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23 May 2003

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AIR CONDITIONER



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TECHNICAL FIELD

5 The present invention relates to an air conditioner capable of preventing dew from being formed.

BACKGROUND ART

10 Conventionally, there has been an indoor unit as shown in Fig. 4A. In the indoor unit 101, air is sucked from a suction inlet 105 by a turbo fan 103 which is driven by a motor 102. The air is heat-exchanged by a heat exchanger 106, and then blown out from a blow-off outlet 108 via a blow-off path 107. Reference numeral 109 denotes a wind direction blade.

15 Fig. 4B is a bottom view of the indoor unit 101. Fig. 4A is a sectional view of the indoor unit 101 taken along a line Z-Z of Fig. 4B. Blow-off outlets 108, 110, and 111 having a shape of a long and narrow rectangle and surrounding the suction inlet 105 are formed on a panel 112.

20 A casing 115 has closing parts 113A and 113B which close end regions of the blow-off outlet 110 having a predetermined length ranging from one end of the blow-off outlet 110 toward the center thereof. Similarly, the casing 115 has a closing part 116 closing an end region of

25 the blow-off outlet 108 having a predetermined length

ranging from one end of the blow-off outlet 108 toward the center thereof. Similarly, the casing 115 has a closing part 117 closing an end region of the blow-off outlet 111 having a predetermined length ranging from an end of the blow-off outlet 111 toward the center thereof.

By narrowing the area of the blow-off outlets 110, 108, and 111 with the closing parts 113A, 113B, 116, and 117, the speed of wind blown out from the blow-off outlets 108, 110, and 111 is increased to lengthen the travel distance of the wind.

In air-cooling time, cold blown-off air and indoor air having a higher temperature than the blown-off air contact each other at an end of the wind direction blade 109. As a result, dew is formed on the end of the wind direction blade 109 and a water-drop falls therefrom.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide an air conditioner which increases a blow-off speed without forming dew at a blow-off outlet.

In order to achieve the object, the present invention provides an air conditioner comprising:

a blow-off outlet for discharging air coming from an indoor heat-exchanger;

a closing member provided such that one end of the closing member is spaced by a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet, for the closing member to partly close the blow-off outlet; and

a wind direction blade for directing air, provided downstream of the closing member.

In the air conditioner, the closing member is provided at a position spaced by the predetermined length from an end of the blow-off outlet. Therefore, when cold air blown out from the indoor heat exchanger strikes the closing member during an air-cooling operation, the cold air is capable of dividedly flowing to openings positioned at both sides of the closing member.

Thus, according to the air conditioner, unlike the conventional construction having the closing part extending continuously from the end of the blow-off outlet, the end portion of the wind direction blade is covered with the cold air. Thus, it is possible to prevent the cold air and indoor air from contacting each other at the end portion of the wind direction blade. Accordingly, it is possible to prevent dew from being formed. Thus, according to the air conditioner, it is possible to increase the blow-off speed and the travel distance of the blow-off air without forming dew on the end portion of the air direction blade.

In an air conditioner of the invention, a dimension between both ends of the blow-off outlet may be smaller than a dimension between both ends of an open section on which the wind direction blade is installed.

In such an air conditioner, when, owing to a drain pan installed, for example, the dimension between both ends of the blow-off outlet is smaller than the dimension between both ends of the open section on which the wind direction blade is installed, it is possible to increase the blow-off speed and the travel distance of the blow-off air without forming dew on the end portion of the wind direction blade, owing to the closing member spaced at a predetermined interval from the end of the blow-off outlet.

Another aspect of the present invention is an air conditioner comprising :

a fan and a heat exchanger disposed in a casing;

a blow-off path-forming member forming a blow-off path along which air is to be discharged

a wind direction blade for directing air, provided on a blow-off outlet for discharging air,

a guide plate for guiding air from the blow-off path to a space, between the blow-off path and axially end portion of the wind direction blade to introduce the wind to said axially end portion and

a closing member one end of which is spaced a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet to partly close the blow-off outlet.

In such an air conditioner, assuming that an air-cooling operation is performed, a part of cold air flowing through the blow-off path is guided by the guide plate toward the space between the blow-off path forming member and the axially end portion of the wind direction blade and is further guided to the axially end portion of the wind direction blade.

Therefore, a slight amount of cold air flows on the periphery of the axially end portion of the wind direction blade. Thus, it is possible to prevent air from becoming turbulent on the periphery of the axially end portion. Thus, the cold air and indoor warm air are prevented from mixing with each other on the periphery of the axially end portion of the wind direction blade, and hence, dew is not formed on the axially end portion of the wind direction blade.

In an air conditioner of the invention, a part of the guide plate may project into the blow-off path; and holes for introducing air to the axially end portion of the wind direction blade may be formed on the guide plate.

In such an air condition, a part of cold air flowing inside the blow-off path may be curved by the part of the guide plate projecting into the blow-off outlet to flow the cold air along the surface of the guide plate. The curved cold air flows inside the space along the guide plate and then guided into

the axially end portion of the wind direction blade through the holes formed on the guide plate, Accordingly, it is possible to reliably flow a slight amount of cold air on the periphery of the axially end portion of the wind direction blade and prevent air from being turbulent on the periphery of the axially end portion. Thus, it is possible to reliably prevent cold air and indoor warm air from mixing with each other on the periphery of the axially end portion of the wind direction blade and securely prevent dew from being formed on the axially end portion of the wind direction blade.

In an air conditioner of the invention, a front end portion of the guide plate projecting into the blow-off path may be bent toward an upstream side of the blow-off path such that the front end portion of the guide plate is oblique with respect to a base portion of the guide plate.

In such an air conditioner, the front end portion of the guide plate projects into the blow-off path and is bent toward the upstream side of the blow-off path such that the front end portion of the guide plate is oblique with respect to the base portion thereof. Thus, the front end portion of the guide plate introduces a part of the cold wind flowing through the blow-off path smoothly and reliably into the space along the surface of the guide plate. Thus, it is possible to reliably and smoothly introduce the cold air into the axially end portion of the wind direction blade and prevent dew from being formed on the axially end portion of the wind direction blade.

In an air conditioner of the invention, a decorative panel having the blow-off outlet may be provided with a guide section for guiding air to the axially end portion of the wind direction blade.

In such an air conditioner, cold air which is to be blown out from the blow-off outlet strikes the guide section formed on the decorative panel, thus being guided by the guide section. As a result, the cold air flows on the periphery of the axially end portion of the wind direction blade and in particular flows along the back side of the axially end portion of the wind direction blade. Therefore, it is possible to prevent dew from being formed on the peripheral surface of the axially end portion of the wind direction blade. The guide plate guides the cold air from the upstream side to the axially end portion of the wind direction blade and further the guide section of the decorative panel guides the cold air from the downstream side to the back side of the axially end portion of the wind direction blade. Accordingly, it is possible to securely prevent dew from being formed on the peripheral surface of the axially end portion of the wind direction blade.

Another aspect of the invention is an air conditioner, comprising:

a fan and a heat exchanger disposed in a casing;

a blow-off path-forming member forming a blow-off path along which air is to be discharged;

a suction inlet and a blow-off outlet for discharging air, provided on a decorative panel and a wind direction blade is for directing air, provided on the blow-off outlet

a guide section on the decorative panel, for guiding air to an axially end portion of the wind direction blade; and

a closing member one end of which is spaced a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet to partly closed the blow-off outlet wherein

the air conditioner is operable to suck air from the suction inlet and discharge the air from the blow-off outlet through the fan and the blow-off path.

In such an air conditioner, cold air which is to be blown out from the blow-off outlet strikes the guide section formed on the decorative panel and is guided thereby. As a result, the cold air flows on the periphery of the axially end portion of the wind direction blade and in particular flows along the back side of the axially end portion of the wind direction blade. Accordingly, it is possible to prevent dew from being formed on the peripheral surface of the axially end portion of the wind direction blade and in particular, on the back side of the axially end portion of the wind direction blade.

In an air conditioner of the invention, at least part of the guide section may located outside a corner of the blow-off outlet and a part of the guide section may confront a part of an inner side of the blow-off path.

In such an air conditioner, cold air which is to be blown out from the blow-off outlet strikes a part of the guide section confronting a part of the inner side of the blow-off path and is guided along the surface of the guide section. Because at

least part of the guide section is located outside the corner of the blow-off outlet, the cold wind flowing along the surface of the guide section is blown out smoothly from the blow-off outlet to the outside. Because the cold wind flows smoothly on the periphery of the axially end portion of the wind direction blade, it is possible to prevent dew from being formed thereon.

In an air conditioner of the invention, the blow-off path-forming member may be a part of a drain pan.

In such an air conditioner, because the blow-off path-forming member is a part of the drain pan, it is possible to form the blow-off path easily. Further, when the space for the guide plate is provided, it is possible to form the space easily and at a low cost by cutting off a predetermined portion of the drain pan.

In an air conditioner of the invention, a value determined by dividing an interval (X) between the end of the blow-off outlet and one end of the closing member toward the center of the blow-off outlet by a width (Y) of the closing member may be more than 0.2 and less than 1.0.

In such an air conditioner, (interval X) / (width Y) is set to:

$$0.2 < X/Y < 1.0$$

Thus, it is possible to appropriately achieve dew formation prevention performance and increase the travel distance of the blow-off air. That is, when X/Y is less than 0.2, the interval X is short, which causes the amount of the cold wind

flowing to the end portion of the wind direction blade to be short. Thus, the dew formation prevention performance is inferior at the end portion of wind direction blade. When the width Y of the closing member is large, dew is formed on the wind direction blade located in a region confronting the closing member. When X/Y is more than 1.0, the interval X is too great or the width Y is too small. Thus, it is impossible to increase the travel distance of the blow-off air.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is a sectional view showing an indoor unit of an air conditioner according to an embodiment of the present invention;

Fig. 1B is a bottom view of the indoor unit;

Fig. 2 is a sectional view showing the neighborhood of a blow-off outlet of the indoor unit;

Fig. 3A is a sectional view showing the neighborhood of a blow-off outlet of a modification of the embodiment;

Fig. 3B is a bottom view of the modification;

Fig. 4A is a sectional view showing an indoor unit of a conventional air conditioner; and

Fig. 4B is a bottom view of the indoor unit.

BEST MODE FOR CARRYING OUT THE INVENTION

The embodiments of the air conditioner of the present invention will be described in detail below.

Fig. 1A is a sectional view of an indoor unit 1 of an embedded-in-ceiling type of an air conditioner, which is embedded in a ceiling, according to an embodiment of the present invention. Fig. 1B is a bottom view showing the indoor unit 1. Fig. 1A is a sectional view taken along a cut line A-A of Fig. 1B.

As shown in Fig. 1A, an indoor unit 1 has a decorative panel 2, a casing 3, a motor 5, a turbo fan 6, and an indoor heat exchanger 7, wherein the motor 5, turbo fan 6, and indoor heat exchanger 7 are positioned inside the casing main body 3. The decorative panel 2 has a suction inlet 8 opening spaciouly at the center thereof and blow-off outlets 10, 11, and 12 having a shape of a long and narrow rectangle and formed on the periphery of the suction inlet 8. A grille 13 and a filter 14 are installed on the suction inlet 8. Wind direction blades 15, 16, and 17 are installed on the blow-off outlets 10, 11, and 12, respectively.

Closing members 20, 21 having a width Y are disposed so that one end of each closing members 20, 21 is spaced from each end 11a, 11b of the blow-off outlet 11 toward the center thereof by a predetermined length X . The closing members 20 and 21 are so fixed to the casing 3 that the closing members 20 and 21 extend over the blow-off outlet 11 and a blow-off outlet 51 of the casing 3 of the air conditioner, respectively. Closing members 22 and 23 are so fixed to the casing 3 that the closing members 22 and 23 extend over the blow-off outlet 10 and a blow-off outlet 52 of the casing 3, and the blow-off outlet 12 and a blow-off outlet 53 of the casing 3, respectively.

According to the above construction, the closing members 20 and 21 are provided at the position spaced by the predetermined length X from the ends 11a and 11b of the blow-off outlet 11, respectively. Therefore, when cold
5 wind blown out from the indoor heat exchanger 7 strikes the closing member 20 (21) during air cooling time, the cold wind is capable of dividedly flowing to openings 31, 32 (33) positioned at both sides of the closing member 20 (21), as shown in Fig. 2. Thus, according to the embodiment,
10 unlike the conventional construction having the closing part extending continuously from the end of the blow-off outlet, end portions 16A and 16B of the wind direction blade 16 are covered with the cold wind blown thereto from the openings 32 and 33. Thus, it is possible to prevent
15 the cold wind and indoor air from contacting each other at the end portions 16A and 16B of the wind direction blade 16. Accordingly, it is possible to prevent dew from being formed on the end portions 16A and 16B of the wind direction blade 16. Thus, it is possible to increase the
20 blow-off speed and the travel distance of the blow-off wind without forming dew.

In the embodiment, (interval X) of the closing members 20, 21/(width Y) thereof is set to:

$$0.2 < X/Y < 1.0$$

Thus, it is possible to appropriately achieve dew formation prevention performance and increase the travel distance of the blow-off wind. That is, when X/Y is less than 0.2 because the interval X is short, which causes the amount of the cold wind flowing to the end portions 16A and 16B of the wind direction blade 16 to be short. Thus, the dew formation prevention performance is inferior at the end portions 16A and 16B. When X/Y is less than 0.2 because the width Y of the closing members 20 and 21 is large, dew is formed on the wind direction blade 16 located in a region confronting the closing members 20 and 21. When X/Y is more than 1.0, the interval X is too great or the width Y is too small. Thus, it is impossible to increase the travel distance of the blow-off wind. In particular, when $(\text{interval } X)/(\text{width } Y)$ is set to about 0.6, it is possible to prevent formation of dew and maximize the travel distance of the blow-off wind.

Figs. 3A and 3B show a modification of the embodiment. In the modification, guide plates 37 and 38 are respectively provided between the wind direction blade 16 positioned downstream from the closing members 20, 21 and projection portions 35, 36 projecting substantially horizontally from a lower end 3A of the casing 3 toward the closing members 20, 21. Spaces 43 and 43 are provided between the projection portion 35 and the end portion 16A

in the axial direction of the wind direction blade 16 and between the projection portion 36 and the end portion 16B in the axial direction of the wind direction blade 16, respectively.

5 The guide plates 37 and 38 are fixed to the decorative panel 2 and partly confront the end opening 32 positioned between the closing member 20 and the projection portion 35 and the end opening 33 positioned between the closing member 21 and the projection portion 36. As shown
10 in Fig. 3B, the guide plates 37 and 38 have a plurality of through-holes 41. In the modification, owing to the formation of the projection portions 35 and 36, a dimension D1 between both ends of a blow-off outlet constituted of the openings 32, 33, and 31 is smaller than a dimension D2
15 between both ends of a blow-off outlet (open section) on which the wind direction blade 16 is installed. A part of a drain pan can be installed on a space positioned above the projection portions 35 and 36.

 The projection portions 35 and 36 constitute a
20 blow-off path-forming member. The end openings 32, 33, and opening 31 constitute a blow-off path. When the projection portions 35 and 36 are constituted of a part of the drain pan (not shown), the construction of the indoor unit can be simplified and a cost reduction can be accomplished.
25 Further, it is possible to form the spaces 43 and 43 for

the guide plates 37 and 38 easily and at a low cost by cutting off a predetermined portion of the drain pan.

In the modification, assuming that an air-cooling operation is performed, a part of cold air (cold wind) flowing through the openings 32 and 33 constituting part of the blow-off path is guided by the guide plates 37 and 38 toward the space 43 between the projection portion 35 and the end portion 16A in the axial direction of the wind direction blade 16 and the space 43 between the projection portion 36 and the end portion 16B in the axial direction of the wind direction blade 16. The projections 35 and 36 form the blow-off outlet. The part of the cold air (cold wind) is further guided to the end portions 16A and 16B in the axial direction of the wind direction blade 16.

Therefore, a slight amount of cold wind flows on the periphery of the end portions 16A and 16B in the axial direction of the wind direction blade 16. Thus, it is possible to prevent the cold wind from becoming turbulent on the periphery of the end portions 16A and 16B. Accordingly, the cold air and indoor warm air are prevented from mixing with each other on the periphery of the end portions 16A and 16B in the axial direction of the wind direction blade 16, and hence, dew is not formed on the end portions 16A and 16B. As described above, in the modification, the spaces are formed above the projection

portions 35 and 36 to install a desired mechanism (for example, drain pan) therein. In addition, it is possible both to prevent dew from being formed on the end portions 16A and 16B and to increase wind speed.

5 In the modification, parts of the guide plates 37 and 38 respectively overlap the openings 32 and 33 constituting the blow-off outlet, and holes 41 for guiding wind to the end portions 16A and 16B in the axial direction of the wind direction blade 16 are formed on the guide
10 plates 37 and 38. Therefore, parts of cold wind flowing inside the openings 32 and 33 are curved to flow along the surface of each of the guide plates 37 and 38 by parts of the guide plates 37 and 38. The curved cold winds flow inside the spaces 43 and 43 along the guide plates 37 and
15 38 and then guided into the end portions 16A and 16B in the axial direction of the wind direction blade 16 through the holes 41 formed on the guide plates 37 and 38. Accordingly, it is possible to reliably flow a slight amount of cold wind on the periphery of the end portions 16A and 16B in
20 the axial direction of the wind direction blade 16 and prevent wind from being turbulent on the periphery of the end portions 16A and 16B. Thus, it is possible to reliably prevent cold air and indoor warm air from mixing with each other on the periphery of the end portions 16A and 16B of

the wind direction blade 16 and securely prevent dew from being formed on the end portions 16A and 16B.

Although not shown, when the front end portion of each of the guide plates 37 and 38 projecting into the blow-off path is bent toward the upstream side of the blow-off path such that the front end portion of each of the guide plates 37 and 38 is oblique with respect to the base portion thereof, the front end portion of each of the guide plates 37 and 38 introduces a part of the cold wind flowing through the blow-off path smoothly and reliably into each of the spaces 43 and 43 along the surface of each of the guide plates 37 and 38. Thus, it is possible to reliably and smoothly introduce the cold wind into the end portions 16A and 16B of the wind direction blade 16 in the axial direction thereof and prevent dew from being formed on the end portions 16A and 16B.

In the modification, when the decorative panel 2 having the blow-off outlet 11 is provided with a guide section (not shown) located downstream from the end portions 16A and 16B of the wind direction blade 16, cold wind which is to be blown out from the blow-off outlet 11 strikes the guide section. As a result, the cold wind flows on the periphery of the axially end portions 16A and 16B of the wind direction blade 16 in the axial direction and in particular flows along the back side of the end

portions 16A and 16B. Therefore, it is possible to prevent dew from being formed on the peripheral surface of the axially end portions 16A and 16B of the wind direction blade 16. The guide plates 37 and 38 guide the cold wind to the axially end portions 16A and 16B of the wind direction blade 16 from the upstream side and further the guide section of the decorative panel 2 guides the cold wind to the back side of the end portions 16A and 16B from the downstream side. Accordingly, it is possible to more securely prevent dew from being formed on the peripheral surface of the end portions 16A and 16B.

Further, when the guide section is located outside the corner of the blow-off outlet 11 and a part of the guide section confronts a part of the inner side of each of the openings 32 and 33 constituting the blow-off path, cold wind which is to be blown out from the blow-off outlet 11 is guided along the surface of the guide section by striking the cold wind with a part of the guide section. Because the guide section is located outside the corner of the blow-off outlet 11, the cold wind flowing along the surface of the guide section is blown out smoothly from the blow-off outlet 11. Because the cold wind flows smoothly on the periphery of the end portions 16A and 16B of the wind direction blade 16, it is possible to prevent dew from being formed thereon.

APPLICABILITY IN INDUSTRY

As described above, the air conditioner of the present invention is capable of increasing a blow-off speed without forming dew at a blow-off outlet and is useful for
5 improving air-conditioning performance without forming dew.

CLAIMS

1. An air conditioner comprising:
 - a blow-off outlet for discharging air coming from an indoor heat-exchanger;
 - a closing member provided such that one end of the closing member is spaced by a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet, for the closing member to partly close the blow-off outlet; and
 - a wind direction blade for directing air, provided downstream of the closing member.
2. An air conditioner according to claim 1, wherein a dimension between both ends of the blow-off outlet is smaller than a dimension between both ends of an open section on which the wind direction blade is installed.
3. An air conditioner comprising:
 - a fan and a heat exchanger disposed in a casing);
 - a blow-off path-forming member forming a blow-off path along which air is to be discharged;
 - a wind direction blade for directing air, provided on a blow-off outlet for discharging air;
 - a guide plate for guiding air from the blow-off path to a space between the blow-off path and an axially end portion of the wind direction blade, to

introduce the wind to said axially end portion; and

a closing member, one end of which is spaced a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet to partly close the blow-off outlet.

4. An air conditioner according to claim 3, wherein a part of the guide plate projects into the blow-off path (32, 33); and holes for introducing air to the axially end portion of the wind direction blade are formed on the guide plate.

5. An air conditioner according to claim 3 or 4, wherein a front end portion of the guide plate projecting into the blow-off path is bent toward an upstream side of the blow-off path such that the front end portion of the guide plate is oblique with respect to a base portion of the guide plate.

6. An air conditioner according to any one of claims 3 through 5, wherein a decorative panel having the blow-off outlet is provided with a guide section for guiding air to the axially end portion of the wind direction blade (16).

7. An air conditioner comprising:
a fan and a heat exchanger disposed in a casing;
a blow-off path-forming member forming a blow-off path along which air is to be discharged;

a suction inlet and a blow-off outlet for discharging air, provided on a decorative panel (2); and a wind direction blade for directing air, provided on the blow-off outlet;

a guide section on the decorative panel, for guiding air to an axially end portion of the wind direction blade; and

a closing member one end of which is spaced a predetermined length from an end of the blow-off outlet toward the center of the blow-off outlet to partly closed the blow-off outlet ; wherein

the air conditioner is operable to suck air from the suction inlet and discharge the air from the blow-off outlet through the fan and the blow-off path.

8. An air conditioner according to claim 6 or 7, wherein at least part of the guide section is located outside a corner of the blow-off outlet, and a part of the guide section confronts a part of an inner side of the blow-off path.

9. An air conditioner according to any one of claims 3 through 8, wherein the blow-off path-forming member is a part of a drain pan.

10. An air conditioner according to any one of claims 1 through 9, wherein a value determined by dividing an interval, X, between the end of the blow-off outlet and one end of the closing member toward the center of the blow-off outlet by a width, Y, of the closing member is more than 0.2 and less than 1.0.