(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 304 530 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
23.04.2003 Bulletin 2003/17

(21) Application number: **01948036.7**

(22) Date of filing: **17.07.2001**

(51) Int Cl.[7]: **F24F 6/00**

(86) International application number:
PCT/JP01/06154

(87) International publication number:
WO 02/008672 (31.01.2002 Gazette 2002/05)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

(30) Priority: **25.07.2000 JP 2000223717**

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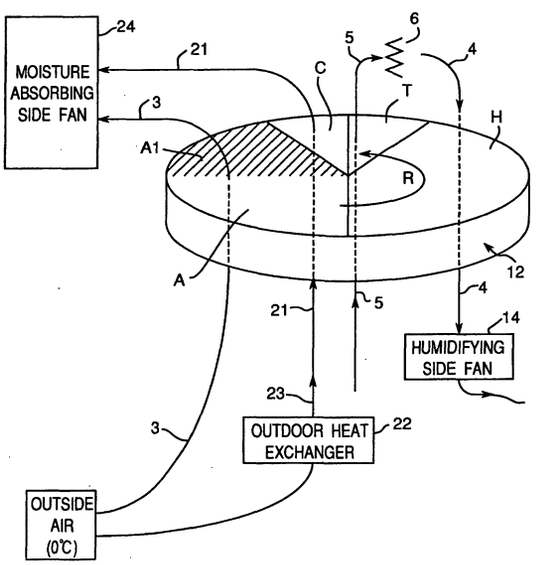
(54) HUMIDIFIER REQUIRING NO FEED WATER

(57) There is provided a humidifier without water supply, which enables sufficient cooling of a humidifying rotor and implements sufficient humidification even in the low-temperature and low-humid winter season. Into a cooling passage (21) running through a cooling area C, there flows cooling air cooled by passing an outdoor heat exchanger (22) of an air conditioner, by which a humidifying rotor (12) is cooled to extremely low temperature in the cooling area C. Cooling air is obtained by taking heat of evaporation out of the outside air with the outdoor heat exchanger (22) of an air conditioner, which makes it .possible to obtain the cooling air without increased costs and energy. Since the humidifying rotor (12) cooled in the cooling area C is cooled with the air with extremely low temperature in the cooling area C, the humidifying rotor (12) can sufficiently collect moisture from the outside air even in the winter season when the outside air is in low temperature. A portion of the humidifying rotor (12) that sufficiently collected moisture discharges the moisture to high-temperature heated air in a humidifying area.

Fig.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a humidifier without water supply, which collects water in the air and humidifies, for example, the air fed to the inside of a room.

BACKGROUND ART

[0002] As this kind of humidifier without water supply, there has been one that shown in Fig. 3. In the humidifier without water supply, a disc-shape humidifying rotor 2 composed of an adsorbent such as silica gel and zeolite is rotated as shown by an arrow R by an unshown motor, so that each portion of the humidifying rotor 2 passes in sequence a moisture absorbing area A, a humidifying area H, and a heat recovering area T. A moisture absorbing passage 3 runs across the moisture absorbing area A, a humidifying passage 4 runs across the humidifying area H, and a heat recovering passage 5 runs across the heat recovering area T.

[0003] The humidifying rotor 2 performs humidification by absorbing moisture from the air that passes the moisture absorbing passage 3 in the moisture absorbing area A, and discharging moisture to high-temperature air in the humidifying passage 4, that is heated by a heater 6, in the humidifying area H. The air passing the heat recovering passage 5 recovers heat in the heat recovering area T, so that each portion of the humidifying rotor 2 is cooled before reaching the moisture absorbing area A, which enables the humidifying rotor 2 to sufficiently adsorb moisture in the moisture absorbing area A and reduces a load on the heater 6.

[0004] The humidifier without water supply has an advantage of disusing water supply equipment because the humidifying rotor 2 adsorbs moisture from the air in the moisture absorbing passage 3 and discharging the moisture to the air in the humidifying passage 4.

[0005] As shown in Figs. 3 and 4, the conventional humidifier without water supply absorbs moisture in the moisture absorbing area A after each portion of the humidifying rotor 2 is cooled in the heat recovering area T. Because the humidifying rotor 2 has considerably large heat capacity, the humidifying rotor 2 may go into the moisture absorbing area A before undergoing full cooling. This decreases relative humidity of the air in the vicinity of the surface of the humidifying rotor 2, and causes a problem that sufficient humidification is not provided in the low-temperature and low-humid winter season when a moisture content is discontented and humidification is most required.

DISCLOSURE OF THE INVENTION

[0006] Accordingly, it is an object of the present invention to provide a humidifier without water supply, which enables sufficient cooling of a humidifying rotor and implements sufficient humidification even in the low-temperature and low-humid winter season.

[0007] In order to accomplish the above object, a humidifier without water supply in the present invention comprises:

> a humidifying rotor; a moisture absorbing passage running through the humidifying rotor; a humidifying passage running through the humidifying rotor; and heating means for heating air in the humidifying passage, wherein the humidifying rotor absorbs moisture from air in the moisture absorbing passage while humidifying heated air in the humidifying passage, and further comprises:
>
> > a cooling passage for flowing cooling air for cooling a portion of the humidifying rotor before the portion encounters the moisture absorbing passage.

[0008] In the above structured humidifier without water supply, the humidifying rotor is sufficiently cooled by cooling air flowing in the cooling passage before it encounters the humidifying passage. Consequently, relative humidity of the air in the vicinity of the surface of the humidifying rotor becomes high, which enables sufficient adsorption of moisture from the air running in the moisture absorbing passage, thereby implementing sufficient humidification of the air in the humidifying passage.

[0009] The humidifier without water supply in one embodiment comprises a heat recovering passage which locates upstream of the heating means in the humidifying passage and runs through the humidifying rotor, wherein

the cooling passage is disposed in between the heat recovering passage and the moisture absorbing passage.

[0010] In the above embodiment, the air flowing in the heat recovering passage recovers heat, and the cooled humidifying rotor is further cooled by cooling air flowing in the cooling passage. In this way, the humidifying rotor is cooled by the air flowing in the heat recovering passage, and then cooled by the cooling air flowing in the cooling passage, which enables effective cooling of the humidifying rotor. Further, heat is recovered from the humidifying rotor to the air in the heat recovering passage before the humidifying rotor is cooled by cooling air in the cooling passage, which enables effective heat recovery. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air running in the moisture absorbing passage, and thereby implements sufficient humidification of the air in the humidifying passage.

[0011] The humidifier without water supply in one embodiment comprises a passage for leading cooling air passed through an evaporator to the cooling passage.

[0012] According to the above embodiment, the air cooled by the evaporator travels through the passage and the cooling passage to the humidifying rotor, and cools the humidifying rotor. In this way, obtaining cooling air with use of an evaporator of an air conditioner enables cooling of the humidifying rotor without increased costs and energy. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air running through the moisture absorbing passage, and thereby implements sufficient, humidification of the air in the humidifying passage without increased costs and energy.

[0013] One embodiment comprises a humidifying rotor, each portion of which passes in sequence a moisture absorbing area, a humidifying area, and a cooling area.

[0014] According to the above embodiment, the cooling area is disposed between the humidifying area and the moisture absorbing area. Consequently, each portion of the humidifying rotor heated in the humidifying area is sufficiently cooled by cooling air in the cooling area before each portion reaches the moisture absorbing area. Therefore, in each portion of the humidifying rotor, relative humidity of the air in the vicinity of the surface becomes high, which enables sufficient adsorption of moisture from the air in the moisture absorbing area, and implements sufficient humidification of the air in the humidifying area.

[0015] According to one embodiment, the heat recovering area is disposed between the humidifying area and the cooling area.

[0016] According to the above embodiment, the humidifying rotor cooled through heat recovery in the heat recovering area is further cooled by cooling air flowing in the cooling area. In this way, the humidifying rotor is cooled by the air flowing in the heat recovering area and then cooled by cooling air flowing in the cooling area, which enables effective cooling of the humidifying rotor. Further, heat is recovered from each portion of the humidifying rotor to the air in the heat recovering area before each portion of the humidifying rotor is cooled in the cooling area, which enables effective heat recovery. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air running through the moisture absorbing area, and thereby implements sufficient humidification of the air in the humidifying area.

[0017] The humidifier without water supply in one embodiment comprises a passage for leading cooling air passed through an evaporator to the cooling passage that runs through the cooling area.

[0018] According to the above embodiment, the air cooled by the evaporator travels through the passage and the cooling passage to the cooling area of the humidifying rotor, and cools the humidifying rotor. In this way, obtaining cooling air with use of an evaporator of an air conditioner enables cooling of the humidifying rotor without increased costs and energy. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air in the moisture absorbing area, and thereby implements sufficient humidification of the air in the humidifying passage without increased costs and energy.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a schematic view showing a humidifier without water supply in an embodiment of the present invention;

Fig. 2 is a plan view showing a humidifying rotor in the embodiment;

Fig. 3 is a schematic view showing a conventional humidifier without water supply; and

Fig. 4 is a plan view showing a humidifying rotor of the conventional humidifier without water supply.

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] Hereinbelow, the embodiments of the present invention will be described in detail with accompanied drawings.

[0021] As shown in Fig. 1, the humidifier without water supply has a disc-shape humidifying rotor 12. The humidifying rotor 12 is composed of an adsorbent such as silica gel, zeolite, and alumina formed, for example, in the shape of a honeycomb or a porous multiparticle. The humidifying rotor 12 is rotated around a central axis in the direction of an arrow R by an unshown motor. As the humidifying rotor 12 is rotated, each portion thereof passes in sequence a moisture absorbing area A, a humidifying area H, a heat recovering area T, and a cooling area C. The humidifying rotor 12 is housed in an unshown casing. The inside of the casing is partitioned by unshown partition plates so as to form a moisture absorbing passage 3 running across the moisture absorbing area A, a humidifying passage 4 running across the humidifying area H, a heat recovering passage 5 running across the heat recovering area T, and a cooling passage 21 running across the cooling area C. A section of the cooling passage 21 that encounters the humidifying rotor 12 is located between the heat recovering passage 5 and the moisture absorbing passage 3.

[0022] The humidifying passage 4 locates downstream of the heat recovering passage 5, and has a heater 6 as a heating means for further heating the air preheated in the heat recovering area T.

[0023] A humidifying side fan 14 is provided in a section of the humidifying passage 4 that is downstream from the humidifying rotor 12 for flowing the air as shown with an arrow to feed the air humidified with moisture taken in the humidifying area H to the inside of an unshown room.

[0024] A moisture absorbing side fan 24 is provided in a section of the moisture absorbing passage 3 that is downstream from the humidifying rotor 12 and in a sec-

tion of the cooling passage 21 that is downstream from the humidifying rotor 12 for sucking and flowing outside air with a temperature of, for example, 0°C as shown with an arrow. The outside air is sucked to the moisture absorbing passage 3, and when the outside air passes the moisture absorbing area A of the humidifying rotor 12, moisture thereof is adsorbed by the humidifying rotor 12.

[0025] To a section of the cooling passage 21 that is upstream to the humidifying rotor 12, there is connected a passage 23 for leading cooling air with a temperature of, for example, -3 to -5°C cooled by passing an outdoor heat exchanger 22 as the evaporator. Therefore, the humidifying rotor 12 cooled by heat recovery in the heat recovering area T is further cooled in the cooling area C to be in extremely low temperature. Accordingly, even if the outside air is in low temperature of, for example, 0°C, the humidifying rotor 12 is cooled to be in extremely low temperature of, for example, -3 to -5°C. Therefore, even in the winter season when moisture adsorption is difficult, relative humidity of the air in the vicinity of the surface of the humidifying rotor 12 is high, and therefore sufficient moisture adsorption is implemented in the moisture absorbing area A.

[0026] In the above structured humidifier without water supply, the outside air sucked by the humidifying side fan 14 to the heat recovering passage 5 is first preheated by utilizing the heat recovered from the humidifying rotor 12 in the heat recovering area T, and then the outside air is heated by the heater 6 in the humidifying passage 4. In this way, the air is preheated in the heat recovering area T and then heated by the heater 6, which makes it possible to provide high-temperature heated air with small energy. When passing the humidifying area H, the heated air is humidified with moisture evaporated from the humidifying rotor 12, and becomes humidified air, which is fed through the humidifying side fan 14 to the inside of an unshown room.

[0027] Since the humidifying rotor 12 is rotated in the direction of the arrow R, a portion of the humidifying rotor 12 located in the heat recovering area T reaches the cooling area C. Into the cooling passage 21 running across the cooling area C, there flows from the passage 23 cooling air cooled to -3 to -5°C by passing through the outdoor heat exchanger (evaporator) 22 of an air conditioner. This makes the humidifying rotor 12 cooled to an extremely low temperature in the cooling area C. In this way, cooling air is obtained by heat of evaporation taken from the outside air by the outdoor heat exchanger 22 of an air conditioner. Therefore, cooling air is obtained without increased costs and energy. The cooling air which cooled the humidifying rotor 12 in the cooling area C is sucked and discharged outside by the moisture absorbing side fan 24.

[0028] A portion of the humidifying rotor 12 cooled in the cooling area C then reaches the moisture absorbing area A. Into the moisture absorbing area A, outside air with a low temperature of approx. 0°C flows from the moisture absorbing passage 3. Since the humidifying rotor 12 is cooled in the cooling area C with the air in extremely low temperature of -3 to -5°C coming from the outdoor heat exchanger 22, relative humidity of the outside air in the vicinity of the surface of the humidifying rotor 12 becomes high, enabling sufficient collection of water from the outside air even in the winter season when the outside air is in low temperature and low humidity. Particularly, in an area A1 in the moisture absorbing area A that is close to the cooling area C, the humidifying rotor 12 is in the state of extremely low temperature of -3 to -5°C, which enables sufficient collection of moisture even if the outside air is in low temperature.

[0029] A portion of the humidifying rotor 12 that sufficiently collects moisture then reaches the humidifying area H, where the portion fully discharges moisture to high-temperature heated air. Thus-obtained humidified air is fed to the inside of a room through the humidifying side fan 14.

[0030] In the above embodiment, by taking heat of evaporation out of the outside air with the outdoor heat exchanger 22 of an air conditioner, there is obtained the cooling air with extremely low temperature, which cools the humidifying rotor 12 to an extremely low temperature. This enables the humidifying rotor 12 to sufficiently absorb moisture from the air running through the moisture absorbing area A, and to implement sufficient humidification of the air in the humidifying area H without increased costs and energy.

[0031] In the above embodiment, although the heat recovering area T and the heat recovering passage 5 are provided, they may be omitted.

[0032] The area proportion of the moisture absorbing area A, the humidifying area H, the heat recovering, area T, and the cooling area C is not limited to the proportion shown in Figs. 1 and 2, and may take various values depending on the situations.

[0033] In the above embodiment, although a heater is used as a heating means, a condenser may be used instead thereof.

[0034] As is clear from the above description, according to the present invention, there is provided a cooling passage for flowing cooling air that cools a portion of the humidifying rotor before the portion encounters the moisture absorbing passage. This enables sufficient cooling of the humidifying rotor before the humidifying rotor's encountering the moisture absorbing passage. Consequently, even in the winter season when temperature and humidity are low, relative humidity of the air in the vicinity of the surface of the humidifying rotor becomes high, thereby enabling sufficient adsorption of moisture from the outside air to the humidifying rotor, and implementing sufficient humidification of the air in the humidifying passage.

[0035] In the humidifier without water supply according to one embodiment, the humidifying rotor is cooled by the air flowing in the heat recovering passage, and then cooled by the cooling air flowing in the cooling pas-

sage, which enables effective cooling of the humidifying rotor. Further, heat is recovered from the humidifying rotor to the air in the heat recovering passage before the humidifying rotor is cooled by cooling air in the cooling passage, which enables effective heat recovery.

[0036] In the humidifier without water supply according to one embodiment, the air cooled by the evaporator travels through the passage and the cooling passage to the humidifying rotor, and cools the humidifying rotor, so that cooling air may be obtained for cooling the humidifying rotor without increased costs and energy. This enables sufficient adsorption of moisture from the air running through the moisture absorbing passage to the humidifying rotor, and thereby implements sufficient humidification of the air in the humidifying passage without increased costs and energy.

[0037] In the humidifier without water supply according to one embodiment, the cooling area is disposed between the humidifying area and the moisture absorbing area. Consequently, each portion of the humidifying rotor heated in the humidifying area is sufficiently cooled by cooling air in the cooling area before each portion reaches the moisture absorbing area. This enables sufficient adsorption of moisture from the air in the moisture absorbing area to the humidifying rotor, and implements sufficient humidification of the air in the humidifying area.

[0038] In the humidifier without water supply according to one embodiment, the humidifying rotor cooled through heat recovery in the heat recovering area is further cooled by cooling air flowing in the cooling area, which implements effective cooling of the humidifying rotor. Further, heat is recovered from each portion of the humidifying rotor to the air in the heat recovering area before each portion of the humidifying rotor is cooled in the cooling area, which implements effective heat recovery. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air running through the moisture absorbing area, and thereby implements sufficient humidification of the air in the humidifying area.

[0039] In the humidifier without water supply according to one embodiment, the air cooled by the evaporator is led to the cooling area through the passage and the cooling passage for cooling the humidifying rotor, which makes it possible to obtain cooling air for cooling the humidifying rotor without increased costs and energy. The humidifying rotor, therefore, enables sufficient adsorption of moisture from the air in the moisture absorbing area, and thereby implements sufficient humidification of the air in the humidifying passage without increased costs and energy.

Claims

1. A humidifier without water supply comprising:

a humidifying rotor (12); a moisture absorbing passage (3) running through the humidifying rotor (12); a humidifying passage (4) running through the humidifying rotor (12); and heating means (6) for heating air in the humidifying passage (4), wherein the humidifying rotor (12) absorbs moisture from air in the moisture absorbing passage (3) while humidifying heated air in the humidifying passage (4), and further comprising:

a cooling passage (21) for flowing cooling air for cooling a portion of the humidifying rotor (12) before the portion encounters the moisture absorbing passage (3).

2. The humidifier without water supply as defined in Claim 1, further comprising a heat recovering passage (5) which locates upstream of the heating means (6) in the humidifying passage (4) and runs through the humidifying rotor (12), wherein

the cooling passage (21) is disposed in between the heat recovering passage (5) and the moisture absorbing passage (3).

3. The humidifier without water supply as defined in Claim 1 or 2, further comprising a passage (23) for leading cooling air passed through an evaporator (22) to the cooling passage (3).

4. A humidifier without water supply, comprising a humidifying rotor (12), each portion of which passes in sequence a moisture absorbing area (A), a humidifying area (H), and a cooling area (C).

5. The humidifier without water supply as defined in Claim 4, wherein the heat recovering area (T) is disposed between the humidifying area (H) and the cooling area (C).

6. The humidifier without water supply as defined in Claim 4 or 5, further comprising a passage (23) for leading cooling air passed through an evaporator (22) to the cooling passage (21) that runs through the cooling area (C).

Fig.1

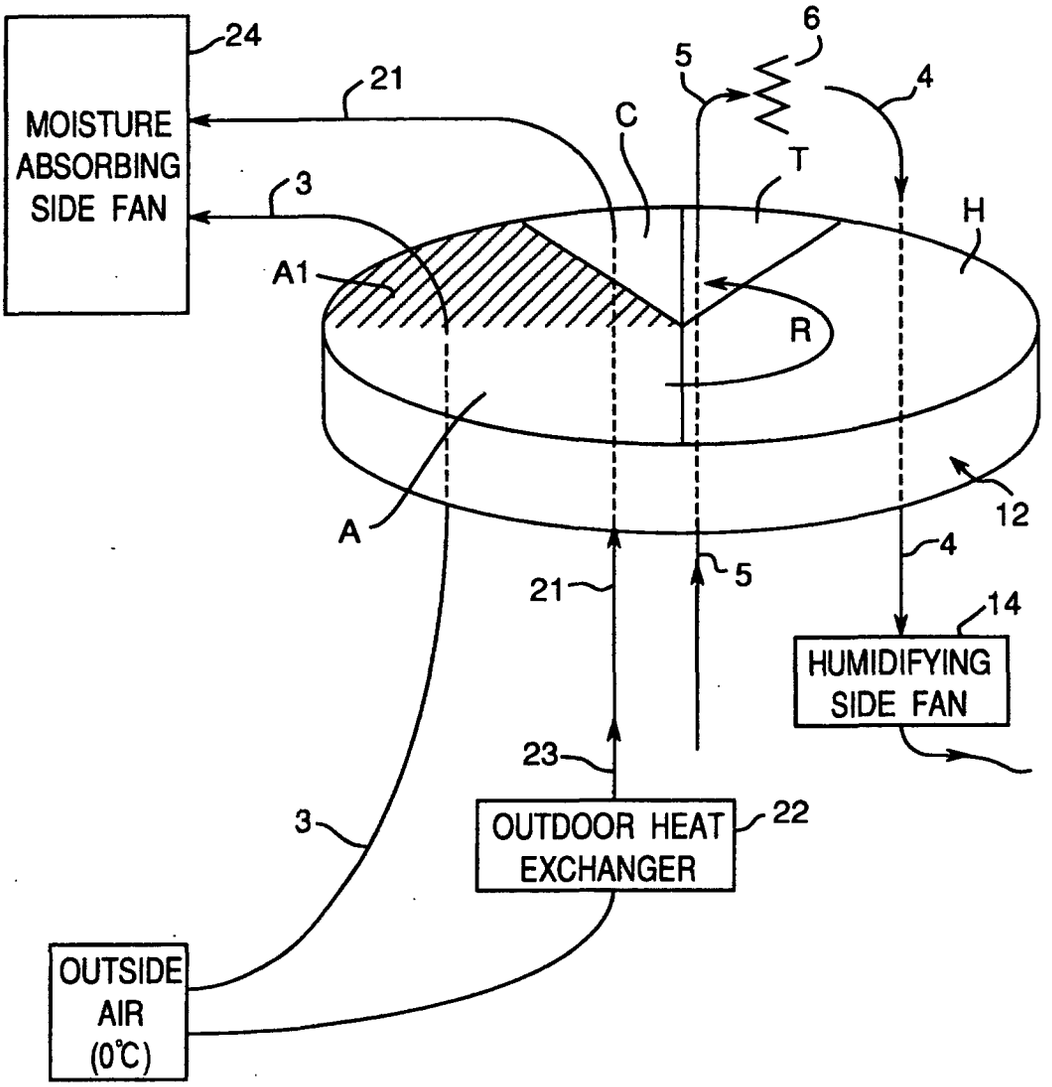

MOISTURE ABSORBING SIDE FAN
24
21
3
A1
A
C
5
6
T
4
H
R
12
21
5
4
14
HUMIDIFYING SIDE FAN
23
3
OUTDOOR HEAT EXCHANGER
22
OUTSIDE AIR (0℃)

Fig.2

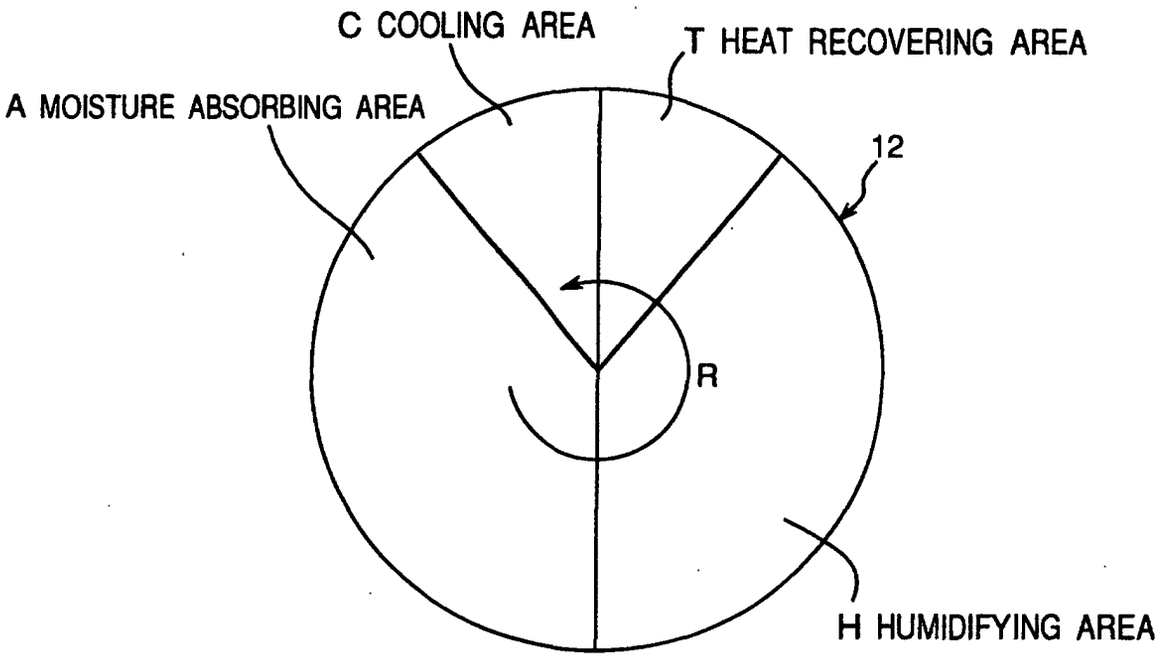

C COOLING AREA
T HEAT RECOVERING AREA
A MOISTURE ABSORBING AREA
12
R
H HUMIDIFYING AREA

Fig.3

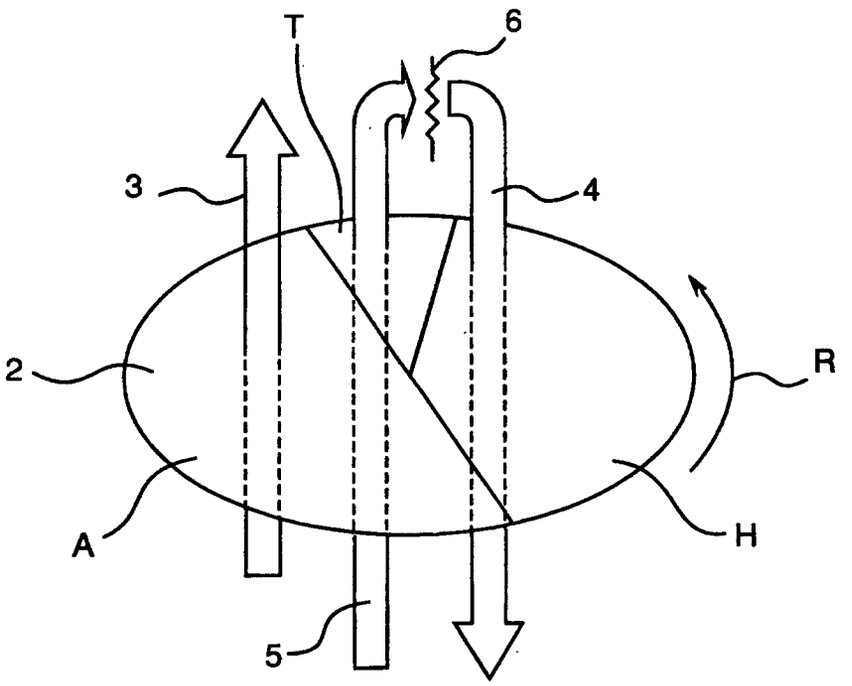
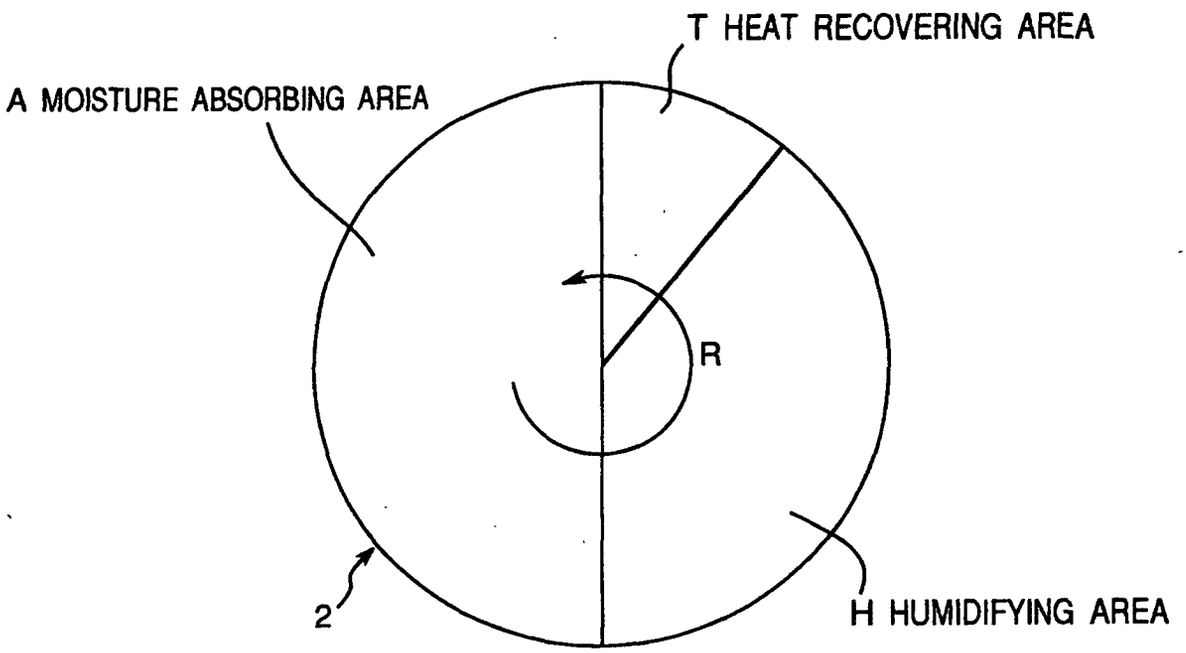


Fig.4


T HEAT RECOVERING AREA
A MOISTURE ABSORBING AREA
R
2
H HUMIDIFYING AREA

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/06154

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

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] F24F6/00, B01D53/26, B01D53/06

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-128655 A (Matsushita Electric Ind. Co., Ltd.), 18 May, 1999 (18.05.99), Full text; Figs. 5, 6 (Family: none)	1-6
A	EP 0939283 A2 (Sanyo Electric Co., Ltd.), 01 September, 1999 (01.09.99), Full text; all drawings & US 6099623 A & JP 11-241842 A	1-6
A	JP 10-332174 A (Mitsubishi Electric Corporation), 15 December, 1998 (15.12.98), Full text; all drawings (Family: none)	1-6
EA	JP 2001-201106 A (Matsushita Electric Ind. Co., Ltd.), 27 July, 2001 (27.07.01), Full text; all drawings (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 September, 2001 (04.09.01)	18 September, 2001 (18.09.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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