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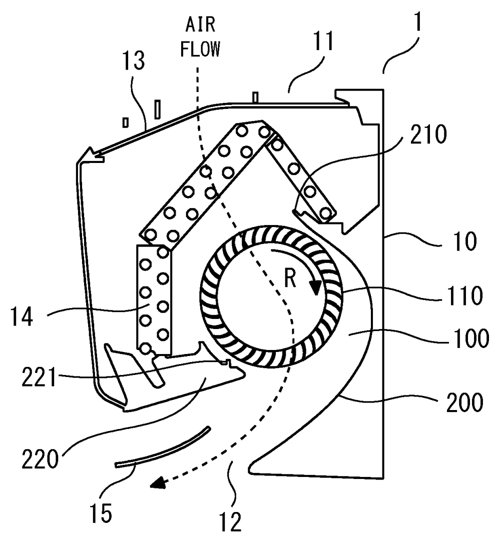
(54) **CROSS-FLOW FAN**

(57) Provided is a crossflow fan that can suppress loss of speed on an end of an impeller, leading to an increase in resistance to loss of speed. Therefore, a crossflow fan (100) includes an impeller (110) including a plurality of support members and a plurality of blades provided between adjacent support members, a motor (150) provided on one end of a rotation axis of the impeller, a stabilizer (220) spaced from an outer circumference of the impeller, the stabilizer being located along a direction of the rotation axis, and a convex portion (221) provided, on a surface of the stabilizer facing the impeller, in such a way as to protrude toward the impeller, the convex portion being located along the direction of the rotation axis. In a rotation direction of the impeller, an end of the convex portion on a motor side in the direction of the rotation axis is located downstream of a center of the convex portion in the direction of the rotation axis.

FIG. 1



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Description

Technical Field

[0001] The present disclosure relates to a crossflow fan.

Background Art

[0002] There is a known crossflow fan that includes a fan, a stabilizer disposed along an axial direction of the fan, and a straightening part provided on the side of the stabilizer opposite to the side that faces the fan, the straightening part being configured to adjust an air flow rate in the direction perpendicular to the axial direction of the fan (see PTL 1, for example).

Citation List

Patent Literature

[0003] [PTL 1] JP 2018-138854 A

Summary of the Invention

Problems to be Solved by the Invention

[0004] In the crossflow fan disclosed in PTL 1, the length of the straightening part on the motor side is decreased in the direction in which the straightening part and the fan are aligned, thus increasing the inflow air volume to the end on the motor side where a flow in the fan tends to have a disturbance. However, in such a crossflow fan, the inflow air volume at the end of the fan in the direction of the rotation axis is increased by providing the straightening part to the stabilizer and hence, the inflow air volume is increased mainly in an area close to the stabilizer. As a result of an increase in inflow air volume in the area close to the stabilizer, there may be cases in which the inflow air volume in the area close to the stabilizer increases excessively with respect to the inflow air volume in an area close to the rear guide, which is far from the stabilizer, so that the outflow from the upstream side of the fan casing increases, leading to a reduction in resistance to loss of speed.

[0005] The present disclosure has been made to solve such a problem. The object of the present disclosure is to provide a crossflow fan that can suppress loss of speed on the end of the impeller on the motor side, leading to an increase in resistance to loss of speed.

Solution to Problem

[0006] An crossflow fan according to the present disclosure includes: an impeller including a plurality of support members arranged at predetermined interval in a direction of a rotation axis, the support members being formed in the shape of a circular or ring-shaped flat plate, and a plurality of blades provided between adjacent support members, located close to outer circumferences of the adjacent support members, and spaced apart in a circumferential direction; a motor provided on one end of the rotation axis of the impeller; a stabilizer spaced from an outer circumference of the impeller, the stabilizer being located along a direction of the rotation axis; and a convex portion protruding toward the impeller on a surface of the stabilizer facing the impeller, the convex portion located along the direction of the rotation axis, in a rotation direction of the impeller, an end of the convex portion on a motor side in the direction of the rotation axis being located downstream of a center of the convex portion in the direction of the rotation axis.

Advantageous Effects of the Invention

[0007] With the crossflow fan according to the present disclosure, it is possible to obtain an advantageous effect that loss of speed on the end of the impeller on the motor side can be suppressed, leading to an increase in resistance to loss of speed.

Brief Description of the Drawings

[0008]

Fig. 1 is a cross-sectional view of an air-conditioning apparatus that includes a crossflow fan according to Embodiment 1.

Fig. 2 is a diagram showing the configuration of the crossflow fan according to Embodiment 1 excluding a casing.

Fig. 3 is a diagram of a stabilizer of the crossflow fan according to Embodiment 1 as viewed from an impeller side.

Fig. 4 and Fig. 5 are cross-sectional views of the air-conditioning apparatus that includes the crossflow fan according to Embodiment 1.

Fig. 6 is a diagram of a stabilizer for a modification of the crossflow fan according to Embodiment 1 as viewed from the impeller side.

Fig. 7 is a cross-sectional view showing the main part of the modification of the crossflow fan according to Embodiment 1 in an enlarged manner.

Description of Embodiment

[0009] Modes for carrying out a crossflow fan according to the present disclosure will be described with reference to attached drawings. In the respective drawings, identical or corresponding components are given the same reference symbols, and the repeated description will be simplified or omitted when appropriate. In the description made hereinafter, for the sake of convenience, the positional relationship of respective structures may be expressed with reference to the states shown in the drawings. The present disclosure is not limited to the following embodiments, and respective embodiments may be freely combined, optional constitutional elements of the respective embodiments may be modified, or optional constitutional elements of the respective embodiments may be omitted without departing from the gist of the present disclosure.

Embodiment 1.

[0010] An embodiment 1 of the present disclosure will be described with reference to Fig. 1 to Fig. 7. Fig. 1 is a cross-sectional view of an air-conditioning apparatus that includes a crossflow fan. Fig. 2 is a diagram showing the configuration of the crossflow fan excluding a casing. Fig. 3 is a diagram of a stabilizer of the crossflow fan as viewed from an impeller side. Fig. 4 and Fig. 5 are cross-sectional views of the air-conditioning apparatus that includes the crossflow fan. Fig. 6 is a diagram of a stabilizer for a modification of the crossflow fan as viewed from the impeller side. Fig. 7 is a cross-sectional view showing the main part of the modification of the crossflow fan in an enlarged manner.

[0011] The description will be made for a constitutional example of the air-conditioning apparatus as an example of a refrigeration cycle device that includes the crossflow fan according to the present disclosure. Examples of the refrigeration cycle device that includes the crossflow fan according to the present disclosure include a showcase in addition to the air-conditioning apparatus. As will be described later, the air-conditioning apparatus has a function of blowing air. Accordingly, the air-conditioning apparatus described in the present embodiment is also an example of a blowing device that includes the crossflow fan according to the present disclosure. Examples of the blowing device that includes the crossflow fan according to the present disclosure include a circulator and a tower fan in addition to the air-conditioning apparatus.

[0012] The air-conditioning apparatus being the refrigeration cycle device according to the present embodiment includes indoor unit 1 shown in Fig. 1 and outdoor unit (not shown in the drawing) . The indoor unit 1 is installed in a room that is the target of air conditioning, that is, in a room. The outdoor unit is installed outside the room, that is, outdoors.

[0013] The indoor unit 1 and the outdoor unit are connected with each other by refrigerant pipes not shown in the drawing. The indoor unit 1 includes a crossflow fan 100 and a heat exchanger 14. The outdoor unit includes an outdoor unit fan, a heat exchanger, a compressor, an expansion valve, a four-way valve, and other components, none of these being shown in the drawing. The refrigerant pipes are provided between the heat exchanger 14 of the indoor unit 1 and the heat exchanger of the outdoor unit (not shown in the drawing) in a state that allows circulation. A refrigerant is sealed in the refrigerant pipes. An example of the refrigerant sealed in the refrigerant pipes includes difluoromethane (CH_2F_2:R32). The refrigerant pipes sequentially connect the heat exchanger 14 of the indoor unit 1, and the four-way valve, the compressor, the heat exchanger, and the expansion valve of the outdoor unit. Accordingly, a refrigerant circuit is formed in which a refrigerant circulates between the heat exchanger of the indoor unit 1 and the heat exchanger of the outdoor unit.

[0014] The compressor of the outdoor unit is equipment that compresses a supplied refrigerant to increase the pressure and the temperature of the refrigerant. A rotary compressor, a scroll compressor, or a reciprocating compressor, for example, may be used for the compressor. The expansion valve expands the refrigerant, condensed by the heat exchanger of the outdoor unit, to reduce the pressure of the refrigerant.

[0015] The heat exchanger 14 of the indoor unit 1 causes the refrigerant that flows into the heat exchanger 14 to exchange heat with air around the heat exchanger 14. The crossflow fan 100 blows air in such a way as to cause indoor air to pass through an area around the heat exchanger 14, thus promoting heat exchange between the refrigerant and air by the heat exchanger 14, and sending the air heated or cooled by the heat exchange into the room again. The heat exchanger of the outdoor unit causes the refrigerant that flows into the heat exchanger to exchange heat with air around the heat exchanger. The outdoor unit fan blows air in such a way as to cause outdoor air to pass through an area around the heat exchanger of the outdoor unit, thus promoting heat exchange between the refrigerant and air by the heat exchanger.

[0016] In the refrigerant circuit having such a configuration, heat exchange between a refrigerant and air is performed in each of the heat exchanger 14 of the indoor unit 1 and the heat exchanger of the outdoor unit and hence, the refrigerant circuit serves as a heat pump that transfers heat between the indoor unit 1 and the outdoor unit. When the four-way valve is switched, a circulating direction of the refrigerant in the refrigerant circuit is reversed, so that a cooling operation and a heating operation of the air-conditioning apparatus can be switched.

[0017] As shown in Fig. 1, the indoor unit 1 includes a housing 10. The housing 10 is installed in the room. The heat exchanger 14 and the crossflow fan 100 are housed in the housing 10. An upper surface portion of the housing 10 has an air inlet 11. The air inlet 11 is an opening through which air is taken into the housing 10 from the outside. A lower surface of the housing 10 has an air outlet 12. The air outlet 12 is an opening through which air is discharged to the outside from the inside of the housing 10.

[0018] An air passage extending from the air inlet 11 to the air outlet 12 is formed in the housing 10. A filter 13 is installed in the air inlet 11. The filter 13 is provided to remove relatively large refuse, dust, dirt, and the like from air that flows into the housing 10 from the air inlet 11.

[0019] In the air passage in the housing 10, the heat exchanger 14 is installed on the downwind side of the filter 13. The heat exchanger 14 performs heat exchange with air flowing through the air passage in the housing 10, thus heating or cooling the air flowing through the air passage. Whether air is heated or cooled depends on whether the air-conditioning apparatus is performing a heating operation or a cooling operation.

[0020] In the above-described air passage, the crossflow fan 100 is installed on the downwind side of the heat exchanger 14. The crossflow fan 100 is provided to generate, in the air passage in the housing 10, an air flow directing to the air outlet 12 from the air inlet 11. In the housing 10, a rear guide 210 is provided on the rear surface side of an impeller of the crossflow fan 100. Further, in the housing 10, a stabilizer 220 is provided on the front surface side of the impeller of the crossflow fan 100.

[0021] The rear guide 210 is disposed to have a helical shape in which a distance from the impeller of the crossflow fan 100 increases as the rear guide 210 approaches the air outlet 12 from the heat exchanger 14. The stabilizer 220 disposed on the front surface side of the impeller of the crossflow fan 100 protrudes toward the rear surface side to have a tongue shape at a position on the air outlet 12 side of the impeller. The rear guide 210 and the stabilizer 220 form a casing 200 of the crossflow fan 100. The impeller of the crossflow fan 100 is housed in the casing 200 of the crossflow fan 100. By providing such a casing 200, when the impeller of the crossflow fan 100 is rotated in a rotation direction R indicated by an arrow in the drawing, the following air flow is generated. That is, air is suctioned into areas between blades of the impeller from an area having the smallest flow passage resistance, that is, an area close to the heat exchanger 14. Then, the suctioned air flows in such a way as to penetrate through the impeller, and is blown out to an area having the second smallest flow passage resistance, that is, an area close to the air outlet 12.

[0022] A wind direction plate 15 is provided to the air outlet 12. The wind direction plate 15 is provided to adjust a blowing angle of air to be blown out from the air outlet 12. Fig. 1 shows an up-down wind direction plate of the wind direction plate 15. By changing the direction of the up-down wind direction plate, the indoor unit 1 can change an air blowing direction in an up-down direction. Although not shown in the drawing, a left-right wind direction plate is also provided to the air outlet 12 as the wind direction plate 15. The left-right wind direction plate is provided to adjust a blowing angle of air to be blown out from the air outlet 12 in a left-right direction.

[0023] When the crossflow fan 100 is operated, an air flow directing toward the air outlet 12 from the air inlet 11 is generated in the air passage, so that air is suctioned from the air inlet 11 and the air is blown out from the air outlet 12. The air suctioned from the air inlet 11 forms an air flow that passes through the filter 13, the heat exchanger 14, and the crossflow fan 100 in this order along the air passage in the housing 10, and is blown out from the air outlet 12. At this point of operation, the wind direction plate 15 disposed on the downwind side of the crossflow fan 100 adjusts a direction of air to be blown out from the air outlet 12, that is, the air blowing direction. The indoor unit 1 of the air-conditioning apparatus having the above-mentioned configuration blows air into a room. The indoor unit 1 can change the temperature and the direction of the air flow to be blown.

[0024] As shown in Fig. 2, the crossflow fan 100 includes an impeller 110 and a motor 150. The impeller 110 includes support members 120, blades 130, and a rotation axis 140. The motor 150 rotates the impeller 110 about the rotation axis 140. The motor 150 is provided on one end of the rotation axis 140 of the impeller 110.

[0025] The impeller 110 includes a plurality of support members 120. The support member 120 is a flat plate member having a circular shape or a ring shape. The plurality of support members 120 are arranged at predetermined intervals in a direction parallel to the rotation axis 140 (hereinafter also referred to as "direction of the rotation axis 140"). The rotation axis 140 of the impeller 110 is provided in such a way as to penetrate through the center of the circular shape or the ring shape of each of the plurality of support members 120. The plurality of blades 130 are provided between adjacent support members 120. The plurality of blades 130 are provided at a position close to the outer circumferences of the support members 120. The plurality of blades 130 are aligned in a spaced-apart manner along the circumferential direction of the support member 120. The plurality of blades 130 supported between a pair of support members 120 form one series of blades. The impeller 110 of the crossflow fan 100 is formed of approximately seven to fourteen series of blades that are connected continuously in the direction of the rotation axis 140.

[0026] As described above, the casing 200 of the crossflow fan 100 includes the rear guide 210 and the stabilizer 220. The impeller 110 is housed in the casing 200 of the crossflow fan 100. The stabilizer 220 being a portion of the casing 200 is located in a state of being spaced from the outer circumference of the impeller 110. The stabilizer 220 is located along the direction of the rotation axis 140.

[0027] As shown in Fig. 1, the crossflow fan 100 according to the present embodiment includes a convex portion 221. The convex portion 221 is provided on the surface of the stabilizer 220 facing the impeller 110. The convex portion 221 protrudes toward the impeller 110 from the surface of the stabilizer 220 facing the impeller 110.

[0028] Fig. 3 is a diagram of the surface of the stabilizer 220 facing the impeller 110 as viewed from the impeller 110 side. As shown in the drawing, the convex portion 221 is located along the direction of the rotation axis 140. In the example shown in the drawing, the convex portion 221 smoothly continues along the direction of the rotation axis 140.

[0029] In the rotation direction R of the impeller 110, both ends of the convex portion 221 in the direction of the rotation axis 140 are located downstream of the center of the convex portion 221 in the direction of the rotation axis 140. That is, in the rotation direction R of the impeller 110, the end of the convex portion 221 on the motor 150 side in the direction of the rotation axis 140 is located downstream of the center of the convex portion 221 in the direction of the rotation axis 140. In the rotation direction R of the impeller 110, the end of the convex portion 221 on the side opposite to the motor 150 in the direction of the rotation axis 140 is also located downstream of the center of the convex portion 221 in the direction of the rotation axis 140. An arrow indicating the rotation direction R is directed from the downstream side toward the upstream side of the rotation direction R.

[0030] Fig. 4 shows a cross-sectional view of the center in the direction of the rotation axis 140. Fig. 5 shows a cross-sectional view of the end in the direction of the rotation axis 140. In these drawings, arrows show air flows that are generated when the impeller 110 is rotated in the rotation direction R. As shown in these drawings, when the impeller 110 rotates in the rotation direction R, an air flow is generated that flows in such a way as to penetrate through the impeller 110 from the heat exchanger 14 side, and that is then blown out toward the air outlet 12. A portion of the air flow that is blown out toward the air outlet 12 from the impeller 110 flows again into an area close to the stabilizer 220 of the casing 200 in such a way as to be involved.

[0031] The air flow that flows again into the area close to the stabilizer 220 returns to the center of the impeller 110, that is, toward the rotation axis 140, and is then blown out toward the air outlet 12 again from the inside of the casing 200. A standing circulating flow is generated at a position close to the stabilizer 220 in this manner. After flowing again into the area close to the stabilizer 220, the circulating flow mainly flows along the surface of the stabilizer 220 facing the impeller 110.

[0032] As described above, in the crossflow fan 100 according to the present embodiment, the convex portion 221 is provided on the surface of the stabilizer 220 facing the impeller 110. The air flow that flows into the area close to the stabilizer 220 again impinges on the convex portion 221, thus being returned toward the impeller 110. Therefore, the position at which the circulating flow stands and the size of the circulating flow are determined by the position of the convex portion 221. A portion of the circulating flow is present within the region where the air flow is blown out from the casing 200 (hereinafter also referred to as "fan blowing-out region").

[0033] At the center of the stabilizer 220 in the direction of the rotation axis 140, as shown in Fig. 4, the convex portion 221 is located on the upstream side in the rotation direction R, that is, located on the stabilizer 220 at a position close to the air outlet 12. Therefore, the position at which the circulating flow stands is located on the stabilizer 220 at a position close to the air outlet 12. As a result, the size of the circulating flow is reduced and hence, it is possible to reduce the shaft output of the motor 150 of the crossflow fan 100 that is required to obtain the same air volume, that is, it is possible to reduce the shaft input of the impeller 110.

[0034] In contrast, on each of both ends of the stabilizer 220 in the direction of the rotation axis 140, as shown in Fig. 5, the convex portion 221 is located on the downstream side in the rotation direction R, that is, located on the stabilizer 220 at a position close to the heat exchanger 14. Therefore, the position at which the circulating flow stands is located on the stabilizer 220 at a position close to the heat exchanger 14. As a result, a portion of the circulating flow that overlaps with the fan blowing-out region is reduced, thus achieving a reduction in ventilation resistance.

[0035] Particularly, the end of the impeller 110 on the motor 150 side requires space occupied by screws or the like that couple the rotation axis 140 of the impeller 110 with the motor 150, thus having a smaller number of blades 130 than the center of the impeller 110 in the direction of the rotation axis 140. Therefore, the flow becomes unstable on the end of the impeller 110 on the motor 150 side, thus easily causing loss of speed.

[0036] In the crossflow fan 100 according to the present embodiment, the convex portion 221 is provided on the surface of the stabilizer 220 facing the impeller 110 and, in the rotation direction R of the impeller 110, the end of the convex portion 221 on the motor 150 side in the direction of the rotation axis 140 is located downstream of the center of the convex portion 221 in the direction of the rotation axis 140. Therefore, on the end of the impeller 110 on the motor 150 side, the position at which the circulating flow stands is moved toward the depth side in the casing 200, so that a portion of the circulating flow that overlaps with the fan blowing-out region is reduced, thus achieving a reduction in ventilation resistance. Further, at the center of the impeller 110, the size of the circulating flow is reduced and hence, it is possible to reduce the shaft input that is required to obtain the same air volume. Accordingly, an increase in shaft input can be suppressed, and it is also possible to suppress loss of speed caused by, for example, a backflow toward the rear guide 210 on the end of the impeller 110 on the motor 150 side.

[0037] Also at the end of the impeller 110 on the side opposite to the motor 150, the flow is easily affected by surrounding of a position at which the crossflow fan 100 is installed, so that the flow becomes unstable, thus easily causing loss of speed. For example, in the crossflow fan 100 provided to the indoor unit 1 of the air-conditioning apparatus described in the present embodiment, on the end on the side opposite to the motor 150, there may be cases in which an inflow air volume is low due to an influence of an installation space for pipes or the like, the installation space being located on the rear surface side in the housing 10. In such a case, due to a low inflow air volume, loss of speed is more likely to occur on the end of the impeller 110 on the side opposite to the motor 150 than on the middle portion in the direction of the rotation axis 140.

[0038] In view of the above, in the rotation direction R of the impeller 110, the end of the convex portion 221 on the side opposite to the motor 150 in the direction of the rotation axis 140 is located downstream of the center of the convex portion 221 in the direction of the rotation axis 140. With such a configuration, on the end of the impeller 110 on the side opposite to the motor 150, the position at which the circulating flow stands is moved toward the depth side in the casing 200, so that a portion of the circulating flow that overlaps with the fan blowing-out region is reduced, thus achieving a reduction in ventilation resistance. Further, at the center of the impeller 110, the size of the circulating flow is reduced and hence, it is possible to reduce the shaft input that is required to obtain the same air volume. Accordingly, an increase in shaft input of the crossflow fan 100 can be suppressed, and it is also possible to suppress loss of speed on the end of the impeller 110 on the side opposite to the motor 150.

[0039] Further, the convex portion 221 smoothly continues along the direction of the rotation axis 140. Therefore, it is possible to suppress disturbance that is generated when a circulating flow collides with the convex portion 221 and hence, an increase in shaft input of the crossflow fan 100 can be suppressed, and it is also possible to increase resistance to loss of speed.

[0040] Next, modifications of the crossflow fan 100 according to the present embodiment will be described. Fig. 6 shows a first modification of the crossflow fan 100 according to the present embodiment. In the first modification, the area of the surface of the convex portion 221 facing the impeller 110 is varied in the direction of the rotation axis 140. The convex portion 221 has a fan facing surface 222. The fan facing surface 222 is the surface of the convex portion 221 facing the impeller 110. In the constitutional example shown in Fig. 6, each of both ends of the fan facing surface 222 in the direction of the rotation axis 140 has a larger area than the center of the fan facing surface 222 in the direction of the rotation axis 140. That is, the end of the convex portion 221 on the motor 150 side in the direction of the rotation axis 140 has a larger area of a surface facing the impeller 110 than the center of the convex portion 221 in the direction of the rotation axis 140. In the example shown in the drawing, the end of the convex portion 221 on the side opposite to the motor 150 in the direction of the rotation axis 140 has a larger area of a surface facing the impeller 110 than the center of the convex portion 221 in the direction of the rotation axis 140.

[0041] According to the crossflow fan 100 according to the first modification, the end of the impeller 110 on the motor 150 side has a large area of the fan facing surface 222 of the convex portion 221 and hence, it is possible to increase ventilation resistance, leading to a reduction in air volume of a circulating flow. As described above, in the crossflow fan 100 according to the present embodiment, on the end of the impeller 110 on the motor 150 side, the position at which the circulating flow stands is moved toward the depth side in the casing 200 and hence, the circulating flow tends to increase. By increasing the area of the fan facing surface 222 of the convex portion 221 at a position corresponding to the end of the impeller 110 on the motor 150 side, the air volume of the circulating flow can be reduced, leading to a reduction in size of the circulating flow. Accordingly, an increase in shaft input of the crossflow fan 100 can be further suppressed, and it is also possible to increase resistance to loss of speed.

[0042] Fig. 7 shows a second modification of the crossflow fan 100 according to the present embodiment. In the second modification, as shown in the drawing, the fan facing surface 222 of the convex portion 221 is formed such that a distance between the fan facing surface 222 and the impeller 110 gradually decreases as the fan facing surface 222 extends from the upstream side to the downstream side in the rotation direction R of the impeller 110. Therefore, it is possible to smoothly guide the circulating flow toward the impeller 110 by the fan facing surface 222 of the convex portion 221. Accordingly, it is possible to particularly suppress disturbance of an air flow that is generated when a circulating flow collides with a mainstream that enters the casing 200 by passing through the heat exchanger 14 on the front surface side of the housing 10 and hence, an increase in shaft input of the crossflow fan 100 can be further suppressed, and it is also possible to increase resistance to loss of speed.

Industrial Applicability

[0043] The present disclosure can be used for a crossflow fan that includes the impeller, the motor provided on one end of the rotation axis of the impeller, and the stabilizer spaced from the outer circumference of the impeller, the stabilizer being located along the direction of the rotation axis. The present disclosure is also used for a blowing device and a refrigeration cycle device that includes the crossflow fan.

Reference Signs List

[0044]

1	Indoor unit
10	Housing
11	Air inlet
12	Air outlet
13	Filter
14	Heat exchanger
15	Wind direction plate
100	Crossflow fan
110	Impeller
120	Support member
130	Blade
140	Rotation axis
150	Motor
200	Casing

210 Rear guide
220 Stabilizer
221 Convex portion
222 Fan facing surface

Claims

1. A crossflow fan comprising:

    an impeller comprising,

        a plurality of support members arranged at predetermined interval in a direction of a rotation axis, the support members being formed in the shape of a circular or ring-shaped flat plate, and
        a plurality of blades provided between adjacent support members, located close to outer circumferences of the adjacent support members, and spaced apart in a circumferential direction;

    a motor provided on one end of the rotation axis of the impeller;
    a stabilizer spaced from an outer circumference of the impeller, the stabilizer being located along a direction of the rotation axis; and
    a convex portion protruding toward the impeller on a surface of the stabilizer facing the impeller, the convex portion located along the direction of the rotation axis,
    in a rotation direction of the impeller, an end of the convex portion on a motor side in the direction of the rotation axis being located downstream of a center of the convex portion in the direction of the rotation axis.

2. The crossflow fan according to claim 1, wherein, in the rotation direction of the impeller, an end of the convex portion on a side opposite to the motor in the direction of the rotation axis is located downstream of the center of the convex portion in the direction of the rotation axis.

3. The crossflow fan according to claim 1 or claim 2, wherein the convex portion smoothly continues along the direction of the rotation axis.

4. The crossflow fan according to any one of claims 1 to 3, wherein the end of the convex portion on the motor side in the direction of the rotation axis has a larger area of a surface facing the impeller than the center of the convex portion in the direction of the rotation axis.

5. The crossflow fan according to any one of claims 1 to 4, wherein a surface of the convex portion facing the impeller is formed such that a distance between the surface and the impeller gradually decreases as the surface extends from an upstream side to a downstream side in the rotation direction of the impeller.

FIG. 1

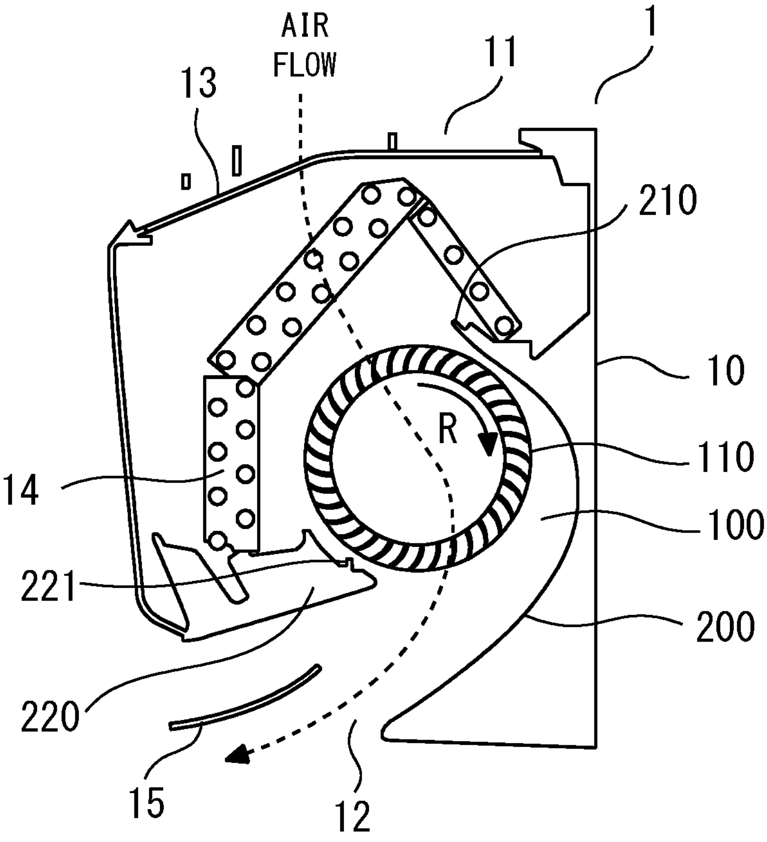


FIG. 2

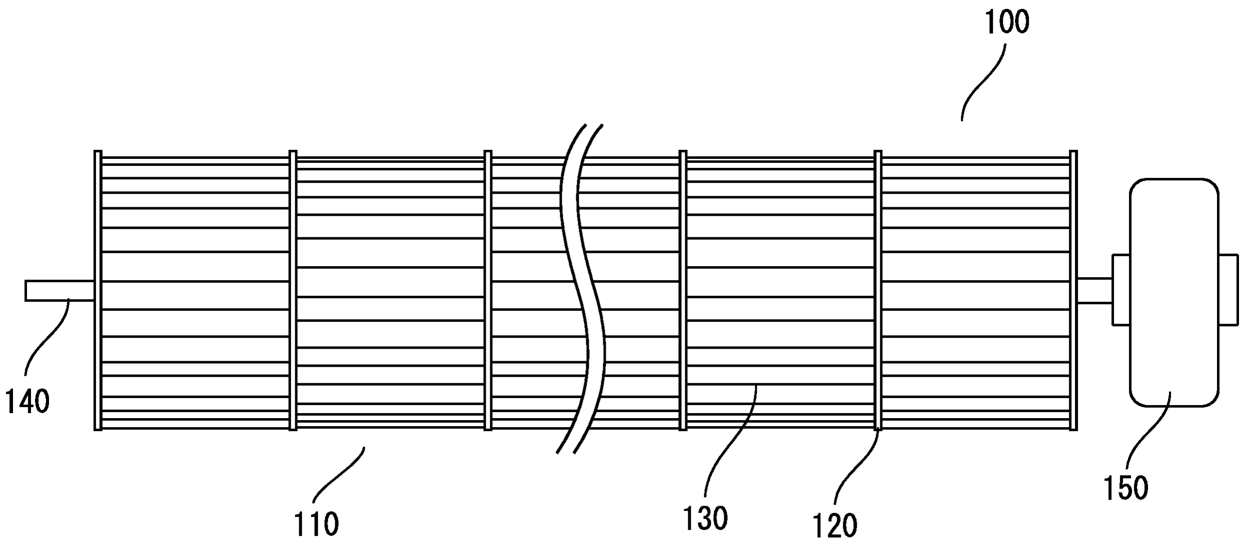
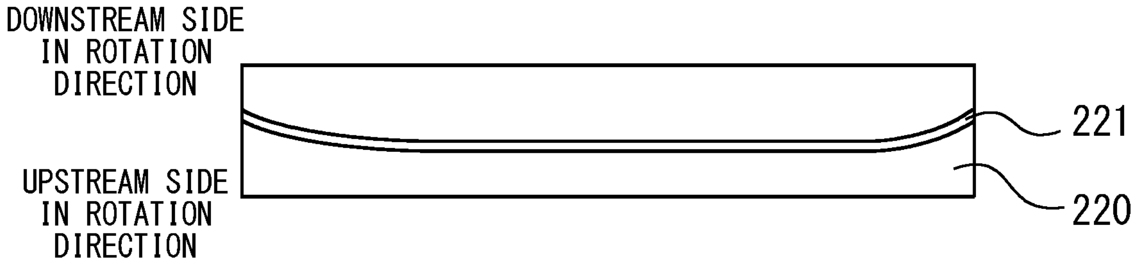


FIG. 3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IN ROTATION
DIRECTION
UPSTREAM SIDE
IN ROTATION
DIRECTION
221
220

FIG. 4

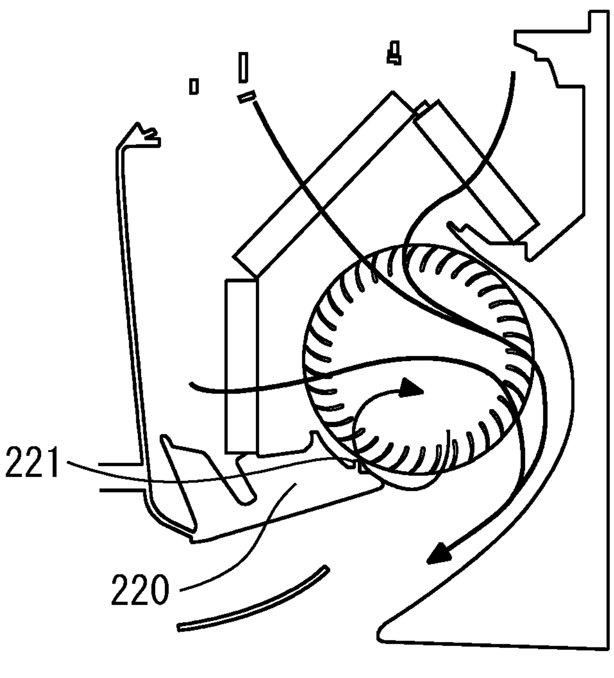

221
220

FIG. 5

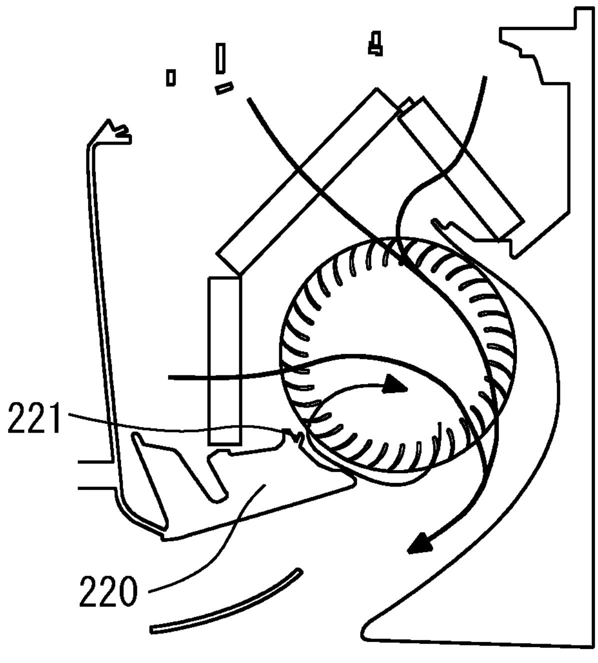


FIG. 6

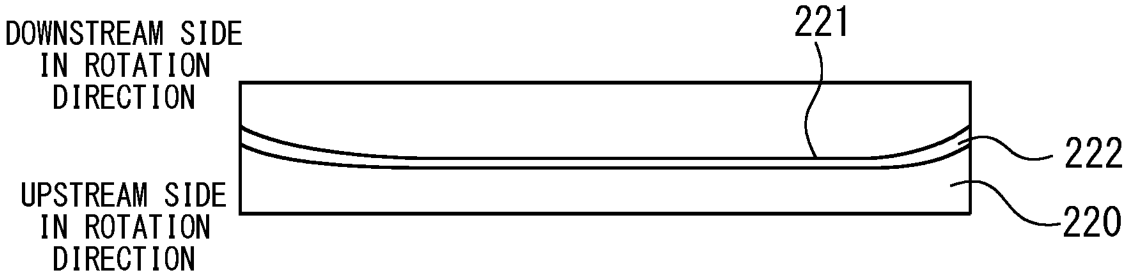
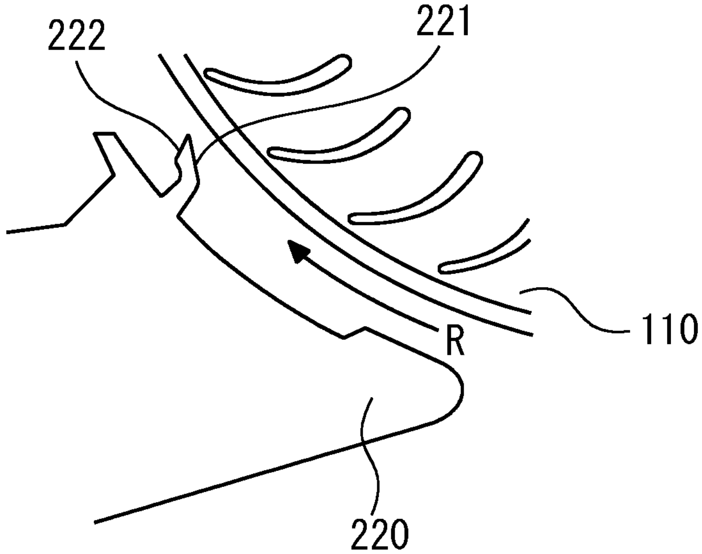

DOWNSTREAM SIDE
IN ROTATION
DIRECTION
UPSTREAM SIDE
IN ROTATION
DIRECTION
221
222
220

FIG. 7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INTERNATIONAL SEARCH REPORT

International application No. **PCT/JP2022/006913**

A. CLASSIFICATION OF SUBJECT MATTER

F04D 17/04(2006.01)i; ***F24F 1/0025***(2019.01)i
FI: F04D17/04 D; F24F1/0025

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D17/04; F24F1/0025

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11-304178 A (SAMSUNG ELECTRONICS CO., LTD.) 05 November 1999 (1999-11-05) paragraphs [0010]-[0016], fig. 1-7	1-3
Y		5
A		4
Y	KR 10-2007-0005178 A (LG ELECTRONICS INC.) 10 January 2007 (2007-01-10) p. 8, lines 11, 12, fig. 6	5
A	JP 9-170770 A (FUJITSU GENERAL LTD.) 30 June 1997 (1997-06-30) entire text, all drawings	1-5
A	JP 5-231667 A (FUJITSU GENERAL LTD.) 07 September 1993 (1993-09-07) entire text, all drawings	1-5

☐ Further documents are listed in the continuation of Box C.   ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 April 2022	**10 May 2022**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/006913

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 11-304178 A	05 November 1999	CN 1233717 A	
KR 10-2007-0005178 A	10 January 2007	(Family: none)	
JP 9-170770 A	30 June 1997	(Family: none)	
JP 5-231667 A	07 September 1993	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2018138854 A **[0003]**