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• **Lee, Jun Woo**
Gangseo-gu,
Seoul (KR)
• **Hong, Ki Su**
Dongan-gu,
Anyang-si,
Gyeonggi-do (KR)

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(71) Applicant: **LG Electronics Inc.**
Yongdungpo-gu
Seoul (KR)

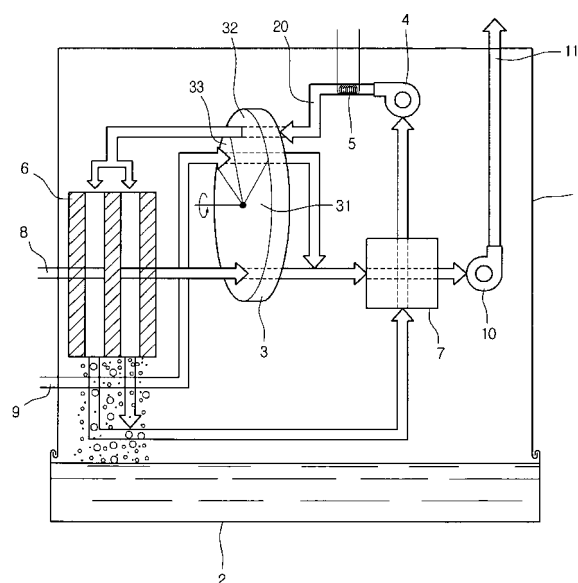
(74) Representative: **Cohausz & Florack**
Patent- und Rechtsanwälte
Bleichstrasse 14
40211 Düsseldorf (DE)

(72) Inventors:
• **Chin, Sim Won**
Gumchun-gu,
Seoul
153-023 (KR)

(54) **Dehumidifying apparatus**

(57) A dehumidifying apparatus is provided. The dehumidifying apparatus includes a desiccant dehumidifying unit, a recovery channel (20) disposed to pass air through a first section (32) of the desiccant dehumidifying unit, for evaporating and condensing moisture of the desiccant dehumidifying unit. A first inlet channel (8) is disposed to pass through a second section (31) of the desiccant dehumidifying unit, for allowing air to flow there-through and eliminating moisture from the air. A second inlet channel (9) is disposed to directly introduce external air to pass through a third section (33) of the desiccant dehumidifying unit, for recovering heat of the desiccant dehumidifying unit.

FIG.1



Description

BACKGROUND OF THE INVENTION

[0001] The present disclosure relates to subject matter contained in priority Korean Application No. 102375/2004, filed on December 7, 2004, the disclosure of which is herein expressly incorporated by reference in its entirety.

Field of the Invention

[0002] The present invention relates to a dehumidifying apparatus, and more particularly, to a desiccant dehumidifying apparatus. Much more particularly, the present invention relates to a dehumidifying apparatus for recovering much more of the applied heat, thereby reducing power consumption of its heater.

Description of the Related Art

[0003] Desiccant dehumidifying apparatus refers to a dehumidifying apparatus using a property of a moisture absorbing material for absorbing moisture from air at a room temperature and evaporating moisture at the time of heating-up. In particular, in the desiccant dehumidifying apparatus used as a household appliance, a circular desiccant roller is formed of moisture absorbing material. When the desiccant roller rotates, it absorbs moisture from the interior of a system to a predetermined section of the desiccant roller, and discharges the moisture from an other section of the desiccant roller to the exterior of the system, thereby eliminating the moisture from the system.

[0004] In addition to the desiccant roller, the desiccant dehumidifying apparatus includes a heater for generating heat; a condenser for condensing a moisture holding air using external air; a heat exchanger for exchanging heat between air passing through the condenser and being cooled, and air passing through a hot portion of the desiccant roller and being heated due to its absorption of heat; and a fan for forcing air to flow through an air channel.

[0005] In detail, when the desiccant roller operates, the heat exchanger exchanges heat between the air absorbing heat and being heated, and the air passing through the condenser and being cooled. Therefore, the air passing through the condenser and getting cold is heated up. Accordingly, even when the heater applies a smaller amount of heat to the air, a high heat is transferred to the desiccant roller, thereby eliminating moisture from the desiccant roller.

[0006] However, the conventional dehumidifying apparatus has a disadvantage in that since the air already absorbs heat from the condenser when passing through the condenser, the air has a small temperature difference with the desiccant roller when passing through the desiccant roller, thereby not absorbing much heat from the

desiccant roller.

[0007] Further, the dehumidifying apparatus has a disadvantage in that even when a heat exchange is performed by the heat exchanger, much heat is not recovered by the heat exchanger due to a small difference of temperature of the air facing and the air flowing.

SUMMARY OF THE INVENTION

[0008] Accordingly, the present invention is directed to a desiccant dehumidifying apparatus that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0009] An object of the present invention is to provide a desiccant dehumidifying apparatus for recovering much more heat of a heater activated in the desiccant dehumidifying apparatus, to reduce its total power consumption.

[0010] Another object of the present invention is to provide a desiccant dehumidifying apparatus for recovering much more heat of a heater to maintain air of low temperature to be exhausted to an interior space, thereby reducing user's discomfort caused by high temperature air.

[0011] A another further object of the present invention is to provide a desiccant dehumidifying apparatus for improving a performance of moisture absorption.

[0012] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0013] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a dehumidifying apparatus, including: a desiccant dehumidifying unit; a recovery channel positioned to pass air through a first section of the desiccant dehumidifying unit, for evaporating and condensing moisture of the desiccant dehumidifying unit; a first inlet channel positioned to pass air through a second section of the desiccant dehumidifying unit, for allowing air to flow therethrough and eliminating moisture from the air; and a second inlet channel positioned to directly introduce external air to pass through a third section of the desiccant dehumidifying unit, for recovering heat of the desiccant dehumidifying unit.

[0014] In another aspect of the present invention, there is provided a dehumidifying apparatus, including: a main body; a desiccant dehumidifying unit housed within the main body; a condenser for condensing air, which passes through a dry section of the desiccant dehumidifying unit and retains moisture; a first inlet channel positioned to pass air through the condenser and a moisture absorp-

tion section of the desiccant dehumidifying unit, for allowing air to flow therethrough and eliminating moisture from the air; a second inlet channel positioned to directly introduce external air to pass through a heat recovery section of the desiccant dehumidifying unit, for allowing air to flow therethrough and recovering heat from the air; a heat exchanger in which the air in the first inlet channel and the second inlet channel and passing through the desiccant dehumidifying unit flow to one side of the heat exchanger, and in which the air passing through the condenser flows to an other side of the heat exchanges, thereby exchanging heat; and a heater for heating the air flowing to the other side of the heat exchanger and introducing the heated air to the dry section of the desiccant dehumidifying unit.

[0015] In a another further aspect of the present invention, there is provided a dehumidifying apparatus, including: a desiccant dehumidifying unit for absorbing or evaporating moisture depending on temperature; a moisture absorption section provided at the desiccant dehumidifying unit, for receiving external air and eliminating moisture from the air; a dry section provided at the desiccant dehumidifying unit, for evaporating moisture absorbed in the moisture absorption section, using heated air; and a heat recovery section provided at the desiccant dehumidifying unit, for recovering heat applied to the dry section, using cold air directly introduced to the desiccant dehumidifying unit from the exterior.

[0016] The present invention has an effect of reduction of power consumption, and has an advantage in that the air discharged from the desiccant dehumidifying apparatus to an interior space can be decreased in temperature, so that a user's sense of comfort can be promoted.

[0017] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objects, features and advantages of the present invention will be made apparent from the following description of the preferred embodiments, given as non-limiting examples, with reference to the accompanying drawings.

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

Fig. 1 is a view illustrating a construction of a desiccant dehumidifying apparatus according to the present invention; and

Fig. 2 is a plan view illustrating a dehumidification roller installed in a desiccant dehumidifying apparatus

according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention is further described in the detailed description which follows, by reference the noted plurality of drawings by way of non-limiting examples of preferred embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings.

[0021] Fig. 1 is a view illustrating a construction of a desiccant dehumidifying apparatus according to the present invention.

[0022] Referring to Fig. 1, the inventive desiccant dehumidifying apparatus includes a main body 1 for forming an exterior of the dehumidifying apparatus and having a plurality of parts installed therein; and a condensation water collector 2 disposed at a lower side of the main body 1 for collecting water resulting from dehumidification, from the main body 1.

[0023] A dehumidification roller 3 formed of desiccant material is provided in the main body 1 and performs a rotational motion. The dehumidification roller 3 retains moisture in a room temperature environment, and emits the retained moisture in a high temperature environment. Specifically, the dehumidification roller 3 is partitioned into three sections. The sections are shown in Fig. 2 illustrating a plan view of the dehumidification roller.

[0024] Referring to Fig. 2, the dehumidification roller 3 is partitioned into a moisture absorption section 31, a dry section 32, and a heat recovery section 33. In the dehumidification roller 3, when a room temperature air in the interior of a system passes through the moisture absorption section 31, the moisture absorption section 31 absorbs moisture from the room temperature air. The dry section 32 evaporates moisture, which is held by the dehumidification roller 3 when the air passes through the moisture absorption section 31, using heat. The heat recovery section 33 recovers heat applied from the dry section 32 to the dehumidification roller 3. Each of the sections 31, 32 and 33 is not fixed to a specific portion of the dehumidification roller 3, but is provided at each specific portion of the dehumidification roller 3 depending on its relative position with respect to the main body 1 when the dehumidification roller 3 rotates. Of course, while a roller is shown in Figs. 1 and 2 the present invention is applicable to and includes different shapes of desiccant members such as for example cylindrical rollers or belts.

[0025] Air suitable for allowing the sections 31, 32 and 33 to perform their functions passes through each of the sections 31, 32 and 33. A state of air flowing through the sections 31, 32 and 33 will be described later.

[0026] Referring again to Fig. 1, the inventive dehumidifying apparatus includes a recovery channel 20 forming a closed loop and circulating air in the main body 1; a first inlet channel 8 and a second inlet channel 9 for introducing external air requiring dehumidification; and an outlet channel 11 for discharging the dehumidified air

from the main body 1 to the exterior of the system.

[0027] First, an operation of the main body 1 will be described centering on a flow sequence of air introduced through the first inlet channel 8.

[0028] A low temperature and high humidity air is introduced through the first inlet channel 8 from the exterior of the system. After that, the low temperature and high humidity air passes through a condenser 6 so that a high temperature and high humidity air flowing through one duct of the condenser 6 is condensed. When the air of the first inlet channel 8 flows through the condenser 6, the air is changed to a middle temperature and high humidity air due to its absorbed latent heat of condensation.

[0029] After that, the air passes through the moisture absorption section 31 of the dehumidification roller 3 so that the air is changed to a middle temperature and low humidity air due to its eliminated moisture. Next, the middle temperature and low humidity air is introduced into and heat-exchanged in a heat exchanger 7 so that the air is further reduced in temperature due to its thermal loss. After that, the resultant air is discharged through a dehumidification ventilator 10 and the outlet channel 11 to the exterior of the system. It will be easily expected that the dehumidification ventilator 10 forms a negative pressure region, thereby introducing the air from the exterior of the system to the interior of the main body 1.

[0030] An operation of the main body 1 will be described centering on a flow sequence of air introduced through the second inlet channel 9.

[0031] A low temperature and high humidity air is introduced into the main body 1 through the second inlet channel 9. After that, the introduced air passes through the heat recovery section 33 of the dehumidification roller 3, not passing through the condenser 6 so that the air is changed to a high temperature and high humidity air. Of course, since the specific portion of the dehumidification roller 3 already absorbing heat when the air passes through the dry section 32 is positioned at the heat recovery section 33, the air passing through the heat recovery section 33 via the second inlet channel 9 can be changed to a high temperature and high humidity air.

[0032] Next, after the air is totally changed to a high temperature and low humidity air at an intersection of the first and second inlet channels 8 and 9, the resultant air is introduced into the heat exchanger 7. In a detailed description, the air flowing through the first inlet channel 8 is changed to a middle temperature and low humidity air, and the air flowing through the second inlet channel 9 is changed to a high temperature and high humidity air. Therefore, when both are mixed, the mixed air is changed to a high temperature and low humidity air at the intersection of the first and second inlet channels 8 and 9. However, if the air flowing through the first and second inlet channels 8 and 9 are suitably just controlled in amount, the air can be also controlled to any one between a state of high temperature and low humidity and a state of middle temperature and middle humidity. However, for description convenience, it is hereinafter assumed that

the air is controlled to the state of high temperature and low humidity.

[0033] After that, when the air flows through the heat exchanger 7, the air is changed to a low temperature and low humidity air due to thermal loss, and the resultant air is discharged to the exterior of the system via the dehumidification ventilator 10 and the outlet channel 11.

[0034] An operation of the main body 1 will be sequentially described centering on air flowing along the recovery channel 20 within the main body 1.

[0035] When the air passes through the heat exchanger 7, the heat exchanger 7 absorbs heat from the air passing through the inlet channels 8 and 9, and changes the air to a middle temperature and low humidity air. After that, the resultant air is guided to and ventilated through the recovery ventilator 4. When the air passes through the heater 5, the air is changed to a high temperature and low humidity air. Next, the air is introduced to the dry section 32 of the dehumidification roller 3 to allow moisture of the dehumidification roller 3 to be evaporated into the air. When the air passes through the dry section 32 of the dehumidification roller 3, the air is changed to a high temperature and high humidity air, and the resultant air is introduced into the condenser 6. Specifically, when the air passes through the dry section 32, the air decreases a little in temperature due to its absorption of latent heat of moisture, thereby continuously maintaining the air at a high temperature.

[0036] When the high temperature and high humidity air passes through the condenser 6, it is heat-exchanged with the low temperature and high humidity air flowing through the first inlet channel 8, and is condensed. Therefore, the high temperature and high humidity air is changed to a low temperature and low humidity air due to its loss of moisture, and the resultant air is introduced into the heat exchanger 7.

[0037] When the low temperature and low humidity air flows through the heat exchanger 7, it is heat-exchanged with the high temperature and low humidity air, which passes through the heat exchanger 7 within the first and second inlet channels 8 and 9, and is changed to a middle temperature and low humidity air. Next, the resultant air is again introduced into the recovery ventilator 4.

[0038] As described above, when the air passes through the first inlet channel 8, the second inlet channel 9 and the recovery channel 20, the air is sequentially changed in temperature and humidity. Specifically, the present invention is characterized in that the air introduced into the heat exchanger 7 can be changed in temperature and humidity owing to existence of the second inlet channel 9. In other words, a mixture of the air guided through the first and second inlet channels 8 and 9 is introduced into the heat exchanger 7. At this time, the user can suitably control amounts of the air flowing through the first and second inlet channels 8 and 9, thereby controlling a state of the air as desired.

[0039] Describing in detail, the air flowing through the first and second inlet channels 8 and 9 can be also suit-

ably controlled in amount (for example by suitable air valves) to control the air to be in any state between a state of the high temperature and low humidity air and a state of the middle temperature and middle humidity air. This state can be variably formed between the state of the middle temperature and low humidity air flowing through the first inlet channel 8 and the state of the high temperature and high humidity air flowing through the second inlet channel 9.

[0040] Describing in more detail, it is desirable that before the air is introduced into the heat exchanger 7, the air increases in temperature to recover a large amount of heat in the dehumidification roller 3, and decreases in humidity to eliminate a larger amount of moisture from the dehumidification roller 3.

[0041] In a state where a larger amount of air is introduced to the first inlet channel 8 than to the second inlet channel 9, the air introduced into the heat exchanger 7 can be promoted to be in an atmosphere of low humidity, but disadvantageously decreases in temperature. Therefore, the above state is undesirable in the following respects. Since the heat exchanger 7 does not recover a large amount of heat, the heater 5 needs to apply a large amount of heat, thereby increasing power consumption of the main body 1. Further, since the heat exchanger 7 is deteriorated in efficiency, dew condensation occurs in an inlet duct disposed toward the recovery ventilator 4. Furthermore, a larger amount of heat of the heater 5 is not recovered and is discharged through the outlet channel 11, thereby causing user discomfort and inconvenience.

[0042] In a state where a larger amount of air is introduced through the second inlet channel 9 than the first inlet channel 8, there is an advantage in that since a performance of the heat exchanger 7 is improved and a large amount of heat is recovered by the heat recovery section 33 of the dehumidification roller 3. Thus, a large amount of moisture can be advantageously absorbed by the moisture absorption section 31 of the dehumidification roller 3. However, there is a disadvantage in that since the air passing through the moisture absorption section 31 in the dehumidifying apparatus can be decreased in amount, an amount of dehumidification of the dehumidifying apparatus is decreased.

[0043] Considering the above relation, it is desirable that the amount of the air introduced through the first and second inlet channels 8 and 9 is suitably controlled. It is desirable that the air is controlled to be in any state depending on an installation environment of the dehumidifying apparatus.

[0044] It is desirable that since external air, introduced through all of the first and second inlet channels 8 and 9, is exhausted via the single dehumidification ventilator 10, a damper, or other flow control mechanism though not described in detail, is installed at all or any one of the inlet channels 8 and 9 to control an amount of inflow of the air.

[0045] However, the air passing through the moisture

absorption section 31 and the air passing through the heat recovery section 33 can be also independently varied in amount in such a manner that different fans are respectively used to introduce the air into the first and second inlet channels 8 and 9. At this time, as a larger amount of air is introduced into the first inlet channel 8, a larger amount of moisture can be absorbed by the moisture absorption section 31 and therefore, an entire performance of the dehumidifying apparatus can be improved.

[0046] If the air flowing through the first and second inlet channels 8 and 9 are suitably controlled in amount considering the above relation, the heat of the heater 5 is sufficiently recovered almost without degrading a performance of dehumidification. Accordingly, the power consumption is reduced, and less dew condensation occurs in the inlet duct disposed at a side of the recovery ventilator 4, and the performance of moisture absorption of the dehumidification roller 3 is improved, thereby improving the performance of dehumidification of the dehumidifying apparatus, and the heat is prevented from being dissipated from the main body 1, thereby reducing user displeasure and discomfort.

[0047] The air flowing through the first and second inlet channels 8 and 9 can be set to an amount ratio of 80% to 20%. In such a flow environment, an optimal driving state of the dehumidifying apparatus can be realized without degrading the performance of dehumidification.

[0048] Depending on a driving state desired by a user and the installation environment of the dehumidifying apparatus, the air flowing through the first and second inlet channels 8 and 9 can be also variably controlled in amount, thereby additionally enhancing user convenience.

[0049] For example, when it is required to reduce power consumption without dissipating any heat to the exterior during a dehumidification operation, the air flowing through the second inlet channel 9 can be increased in amount. When it is required to rapidly eliminate the moisture without considering other conditions, the air flowing through the first inlet channel 8 is increased in amount, thereby improving the performance of dehumidification.

[0050] As such, predetermined valves for controlling the amounts of the air flowing through each of the inlet channels 8 and 9 can be installed at any one or both of the inlet channels 8 and 9 or at any appropriate location along the inlet channels 8 and/or 9. Such valves or dampers can be manually operated or can be controlled in any appropriate fashion.

[0051] In the present invention, the condensation water collector 2 is detachable, thereby conveniently eliminating water resulting from dehumidification.

[0052] The inventive desiccant dehumidifying apparatus has advantages in that much more of the heat of the heater can be recovered, thereby totally reducing the power consumption of the dehumidifying apparatus, and the performance of moisture absorption is improved, thereby enhancing an efficiency of dehumidification, and

the heat emitted to the exterior of the system is reduced, thereby decreasing user's displeasure.

[0053] The inventive desiccant dehumidifying apparatus has an advantage in that the dehumidifying apparatus is prevented from being dew-laden at its duct, thereby reducing a concern about trouble, which can be caused during the operation of the dehumidifying apparatus.

[0054] Although the invention has been described with reference to an exemplary embodiment, it is understood that the words that have been used are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the invention has been described herein with reference to particular means, materials and embodiments, the invention is not intended to be limited to the particulars disclosed herein. Instead, the invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

[0055] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description is taken with the drawings making apparent to those skilled in the art how the forms of the present invention may be embodied in practice.

Claims

1. A dehumidifying apparatus comprising:

a desiccant dehumidifying unit;
a recovery channel positioned to pass air through a first section of the desiccant dehumidifying unit, for evaporating and condensing moisture of the desiccant dehumidifying unit;
a first inlet channel positioned to pass air through a second section of the desiccant dehumidifying unit, for allowing air to flow therethrough and eliminating moisture from the air; and
a second inlet channel positioned to directly introduce external air to pass through a third section of the desiccant dehumidifying unit, for recovering heat of the desiccant dehumidifying unit.

2. The apparatus according to claim 1, wherein the air passing through the third section recovers heat extracted from the air passing the second section of the desiccant dehumidifying unit.

3. The apparatus according to claim 1, further comprising a heat exchanger for exchanging heat between the air completing passage through the second section and the third section, and the air to pass through the first section.

4. The apparatus according to claim 1, further comprising a condenser for condensing moisture out of the air, which is in the recovery channel and has passed through the desiccant dehumidifying unit, using the air, which is in the first inlet channel and has not been introduced to the desiccant dehumidifying unit.

5. The apparatus according to claim 1, further comprising a recovery ventilator for circulating the air along the recovery channel.

6. The apparatus according to claim 1, further comprising a dehumidification ventilator for causing the air to flow along the inlet channels.

7. The apparatus according to claim 1, further comprising a dehumidification ventilator for causing the air to flow along the first inlet channel and the second inlet channel.

8. The apparatus according to claim 1, wherein the air flowing through the first inlet channel and the second inlet channel is controllable to be different in amount.

9. The apparatus according to claim 1, wherein the desiccant dehumidifying unit comprises a rotary dehumidification roller.

10. A dehumidifying apparatus comprising:

a main body;
a desiccant dehumidifying unit housed within the main body;
a condenser for condensing air, which passes through a dry section of the desiccant dehumidifying unit and retains moisture;
a first inlet channel positioned to pass air through the condenser and a moisture absorption section of the desiccant dehumidifying unit, for allowing air to flow therethrough and eliminating moisture from the air;
a second inlet channel positioned to directly introduce external air to pass through a heat recovery section of the desiccant dehumidifying unit, for allowing air to flow therethrough and recovering heat from the air;
a heat exchanger in which the air in the first inlet channel and the second inlet channel and passing through the desiccant dehumidifying unit flow to one side of the heat exchanger, and in which the air passing through the condenser flows to an other side of the heat exchanger,

thereby exchanging heat; and
a heater for heating the air flowing to the other
side of the heat exchanger, and introducing the
heated air to the dry section of the desiccant
dehumidifying unit.

11. The apparatus according to claim 10, wherein the
desiccant dehumidifying unit is a roller. 5
12. The apparatus according to claim 10, wherein rela- 10
tive amounts of air flowing through the first inlet chan-
nel and/or the second inlet channel are controllable.
13. The apparatus according to claim 10, further com- 15
prising a dehumidification ventilator for discharging
the air introduced to one side of and heat-exchanged
in the heat exchanger, to the exterior.
14. The apparatus according to claim 10, further com- 20
prising a recovery ventilator for forcibly ventilating
the air from the heat exchanger, toward the heater.
15. The apparatus according to claim 10, wherein the 25
desiccant dehumidifying unit is sequentially rotated
to the moisture absorption section, the dry section,
and the heat recovery section.
16. The apparatus according to claim 10, further com- 30
prising a condensation water collector selectively de-
tachable from the main body, for collecting conden-
sation water resulting from condensation performed
in the condenser.
17. A dehumidifying apparatus comprising: 35

a desiccant dehumidifying unit for absorbing or
evaporating moisture depending on tempera-
ture;
a moisture absorption section provided at the
desiccant dehumidifying unit, for receiving ex- 40
ternal air and eliminating moisture from the air;
a dry section provided at the desiccant dehu-
midifying unit, for evaporating moisture ab-
sorbed in the moisture absorption section, using
heated air; and 45
a heat recovery section provided at the desic-
cant dehumidifying unit, for recovering heat ap-
plied to the dry section, using cold air directly
introduced to the desiccant dehumidifying unit
from the exterior. 50
18. The apparatus according to claim 17, further com- 55
prising a heat exchanger for exchanging heat be-
tween hot air passing through the moisture absorp-
tion section and the heat recovery section, and cold
air that passed through the dry section and through
a condenser.

19. The apparatus according to claim 17, further com-
prising a condenser for condensing moisture of air
that passed through the dry section, using air to be
introduced to the moisture absorption section.

20. The apparatus according to claim 17, wherein air
introduced to the heat recovery section is cold air
introduced from the exterior.

FIG.1

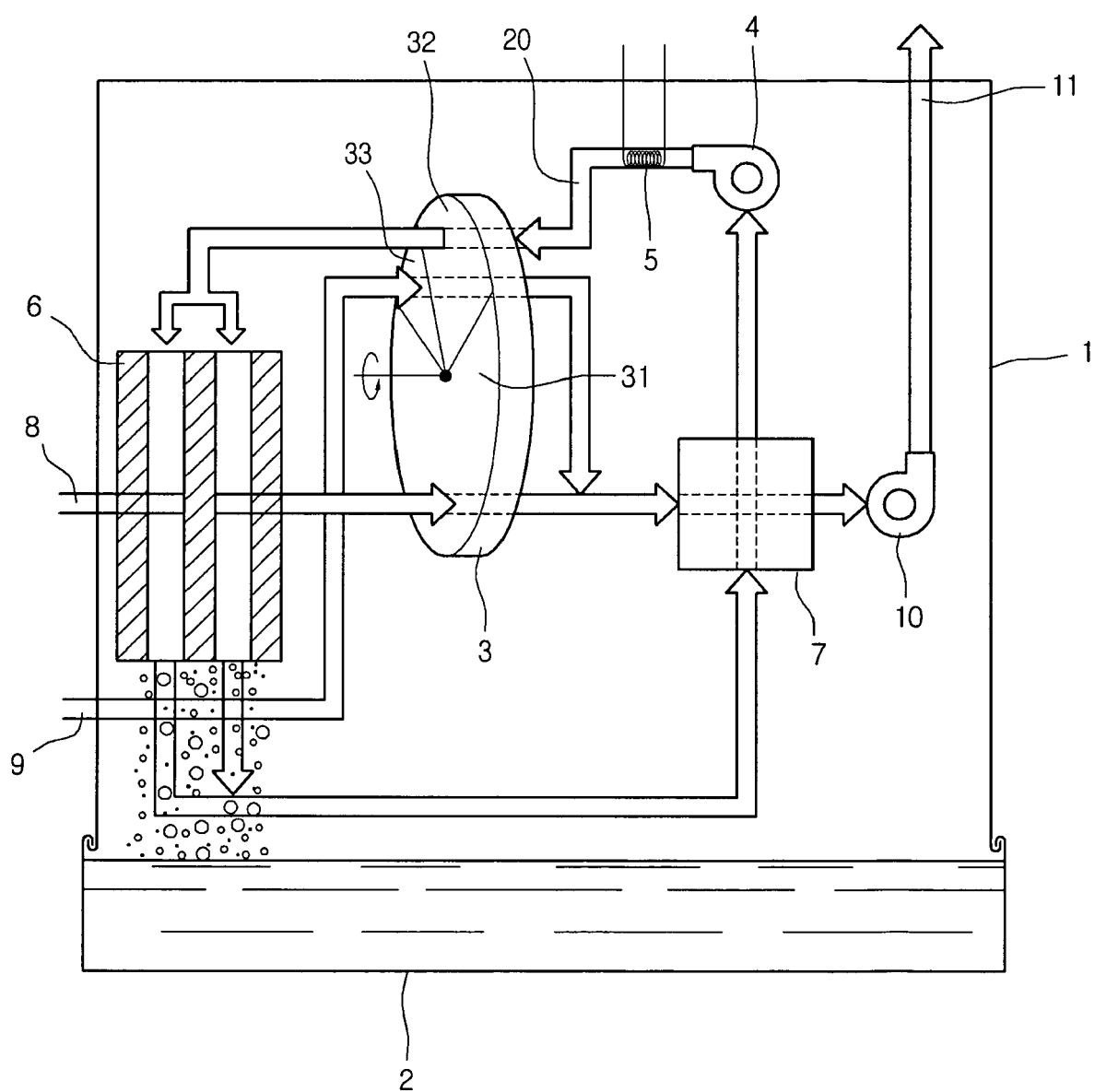


FIG.2

