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(54) **AIR CONDITIONER**
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Description

[Technical Field]

[0001] The present invention relates to an air conditioner including a cross flow fan.

[Background]

[0002] A cross flow fan is a blower which extends in the axial direction and includes a plurality of vanes lined up in the rotational direction. The cross flow fan used in an air conditioner is arranged such that vane wheels each having vanes are lined up in the axial direction and connected with one another. In an air conditioner including this cross flow fan, a stabilizer and a rear guider are provided to oppose the outer periphery of the fan, respectively. The stabilizer is termed a front tongue portion, whereas a part of the rear guider which part extends from the leading end portion to the portion closest to the fan is termed a rear tongue portion. These tongue portions form an air passage on the blow-out side of the fan. Between each tongue portion and the fan, a vortex airflow is generated. When a vane of the fan passes this vortex airflow, wind noise (NZ noise) is generated on account of the interference between the vortex airflow and the vane.

[0003] To reduce this wind noise, in known arrangements, timings of generation of wind noise are dispersed by differentiating the positions of the vanes of neighboring vane wheels or changing the shape of the tongue portions.

[0004] As an example of the reduction of the wind noise by changing the shape of the tongue portions, Patent Document 1 recites that positions where a front tongue portion and a rear tongue portion are closest to the fan are differentiated in the rotational axis direction between the vane wheels. To put it differently, the front tongue portion and the rear tongue portion have level-difference portions each at a position of opposing to the connecting portion of the vane wheels. With this arrangement, because the timing at which the vane passes the leading end of the front tongue portion or the rear tongue portion is different between the vane wheels, the timings of the generation of the wind noise are dispersed and the wind noise is reduced.

[0005] As another example Patent Document 2 describes a cross flow fan wherein the number of concaves and convexes at an irregular part formed on the end of a stabilizer is made equal to the number of cross flow fans arranged in series and the convexes are made to correspond to the positions of the side of the fans, in order to reduce noise. The Patent Documents 3 to 6 describe similar cross flow fans.

[Citation List]

[Patent Document]

[0006]

[Patent Document 1] Japanese Unexamined Patent Publication No. 62-118094
[Patent Document 2] Japanese Unexamined Patent Publication No. S63-113198 A
[Patent Document 3] EP Unexamined Patent Publication No. 2 405 206 A1
[Patent Document 4] CN Unexamined Patent Publication No. 1752 461 A
[Patent Document 5] Japanese Unexamined Patent Publication S62-131994 A
[Patent Document 6] Japanese Unexamined Patent Publication S62-690A

[Summary of Invention]

[Technical Problem]

[0007] However, in the air conditioner of Patent Document 1, the wind noise is reduced to some extent because the timings at which the vanes pass the leading end of the front tongue portion or the rear tongue portion are different between the vane wheels, but the noise reduction effect is insufficient because one vane of one vane wheel passes the leading end of the front tongue portion or the rear tongue portion at once.

[0008] An object of the present invention is to provide an air conditioner in which wind noise is further reduced.

[Solution to Problem]

[0009] According to the first aspect of the invention, a air conditioner includes: a cross flow fan in which vane wheels each including vanes lined up in a circumferential direction are lined up in an axial direction; and a stabilizer and a rear guider which are provided on respective sides of an outer periphery of the cross flow fan to form an air passage, a leading end portion of at least one of the stabilizer and the rear guider having a multi-stage shape so as to include level-difference portions which are deviated in the circumferential direction of the cross flow fan, and the level-difference portions including at least one first level-difference portion which opposes an intermediate portion in the axial direction of corresponding one of the vane wheels, wherein vanes of a vane wheel opposing the first level-difference portion and of a vane wheel neighboring to this vane wheel being provided to be deviated from one another by a predetermined angle in the circumferential direction, and in a direction from one end to the other end in the axial direction, the direction of deviation in the circumferential direction of the first level-difference portion being opposite to the direction of deviation in the circumferential direction of the vanes of the neighboring two vane wheels.

[0010] In this air conditioner, the leading end portion of at least one of the rear guider and the stabilizer has the first level-difference portion which is deviated in the circumferential direction and opposes the intermediate part in the axial direction of the vane wheel, and hence the time duration over which one vane passes the leading end of the stabilizer or the rear guider is divided into before and after reaching the first level-difference portion. Therefore the wind noise is not generated at once by one vane, and the wind noise is generated in a divided manner. In this way, the wind noise is reduced.

[0011] According to the second aspect of the invention, the air conditioner of the first aspect is arranged so that the level-difference portions include a second level-difference portion which opposes a connecting portion between the vane wheels.

[0012] In this air conditioner, the leading end portion of the stabilizer or the rear guider has the second level-difference portion which is deviated in the circumferential direction and opposes the connecting portion between the vane wheels. With this, the timing of the generation of the wind noise is differentiated between the vane wheels, with the result that the wind noise is further reduced.

[0013] According to the third aspect of the invention, the air conditioner of the first or second aspect is arranged so that the height of a part between neighboring two of the level-difference portions is constant in the axial direction.

[0014] In this air conditioner, because in the leading end portion of the stabilizer or the rear guider the part between the two neighboring level-difference portions linearly extends in the axial direction, the stabilizer or the rear guider is easily manufactured.

[0015] According to the fourth aspect of the invention, the air conditioner of the third aspect is arranged so that the level-difference portions include the at least one first level-difference portion which include one or more first level-difference portion opposing the intermediate portion in the axial direction of each of neighboring two of the vane wheels and a second level-difference portion opposing a connecting portion of the neighboring two vane wheels, in a direction from one end to the other end in the axial direction, a direction of deviation in the circumferential direction of the first level-difference portion is opposite to a direction of deviation in the circumferential direction of the second level-difference portion, and parts of the leading end portion which parts oppose the neighboring two of the vane wheels are identical in shape and height.

[0016] In this air conditioner, the leading end portion of the stabilizer or the rear guider has the first level-difference portion in the range opposing neighboring two of the vane wheels, and the parts, which oppose the two vane wheels, of the leading end portion of the rear guider or the stabilizer are identical in shape and height. It is therefore easy to manufacture the rear guider or the stabilizer. Furthermore, the leading end portion of the rear guider or the stabilizer is arranged to be substantially identical in height overall.

[0017] According to the fifth aspect of the invention, the air conditioner of the third aspect is arranged so that the level-difference portions include two second level-difference portions which oppose connecting portions between the vane wheel opposing the first level-difference portion and the vane wheels on the respective sides of the vane wheel opposing the first level-difference portion, in a direction from one end to the other end in the axial direction, a direction of deviation in the circumferential direction of the first level-difference portion is opposite to a direction of deviation in the circumferential direction of the second level-difference portion, and a deviation angle in the circumferential direction of the second level-difference portion is smaller than the predetermined angle.

[0018] In this air conditioner, the direction of deviation of the first level-difference portion is opposite to the direction of deviation of the second level-difference portion, the direction of deviation of the vanes deviated from each other at the predetermined angle is opposite to the direction of deviation of the first level-difference portion, and the deviation angle of the second level-difference portion is smaller than the predetermined angle. On this account, the direction of temporal deviation of two wind noises generated before and after reaching the first level-difference portion is identical with the direction of temporal deviation of two wind noises generated before and after reaching the second level-difference portion. With this arrangement, the wind noise is sequentially generated from one end to the other end in the axial direction of the cross flow fan. This restrains the directivity due to the interference of wind noises generated between the level-difference portions, and noise reduction is effectively done across the entire room.

[0019] According to the sixth aspect of the invention, the air conditioner of the fifth aspect is arranged so that the deviation angle in the circumferential direction of the first level-difference portion is identical with a value calculated by dividing the predetermined angle by a result of addition of 1 to the number of the first level-difference portions within a range in the axial direction of the vane wheel opposing the first level-difference portion, and the deviation angle in the circumferential direction of the second level-difference portion is identical with a total sum of the deviation angle in the circumferential direction of the first level-difference portion within the range in the axial direction.

[0020] In this air conditioner, two wind noises generated before and after reaching the first level-difference portion are deviated from each other by the deviation angle angle of the first level-difference portion (the value calculated by dividing the deviation angle (the predetermined angle) between the vanes by a result of addition of 1 to the number of the first level-difference portions within the range in the axial direction of the vane wheel), whereas two wind noises generated before and after reaching the second level-difference portion are deviated from each other by an angle calculated by subtracting the deviation angle angle of the second level-difference portion from the deviation angle (predetermined angle) between the vanes. For this reason, the deviation time between the two wind noises generated before and after reaching the first level-difference portion is arranged to be identical with the deviation time between the two wind noises generated before and after reaching the second level-difference portion. The present embodiment therefore achieves a noise reduction effect similar to the noise reduction effect in case where the first level-difference portion is not provided and the number of the vane wheels is increased so that each connecting portion of the vane wheels is provided to oppose the position equivalent to the first level-difference portion. To put it differently, in the present embodiment, the vane length of the vane wheel is elongated and the number of the vane wheels is reduced, while the noise reduction capability is maintained. Furthermore, the blowing characteristic is improved because the number of the connecting portions of the vane wheels, which hinder the ventilation, is reduced.

[Advantageous Effects of Invention]

[0021] As described above, the following effects are obtained by the present invention.

[0022] According to the first aspect of the invention, the leading end portion of at least one of the rear guider and the stabilizer has the first level-difference portion which is deviated in the circumferential direction and opposes the intermediate part in the axial direction of the vane wheel, and hence the time duration over which one vane passes the leading end of the stabilizer or the rear guider 20 is divided into before and after reaching the first level-difference portion. Therefore the wind noise is not generated at once by one vane, and the wind noise is generated in a divided manner. In this way, the wind noise is reduced.

[0023] According to the second aspect of the invention, the leading end portion of each of the rear guider or the stabilizer has the second level-difference portion which is deviated in the circumferential direction and opposes the connecting portion between the vane wheels. With this, the timing of the generation of the wind noise is differentiated between the vane wheels, with the result that the wind noise is further reduced.

[0024] According to the third aspect of the invention, because in the leading end portion of each of the rear guider and the stabilizer the part between the two neighboring level-difference portions linearly extends in the axial direction, the stabilizer or the rear guider is easily manufactured.

[0025] According to the fourth aspect of the invention, the leading end portion of the stabilizer or the rear guider has the first level-difference portion in the range opposing neighboring two of the vane wheels, and the parts, which oppose the two vane wheels, of the leading end portion of the rear guider or the stabilizer are identical in shape and height. It is therefore easy to manufacture the rear guider or the stabilizer. Furthermore, the leading end portion of the rear guider or the stabilizer is arranged to be substantially identical in height overall.

[0026] According to the fifth aspect of the invention, the direction of deviation of the first level-difference portion is opposite to the direction of deviation of the second level-difference portion, the direction of deviation of the vanes deviated from each other at the predetermined angle is opposite to the direction of deviation of the first level-difference portion, and the deviation angle of the second level-difference portion is smaller than the predetermined angle. On this account, the direction of temporal deviation of two wind noises generated before and after reaching the first level-difference portion is identical with the direction of temporal deviation of two wind noises generated before and after reaching the second level-difference portion. With this arrangement, the wind noise is sequentially generated from one end to the other end in the axial direction of the cross flow fan. This restrains the directivity due to the interference of wind noises generated between the level-difference portions, and noise reduction is effectively done across the entire room.

[0027] According to the sixth aspect of the invention, two wind noises generated before and after reaching the first level-difference portion are deviated from each other by the deviation angle angle of the first level-difference portion (the value calculated by dividing the deviation angle (the predetermined angle) between the vanes by a result of addition of 1 to the number of the first level-difference portions within the range in the axial direction of the vane wheel), whereas two wind noises generated before and after reaching the second level-difference portion are deviated from each other by an angle calculated by subtracting the deviation angle angle of the second level-difference portion from the deviation angle (predetermined angle) between the vanes. For this reason, the deviation time between the two wind noises generated before and after reaching the first level-difference portion is arranged to be identical with the deviation time between the two wind noises generated before and after reaching the second level-difference portion. The present embodiment therefore achieves a noise reduction effect similar to the noise reduction effect in case where the first level-difference portion is not provided and the number of the vane wheels is increased so that each connecting portion of the vane wheels is provided to oppose the position equivalent to the first level-difference portion. To put it differently, in the present embodiment, the vane length of the vane wheel is elongated and the number of the vane wheels is reduced, while the noise reduction capability is maintained. Furthermore, the blowing characteristic is improved because the number of the connecting portions of the vane wheels, which hinder the ventilation, is reduced.

[Brief Description of Drawings]

[0028]

[FIG. 1] FIG. 1 is an oblique perspective of the external appearance of an indoor unit of an air conditioner of an embodiment of the present invention.
[FIG. 2] FIG. 2 is a cross section of the indoor unit.
[FIG. 3] FIG. 3 is an oblique perspective of a cross flow fan.
[FIG. 4] FIG. 4 is a partial oblique perspective of the cross flow fan and its surroundings in the indoor unit.
[FIG. 5] FIG. 5 is a front view of the cross flow fan and its surroundings in the indoor unit.
[FIG. 6] FIG. 6 is a top view of the cross flow fan and its surroundings in the indoor unit.
[FIG. 7] FIG. 7 is a cross section taken at the A-A line in FIG. 5 and FIG. 6 and is a partial enlarged view of a rear guider and its surroundings.
[FIG. 8] FIG. 8 is an oblique perspective of a part on the leading end side of a rear guider.
[FIG. 9] FIG. 9 is a cross section taken at the A-A line in FIG. 5 and FIG. 6 and is a partial enlarged view of a stabilizer and its surroundings.
[FIG. 10] FIG. 10 is an oblique perspective of a front guider.
[FIG. 11] FIG. 11 is a partial enlarged view of FIG. 6.
[FIG. 12] FIG. 12 is a partial enlarged view of a rear guider and a cross flow fan of another embodiment of the present invention, when viewed from above.
[FIG. 13] FIG. 13 is an oblique perspective of a rear guider of another embodiment of the present invention.
[FIG. 14] FIG. 14 is an oblique perspective of a front guider of another embodiment of the present invention.

[Description of Embodiments]

[0029] The following will describe an embodiment of the present invention.

[0030] As shown in FIG. 1, an indoor unit 1 of an air conditioner of the present embodiment is as a whole narrow and long in one direction in shape, and is attached to a wall of a room so that the length of the air conditioner is horizontal. The indoor unit 1 and an unillustrated outdoor unit constitute the air conditioner which cools or warms the room.

[0031] Hereinafter, a direction of protrusion from the wall to which the indoor unit 1 is attached will be referred to as "frontward" , whereas the direction opposite to the frontward will be referred to as "backward". Furthermore, the left-right direction in FIG. 1 will be simply referred to as "left-right direction".

[0032] As shown in FIG. 2, the indoor unit 1 includes a casing 2 and internal devices stored in the casing 2 such as a heat exchanger 3, a cross flow fan 10, a filter 4, and an electronic component box (not illustrated). Through the upper surface of the casing 2 is formed an inlet port 2a, whereas through the lower surface of the casing 2 is formed an outlet port 2b. In the vicinity of the outlet port 2b, a horizontal flap 5 is provided for adjusting the wind direction in the up-down direction and for opening and closing the outlet port 2b.

[0033] The cross flow fan 10 (hereinafter, this will be simply referred to as a fan 10) is disposed so that its axial direction is in parallel to the left-right direction. This fan 10 rotates in the direction indicated by the arrow in FIG. 2. To the front and to the back of the fan 10, a front guider 30 and a rear guider (rear tongue portion) 20 are provided, respectively, to form an air passage. A substantial upper half of the front guider 30 is constituted by a stabilizer (front tongue portion) 32. As the stabilizer 32 and the rear guider 20 are provided on the respective sides of the fan 10, the fan 10 sucks air from the upper front and blows out the air downward and backward. The heat exchanger 3 is disposed to surround the front side and the upper side of the fan 10. In an air conditioning operation, the fan 10 is driven so that indoor air is sucked through the inlet port 2a, and the sucked air is heated or cooled in the heat exchanger 3 and is then blown out through the outlet port 2b.

[0034] The following will detail the fan 10, the rear guider 20, and the front guider 30.

[Fan]

[0035] As shown in FIG. 3, the fan 10 is constituted by a plurality of (six in the present embodiment) vane wheels 12 lined up in the axial direction (left-right direction) and an end plate 11.

[0036] The end plate 11 constitutes the right end portion of the fan 10. From a central portion of the right surface of the end plate 11, a boss portion 11a protrudes to be connected with the rotational axis of a motor (not illustrated) for driving the fan 10.

[0037] Among the six vane wheels 12, each of the right five vane wheels 12A is made up of vanes 15 lined up in the circumferential direction and a substantially annular supporting plate 13 connected to the left ends of the vanes. The vanes 15 and the supporting plate 13 are integrally formed. The right end of each vane 15 of each vane wheel 12A is joined by welding or the like with the neighboring end plate 11 or the supporting plate 13 of the neighboring vane wheel 12A.

[0038] The leftmost vane wheel 12B among the six vane wheels 12 is made up of vanes 15 lined up in the circumferential direction and a substantially disc-shaped end plate 14 which is connected to the left ends of the vanes 15. The vanes 15 are integrated with the end plate 14. The right end of each vane 15 of the vane wheel 12B is joined by welding or the like with the supporting plate 13 of the neighboring vane wheel 12A. From a central portion of the left surface of the end plate 14, a shaft (not illustrated) which is rotatably supported by a bearing attached to the casing 2 protrudes.

[0039] The vanes 15 of each vane wheel 12 extend in the axial direction (left-right direction), and each of which is disposed as a forward-swept wing at a predetermined blade angle. The lengths of the vanes 15 of each of the five vane wheels 12A are identical in the axial direction and each of the vanes 15 is substantially twice as long as the length of each of the vanes 15 of the vane wheel 12B in the axial direction. In the present embodiment, the vanes 15 of each vane wheel 12 are lined up in the circumferential direction at irregular intervals. The intervals of the vanes 15 are identical between the six vane wheels 12. The vanes 15 may be lined up at regular intervals.

[0040] As shown in FIG. 4, the vanes 15 of one vane wheel 12 and the vanes 15 of the neighboring vane wheel 12 are deviated from one another in the circumferential direction. To be more specific, vanes 15 of any given vane wheel 12 are deviated from the vanes 15 of the vane wheel 12 immediately to the left of the any given vane wheel 12 each by an angle θ in the rotational direction (indicated by the arrow in FIG. 4). To put it differently, from the leftmost wheel 12 to the rightmost wheel 12 of the six vane wheels 12, each vane 15 is deviated from the corresponding vane 15 of the neighboring vane wheel 12 by the angle θ in the rotational direction.

[Rear Guider]

[0041] The rear guider 20 is provided to the back of the fan 10, and the lower edge of the rear guider 20 is connected to the outlet port 2b (see FIG. 2). As shown in FIG. 5 and FIG. 6, the length in the left-right direction of the rear guider 20 is substantially identical with the length in the left-right direction of the fan 10, and the rear guider 20 opposes substantially the entirety of the fan 10 in the left-right direction. The upper edge of the rear guider 20 is slightly above the upper edge of the fan 10 (see FIG. 2 and FIG. 6).

[0042] As shown in FIG. 2, in the surface of the rear guider 20 which surface opposes the fan 10, a part which is not the upper and lower end portions is a curved surface 21 which is substantially arc-shaped. The distance (shortest distance) between the curved surface 21 and the outer periphery of the fan 10 decreases upward.

[0043] In addition to the above, the rear guider 20 includes a protruding portion 22 at a part above the curved surface 21 (i.e., to the leading end side of the curved surface 21). The protruding portion 22 is substantially arc-shaped and bulges in the direction away from the fan 10 in cross section orthogonal to the left-right direction. The distance (shortest distance) between the protruding portion 22 and the outer periphery of the fan 10 increases upward. As described above, because the distance (shortest distance) between the curved surface 21 and the outer periphery of the fan 10 decreases upward, the rear guider 20 is closest to the fan 10 at a border 20a (hereinafter, closest position 20a) between the lower edge of each protruding portion 22 and the upper edge of the curved surface 21.

[0044] As shown in FIG. 8, the protruding portion 22 is constituted by divisional pieces 23 and 24 which are alternately lined up in the left-right direction. The protruding portion 22 is constituted by six divisional pieces 23 and five divisional pieces 24.

[0045] Each of the divisional pieces 23 and 24 linearly extends along the left-right direction, and each divisional piece 23 is deviated from each divisional piece 24 by an angle $\alpha 1$ in the circumferential direction of the fan 10 (see FIG. 7). The cross sectional shape of each divisional piece 23 in the direction orthogonal to the left-right direction is substantially identical with the cross sectional shape of each divisional piece 24 in the direction orthogonal to the left-right direction. The upper edges of the six divisional pieces 23 are at the same height. Furthermore, the upper edges of the five divisional pieces 24 are at the same height.

[0046] The right five divisional pieces 23 among the six divisional pieces 23 are identical in length in the left-right direction, and each of which is substantially half as long as the vane 15 of the vane wheel 12A in the left-right direction. The leftmost divisional piece 23 is substantially as long as the vane 15 of the vane wheel 12B in the left-right direction. The five divisional pieces 24 are identical in length in the left-right direction, and each of which is substantially half as long as the vane 15 of the vane wheel 12A in the left-right direction.

[0047] A level difference at the border between the leading end (upper edge) of the divisional piece 24 and the leading end of the divisional piece 23 which is adjacent on the left is termed a level-difference portion (second level-difference portion) 25, whereas a level difference at the border between the leading end of the divisional piece 24 and the leading end of the divisional piece 23 which is adjacent on the right is termed a level-difference portion (first level-difference portion) 26. The direction of deviation in the circumferential direction of the level-difference portion 25 is opposite to the direction of deviation in the circumferential direction of the level-difference portion 26. The level-difference portion 25 opposes the connecting portion (supporting plate 13) between the vane wheels 12 whereas the level-difference portion 26 opposes a substantially central portion in the left-right direction of the vane wheel 12.

[0048] As shown in FIG. 11, each divisional piece 23 is deviated from the divisional piece 24 adjacent on the left by an angle $\alpha 1$, in the direction opposite to the rotational direction (indicated by the arrow in FIG. 11) of the fan 10. To put it differently, the level-difference portion 26 is deviated by the angle $\alpha 1$ in the direction opposite to the rotational direction when viewed from left to right, whereas the level-difference portion 25 is deviated by the angle $\alpha 1$ in the rotational direction of the fan 10 when viewed from left to right. As such, the direction of deviation between the two vanes 15 of the neighboring two vane wheels 12, which are deviated from each other by the angle θ, is identical with the direction of deviation of the level-difference portion 25 in the circumferential direction and is opposite to the direction of deviation of the level-difference portion 26 in the circumferential direction. In the present embodiment, the angle $\alpha 1$ is substantially half as large as the deviation angle θ between the vanes 15 of the neighboring two vane wheels 12.

[Front Guider]

[0049] The front guider 30 is provided to the front of the fan 10, and the lower edge of the front guider 30 is connected to the outlet port 2b (see FIG. 2). The front guider 30 is made up of the stabilizer 32 provided to oppose the fan 10 and a front wall portion 31 which extends from the lower edge of the stabilizer 32 to the outlet port 2b.

[0050] As shown in FIG. 5 and FIG. 6, the length in the left-right direction of the stabilizer 32 is substantially identical with the length in the left-right direction of the fan 10, and the stabilizer 32 opposes substantially the entirety of the fan 10 in the left-right direction. The upper edge of the stabilizer 32 is lower than the center of the fan 10 (see FIG. 2 and FIG. 5).

[0051] As shown in FIG. 9, in the surface of the stabilizer 32 which surface opposes the fan 10, a part which is not the upper and lower end portions is a curved surface 33 which is substantially arc-shaped. The distance (shortest distance) between the curved surface 33 and the outer periphery of the fan 10 decreases upward. The stabilizer 32 includes a bending surface 34 which is bent to extend substantially frontward from the lower edge of the curved surface 33. The lower edge of the bending surface 34 is connected to the front wall portion 31.

[0052] In addition to the above, the stabilizer 32 includes a flat end face 35 which extends downward and frontward from the upper edge of the curved surface 33 and a convex portion 36 which is provided to the front of the end face 35 and protrudes upward to be higher than the end face 35. The convex portion 36 and the end face 35 constitute the upper end portion of the rear guider 20. The stabilizer 32 is closest to the outer periphery of the fan 10 at an upper edge 32a (hereinafter, closest position 32a) of the curved surface 33.

[0053] As shown in FIG. 10, the stabilizer 32 (the convex portion 36, the end face 35, the curved surface 33, and the bending surface 34) is formed of divisional pieces 37 and 38 which are alternately lined up in the left-right direction. The stabilizer 32 is formed of six divisional pieces 37 and five divisional pieces 38.

[0054] Each of the divisional pieces 37 and 38 linearly extends along the left-right direction, and each divisional piece 37 and each divisional piece 38 are deviated from each other by an angle $\beta 1$ in the circumferential direction of the fan 10 (see FIG. 9). The cross sectional shape of each divisional piece 37 in the direction orthogonal to the left-right direction is substantially identical with the cross sectional shape of each divisional piece 38 in the direction orthogonal to the left-right direction. The upper edges of the six divisional pieces 37 are at the same height. Furthermore, the upper edges of the five divisional pieces 38 are at the same height.

[0055] The right five divisional pieces 37 among the six divisional pieces 37 are identical in length in the left-right direction, and each of which is substantially half as long as the vane 15 of the vane wheel 12A in the left-right direction. The leftmost divisional piece 37 is substantially as long as the vane 15 of the vane wheel 12B in the left-right direction. The five divisional pieces 38 are identical in length in the left-right direction and each of which is substantially half as long as the vane 15 of the vane wheel 12A in the left-right direction.

[0056] A level difference at the border between the divisional piece 38 and the divisional piece 37 adjacent on the left is termed a level-difference portion (second level-difference portion) 39, whereas a level difference at the border between the divisional piece 38 and the divisional piece 37 adjacent on the right is termed a level-difference portion (first level-difference portion) 40. The direction of deviation in the circumferential direction of the level-difference portion 39 is opposite to the direction of deviation in the circumferential direction of the level-difference portion 40. The level-difference portion 39 opposes the connecting portion (supporting plate 13) between the vane wheels 12 whereas the level-difference portion 40 opposes a substantially central portion in the left-right direction of the vane wheel 12.

[0057] As shown in FIG. 5, each divisional piece 37 is deviated from the divisional piece 38 adjacent on the left by an angle $\beta 1$, in the direction opposite to the rotational direction of the fan 10. To put it differently, the level-difference portion 40 is deviated by the angle $\beta 1$ in the direction opposite to the rotational direction when viewed from left to right, whereas the level-difference portion 39 is deviated by the angle $\beta 1$ in the rotational direction of the fan 10 when viewed from left to right. On this account, the direction of deviation between the two vanes 15 of the neighboring two vane wheels 12, which are deviated by the angle θ, is identical with the direction of deviation of the level-difference portion 39 in the circumferential direction and is opposite to the direction of deviation of the level-difference portion 40 in the circumferential direction. In the present embodiment, the angle $\alpha 1$ is substantially half as large as the deviation angle θ between the vanes 15 of the neighboring two vane wheels 12.

[0058] Now, the wind noise generated between the rear guider 20 and the fan 10 will be described with reference to FIG. 11. FIG. 11 shows only the right three vane wheels 12 among the six vane wheels 12. Furthermore, among the vanes 15 of these three vane wheels 12, the figure shows only three vanes 15 each of which is deviated from the left one in the rotational direction by the angle θ.

[0059] When the fan 10 rotates, after a substantially right half of the rightmost vane 15 among the six vanes 15 which are deviated from one another by the angle θ passes the divisional piece 23 first, a substantially left half of this vane 15 passes the divisional piece 24. A vortex airflow (indicated by the arrow in FIG. 7) is generated between the leading end portion of the rear guider 20 and the fan 10, and wind noise is generated on account of the interference between this vortex airflow and the vanes. In this regard, in the present embodiment, the wind noise generated when one vane 15 passes the rear guider 20 is dividingly generated in twice.

[0060] After the rightmost vane 15 has passed the divisional piece 24, a substantially right half of the second rightmost vane 15 passes the divisional piece 23. As such, in the present embodiment, the wind noise, which is generated when two vanes 15 deviated from each other by the angle θ pass the rear guider 20, is generated at different timings. Then a substantially left half of the second rightmost vane passes the divisional piece 24, and the remaining four vanes 15 similarly pass the divisional pieces 23 and 24 one by one.

[0061] In addition to the above, a vortex airflow (indicated by the arrow in FIG. 9) is generated between the curved surface 33 of the stabilizer 32 and the fan 10, too, and wind noise is generated on account of the interference between the vortex airflow and the vanes 15 when the vanes 15 pass the curved surface 33 of the stabilizer 32. Because the stabilizer 32 is provided with the level-difference portions 39 and 40, the wind noise generated when one vane 15 passes the stabilizer 32 is dividingly generated in twice and the wind noise generated when two vanes 15 deviated from each other by the angle θ pass the stabilizer 32 is generated at different timings, in a similar manner as in the rear guider 20.

[0062] As described above, in the air conditioner of the present embodiment, the leading end portion of each of the rear guider 20 and the stabilizer 32 has the level-difference portion (first level-difference portion) 26, 40 which is deviated in the circumferential direction and opposes the intermediate part in the axial direction of the vane wheel 12A, and hence the time duration over which one vane 15 passes the leading end of the stabilizer 32 or the rear guider 20 is divided into before and after reaching the first level-difference portion 26, 40. Therefore the wind noise is not generated at once by one vane 15, and the wind noise is generated in a divided manner. In this way, the wind noise is reduced.

[0063] In addition to the above, in the present embodiment, the leading end portion of each of the rear guider 20 and the stabilizer 32 has the level-difference portion (second level-difference portion) 25, 39 which is deviated in the circumferential direction and opposes the connecting portion between the vane wheels 12. With this, the timing of the generation of the wind noise is differentiated between the vane wheels 12, with the result that the wind noise is further reduced.

[0064] Furthermore, in the present embodiment, because in the leading end portion of each of the rear guider 20 and the stabilizer 32 the part between the two neighboring level-difference portions linearly extends in the axial direction, the stabilizer 32 or the rear guider 20 is easily manufactured.

[0065] Furthermore, in the present embodiment, the parts, which oppose the five vane wheels 12A, of the leading end portions of the rear guider 20 and the stabilizer 32 are identical in shape and height. It is therefore easy to manufacture the rear guider 20 and the stabilizer 32. Furthermore, the leading end portions of the rear guider 20 and the stabilizer 32 are arranged to be substantially constant in height overall.

[0066] In addition to the above, in the present embodiment, the direction of deviation of the first level-difference portion 26, 40 is opposite to the direction of deviation of the second level-difference portion 25, 39, the direction of deviation of the vanes 15 deviated from each other at the angle θ is opposite to the direction of deviation of the first level-difference portion 26, 40, and the deviation angle of the second level-difference portion 25, 39 is smaller than the angle θ. On this account, the direction of temporal deviation of two wind noises generated before and after reaching the first level-difference portion 26, 40 is identical with the direction of temporal deviation of two wind noises generated before and after reaching the second level-difference portion 25, 39. With this arrangement, the wind noise is sequentially generated from one end to the other end in the axial direction of the fan 10. This decreases the directivity due to the interference of wind noises generated at the respective divisional pieces (i.e., between the level-difference portions), and noise reduction is effectively done across the entire room.

[0067] In addition to the above, in the present embodiment, two wind noises generated before and after reaching the first level-difference portion 26, 40 are deviated from each other by the deviation angle (α1, β1) of the first level-difference portion 26, 40, whereas two wind noises generated before and after reaching the second level-difference portion 25, 39 are deviated from each other by an angle calculated by subtracting the deviation angle (α1, β1) of the second level-difference portion 25, 39 from the deviation angle θ between the vanes 15. For this reason, the deviation time between the two wind noises generated before and after reaching the first level-difference portion 26, 0 is arranged to be identical with the deviation time between the two wind noises generated before and after reaching the second level-difference portion 25, 39. The present embodiment therefore achieves a noise reduction effect similar to the noise reduction effect in case where the first level-difference portion is not provided and the number of the vane wheels 12 is increased so that each connecting portion of the vane wheels 12 is provided to oppose the position equivalent to the first level-difference portion. To put it differently, in the present embodiment, the vane length of the vane wheel 12 is elongated and the number of the vane wheels is reduced, while the noise reduction capability is maintained. Furthermore, the blowing characteristic is improved because the number of the connecting portions of the vane wheels, which hinder the ventilation, is reduced.

[0068] While the embodiment of the present invention has been described, it should be noted that the scope of the invention is not limited to the above-described embodiment. The scope of the present invention is defined by the appended claims rather than the foregoing description of the embodiment, and the present invention is intended to embrace all alternatives, modifications and variances which fall within the scope of the appended claims. It is noted that the modifications below may be suitably combined and implemented.

[0069] While in the embodiment the deviation angle $\alpha 1$ of the level-difference portion 25, 26 and the deviation angle $\beta 1$ of the level-difference portion 39, 40 are substantially half as large as the deviation angle θ between the vane 15, the deviation angle $\alpha 1$ may be larger than or smaller than the deviation angle θ. However, when the deviation angle $\alpha 1$ is larger than $\theta/2$, the deviation angle $\alpha 1$ is preferably smaller than the angle θ.

[0070] While in the embodiment the direction of deviation of the first level-difference portion 26, 40 is opposite to the direction of deviation between the vanes 15 whereas the direction of deviation of the second level-difference portion 25, 39 is identical with the direction of deviation between the vanes 15, the direction of deviation of the first level-difference portion 26, 40 may be identical with the direction of deviation between the vanes 15 whereas the direction of deviation of the second level-difference portion 25, 39 may be opposite to the direction of deviation between the vanes 15.

[0071] While in the embodiment the rear guider 20 has only one first level-difference portion 26, 40 within a range of one vane wheel 12A in the axial direction, two or more first level-difference portions 126 and 127 may be provided within a range of one vane wheel 12A in the axial direction as in the case of a rear guider 120 shown in FIG. 12, for example.

[0072] In this modification, a deviation angle $\alpha 2$ of a second level-difference portion 125 is preferably identical with the total sum of deviation angles $\alpha 3$ and $\alpha 4$ of the first level-difference portions 126 and 127 within a range of one vane wheel 12A in the axial direction. Furthermore, each of the deviation angles $\alpha 3$ and $\alpha 4$ of the first level-difference portions 126 and 127 is preferably at a value calculated by dividing the deviation angle θ between the vanes 15 by a number which is a result of addition of 1 to the number of the first level-difference portions within the range of the vane wheel 12A in the axial direction. This arrangement makes it possible to cause the deviation time between the wind noises generated before and after reaching the first level-difference portion 126, 127 to be identical with the deviation time between the wind noises generated before and after reaching the second level-difference portion 125.

[0073] The deviation angles of the two or more first level-difference portions provided within the range of one vane wheel in the axial direction may be different from the above. In this regard, the deviation angles of the two or more first level-difference portions may be identical with one another or different from one another.

[0074] In the stabilizer 32, in a similar manner, two or more first level-difference portions may be provided within the range of one vane wheel 12A in the axial direction.

[0075] While in the embodiment parts of the leading end portion of the rear guider 20 are identical with one another in shape and height in the range opposing the five vane wheels 12A, the parts may be different from one another.

[0076] For example, the number of the first level-difference portions, the deviation angles, or the directions of deviation may be different between the vane wheels 12A. Furthermore, the first level-difference portion may be provided to oppose an intermediate part in the axial direction of only one or some vane wheel 12A among the five vane wheels 12A. Furthermore, the second level-difference portion may be provided to oppose only one or more connecting portion among the connecting portions of the six vane wheels 12.

[0077] In the stabilizer 32, in a similar manner, parts opposing the five vane wheels 12A may be different from one another in shape and height.

[0078] While in the embodiment the rear guider 20 is arranged such that the divisional pieces 23 and 24 are identical in height (i.e., the height of the part between the neighboring level-difference portions) in the axial direction, the height of each of the divisional pieces 228 may be gradually varied in the axial direction as in the case of a rear guider 220 shown in FIG. 13. The cross sectional shape in the axial direction of each divisional piece 228 is substantially constant. This makes it possible to sequentially generate the wind noise generated when the vane 15 passes one divisional piece 228. In FIG. 13, the level-difference portions 229 on the respective sides of the divisional piece 228 oppose a central portion in the axial direction of the vane wheel 12A (or an end portion of the vane wheel 12) and the connecting portion between the vane wheels 12, respectively.

[0079] In the stabilizer 32, in a similar manner, the height of each divisional piece 241 may be gradually changed in the axial direction as in the case of a stabilizer 232 of a front guider 230 shown in FIG. 14, for example. In FIG. 14, the level-difference portions 242 on the respective sides of the divisional piece 241 opposes a central portion in the axial direction of the vane wheel 12A (or the end portion of the vane wheel 12) and the connecting portion between the vane wheels 12, respectively.

[0080] While in the embodiment above the part of the rear guider 20 where the shape is deviated in the circumferential direction ranges from the leading end to the border between the protruding portion 22 and the curved surface 21, the deviated part of the rear guider 20 may range from the leading end to an intermediate part of the curved surface 21. In other words, the lower edges of the divisional pieces 23 and 24 may be above the border between the protruding portion 22 and the curved surface21.

[0081] While in the embodiment above the entirety of the stabilizer 32 in the up-down direction is multi-staged in the circumferential direction, only a part of the stabilizer 32 on the leading end side may be multi-staged in the circumferential direction. In other words, the lower edges of the divisional pieces 37 and 38 may be above the lower edge of the stabilizer 32. For example, only the end face 35 and the convex portion 36 are multi-staged in the circumferential direction, and a part of the stabilizer 32 which part extends from the leading end to an intermediate part of the curved surface 33 may be multi-staged in shape in the circumferential direction.

[0082] While in the embodiment a multi-stage shape is formed as both of the rear guider 20 and the stabilizer 32 have the first level-difference portions opposing the intermediate portions in the axial direction of the vane wheel 12A, only one of the rear guider 20 and the stabilizer 32 may have a multi-stage shape including the first level-difference portion opposing the intermediate portion in the axial direction of the vane wheel 12A, while the other does not have the first level-difference portion (i.e., the level-difference portion is not provided at all, or a multi-stage shape in which only the second level-difference portions opposing the connecting portions of the vane wheel 12).

[0083] In the embodiment above, the cross sectional shape of the rear guider 20 in the direction orthogonal to the left-right direction is constituted by the arc-shaped curved surface 21 and the protruding portion 22 which is substantially arc-shaped in cross section and above the curved surface 21. The cross sectional shape of the rear guider may be different from this shape. For example, the cross sectional shape may be arranged such that a protruding portion which is substantially arc-shaped on the fan 10 side and is flat on the side opposite to the fan 10 is formed above the curved surface 21. When the cross sectional shape of the rear guider 20 is different from the shape described in the embodiment above, at least a part of the rear guider which part ranges from the closest position where the rear guider 20 is closest to the fan 10 to the leading end is deviated in the circumferential direction (i.e., a divisional piece).

[0084] In the embodiment above, the cross sectional shape of the stabilizer 32 in the direction orthogonal to the left-right direction is arranged such that the flat end face 35 and the convex portion 36 substantially triangular in cross section are provided above the curved surface 33. The cross sectional shape of the stabilizer may be different from this shape. For example, in the cross sectional shape, no end face 35 may be provided and the convex portion 36 may be connected to the upper edge of the curved surface 33. When the cross sectional shape of the stabilizer 32 is different from the shape described in the embodiment above, at least a part of the stabilizer 32 which part ranges from the closest position where the stabilizer 32 is closest to the fan 10 to the leading end is deviated in the circumferential direction (i.e., a divisional piece).

[0085] While the embodiment above describes a case where the present invention is employed in a wall-mounted indoor unit which is arranged to suck indoor air from an upper part of the indoor unit and blow out the air from a lower part of the indoor unit, the present invention may be applicable to other purposes. For example, the present invention may be employed in a floor-mounted indoor unit which is arranged to suck indoor air from a lower part of the indoor unit and blow out the air from an upper part of the indoor unit.

[Industrial Applicability]

[0086] The present invention makes it possible to further reduce wind noise.

[Reference Signs List]

[0087]

1 INDOOR UNIT OF AIR CONDITIONER
10 CROSS FLOW FAN
12 (12A, 12B) VANE WHEEL
15 VANE
20, 120, 220 REAR GUIDER
25, 125 LEVEL-DIFFERENCE PORTION (SECOND LEVEL-DIFFERENCE PORTION)
26, 126, 127 LEVEL-DIFFERENCE PORTION (FIRST LEVEL-DIFFERENCE PORTION)
30, 230 FRONT GUIDER
32, 232 STABILIZER
39 LEVEL-DIFFERENCE PORTION (SECOND LEVEL-DIFFERENCE PORTION)
40 LEVEL-DIFFERENCE PORTION (FIRST LEVEL-DIFFERENCE PORTION)
229 LEVEL-DIFFERENCE PORTION (FIRST LEVEL-DIFFERENCE PORTION,
SECOND LEVEL-DIFFERENCE PORTION)
242 LEVEL-DIFFERENCE PORTION (FIRST LEVEL-DIFFERENCE PORTION, SECOND LEVEL-DIFFERENCE PORTION)

Claims

1. An air conditioner comprising:

a cross flow fan (10) in which vane wheels (12A, 12B) each including vanes (15) lined up in a circumferential direction are lined up in an axial direction; and
a stabilizer (32, 232) and a rear guider (20, 120, 220) which are provided on respective sides of an outer periphery of the cross flow fan (10) to form an air passage,
a leading end portion of at least one of the stabilizer (32, 232) and the rear guider (20, 120, 220) having a multi-stage shape so as to include

level-difference portions which are deviated in the circumferential direction of the cross flow fan (10), and

the level-difference portions including at least one first level-difference portion (26, 126, 127) which opposes an intermediate portion in the axial direction of corresponding one of the vane wheels (12A, 12B)

characterized in that

vanes (15) of a vane wheel (12A, 12B) opposing the first level-difference portion and of a vane wheel (12A, 12B) neighboring to this vane wheel (12A, 12B) being provided to be deviated from one another by a predetermined angle in the circumferential direction, and

in a direction from one end to the other end in the axial direction, the direction of deviation in the circumferential direction of the first level-difference portion (26, 126, 127) being opposite to the direction of deviation in the circumferential direction of the vanes (15) of the neighboring two vane wheels (12A, 12B).

2. The air conditioner according to claim 1, wherein, the level-difference portions include a second level-difference portion (25, 125) which opposes a connecting portion between the vane wheels (12A, 12B).

3. The air conditioner according to claim 1 or 2, wherein, the height of a part between neighboring two of the level-difference portions is constant in the axial direction.

4. The air conditioner according to claim 3, wherein, the level-difference portions include the at least one first level-difference portion (26, 126, 127) which include one or more first level-difference portion (26, 126, 127) opposing the intermediate portion in the axial direction of each of neighboring two of the vane wheels (12A, 12B) and a second level-difference portion (25, 125) opposing a connecting portion of the neighboring two vane wheels (12A, 12B),

in a direction from one end to the other end in the axial direction, a direction of deviation in the circumferential direction of the first level-difference portion (26, 126, 127) is opposite to a direction of deviation in the circumferential direction of the second level-difference portion (25, 125), and

parts of the leading end portion which parts oppose the neighboring two of the vane wheels (12A, 12B) are identical in shape and height.

5. The air conditioner according to claim 3, wherein, the level-difference portions include two second level-difference portions (25, 125) which oppose connecting portions between the vane wheel (12) opposing the first level-difference portion (26, 126, 127) and the vane wheels (12) on the respective sides of the vane wheel (12) opposing the first level-difference portion (26, 126, 127),

in a direction from one end to the other end in the axial direction, a direction of deviation in the circumferential direction of the first level-difference portion (26, 126, 127) is opposite to a direction of deviation in the circumferential direction of the second level-difference portion (25, 125), and

a deviation angle in the circumferential direction of the second level-difference portion (25, 125) is smaller than the predetermined angle.

6. The air conditioner according to claim 5, wherein, the deviation angle in the circumferential direction of the first level-difference portion (26, 126, 127) is identical with a value calculated by dividing the predetermined angle by a result of addition of 1 to the number of the first level-difference portions (26, 126, 127) within a range in the axial direction of the vane wheel (12) opposing the first level-difference portion, and

the deviation angle in the circumferential direction of the second level-difference portion (25, 125) is identical with a total sum of the deviation angle in the circumferential direction of the first level-difference portion (26, 126, 127) within the range in the axial direction.

Patentansprüche

1. Klimaanlage, umfassend:

ein Querstrom-Gebläse (10), in welchem Schaufelräder (12A, 12B), die jeweils Schaufeln (15) aufweisen, die in einer Umfangsrichtung aufgereiht sind, in einer Axialrichtung aufgereiht sind; und

einen Stabilisator (32, 232) und eine Heckführung (20, 120, 220), die auf den jeweiligen Seiten eines äußeren Umfangs des Querstrom-Gebläses (10) bereitgestellt sind, um einen Luftdurchgang auszubilden;

einen vorderen Endbereich von zumindest einem von dem Stabilisator (32, 232) und der Heckführung (20, 120, 220), der eine Mehrstufenform hat, damit Pegeldifferenz-Bereiche, die in der Umfangsrichtung des Querstrom-Gebläses (10) abweichen, aufgewiesen sind, und

wobei die Pegeldifferenz-Bereiche mindestens einen ersten Pegeldifferenz-Bereich (26, 126, 127) aufweisen, der einem dazwischenliegenden Bereich in der Axialrichtung des entsprechenden der Schaufelräder (12A, 12B) gegenüberliegt,

dadurch gekennzeichnet, dass

Schaufeln (15) eines Schaufelrads (12A, 12B), die dem ersten Pegeldifferenz-Bereich gegen-

überliegen, und eines Schaufelrads (12A, 12B), das diesem Schaufelrad (12A, 12B) benachbart ist, bereitgestellt sind, um voneinander um einen vorbestimmten Winkel in der Umfangsrichtung abzuweichen, und
in einer Richtung von einem Ende zu dem anderen Ende in der Axialrichtung die Abweichungsrichtung in der Umfangsrichtung des ersten Pegeldifferenz-Bereichs (26, 126, 127) der Abweichungsrichtung in der Umfangsrichtung der Schaufeln (15) der benachbarten zwei Schaufelräder (12A, 12B) gegenüberliegend ist.

2. Klimaanlage nach Anspruch 1, wobei die Pegeldifferenz-Bereiche einen zweiten Pegeldifferenz-Bereich (25, 125) aufweisen, der einem Verbindungsbereich zwischen den Schaufelrädern (12A, 12B) gegenüberliegt.

3. Klimaanlage nach Anspruch 1 oder 2, wobei die Höhe eines Teils zwischen benachbarten zwei der Pegeldifferenz-Bereiche in der Axialrichtung konstant ist.

4. Klimaanlage nach Anspruch 3, wobei
die Pegeldifferenz-Bereiche den mindestens einen ersten Pegeldifferenz-Bereich (26, 126, 127) aufweisen, der einen oder mehrere erste Pegeldifferenz-Bereiche (26, 126, 127), die dem dazwischenliegenden Bereich in der Axialrichtung von jedem der benachbarten zwei der Schaufelräder (12A, 12B) gegenüberliegen, und einen zweiten Pegeldifferenz-Bereich (25, 125) aufweisen, der einem Verbindungsbereich der benachbarten zwei Schaufelräder (12A, 12B) gegenüberliegt,
in einer Richtung von einem Ende zu dem anderen Ende in der Axialrichtung die Abweichungsrichtung in der Umfangsrichtung des ersten Pegeldifferenz-Bereichs (26, 126, 127) einer Abweichungsrichtung in der Umfangsrichtung des zweiten Pegeldifferenz-Bereichs (25, 125) gegenüberliegend ist, und
Teile des vorderen Endbereichs, die den benachbarten zwei der Schaufelräder (12A, 12B) gegenüberliegen, in Form und Höhe identisch sind.

5. Klimaanlage nach Anspruch 3, wobei
die Pegeldifferenz-Bereiche zwei zweite Pegeldifferenz-Bereiche (25, 125) aufweisen, die Verbindungsbereichen zwischen dem Schaufelrad (12), das dem ersten Pegeldifferenz-Bereich (26, 126, 127) und den Schaufelrädern (12) auf den jeweiligen Seiten des Schaufelrads (12) gegenüberliegen, die dem ersten Pegeldifferenz-Bereich (26, 126, 127) gegenüberliegen,
in einer Richtung von einem Ende zu dem anderen Ende in der Axialrichtung die Abweichungsrichtung in der Umfangsrichtung des ersten Pegeldifferenz-Bereichs (26, 126, 127) einer Abweichungsrichtung in der Umfangsrichtung des zweiten Pegeldifferenz-Bereichs (25, 125) gegenüberliegend ist, und
ein Abweichungswinkel in der Umfangsrichtung des zweiten Pegeldifferenz-Bereichs (25, 125) kleiner als der vorbestimmte Winkel ist.

6. Klimaanlage nach Anspruch 5, wobei
der Abweichungswinkel in der Umfangsrichtung des ersten Pegeldifferenz-Bereichs (26, 126, 127) identisch mit einem Wert ist, der berechnet wird, indem der vorbestimmte Winkel durch ein Ergebnis einer Addition von 1 zu der Anzahl von ersten Pegeldifferenz-Bereichen (26, 126, 127) innerhalb eines Bereichs in der Axialrichtung des Schaufelrads (12) geteilt wird, das dem ersten Pegeldifferenz-Bereich gegenüberliegt, und
der Abweichungswinkel in der Umfangsrichtung des zweiten Pegeldifferenz-Bereichs (25, 125) identisch mit einer Gesamtsumme des Abweichungswinkels in der Umfangsrichtung des ersten Pegeldifferenz-Bereichs (26, 126, 127) innerhalb des Bereichs in der Axialrichtung ist.

Revendications

1. Climatiseur comprenait
un ventilateur à flux transversal (10) dans lequel des roues à ailettes (12A, 12B) incluant chacune des ailettes (15) alignées dans une direction circonférentielle sont alignées dans une direction axiale ; et
un stabilisateur (32, 232) et un orienteur arrière (20, 120, 220) qui sont prévus sur des côtés respectifs d'une périphérie extérieure du ventilateur à flux transversal (10) pour former un passage d'air,
une portion d'extrémité d'attaque d'au moins un du stabilisateur (32, 232) et de l'orienteur arrière (20, 120, 220) ayant une forme à plusieurs étages afin d'inclure des portions de différence de niveau qui sont déviées dans la direction circonférentielle du ventilateur à flux transversal (10), et
les portions de différence de niveau incluant au moins une première portion de différence de niveau (26, 126, 127) qui fait face à une portion intermédiaire dans la direction axiale d'une correspondante des roues à ailettes (12A, 12B)
caractérisé en ce que
des ailettes (15) d'une roue à ailettes (12A, 12B) opposée à la première portion de différence de niveau et d'une roue à ailettes (12A, 12B) voisine de cette roue à ailettes (12A, 12B) étant prévues pour être déviées les unes par rapport aux autres d'un angle prédéterminé dans la direction circonférentielle, et
dans un sens allant d'une extrémité à l'autre extrémité dans la direction axiale, le sens de déviation dans la direction circonférentielle de la première portion de différence de niveau (26, 126, 127) étant op-

posé au sens de déviation dans la direction circonférentielle des ailettes (15) des deux roues à ailettes voisines (12A, 12B).

2. Climatiseur selon la revendication 1, dans lequel, les portions de différence de niveau incluent une seconde portion de différence de niveau (25, 125) qui s'oppose à une portion de connexion entre les roues à ailettes (12A, 12B).

3. Climatiseur selon la revendication 1 ou 2, dans lequel la hauteur d'une partie entre deux voisines des portions de différence de niveau est constante dans la direction axiale.

4. Climatiseur selon la revendication 3, dans lequel, les portions de différence de niveau incluent la au moins une première portion de différence de niveau (26, 126, 127) qui inclut une ou plusieurs premières portions de différence de niveau (26, 126, 127) opposées à la portion intermédiaire dans la direction axiale de chacune de deux voisines des roues à ailettes (12A, 12B) et une seconde portion de différence de niveau (25, 125) opposée à une portion de connexion des deux roues à ailettes voisines (12A, 12B), dans un sens allant d'une extrémité à l'autre extrémité dans la direction axiale, un sens de déviation dans la direction circonférentielle de la première portion de différence de niveau (26, 126, 127) est opposé à un sens de déviation dans la direction circonférentielle de la seconde portion de différence de niveau (25,125), et
des parties de la portion d'extrémité d'attaque, lesquelles parties s'opposent aux deux voisines des roues à ailettes (12A, 12B), sont identiques en ce qui concerne la forme et la hauteur.

5. Climatiseur selon la revendication 3, dans lequel, les portions de différence de niveau incluent deux secondes portions de différence de niveau (25, 125) qui s'opposent à des portions de connexion entre la roue à ailettes (12) opposée à la première portion de différence de niveau (26, 126, 127) et les roues à ailettes (12) sur les côtés respectifs de la roue à ailettes (12) opposée à la première portion de différence de niveau (26, 126, 127),
dans un sens allant d'une extrémité à l'autre extrémité dans la direction axiale, un sens de déviation dans la direction circonférentielle de la première portion de différence de niveau (26, 126, 127) est opposé à un sens de déviation dans la direction circonférentielle de la seconde portion de différence de niveau (25, 125), et
un angle de déviation dans la direction circonférentielle de la seconde portion de différence de niveau (25, 125) est plus petit que l'angle prédéterminé.

6. Climatiseur selon la revendication 5, dans lequel,
l'angle de déviation dans la direction circonférentielle de la première portion de différence de niveau (26, 126, 127) est identique à une valeur calculée en divisant l'angle prédéterminé par un résultat d'addition de 1 au nombre des premières portions de différence de niveau (26, 126, 127) à l'intérieur d'une plage dans la direction axiale de la roue à ailettes (12) opposée à la première portion de différence de niveau, et
l'angle de déviation dans la direction circonférentielle de la seconde portion de différence de niveau (25, 125) est identique à une somme totale de l'angle de déviation dans la direction circonférentielle de la première portion de différence de niveau (26, 126, 127) à l'intérieur de la plage dans la direction axiale.

FIG.1

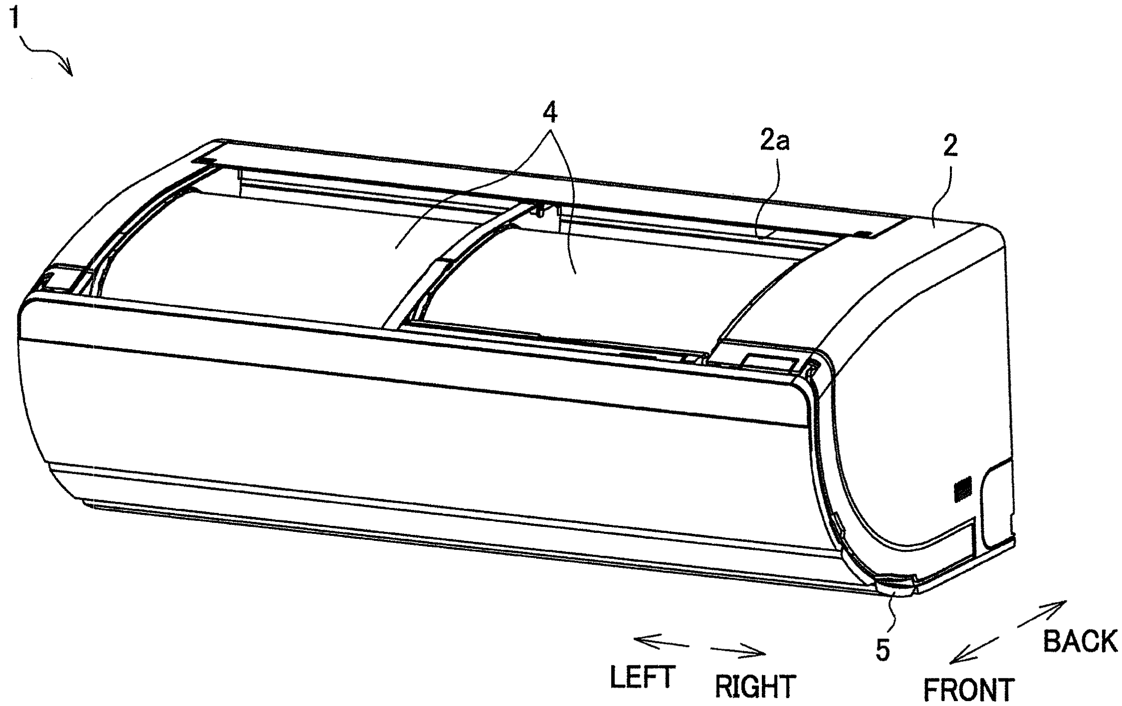


FIG.2

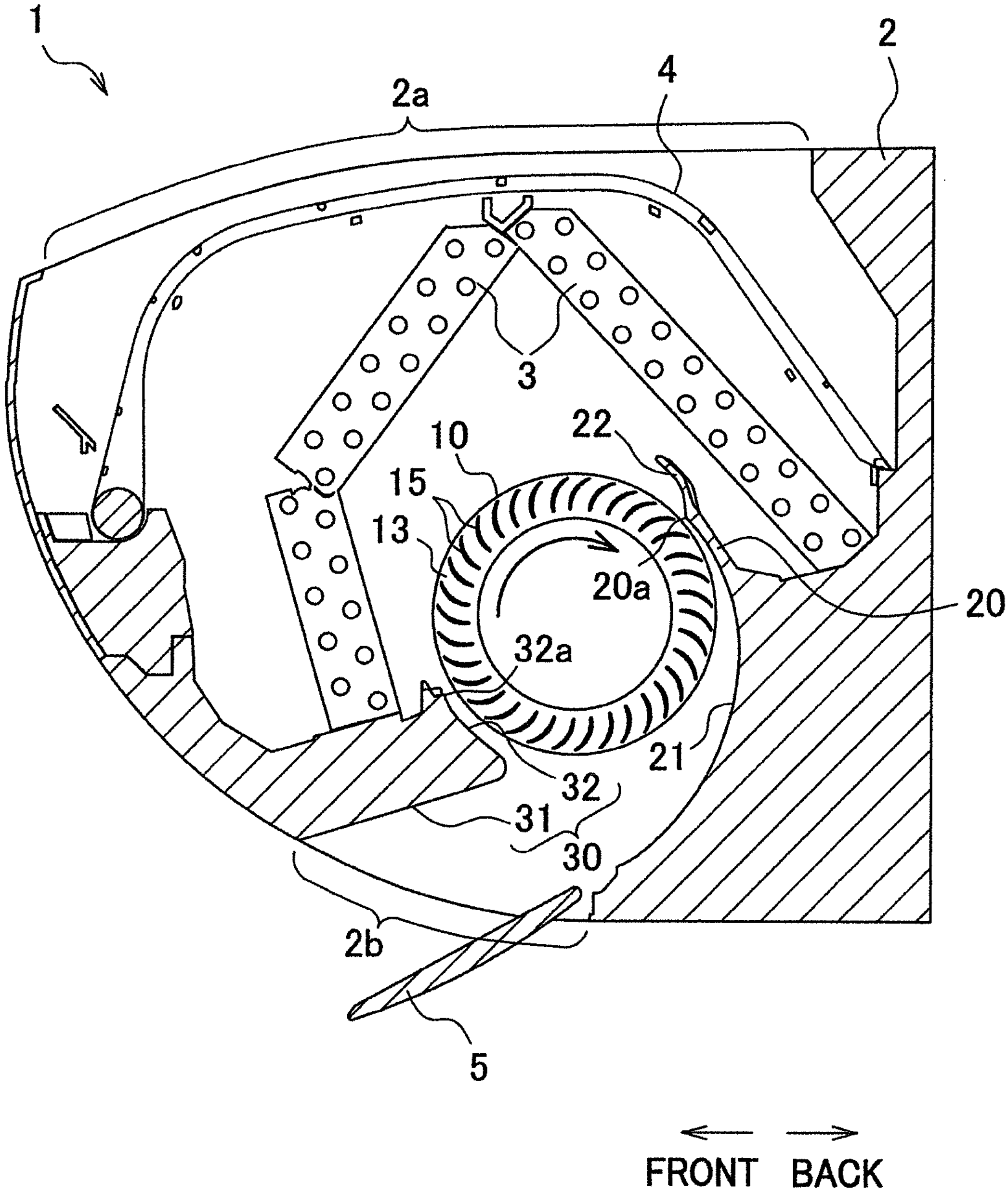


FIG.3

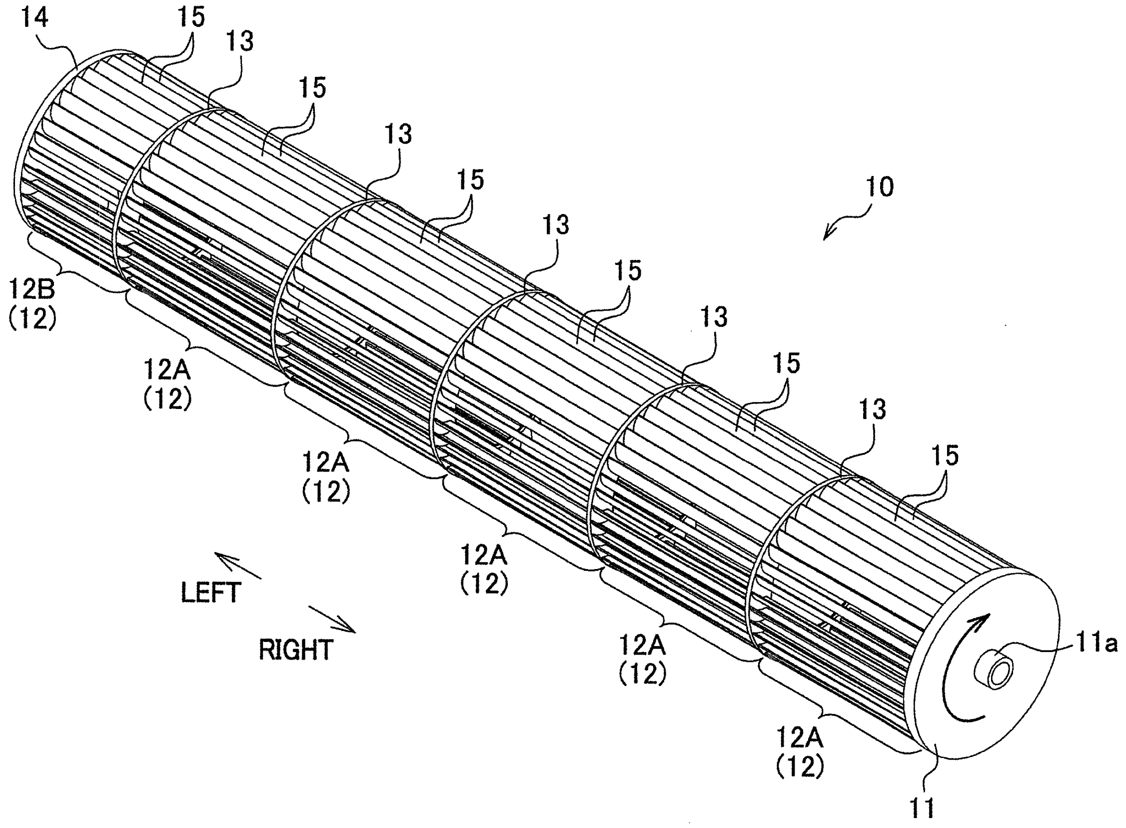

14
15
13
15
13
15
13
15
13
15
13
15
10
12B
(12)
12A
(12)
12A
(12)
12A
(12)
12A
(12)
12A
(12)
LEFT
RIGHT
11a
11

FIG.4

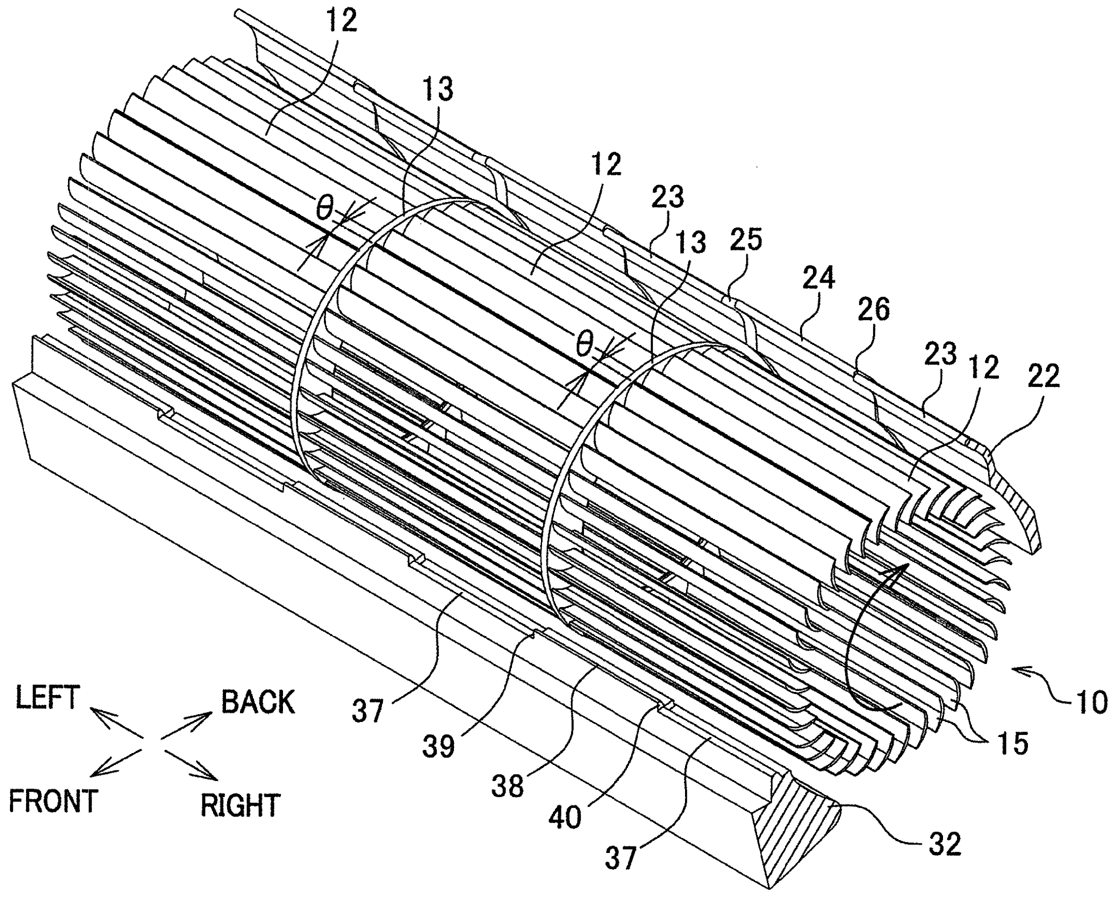

12
13
12
23
13
25
24
26
23
12
22
θ
θ
10
15
32
37
39
38
40
37
LEFT
BACK
FRONT
RIGHT

FIG.5

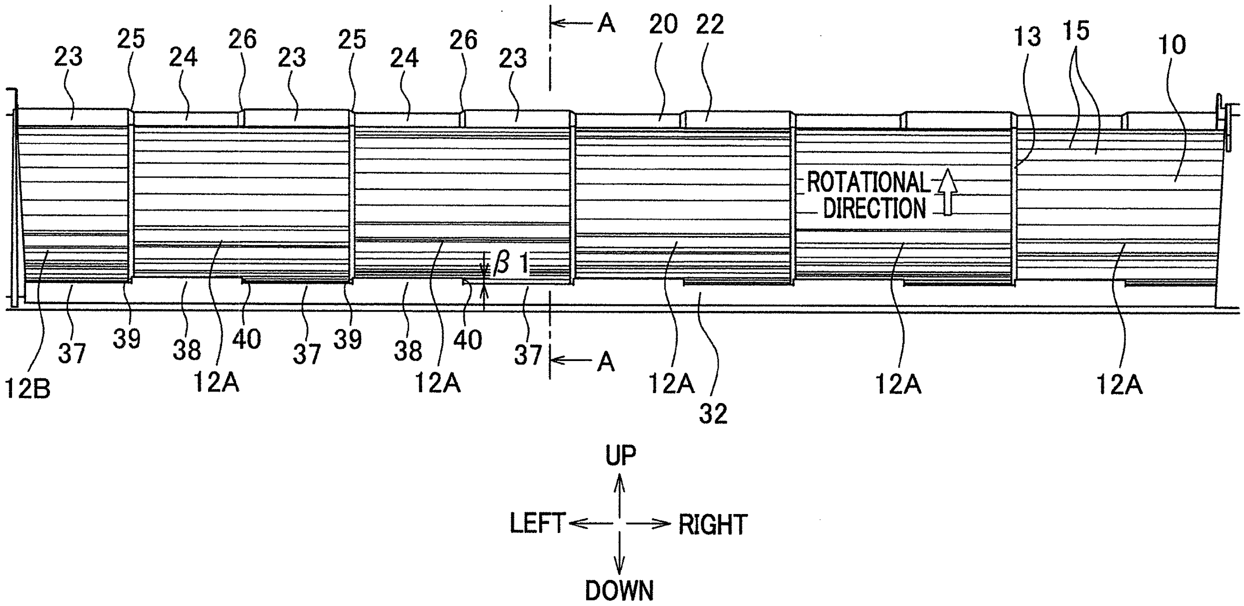

A
20
22
23
25
24
26
13
15
10
ROTATIONAL
DIRECTION
β 1
37
39
38
40
12B
12A
32
UP
LEFT
RIGHT
DOWN

FIG.6

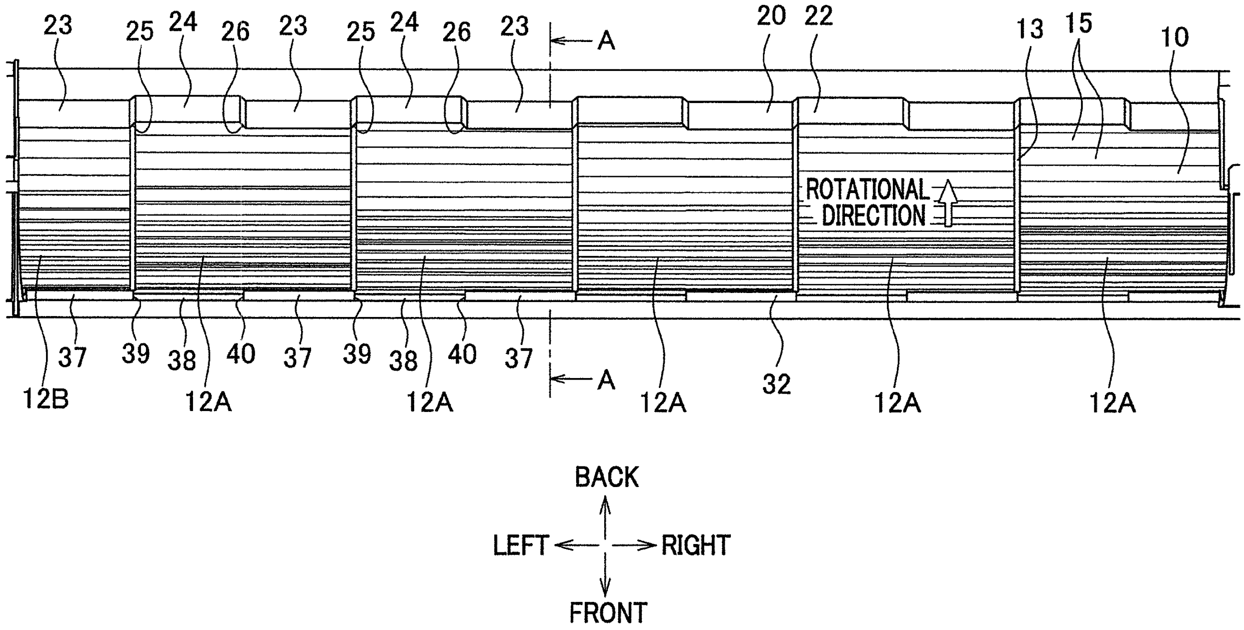

23
25
24
26
23
25
24
26
23
A
20
22
13
15
10
ROTATIONAL
DIRECTION
37
39
38
40
37
39
38
40
37
A
32
12B
12A
12A
12A
12A
12A
BACK
LEFT
RIGHT
FRONT

FIG.7

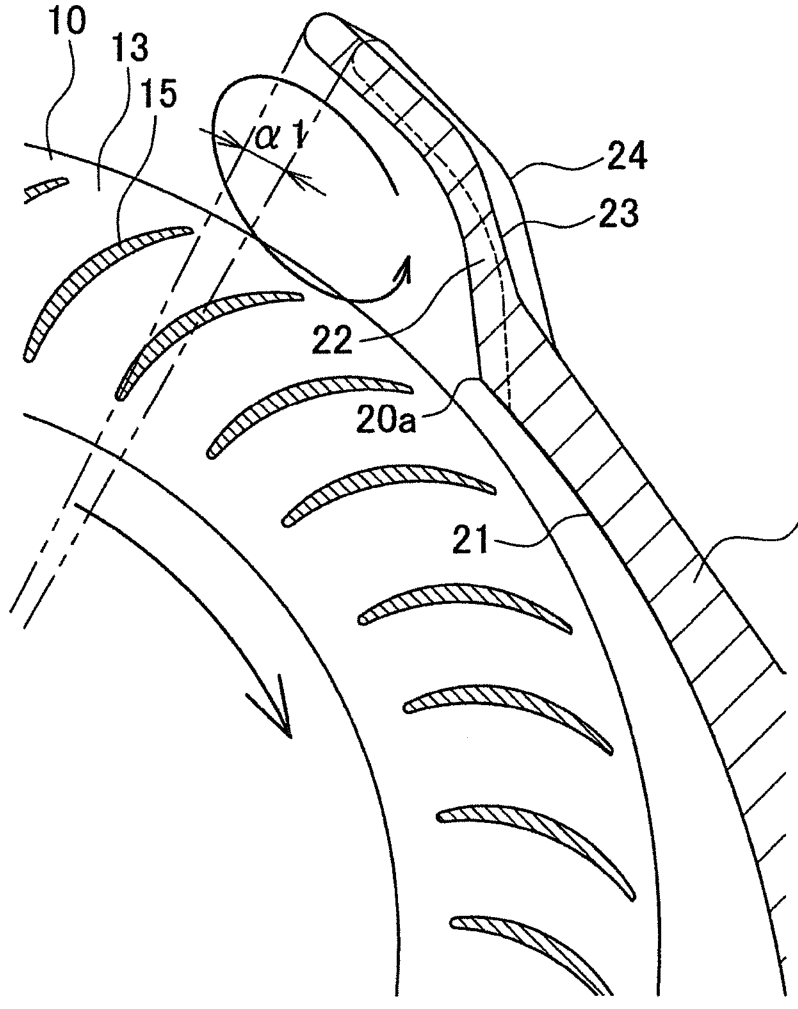


FIG.8

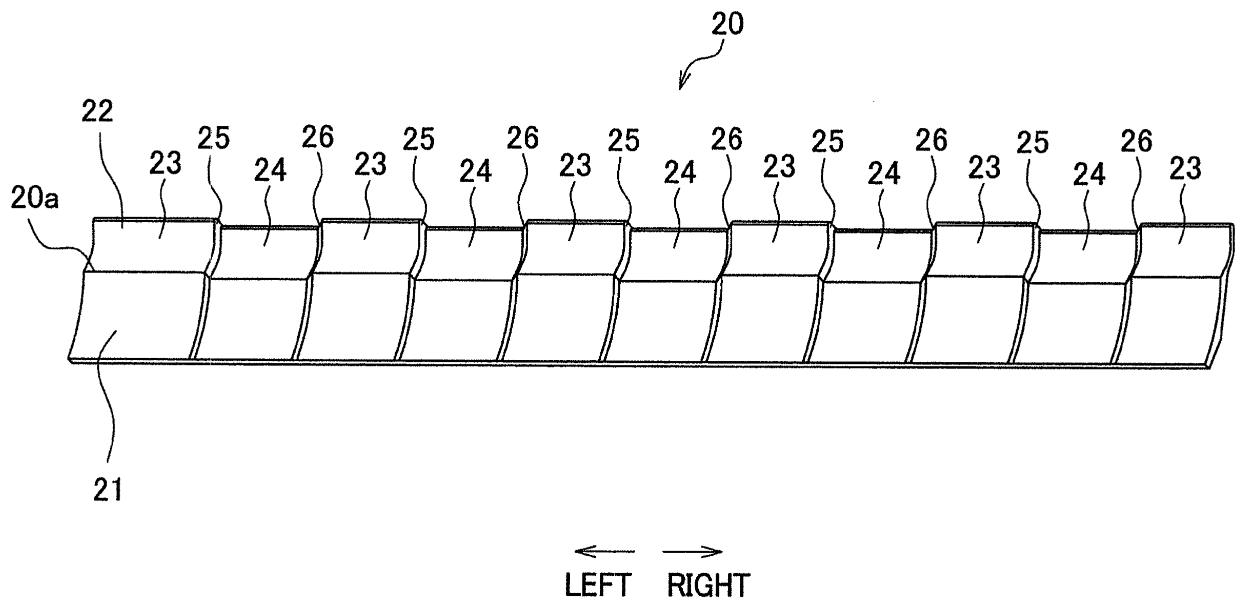

20
22
20a
23
25
24
26
23
25
24
26
23
25
24
26
23
25
24
26
23
25
24
26
23
21
LEFT
RIGHT

FIG.9

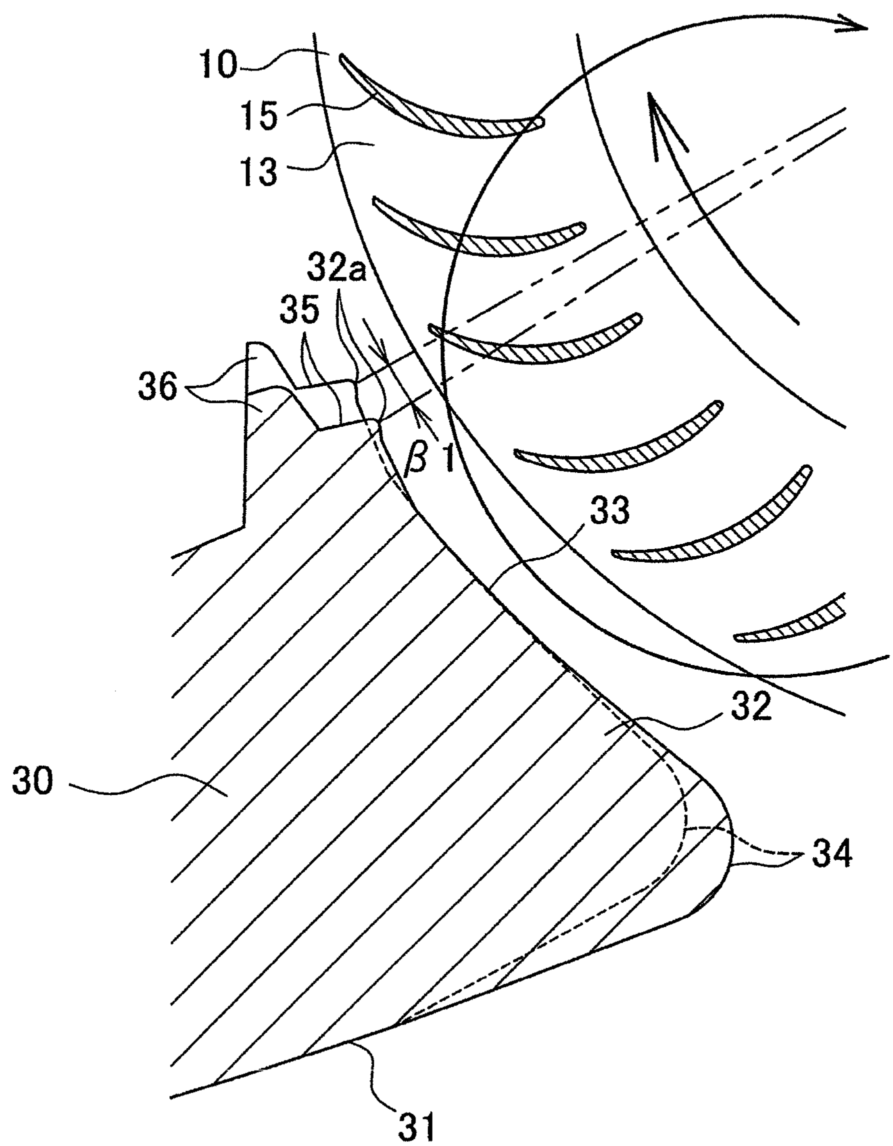


FIG.10

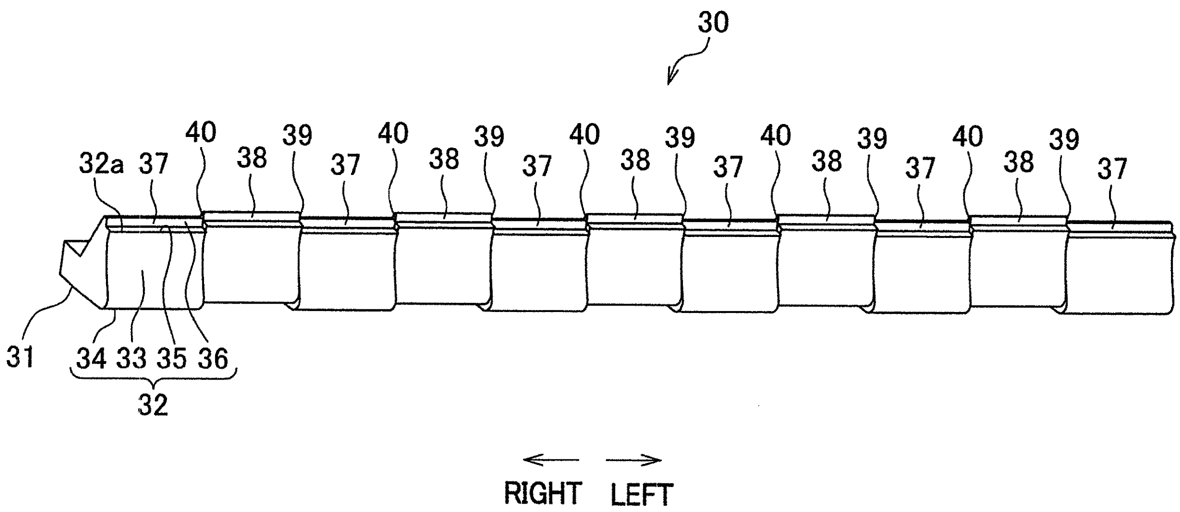

30
32a
37
40
38
39
37
40
38
39
37
40
38
39
37
40
38
39
37
40
38
39
37
31
34
33
35
36
32
RIGHT
LEFT

FIG.11

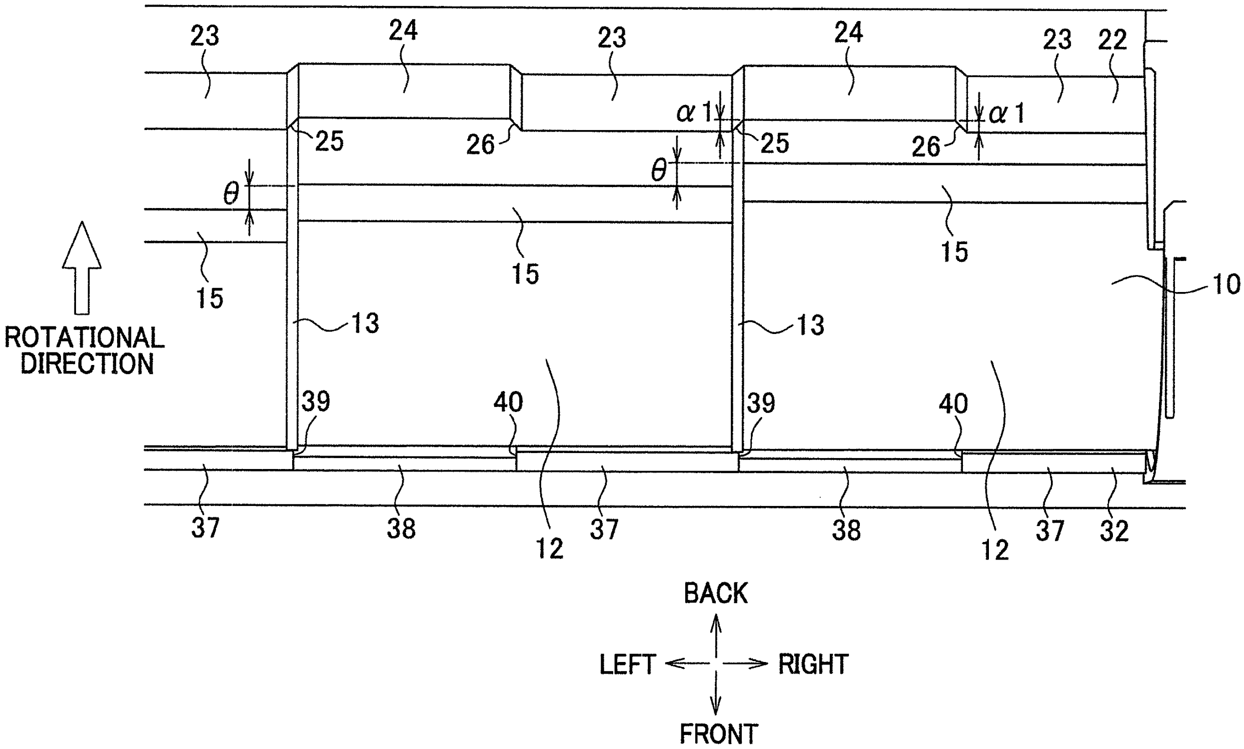

23
24
23
24
23
22
α1
α1
25
26
25
26
θ
θ
15
15
15
10
ROTATIONAL DIRECTION
13
13
39
40
39
40
37
38
12
37
38
12
37
32
BACK
LEFT
RIGHT
FRONT

FIG.12

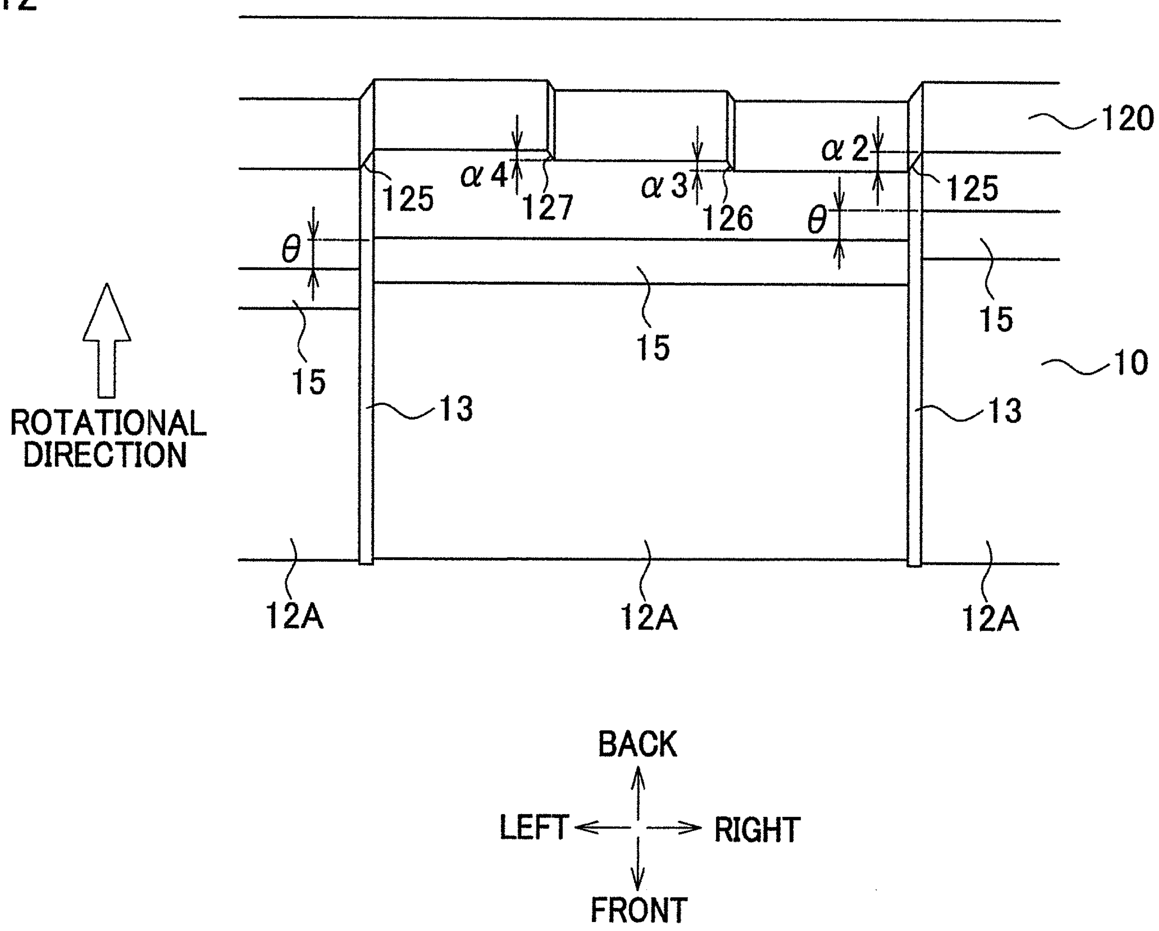

120
α 2
α 4
α 3
125
127
126
125
θ
θ
15
15
15
10
ROTATIONAL DIRECTION
13
13
12A
12A
12A
BACK
LEFT
RIGHT
FRONT

FIG.13

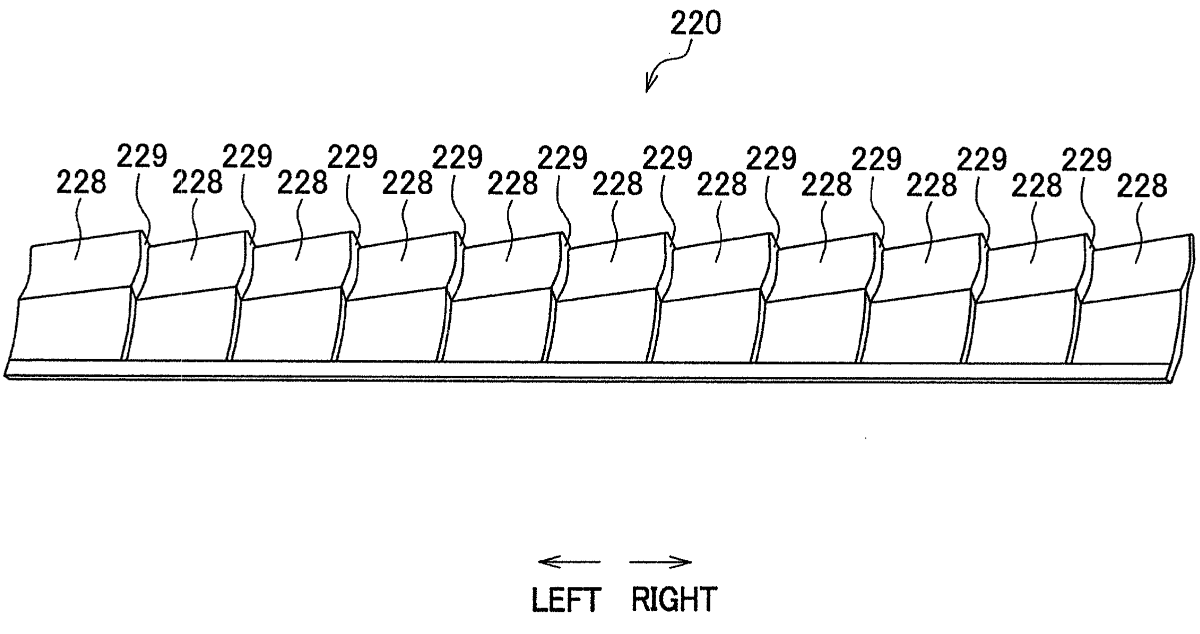
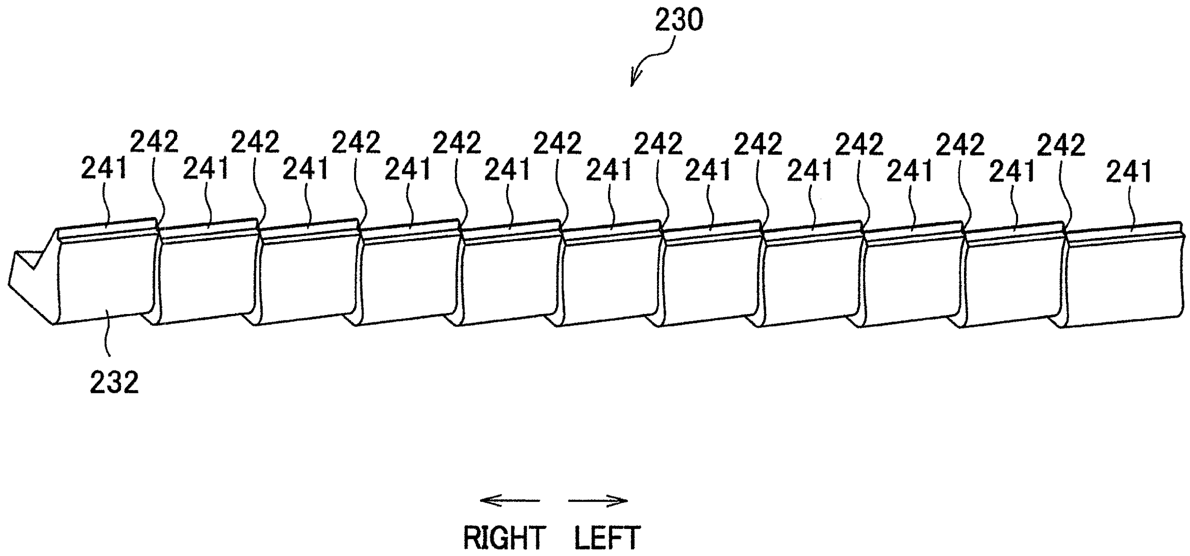

220
228
229
228
229
228
229
228
229
228
229
228
229
228
229
228
229
228
229
228
229
228
LEFT
RIGHT

FIG.14


230
242
242
242
242
242
242
242
242
242
242
241
241
241
241
241
241
241
241
241
241
241
232
RIGHT
LEFT

REFERENCES CITED IN THE DESCRIPTION

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