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Description

Title of Invention

HUMIDIFICATION FILTER AND HUMIDIFIER

5 Technical Field

[0001]

The present invention relates to a humidifier and to a humidifying filter for use in a humidifier.

10 Background Art

[0002]

In a case where a typical home-use humidifying air purifier is used, impurities, such as minerals contained in water for humidification, stick to a humidifying filter. This causes odor to be generated, and leads to a reduction in humidification amount. Accordingly, it is necessary to periodically replace the humidifying filter in its entirety, and therefore costs for replacement of humidifying filters are incurred.

20 [0003]

Patent Literature 1 discloses a technique for reducing the cost for replacement of a humidifying filter by, instead of replacing a humidifying filter in its entirety, replacing only part of the humidifying filter which part has impurities stuck thereon.

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[0004]

There are also proposals for washing off, with water, impurities stuck on a humidifying filter, instead of replacing the humidifying filter.

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Citation List

[Patent Literature]

[0005]

[Patent Literature 1]

10 Japanese Patent Application Publication Tokukai No. 2009-68732 (Publication date: April 2, 2009)

Summary of Invention

Technical Problem

15 [0006]

A typical humidifying filter is formed by folding a nonwoven fabric into an accordion-like shape because the humidifying filter needs a certain degree of hardness for avoiding deformation which would cause (i) deterioration and (ii) an effect on a humidification amount. Therefore, the humidifying filter cannot be washed through rubbing. This unfortunately prevents impurities, which are stuck on the humidifying filter, from being sufficiently removed even through washing with water.

25 [0007]

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The present invention has been made in view of the problem, and an object of the present invention is to achieve (i) a humidifying filter that allows impurities, which are stuck on the humidifying filter, to be sufficiently removed by washing with water and (ii) a humidifier including such a humidifying filter.

Solution to Problem

[0008]

In order to attain the object, a humidifying filter in accordance with an aspect of the present invention is a humidifying filter to be provided in a humidifier, including: two sheet members which are removably combined together; and a support member which supports the two sheet members while the two sheet members are combined together.

Advantageous Effects of Invention

[0009]

With an aspect of the present invention, it is advantageously possible that in a case where a sheet member is removed from a support member, impurities stuck on a humidifying filter are sufficiently removed by washing with water.

Brief Description of Drawings

[0010]

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Fig. 1 is a view schematically illustrating a configuration of a humidifying filter in accordance with Embodiment 1 of the present invention.

5 Fig. 2 is a perspective view illustrating an appearance of a humidifier including the humidifying filter illustrated in Fig. 1.

Fig. 3 is a cross-sectional view schematically illustrating a configuration of the humidifier illustrated in Fig. 2.

10 Fig. 4 is a perspective view illustrating a structure in which a humidifying filter unit in the humidifier illustrated in Fig. 2 is supported.

Fig. 5 is a set of perspective views illustrating a support frame which supports a humidifying filter in accordance with Embodiment 2 of the present invention. (a) of Fig. 5 is a perspective view illustrating the support frame before the humidifying filter is mounted. (b) of Fig. 5 is a perspective view illustrating the support frame after the humidifying filter is mounted.

20 Fig. 6 is a view schematically illustrating a configuration of a humidifier in accordance with Embodiment 3 of the present invention for describing humidity control by the humidifier.

Fig. 7 is a graph showing relationships between a rotation angle of the humidifying filter and a humidification
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amount.

Fig. 8 is a graph showing a relationship between time and a target humidity as a result of humidity control in accordance with an embodiment of the present invention.

5 Fig. 9 is a graph showing a relationship between time and a target humidity as a result of humidity control in accordance with a comparative example.

Fig. 10 is a main-part cutaway front view illustrating a structure for supporting a humidifying filter unit for
10 controlling rotation of the humidifying filter.

Fig. 11 is a view schematically illustrating a configuration of a humidifying filter in accordance with Embodiment 4 of the present invention.

15 Description of Embodiments

[0011]

[Embodiment 1]

The following description will discuss embodiments of the present invention in detail.

20 [0012]

(Overview of humidifier)

As illustrated in Fig. 3, a humidifier in accordance with an embodiment of the present invention includes, in a housing 1 having a shape of a rectangular box, (i) an air
25 blowing fan 2, (ii) a humidifying filter unit 3, and (iii) a water

tank 4. The inside of the housing 1 is divided, by a partition wall 1a, into (i) a suction chamber 1b located backwards and (ii) a discharge chamber 1c located frontwards. The suction chamber 1b is connected to the outside via multiple air inlets 15 which are opened in a back surface panel 14 of the housing 1. The discharge chamber 1c is connected to the outside via an air outlet 16 which is opened in a top plate of the housing 1. The suction chamber 1b and the discharge chamber 1c are connected to each other via an opening 1d provided at a bottom part of the partition wall 1a.

[0013]

As illustrated in Fig. 1, the back surface panel 14 is removable. At a front side of the back surface panel 14, there are provided a deodorization filter 17 and a dust collecting filter 18 which are stacked together. The deodorization filter 17 is formed by, for example, causing a nonwoven fabric to hold activated carbon in a dispersed manner. The deodorization filter 17 functions to adsorb and remove an odor component passing through the deodorization filter 17. The dust collecting filter 18 is, for example, a publicly-known HEPA (High Efficiency Particulate Air) filter, and functions to collect and remove fine dust passing through the dust collecting filter 18. The deodorization filter 17 and the dust collecting filter 18 are fitted into a filter chamber provided at the front side of the back surface panel

14.

[0014]

The air blowing fan 2 includes an impeller 20 and a fan motor 21 which drives the impeller 20. The fan motor 21 is fixed outside the discharge chamber 1c. The impeller 20 is fixed to an output terminal of the fan motor 21 which protrudes into the discharge chamber 1c. The impeller 20 is provided so as to face the opening 1d at the bottom part of the partition wall 1a. The impeller 20 of the air blowing fan 2 is driven by the fan motor 21 so as to rotate. In a case where the impeller 20 rotates, outside air is, as indicated by outline arrows in Fig. 3, (i) introduced into the suction chamber 1b via the air inlets 15 which are provided in the back surface panel 14, (ii) allowed to flow frontwards in the suction chamber 1b, (iii) sucked into the impeller 20 via the opening 1d at the bottom part of the partition wall 1a, (iv) allowed to turn upwards, (v) led out into the discharge chamber 1c, and (vi) guided out via the air outlet 16 at an end of the discharge chamber 1c.

[0015]

The suction chamber 1b and the discharge chamber 1c inside the housing 1 thus form an air flow path in which airflow as described above is generated by an operation of the air blowing fan 2. The deodorization filter 17 and the dust collecting filter 18 are located at an upstream side of

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the air flow path described above. Outside air, which is introduced into the suction chamber 1b via the air inlets 15, (i) loses its odor component by passing through the deodorization filter 17 and (ii) becomes, by passing through the dust collecting filter 18, clean air from which dust has been removed. Then, the clean air is guided out via the air outlet 16 at the end of the discharge chamber 1c. The humidifier illustrated in the drawings serves also as an air purifier by including the deodorization filter 17 and the dust collecting filter 18.

[0016]

The humidifying filter unit 3 and the water tank 4 are provided between the dust collecting filter 18 and the air blowing fan 2 so as to humidify air which is flowing in the air flow path as described above.

[0017]

The water tank 4 is a dish-shaped container which is opened upwards. The water tank 4 is fitted into a guide 19 which is provided on a bottom plate of the housing 1, so that the water tank 4 is provided in the suction chamber 1b located in front of the dust collecting filter 18. As illustrated in Fig. 2, the water tank 4 slides, along the guide 19, together with the humidifying filter unit 3 which is supported by the water tank 4 as described later. This allows the water tank 4 to be taken out from one side surface of the

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housing 1. To an end part on a side where the water tank 4 is taken out, a tank receiver 40 having a wide with is connected. To the tank receiver 40, a water feed tank 41 is to be removably attached.

5 [0018]

The water feed tank 41 is a rectangular parallelepiped tank having a faucet 42 at one end part thereof. The water feed tank 41 is to be mounted on the tank receiver 40 while the water feed tank 41 is upside down so that the faucet 42
10 faces downwards. The faucet 42 includes publicly-known overflow valve therein. While the water feed tank 41 is mounted on the tank receiver 40, the overflow valve is pushed up by a push-up protrusion 43 which is provided in the tank receiver 40 so as to correspond to the overflow valve
15 (see Fig. 4). This causes the overflow valve to open. As a result, water contained in the water feed tank 41 is sent out into the water tank 4, so that water in the water tank 4 is stored at a certain level.

[0019]

20 The humidifying filter unit 3 is configured by containing and holding a humidifying filter 31 in a retention frame 30 having a form of a hollow disk. Specifically, the retention frame 30 has a form of a disk that rotates around a horizontal axis, and contains and holds the humidifying
25 filter 131 therein. The humidifying filter 31 is formed by

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removable two sheets that are each made of a material, such as a nonwoven fabric, which (i) is highly capable of containing water, (ii) has air permeability, and (iii) can be washed through rubbing. The humidifying filter 31 will be described in detail later.

[0020]

Fig. 4 is a perspective view illustrating a structure in which the humidifying filter unit 3 is supported. Note that Fig. 4 illustrates only the retention frame 30 instead of also illustrating the humidifying filter 31 in the retention frame 30. Note also that Fig. 4 illustrates only the tank receiver 40 at the one end part of the water tank 4 instead of also illustrating the water feed tank 41 mounted on the tank receiver 40.

[0021]

As illustrated in Fig. 4, the retention frame 30 is mounted on two support rollers 6 provided in the water tank 4, so that the humidifying filter unit 3 is supported while oriented so as to stand vertically on the water tank 4. The support rollers 6 are each a roller that rotates around an axis that extend frontwards and backwards. The support rollers 6 are provided at respective sides so as to (i) spread longitudinally on a bottom surface of the water tank 4 and (ii) contact an outer circumferential surface of the retention frame 30 at respective positions. The humidifying filter unit

- 11 -

3 thus supported is capable of rotating around a center axis by rolling of the support rollers 6.

[0022]

The humidifying filter unit 3 thus supported can be easily removed, as illustrated in Fig. 2, by (i) taking out the humidifying filter unit 3 together with the water tank 4 from the one side surface of the housing 1 and (ii) lifting the humidifying filter unit 3 upwards. On the other hand, by inserting part of the humidifying filter unit 3 into the water tank 4 so as to mount the humidifying filter unit 3 on the two support rollers 6, it is possible to easily support the humidifying filter unit 3 while the humidifying filter unit 3 is oriented as described above. In so doing, in a case where the humidifying filter unit 3 is pushed into the housing 1 together with the water tank 4, it is possible to set the humidifying filter unit 3 at a certain position in the housing 1. The humidifying filter unit 3 is thus attached and removed so as to (i) maintain or replace a humidifying filter 31 contained in the retention frame 30 and (ii) clean the inside of the water tank 4.

[0023]

As illustrated in Fig. 4, a ring gear 32 is provided so as to be integrated with the outer circumferential surface of the retention frame 30. The ring gear 32 has an appropriate width and has teeth which are provided (i) at a center part

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with respect to the width and (ii) along the entire outer circumferential surface. As illustrated in Fig. 3, the ring gear 32 intermeshes with a transmission gear 51 of a drive unit 5 which is provided at an upper part of the retention frame 30.

[0024]

The drive unit 5 includes (i) a transmission gear 51 and a drive gear 52 which are attached to one surface of a base 50 and (ii) a driving motor 53 which is attached to the other surface of the base 50. The drive unit 5 is fixed at an appropriate position of the partition wall 1a in the housing 1 with use of a plurality of fixing screws (not illustrated) which run through the base 50. The drive gear 52 is fitted to an output shaft of the driving motor 53, so that rotation of the driving motor 53 is transmitted to the transmission gear 51 via the drive gear 52. This causes the transmission gear 51 to rotate.

[0025]

In a case where the humidifying filter unit 3 is set at the certain position described above, the transmission gear 51 of the drive unit 5 and the ring gear 32 of the retention frame 30 intermesh with each other as illustrated in Fig. 3. Because of this intermeshing, the humidifying filter unit 3 is supported by the following three points along a circumference of the humidifying filter unit 3: the two

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support rollers 6 in the water tank 4; and the transmission gear 51 of the drive unit 5.

[0026]

As illustrated in Fig. 3, the humidifying filter unit 3 thus supported is located in the suction chamber 1b so as to face (i) the front side of the dust collecting filter 18 and (ii) a back side of the air blowing fan 2. In a case where the driving motor 53 drives, rotation of the drive gear 52 is transmitted to the retention frame 30 via the transmission gear 51 and the ring gear 32. This causes the humidifying filter unit 3 to rotate around the center axis while maintaining the position, as illustrated in Fig. 3, at which the humidifying filter unit 3 is supported.

[0027]

As illustrated in Fig. 4, the retention frame 30 has (i) a back surface (counter surface facing the dust collecting filter 18) and (ii) a front surface located opposite the back surface. On a center part of the back surface and the front surface, respective support rings 33 each having a circular shape is provided. A plurality of support ribs 34 (six support ribs in Fig. 4) for each of the support rings 33 are provided so as to the support ring 33 to an outer peripheral part. Furthermore, a stopping part 35 having a bow-like shape is provided so as to block a part in the vicinity of the outer peripheral part.

[0028]

A space in the retention frame 30, which space is to contain a humidifying filter 31, has a cross-section whose shape excludes the bow-like shape of the stopping part 35, that is, the cross section having a shape obtained by cutting out a bow-like part from a circular shape. The humidifying filter 31 contained in the space is held while being supported by the support rings 33 and the support ribs 34 from both the front side and the back side.

[0029]

As described above, water in the water tank 4 is stored at a certain level. A bottom part of the retention frame 30, which rotates as described above, is to be immersed in stored water in the water tank 4. The stored water enters the retention frame 30 via openings located at a front and a back of the retention frame 30. Then, the stored water is absorbed by the humidifying filter 31 which is contained and held in the retention frame 30.

[0030]

In a case where the air blowing fan 2 is driven in the humidifier thus configured, airflow through the suction chamber 1b and the discharge chamber 1c in the housing 1 is generated as described above. This causes air to (i) be introduced into the retention frame 30 of the humidifying filter unit 3 via the opening at the front surface of the

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retention frame 30, (ii) pass through the humidifying filter 31, and then (iii) be guided out via the opening at the back surface. In a case where the drive unit 5 is driven, the humidifying filter unit 3 rotates. This, as described above, causes the stored water in the water tank 4 to (i) be absorbed by the humidifying filter 31 of the retention frame 30 and (ii) lifted by the rotation of the retention frame 30, so as to permeate the entire humidifying filter 31. Therefore, the air flowing as described above comes into contact with the humidifying filter 31 containing water, so as to become moist air containing vaporized moisture. Then, the moist air is guided out via the air outlet 16 at the end of the discharge chamber 1c, and then humidifies a room in which the humidifier is provided.

[0031]

(Humidifying filter)

A humidifying filter 31 will be described in detail below with reference to Fig. 1.

[0032]

A humidifying filter 31 is to be provided in the humidifier, and, as illustrated in (a) of Fig. 1, includes two sheet members 11 and 12. The sheet members 11 and 12 are each made of a material (e.g. rayon, PET), such as a nonwoven fabric, which (i) highly capable of containing water, (ii) has air permeability, and (iii) can be washed

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through rubbing. The sheet members 11 and 12 are also each configured to be removable. The sheet members 11 and 12 are attached and removed with use of attaching and removing members 13a and 13b which are provided at peripheries of the sheet members 11 and 12. The attaching and removing members 13a and 13b can be any members, provided that the attaching and removing members 13a and 13b are members, such as hook and loop fasteners (known in Japan as Magic Tape (registered trademark)) and snap fasteners, which can attach and remove the sheet members 11 and 12 with a single touch. Note that views in (a) of Fig. 1 are plan views showing respective back surfaces of the sheet members 11 and 12. Therefore, the sheet members 11 and 12 are combined together with use of the attaching and removing members 13a and 13b while the respective back surfaces of the sheet members 11 and 12 are facing each other. The sheet members 11 and 12, which are combined together, can hardly stand by themselves because the materials are soft. Therefore, the sheet members 11 and 12 are supported in the retention frame 30 which serves as a support member.

[0033]

While the sheet member 12 has a circular shape, the sheet member 11 has a structure in which an end part 11a is cut out (see (a) of Fig. 1). Therefore, in a case where the two

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sheet members 11 and 12 are combined together, the sheet member 12 is partly exposed toward the sheet member 11 because of the end part 11a of the sheet member 11 (see (b) of Fig. 1).

5 [0034]

The humidifying filter 31 thus configured has a structure in which the two sheet members 11 and 12 overlap each other. However, since there is no overlapping of the sheet member 11 and the sheet member 12 at one end part 10 31a, it is possible to easily remove the sheet member 11 and the sheet member 12 from each other by inserting a finger at the one end part 31a.

[0035]

Alternatively, the sheet members 11 and 12 can have 15 respective structures.

[0036]

(Effects)

After the humidifying filter 31 is removed from the device, the sheet members 11 and 12 can be easily separated 20 and each washed through rubbing. This makes it possible to easily remove impurities stuck on the sheet members 11 and 12. That is, a user can easily maintain the humidifying filter 31.

[0037]

25 In particular, since the sheet members 11 and 12 can

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be easily attached and removed with use of the attaching and removing members 13a and 13b such as hook and loop fasteners (known in Japan as Magic Tape) and snap fasteners, it is possible to sufficiently wash the front surfaces and the back surface of the sheet members 11 and 12.

[0038]

However, while the sheet members 11 and 12 are combined together, the sheet members 11 and 12 are supported by the retention frame 30 which serves as a support member. Therefore, neither one of the sheet members 11 and 12 needs much thickness or strength. That is, the sheet members 11 and 12 can each be made of a soft material which can be washed through rubbing. This makes it possible that through washing of the sheet members 11 and 12 through rubbing, impurities which are stuck on the humidifying filter 31 can be sufficiently removed only by washing with water.

[0039]

Since the end part 11a of the sheet member 11 is cut out, it is possible to easily judge, when the sheet members 11 and 12 are combined together, which surface of the humidifying filter 31 is to face upwind or downwind.

[0040]

Furthermore, the sheet members 11 and 12 are

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removably provided with use of the attaching and removing members 13a and 13b, such as hook and loop fasteners (known in Japan as Magic Tape) or snap fasteners, which are provided at positions which are decided in advance. This makes it possible to easily decide positions of the sheet members 11 and 12 relative to each other.

[0041]

Therefore, in a case where the sheet members 11 and 12 are combined together, it is possible to (i) prevent the sheet members 11 and 12 from being incorrectly positioned and (ii) prevent the sheet members 11 and 12 from being attached while facing wrong directions.

[0042]

The sheet members 11 and 12, which are included in the humidifying filter 31, can have respective water absorbing capacities. In a case where the sheet members 11 and 12 are made of identical materials, it is possible to cause the sheet members 11 and 12 to have respective water absorbing capacities by cutting out the end part 11a of the sheet member 11.

[0043]

Alternatively, the sheet members 11 and 12 can have identical shapes (surface areas), so that the neither of the sheet members 11 and 12 has a structure made by cutting out a part. In such a case, it is possible to cause the sheet

- 20 -

members 11 and 12 to have respective water absorbing capacities by making the sheet members 11 and 12 with use of respective materials.

[0044]

5 In a case where the sheet members 11 and 12 have identical shapes (surface areas) and neither of the sheet members 11 and 12 has a structure made by cutting out a part, it is possible to cause the sheet members 11 and 12 to have respective water absorbing capacities by (i) making the
10 sheet members 11 and 12 with use of identical materials and (ii) causing the sheet members 11 and 12 to differ in thickness.

[0045]

15 In a case where the sheet members 11 and 12 thus have respective water absorbing capacities, one of the sheets in the humidifying filter retains a water content even when the other one of the sheets has lost a water content. This makes it possible to avoid a considerable reduction in humidification performance.

20 [0046]

25 In a case where the sheet member 11 and the sheet member 12 are provided so as to respectively face downstream and upstream while the humidifying filter 31 is set in the humidifier, the sheet member 11 is to be lower in open area ratio than the sheet member 12. The "open area

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ratio" herein refers to fineness of a nonwoven fabric of which a sheet member is made. A smaller open area ratio and a larger open area ratio mean that the nonwoven fabric is fine and coarse, respectively. Therefore, in a case where the sheet members 11 and 12 have respective open area ratios as described above, the humidifying filter 31 has not only a humidification function but also a dust collection function which is a function to (i) collect relatively large pieces of dust by the sheet member 12 at the upstream side and (ii) further collect, by the sheet member 11, dust which is contained in air having passed through the sheet member 12.

[0047]

The humidifying filter 31 is held by the retention frame 30 (support member) while the sheet members 11 and 12 are combined together. The retention frame 30 has a hollow disk-like structure so as to contain and hold the humidifying filter 31 therein. This makes it necessary to take the humidifying filter 31 out of the retention frame 30 in order to wash the humidifying filter.

[0048]

Alternatively, the sheet members 11 and 12 can be combined together at their peripheries by ultrasonic welding. In such a case, the sheet members 11 and 12 form a hollow. Furthermore, the sheet members 11 and 12 can be combined

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together at their center parts by ultrasonic welding. In a case where the sheet members 11 and 12 each have a structure made by cutting out a part at a cut-out part, the sheet members 11 and 12 can be combined together by ultrasonic welding at the cut-out parts.

[0049]

Embodiment 2 below will discuss a structure in which a humidifying filter 31 is not contained in a retention frame 30 with use of a structure of the humidifying filter 31 but is instead made to stand by itself through inserting a frame body into the humidifying filter 31.

[0050]

[Embodiment 2]

The following description will discuss another embodiment of the present invention. For convenience, members which are identical in function to the members described in Embodiment 1 are given respective identical reference signs, and descriptions of those members are omitted.

[0051]

As illustrated in (a) of Fig. 5, the humidifying filter 31 in accordance with Embodiment 2 includes a support member 60 which supports two sheet members 11 and 12 while the sheet members 11 and 12 are combined together. Specifically, as illustrated in (b) of Fig. 5, the two sheet

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members 11 and 12 cover the support member 60 while the sheet members 11 and 12 are combined together.

[0052]

The support member 60 has a three-dimensional frame body structure having an inner part 60a which is structured to be hollow. This makes it possible to enlarge a surface area of the humidifying filter 31 by causing the humidifying filter 31 to cover the support member 60. It is therefore possible to increase a humidifying effect.

[0053]

In addition, since the humidifying filter 31 is configured so that the support member 60 is covered, it is possible to easily remove the humidifying filter 31 from the support member 60.

[0054]

In a case where the sheet member 11 and the sheet member 12 are provided so as to respectively face downstream and upstream while the humidifying filter 31 is set in a humidifier, the sheet member 11 preferably has an open area ratio lower than that of the sheet member 12.

[0055]

The structure of the support member 60 is not limited to that illustrated in (a) of Fig. 5. The support member 60 can have any shape, provided that the shape allows a three-dimensional structure of the humidifying filter 31 to

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be maintained while the humidifying filter 31 covers the support member 60.

[0056]

5 The inner part 60a of the support member 60 is preferably structured to be hollow. This allows air to pass through the inner part 60a, and therefore allows water contained in the humidifying filter 31, which covers the support member 60, to be vaporized. However, the inner part 60a is not necessarily structured to be hollow.

10 [0057]

Alternatively, it is possible that (i) the inner part 60a of the support member 60 is structured to be hollow and (ii) a rotation center 31b of the humidifying filter 31 covering the support member 60 is an opening. With use of this opening, the humidifying filter 31 rotates along with the support member 60.

15 [0058]

[Embodiment 3]

20 The following description will discuss an embodiment of the present invention. For convenience, members which are identical in function to the members described in the previous embodiments are given respective identical reference signs, and descriptions of those members are omitted.

25 [0059]

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(Overview of humidity control)

Unlike the humidifying filter 31 described in Embodiments 1 and 2, a humidifying filter 131 used in Embodiment 3 is obtained by folding sheet members so that the sheet members are stacked so as to form an accordion-like shape (see Fig. 6).

[0060]

In Embodiment 3, a humidifier has a structure identical to the structures described in Embodiments 1 and 2 except that the humidifying filter 131 is used.

[0061]

Since the humidifying filter 131 is obtained by folding the sheet members so that the sheet members are stacked so as to form an accordion-like shape, a plurality of crease lines 131a are formed as illustrated in Fig. 6.

[0062]

According to the humidifying filter 131, water is absorbed along the crease lines 131a. This causes a water absorbing capacity to vary, depending on an angle between (i) a direction in which the crease lines 131a extend and (ii) a direction extending parallel to a surface of stored water in a water tank 4. For example, the angle, which is made between (i) the direction in which the crease lines 131a extend and (ii) the direction extending parallel to the surface of the stored water in the water tank 4, is 90° in (a) of Fig. 6,

180° in (b) of Fig. 6, and 45° in (c) of Fig. 6. Fig. 7 is a graph showing changes in humidification amount over time, which changes occur in respective cases where rotation of the humidifying filter 131 is stopped while the angles shown in Fig. 6 are made. In Embodiment 3, a volume of air blowing against the humidifying filter 131 is constantly 6.8 cmm.

[0063]

The graph of Fig. 7 indicates that the humidification amount is (i) largest in the case where the angle, which is made between the direction in which the crease lines 131a extend and the direction extending parallel to the surface of the stored water in the water tank 4, is 90° and (ii) smallest in the case where the angle is 180°.

[0064]

(Effects)

It is therefore understood that a humidification amount can be controlled by adjusting an angle between (i) a direction in which the crease lines 131a of the humidifying filter 131 extend and (ii) a direction which extends parallel to a surface of stored water in the water tank 4 (such an angle is hereinafter referred to as "humidity control angle").

[0065]

For example, Fig. 8 is a graph showing humidity control in Embodiment 3. Fig. 9 is a graph showing conventional humidity control for the purpose of comparison

with Fig. 8.

[0066]

The graph of Fig. 9 shows that large fluctuations occur with respect to a target humidity of a room, and therefore indicates that a large degree of unnecessary humidification is carried out. Note that a volume of air is assumed to be constant. In this case, when the target humidity is reached, rotation of a humidifying filter is stopped. However, due to a water content in the humidifying filter, humidification does not immediately stop even after the rotation is stopped. In addition, the rotation of the humidifying filter is started when the humidity is lower than the target humidity. However, since it takes time for the humidifying filter to contain water, humidification requires time. According to the conventional humidity control, humidity thus cannot be controlled properly because, even if a target humidity is set, there are times when the humidity is above and below the target humidity.

[0067]

In contrast, the graph of Fig. 8 indicates that humidity is controlled such that any fluctuation hardly occurs with respect to a target humidity of a room. In this case also, a volume of air is assumed to be constant. In this case, rotation of a humidification motor for rotating the humidifying filter 131 can be kept at minimum. This allows

noise, which is caused by driving of the humidification motor, to be reduced. In addition, since the rotation of the humidification motor is at minimum, it is possible to suppress an electric power consumption required for driving the humidification motor.

[0068]

Furthermore, since a humidification amount can be controlled merely by adjusting a rotation angle of the humidifying filter 131, a volume of air to blow against the humidifying filter 131 can be constant. Therefore, unlike the conventional humidity control, it is unnecessary to increase or decrease the volume of air more than necessary to adjust the humidification amount. This allows noise, which is caused by an air blowing fan, to be reduced. It is therefore possible to considerably reduce, in comparison with the case of a conventional humidifier, noise which is generated when the humidifier is carrying out a humidification operation.

[0069]

A mechanism for achieving humidity control by controlling rotation of the humidifying filter 131 will be described below.

[0070]

(Humidity controlling device)

Fig. 10 is a view illustrating a structure for supporting a humidifying filter unit for achieving humidity control by

the humidifier in accordance with Embodiment 3.

[0071]

As illustrated in Fig. 10, the humidifier includes a position detector 7 for detecting that the humidifying filter 131 is at certain rotation positions (rotation positions illustrated in (a) through (c) of Fig. 6). As shown by two-dot chain line in Fig. 10, the position detector 7 is configured so that a sensor, which is provided at the stopping part 35 of the retention frame 30 so as to be away from a center by an appropriate distance toward a part of a circumference, outputs a detection signal when the sensor is located at a bottommost position during the rotation of the retention frame 30. The position detector 7 can be configured by a combination of, for example, (i) a magnet serving as the sensor and (ii) a proximity switch.

[0072]

The detection signal from the position detector 7 is supplied to a control section (humidity controlling section) 8 which controls an operation. The control section 8 shown by a block in Fig. 10 is a computer which includes CPU, ROM, and RAM. An operation of the control section 8 is to control driving of a drive unit 5 by supplying the drive unit 5 with an operation command in accordance with an operation of a user.

[0073]

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In a case where the drive unit 5 is driven, the humidifying filter unit 3 rotates. This, as described above, causes stored water in the water tank 4 to (i) be absorbed by the humidifying filter 131 of the retention frame 30 and (ii) lifted by the rotation of the retention frame 30, so as to permeate the entire humidifying filter 131. Therefore, the air flowing as described above comes into contact with the humidifying filter 131 containing water, so as to become moist air containing vaporized moisture. Then, the moist air is guided out the humidifier, and then humidifies a room in which the humidifier is provided. Specifically, air, which is passing from one surface of the retention frame 30 to the other surface, comes into contact with the humidifying filter 131 which is rotating along with the retention frame 30 while the humidifying filter 131 is containing stored water that was stored in the water tank 4, so that the air becomes moist air containing vaporized moisture. Then, the moist air is sent out toward the other surface of the retention frame 30, and then humidifies a room in which the humidifier is provided.

[0074]

Note that a desired humidification amount can be obtained by stopping the rotation of the humidifying filter unit 3 such that an angle, which is made between (i) a direction in which the crease lines 131a of the humidifying

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filter 131 extends and (ii) a direction extending parallel to a water surface L of stored water in the water tank, becomes any of the angles shown in (a) through (c) of Fig. 6. By controlling this rotation angle of the humidifying filter unit
5 3, it is possible to control humidity in a room in which the humidifier is provided. Provided that a humidification amount is controlled to be a proper amount, the rotation angle can be controlled not only by the method in which the position detector 7 is used, but also by (i) a period of time in
10 which the rotation is made or (ii) any other method.

[0075]

In a case where a humidification operation of the humidifier is paused, the control section 8 refers to a detection signal from the position detector 7 so as to stop
15 driving of the drive unit 5 with a timing with which the detection signal is supplied. This causes the humidifying filter unit 3 to stop in the rotation position illustrated in Fig. 10. At this rotation position, the sensor, which is provided at the stopping part 35 of the retention frame 30 as
20 described above, is located at a bottommost position on the circumference along which the retention frame 30 rotates. As illustrated in Fig. 10, the humidifying filter unit 3 stops while being oriented so that a string-like portion of the stopping part 35 having the bow-like shape is (i) mostly
25 above the water surface (internal water level L) of the stored

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water in the water tank 4 and (ii) sloped with respect to the water surface.

[0076]

As described above, the humidifying filter 131
5 contained in the retention frame 30 has the crease lines
extending substantially parallel to the string-like portion of
the stopping part 35 having the bow-like shape. Therefore,
when the humidifying filter unit 3 stops, the crease lines
131a, which are the crease lines of the humidifying filter 131,
10 are also sloped with respect to the surface of the stored
water, that is, with respect to a horizontal direction.

[0077]

While Fig. 10 shows that the string-like portion of the
stopping part 35 is partly below the surface of the stored
15 water when the retention frame 30 stops, it is alternatively
possible to stop the retention frame 30 in the rotation
position in which the string-like portion of the stopping part
35 is above the surface of the stored water in its entirety. In
this configuration, the humidifying filter 131 absorbs no
20 water at all after the rotation is stopped. This configuration
is therefore more effective.

[0078]

Embodiment 4 below will discuss a configuration in
which a humidifying filter is not in contact with stored water
25 while a humidifier is not carrying out a humidification

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operation.

[0079]

[Embodiment 4]

The following description will discuss another
5 embodiment of the present invention. For convenience,
members which are identical in function to the members
described in the previous embodiments are given respective
identical reference signs, and descriptions of those members
are omitted.

10 [0080]

Fig. 11 is a set of views each schematically illustrating
a configuration of a humidifying filter. (a) of Fig. 11
illustrates the humidifying filter 131 used in Embodiment 3.
(b) of Fig. 11 illustrates a humidifying filter 231 in
15 accordance with Embodiment 4.

[0081]

In Embodiment 3, as illustrated in (a) of Fig. 11, a
center of a circle is a rotation center around which the
humidifying filter 131 rotates. In Embodiment 4, as
20 illustrated in (b) of Fig. 11, a rotation center around which
the humidifying filter 231 rotates is a position which is
shifted from a center of a circle. The rotation center is
located so that when the humidifying filter 231 stops
rotating, (i) a portion of the humidifying filter 231, at which
25 portion a distance from the rotation center to a

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circumference of the humidifying filter 231 is the shortest, faces a surface of stored water and (ii) the humidifying filter 231 is not immersed in the stored water.

[0082]

5 That is, in a case where the center of the circle is the rotation center as in the case of the humidifying filter 131 illustrated in (a) of Fig. 11, the humidifying filter 131 can be prevented from being immersed in stored water, by configuring the humidifying filter 131 so that, as illustrated
10 in Fig. 10 of Embodiment 3, the string-like portion of the stopping part 35 is partly below the surface of the stored water when the retention frame 30 stops rotating. In a case where the stopping part 35 is not provided on the retention frame 30, the humidifying filter 131 becomes immersed in
15 the stored water. In such a case, a part of the humidifying filter 131 is to be cut out, so that the humidifying filter 131 is not immersed in the stored water after the humidifying filter 131 stops rotating.

[0083]

20 In contrast, in a case where, as in the case of the humidifying filter 231 of (b) of Fig. 11, the rotation center is a position which is shifted from the center of the circle, the humidifying filter 231 can be prevented from being immersed in the stored water, by causing the humidifying
25 filter 231 to stop rotating so that a portion of the

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humidifying filter 231, at which portion the distance from the rotation center of the humidifying filter 231 to the end surface is the shortest, is located at a bottom.

[0084]

5 In the case of the humidifying filter 131 illustrated in (a) of Fig. 11, the rotation is made by causing the ring gear 32, which is provided at the outer circumferential surface of the retention frame 30, to mesh with the drive gear 52 of the drive unit 5 (see Fig. 10). In the case of the humidifying filter
10 231 illustrated in (b) of Fig. 11, the rotation is made by (i) providing a ring gear 132 around the rotation center instead of providing the ring gear 132 at an outer circumferential surface of a retention frame 30 and (ii) causing the ring gear 132 to mesh with the drive gear 52 of the drive unit 5 (see Fig.
15 10).

[0085]

 Alternatively, it is possible to provide the ring gear 132 at the outer circumferential surface of the retention frame 30 of the humidifying filter 231 illustrated in (b) of Fig.
20 11. In such a case, the drive unit 5 illustrated in Fig. 10 follows the rotation of the humidifying filter 231 by vertically moving.

[0086]

 For the purpose of preventing the humidifying filter
25 231 from being immersed in the stored water after the

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humidifying filter 231 stops rotating, the rotation center of the humidifying filter 231 is merely shifted from the center of the circle as described above without cutting out a part of the humidifying filter 231. This prevents a decrease in surface area, which decrease is caused by cutting out a part of the humidifying filter 231. A reduction in humidification performance is therefore prevented.

[0087]

Since the rotation center of the humidifying filter is to be merely shifted, it is possible to produce a humidifying filter more simply than is the case where a part of a humidifying filter is to be cut out.

[0088]

Embodiment 4 discussed an example in which the rotation center of the humidifying filter 231, which has a circular shape, is shifted as illustrated in (b) of Fig. 11. Alternatively, the humidifying filter can have an ellipsoidal shape instead of the circular shape.

[0089]

[Recapitulation]

A humidifying filter in accordance with Aspect 1 of the present invention is a humidifying filter 31 to be provided in a humidifier, including: two sheet members 11 and 12 which are removably combined together; and a support member (retention frame 30, support member 60) which supports the

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two sheet members 11 and 12 while the two sheet members 11 and 12 are combined together.

[0090]

With the arrangement, it is possible, when the humidifying filter is to be cleaned, to separate the sheet members 11 and 12 and wash a front surface and a back surface of each of the sheet members. This makes it possible to sufficiently remove, through washing with water, impurities which are stuck on the humidifying filter.

[0091]

Note that since the humidifying filter has a structure in which the two sheet members are removably combined together, it is difficult to allow the sheet members to stand by themselves unless the sheet members each have a certain degree of thickness and strength. However, since the humidifying filter includes the support member, neither one of the sheet members needs much thickness or strength. That is, the sheet members can each be made of a soft material which can be washed through rubbing. This makes it possible that through washing of the sheet members through rubbing, impurities which are stuck on the humidifying filter can be sufficiently removed only by washing with water.

[0092]

In Aspect 2 of the present invention, the humidifying

filter of Aspect 1 can be arranged so that the two sheet members 11 and 12 cover the support member 60 while the two sheet members 11 and 12 are combined together.

[0093]

5 According to the arrangement, the humidifying filter covers the support member. This allows the humidifying filter to be easily removed from the support member 60.

[0094]

10 In Aspect 3 of the present invention, the humidifying filter of Aspect 2 is preferably arranged so that the support member 60 has a three-dimensional frame body structure.

[0095]

15 With the arrangement, it is possible to enlarge a surface area of the humidifying filter with which the support member is covered. This allows humidification performance to be improved.

[0096]

20 In Aspect 4 of the present invention, the humidifying filter of any one of Aspects 1 through 3 is preferably arranged so that an end part 11a of a sheet member 11, which is at least one of the two sheet members 11 and 12, is cut out.

[0097]

25 With the arrangement, the following is possible: in a case where the sheet member 11 and the sheet member 12

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are combined together, an orientation of the sheet member 11 can be easily recognized merely by checking whether or not any portion is cut out. In addition, the end part of the sheet member 11 is cut out. Therefore, in a case where the sheet member 11 and the sheet member 12 are combined together, it is easy to peel off the sheet member 11 from the sheet member 12 and vice versa.

[0098]

A humidifier in accordance with Aspect 5 of the present invention is a humidifier including: a humidifying filter 131 which is obtained by folding sheet members so that the sheet members are stacked so as to form an accordion-like shape; a retention frame 30 which (i) contains and holds the humidifying filter 131 therein and (ii) has a form of a disk that rotates around a horizontal axis; a water tank 4 in which the retention frame 30 is provided so that a bottom part of the retention frame 30 is immersed in stored water; and a humidity controlling section (control section 8) which controls a humidification amount by adjusting an angle between (i) a direction in which crease lines 131a of the humidifying filter 131 extend and (ii) a direction which extends parallel to a surface L of the stored water in the water tank 4, the humidifier being configured so that (i) air, which is passing from one surface of the retention frame 30 to the other surface, comes into contact

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with the humidifying filter 131 which is rotating along with the retention frame 30 while the humidifying filter 131 is containing the stored water that was stored in the water tank 4, so that the air becomes moist air containing vaporized moisture and then (ii) the moist air is sent out from the other surface.

[0099]

Note that the humidifying filter includes the sheet members which are folded so that the sheet members are stacked so as to form an accordion-like shape. Therefore, a water absorbing capacity of the humidifying filter varies, depending on an angle between (i) a direction in which crease lines of the humidifying filter extend and (ii) a direction extending parallel to a surface of the stored water. To take advantage of this mechanism, it is possible to control the humidification amount by causing the humidity controlling section to adjust the angle.

[0100]

Therefore, a humidification amount can be easily controlled by adjusting a rotation angle of the humidifying filter.

[0101]

In Aspect 6 of the present invention, the humidifier of Aspect 5 can be arranged so that the humidity controlling section (control section 8) controls the humidification

amount while a volume of the air passing is constant.

[0102]

With the arrangement, it is possible to cause a volume of passing air to be constant during humidity control. This allows a rotation speed of an air blowing fan for passing air to be constant. Therefore, noise and a fluctuation of an electric power consumption, which are caused by changes in rotation speed of the air blowing fan, can be reduced.

[0103]

In Aspect 7 of the present invention, the humidifier of Aspect 5 or 6 can be arranged so that in a case where the humidifying filter 231 has a shape of a circle, a rotation center of the humidifying filter 231 is shifted from a center of the circle.

[0104]

With the arrangement, it is possible to prevent the humidifying filter 231 from being immersed in stored water when the humidifying filter 231 stops rotating.

[0105]

In Aspect 8 of the present invention, the humidifier of Aspect 7 can be arranged so that the rotation center is located so that when the humidifying filter 231 stops rotating, (i) a portion of the humidifying filter 231, at which portion a distance from the rotation center to a circumference of the humidifying filter 231 is the shortest,

faces a surface of stored water and (ii) the humidifying filter 231 is not immersed in the stored water.

[0106]

With the arrangement, it is possible to certainly prevent the humidifying filter 231 from being immersed in stored water when the humidifying filter 231 stops rotating.

[0107]

The present invention is not limited to the embodiments, but can be altered by a skilled person in the art within the scope of the claims. The present invention also encompasses, in its technical scope, any embodiment derived by combining technical means disclosed in differing embodiments. Further, it is possible to form a new technical feature by combining the technical means disclosed in the respective embodiments.

Reference Signs List

[0108]

- 1 Housing
- 1a Partition wall
- 1b Suction chamber
- 1c Discharge chamber
- 1d Opening
- 2 Air blowing fan
- 3 Humidifying filter unit

	4	Water tank
	5	Drive unit
	6	Support roller
	7	Position detector
5	8	Control section (humidity controlling section)
	11	Sheet member
	11a	End part
	12	Sheet member
	13a, 13b	Attaching and removing member
10	14	Back surface panel
	15	Air inlet
	16	Air outlet
	17	Deodorization filter
	18	Dust collecting filter
15	19	Guide
	20	Impeller
	21	Fan motor
	30	Retention frame
	31	Humidifying filter
20	31a	One end part
	32	Ring gear
	34	Rib
	35	Stopping part
	41	Water feed tank
25	42	Faucet

	43	Protrusion
	50	Base
	51	Transmission gear
	52	Drive gear
5	53	Driving motor
	60	Support member
	60a	Inner part
	131	Humidifying filter
	132	Ring gear
10	231	Humidifying filter
	L	Water surface

Claims

Claim 1

A humidifying filter to be provided in a humidifier, comprising:

5 two sheet members which are removably combined together; and

 a support member which supports the two sheet members while the two sheet members are combined together.

10

Claim 2

The humidifying filter as set forth in claim 1, wherein the two sheet members cover the support member while the two sheet members are combined together.

15

Claim 3

The humidifying filter as set forth in claim 2, wherein the support member has a three-dimensional frame body structure.

20

Claim 4

The humidifying filter as set forth in any one of claims 1 through 3, wherein

25 an end part of at least one of the two sheet members is cut out.

Claim 5

A humidifier comprising:

5 a humidifying filter which is obtained by folding sheet members so that the sheet members are stacked so as to form an accordion-like shape;

a retention frame which (i) contains and holds the humidifying filter therein and (ii) has a form of a disk that rotates around a horizontal axis;

10 a water tank in which the retention frame is provided so that a bottom part of the retention frame is immersed in stored water; and

15 a humidity controlling section which controls a humidification amount by adjusting an angle between (i) a direction in which crease lines of the humidifying filter extend and (ii) a direction which extends parallel to a surface of the stored water in the water tank,

20 the humidifier being configured so that (i) air, which is passing from one surface of the retention frame to the other surface, comes into contact with the humidifying filter which is rotating along with the retention frame while the humidifying filter is containing the stored water that was stored in the water tank, so that the air becomes moist air containing vaporized moisture and then (ii) the moist air is
25 sent out from the other surface.