DESCRIPTION

BLOWER AND REFRIGERATION DEVICE COMPRISING BLOWER

TECHNICAL FIELD

The present invention relates to a fan, and a refrigeration apparatus including the fan.

BACKGROUND ART

Conventionally, fans which generate an air flow in an air conditioner or the like are known. For example, Patent Literature 1 (WO 2015/125486) discloses a fan which generates an air flow flowing in the rotation axis direction. The fan disclosed in Patent Literature 1 includes a plurality of vanes radially extending from a core part as seen in the rotation axis direction, a ring part connected to respective tips of the vanes, and a flow rectifying member which is cylindrical and extends along the rotation axis direction.

In the fan disclosed in Patent Literature 1, a clearance is formed between the ring part and the flow rectifying member so as to allow the ring part to rotate with the vanes. Through the clearance, part of an air flow on the secondary side (the blow-out side) reversely flows toward the primary side (the intake side). The air having reversely flowed in such a manner (i.e., backflow air) merges with air to be taken into the fan (i.e., intake air) (that is, a short-circuit may occur). In order to minimize noises in merging which occur due to the backflow air creating a swirl before merging with the intake air, Patent Literature 1 includes a flange part at the tip of the ring part for rectifying the flow of the backflow air. Thus, Patent Literature 1 prevents the backflow air from generating a swirl.

SUMMARY OF THE INVENTION

<Technical Problem>

With the above-described fan, as the flow rate of the backflow air (the backflow volume) increases, the flow rate of an airflow blown out from the fan (the airflow volume) reduces. That is, reducing the backflow volume increases the airflow volume, contributing to improving the efficiency of the fan. However, Patent Literature 1 mainly discusses reducing the noises, which is achieved by rectifying the backflow air thereby minimizing an occurrence of a swirl. Patent Literature 1 is silent about reducing the backflow volume (that is, improving the efficiency of the fan).

Embodiments of the present invention provide a fan with improved efficiency.

<Solution to Problem>

According to a first aspect of the present invention, there is provided a fan including: a core part connected to a drive source; a plurality of vanes radially extending from the core part as seen in a rotation axis direction; a ring part being ring-like as seen in the rotation axis direction and connected to respective tips of the vanes on a radially outer side relative to the vanes; and a flow rectifying member disposed spaced apart in the radial direction from the ring part, the flow rectifying member being a cylindrical member extending along the rotation axis direction and configured to rectify air sent by the vanes, wherein the ring part includes: a first part including a first end overlapping with a flow rectifying member end being an upstream side end of the flow rectifying member as seen in the radial direction, the first part extending along the rotation axis direction on a radially inner side relative to the flow rectifying member; a second part including a second end being spaced apart in the rotation axis direction from the flow rectifying member end and overlapping with the flow rectifying member as seen in the rotation axis direction, the second part being connected to the first end and extending along the radial direction to reach the second end; and a third part connected to the second end and extending along the radial direction on the radially outer side than the flow rectifying member end, wherein the second end overlaps with a virtual point which is reached by the flow rectifying member end being linearly extended toward the upstream side to the rotation axis direction, and a first dimension being a length in the radial direction of the third part is at least 0.5 times as great as a first distance being a straight-line distance between the flow rectifying member end and the virtual point.

According to a second aspect of the present invention, there is provided a fan including: a core part connected to a drive source; a plurality of vanes radially extending from the core part as seen in a rotation axis direction; a ring part being ring-like as seen in the rotation axis direction and connected to respective tips of the vanes on a radially outer side relative to the vanes; and a flow rectifying member disposed spaced apart in the radial direction from the ring part, the flow rectifying member being a cylindrical member extending along the rotation axis direction and configured to rectify air sent by the vanes, wherein the ring part includes: a first part including a first end overlapping with a flow rectifying member end being an upstream side end of the flow rectifying member as seen in the radial direction, the first part extending along the rotation axis direction on a radially inner side relative to the flow rectifying member; a second part including a second end being spaced apart in the rotation axis direction from the flow rectifying member end and overlapping with the flow rectifying member as seen in the rotation axis direction, the second part being connected to the first end and extending along the rotation axis direction and then along the radial direction to reach the second end; and a third part connected to the second end and extending on the radially outer side than the flow rectifying member end, wherein the second end overlaps with a virtual point which is reached by the flow rectifying member end

being linearly extended toward the upstream side to the rotation axis direction, and a first dimension being a length in the radial direction of the third part is at least 0.5 times as great as a first distance being a straight-line distance between the flow rectifying member end and the virtual point. In the fan according to the above aspects of the present invention, the ring part includes the third part connected to the second end which overlaps with the virtual point which is reached by the flow rectifying member end being linearly extended toward the upstream side in the rotation axis direction, the third part extending along the radial direction on the radially outer side than the flow rectifying member end. The first dimension (the length in the radial direction of the third part) is at least 0.5 times as great as the first distance (the straight-line distance between the flow rectifying member end and the virtual point). That is, the third part extends on the radially outer side than the flow rectifying member end by a length which is at least 0.5 times as great as the clearance formed between the ring part and the flow rectifying member. Thus, the third part provides resistance on the backflow air (the air that reversely flows through the clearance between the ring part and the flow rectifying member) flowing toward a point where it merges with the intake air (the air taken into the fan), thereby greatly detours the backflow air flowing toward the merging point. Consequently, the flow path resistance on the backflow air flowing toward the merging point becomes great, whereby the backflow volume (the amount of the backflow air) per unit time reduces. Hence, the efficiency of the fan improves.

As used herein, the expression "extending along the rotation axis direction or the radial direction" does not strictly mean extending in the rotation axis direction or the radial direction, but also means extending while being inclined relative to the rotation axis direction or the radial direction. The expression "radially inner side" refers to the inner circumference side of the fan, and the expression "radially outer side" refers to the outer circumference side of the fan. The expression "upstream side" refers to the side nearer to the intake side of the fan.

As used herein, the expression "ring-like" does not strictly mean ring-like, but also means a substantially annular shape which is substantially annular as a whole while meandering or bending. The expression "cylindrical" does not strictly mean cylindrical, but also means substantially cylindrical including a flare-like shape with its cross section on one end side gradually increasing toward other end, and an hourglass shape with its cross section gradually reducing from the opposite ends.

In an embodiment, the third part extends in a direction perpendicular to a direction in which the flow rectifying member extends. This simple configuration greatly detours the backflow air flowing toward a point where it merges with the intake air. This reduces the backflow volume at lower costs.

In an embodiment, the third part extends along the radial direction on the radially outer side than the flow rectifying member end, and then extends along the rotation axis

direction. The flow rectifying member end is positioned on the radially inner side relative to the third part. The flow rectifying member end overlaps with the third part as seen in the radial direction. This configuration further greatly detours the backflow air flowing toward a point where it merges with the intake air. This further reduces the backflow volume and further improves the efficiency of the fan.

In an embodiment, the flow rectifying member is a bell mouth disposed on the downstream side relative to the vanes. This greatly detours the backflow air passing through the clearance between the bell mouth disposed on the blow-out side relative to the vanes and the ring part. Hence, this improves the efficiency of the fan including the bell mouth and the ring part.

In an embodiment, the first distance falls within a range of 5 mm to 15 mm inclusive. The first dimension is 4 mm or more. This surely detours the backflow air flowing toward a point where it merges with the intake air while preventing an increase in size of the fan.

In an embodiment, the fan is an axial flow fan configured to send air in the rotation axis direction. This improves the efficiency of the axial flow fan including the flow rectifying member and the ring part.

According to a third aspect of the present invention, there is provided a refrigeration apparatus, including: the fan according to the above aspects, and a heat exchanger including a heat transfer pipe through which a refrigerant flows, the heat exchanger being configured to allow an air flow generated by the fan to exchange heat with the refrigerant.

The refrigeration apparatus according to the third aspect of the present invention includes the fan with improved efficiency and the heat exchanger with increased heat exchange volume. Hence, the refrigeration apparatus with improved performance is provided.

<Advantageous Effects of Invention>

With the fan according to the above aspects of the present invention, the third part provides resistance on the backflow air (the air that reversely flows through the clearance formed between the ring part and the flow rectifying member) flowing toward a point where it merges with the intake air (the air taken into the fan), thereby greatly detours the backflow air flowing toward the merging point. Consequently, the flow path resistance on the backflow air flowing toward the merging point becomes great, whereby the backflow volume (the amount of the backflow air) per unit time reduces. Hence, the efficiency of the fan improves.

The fan according to an embodiment of the present invention reduces the backflow volume at lower costs.

The fan according to an embodiment of the present invention further reduces the backflow volume and further improves the efficiency of the fan.

The fan according to an embodiment of the present invention including the bell mouth and the ring part exhibits improved efficiency.

The fan according to an embodiment of the present invention surely detours the backflow air flowing toward a point where it merges with the intake air while preventing an increase in size of the fan.

The fan according to an embodiment of the present invention provides the axial flow fan including the flow rectifying member and the ring part with improved efficiency.

The refrigeration apparatus according to the third aspect of the present invention includes the fan with improved efficiency and the heat exchanger with increased heat exchange volume. Hence, the refrigeration apparatus with improved performance is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic configuration diagram of a refrigeration apparatus according to an embodiment of the present invention.

FIG. 2 is an exterior view of the refrigeration apparatus.

FIG. 3 is a schematic diagram schematically showing a target space and a heat-source-side heat exchanger housing space.

FIG. 4 is a perspective view of a heat-source-side fan as seen from the blow-out side.

FIG. 5 is a front view of the heat-source-side fan as seen from the blow-out side.

FIG. 6 is a cross-sectional view taken along line VI-VI in FIG. 5.

FIG. 7 is a perspective view of a fan rotor as seen from the blow-out side.

FIG. 8 is a front view of the fan rotor as seen from the blow-out side.

FIG. 9 is a front view of the fan rotor as seen from the intake side.

FIG. 10 is an enlarged view of X portion in FIG. 6.

FIG. 11 is a schematic diagram showing the state where a shroud in FIG. 10 is replaced by a shroud not including a third extending part.

FIG. 12 is a graph showing an exemplary pressure gain when the fan including the shroud shown in FIG. 10 and the fan including the shroud shown in FIG. 11 operate under an identical condition.

FIG. 13 is a schematic diagram showing the state where the shroud in FIG. 10 is replaced by a shroud according to a variation A.

FIG. 14 is a graph showing an exemplary pressure gain when the fan including the shroud in FIG. 10, the fan including the shroud in FIG. 11, and the fan including the shroud in FIG. 13 operate under an identical condition.

DESCRIPTION OF EMBODIMENT

CLAIMS

1. A fan (30) comprising:

a core part (51) connected to a drive source (M30);

a plurality of vanes (55) radially extending from the core part as seen in a rotation axis (A1) direction (dr1);

a ring part (60) being ring-like as seen in the rotation axis direction and connected to respective tips of the vanes on a radially outer side (dr2) relative to the vanes; and

a flow rectifying member (65) disposed spaced apart in the radial direction from the ring part, the flow rectifying member (65) being a cylindrical member extending along the rotation axis direction and configured to rectify air sent by the vanes, wherein

the ring part includes:

a first part (61) including a first end (611) overlapping with a flow rectifying member end (66) being an upstream side end of the flow rectifying member as seen in the radial direction, the first part (61) extending along the rotation axis direction on a radially inner side relative to the flow rectifying member;

a second part (62) including a second end (621) being spaced apart in the rotation axis direction from the flow rectifying member end and overlapping with the flow rectifying member as seen in the rotation axis direction, the second part (62) being connected to the first end and extending along the rotation axis direction and then along the radial direction to reach the second end; and

a third part (63) connected to the second end and extending along the radial direction on the radially outer side than the flow rectifying member end, wherein

the second end overlaps with a virtual point (P1) which is reached by the flow rectifying member end being linearly extended toward the upstream side to the rotation axis direction, and

a first dimension (L1) being a length in the radial direction of the third part is at least 0.5 times as great as a first distance (D1) being a straight-line distance between the flow rectifying member end and the virtual point.

2. A fan (30) comprising:

a core part (51) connected to a drive source (M30);

a plurality of vanes (55) radially extending from the core part as seen in a rotation axis (A1) direction (dr1);

a ring part (60a) being ring-like as seen in the rotation axis direction and connected to respective tips of the vanes on a radially outer side (dr2) relative to the vanes; and

a flow rectifying member (65) disposed spaced apart in the radial direction from the ring part, the flow rectifying member (65) being a cylindrical member extending along the rotation axis direction and configured to rectify air sent by the vanes, wherein

the ring part includes:

a first part (61) including a first end (611) overlapping with a flow rectifying member end (66) being an upstream side end of the flow rectifying member as seen in the radial direction, the first part (61) extending along the rotation axis direction on a radially inner side relative to the flow rectifying member;

a second part (62) including a second end (621) being spaced apart in the rotation axis direction from the flow rectifying member end and overlapping with the flow rectifying member as seen in the rotation axis direction, the second part (62) being connected to the first end and extending along the rotation axis direction and then along the radial direction to reach the second end; and

a third part (63a) connected to the second end and extending on the radially outer side than the flow rectifying member end, wherein

the second end overlaps with a virtual point (P1) which is reached by the flow rectifying member end being linearly extended toward the upstream side to the rotation axis direction, and

a first dimension (L1') being a length in the radial direction of the third part is at least 0.5 times as great as a first distance (D1) being a straight-line distance between the flow rectifying member end and the virtual point.

3. The fan (30) according to claim 2, wherein

the third part extends along the radial direction on the radially outer side than the flow rectifying member end, and then extends along the rotation axis direction, and

the flow rectifying member end is positioned on the radially inner side relative to the third part and overlaps with the third part as seen in the radial direction.

4. The fan (30) according to any one of claims 1 to 3, wherein the flow rectifying member is a bell mouth disposed on the downstream side relative to the vanes.

5. The fan (30) according to any one of claims 1 to 4, wherein
the first distance is no less than 5 mm and no more than 15 mm, and
the first dimension is 4 mm or more.

6. The fan (30) according to any one of claims 1 to 5, wherein the fan (30) is an axial flow fan configured to send air in the rotation axis direction.

7. A refrigeration apparatus (100), comprising:
the fan (30) according to any one of claims 1 to 6, and
a heat exchanger (12) including a heat transfer pipe through which a refrigerant flows, the heat exchanger (12) being configured to allow an air flow generated by the fan to exchange heat with the refrigerant.