(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 902 632 B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
11.01.2017 Bulletin 2017/02

(21) Application number: **13841557.5**

(22) Date of filing: **20.08.2013**

(51) Int Cl.:
F04D 17/04 (2006.01) ***F04D 29/66*** (2006.01)
F24F 1/00 (2011.01)

(86) International application number:
PCT/JP2013/072148

(87) International publication number:
WO 2014/050365 (03.04.2014 Gazette 2014/14)

(54) **AIR CONDITIONER**

KLIMAANLAGE

CLIMATISEUR

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **28.09.2012 JP 2012215536**

(43) Date of publication of application:
05.08.2015 Bulletin 2015/32

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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. 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, JP H02 203129 A 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 and the wind noise is suppressed.

[Summary of Invention]

[Technical Problem]

[0004] In the air conditioner of JP H02 203129 A, 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. 21, 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.

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

[0005] In addition, JP H11 304178 A discloses a transverse fan air blower including a transverse fan which is comprised of a large number of unit fans arrnaged in a row, a motor which affords a driving force of the transverse fan, a rear guide which provides a passage of air blown off by the transverse fan, and a stabilizer which is disposed in front of the transverse fan and is provided with a semicircular facing portion defining a proper gap with the outer peripheral surface of the transverse fan and stabilizes a vortex generated at the time of rotating the transverse fan. A rib is formed on the facing portion of the stabilizer and such a rib changes the top thereof such that the position of the top is continuously and regularly changed along an axial direction of the transverse fan at the time of rotating the transverse fan while always maintaining the proper gap with the outer peripheral surface of the transverse fan thus dispersing the noise generating point of time.

[0006] JP H01 167494 A discloses a cross flow fan including a nose part provided close to a peripheral side face of a fan body and an inner wall of a casing form a discharge opening for air. A projecting part is provided on inner corner portion of the nose part for the purpose of making a gap between the fan body and the nose part small. A vane fixing position of vortex, guiding vortex going toward the discharge opening and recovering static pressure is provided still more on the projecting part toward tangential direction on the bottom end of the fan body.

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

[Solution to Problem]

[0008] An air conditioner according to the present invention is defined by the combination of features of claim 1. Dependent claims relate to preferred embodiments.

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 least one of the stabilizer and the rear guider having, at a leading end portion, level-difference portions which are lined up in an axial direction and include first level-difference portions each of which decreases in height toward a central part in the axial direction of the fan; a bulging portion being formed in the vicinity of at least one of the first level-difference portions on a surface of the at least one of the stabilizer and the rear guider which surface is opposite to the cross flow fan.

[0009] In this air conditioner, at least one of the stabilizer and the rear guider has a bulging portion which bulges in shape as compared to its surroundings and is bulging away from the fan, in the vicinity of the first level-difference portion which decreases in height toward the central part of the fan. For this reason, the airflow sucked into the fan is unlikely to climb over the bulging portion. 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.

Furthermore, because the level-difference portions are provided at the leading end portion of at least one of the stabilizer and the rear guider, it is possible to cause the vane of the fan to pass the end portions in the axial direction of the level-difference portion at different timings or to cause the vane not to pass the part between the level-difference portions at once, as the height of this 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.

[0010] According to the second aspect of the invention, the air conditioner of the first aspect is arranged such that the bulging portion is formed along the first level-difference portion.

[0011] In this air conditioner, because the bulging portion is formed along the first level-difference portion, it is possible to restrain the airflow sucked into the fan from climbing over the first level-difference portions. With this, it is possible to further certainly restrain the flowing of the air into the bended portion of the vortex airflow in a concentrated manner.

[0012] According to the third aspect of the invention, the air conditioner of the first or second aspect is arranged such that the bulging portion is provided in the vicinity of a first level-difference portion which is farthest in the axial direction from the central part of the fan, among the first level-difference portions.

[0013] In this air conditioner, because the airflow sucked into the cross flow fan tends to converge on the central part of the fan in the axial direction, the disturbance of the vortex airflow is further certainly suppressed when the bulging portion is provided in the vicinity of the first level-difference portion farthest from the central part of the fan in the axial direction.

[0014] According to the fourth aspect of the invention, the air conditioner of any one of the first to third aspects is arranged such that at least one of the stabilizer and the rear guider further includes one or more bulging portion, and the two or more bulging portions are arranged such that, the farther a bulging portion is from the central part of the fan in the axial direction, the higher the bulging height of the bulging portion is.

[0015] In this air conditioner, because the airflow sucked into the cross flow fan tends to converge on the central part of the fan in the axial direction, the disturbance of the vortex airflow is further certainly suppressed when the farther a bulging portion is from the central part of the fan in the axial direction, the higher the bulging height of the bulging portion is.

[0016] According to the fifth aspect of the invention, the air conditioner of any one of the first to fourth aspects is arranged such that each of the first level-difference portions extends linearly or in a curved manner from a highest point to a lowest point.

[0017] In this air conditioner, the first level-difference portions are easily formed because the first level-difference portions extend linearly or in a curved manner across the entirety in the axial direction.

[0018] According to the sixth aspect of the invention, the air conditioner of any one of the first to fourth aspects is arranged such that the height of each of the first level-difference portions changes in stages.

[0019] In this air conditioner, because each first level-difference portion changes in height 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 seventh aspect of the invention, the air conditioner of any one of the first to sixth aspects is arranged such that two first level-difference portions among the first level-difference portions are provided to neighbor each other, and the height of a part between the two neighboring level-difference portions gradually changes in the axial direction.

[0021] 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.

[0022] According to the eighth aspect of the invention, the air conditioner of any one of the first to sixth aspects is arranged such that, a level-difference portion which increases in height toward the central part of the fan in the axial direction is provided in the vicinity of one of the first level-difference portions, and the height of a part between the two neighboring level-difference portions is constant in the axial direction.

[0023] 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.

[0024] 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 level-difference portions include second level-difference portions each of which increases in height toward the central part of the fan in the axial direction, and in the at least one of the stabilizer and the rear guider, no bulging portion is formed in the vicinity of the second level-difference portions on the surface of the at least one of the stabilizer and the rear guider which surface is opposite to the cross flow fan.

[0025] In this air conditioner, because each second level-difference portion increases in height toward the central part of the fan, the airflow sucked into the fan does not change its direction toward the second level-difference portion. It is therefore unnecessary to provide a bulging portion in the vicinity of the second level-difference portion. When a bulging portion is provided in the vicinity of each of all the level-difference portions, air-blowing resistance is high and the air-blowing capability may be deteriorated. In the present embodiment, because no bulging portion is provided in the vicinity of each of the second level-difference portions, the deterioration of the air-blowing capability is prevented.

[Advantageous Effects of Invention]

[0026] As described above, the following effects are obtained by the present invention.

[0027] According to the first aspect of the invention, at least one of the stabilizer and the rear guider has a bulging portion which bulges in shape as compared to its surroundings and is bulging away from the fan, in the vicinity of the first level-difference portion which decreases in height toward the central part of the fan. For this reason, the airflow sucked into the fan is unlikely to climb over the bulging portion. 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. Furthermore, because the level-difference portions are provided at the leading end portion of at least one of the stabilizer and the rear guider, it is possible to cause the vane of the fan to pass the end portions in the axial direction of the level-difference portion at different timings or causes the vane not to pass the part between the level-difference portions at once, as the height of this 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.

[0028] According to the second aspect of the invention, because the bulging portion is formed along the first level-difference portions, it is possible to restrain the airflow sucked into the fan from climbing over the first level-difference portions. With this, it is possible to further certainly restrain the flowing of the air into the bended portion of the vortex airflow in a concentrated manner.

[0029] According to the third aspect of the invention, because the airflow sucked into the cross flow fan tends to converge on the central part of the fan in the axial direction, the disturbance of the vortex airflow is further certainly suppressed when the bulging portion is provided in the vicinity of the first level-difference portion farthest from the central part of the fan in the axial direction.

[0030] According to the fourth aspect of the invention, because the airflow sucked into the cross flow fan tends to converge on the central part of the fan in the axial direction, the disturbance of the vortex airflow is further certainly suppressed when the farther a bulging portion is from the central part of the fan in the axial direction, the higher the bulging height of the bulging portion is.

[0031] According to the fifth aspect of the invention, the first level-difference portions are easily formed because the first level-difference portions extend linearly or in a curved manner across the entirety in the axial direction.

[0032] According to the sixth aspect of the invention, because each first level-difference portion changes in height 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.

[0033] 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.

[0034] According to the eighth aspect of the invention, 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.

[0035] According to the ninth aspect of the invention, because each second level-difference portion increases in height toward the central part of the fan, the airflow sucked into the fan does not change its direction toward the second level-difference portion. It is therefore unnecessary to provide a bulging portion in the vicinity of the second level-difference portion. When a bulging portion is provided in the vicinity of each of all the level-difference portions, air-blowing resistance is high and the air-blowing capability may be deteriorated. In the present embodiment, because no bulging portion is provided in the vicinity of each of the level-difference portions, the deterioration of the air-blowing capability is prevented.

[Brief Description of Drawings]

[0036]

[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] 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] Each of FIGs. 17(a) and 17(b) shows a rear guider of another embodiment of the present invention, when it is viewed from above.

[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] Each of FIGs. 20(a) to 20(c) shows a rear guider of another embodiment of the present invention, when it is viewed from above.

[FIG. 21] FIG. 21 shows a known front tongue portion and a known fan, when they are viewed from above.

[Description of Embodiments]

[0037] The following will describe an embodiment of the present invention.

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. 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".

[0038] 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.

[0039] 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.

[0040] The following will detail the fan 10, the rear guider 20, and the front guider 30.

[Fan]

[0041] 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] 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 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 for the angle θ in the rotational direction.

[Rear Guider]

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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).

[0051] 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.

[0052] 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 gradually 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).

[0053] 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 β1 is identical with the angle α1.

[0054] 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).

[0055] 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. As shown in FIG. 7, 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 provided to the left 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 alleviation 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.

[0056] 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.

[0057] 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.

[0058] On the surface of the protruding portion 22 which surface is on the side opposite to the fan 10, the inclination alleviation portion 25 and the rib portion 26 are bulging in shape as compared to its surrounding (the twisted portion 23 and the connecting portion 24). This bulging part is termed a bulging portion 27. The range of the bulging portion 27 when viewed from above is identical with the range occupied by the inclination alleviation portion 25 and the rib portions 26.

[0059] The height of the bulging 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 bulging height. The highest position 27a of the bulging height of the bulging 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 bulging height of a part of the bulging portion 27 which part is to the right of the apex 27a decreases rightward, whereas the bulging height of a part of the bulging portion 27 which part is to the left of the apex 27a rapidly decreases leftward.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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 in each of the level-difference portions 28a and 28b is referred to as ΔH1. Furthermore, a variation in height within the predetermined length W in the left-right direction from the highest point in each of the level-difference portions 28c to 28e is referred to as ΔH2. The variation ΔH1 is smaller than the variation ΔH2. "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]

[0064] 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.

[0065] 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.

[0066] 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 21 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.

[0067] 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.

[0068] 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.

[0069] 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 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 is substantially identical with the length in the left-right direction of each of the vanes 15 of the vane wheel 12B.

[0070] 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 gradually 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. 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 23 are at the same height and the lowest ends of the six twisted portions 23 are at the same height (see FIG. 6).

[0071] 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 portions 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 $\alpha 2$.

[0072] 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.

[0073] 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.

[0074] 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 $\beta 1$ ($=\alpha 1$). As such, the wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

[0075] 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 no bulging portion 27 is provided in the vicinity of the level-difference portions 28a and 28b, the airflow tends to change its direction toward each of the level-difference portions 28a and 28b, with the result that the air flows in a concentrated manner into the bended portion of the vortex airflow. Consequently, the vortex airflow is disturbed and hence the wind noise increases.

[0076] In the meanwhile, in the present embodiment, the bulging portion 27 which is bulging away from the fan 10 as compared to the twisted portion and the connecting portion 24 is provided in the vicinity of each of the level-difference portions 28a and 28b. For this reason, as shown in FIG. 15, the airflow is unlikely to change its direction toward each of the level-difference portions 28a and 28b and the airflow passing across the range of the bulging portion 27 is reduced. 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.

[0077] In addition to the above, in the present embodiment, the inclination angle $\phi 1$ of each of the level-difference portions 28a and 28b is smaller than the inclination angle $\phi 2$ of each of the other level-difference portions 28c to 28e. For this reason, as compared to the case where the inclination angle of each of the level-difference portions 28a and 28b is identical with the angle $\phi 2$ (i.e., where no inclination alleviation portion 25 is provided), the airflow is unlikely to change its direction toward each of the level-difference portions 28a and 28b, and the flowing of the air into the bended portion of the vortex airflow is further 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.

[0078] 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 linearly 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 the two neighboring twisted portions 37 are deviated from each other for $\beta 2$ 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 $\beta 2$ ($=\alpha 2$). As such, the wind noise is suppressed by differentiating the timings of the generation of the wind noise in this way.

[0079] The air conditioner of the present embodiment has the following characteristics.

[0080] Because the rear guider 20 includes the bulging portion 27 bulging away from the fan 10 in the vicinity of each of the level-difference portions 28a and 28b which decreases in height toward the central part M in the axial direction of the fan 10, the airflow sucked into the fan 10 is unlikely to climb over the bulging portion 27. 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.

[0081] 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.

[0082] 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 provide a bulging portion in the vicinity of each of the level-difference portions 28d and 28e. If a bulging portion is provided in the vicinity of each of all the level-difference portions 28a to

28e, the air-blowing capability may be deteriorated on account of high air-blowing resistance. In the present embodiment, because no bulging portion is provided in the vicinity of each of the level-difference portions 28d and 28e, the deterioration of the air-blowing capability is prevented.

[0083] 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 disturbance of the vortex airflow is further restrained as the bulging portion 27 is provided in the vicinity of the level-difference portion 28a which is closest to the end portion in the axial direction of the fan 10.

Furthermore, because in the present embodiment the bulging portion 27 is provided also in the vicinity of the level-difference portion 28b which is the second closest to the end portion in the axial direction of the fan 10, the disturbance of the vortex airflow is further restrained. In addition to the above, in the present embodiment, no bulging portion is provided in the vicinity of the level-difference portion 28c which decreases in height toward the central part M in the axial direction of the fan 10. 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 air flowing around the level-difference portion 28c is substantially orthogonal to the axial direction, and the airflow scarcely changes its direction toward the level-difference portion 28c. In the present embodiment, the deterioration in the air-blowing capability is restrained because no bulging portion is provided in the vicinity of the level-difference portion 28c.

[0084] In addition to the above, because in the present embodiment the bulging portion 27 is formed along each of the level-difference portions 28a and 28b, it is possible to restrain the airflow sucked into the fan 10 from climbing over each of the level-difference portions 28a and 28b. In this way, the flowing of the air in a concentrated manner into the bended portion of the vortex airflow is further certainly restrained.

[0085] In addition to the above, in the present embodiment, the variation in height of each of the level-difference portions 28a and 28b within the predetermined length in the axial direction is smaller than the variation in height of each of the other level-difference portions 28c to 28e. Provided that the variation in height of each of the level-difference portions 28a and 28b is identical with that of each of the level-difference portions 28c to 28e, the air flow 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, with the result that the disturbance is likely to occur at the bended portion of the vortex airflow. In this regard, in the present embodiment, because the variation in height of each of the level-difference portions 28a and 28b is small, 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. 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.

[0086] 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.

[0087] While in the embodiment above two neighboring 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 (a) to FIG. 16 (f) . 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 (a) to FIG. 16 (f) 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.

[0088] The shape of each of the level-difference portions 28a and 28b may be different from the shape described in the embodiment above.

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).

[0089] 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.

[0090] 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.

[0091] 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-difference portions 328a to 628a from the highest point of each of the level-difference portions 328a to 628a and 128e.

[0092] 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).

[0093] 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.

[0094] 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.

[0095] 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.

[0096] 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.

[0097] 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.

[0098] 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.

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 bulging portion 927 is formed in the vicinity of each of the level-difference portions 928a, 928b, 929d, and 929e. The bulging height of this bulging portion 927 decreases toward the central part M in the axial direction of the fan 10.

[0099] The shape of the bulging portion 27 is not limited to the shape described in the embodiment above, and is only required to be bulging away from the fan 10 as compared to the surrounding of the bulging portion 27.

[0100] While in the embodiment above two bulging portions 27 are identical in the bulging height, they may be different in the bulging height. In such a case, to restrain the disturbance of the vortex airflow, the bulging height of the bulging 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 bulging height of the other bulging portion 27.

[0101] While in the embodiment above the bulging portion 27 is provided in the vicinity of each of the level-difference portions 28a and 28b, no bulging portion 27 may be provided in the vicinity of only one 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 of the two inclination alleviation portions 25 may not be bulging as compared to the twisted portion 23 and the connecting portion 24. For the purpose of restraining the disturbance of the vortex airflow, the bulging portion 27 is preferably provided at the level-difference portion 28a which is farther from the central part M in the axial direction of the fan 10.

[0102] In the embodiment above, the inclination of each of the level-difference portions 28a and 28b in the vicinity of the bulging portion 27 is more gentle than the inclination of each of the level-difference portions (second level-difference portions) 28d and 28e which increase in height toward the central part M in the axial direction of the fan 10 (i.e. , the variation in height within the predetermined range in the axial direction is small). In this regard, as shown in, for example, FIG. 20(a) to FIG. 20(c), the variation in height of each of level-difference portions 1028a, 1128a, and 1228a in the vicinity of each of bulging portions 1027, 1127, and 1227 may be equal to the variation in height of the level-difference portion (second level-difference portion) 128e which increases in height toward the central part M in the axial direction of the fan 10. In FIG. 20(a) to FIG. 20(c), the ranges of the bulging portions 1027, 1127, and 1227 are hatched.

[0103] In addition to the above, while in the embodiment above the bulging portion 27 is formed along each of the level-difference portions 28a and 28b, the range of the formation of the bulging portion 27 is not limited to this. The bulging portion may be differently formed as long as the bulging 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 of air flowing into the bended portion of the vortex airflow can be reduced. For example, as in the bulging portion 1127 shown in FIG. 20(b), a bulging portion may be formed only at around the lowest part of the level-difference portion 1128a. Furthermore, for example, as in the bulging portion 1227 shown in FIG. 20(c), a bulging portion may be formed only at around the highest part of the level-difference portion 1228 (a). In any modifications, the air flowing into the bended portion of the vortex airflow is reduced.

[0104] 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.

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

[0105] In addition to the above, while in the embodiment above no bulging portion is provided in the vicinity of each of the level-difference portions provided at the leading end of the stabilizer 32, a bulging 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 bulging portion which is bulging 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.

Furthermore, a bulging portion may be provided in only one of the rear guider 20 and the stabilizer 32.

[0106] 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]

[0107] The present invention makes it possible to suppress wind noise by restraining the disturbance of a vortex airflow.

[Reference Signs List]

[0108]

1 INDOOR UNIT OF AIR CONDITIONER
10 CROSS FLOW FAN
20, 920 REAR GUIDER
25 INCLINATION ALLEVIATION PORTION
26 RIB PORTION
27, 927 BULGING PORTION
27a APEX
28a to 28c, 128a, 228a, 328a, 428a, 528a, 628a,

728a, 828a, 928a to 928c, 929c to 929e, 1028a, 1128a, 1228a 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 (10); and
   a stabilizer (32) and a rear guider (20) which are provided on respective sides of an outer periphery of the cross flow fan (10) to form an air passage,

   at least one of the stabilizer (32) and the rear guider (20) having, at a leading end portion, level-difference portions (28a-28c) which are lined up in an axial direction of the fan and include first level-difference portions (28a-28c) each of which decreases in height toward a central part (M) in the axial direction of the fan (10) ; a bulging portion (27) being formed in the vicinity of at least one of the first level-difference portions (28a, 28b) on a surface of the at least one of the stabilizer (32) and the rear guider (20) which surface is opposite to the cross flow fan (10),
   characterized in that:

   the bulging portion (27) bulges in shape as compared to its surrounding and bulges away from the fan.

2. The air conditioner according to claim 1, wherein, the bulging portion (27) is formed along the first level-difference portions (28a-28c).

3. The air conditioner according to claim 1 or 2, wherein, the bulging portion (27) is provided in the vicinity of a first level-difference portion (28a) which is farthest in the axial direction from the central part (M) of the fan, among the first level-difference portions.

4. The air conditioner according to any one of claims 1 to 3, wherein, at least one of the stabilizer (32) and the rear guider (20) further includes one or more bulging portion (27), and the two or more bulging portions (27) are arranged such that the bulging height of each bulging portion (27) increases with an increase in distance from the central part (M) of the fan in the axial direction.

5. The air conditioner according to any one of claims 1 to 4, wherein, each of the first level-difference portions (28a-28c) extends linearly or in a curved manner from a highest point to a lowest point.

6. The air conditioner according to any one of claims 1 to 4, wherein, the height of each of the first level-difference portions (28a, 28c) changes in stages.

7. The air conditioner according to any one of claims 1 to 6, wherein, two first level-difference portions (28a, 28b) among the first level-difference portions (28a-28c) are provided to neighbor each other, and
   the height of a part between the two neighboring level-difference portions (28a, 28b) gradually changes in the axial direction.

8. The air conditioner according to any one of claims 1 to 6, wherein, a level-difference portion (28d) which increases in height toward the central part (M) of the fan (10) in the axial direction is provided in the vicinity of one of the first level-difference portions (28c), and the height of a part between the two neighboring level-difference portions is constant in the axial direction.

9. The air conditioner according to any one of claims 1 to 8, wherein, the level-difference portions include second level-difference portions (28d, 28e) each of which increases in height toward the central part (M) of the fan (10) in the axial direction, and
   in the at least one of the stabilizer (32) and the rear guider (20), no bulging portion (27) is formed in the vicinity of each of the second level-difference portions (28d, 28e) on the surface of the at least one of the stabilizer (32) and the rear guider (20) which surface is opposite to the cross flow fan (10).

Patentansprüche

1. Klimaanlage, umfassend:

   ein Querstromgebläse (10); und
   einen Stabilisator (32) und ein hinteres Führungselement (20), die an jeweiligen Seiten eines Außenumfangs des Querstromgebläses (10) vorgesehen sind, um einen Luftdurchgang zu bilden,

   wobei mindestens einer von dem Stabilisator (32) und dem hinteren Führungselement (20) an einem vorderen Endabschnitt Höhenunterschiedsabschnitte (28a-28c) aufweist, die in einer axialen Richtung des Gebläses angeordnet sind und erste Höhenunterschiedsabschnitte (28a-28c) aufweisen, von denen jeder in Richtung eines Mittelteils (M) in axialer Richtung des Gebläses (10) an Höhe abnimmt; wobei in der Nähe von mindestens einem der ersten Höhenunterschiedsabschnitte (28a, 28b) auf einer Oberfläche des mindestens einen Stabilisators

(32) oder hinteren Führungselements (20), die dem Querstromgebläse (10) gegenüberliegt, ein Ausbauchungsabschnitt (27) ausgebildet ist,
dadurch gekennzeichnet, dass:

der Ausbauchungsabschnitt (27) im Vergleich zu seiner Umgebung eine gewölbte Form aufweist und von dem Gebläse weg ausbaucht.

2. Klimaanlage nach Anspruch 1, wobei der Ausbauchungsabschnitt (27) entlang der ersten Höhenunterschiedsabschnitte (28a-28c) ausgebildet ist.

3. Klimaanlage nach Anspruch 1 oder 2, wobei der Ausbauchungsabschnitt (27) in der Nähe eines ersten Höhenunterschiedsabschnitts (28a) vorgesehen ist, der am weitesten in axialer Richtung von dem Mittelteil (M) des Gebläses entfernt ist, unter den ersten Höhenunterschiedsabschnitten.

4. Klimaanlage nach einem der Ansprüche 1 bis 3, wobei mindestens einer von dem Stabilisator (32) und dem hinteren Führungselement (20) ferner einen oder mehrere Ausbauchungsabschnitt (27) aufweist, und die zwei oder mehr Ausbauchungsabschnitte (27) so angeordnet sind, dass die Ausbauchungshöhe jedes der Ausbauchungsabschnitte (27) mit zunehmender Entfernung von dem Mittenteil (M) des Gebläses in axialer Richtung zunimmt.

5. Klimaanlage nach einem der Ansprüche 1 bis 4, wobei jeder der ersten Höhenunterschiedsabschnitte (28a-28c) sich geradlinig oder gekrümmt von einem höchsten Punkt zu einem niedrigsten Punkt erstreckt.

6. Klimaanlage nach einem der Ansprüche 1 bis 4, wobei sich die Höhe jedes der ersten Höhenunterschiedsabschnitte (28a, 28c) stufenweise ändert.

7. Klimaanlage nach einem der Ansprüche 1 bis 6, wobei zwei erste Höhenunterschiedsabschnitte (28a, 28b) unter den ersten Höhenunterschiedsabschnitten (28a-28c) zueinander benachbart vorgesehen sind, und
sich die Höhe eines Teils zwischen den beiden benachbarten Höhenunterschiedsabschnitten (28a, 28b) allmählich in axialer Richtung ändert.

8. Klimaanlage nach einem der Ansprüche 1 bis 6, wobei in der Nähe von einem der ersten Höhenunterschiedsabschnitte (28c) ein Höhenunterschiedsabschnitt (28d), dessen Höhe in Richtung des Mittenteils (M) des Gebläses (10) in axialer Richtung zunimmt, vorgesehen ist, und
die Höhe eines Teils zwischen den beiden benachbarten Höhenunterschiedsabschnitten in axialer Richtung konstant ist.

9. Klimaanlage nach einem der Ansprüche 1 bis 8, wobei die Höhenunterschiedsabschnitte zweite Höhenunterschiedsabschnitte (28d, 28e) aufweisen, von denen jeder in Richtung zum Mittelteil (M) des Gebläses (10) in axialer Richtung an Höhe zunimmt, und
in dem zumindest einen von dem Stabilisator (32) und dem hinteren Führungselement (20) in der Nähe jedes der zweiten Höhenunterschiedsabschnitte (28d, 28e) auf der Oberfläche des mindestens einen von dem Stabilisator (32) und dem hinteren Führungselement (20), die dem Querstromgebläse (10) gegenüberliegt, kein Ausbauchungsabschnitt (27) ausgebildet ist.

Revendications

1. Climatiseur comprenant:

un ventilateur à écoulement d'air transversal (10) ; et
un stabilisateur (32) et un guide arrière (20) qui sont prévus sur des côtés respectifs d'une périphérie extérieure du ventilateur à écoulement d'air transversal (10) pour former un passage d'air,

au moins un du stabilisateur (32) et du guide arrière (20) ayant, au niveau d'une partie d'extrémité d'attaque, des portions à différence de niveau (28a-28c) qui sont alignées dans une direction axiale du ventilateur et qui incluent des premières portions à différence de niveau (28a-28c) dont chacune diminue en hauteur vers une partie centrale (M) dans la direction axiale du ventilateur (10) ; une portion à renflement (27) étant formée au voisinage d'au moins une des premières portions à différence de niveau (28a, 28b) sur une surface du au moins un du stabilisateur (32) et du guide arrière (20), laquelle surface est opposée au ventilateur à écoulement d'air transversal (10),
caractérisé en ce que :

la portion à renflement (27) a une forme renflée en comparaison à son environnement, et renflée à l'écart du ventilateur.

2. Climatiseur selon la revendication 1, dans lequel la portion à renflement (27) est formée le long des premières portions à différence de niveau (28a-28c).

3. Climatiseur selon la revendication 1 ou 2, dans lequel la portion à renflement (27) est disposée au voisinage d'une première portion à différence de niveau (28a) qui est la plus éloignée dans la direction axiale de la partie centrale (M) du ventilateur, parmi les premières portions à différence de niveau.

4. Climatiseur selon l'une quelconque des revendications 1 à 3, dans lequel, au moins un du stabilisateur (32) et du guide arrière (20) inclut en outre une ou plusieurs portions à renflement (27), et les deux portions à renflement (27) ou plus sont agencées de sorte que la hauteur de renflement de chaque portion à renflement (27) augmente avec une augmentation de la distance par rapport à la partie centrale (M) du ventilateur dans la direction axiale.

5. Climatiseur selon l'une quelconque des revendications 1 à 4, dans lequel chacune des premières portions à différence de niveau (28a-28c) s'étend de façon linéaire ou de façon incurvée d'un point le plus haut à un point le plus bas.

6. Climatiseur selon l'une quelconque des revendications 1 à 4, dans lequel la hauteur de chacune des premières portions à différence de niveau (28a, 28c) change par étapes.

7. Climatiseur selon l'une quelconque des revendications 1 à 6, dans lequel deux premières portions à différence de niveau (28a, 28b) parmi les premières portions à différence de niveau (28a-28c) sont prévues pour être voisines l'une de l'autre, et
la hauteur d'une partie entre les deux portions à différence de niveau voisines (28a, 28b) change progressivement dans la direction axiale.

8. Climatiseur selon l'une quelconque des revendications 1 à 6, dans lequel une portion à différence de niveau (28d) qui augmente en hauteur vers la partie centrale (M) du ventilateur (10) dans la direction axiale est disposée au voisinage d'une des premières portions à différence de niveau (28c), et
la hauteur d'une partie entre les deux portions à différence de niveau voisines est constante dans la direction axiale.

9. Climatiseur selon l'une quelconque des revendications 1 à 8, dans lequel les portions à différence de niveau incluent des secondes portions à différence de niveau (28d, 28e) dont chacune augmente en hauteur vers la partie centrale (M) du ventilateur (10) dans la direction axiale, et
dans le au moins un du stabilisateur (32) et du guide arrière (20), aucune portion à renflement (27) n'est formée au voisinage de chacune des secondes portions à différence de niveau (28d, 28e) sur la surface du au moins un du stabilisateur (32) et du guide arrière (20), laquelle surface est opposée au ventilateur à écoulement d'air transversal (10).

FIG.1

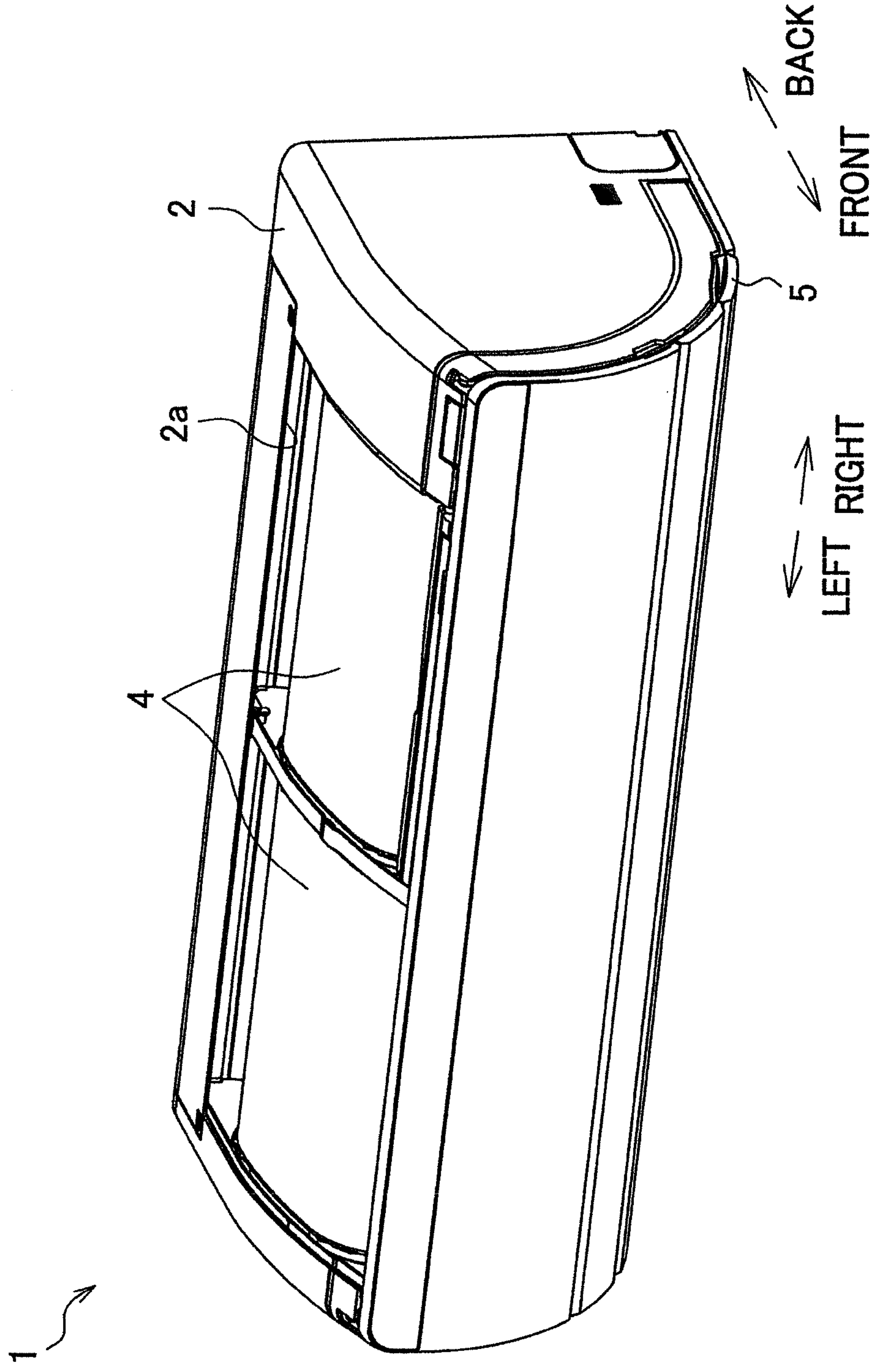
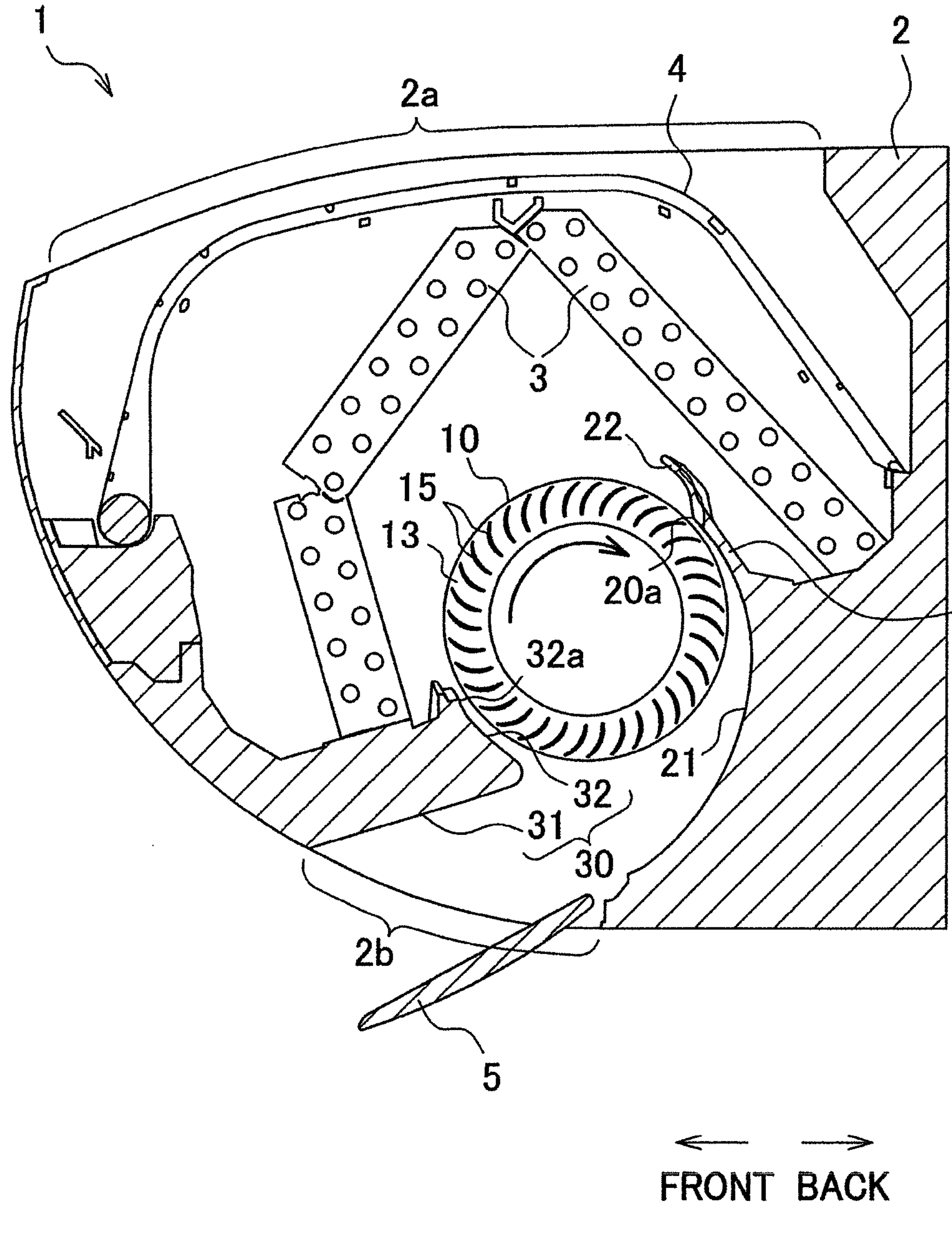


FIG.2



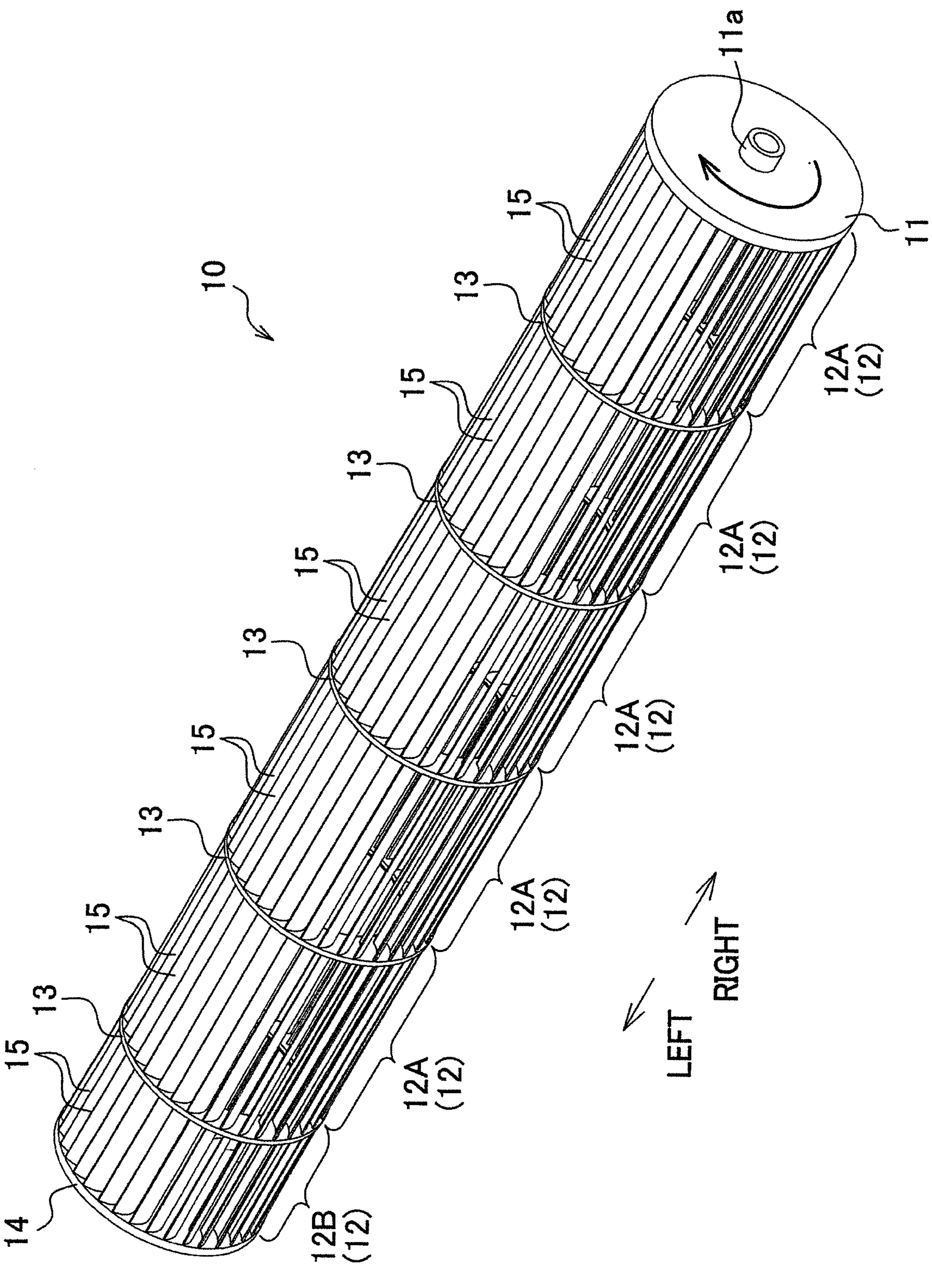


FIG.3

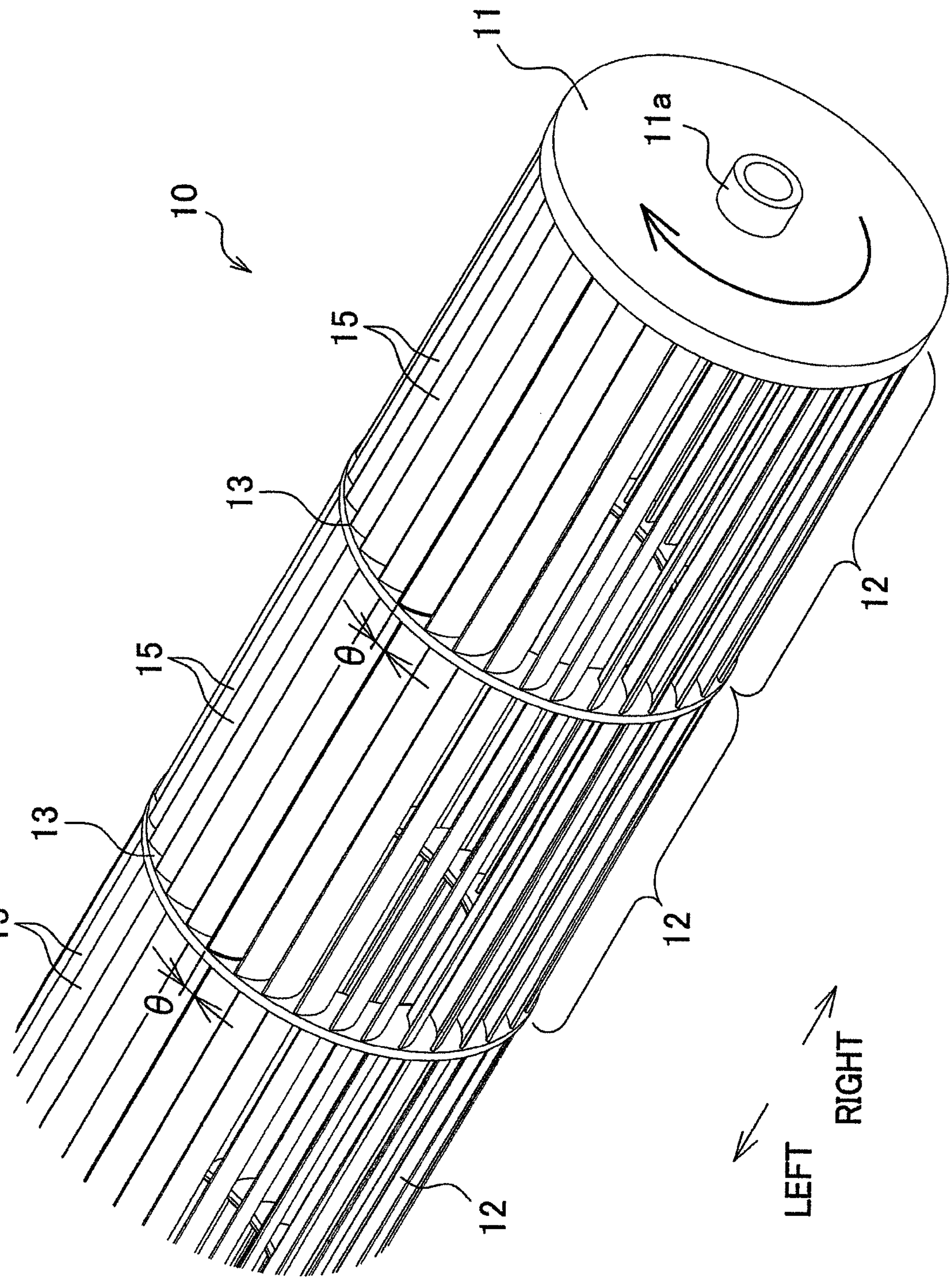
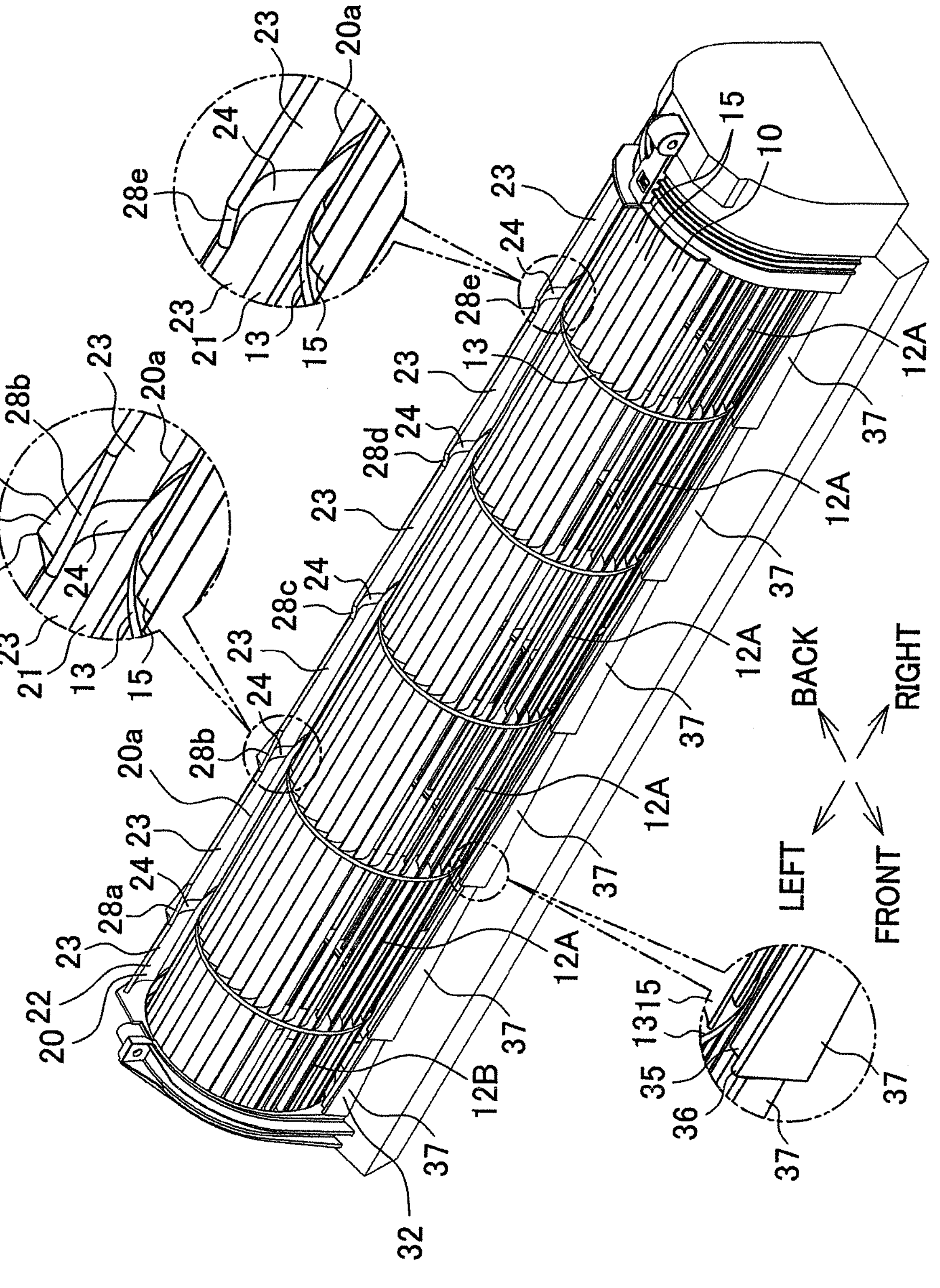


FIG.4

FIG.5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12A
12B
13
15
20
20a
21
22
23
24
25
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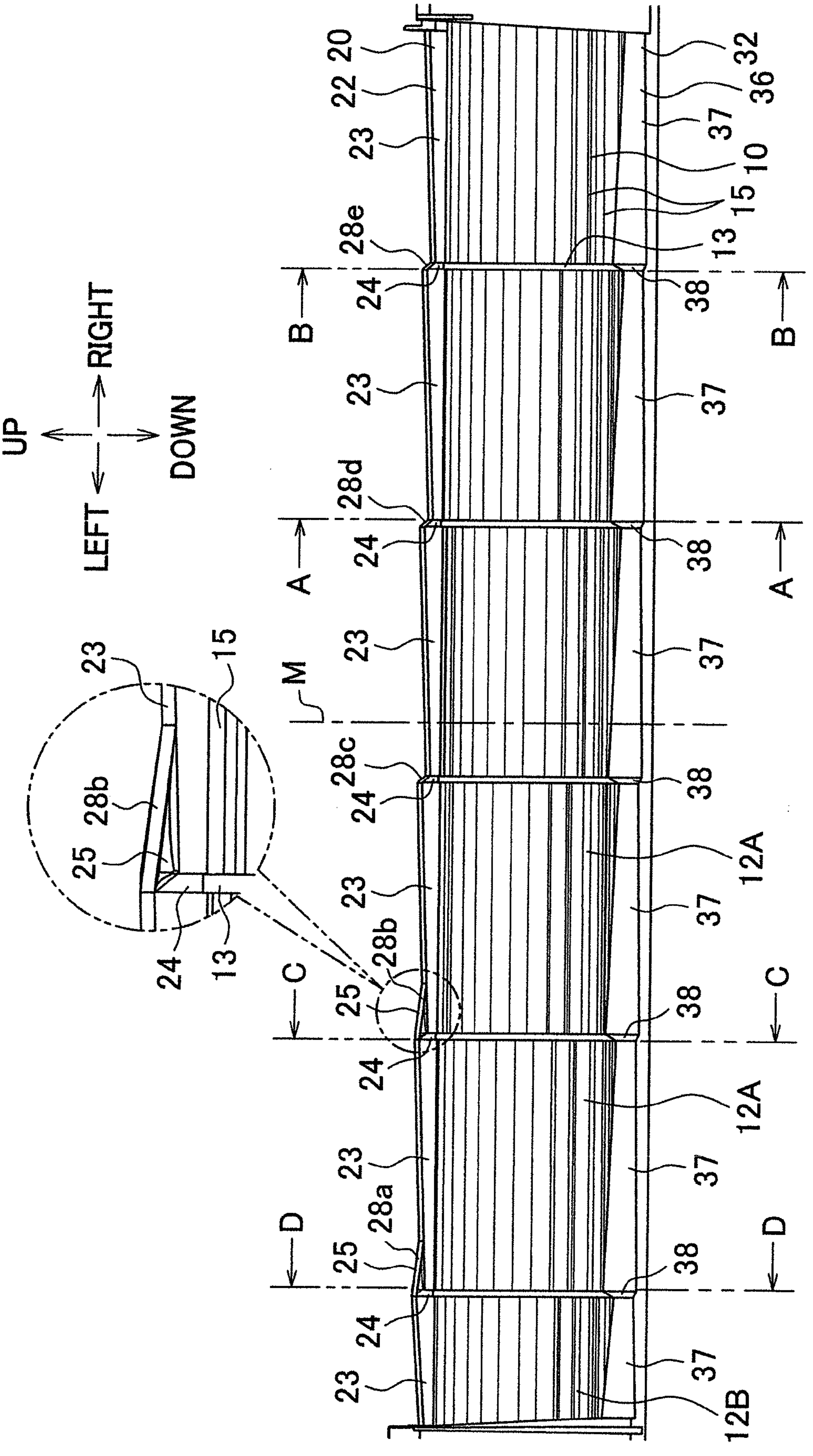
27a
28a
28b
28c
28d
28e
32
35
36
37
BACK
RIGHT
LEFT
FRONT


UP
DOWN
LEFT
RIGHT
A
B
C
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M
10
12A
12B
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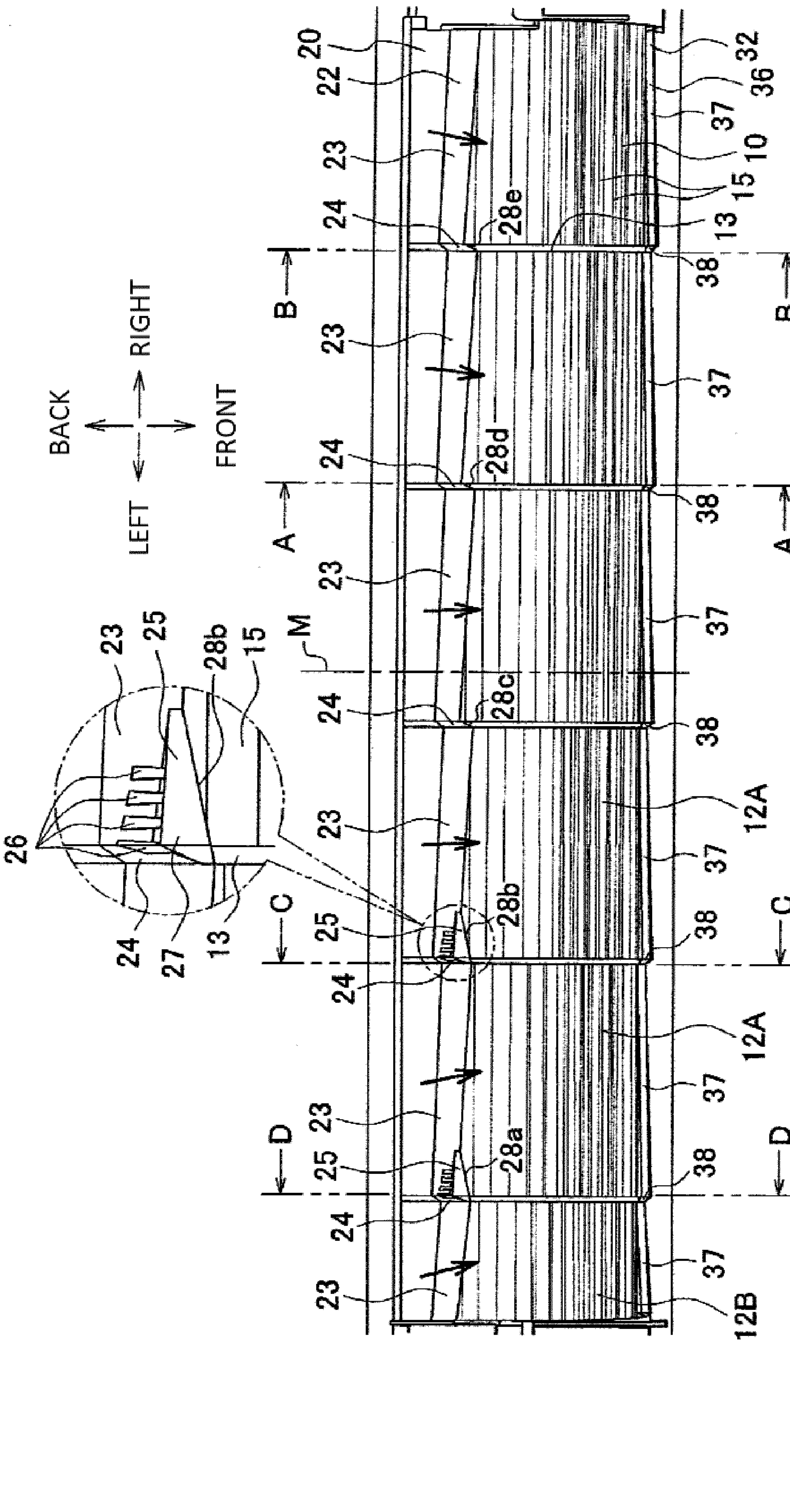
28e
32
36
37
38

FIG.6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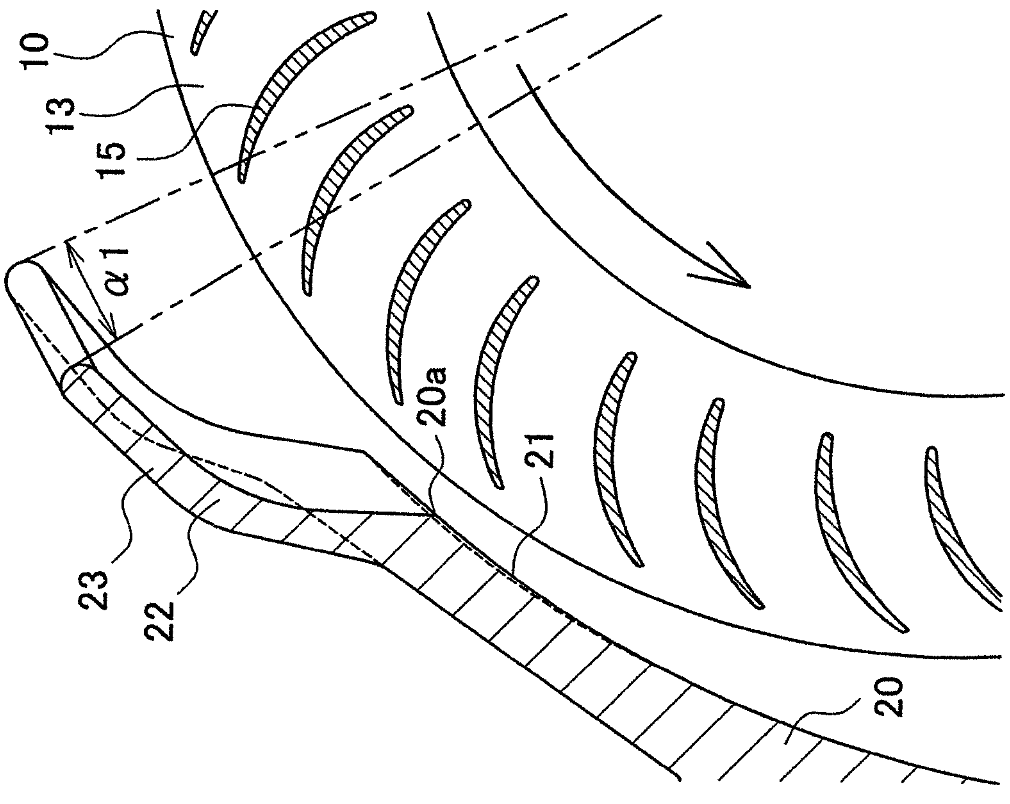


FIG.8(a)

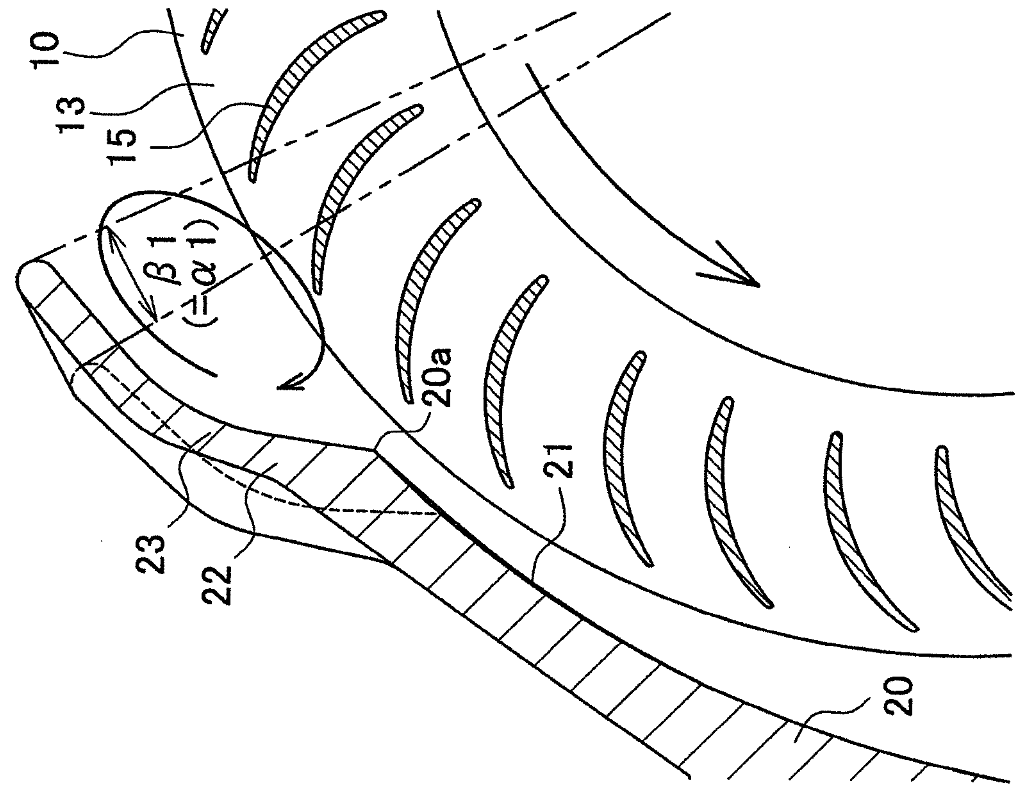
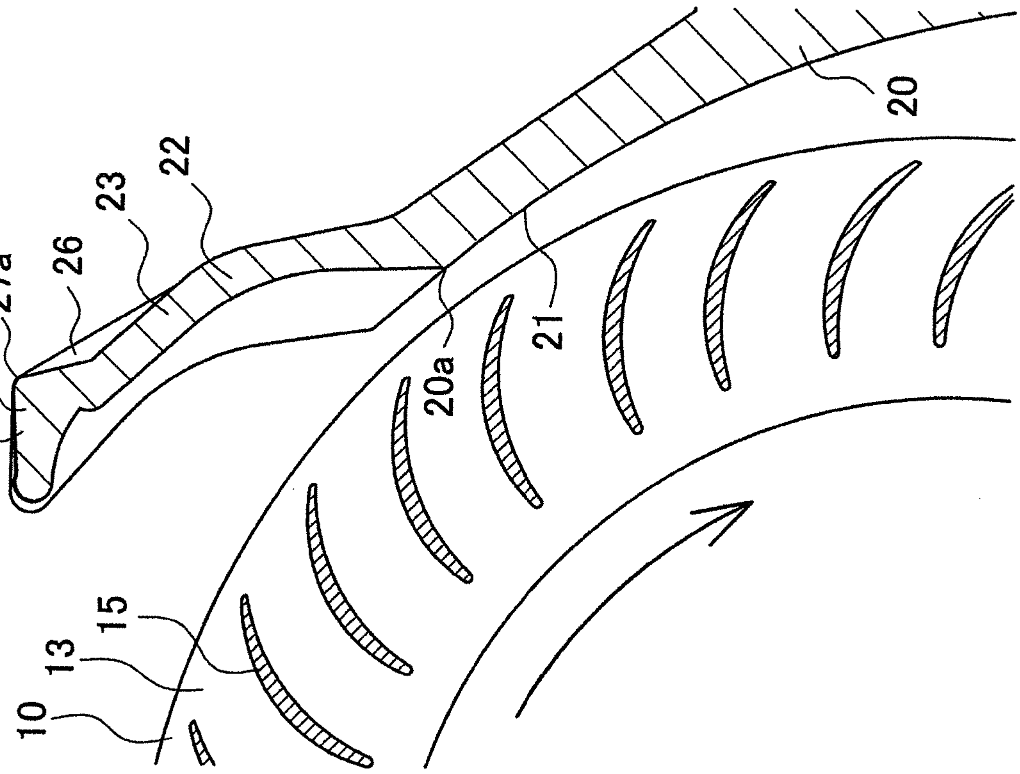


FIG.8(b)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27
27a
D
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20a
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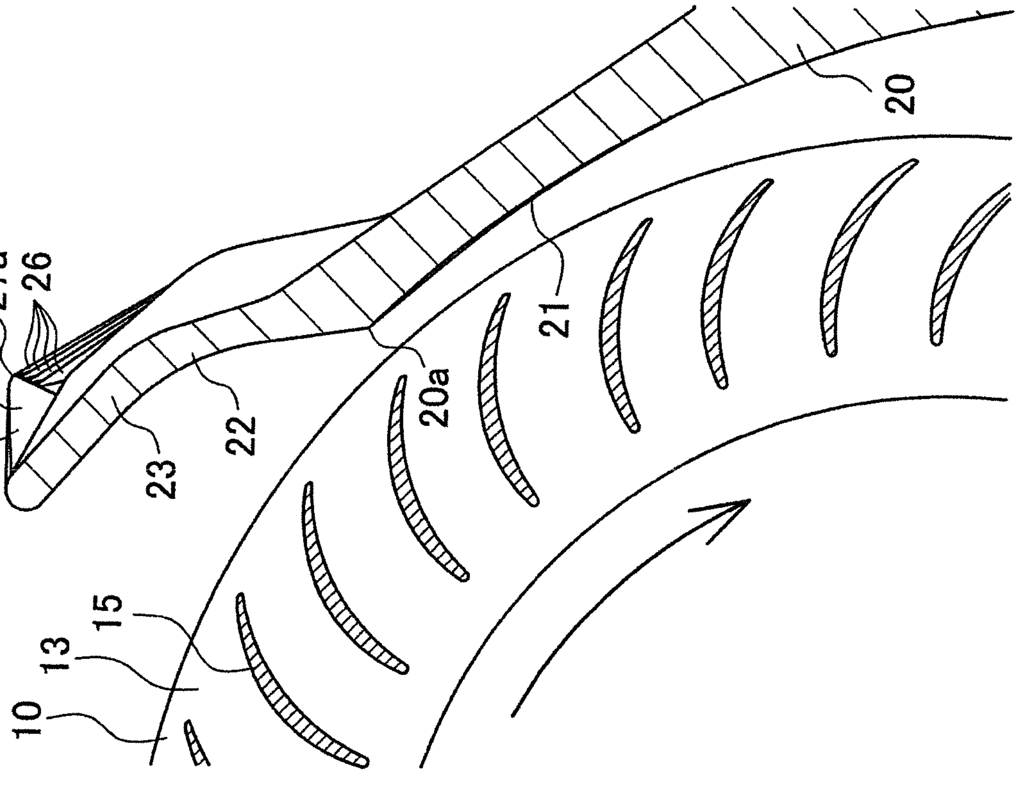
13
10

FIG.9(b)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D
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20a
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15
13
10

FIG.9(a)

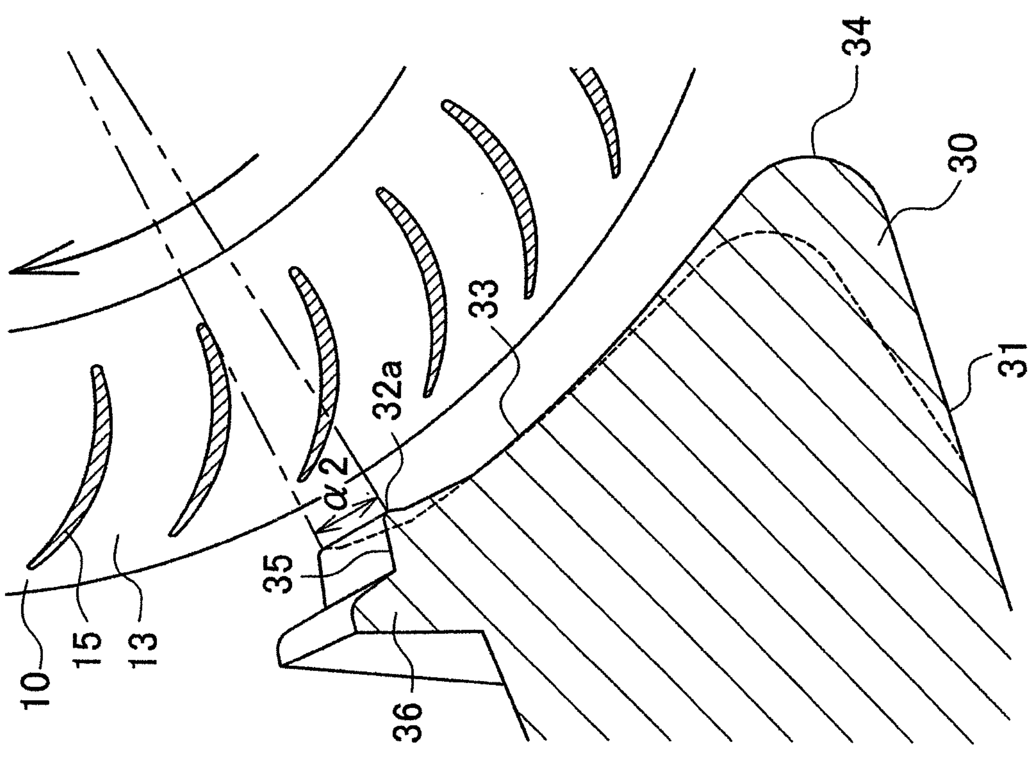


FIG.10(a)

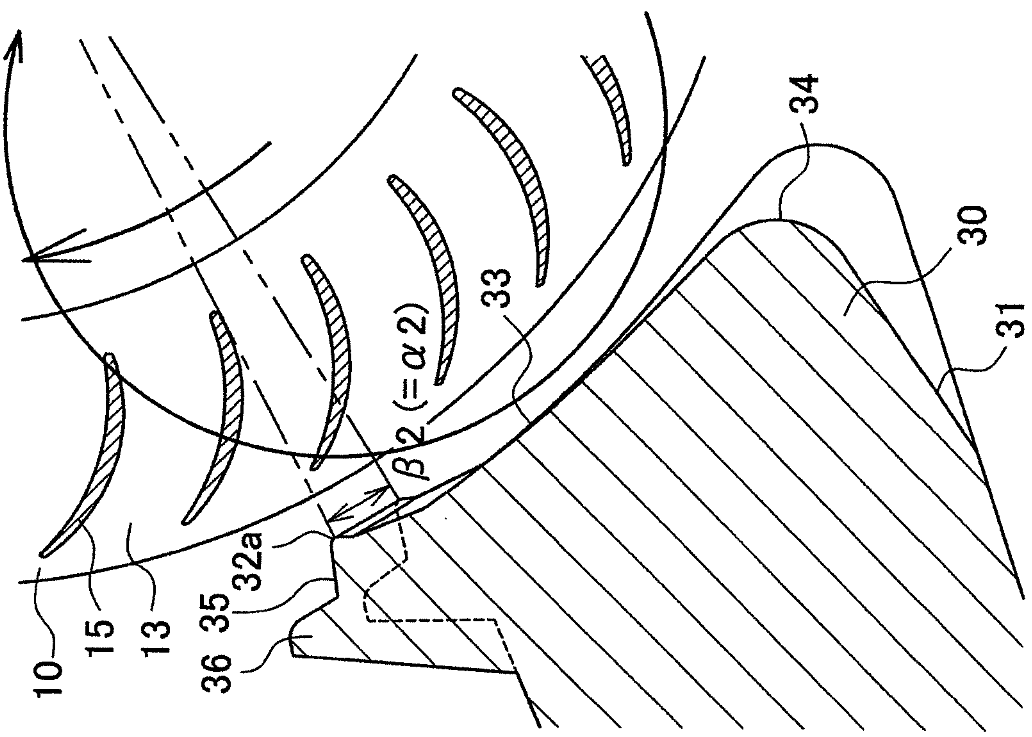
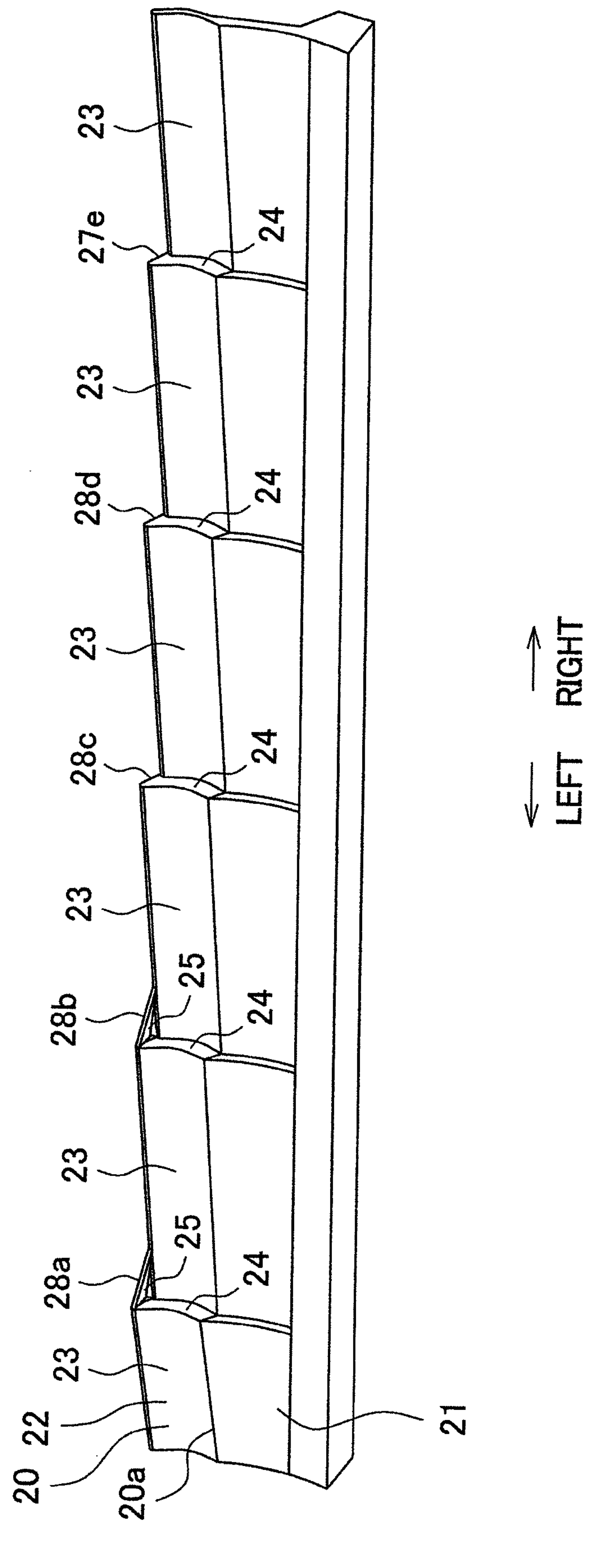


FIG.10(b)

FIG.11


23
27e
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23
28d
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28c
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28b
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23
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28a
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22
20
20a
21
LEFT
RIGHT

FIG.12

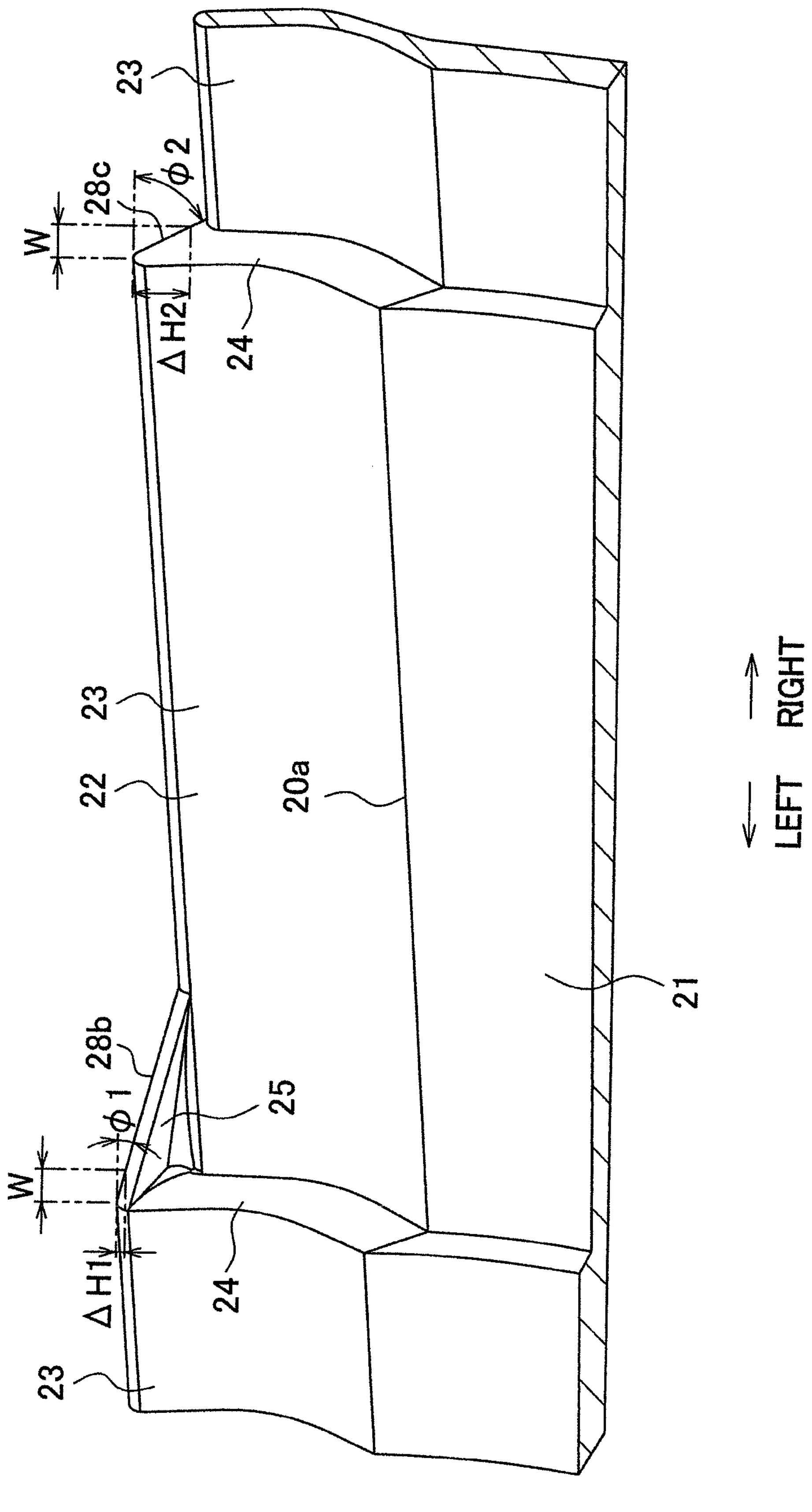


FIG.13

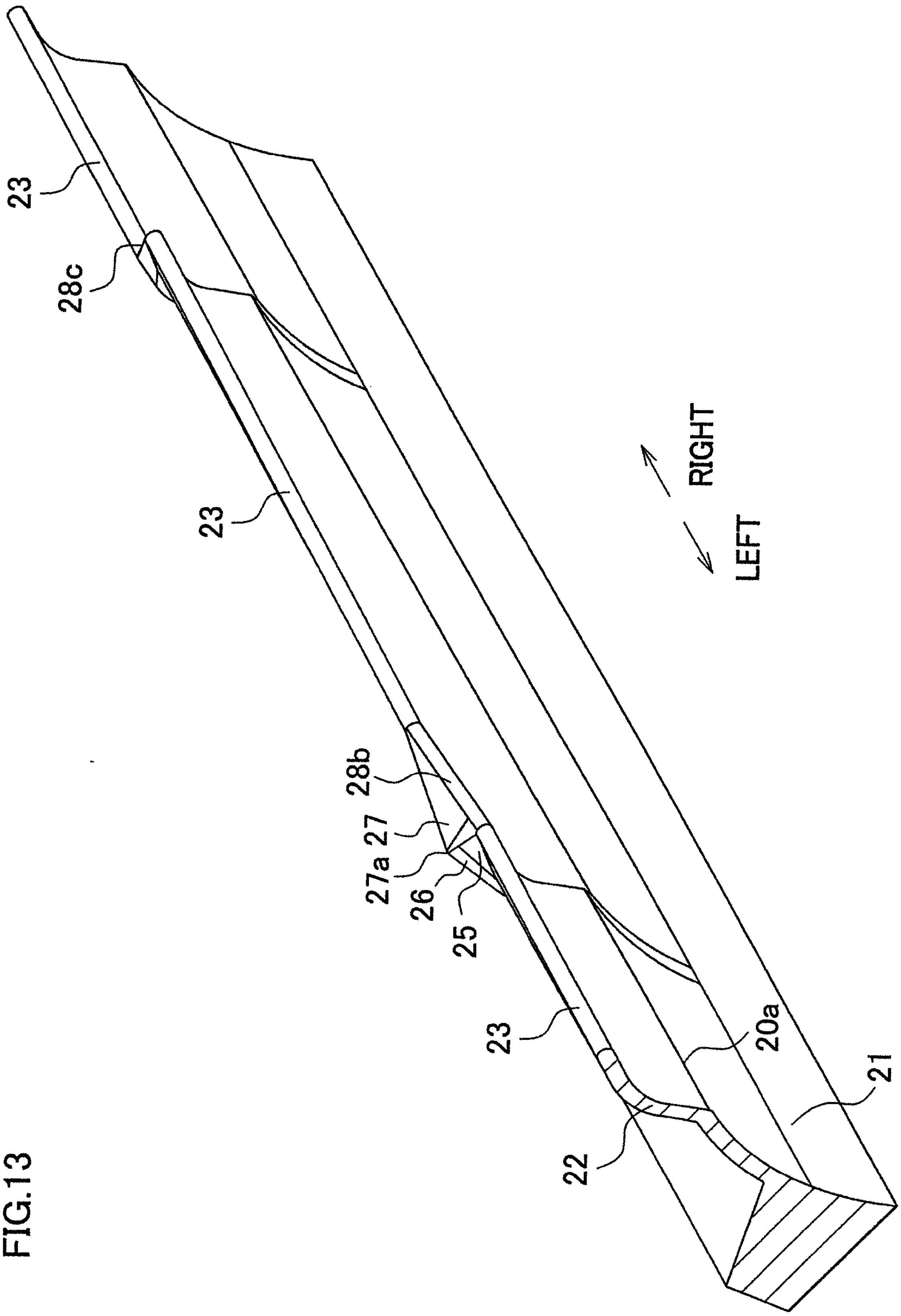


FIG.14

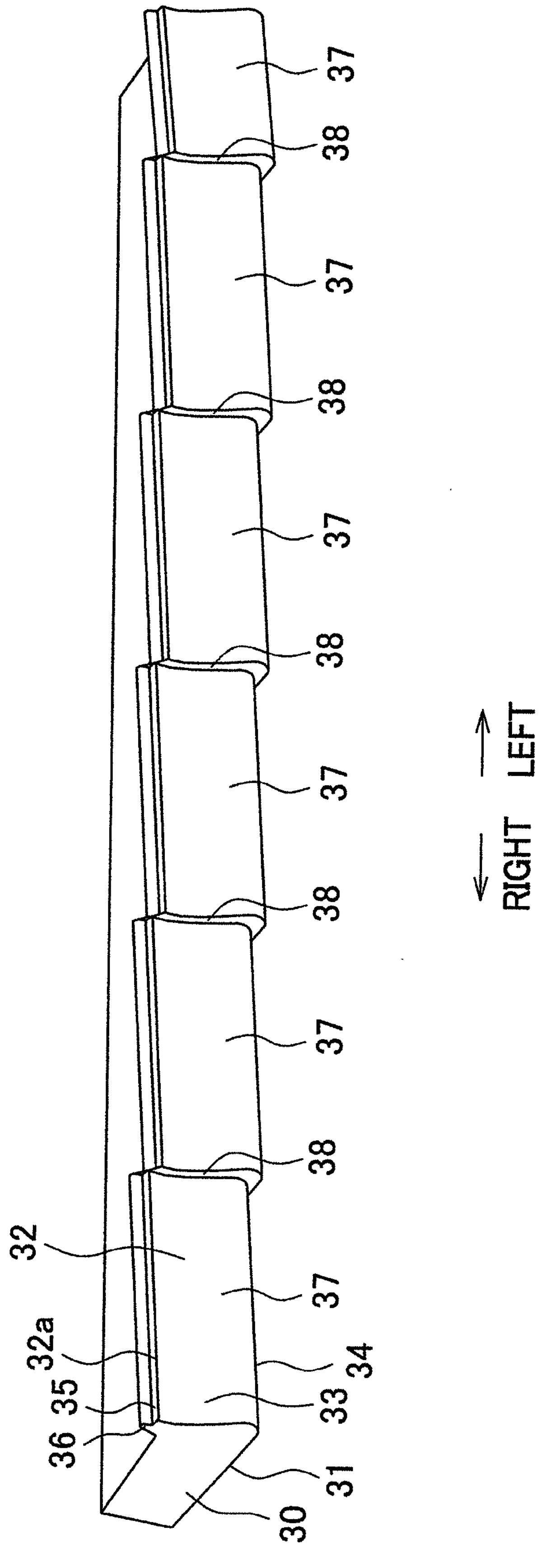


FIG.15

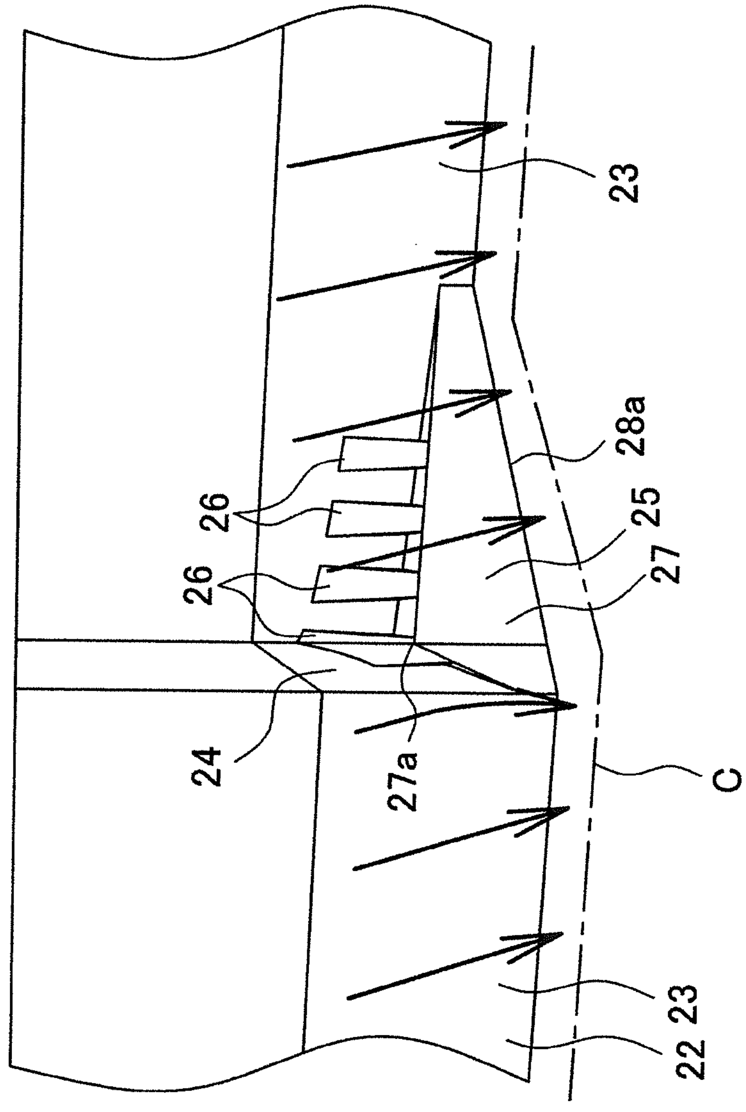


FIG.16(a)

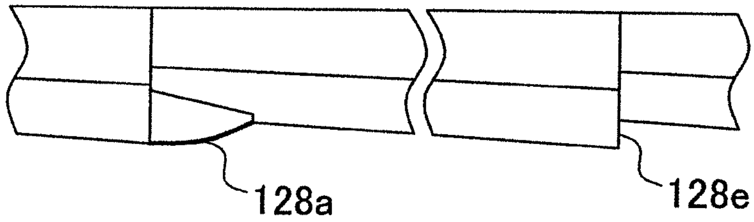


FIG.16(b)

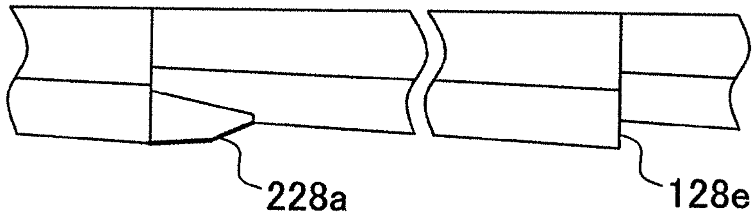


FIG.16(c)

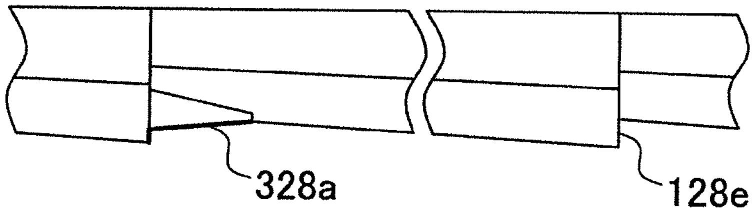


FIG.16(d)

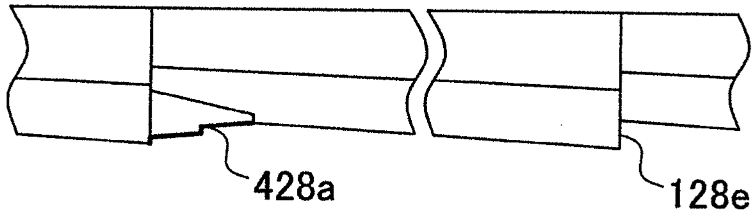


FIG.16(e)

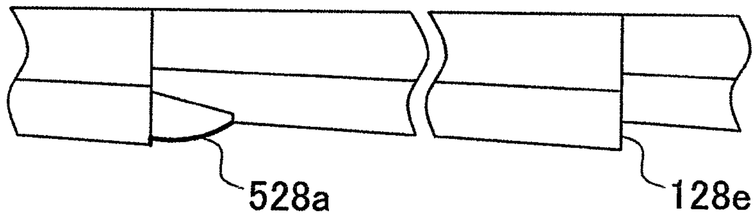


FIG.16(f)

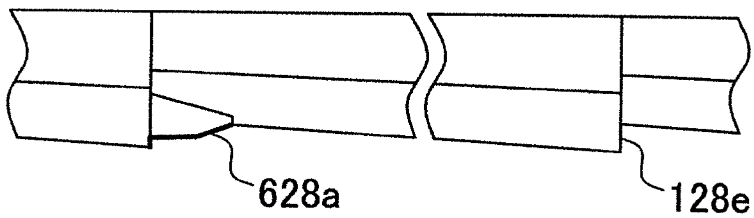


FIG.17(a)

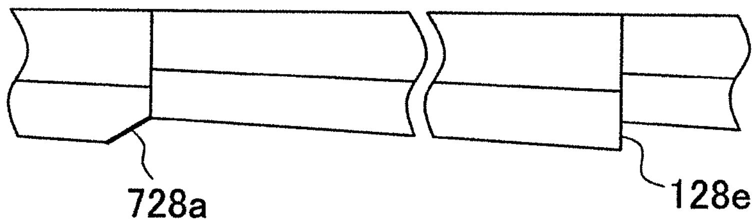
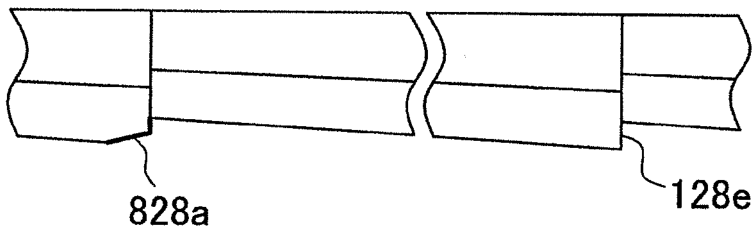


FIG.17(b)



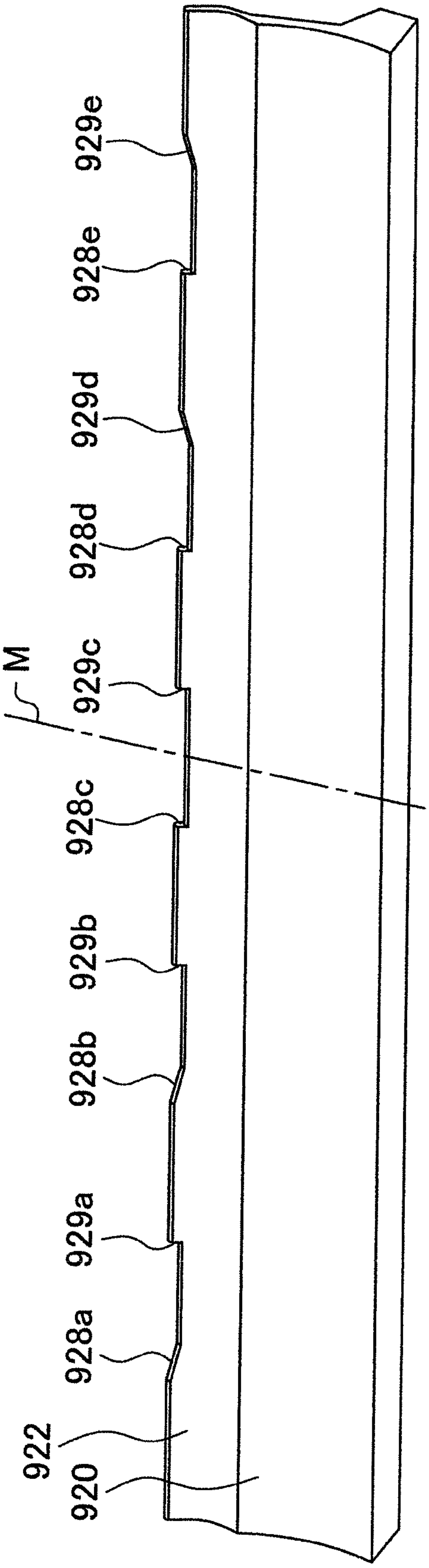


FIG.18

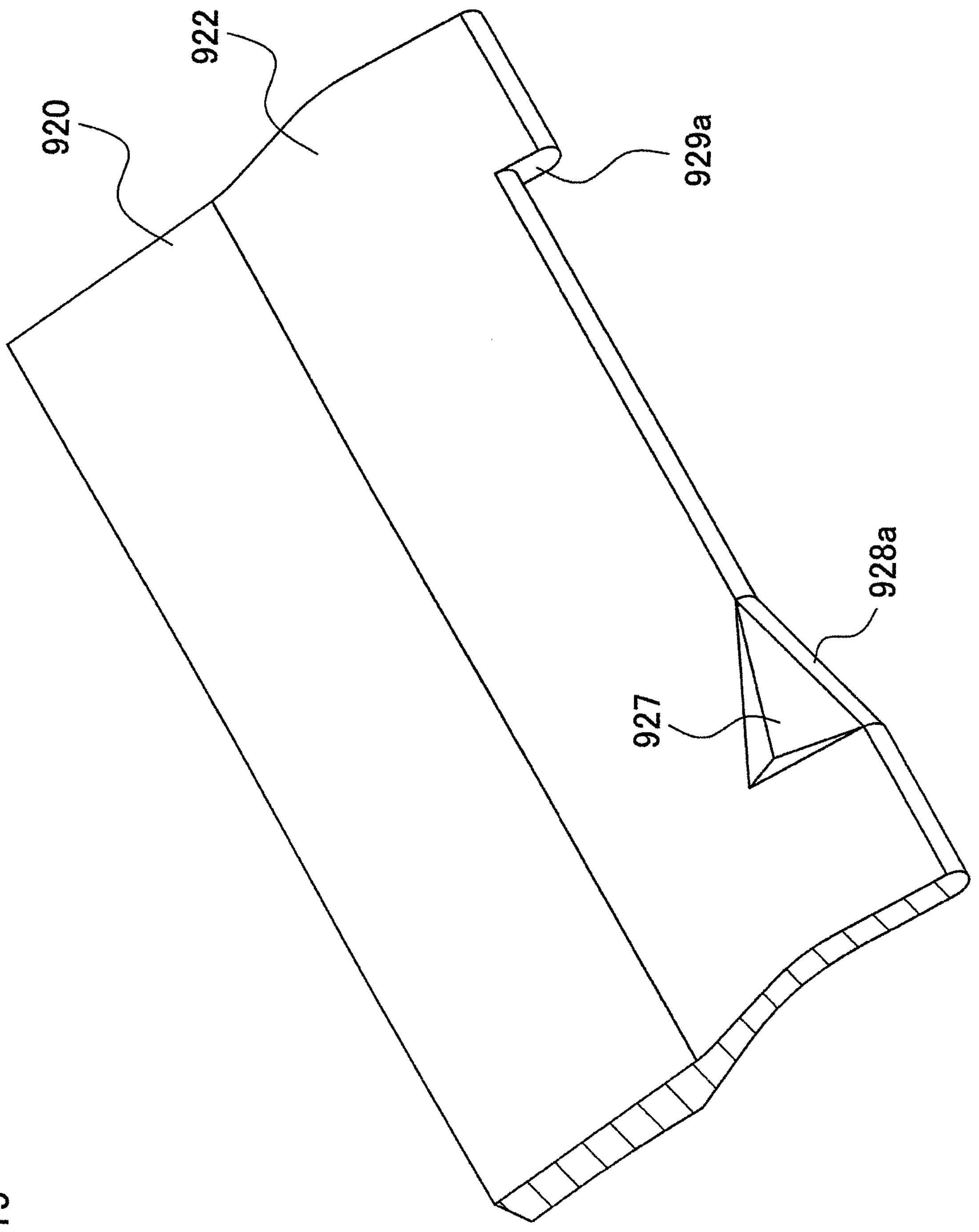


FIG.19

FIG.20(a)

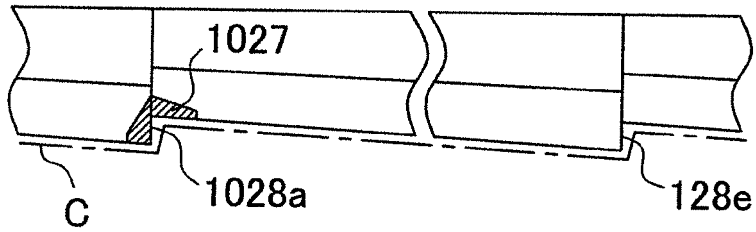


FIG.20(b)

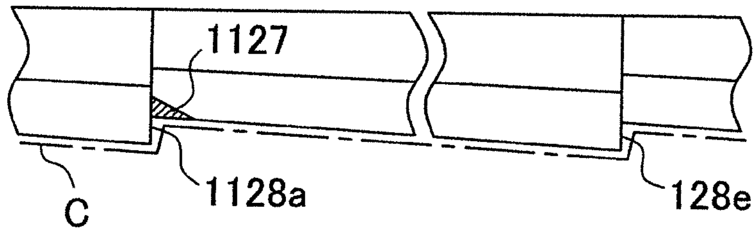


FIG.20(c)

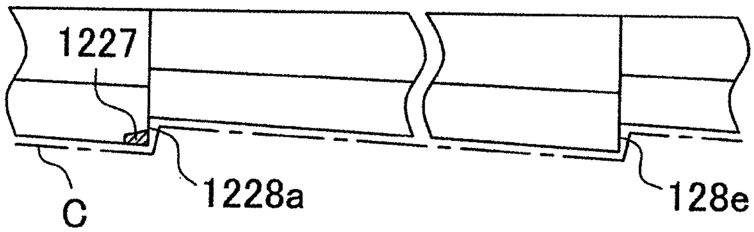
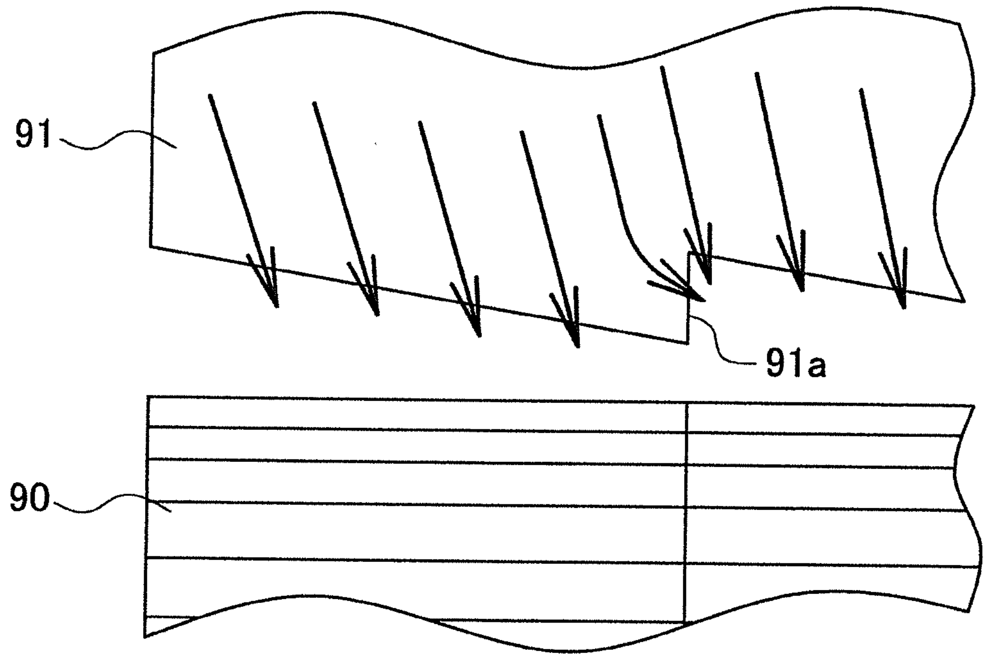


FIG.21



REFERENCES CITED IN THE DESCRIPTION

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- JP H11304178 A **[0005]**
- JP H01167494 A **[0006]**