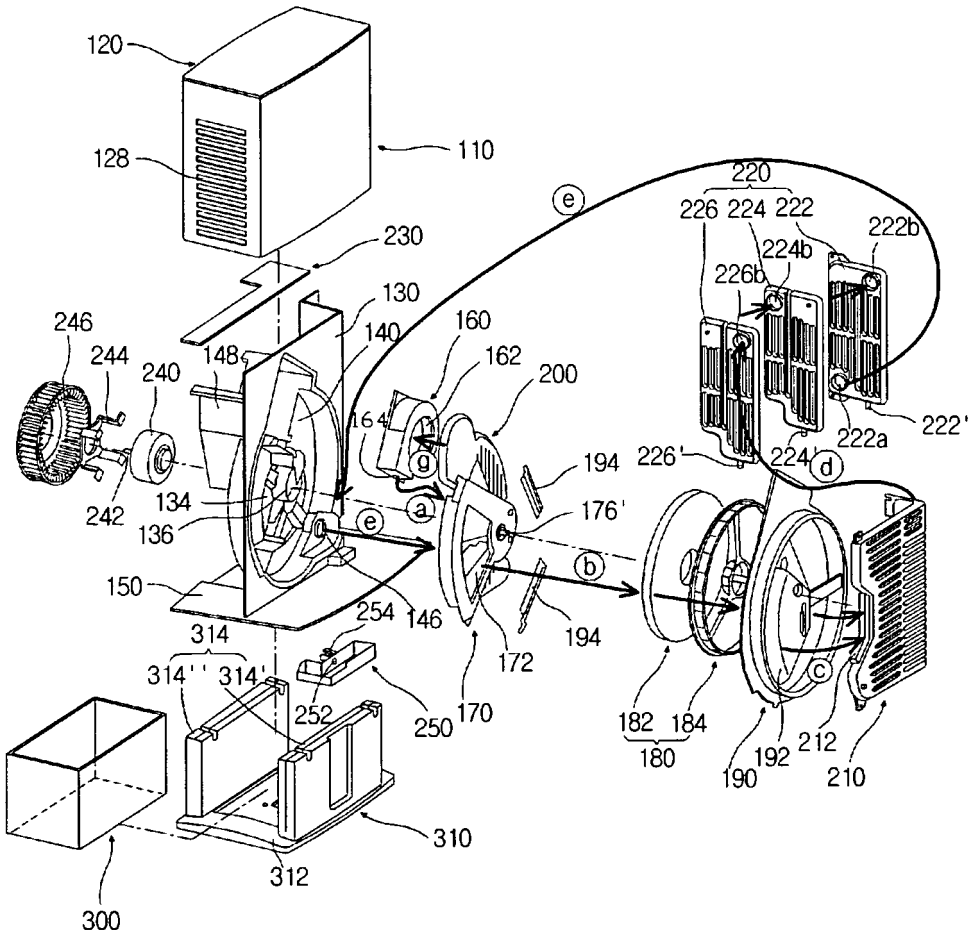
128
148
230
130
246
144
134
240
244
140
130a
180
200
160
162
170
174
184
182
194
142
138
190
184b
184c
184a
136
242
192
146'
142
132
212
210
158
154c
154b
154
226a
224a
154a
194
172
176
176
314
156
150
152
314'
314''
254
252
250
216
214
226'
224'
222'
300
312
310
226
224
222
220

[Fig. 20]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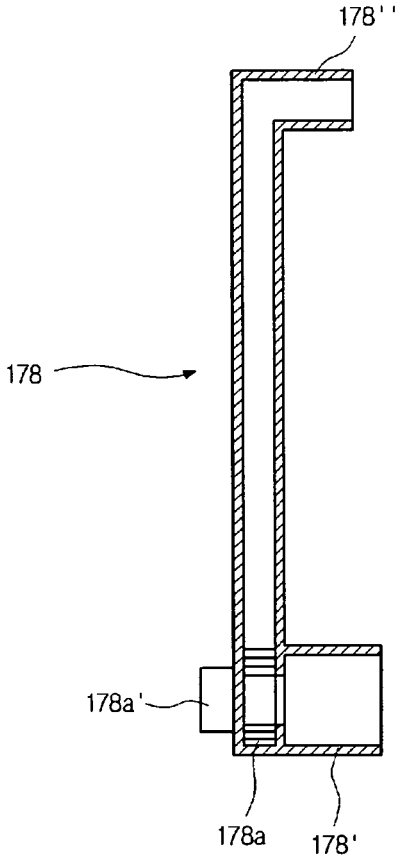
128
110
230
130
140
148
246
244
240
242
134
136
150
314
314''
314'
254
252
250
146
160
162
164
200
194
176'
172
170
194
220
226 224 222
222b
224b
226b
222'
222a
226'
224'
182 184
180
190
192
212
210
310
312
300

[Fig. 21]



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Patent documents cited in the description

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