

INDOOR UNIT OF A VENTILATION SYSTEM,
VENTILATOR AND AIR CONDITIONER

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an indoor unit configuration of a ventilation system, a ventilator and an air conditioner indoor unit in which reduction of noise is attained.

RELATED ART

A conventional example of this type air conditioner has been described in Unexamined Japanese Utility Model Application No. Sho 58-71613. A conventional example of the ventilator as a constituent member of the air conditioner indoor unit has been described in Unexamined Japanese Utility Model Application No. Hei 1-78292. Fig. 5 is a sectional view showing a conventional air conditioner indoor unit, and Fig. 6 is a perspective view thereof. In the drawings, the reference numeral 1 designates a ceiling panel, 2 a suction grill which forms an inlet port and 3 a ventilator disposed between the suction grill 2 and the ceiling panel 1. The reference numeral 4 designates a heat exchanger which is fixed to the ceiling panel 1 or the like. The reference numeral 5 designates a partition plate which is provided between the ventilator 3 and the heat exchanger 4 to form an air inlet chamber 10 and an air outlet chamber 11. The reference numeral 6 designates a

decorative panel which is fixed to the partition plate 5 or a side wall (not shown). The reference numeral 7 designates a drain pan provided at the lower portion of the heat exchanger 4 and 8 a front panel fixed to the ceiling panel 1 or the like.

5 The reference numeral 9 designates a blowout grill which forms an outlet port. The reference numeral 12 designates a large number of through holes which are of one size and are arranged at regular intervals in a portion of the ceiling panel 1 between the partition plate 5 and the heat exchanger 4 to form
10 an outlet chamber of the ventilator 3 as shown in Fig. 16. The reference numeral 13 designates a noise absorbing material, such as a urethane foam material, stuck to the inside of the ceiling panel 1 to block the through holes at the inside thereof.

15 Fig. 7 is a vertical sectional view showing a conventional ventilator as described in the Unexamined Japanese Utility Model Application No. Hei 1-78292, and Fig. '8 is a partly sectional view thereof. In the drawings, the reference numeral 14 designates a fan, 15 a blower casing having the fan
20 14 in its inside, 15a an outlet, 16 a porous structure provided along the inner surface of the blower casing 15 so as to be insulated from the inner surface of the blower casing 15, and 17 an air layer formed between the blower casing 15 and the porous structure 16.

25 The operation of the ventilator and the operation of the air conditioner will be described hereunder. The operation

of the air conditioner as described in the Unexamined Japanese Utility Model Application No. Sho 58-71613 will be described now with reference to Figs. 5 and 6. Indoor air sucked into the inlet chamber 10 through the suction grill 2 is blown out to the air outlet chamber 11 by the action of the ventilator 3 and passes through the heat exchanger 4, so that air is blown indoors from the blowout grill 9. At this time, ventilation noise generated from the ventilator 3 and air stream noise caused by air turbulence in the indoor unit are radiated from the suction grill 2 and the blowout grill 9. The noise generated in the inside is partially absorbed to the noise absorbing material 13 stuck to the ceiling panel 1. Furthermore, the noise is diffused upwards with respect to the ceiling panel 1 through the large number of through holes 12 just above the noise absorbing material. As a result, a part of noise generated from the air conditioner can be diffused so that noise propagated from the suction grill 2 and the blowout grill 9 can be suppressed to reduce the level of noise in the indoor living area.

The operation of the ventilator as described in the Unexamined Japanese Utility Model Application No. Hei 1-78292 will be described with reference to Figs. 7 and 8. Air flowing in from the axial direction by the rotation of the fan 14 is pressed out centrifugally, so that the air flows along the porous structure 16 provided in the inner surface of the blower casing 15 and is collected. The collected air is blown

4

out through the outlet 15a. At this time, noise generated in the fan 14 flows together with the air, so that the noise is diffused radially from the fan 14. A part of the noise passes through the porous structure 16 and propagates in the air layer 17 in the inside thereof to strike the blower casing 15. Then, the noise reflects and propagates in the reverse direction, so that the noise is canceled by the next reflected noise. As a result, noise is suppressed.

The conventional air conditioner indoor unit according to the Japanese Utility Model Application No. Sho 58-71631 is constructed as described above to reduce noise by the action of the through holes 12 provided in the ceiling panel 1 and the action of the noise absorbing material 13. It is therefore necessary to use a continuously foamed air-permeable material as the noise absorbing material 13 to achieve a noise absorbing effect. There arises a problem in that air leakage occurs through the noise absorbing material 13 to reduce the quantity of air passing through the heat exchanger to thereby reduce the capacity thereof. A measure to increase the output power of the ventilator 3 to prevent the reduction of the air quantity cannot be used as a radical measure, because ventilation noise in the ventilator 3 is increased by this measure. If the through holes 12 of the ceiling panel 1 are blocked to prevent air leakage, there arises a problem in that the noise absorbing effect by the noise absorbing material 13 is lowered. The ventilator 3 stands a large part of all noise generation

sources in the air conditioner. Accordingly, the area of the noise absorbing material stuck must be widened so that noise generated can be absorbed to the noise absorbing material. In the case of the conventional air conditioner, the area of the noise absorbing material stuck is insufficient. There arises a disadvantage in that the noise absorbing effect cannot be achieved sufficiently.

The conventional ventilator according to Unexamined Japanese Utility Model Application No. Hei 1-78292 is constructed as described above. Accordingly, the blower casing must have the form in which not only a porous member is arranged in the outside of the fan 14 but an air layer is secured in the outside of the porous member. There arises a disadvantage in that the height of the casing becomes so large that a large setting space is required.

SUMMARY OF THE INVENTION

The present invention was made in view of the foregoing problems accompanying the conventional apparatus, and an object the invention is to provide a ventilation system, a ventilator and an air conditioner indoor unit in which not only lowering of air quantity caused by air leakage or the like can be prevented but noise generated in the ventilator portion as a main noise generation source can be reduced, and to provide a parts arrangement adapted for this system.

Another object of the present invention is to provide a ventilation system, a ventilator and an air conditioner indoor unit in which noise can be reduced without increase of the external size of the panel or casing perpendicular to the direction of the air outlet.

The ventilation system according to the present invention comprises: a panel-type a ventilation system comprising a panel-type housing, provided with an air inlet, an air outlet, and an inlet chamber communicating with the air inlet; a centrifugal ventilator having an impeller within a ventilator casing, mounted within the housing, the ventilator casing having an air discharge outlet coupled to the aforesaid air outlet; and a closed air chamber within the housing, separated from the inlet chamber by a partition plate; the ventilator casing comprising first and second portions, of which the first portion is made of impervious material, is disposed in the inlet chamber, and is provided with an air inlet to the ventilator, communicating with the interior of the inlet chamber, and a second portion of air-permeable porous material disposed solely within the air chamber.

In the ventilation system according to the present invention, not only noise from the ventilator is absorbed efficiently but air leakage is prevented, by a combination of an air-permeable porous structure forming a part of the ventilator casing and an air chamber formed at the back surface of the porous structure.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of an air conditioner indoor unit according to a first embodiment of the present invention;

5 Fig. 2 is a sectional view of the air conditioner indoor unit in the first embodiment shown in Fig. 1;

Fig. 3 is a plan sectional view of the air conditioner indoor unit in the first embodiment shown in Fig. 1;

10 Fig. 4 is a structural view of the ventilator portion of the air conditioner indoor unit in the first embodiment shown in Fig. 1;

Fig. 5 is a sectional view showing a conventional air conditioner indoor unit;

Fig. 6 is a perspective view showing the conventional air conditioner indoor unit;

15 Fig. 7 is a sectional view showing a conventional ventilator; and

Fig. 8 is a partly sectional view showing the conventional ventilator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 The preferred embodiments of the present invention will now be described in detail with reference to accompanying drawings.

A first embodiment will be described hereunder with reference to Figs. 1, 2, 3 and 4. Fig. 1 is a perspective view
25 showing an air conditioner indoor unit, Fig. 2 is a sectional

view thereof, Fig. 3 is a plan view thereof, and Fig. 4 is a structural view of a ventilator thereof. In the drawings, parts the same as or equivalent to those in Figs. 17 and 18 are referenced correspondingly. In the drawings, the reference numeral 1 designates a ceiling panel, 2 a suction grill which forms an inlet port and 3 a ventilator disposed between the suction grill 2 and the ceiling panel 1. The ventilator 3 is provided so that the casing thereof is separated into an upper casing 3a and a lower casing 3b. The upper casing 3a is formed from an air-permeable rigid porous structure, and the lower casing 3b is formed from an air-impermeable structure. The reference numeral 4 designates a heat exchanger which is fixed to the ceiling panel 1 or the like. The reference numeral 5 designates a first partition plate which is provided between the ventilator 3 and the heat exchanger 4 to form an air inlet chamber 10 and an air outlet chamber 11. The reference numeral 6 designates a decorative panel which is fixed to the partition plate 5 or a side wall (not shown). The reference numeral 7 designates a drain pan provided at the lower portion of the heat exchanger and 8 a front panel fixed to the ceiling panel or the like. The reference numeral 9 designates a blowout grill which forms an outlet port. The reference numeral 20 designates a motor for driving the ventilator. The reference numeral 18 designates a second partition plate for partitioning the air inlet chamber 12 into upper and lower parts at a surface where the upper and lower casings of the ventilator 3

engage with each other. The upper part of the air inlet chamber 10 separated by the second partition plate forms a closed space 10a surrounded by the upper panel 1, the first partition plate 5 and a rear panel 19. The closed space 10a is communicated with the inside of the ventilator casing and the lower part 10b of the air inlet chamber through small holes of the upper casing 3a formed from an air-permeable rigid porous structure.

Fig. 4 is a view showing the structure of the ventilator 3 and the second partition plate 18. The upper casing 3a and the lower casing 3b are attached to each other so that the second partition plate 18 is disposed therebetween. A portion of the second partition plate 18 where the upper and lower casings engage with each other is formed as an angular through hole 18a. In order to prevent air leakage, flanges 3c and 3d are formed at a portion where the upper and lower casings are brought into contact with the second partition plate. Also, flanges 3e and 3f are formed at a portion where the upper and lower casings are brought into contact with the first partition plate.

The operation of the embodiment will be described hereunder. Indoor air sucked through the suction grill 2 by the action of the ventilator 3 passes through the heat exchanger 4, so that cool or hot air is blown indoors from the blowout grill 9. Noise is produced from the ventilator 3 when the ventilator 3 is operated. The noise propagates to the air

inlet chamber 10 and the air outlet chamber 11. In this embodiment, the upper casing 3a of the ventilator 3 is formed from a porous structure, so that the noise can be absorbed to this portion. As a result, the noise produced from the ventilator 3 can be suppressed. The porous structure is formed from a material having continuous pores, so that the upper casing 3a has air-permeability. Accordingly, the inside space of the ventilator 3 and the upper space 10a of the air inlet chamber 10 are communicated with each other through a large number of pores in the porous structure. There is, however, no air leakage to the outside of the unit, because the upper space 10a of the air inlet chamber 12 is enclosed with the upper panel 1, the first partition plate 5, the second partition plate 18 and the rear panel 19 which form an airtight structure (for example, plate). When the ventilator 3 is operated, the pressure of the inside of the ventilator becomes positive. As a result, the pressure of the upper space 10a of the air inlet chamber 10 becomes positive. There is, however, no passage through which air is leaked. Accordingly, air leakage through the porous structure of the upper casing 3a is prevented, so that deterioration of aerodynamic characteristic of the ventilator is prevented.

On the other hand, noise produced from the ventilator 3 propagates as compressional wave. When the compressional wave passes through small pores of the porous structure of the upper casing 3a, the porous structure serves as resistance to

absorb the energy of the compressional wave, that is, acoustic energy. Then, the compressional wave propagates to the upper space 10a of the air inlet chamber 10 as a closed space and reflects at the upper panel 1, the first partition plate 5, the second partition plate 18, the rear panel 19 and the like which serve as an enclosure of the upper space 10a. As a result, the compressional wave passes through the porous structure of the upper casing 3a again, so that the noise absorbing effect is promoted. That is, the upper space 10a of the air inlet chamber 10 serves as a back air layer for the double purpose of improving the noise absorbing characteristic of the upper casing formed from a porous structure and preventing deterioration of the aerodynamic characteristic of the ventilator, so that noise produced from the ventilator can be reduced greatly. The porous structure constituting the upper casing is formed by fusion molding of a rigid material such as a bead-shaped plastic material. Accordingly, the porous material per se can be used as a strength material, so that no member is required for mounting the upper casing.

The present invention has the following effects.

15 The ventilation system has a first casing portion disposed in a panel incorporating a ventilator and formed from an airtight structure to form a part of the ventilator, a second casing portion united with the first casing portion into one body and formed from an air-permeable porous structure to form a casing of the ventilator, and an air chamber formed by a partition plate for partitioning the second casing portion and the inlet chamber in the panel. Accordingly, not only
20 noise from the ventilator can be absorbed efficiently but deterioration of the aerodynamic characteristic of the ventilator caused by air leakage can be prevented, so that a low-noise ventilation system can be provided.



14.

CLAIMS:

1. A ventilation system comprising a panel-type housing, provided with an air inlet, an air outlet, and an inlet chamber communicating with the air inlet; a centrifugal ventilator having an impeller within a ventilator casing, mounted within the housing, the ventilator casing having an air discharge outlet coupled to the aforesaid air outlet; and a closed air chamber within the housing, separated from the inlet chamber by a partition plate; the ventilator casing comprising first and second portions, of which the first portion is made of impervious material, is disposed in the inlet chamber, and is provided with an air inlet to the ventilator, communicating with the interior of the inlet chamber, and a second portion of air-permeable porous material disposed solely within the air chamber.
2. An air conditioner unit substantially as described with reference to figures 1 to 4 of the accompanying drawings.