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(72) Inventors:
 • **UDA, Masafumi**
Kita-ku, Osaka-shi, Osaka 530-8323 (JP)
 • **NAKAI, Satoshi**
Kita-ku, Osaka-shi, Osaka 530-8323 (JP)

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(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(71) Applicant: **Daikin Industries, Ltd.**
Osaka 530-8323 (JP)

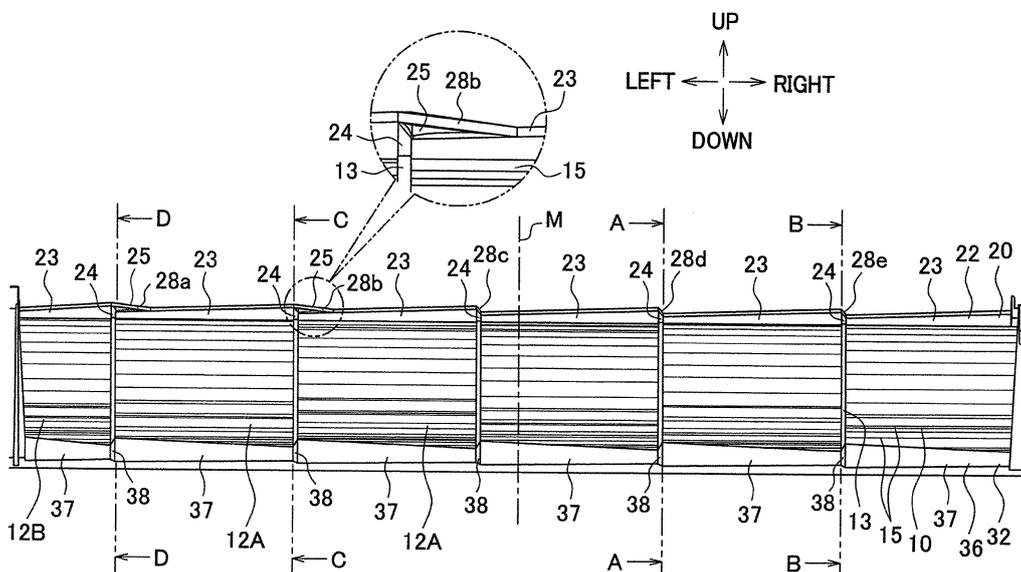
(54) **AIR CONDITIONER**

(57) Wind noise is suppressed by restraining the disturbance of a vortex airflow.

At a leading end portion of at least one of a stabilizer 32 and a rear guider 20, first level-difference portions 28a to 28c each of which decreases in height in the axial direction toward a central part M of a fan 10 and second level-difference portions 28d and 28e each of which increases in height in the axial direction toward the central

part M of the fan 10 are formed to be lined up in the axial direction. A variation in height of at least one of the first level-difference portions 28a to 28c within a predetermined length in the axial direction is equal to a first predetermined value which is smaller than a variation of height of each of the second level-difference portions 28d and 28e.

FIG.6



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. In an air conditioner including this cross flow fan, a front tongue portion (stabilizer) and a rear tongue portion (rear guider) are provided to oppose the outer periphery of the fan, respectively. These tongue portions form an air passage on the blow-out side of the fan. Each tongue portion is closest to the fan at and around the leading end. Between the leading end portion of 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 suppress this wind noise, for example, Patent Document 1 teaches that level-difference portions are provided at the leading end of the front tongue portion (stabilizer) to vary the height of the leading end along the axial direction. The front tongue portion is closest to the fan at the leading end. Each level-difference portion extends in a direction orthogonal to the axial direction, and the leading end of a part between neighboring level-difference portions is deviated from the axial direction of the fan in the rotational direction. With this arrangement, because the vane does not pass the leading end of the front tongue portion at once, the wind noise is continuously generated (i.e., in a spread manner) and the wind noise is suppressed.

[Citation List]

[Patent Document]

[0004] [Patent Document 1] Japanese Unexamined Patent Publication No. 2-203129

[Summary of Invention]

[Technical Problem]

[0005] In the air conditioner of Patent Document 1, because level differences are formed at the leading end of the front tongue portion, a vortex airflow is bended around each level-difference portion and is therefore unstable. The wind speed distribution of the cross flow fan on the blow-out side is arranged such that the wind speed increases toward the center in the axial direction of the fan, and hence the flow of the air sucked into the fan tends to converge on the center in the axial direction of the fan.

For this reason, as shown in FIG. 20, around a level-difference portion 91a which decreases in height toward the center in the axial direction of the fan 90 among the level-difference portions of the front tongue portion 91, the airflow changes its direction toward that level-difference portion 91a and climbs over the level-difference portion 91a. As a result, the air flows into a bended portion of the vortex airflow in a concentrated manner, with the result that the vortex airflow is disturbed and the wind noise increases.

[0006] The same problem occurs also when level differences are provided at the leading end of the rear tongue portion.

[0007] An object of the present invention is therefore to provide an air conditioner in which wind noise is suppressed by restraining the disturbance of a vortex airflow.

[Solution to Problem]

[0008] According to the first aspect of the invention, an air conditioner includes: a cross flow fan; 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, at a leading end portion of at least one of the stabilizer and the rear guider, level-difference portions being formed to be lined up in an axial direction, the level-difference portions including first level-difference portions each of which decreases in height in the axial direction toward a central part of the fan and second level-difference portions each of which increases in height in the axial direction toward the central part of the fan, a variation in height of at least one of the first level-difference portions within a predetermined length in the axial direction being equal to a first predetermined value which is smaller than a variation in height of each of the second level-difference portions.

[0009] In this air conditioner, at least one of the first level-difference portions each of which decreases in height in the axial direction toward the central part of the fan, which are provided at the leading end portion of at least one of the stabilizer and the rear guider, is small in the variation in height within the predetermined length in the axial direction. It is therefore possible to restrain the airflow sucked into the fan from changing its direction toward each of the first level-difference portions and climbing over each of the first level-difference portions. As such, the flowing of the air in a concentrated manner into the bended portion of the vortex airflow generated between each of the first level-difference portions and the fan is restrained, and hence the disturbance of the vortex airflow is restrained. As a result, the wind noise is suppressed.

[0010] Furthermore, because the variation in height of at least one of the first level-difference portions within the predetermined length in the axial direction is small, the degree of bending of the bended portion of the vortex airflow generated between each of the first level-difference portions and the fan is gentle, and hence the bended

portion of the vortex airflow is less disturbed.

[0011] In addition to the above, because the level-difference portions are provided at the leading end portion of at least one of the stabilizer and the rear guider, the vane of the fan passes the end portions in the axial direction of each level-difference portion at different timings and the vane does not pass the part between the level-difference portions at once as the height the part between the level-difference portions is gradually changed in the axial direction. As such, the wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

[0012] In addition to the above, because the height of each second level-difference portion increases toward the central part of the fan, the airflow sucked into the fan does not change its direction toward each second level-difference portion. On this account, it is unnecessary to reduce the above-described variation of each second level-difference portion. When the variations of all level-difference portions are reduced, the length in the axial direction of the part between neighboring level-difference portions becomes short, and hence the continuous generation of the wind noise becomes less effectively done. In the present embodiment, because the variations of the level-difference portions are not reduced, the continuous generation of the wind noise (i.e., generation of wind noise in a spread manner) is maintained to be effective.

[0013] According to the second aspect of the invention, the air conditioner of the first aspect is arranged such that, in the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value, the degree of inclination of an edge portion which extends linearly or in a curved manner from a highest point is more gentle than the degree of inclination of an edge portion of each of the second level-difference portions which edge portion extends linearly or in a curved manner from a highest point.

[0014] In this air conditioner, the inclination of the edge portion of the first level-difference portion in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point linearly or in a curved manner, is gentle. This arrangement restrains the airflow sucked into the fan from changing its direction toward the edge portions of that first level-difference portion.

[0015] According to the third aspect of the invention, the air conditioner of the second aspect is arranged such that the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value extends from the highest point to a lowest point linearly or in a curved manner.

[0016] In this air conditioner, because the first level-difference portion in which the variation in height is equal to the first predetermined value extends from the highest point linearly or in a curved manner, this first level-difference portion can be easily formed. Furthermore, when the first level-difference portion extends linearly, because the inclination of the first level-difference portion is con-

stant and gentle across the entirety thereof in the axial direction, the airflow climbing over the first level-difference portion is reduced across the entirety in the axial direction thereof.

[0017] According to the fourth aspect of the invention, the air conditioner of the first aspect is arranged such that the height of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value changes in stages, and an edge portion of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point linearly or in a curved manner is shorter than an edge portion of each of the second level-difference portions which edge portion extends from the highest point linearly or in a curved manner, and an inclination angle of the edge portion of the at least one of the first level-difference portions is identical with an inclination angle of the edge portion of each of the second level-difference portions.

[0018] In this air conditioner, the edge portion of the first level-difference portion in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point, is identical with the edge portion extending from the highest point of the second level-difference portion in terms of the inclination angle but is shorter than the edge portion extending from the highest point of the second level-difference portion. This restrains the airflow sucked into the fan from changing its direction toward around the edge portion of that first level-difference portion.

[0019] Furthermore, because the height of the first level-difference portion changes in stages, the inclination of the first level-difference portion is adjustable irrespective of the length in the axial direction of the first level-difference portion.

[0020] According to the fifth aspect of the invention, the air conditioner of any one of the first to fourth aspects is arranged such that the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value is positioned to be farthest in the axial direction from the central part of the cross flow fan, among the level-difference portions.

[0021] In this air conditioner, because the airflow sucked into the cross flow fan tends to converge on the central part in the axial direction of the fan, the suppression of the disturbance of the vortex airflow is ensured by reducing the variation in height of the first level-difference portion which is farthest from the central part of the fan.

[0022] According to the sixth aspect of the invention, the air conditioner of any one of the first to fifth aspects is arranged such that at least one of the stabilizer and the rear guider includes two or more first level-difference portions in which the variation in height is equal to the first predetermined value, and among the two or more first level-difference portions, the variation in height of one first level-difference portion which is farther in the

axial direction from the central part of the fan than the other level-difference portion is smaller than the variation in height of the other level-difference portion.

[0023] In this air conditioner, because the airflow sucked into the cross flow fan tends to converge on the central part in the axial direction of the fan, the disturbance of the vortex airflow at the bended portion is restrained while the effect of continuous generation of wind noise is maintained, by reducing the variation in height of the first level-difference portion in accordance with the distance from the central part in the axial direction of the fan.

[0024] According to the seventh aspect of the invention, the air conditioner of any one of the first to sixth aspects is arranged such that the first level-difference portions are provided only on one side in the axial direction of the central part of the fan, whereas the second level-difference portions are provided only on the other side in the axial direction of the central part of the fan, and the height of a part between neighboring ones of the level-difference portions gradually changes in the axial direction.

[0025] In this air conditioner, because the height of the part between neighboring ones of the level-difference portions gradually changes in the axial direction, the vane does not pass across that part between neighboring ones of the level-difference portions at once. For this reason, when the vane passes across the part between the level-difference portions, wind noise is continuously generated, and hence the wind noise is suppressed.

[0026] According to the eighth aspect of the invention, the air conditioner of any one of the first to sixth aspects is arranged such that the first level-difference portions and the second level-difference portions are alternately provided in the axial direction, and the height of a part between two neighboring ones of the level-difference portions is constant in the axial direction.

[0027] In this air conditioner, because in at least one of the stabilizer and the rear guider the height of the part between the level-difference portions is constant in the axial direction, the stabilizer or the rear guider can be easily formed.

[0028] According to the ninth aspect of the invention, the air conditioner of any one of the first to eighth aspects is arranged such that the length in the axial direction of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value is not less than 5% and not more than 30% of the interval between highest points of two neighboring ones of the level-difference portions.

[0029] In this air conditioner, the disturbance of the vortex airflow at the bended portion is restrained while the effect of continuous generation of wind noise is maintained, as the length in the axial direction of the first level-difference portion in which the variation in height is equal to the first predetermined value is arranged to be 5% to 30% of the interval between the highest points of the neighboring two level-difference portions.

[Advantageous Effects of Invention]

[0030] As described above, the following effects are obtained by the present invention.

5 **[0031]** According to the first aspect of the invention, at least one of the first level-difference portions each of which decreases in height in the axial direction toward the central part of the fan, which are provided at the leading end portion of at least one of the stabilizer and the rear guider, decreases in the variation in height within the predetermined length in the axial direction. It is therefore possible to restrain the airflow sucked into the fan from changing its direction toward each of the first level-difference portions and climbing over each of the first level-difference portions. As such, the flowing of the air in a concentrated manner into the bended portion of the vortex airflow generated between each of the first level-difference portions and the fan is restrained, and hence the disturbance of the vortex airflow is restrained. As a result, the wind noise is suppressed.

10 **[0032]** Furthermore, because the variation in height of at least one of the first level-difference portions within the predetermined length in the axial direction is small, the degree of bending of the bended portion of the vortex airflow generated between each of the first level-difference portions and the fan is gentle, and hence the bended portion of the vortex airflow is less disturbed.

15 **[0033]** In addition to the above, because the level-difference portions are provided at the leading end portion of at least one of the stabilizer and the rear guider, the vane of the fan passes the end portions in the axial direction of each level-difference portion at different timings and the vane does not pass the part between the level-difference portions at once as the height the part between the level-difference portions is continuously changed in the axial direction. As such, the wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

20 **[0034]** In addition to the above, because the height of each second level-difference portion increases toward the central part of the fan, the airflow sucked into the fan does not change its direction toward each second level-difference portion. On this account, it is unnecessary to reduce the above-described variation of each second level-difference portion. When the variations of all level-difference portions are reduced, the length in the axial direction of the part between neighboring level-difference portions becomes short, and hence the continuous generation of the wind noise becomes less effectively done.

25 In the present embodiment, because the variations of the level-difference portions are not reduced, the continuous generation of the wind noise (i.e., generation of wind noise in a spread manner) is maintained to be effective.

30 **[0035]** According to the second aspect of the invention, the inclination of the edge portion of the first level-difference portion in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point linearly or in a curved manner, is

gentle. This arrangement restrains the airflow sucked into the fan from changing its direction toward the edge portions of that first level-difference portion.

[0036] According to the third aspect of the invention, because the first level-difference portion in which the variation in height is equal to the first predetermined value extends from the highest point linearly or in a curved manner, this first level-difference portion can be easily formed. When the first level-difference portion extends linearly, because the inclination of the first level-difference portion is constant and gentle across the entirety thereof in the axial direction, the airflow climbing over the first level-difference portion is reduced across the entirety in the axial direction thereof.

[0037] According to the fourth aspect of the invention, the edge portion of the first level-difference portion in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point, is identical with the edge portion extending from the highest point of the second level-difference portion in terms of the inclination angle but is shorter than the edge portion extending from the highest point of the second level-difference portion. This restrains the airflow sucked into the fan from changing its direction toward around the edge portion of that first level-difference portion.

[0038] Furthermore, because the height of the first level-difference portion changes in stages, the inclination of the first level-difference portion is adjustable irrespective of the length in the axial direction of the first level-difference portion.

[0039] According to the fifth aspect of the invention, because the airflow sucked into the cross flow fan tends to converge on the central part in the axial direction of the fan, the suppression of the disturbance of the vortex airflow is ensured by reducing the variation in height of the first level-difference portion which is farthest from the central part of the fan.

[0040] According to the sixth aspect of the invention, because the airflow sucked into the cross flow fan tends to converge on the central part in the axial direction of the fan, the disturbance of the vortex airflow at the bended portion is restrained while the effect of continuous generation of wind noise is maintained, by reducing the variation in height of the first level-difference portion in accordance with the distance from the central part in the axial direction of the fan.

[0041] According to the seventh aspect of the invention, because the height of the part between neighboring ones of the level-difference portions gradually changes in the axial direction, the vane does not pass across that part between neighboring ones of the level-difference portions at once. For this reason, when the vane passes across the part between the level-difference portions, wind noise is continuously generated, and hence the wind noise is suppressed.

[0042] According to the eighth aspect of the invention, because in at least one of the stabilizer and the rear guid-

er the height of the part between the level-difference portions is constant in the axial direction, the stabilizer or the rear guider can be easily formed.

[0043] According to the ninth aspect of the invention, the disturbance of the vortex airflow at the bended portion is restrained while the effect of continuous generation of wind noise is maintained, as the length in the axial direction of the first level-difference portion in which the variation in height is equal to the first predetermined value is arranged to be 5% to 30% of the interval between the highest points of the neighboring two level-difference portions.

[Brief Description of Drawings]

[0044]

[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 partially-enlarged oblique perspective of the cross flow fan.

[FIG. 5] FIG. 5 is an oblique perspective of the cross flow fan and its surroundings in the indoor unit.

[FIG. 6] FIG. 6 is a front view of the cross flow fan and its surroundings in the indoor unit.

[FIG. 7] FIG. 7 shows the cross flow fan and its surroundings in the indoor unit when they are viewed from above.

[FIG. 8] FIG. 8(a) is a partially-enlarged cross section of the leading end of the rear guider and its surroundings, which is taken at the A-A line in FIG. 6 and FIG. 7. FIG. 8(b) is a partially-enlarged cross section of the leading end of the rear guider and its surroundings, which is taken at the B-B line in FIG. 6 and FIG. 7.

[FIG. 9] FIG. 9(a) is a partially-enlarged cross section of the leading end of the rear guider and its surroundings, which is taken at the C-C line in FIG. 6 and FIG. 7. FIG. 9(b) is a partially-enlarged cross section of the leading end of the rear guider and its surroundings, which is taken at the D-D line in FIG. 6 and FIG. 7.

[FIG. 10] FIG. 10 (a) is a partially-enlarged cross section of a stabilizer and its surroundings, which is taken at the A-A line in FIG. 6 and FIG. 7. FIG. 10 (b) is a partially-enlarged cross section of the stabilizer and its surroundings, which is taken at the B-B line in FIG. 6 and FIG. 7.

[FIG. 11] FIG. 11 is an oblique perspective of a leading end portion of the rear guider.

[FIG. 12] FIG. 12 is a partially-enlarged view of FIG. 11.

[FIG. 13] FIG. 13 is a partially-enlarged oblique perspective of the leading end portion of the rear guider.

[FIG. 14] FIG. 14 is an oblique perspective of a front guider.

[FIG. 15] FIG. 15 illustrates the flow of air around a level-difference portion of the rear guider.

[FIG. 16] Each of FIGs. 16(a) to 16(f) shows a rear guider of another embodiment of the present invention, when it is viewed from above.

[FIG. 17] FIG. 17 is a top view a rear guider of another embodiment of the present invention.

[FIG. 18] FIG. 18 is an oblique perspective of a rear guider of another embodiment of the present invention, when it is viewed from the fan side.

[FIG. 19] FIG. 19 is a partially-enlarged oblique perspective of the rear guider of FIG. 18.

[FIG. 20] FIG. 20 shows a known front tongue portion and a known fan, when they are viewed from above.

[Description of Embodiments]

[0045] The following will describe an embodiment of the present invention.

[0046] 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.

[0047] Hereinafter, a direction of protrusion from the wall to which the indoor unit 1 is attached will be referred to as "forward", whereas the direction opposite to the forward will be referred to as "backward". Furthermore, the left-right direction in FIG. 1 will be simply referred to as "left-right direction".

[0048] 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.

[0049] 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 oper-

ation, 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.

[0050] The following will detail the fan 10, the rear guider 20, and the front guider 30.

[Fan]

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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 and the end plate 14 are integrally formed. 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.

[0055] The vanes 15 of each vane wheel 12 extends in the axial direction (left-right direction), and each of which is disposed as a forward-swept wing with 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 is substantially twice as long as the lengths 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.

[0056] 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 for an angle θ in the rotational direction (indicated by the arrow in FIG. 4). To put it differ-

ently, 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 for the angle θ in the rotational direction.

[Rear Guider]

[0057] 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 to FIG. 7, 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. Furthermore, as shown in FIG. 2 and FIG. 6, the upper edge of the rear guider 20 is slightly higher in position than the upper end of the fan 10.

[0058] 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.

[0059] 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 taken at the line orthogonal to the left-right direction. As shown in FIG. 9, the distance (shortest distance) between each 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.

[0060] As shown in FIG. 11 and the like, the protruding portion 22 is constituted by six twisted portions 23 lined up in the left-right direction, five connecting portions 24 each of which is provided between two neighboring twisted portions 23, two inclination alleviation portions 25, and plural rib portions 26 (see FIG. 7 and FIG. 9).

[0061] Each of the six twisted portions 23 is positioned to oppose the vane wheel 12. Among the six twisted portions 23, the right five twisted portions 23A are identical with one another in length in the left-right direction, and are identical with the vanes 15 of the vane wheels 12A in length in the left-right direction. The length of the leftmost twisted portion 23B is substantially identical with the length in the left-right direction of each of the vanes 15 of the vane wheel 12B.

[0062] Each of the twisted portions 23 is substantially arc-shaped in cross section in the direction orthogonal to the left-right direction. As shown in FIG. 11, in the circumferential direction of the fan 10, each twisted portion 23 is deviated from the axial direction of the fan 10 grad-

ually from the left edge to the right edge. On this account, the shape of each twisted portion 23 is substantially uniform across any cross section orthogonal to the left-right direction. Furthermore, the height of the leading end (front upper edge) of each twisted portion 23 gradually changes in the left-right direction. In this specification, the heights of the twisted portion 23, the connecting portion 24, the inclination alleviation portion 25, and each of later-mentioned level-difference portions 28a to 28e are not heights in the up-down direction but heights along the direction in which the protruding portion 22 protrudes (i.e., substantially frontward and upward in the present embodiment). Furthermore, the highest ends of the six twisted portions 23 are at the same height and the lowest ends of the six twisted portions 23 are at the same height (see FIGs. 6 and 7).

[0063] As shown in FIG. 8 (a), between the left edge to the right edge, each twisted portion 23 is deviated for an angle $\alpha 1$ in the direction opposite to the rotational direction (indicated by the arrow in FIG. 8) of the fan 10. The angles $\alpha 1$ of the deviation of the six twisted portions 23 are identical with one another. In addition to the above, as shown in FIG. 8 (b), the left edge of one twisted portion 23 is deviated from the right edge of the twisted portion 23 neighboring to the left of that twisted portion 23 for an angle $\beta 1$ in the rotational direction (indicated by the arrow in FIG. 9) of the fan 10. Furthermore, the angle $\beta 1$ is identical with the angle $\alpha 1$.

[0064] As shown in FIG. 11 and the like, each of the five connecting portions 24 connects end portions of two neighboring twisted portions 23, which end portions oppose each other in the left-right direction, with each other. Each connecting portion 24 is substantially arc-shaped in cross section in the direction orthogonal to the left-right direction, and is substantially as thick as each twisted portion 23. The leading end (front upper edge) of each connecting portion 24 linearly extends to decrease in height rightward. Each of the five connecting portions 24 is positioned to oppose the supporting plate 13 of the fan 10 (see FIGs. 6 and 7).

[0065] As shown in FIG. 7 and the like, the two inclination alleviation portions 25 are connected to the leading ends of the two left connecting portions 24 among the five connecting portions 24, respectively. These two inclination alleviation portions 25 are identical in shape. Each inclination alleviation portion 25 extends substantially frontward from the connecting portion 24 and the front upper edge of the left end portion of the twisted portion 23 which is to the right of that connecting portion 24. The inclination alleviation portion 25 is substantially triangular in shape when viewed from above. The leading end (front edge) of the inclination alleviation portion 25 substantially linearly extends and connects the left edge of the leading end of the connecting portion 24 with the leading end of the twisted portion 23. As shown in FIG. 6, the height of the leading end (front edge) of the inclination alleviation portion 25 decreases rightward. The length in the left-right direction of the inclination allevia-

tion portion 25 is preferably 5% to 30% of the total length of the twisted portion 23 and the connecting portion 24 in the left-right direction.

[0066] As shown in FIG. 9(b), the inclination alleviation portion 25 is substantially triangular in cross section in the direction orthogonal to the axial direction. The rear face of the inclination alleviation portion 25 extends substantially upward from the upper surface of the twisted portion 23 or the connecting portion 24, and the upper surface of the inclination alleviation portion 25 extends substantially frontward from the upper edge of the rear face of the inclination alleviation portion 25. The front edge of the inclination alleviation portion 25 is substantially as thick as the twisted portion 23 and the connecting portion 24.

[0067] As shown in FIG. 7, the rib portions 26 extend backward from the rear face of the inclination alleviation portion 25. As shown in FIG. 9, each rib portion 26 is provided to protrude from the rear face (which is on the side opposite to the fan 10) of the twisted portion 23 or the connecting portion 24. The height in the up-down direction of the front edge of the rib portion 26 is substantially identical with the height in the up-down direction of the upper edge of the rear face of the inclination alleviation portion 25. The thickness of the rib portion 26 decreases backward.

[0068] On the surface of the protruding portion 22 which surface is on the side opposite to the fan 10, each of the inclination alleviation portion 25 and the rib portion 26 is swollen in shape as compared to its surrounding (the twisted portion 23 and the connecting portion 24). This swollen part is termed a swollen portion 27. The range of the swollen portion 27 when viewed from above is identical with the range occupied by the inclination alleviation portion 25 and the rib portions 26.

[0069] The height of the swollen portion 27 in a direction D (see FIG. 9) which is substantially orthogonal to the surface of the protruding portion 22 which surface is opposite to the fan 10 is termed swelling height. The highest position 27a of the swelling height of the swollen portion 27 (hereinafter, apex 27a) corresponds to the right edge of the connecting portion 24, in the upper edge of the rear face of the inclination alleviation portion 25. As shown in FIG. 13, the swelling height of a part of the swollen portion 27 which part is to the right of the apex 27a decreases rightward, whereas the swelling height of a part of the swollen portion 27 which part is to the left of the apex 27a rapidly decreases leftward.

[0070] Because the opposing end portions in the left-right direction of two neighboring twisted portions 23 are different in height, five level-difference portions 28a to 28e are formed at the leading end of the protruding portion 22 to be lined up in the left-right direction. The height of each of the level-difference portions 28a to 28e decreases rightward. The level-difference portions 28a to 28c are provided to the left of a central part M in the axial direction of the fan 10 (see FIG. 6 and FIG. 7), whereas the level-difference portions 28d and 28e are provided

to the right of the central part M in the axial direction of the fan 10. Each of the level-difference portions 28a and 28b is the leading end of the inclination alleviation portion 25, whereas each of the level-difference portions 28c to 28e is the leading end of the connecting portion 24.

[0071] The highest points (left edges) of the five level-difference portions 28a to 28e are identical in height. The lowest points (right edges) of the level-difference portions 28c to 28e which are the leading ends of the connecting portions 24 are identical in height. The lowest points (right edges) of the level-difference portions 28a and 28b which are the leading ends of the inclination alleviation portions 25 are identical in height and are higher than the lowest points of the level-difference portions 28c to 28e.

[0072] As shown in FIG. 12, an inclination angle of each of the level-difference portions 28a and 28b with respect to the axial direction is termed an angle $\phi 1$, whereas an inclination angle of each of the level-difference portions 28c to 28e with respect to the axial direction is termed an angle $\phi 2$. The angle $\phi 1$ is smaller than the angle $\phi 2$. In other words, the inclination of each of the level-difference portions 28a and 28b is more gentle than the inclination of each of the level-difference portions 28c to 28e.

[0073] In addition to the above, as shown in FIG. 12, a variation in height within a predetermined length W in the left-right direction from the highest point of each of the level-difference portions 28a and 28b is referred to as $\Delta H1$. Furthermore, a variation in height within the predetermined length W in the left-right direction from the highest point of each of the level-difference portions 28c to 28e is referred to as $\Delta H2$. The variation $\Delta H1$ is smaller than the variation $\Delta H2$. "The variation in height within the predetermined length W in the left-right direction (axial direction)" is an index for a comparison between inclinations of level-difference portions. The length W is not limited to the length shown in FIG. 12. In the present embodiment, the length W is only required to be shorter than the length in the left-right direction of each of the level-difference portions 28a and 28b. Furthermore, in the present embodiment, the starting point of the length W in the left-right direction is the highest point of each level-difference portion. The starting point, however, may not be the highest point of the level-difference portion.

[Front Guider]

[0074] 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.

[0075] As shown in FIG. 5 to FIG. 7, 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 in the left-right direction of the fan 10. Furthermore,

as shown in FIG. 2 and FIG. 6, the upper edge of the stabilizer 32 is lower in position than the center of the fan 10.

[0076] As shown in FIG. 14, 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. Furthermore, the stabilizer 32 includes a bending surface 34 which is bended 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.

[0077] 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 from the end face 35. The convex portion 36 and the end face 35 constitute the upper end portion of the rear guider 20. The cross sectional shape of the convex portion 36 in the direction orthogonal to the left-right direction is substantially triangular. As shown in FIG. 14, 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.

[0078] The stabilizer 32 (including the convex portion 36, the end face 35, the curved surface 33, and the bending surface 34) is made up of six twisted portions 37 lined up in the left-right direction and five connecting portions 38 each of which is provided between two neighboring twisted portions 37.

[0079] Each of the six twisted portions 23 is positioned to oppose the vane wheel 12. Among the six twisted portions 23, the right five twisted portions 23A are identical with one another in length in the left-right direction, and are identical with the vanes 15 of the vane wheels 12A in length in the left-right direction. The length of the leftmost twisted portion 23B is substantially identical with the length in the left-right direction of each of the vanes 15 of the vane wheel 12B.

[0080] As shown in FIG. 14, in the circumferential direction of the fan 10, each twisted portion 37 is deviated from the axial direction of the fan 10 gradually from the left edge to the right edge. On this account, the shape of each twisted portion 37 is substantially uniform across any cross section orthogonal to the left-right direction. The height of the leading end (upper edge) of each twisted portion 37 gradually changes in the left-right direction. Furthermore, the highest ends of the six twisted portions 37 are at the same height and the lowest ends of the six twisted portions 23 are at the same height (see FIG. 6).

[0081] As shown in FIG. 10(a), between the left edge and the right edge, each twisted portion 37 is deviated for an angle $\alpha 2$ in the direction opposite to the rotational direction (indicated by the arrow in FIG. 11) of the fan 10. The angles $\alpha 2$ of the deviation of the six twisted por-

tions 37 are identical with one another. In addition to the above, as shown in FIG. 11 (b), the left edge of one twisted portion 37 is deviated from the right edge of the twisted portion 37 neighboring to the left of that twisted portion 37 for an angle $\beta 2$ in the direction of the rotational direction (indicated by the arrow in FIG. 10) of the fan 10. Furthermore, the angle $\beta 2$ is identical with the angle $\alpha 2$.

[0082] As shown in FIG. 6 and FIG. 7, each of the five connecting portions 38 connects the end portions of two neighboring twisted portions 37 which end portions oppose each other in the left-right direction. Each of the connecting portions 38 is positioned to oppose the supporting plate 13 of the fan 10. Because the end portions of two neighboring twisted portions 37 which end portions oppose each other in the left-right direction are different in height, five level-difference portions are formed at the leading end of the stabilizer 32 to be lined up in the left-right direction.

[0083] Now, the air flowing in the gap between the rear guider 20 and the fan 10 when the air conditioner is driven will be described. As the fan 10 is driven, a vortex airflow (indicated by the arrow in FIG. 8(b)) is generated between the leading end portion of the rear guider 20 and the fan 10. In FIG. 15, the center C of the vortex airflow is indicated by a chain line. As shown in FIG. 15, the vortex airflow is bended in an area formed by the edges in the axial direction of each of the level-difference portions 28a to 28e and the fan 10.

[0084] When a vane 15 passes the vortex airflow formed between the rear guider 20 and the fan 10, wind noise is generated on account of the interference between the vortex airflow and the vane 15. Because each twisted portion 23 of the rear guider 20 is gradually deviated in the circumferential direction from the left-right direction, wind noise is continuously generated while the vane 15 passes across one twisted portion 23. Furthermore, because end portions of two neighboring twisted portions 23 which end portions oppose each other in the left-right direction are deviated from each other for the angle $\beta 1$ in the circumferential direction, wind noise is generated at different timings at the end portions of two neighboring twisted portions 23 which end portions oppose each other in the left-right direction, when the deviation angle θ of the vane wheel 12 is different from the angle $\beta 1$ ($\neq \alpha 1$). The wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

[0085] In the wind speed distribution of the fan 10 on the blow-out side, the wind speed increases toward the central part in the axial direction of the fan 10. For this reason, as the arrows in FIG. 7 indicate, the airflow sucked into the fan 10 tends to converge on the central part M in the axial direction of the fan 10. For this reason, provided that the inclination angle of each of the level-difference portions 28a and 28b is identical with the inclination angle $\phi 2$ of each of the other level-difference portions 28c to 28e and is larger than the inclination angle in the present embodiment, the airflow tends to change

its direction toward each of the level-difference portions 28a and 28b, around each of the level-difference portions 28a and 28b. As a result, the air flows into each bended portion of the vortex airflow in a concentrated manner. Consequently, the vortex airflow is disturbed and hence the wind noise increases.

[0086] In this regard, in the present embodiment, because the inclination angle ϕ_1 of each of the level-difference portions 28a and 28b is smaller than the inclination angle ϕ_2 of each of the other level-difference portions 28c to 28e, as shown in FIG. 15, a change in the direction of the airflow toward each of the level-difference portions 28a and 28b is restrained around each of the level-difference portions 28a and 28b. Because the flowing of the air into the bended portion of the vortex airflow in a concentrated manner is restrained, the disturbance of the vortex airflow is restrained. Furthermore, because the inclination angle of each of the level-difference portions 28a and 28b is small, the degree of bending of the bended portion of the vortex airflow is gentle, and hence the vortex airflow is less disturbed.

[0087] In addition to the above, in the present embodiment, the swollen portion 27 which is swollen away from the fan 10 as compared to the twisted portion and the connecting portion 24 is formed around each of the level-difference portions 28a and 28b. For this reason, the change in the direction of the airflow toward each of the level-difference portions 28a and 28b is further restrained, and the amount of airflow passing around the swollen portion 27 is reduced. On this account, the airflow climbing over each of the level-difference portions 28a and 28b is reduced, and the flowing of the air into the bended portion of the vortex airflow in a concentrated manner is further restrained.

[0088] In addition to the above, the vortex airflow (indicated by the arrow in FIG. 8 (b)) is generated between the leading end portion of the stabilizer 32 and the fan 10, and the wind noise is generated as the vortex airflow and the vane 15 interfere with each other when the vane 15 passes the vortex airflow. Because the twisted portion 37 of the stabilizer 32 is gradually deviated from the left-right direction in the circumferential direction, wind noise is continuously generated when the vane 15 passes across one twisted portion 37. Furthermore, because the opposing end portions in the left-right direction of two neighboring twisted portions 37 are deviated from each other for β_2 in the circumferential direction, wind noise is generated at different timings at the end portions of the two neighboring twisted portions 23 which end portions oppose each other in the left-right direction, when the deviation angle θ of the vane wheel 12 is different from the angle $\beta_2 (= \alpha_2)$. The wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

[0089] The air conditioner of the present embodiment has the following characteristics.

[0090] Because the variation in height ΔH_1 within the predetermined length W in the axial direction is small in

each of the level-difference portions 28a and 28b which is provided at the leading end portion of the rear guider 20 and decreases in height toward the central part M in the axial direction of the fan 10, it is possible to restrain the airflow sucked into the fan 10 from changing its direction toward each of the level-difference portions 28a and 28b and climbing over each of the level-difference portions 28a and 28b. As such, the flowing of the air in a concentrated manner into the bended portion of the vortex airflow generated between each of the level-difference portions 28a and 28b and the fan 10 is restrained, and hence the disturbance of the vortex airflow is restrained. As a result, the wind noise is suppressed. In addition to the above, because the variation in height ΔH_1 of each of the level-difference portions 28a and 28b within the predetermined length W in the axial direction is small, the degree of bending of the bended portion of the vortex airflow generated between each of the level-difference portions 28a and 28b and the fan 10 is gentle, and hence the bended portion of the vortex airflow is less disturbed.

[0091] In addition to the above, because in the present embodiment the height of a part (twisted portion 23) between neighboring ones of the level-difference portions 28a to 28e gradually changes in the axial direction, the vane 15 does not pass across that part between neighboring ones of the level-difference portions 28a to 28e at once. For this reason, when the vane 15 passes across the part between neighboring ones of the level-difference portions 28a to 28e, wind noise is continuously generated, and hence the wind noise is suppressed.

[0092] In addition to the above, because the height of each of the level-difference portions (second level-difference portions) 28d and 28e increases toward the central part M in the axial direction of the fan 10, the airflow sucked into the fan 10 does not change its direction toward each of the level-difference portions 28d and 28e. On this account, it is unnecessary to reduce the above-described variation of each of the level-difference portions 28d and 28e. When the variations of all the level-difference portions 28a to 28e are reduced, the length in the axial direction of the part between neighboring level-difference portions becomes short, and hence the continuous generation of the wind noise becomes less effectively done. In the present embodiment, because the variations of the level-difference portions 28d and 28e are not reduced, the continuous generation of the wind noise is maintained to be effective.

[0093] In addition to the above, because the airflow sucked into the fan 10 tends to converge on the central part M in the axial direction of the fan 10, the suppression of the disturbance of the vortex airflow is further ensured in such a way that the variation in height ΔH_1 within the predetermined length W in the axial direction of the level-difference portion 28a which is closest to the end portion in the axial direction of the fan 10 is reduced.

[0094] In addition to the above, because in the present embodiment the above-described variation in height of

the level-difference portion 28b which is the second closest to the end portion in the axial direction of the fan 10 is also small, the suppression of the disturbance of the vortex airflow is further ensured.

[0095] In addition to the above, in the present embodiment, the variation in height of the level-difference portion 28c which decreases in height toward the central part M in the axial direction of the fan 10 is not reduced. In this regard, because the level-difference portion 28c is close to the central part M in the axial direction of the fan 10, the direction of the airflow around the level-difference portion 28c is substantially orthogonal to the axial direction, and hence the airflow rarely changes its direction toward the level-difference portion 28c. In the present embodiment, because the variation in height of the level-difference portion 28c is not reduced, the deterioration in the effect of continuous generation of the wind noise is restrained.

[0096] In addition to the above, because in the present embodiment each of the level-difference portions 28a and 28b linearly extends from the highest point to the lowest point, these level-difference portions 28a and 28b can be easily formed. Moreover, because the inclination of each of the level-difference portions 28a and 28b is constant and gentle across the entirety of each of them in the axial direction, the airflow climbing over each of the level-difference portions 28a and 28b is reduced across the entirety in the axial direction of each of the level-difference portions 28a and 28b.

[0097] In addition to the above, when the length in the axial direction of each of the level-difference portions 28a and 28b is arranged to be 5% to 30% of the total length in the left-right direction of the twisted portion 23 and the connecting portion 24 (i.e., the distance between the highest points of neighboring two level-difference portions), the disturbance of the vortex airflow at the bended portion is restrained while the effect of continuous generation of wind noise is maintained.

[0098] In addition to the above, because in the present embodiment the swollen portion 27 which is swollen away from the fan 10 is provided in the vicinity of each of the level-difference portions 28a and 28b, the airflow sucked into the fan 10 is less likely to climb over the swollen portion 27. This further restrains the flowing of the air in a concentrated manner into the bended portion of the vortex airflow generated between each of the level-difference portions 28a and 28b and the fan 10.

[0099] 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.

[0100] While in the embodiment above two neighbor-

ing twisted portions 23 are connected with each other by a connecting portion 24, such a connecting portion 24 may not be provided and end portions of two neighboring twisted portions 23 which end portions oppose each other in the axial direction may be directly connected with each other as shown in FIG. 16. In this case, a level-difference portion for which no inclination alleviation portion is provided (e.g., a level-difference portion 128e shown in FIG. 16) is constituted by the leading end portion of higher one of the opposing end portions of two neighboring twisted portions 23, and is orthogonal to the axial direction.

[0101] The shape of each of the level-difference portions 28a and 28b may be different from the shape described in the embodiment above.

[0102] For example, a level-difference portion may extend in a curved manner from the highest point to the lowest point, as in a level-difference portion 128a which is indicated by the thick line in FIG. 16(a).

[0103] Furthermore, the height of a level-difference portion may change in stages as in level-difference portions 228a to 628a and 828a which are indicated by the thick lines in FIG. 16(b) to FIG. 16(f) and FIG. 17(b). In this way, the inclination of the level-difference portion is adjustable irrespective of the length in the axial direction of the level-difference portion.

[0104] In the level-difference portions 228a and 828a in FIG. 16(b) and FIG. 17(b), the edge portion which extends linearly or in a curved manner from the highest point is gentle in inclination as compared to the level-difference portion (second level-difference portion) 128e which increases in height toward the central part in the axial direction of the fan (i.e., the variation in height within the predetermined length in the axial direction is small). This arrangement restrains the airflow sucked into the fan 10 from changing its direction toward each of the above-described edge portions of the level-difference portions 228a and 828a. It is noted that the predetermined length in the axial direction is, for example, shorter than the length in the axial direction of each of the level-difference portions 228a and 828a from the highest point of each of the level-difference portions 228a, 828a, and 128e.

[0105] In addition to the above, in each of the level-difference portions 328a to 628a shown in FIG. 16(c) to FIG. 16(f), the inclination angle of the edge portion which extends linearly or in a curved manner from the highest point is identical with the inclination angle of the level-difference portion (second level-difference portion) 128e which increases in height toward the central part in the axial direction of the fan, and this edge portion is shorter than the edge portion which extends linearly from the highest point of the level-difference portion 128e. This arrangement restrains the airflow sucked into the fan 10 from changing its direction toward around the edge portion of each of the level-difference portion 328a to 628a. It is noted that the predetermined length in the axial direction is, for example, longer than the length in the axial direction of the edge portion of each of the level-differ-

ence portions 328a to 628a from the highest point of each of the level-difference portions 328a to 628a and 128e.

[0106] In addition to the above, while in the embodiment above the level-difference portions 28a and 28b are identical with the level-difference portions (second level-difference portions) 28d and 28e in the height of the highest point, the height of the highest points of the level-difference portions 28a and 28b may be different from the height of the highest point of the level-difference portion (second level-difference portion) 128e, as in level-difference portions 728a and 828a indicated by the thick lines in FIG. 17(a) and FIG. 17(b).

[0107] While in the embodiment above the two level-difference portions 28a and 28b are identical in the variation in height $\Delta H1$ within the predetermined length W in the axial direction, these portions may be different in the variation. In such a case, to restrain the disturbance of the vortex airflow, the variation in height of the level-difference portion 28a which is farther from the central part M in the axial direction of the fan 10 is preferably arranged to be smaller than the variation in height of the level-difference portion 28b.

[0108] In the embodiment above, the level-difference portions 28a and 28b among the three level-difference portions 28a to 28c each of which decreases in height toward the central part M in the axial direction of the fan 10 are smaller than the level-difference portions 28d and 27e which increase in height toward the central part M in the axial direction of the fan 10, in terms of the variation in height in the predetermined length in the axial direction. Alternatively, all of the three level-difference portions 28a to 28c may be smaller than the level-difference portions 28d and 28e in terms of the variation in height.

[0109] In addition to the above, only one of the level-difference portions 28a and 28b may be smaller than the level-difference portions 28d and 28e in terms of the variation in height, and the other one of the level-difference portions 28a and 28b may be identical with the level-difference portions 28d and 28e in terms of the variation in height. In such a case, to restrain the disturbance of the vortex airflow, the variation in height of the level-difference portion 28a which is farther from the central part M in the axial direction of the fan 10 is preferably arranged to be smaller than the variation in height of the level-difference portion 28b.

[0110] While in the embodiment above the number of the level-difference portions 28a to 28e provided on the rear guider 20 is identical with the number of the supporting plates 13 and the level-difference portions 28a to 28e are disposed to oppose the respective supporting plates 13, the present invention is not limited to this arrangement. The number of the level-difference portions may be different from the number of the supporting plates 13. Furthermore, the level-difference portions may not be disposed to oppose the respective supporting plates 13.

[0111] While in the embodiment above the twisted portion 23 is provided between neighboring ones of the level-difference portions 28a to 28e and the leading end of the

twisted portion 23 gradually changes in height in the axial direction, a part between neighboring ones of level-difference portions 928a to 928e and 929a to 929e may be constant in height in the axial direction, as in a rear guider 920 shown in FIG. 18 and FIG. 19, for example. The rear guider 920 is easily formed in this case.

[0112] As shown in FIG. 18, a protruding portion 922 of the rear guider 920 is arc-shaped in cross section in the direction orthogonal to the axial direction and, high portions and low portions are alternately lined up in the axial direction. To put it differently, at the leading end of the rear guider 920, the level-difference portions 928a to 928e each of which decreases in height toward one end in the axial direction of the fan 10 and the level-difference portions 929a to 929e each of which increases in height toward the one end in the axial direction of the fan 10 are alternately lined up in the axial direction. Among the level-difference portions (first level-difference portions) 928a to 928c and 929c to 929e each of which decreases in height toward the central part M in the axial direction of the fan 10, four level-difference portions 928a, 928b, 929d, and 929e which are close to the ends in the axial direction of the fan 10 are smaller than the level-difference portions (second level-difference portions) 928d, 928e, 929a, and 929b each of which increases in height toward the central part M in the axial direction of the fan 10, in terms of the variation in height within a predetermined length in the axial direction. The predetermined length in the axial direction is, for example, shorter than the length in the axial direction of each of the level-difference portions 928a, 928b, 929d, and 929e from the highest point of each of the level-difference portions 928a to 928e and 929a to 929e.

[0113] In addition to the above, as shown in FIG. 19, on the surface of the protruding portion 922 which surface is on the side opposite to the fan 10, a swollen portion 927 is formed in the vicinity of each of the level-difference portions 928a, 928b, 929d, and 929e. The swelling height of this swollen portion 927 decreases toward the central part M in the axial direction of the fan 10.

[0114] The shape of the swollen portion 27 is not limited to the shape described in the embodiment above, and is only required to be swollen away from the fan 10 as compared to the surrounding of the swollen portion 27.

[0115] While in the embodiment above two swollen portions 27 are identical in the swelling height, they may be different in the swelling height. In such a case, to restrain the disturbance of the vortex airflow, the swelling height of the swollen portion 27 which is farther from the central part M in the axial direction of the fan 10 is preferably arranged to be higher than the swelling height of the other swollen portion 27.

[0116] While in the embodiment above the swollen portion 27 is provided in the vicinity of each of the level-difference portions 28a and 28b, no swollen portion 27 may be provided in the vicinity of one or both of the two level-difference portions 28a and 28b. To put it differently, the surface on the side opposite to the fan 10 of one or

both of the two inclination alleviation portions 25 may not be swollen as compared to the twisted portion 23 and the connecting portion 24. When the swollen portion 27 is provided in the vicinity of only one of the level-difference portions 28a and 28b, to restrain the disturbance of the vortex airflow, the swollen portion 27 is preferably provided in the vicinity of the level-difference portion 28a which is farther from the central part M in the axial direction of the fan 10.

[0117] In addition to the above, while in the embodiment above the swollen portion 27 is formed along each of the level-difference portions 28a and 28b, the range of the formation of the swollen portion 27 is not limited to this. The swollen portion may be differently formed as long as the swollen portion is formed in the vicinity of a level-difference portion which decreases in height toward the central part M in the axial direction of the fan 10 and in a part where the amount air flowing into the bended portion of the vortex airflow can be reduced. For example, the swollen portion may be formed only in the vicinity of the lowest point of the level-difference portion, or only in the vicinity of the highest point of the level-difference portion.

[0118] While in the embodiment above the level-difference portions provided at the leading end of the stabilizer 32 are identical with one another in inclination, the level-difference portions of the stabilizer 32 may be different from one another in inclination as in the rear guider 20 (i.e., they may be different from one another in the variation in height in the predetermined length in the axial direction). To be more specific, the variation in height of at least one of the level-difference portions each of which decreases in height toward the central part M in the axial direction of the fan 10 is arranged to be smaller than the variation in height of the level-difference portions each of which increases in height toward the central part M in the axial direction of the fan 10.

[0119] Furthermore, the level-difference portions are different from each other in inclination only in one of the rear guider 20 and the stabilizer 32.

[0120] In addition to the above, while in the embodiment above no swollen portion is provided in the vicinity of each of the level-difference portions provided at the leading end of the stabilizer 32, a swollen portion may be provided in the vicinity of a level-difference portion of the stabilizer 32, as in the rear guider 20. To be more specific, a swollen portion which is swollen away from the fan 10 as compared to the surrounding is provided in the vicinity of at least one of the level-difference portions each of which decreases in height toward the central part M in the axial direction of the fan 10.

[0121] Furthermore, a swollen portion may be provided in only one of the rear guider 20 and the stabilizer 32.

[0122] 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]

[0123] The present invention makes it possible to suppress wind noise by restraining the disturbance of a vortex airflow.

[Reference Signs List]

[0124]

- 1 INDOOR UNIT OF AIR CONDITIONER
- 10 CROSS FLOW FAN
- 20, 920 REAR GUIDER
- 25 INCLINATION ALLEVIATION PORTION
- 26 RIB PORTION
- 27, 927 SWOLLEN PORTION
- 27a APEX
- 28a to 28c, 128a, 228a, 328a, 428a, 528a, 628a, 728a, 828a, 928a to 928c, 929c to 929e LEVEL-DIFFERENCE PORTION (FIRST LEVEL-DIFFERENCE PORTION)
- 28d, 28e, 128e, 928d, 928e, 929a, 929b LEVEL-DIFFERENCE PORTION (SECOND LEVEL-DIFFERENCE PORTION)
- 32 STABILIZER

Claims

1. An air conditioner comprising:
 - a cross flow fan; 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, at a leading end portion of at least one of the stabilizer and the rear guider, level-difference portions being formed to be lined up in an axial direction, the level-difference portions including first level-difference portions each of which decreases in height in the axial direction toward a central part of the fan and second level-difference portions each of which increases in height in the axial direction toward the central part of the fan, a variation in height of at least one of the first level-difference portions within a predetermined length in the axial direction being equal to a first predetermined value which is smaller than a variation in height of each of the second level-difference portions.

- 2. The air conditioner according to claim 1, wherein, in the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value, the degree of inclination of an edge portion which extends linearly or in a curved manner from a highest point is more gentle than the degree of inclination of an edge portion of each of the second level-difference portions which edge portion extends linearly or in a curved manner from a highest point. 5
- 3. The air conditioner according to claim 2, wherein, the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value extends from the highest point to a lowest point linearly or in a curved manner. 10
- 4. The air conditioner according to claim 1, wherein, the height of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value changes in stages, and an edge portion of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value, which edge portion extends from the highest point linearly or in a curved manner is shorter than an edge portion of each of the second level-difference portions which edge portion extends from the highest point linearly or in a curved manner, and an inclination angle of the edge portion of the at least one of the first level-difference portions is identical with an inclination angle of the edge portion of each of the second level-difference portions. 15 20 25 30 35
- 5. The air conditioner according to any one of claims 1 to 4, wherein, the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value is positioned to be closest in the axial direction to one end of the cross flow fan, among the level-difference portions. 40
- 6. The air conditioner according to any one of claims 1 to 5, wherein, at least one of the stabilizer and the rear guider includes two or more first level-difference portions in which the variation in height is equal to the first predetermined value, and among the two or more first level-difference portions, the variation in height of one first level-difference portion which is farther in the axial direction from the central part of the fan than the other level-difference portion is smaller than the variation in height of the other level-difference portion. 45 50
- 7. The air conditioner according to any one of claims 1 to 6, wherein, the first level-difference portions are provided only on one side in the axial direction of the central part of the fan, whereas the second level- 55

difference portions are provided only on the other side in the axial direction of the central part of the fan, and the height of a part between neighboring ones of the level-difference portions gradually changes in the axial direction.

- 8. The air conditioner according to any one of claims 1 to 6, wherein, the first level-difference portions and the second level-difference portions are alternately provided in the axial direction, and the height of a part between two neighboring ones of the level-difference portions is constant in the axial direction. 10
- 9. The air conditioner according to any one of claims 1 to 8, wherein, the length in the axial direction of the at least one of the first level-difference portions in which the variation in height is equal to the first predetermined value is not less than 5% and not more than 30% of the interval between highest points of two neighboring ones of the level-difference portions. 15 20 25 30 35 40

FIG.1

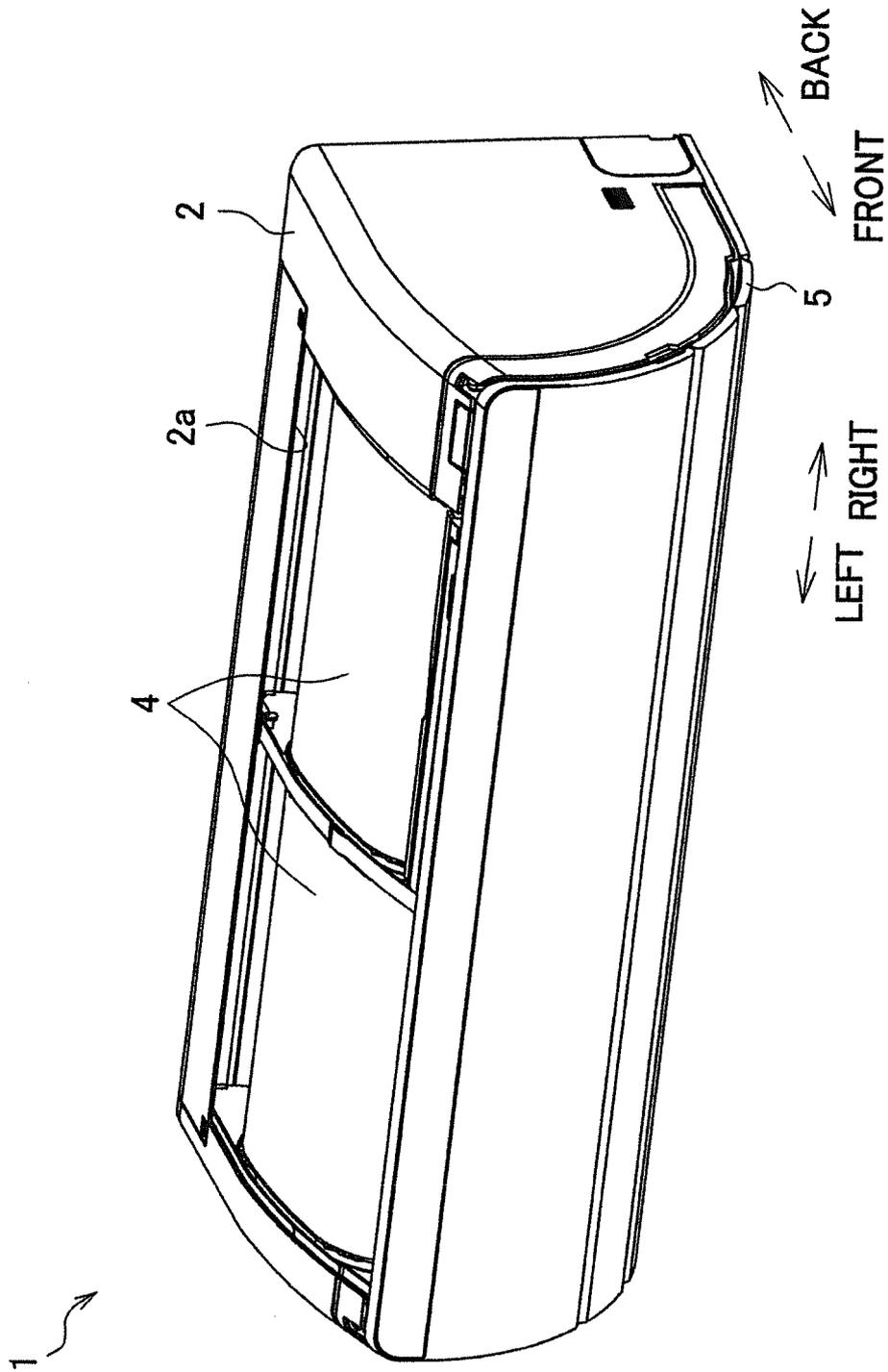
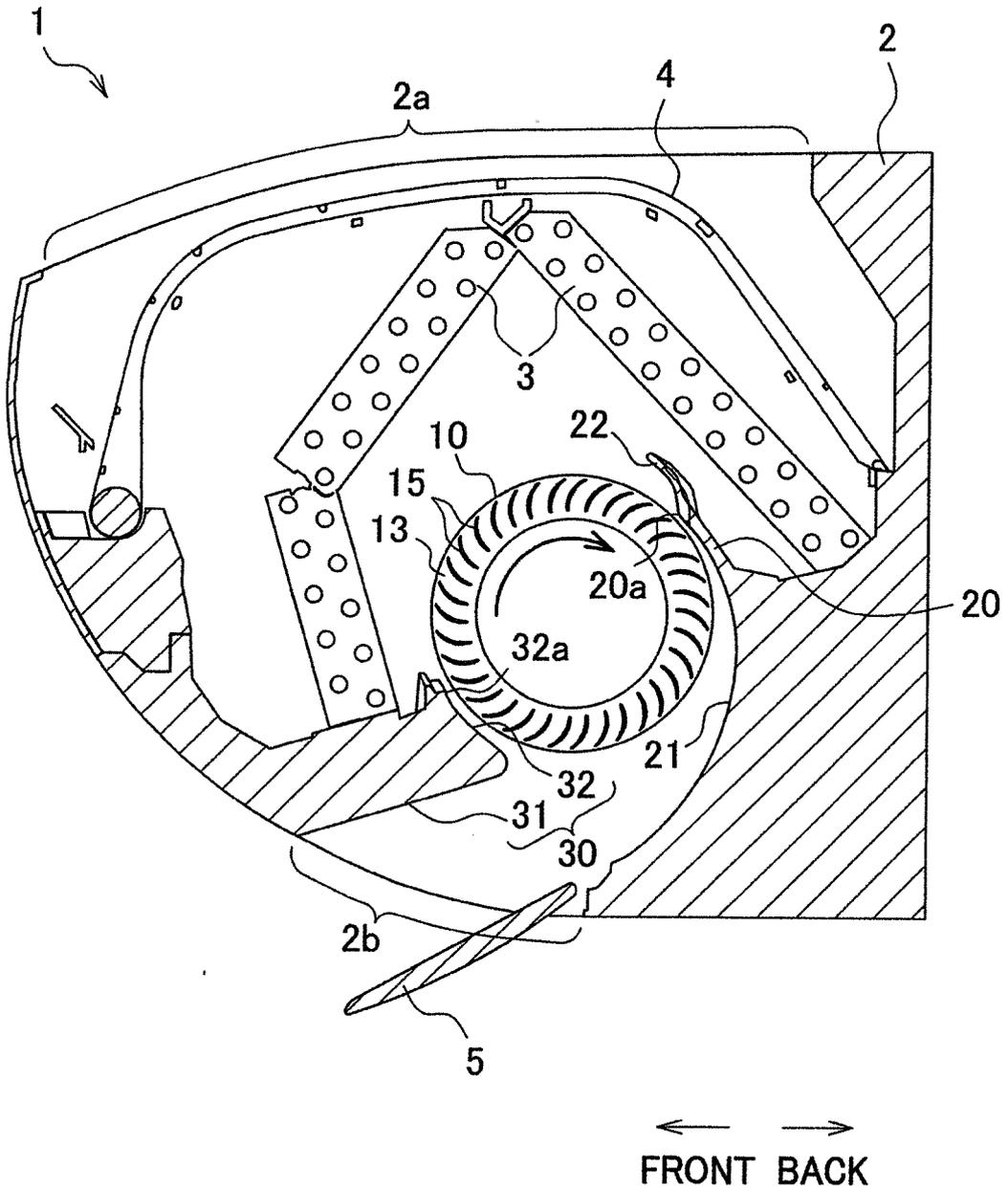


FIG.2



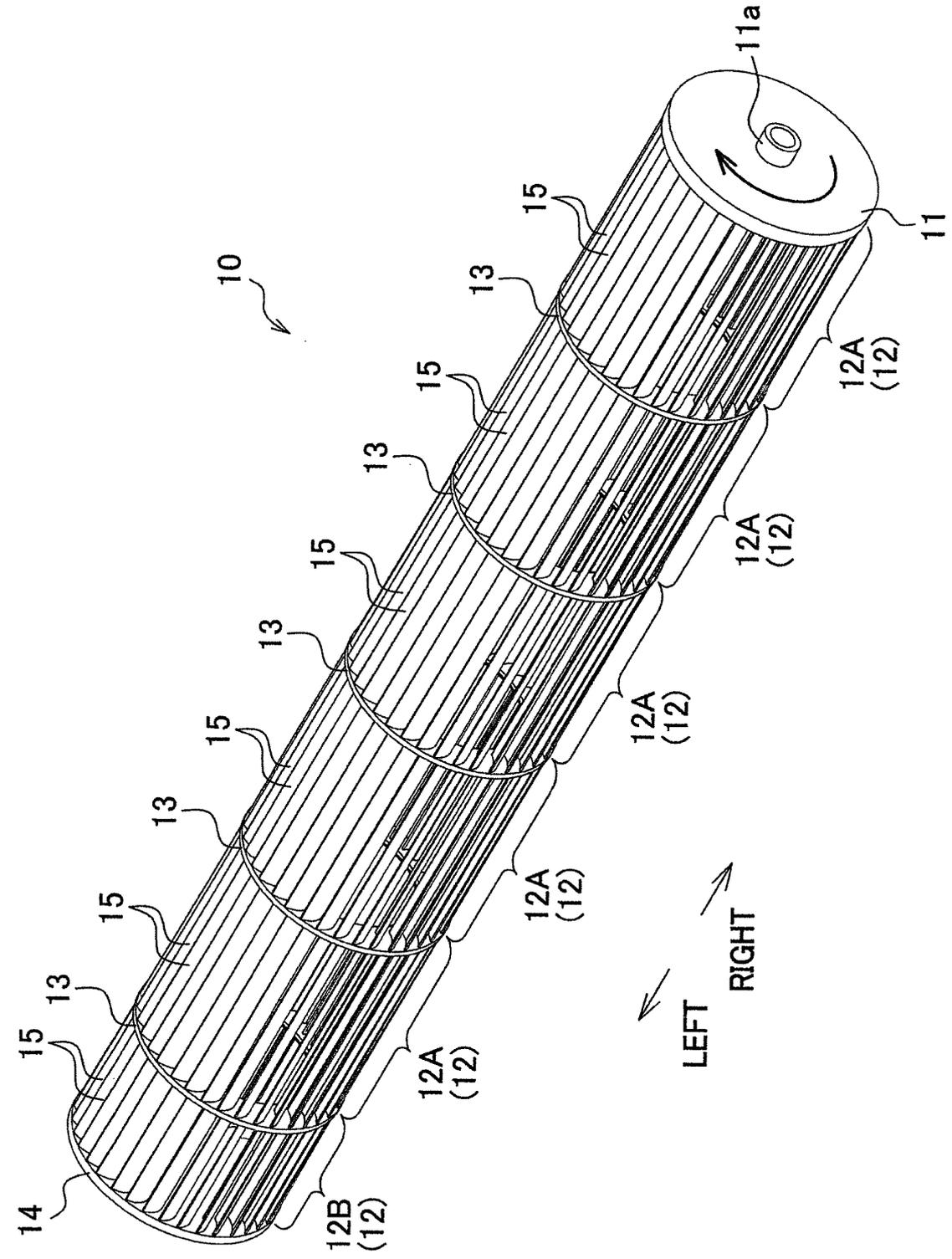
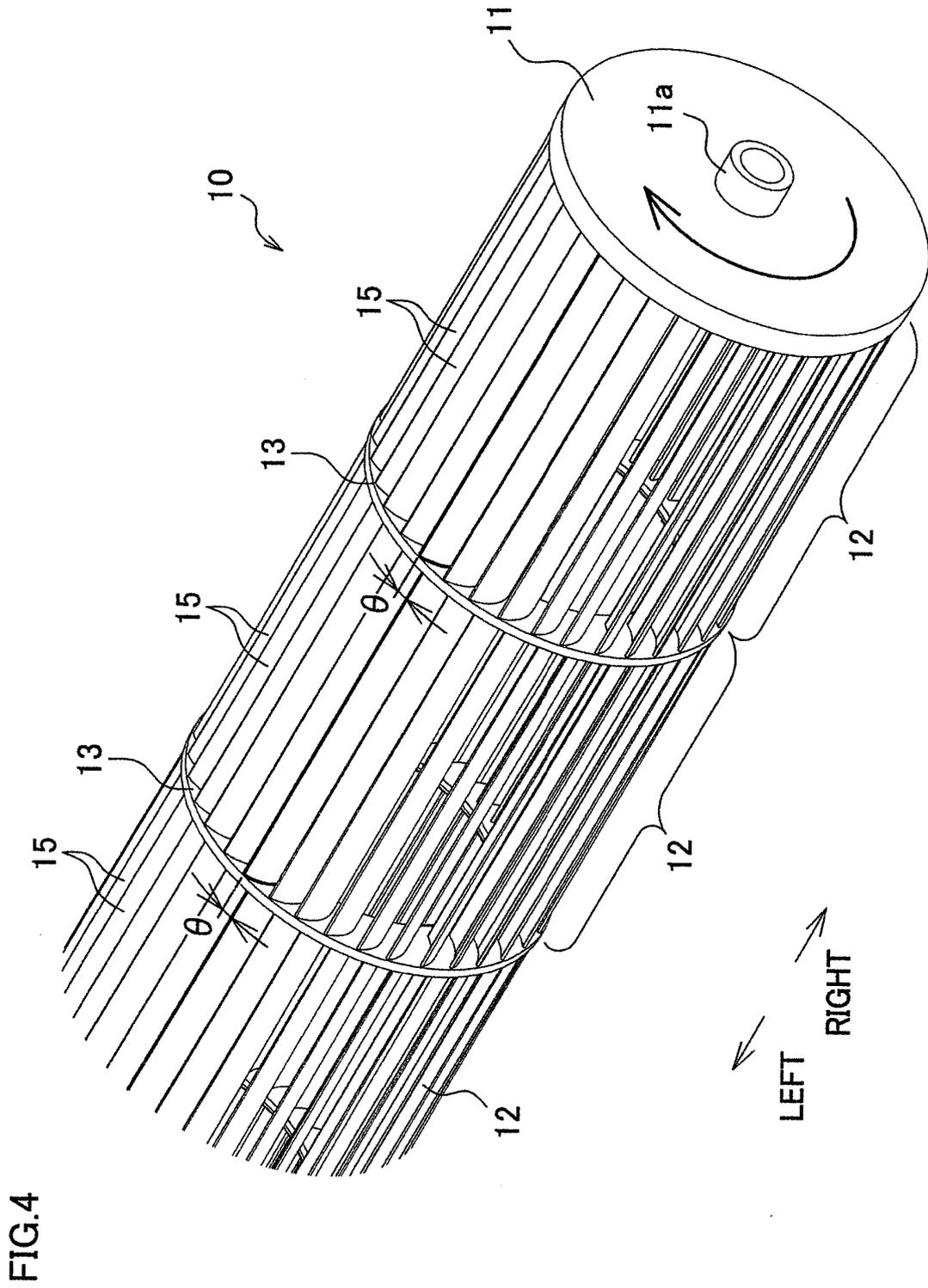


FIG.3



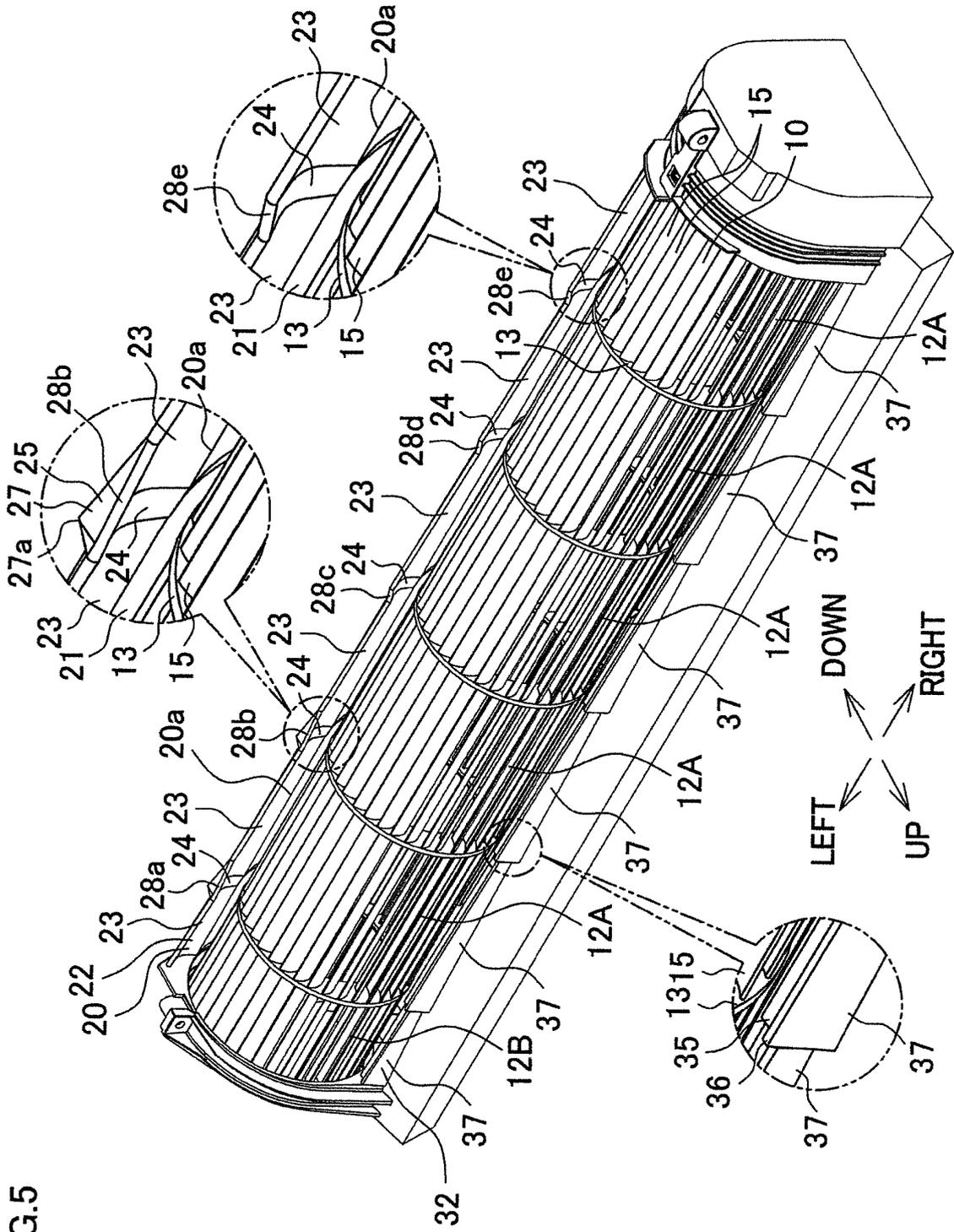


FIG.5

FIG.7

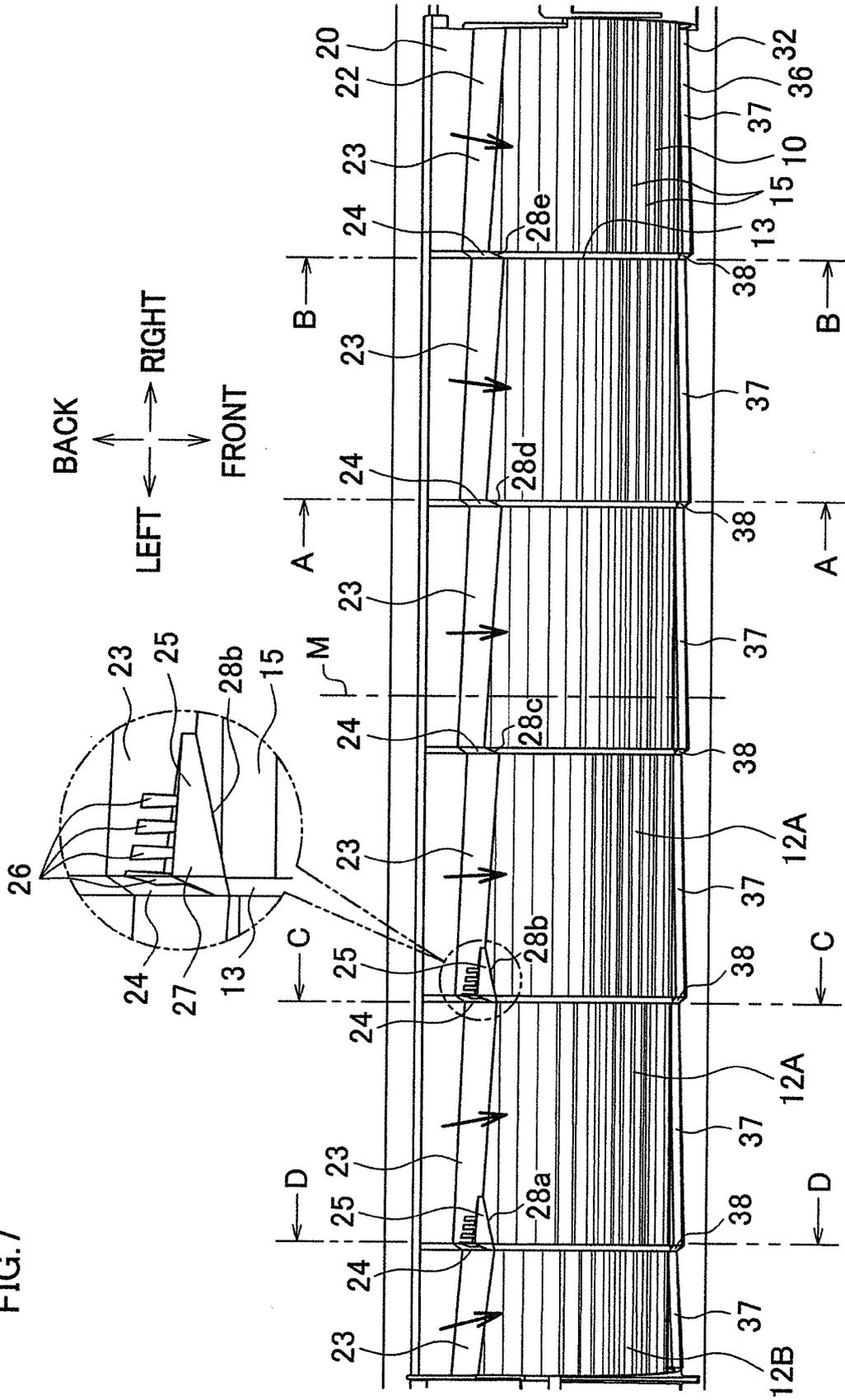


FIG.8(b)

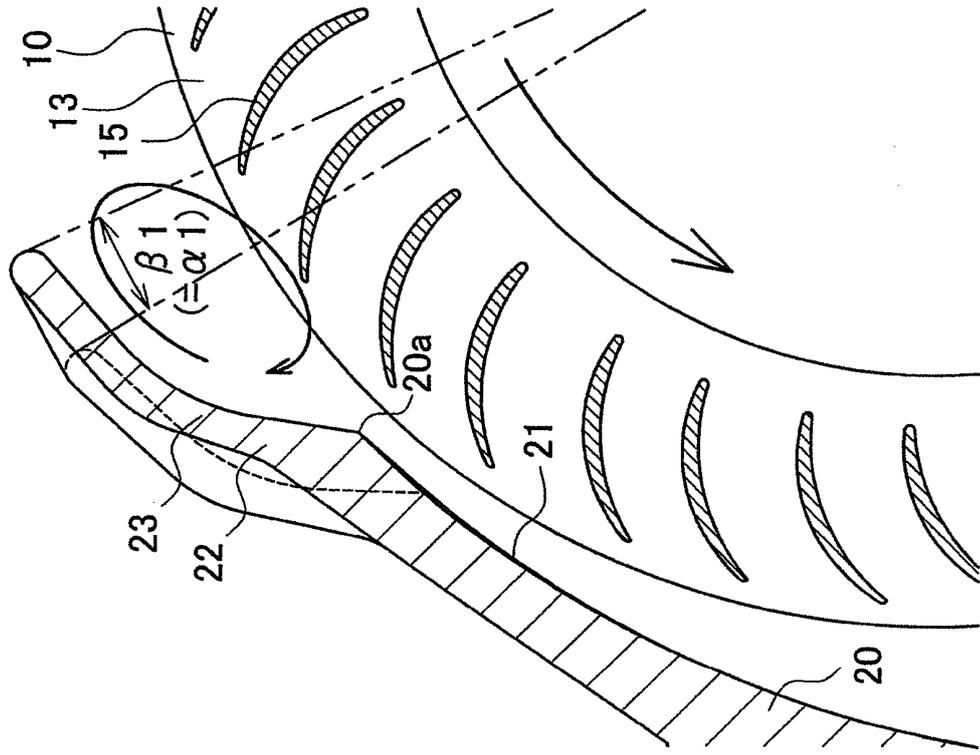


FIG.8(a)

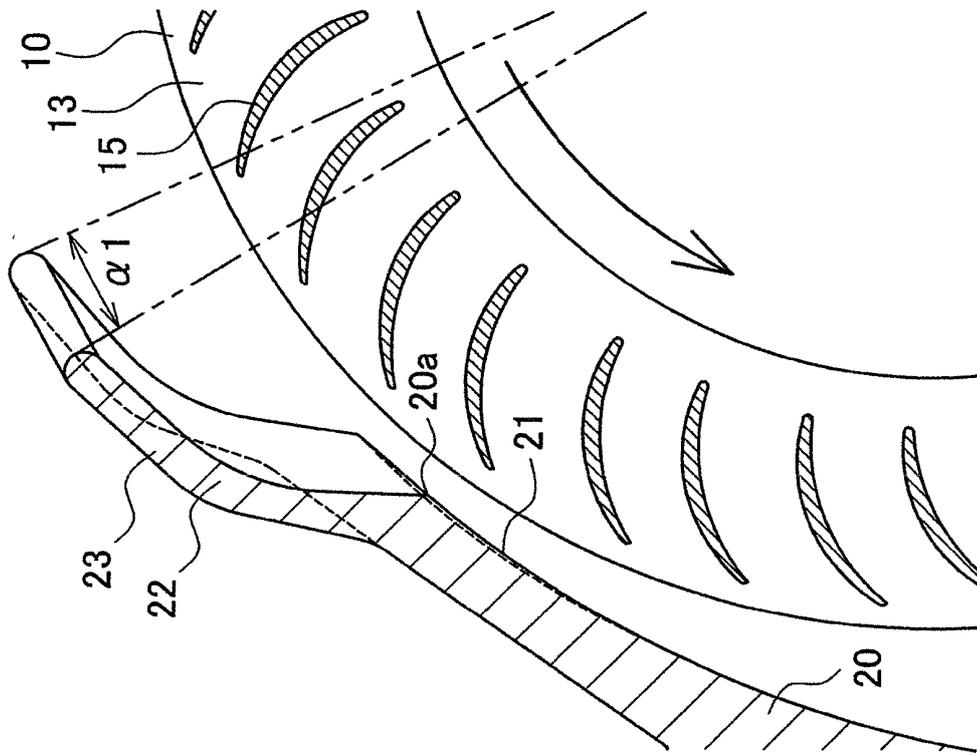


FIG.10(b)

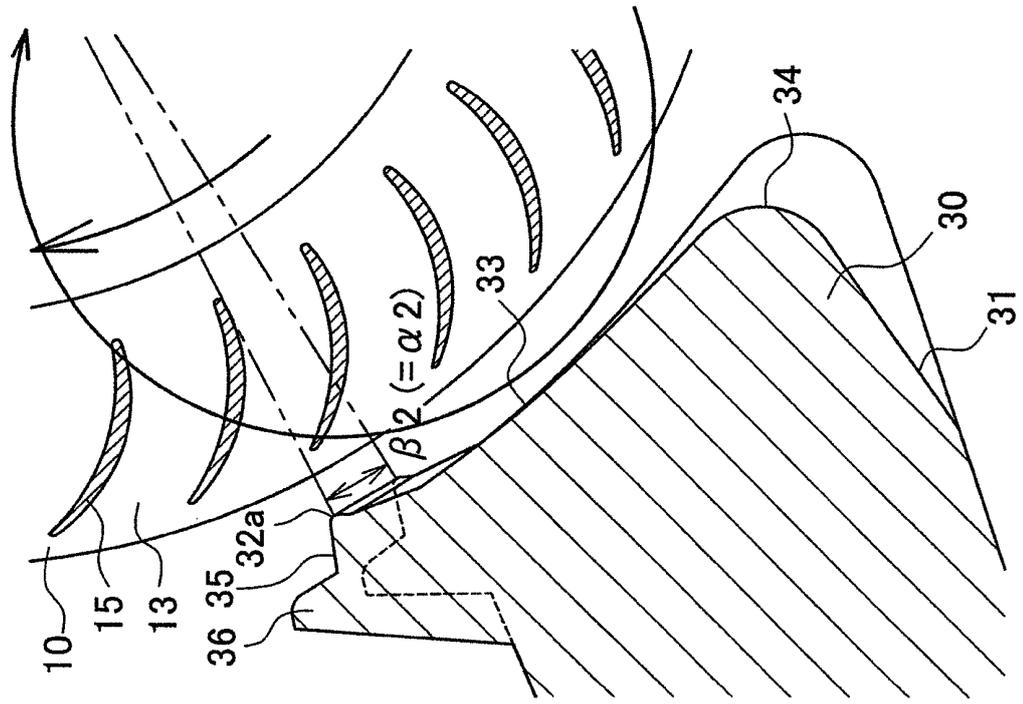


FIG.10(a)

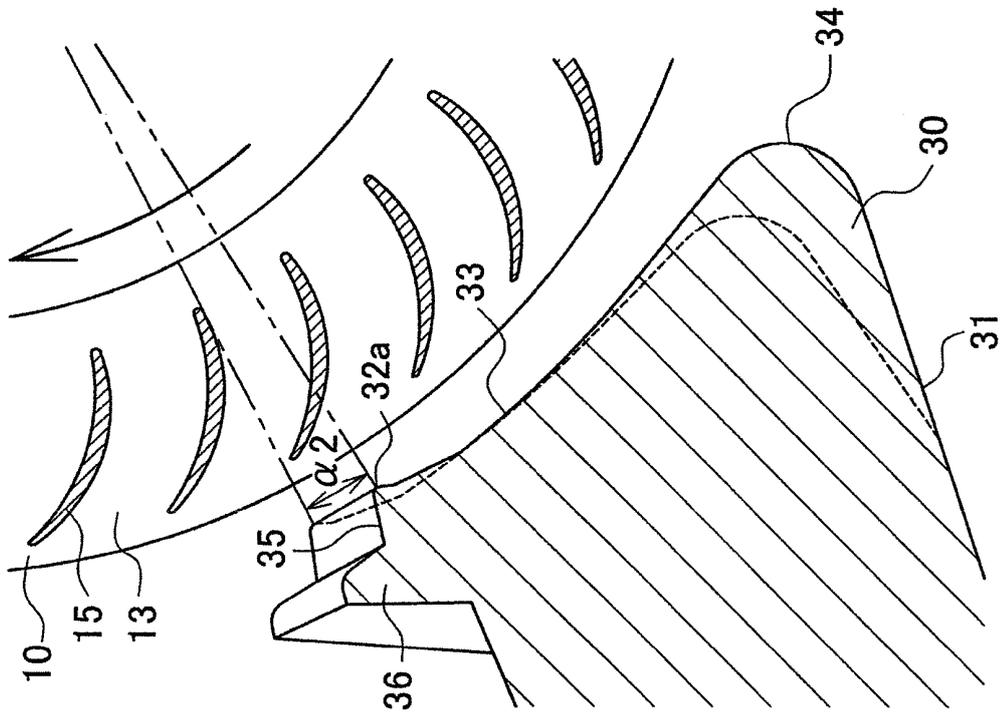
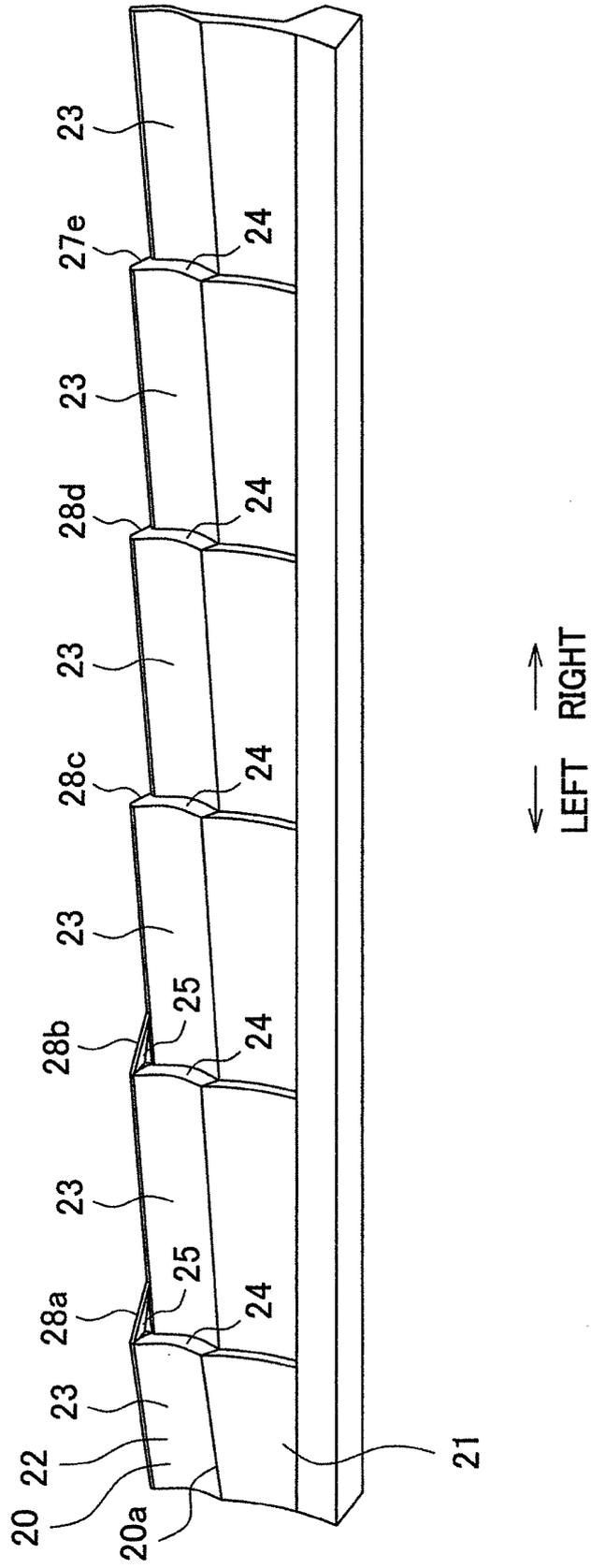


FIG.11



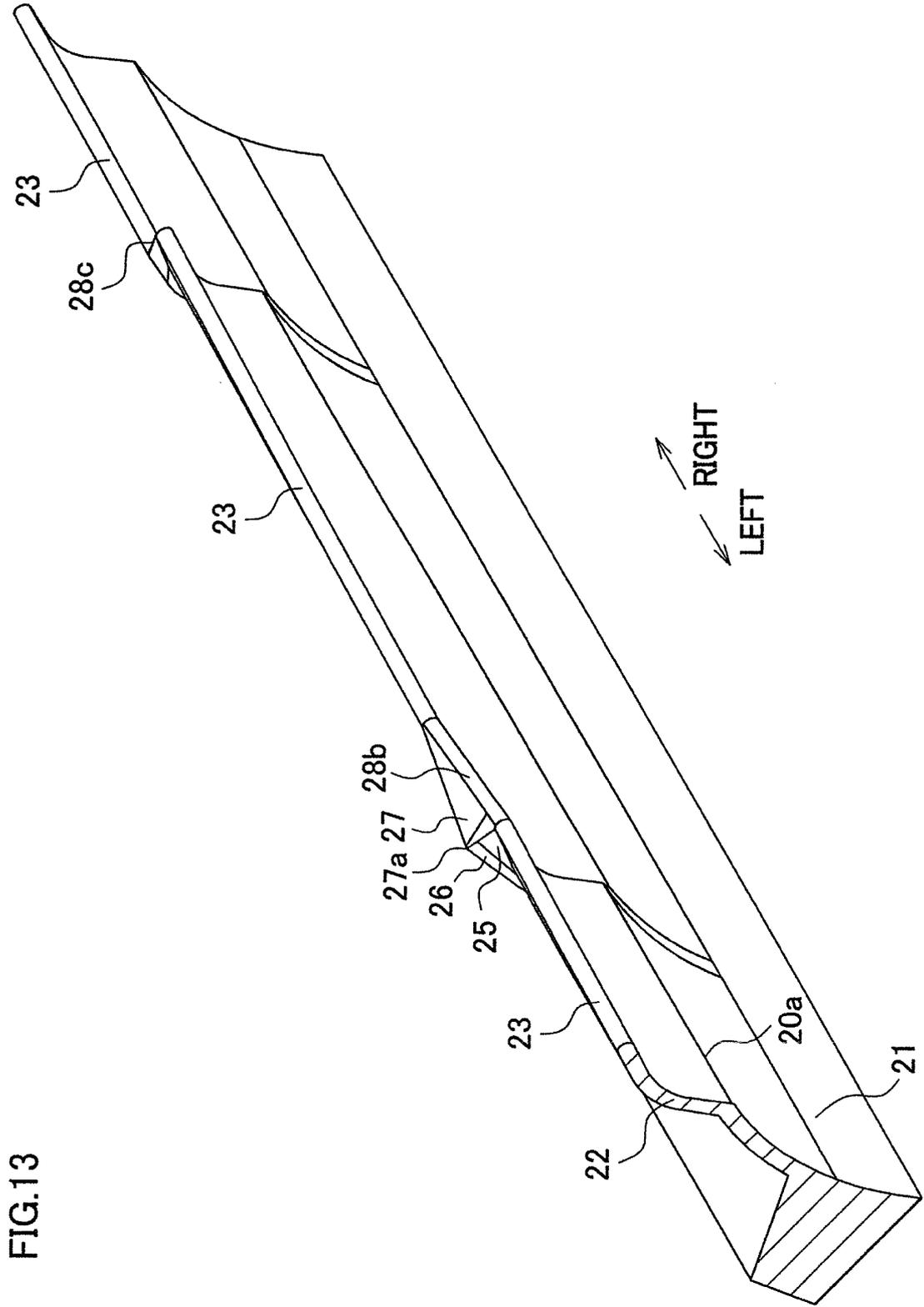


FIG.13

FIG.14

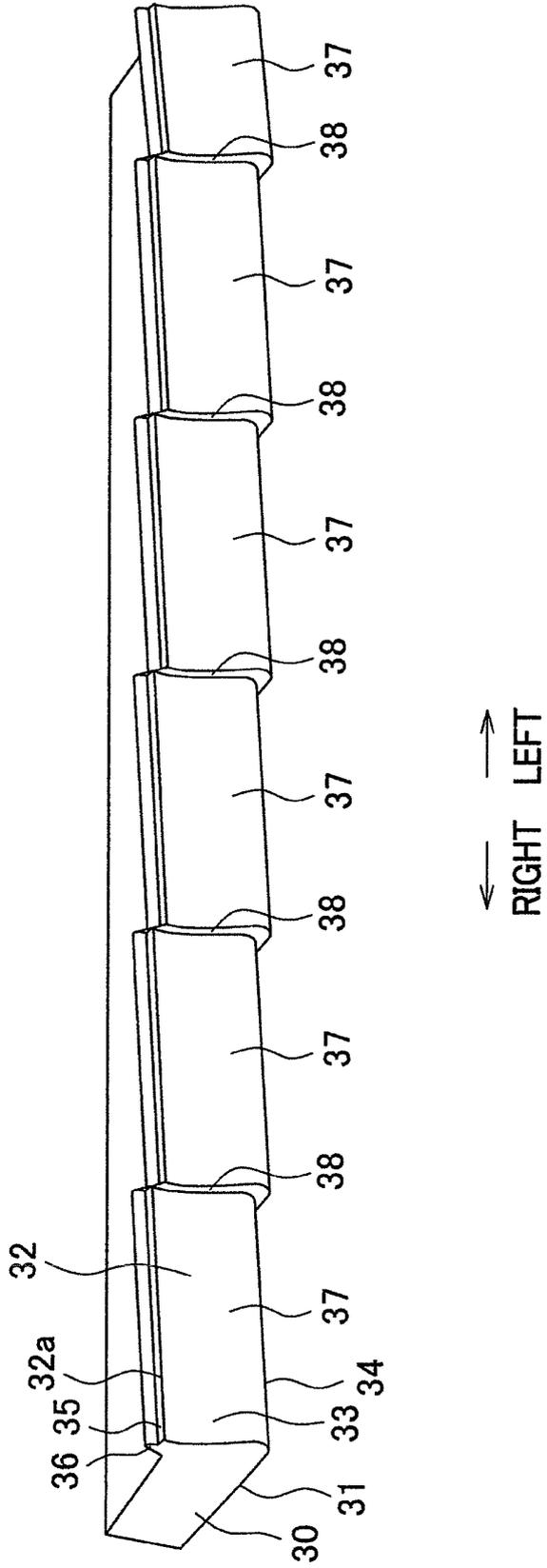


FIG.15

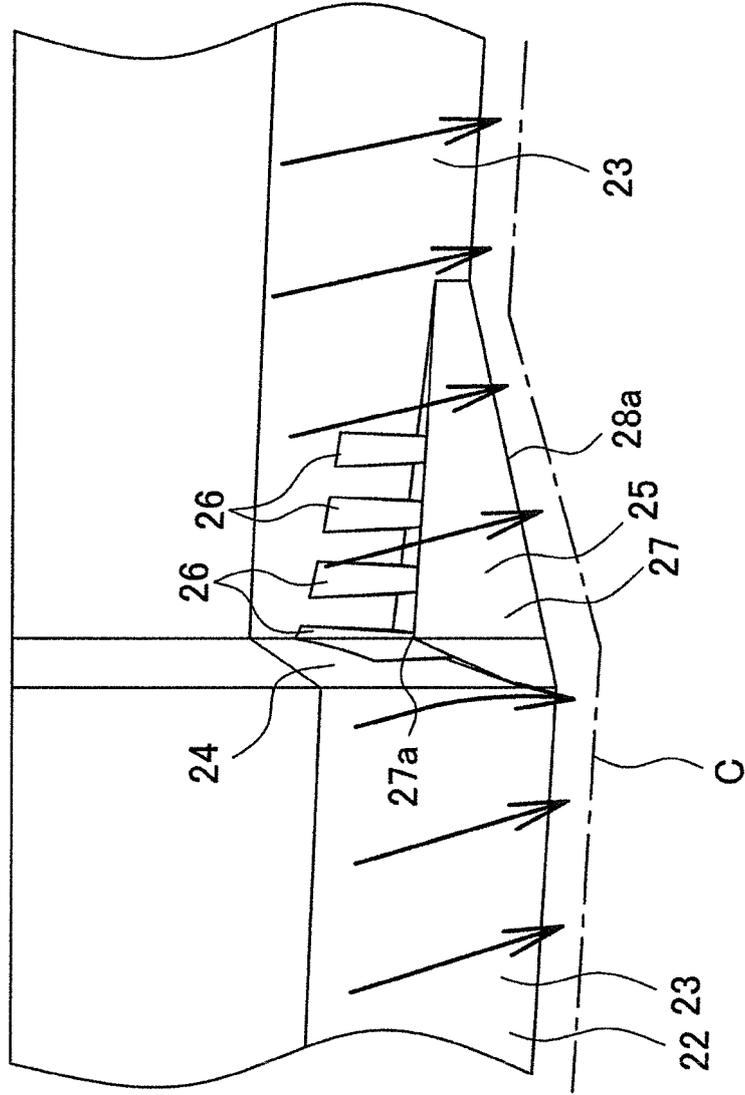


FIG.16(a)

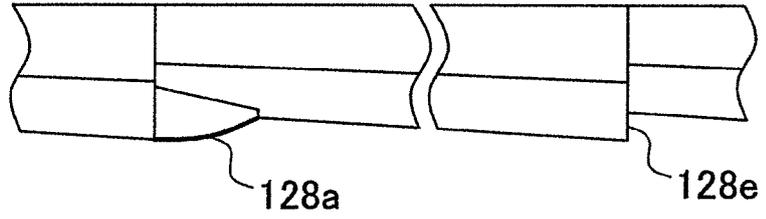


FIG.16(b)

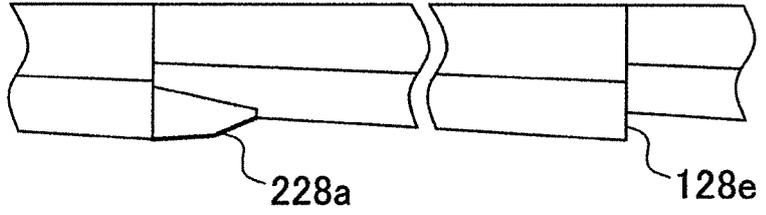


FIG.16(c)

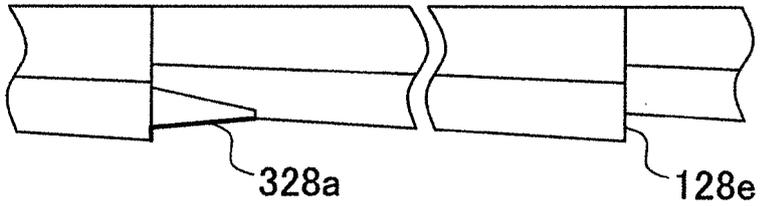


FIG.16(d)

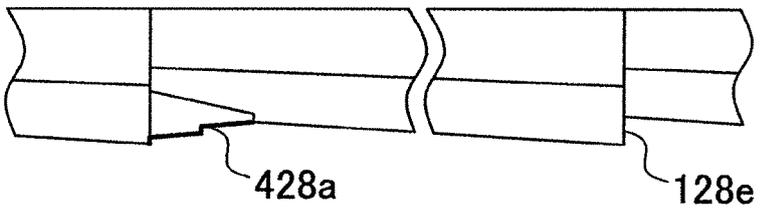


FIG.16(e)

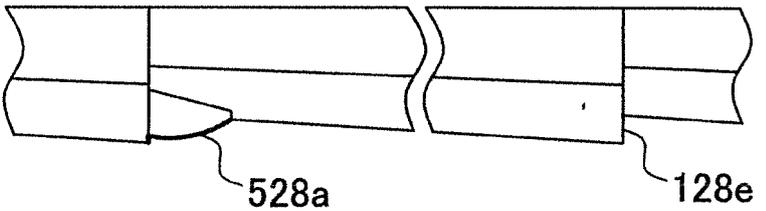


FIG.16(f)

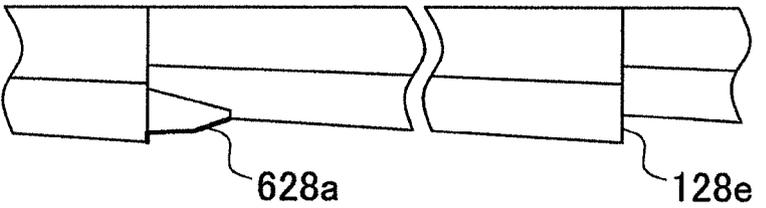


FIG.17(a)

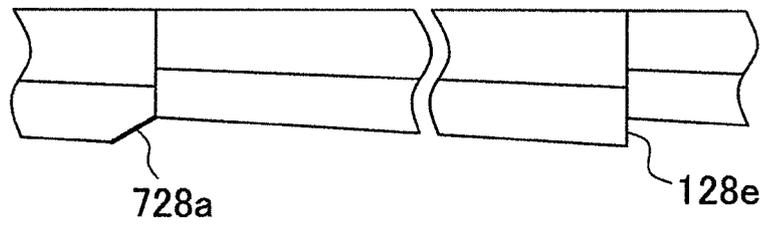


FIG.17(b)

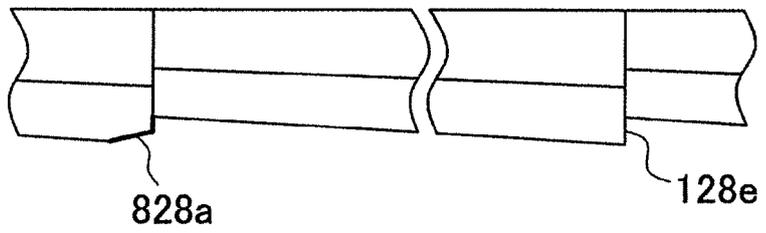


FIG.18

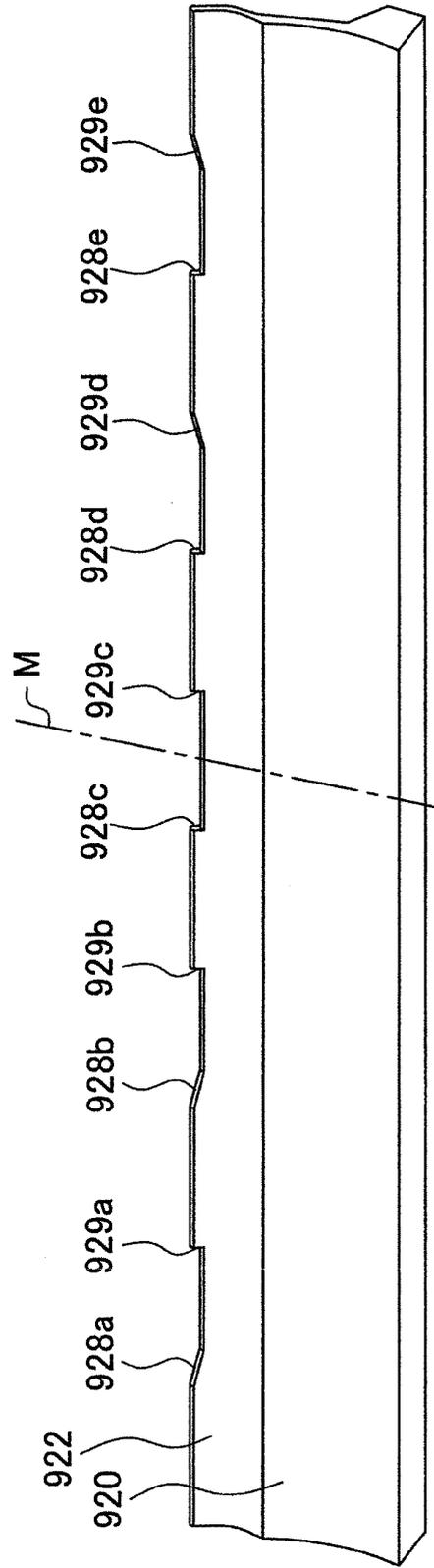


FIG.19

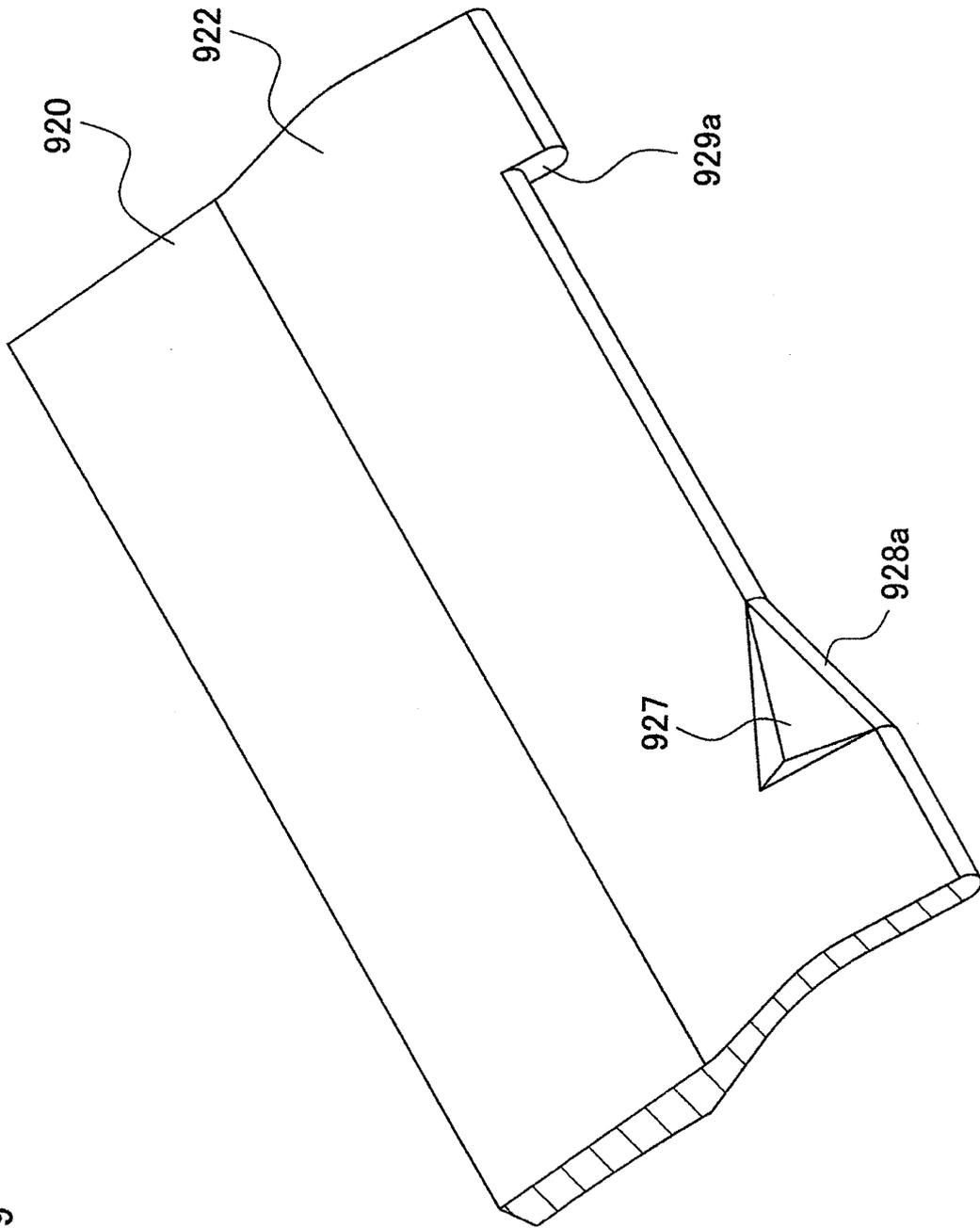
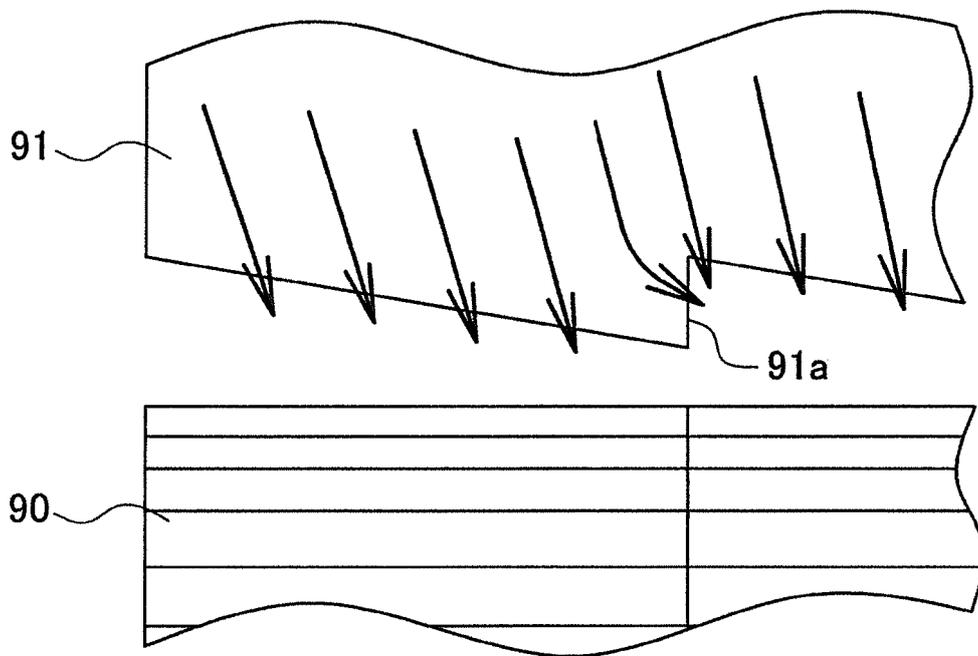


FIG.20



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/072147

5	A. CLASSIFICATION OF SUBJECT MATTER F24F1/00(2011.01) i		
	According to International Patent Classification (IPC) or to both national classification and IPC		
10	B. FIELDS SEARCHED		
	Minimum documentation searched (classification system followed by classification symbols) F24F1/00		
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013 Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013		
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	
		Relevant to claim No.	
25	A	JP 2002-286244 A (Mitsubishi Heavy Industries, Ltd.), 03 October 2002 (03.10.2002), entire text; all drawings (Family: none)	1-9
30	A	JP 9-100795 A (Hitachi, Ltd.), 15 April 1997 (15.04.1997), entire text; all drawings & CN 1148155 A	1-9
35	A	JP 2002-61867 A (Hitachi, Ltd.), 28 February 2002 (28.02.2002), entire text; all drawings (Family: none)	1-9
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
45	* 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	
50	Date of the actual completion of the international search 25 September, 2013 (25.09.13)	Date of mailing of the international search report 08 October, 2013 (08.10.13)	
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	
	Facsimile No.	Telephone No.	

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Patent documents cited in the description

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