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(71) Applicant: **Mitsubishi Electric Corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

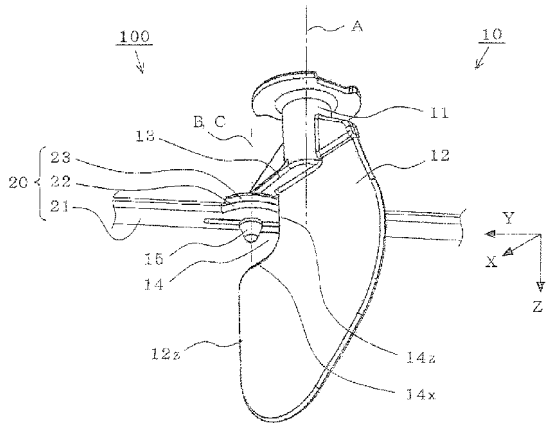
(72) Inventors:
- **Suzuki, Akimoto**
  TOKYO, 102-0073 (JP)
- **Yokota, Shuhei**
  TOKYO, 102-0073 (JP)
- **Ishikawa, Masato**
  TOKYO, 102-0073 (JP)
- **Kinami, Masahide**
  TOKYO, 102-0073 (JP)
- **Ikeda, Hisanori**
  TOKYO, 102-0073 (JP)
- **Koyanagi, Youhei**
  TOKYO, 102-0073 (JP)

(74) Representative: **Ilgart, Jean-Christophe**
BREVALEX
95 rue d'Amsterdam
75378 Paris Cedex 8 (FR)

(54) Right-left air flow direction control device and air-conditioning apparatus indoor unit provided with the same

(57) A right-left air flow direction control device (100) includes right-left deflectors (10) and connecting rods (20). Each right-left deflector (10) includes a base portion (13) defining a plane perpendicular to the center A of rotation of a rotation shaft (11), a planar portion (12), and a connection protrusion (15) extending from the base portion (13). Each connecting rod (20) includes a rod body (21), connection holes (25), rod body extended portions (22) arranged in one side edge (21 d) of the rod body (21) so as to correspond to the connection holes (25), respectively, and contact raised parts (23) arranged along the edges of the rod body extended portions, respectively, the contact raised parts being higher than the rod body (21). Upon frontward air blowing, parts near the connection holes (25) of the connecting rod (20) are held by the respective connection protrusions (15) while being prevented from separating from the connection protrusions (15) and the tops of the contact raised parts (23) and parts near the other side edge are in contact with the respective base portions (13), so that the connecting rod (20) undergoes bending deformation.

FIG. 2



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Description

[Technical Field]

[0001] The present invention relates to right-left air flow direction control devices and air-conditioning apparatus indoor units provided therewith, and in particular, relates to a right-left air flow direction control device provided for an indoor unit of an air-conditioning apparatus and an air-conditioning apparatus indoor unit provided with the right-left air flow direction control device.

[Background Art]

[0002] According to an example of related art, a right-left air flow direction control device, provided for an indoor unit of an air-conditioning apparatus, includes a plurality of right-left deflectors rotatably arranged on a member (hereinafter, referred to as an "air outlet member") which provides an air outlet, a connecting rod (corresponding to a connecting member) which allows the right-left deflectors to rotate, and driving means that translates the connecting rod. The right-left deflectors each include a planar portion, a rotation shaft which extends from the planar portion and serves as the center of rotation, and a connection shaft which extends from the planar portion such that the connection shaft is positioned at a predetermined distance from the rotation shaft. The connecting rod has connection holes in which the connection shafts are rotatably placed. While the connection shafts are placed in the respective connection holes, therefore, the connecting rod functions as a link mechanism. Shift of the connecting rod in the longitudinal direction thereof allows the right-left deflectors to rotate.
The connecting rod includes pairs of stoppers (corresponding to extending portions) arranged at regular intervals. Each planar portion is partly positioned between the corresponding pair of stoppers. Accordingly, each right-left deflector rotates (and the connecting rod is translated) in such a range that the planar portion does not contact the stoppers and the right-left deflector is rotatable (and the connecting rod is movable) until the planar portion contacts any one of the stoppers, thus determining a maximum rotation range (maximum translating range) (refer to Patent Literature 1, for example).

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] Japanese Unexamined Patent Application Publication No. 8-313043 (pp. 2-3, Fig. 2)

[Summary of Invention]

[Technical Problem]

[0004] In the related art disclosed in Patent Literature 1, while the planar portions are oriented in a direction (to the right or left) which is different from the direction toward the front side of the air outlet, a positive pressure acts on one surface of each planar portion and a negative pressure acts on the other surface thereof, so that the planar portion is pressed in a predetermined direction. While the planar portions are oriented to the front side (in the direction different from the direction to the right or left) (hereinafter, such a state will be referred to as "frontward air blowing"), substantially the same air flows are formed on both the surfaces of each planar portion. Disadvantageously, fluctuations (turbulence) of the air flows may cause vibrations of the planar portion, thus causing chatter. In other words, pressures acting on the surfaces of the planar portion are not equalized by the influence of fluctuations of the volume or velocity of blown air.

[0005] The present invention has been made in order to overcome the above-described disadvantage and provides a right-left air flow direction control device capable of suppressing vibrations of right-left deflectors caused upon frontward air blowing and an air-conditioning apparatus indoor unit provided with the right-left air flow direction control device.

[Solution to Problem]

[0006] An aspect of the present invention provides a right-left air flow direction control device placed in an air path of an air-conditioning apparatus indoor unit, the device including a plurality of right-left deflectors rotatably arranged on an air path member providing the air path, a connecting rod connected to the right-left deflectors to provide a link mechanism, the connecting rod being capable of being translated, and driving means, placed in the indoor unit, translating the connecting rod.
Each right-left deflector includes a rotation shaft, a base portion which is integrated with the rotation shaft and defines a plane perpendicular to the center of rotation of the rotation shaft, a planar portion which is integrated with the base portion and includes the rotation center of the rotation shaft, and a connection protrusion which extends from the base portion and is parallel to the rotation shaft.
The connecting rod includes a rod body provided with engaging means for connection to the driving means at one end of the rod body in the longitudinal direction of the connecting rod, connection holes arranged in the rod body such that the connection protrusions of the right-left deflectors extend through the connection holes while being prevented from detaching from the holes, rod body extended portions which are arranged in one side edge of the connecting rod so as to correspond to the connection holes in the longitudinal direction, respectively, and

extend outwardly from the side edge, and contact raised parts arranged along the edges of the rod body extended portions, respectively, the contact raised parts being higher than the rod body.

In a frontward air blowing state in which the angle which the extending direction of the planar portion of each right-left deflector forms with the longitudinal direction of the connecting rod is approximately a right angle, the top of each contact raised part of the connecting rod is in contact with a point closer to the rotation center than the connection protrusion extending from the base portion and the other side edge of the connecting rod is in contact with a point in the base portion distant from the rotation center such that friction acts between the right-left deflector and the connecting rod at the contact points.

[Advantageous Effects of Invention]

[0007] In the right-left air flow direction control device according to this aspect of the present invention, only while the angle which the extending direction of the planar portion of each right-left deflector forms with the longitudinal direction of the connecting rod is approximately the right angle, that is, only upon "frontward air bowing", the contact raised part of the connecting rod is in contact with the base portion of the right-left deflector and the other side edge (at which the contact raised part is not placed) of the connecting rod is in contact with the base portion of the right-left deflector. Since the connecting rod is held between the contact points while being prevented from detaching from the base portion by the connection protrusion, the connecting rod undergoes "three-point bending" in a plane perpendicular to the longitudinal direction. Consequently, reaction force produced by such bending deformation acts on the contact points, thus causing friction, which allows the right-left deflector to be substantially integrally connected to (or held by) the connecting rod. Accordingly, if force acts on the right-left deflector such that the deflector vibrates, the occurrence of vibrations of the right-left deflector can be suppressed. An air-conditioning apparatus indoor unit provided with the right-left air flow direction control device according to this aspect of the present invention can therefore achieve a quiet operation.

[0008] Furthermore, each contact raised part is in contact with the corresponding base portion only while air is blown in a direction close to the frontward air blowing direction. Upon rightward air blowing or leftward air blowing, that is, while the right-left deflector receives force from blown air such that the right-left deflector further rotates, the contact raised part is not in contact with the base portion such that friction is eliminated. Thus, the right-left deflector can be easily rotated. Advantageously, the capacity of a driving motor, included in the driving means translating the connecting rod, can be reduced.

In this specification, a term "predetermined value approximate to a right angle" means not a specific value but a range in which a direction (hereinafter, "air blowing direction") in which conditioned air is blown is substantially a "frontward direction".

As regards the relationship between the right-left deflectors and the connecting rod constituting the link mechanism, for example, let "L" denote the distance between the rotation center of each right-left deflector and a position at which the right-left deflector is connected to the connecting rod. The term "translation" means that when the connecting rod is moved in the longitudinal direction (for example, "Y direction") by "Δy", the connecting rod is moved in a direction (for example, "X direction") perpendicular to the longitudinal direction of the connecting rod by "$\Delta x = \sqrt{(L^2 - \Delta y^2)}$".

[Brief Description of Drawings]

[0009]

Fig. 1 is a perspective view of a right-left air flow direction control device according to Embodiment 1 of the present invention.

Fig. 2 is a partly enlarged perspective view of the right-left air flow direction control device of Fig. 1.

Fig. 3 includes a side elevational view of a component (right-left deflector) of the right-left air flow direction control device of Fig. 1 and a plan view thereof.

Fig. 4 is a perspective view of another component (connecting rod) of the right-left air flow direction control device of Fig. 1.

Fig. 5 includes a partly enlarged perspective view of the component (connecting rod) of the right-left air flow direction control device of Fig. 1, a front view thereof, a plan view thereof, and a sectional view thereof when viewed from the side.

Fig. 6 includes front views of the right-left air flow direction control device of Fig. 1, Fig. 6 explaining actions of the device.

Fig. 7 includes plan views of the right-left air flow direction control device of Fig. 1, Fig. 7 explaining the actions of the device.

Fig. 8 includes partly sectional side elevational views of the right-left air flow direction control device of Fig. 1, Fig. 8 explaining the actions of the device.

Fig. 9 includes partly sectional perspective views of components (connecting rods) according to modifications of the right-left air flow direction control device of Fig. 1.

Fig. 10 explains a right-left air flow direction control device according to Embodiment 2 of the present invention, (a) being a sectional view of the structure of the device when viewed from the side, (b) being a partly enlarged sectional view thereof when viewed from the side.

Fig. 11 is a perspective view of a component (second connecting rod) of the right-left air flow direction control device of Fig. 10.

Fig. 12 includes plan views of components (a first

deflector and a second deflector) of the right-left air flow direction control device of Fig. 10, Fig. 12 explaining a rotating state of the components.

Fig. 13 is a front view of an air-conditioning apparatus indoor unit according to Embodiment 3 of the present invention.

Fig. 14 is a sectional view of the indoor unit of Fig. 13 when viewed from the side.

Fig. 15 is a perspective view of part (including and surrounding an air outlet) of the indoor unit of Fig. 13.

[Description of Embodiments]

[Embodiment 1: Right-left Air Flow Direction Control Device]

[0010] Figs. 1 to 5 explain a right-left air flow direction control device according to Embodiment 1 of the present invention. Fig. 1 is a perspective view of the structure of the device. Fig. 2 is a partly enlarged perspective view of the device. Fig. 3(a) is a side elevational view of a component (right-left deflector). Fig. 3(b) is a plan view of the component (right-left deflector). Fig. 4 is a perspective view of another component (connecting rod). Fig. 5 (a) is a partly enlarged perspective view of the component (connecting rod). Fig. 5(b) is a partly enlarged front view of the component (connecting rod). Fig. 5(c) is a partly enlarged plan view of the component (connecting rod). Fig. 5(d) is a partly enlarged sectional view of the component (connecting rod) when viewed from the side. Note that the figures are schematically illustrated and the present invention is not limited to the illustrated embodiment.

[0011] Referring to Fig. 1, the right-left air flow direction control device 100 includes right-left deflectors 10 (including planar portions 12n, 12m, ..., 12j and rotation shafts 11 n, 11 m, ..., 11j which are illustrated), connecting rods 20 (including a connecting rod 20b which is illustrated) connected to the right-left deflectors 10 to provide a link mechanism, and driving means 30 that translates the connecting rods 20.

For convenience of explanation, directions "X, Y, and Z" are defined with respect to the position of each component disposed in an indoor unit 300 which will be described in Embodiment 3 and the common description will be made with omission of the subscripts "n, m, ..." and those "a, b" (refer to Figs. 13 to 15).

(Driving Means)

[0012] The driving means 30 includes a driving motor 31, a first link rod 32 secured to a rotation shaft of the driving motor 31, and a second link rod 33 having one end pivotably connected to the first link rod 32, the other end of the rod 33 being pivotably connected to the connecting rod 20b. Accordingly, the driving means 30 is configured such that rotation of the driving motor 31 by a predetermined angle translates the connecting rod 20b (or moves the rod in the Y and X directions) by a predetermined distance.

(Right-left Deflector)

[0013] Referring to Figs. 2 and 3, each right-left deflector 10 includes the rotation shaft 11, a base portion 13 which defines a plane perpendicular to the center line (or the center A of rotation which will be referred to as the "rotation center A" hereinafter) of the rotation shaft 11, and the planar portion 12 which extends from the base portion 13 and defines a plane including the rotation center A (which is positioned between two surfaces of the planar portion 12).

The planar portion 12 has a notch 14 which extends from one side edge 12z (on the downstream side in the X direction) toward the rotation center A. In other words, the notch 14 has a notch vertical edge 14z which is generally parallel to the rotation center A and a notch horizontal edge 14x which is generally parallel to the base portion 13 and is generally perpendicular to the rotation center A.

[0014] The base portion 13 includes a base end face 13z placed adjacent to an end (in the +X direction) thereof and a base central face 13x placed adjacent to the rotation center A (in the -X direction). The base end face 13z slightly protrudes downward (in the Z direction) from the base central face 13x (such that a step is formed). The base end face 13z may be omitted such that the base portion 13 has a flat or step-free lower surface.

Furthermore, a connection protrusion 15 protrudes from the base end face 13z of the base portion 13 toward the notch horizontal edge 14x such that the connection protrusion 15 is positioned at a predetermined distance from the rotation center A. The connection protrusion 15 includes a connection cylindrical portion 15x including the center B of the connection protrusion (hereinafter, "connection protrusion center B") parallel to the rotation center A and a bullet-shaped connection conical portion 15z extending from the connection cylindrical portion 15x. The outside diameter of the bottom surface of the connection conical portion 15z is larger than that of the connection cylindrical portion 15x.

The height (length in the Z direction) of the connection cylindrical portion 15x, that is, the distance between the base end face 13z and the bottom surface of the connection conical portion 15z will be called "connection protrusion height H15". Furthermore, the right-left deflector 10 is molded in one piece of synthetic resin. The present invention does not limit the material of this component and the method of forming the component. The portions may be formed of different materials and be joined together.

(Connecting Rod)

[0015] Referring to Figs. 1 and 4, the connecting rod 20b includes a plate-shaped rod body 21 having a pre-

determined width (length in the X direction) throughout its length and including width increased portions arranged at regular intervals such that each portion has an increased width (or extends outward). Engaging means 28 for connection to the driving means 30 is disposed at one end of the rod body 21 and engaging means 29 for connection to a connecting rod 20a is disposed at the other end thereof. Each connecting rod 20 has connection holes 25 through which the connection protrusions 15 of the right-left deflectors 10 extend such that the holes are arranged at regular intervals in the longitudinal direction (corresponding to the Y direction) of the connecting rod 20.

Furthermore, the connecting rod 20a (refer to Fig. 15) has no engaging means 28 because the rod is not connected to the driving means 30. Except this omission, the connecting rod 20a has the same structure as that of the connecting rod 20b. Hereinafter, the common description will be made with omission of the subscripts "a, b" and the components will be referred to as the "connecting rods 20".

[0016] Referring to Fig. 5, the inside diameter of each connection hole 25 is slightly larger than the outside diameter of the connection cylindrical portion 15x of the connection protrusion 15 and is smaller than the outside diameter of the bottom surface of the connection conical portion 15z thereof. Accordingly, while the connection protrusion 15 (or the connection cylindrical portion 15x) extends through the connection hole 25, the bottom surface of the connection conical portion 15z is engaged with part (corresponding to a rod body lower surface 21 b) surrounding the connection hole 25. Consequently, the connection protrusion 15 will not detach from the connection hole 25. In other words, the right-left deflectors 10 will not be disconnected from the connecting rods 20. The right-left deflectors 10 have the same distance between the rotation center A and the connection protrusion center B. The right-left deflectors 10 are arranged at regular intervals. The connection holes 25 are arranged at regular intervals in each connecting rod 20. Each interval between the right-left deflectors 10 is equal to that between the connection holes 25. Accordingly, the right-left deflectors 10 and the connecting rods 20 constitute a link mechanism.

For example, let "L" denote the distance between the rotation center A and the connection protrusion center B. Assuming that each connecting rod 20 is moved in the longitudinal direction (Y direction) by "Δy", the connecting rod 20 is moved in the direction (X direction) perpendicular to the longitudinal direction by "$\Delta x = \sqrt{(L^2 - \Delta y^2)}$".

Furthermore, slits 26 are arranged on both sides of each connection hole 25 in the longitudinal direction of the connecting rod 20 so as to allow for entry (corresponding to insertion) of the connection protrusion 15 into the connection hole 25. Note that the length (dimension in the Y direction) of each slit 26 and the width (length in the X direction) thereof are not limited. In the case where some contrivance to allow the connection protrusion 15 to easily enter the connection hole 25 is made, the slits 26 may be omitted.

[0017] Furthermore, rod body extended portions 22 each extending (projecting) toward the upstream side (in the -X direction) so as to have a generally arcuate outline are arranged at regular intervals on a side edge (hereinafter, referred to as a "rod body side edge") 21 d of the rod body 21 on the upstream side (in the -X direction). In other words, each rod body extended portion 22 has an arc-shaped edge extending between extending start points E1 and E2 on the rod body side edge 21d and a maximum extending point E3 is aligned with the connection hole 25 in a direction perpendicular to the longitudinal direction (Y direction) of the connecting rod 20.

Furthermore, the height (length in the -Z direction) of each rod body extended portion 22 from the edge gradually increases (extends) from the extending start point E1 to the maximum extending point E3. Similarly, the height thereof gradually increases (extends) from the expansion start point E2 to the maximum expansion point E3. The highest (extending) part in the maximum extending point E3 serves as contact raised part 23.

[0018] In other words, a face (hereinafter, referred to as a "rod body upper surface") 21 c facing in the "-Z direction" of the rod body 21 has the contact raised parts 23 in the rod body extending portions 22. Herein, the height (corresponding to the distance in the Z direction) between the rod body upper surface 21 c and a face (hereinafter, referred to as a "rod body lower surface") 21 b facing in the "+Z direction" thereof will be referred to as the "rod body height H21" and the height (corresponding to the distance in the Z direction) between the rod body lower surface 21 b and the top of the contact raised part 23 will be referred to as a "securing protrusion height H23".

Note that the relationship between the connection protrusion height H15 of the right-left deflector 10 and the rod body height H21 and the securing protrusion height H23 of the connecting rod 20 is expressed as "H21 < H15 < H23".

[0019] Herein, the center of each connection hole 25 will be referred to as a "connection hole center C" and the top (positioned at the highest level) of each contact raised part 23 will be referred to as a "contact center D". A line (hereinafter, referred to as a "connecting rod contact center line L20") connecting the connection hole center C and the contact center D is perpendicular to the longitudinal direction (Y direction) of the rod body 21 and is parallel to the X direction.

The contact raised part 23 is mountain-shaped such that the height thereof gradually increases and the top thereof is a "point". The present invention is not limited to this shape. The top may have a predetermined area (a predetermined length along the arc). In this case, the "contact center D" is at the center of the predetermined area.

Furthermore, the connecting rod 20 is molded in one piece of synthetic resin, serving as an elastic material (which can be bent and deformed). The present invention

does not limit the material of this component and the method of forming the component. The portions may be formed of different materials and be joined together.

(Action: Frontward Air Blowing)

[0020] Figs. 6 to 8 explain an action of the right-left air flow direction control device according to Embodiment 1 of the present invention. Fig. 6 includes front views of part of the right-left air flow direction control device, Fig. 7 includes plan views thereof, and Fig. 8 includes partly sectional side elevational views thereof. In each figure, (a) illustrates a front air blowing state and (b) illustrates a rightward air blowing state.

In Fig. 6(a), the right-left deflector 10 in the "frontward air blowing" state is seen in a direction from the inside of an air path 6 to an air outlet 7 (i.e., in the +X direction). Accordingly, the planar portion 12 is seen in the foreground and the connection protrusion 15 is partly seen behind the planar portion 12. In this state, the planar portion 12 is parallel to the "X-Z plane" and is visually recognized as a thin plate. The connection conical portion 15z is partly visually recognized while the connection protrusion center B of the connection protrusion 15 is hidden by the planar portion 12.

[0021] In Fig. 7(a), the right-left deflector 10 in the "frontward air blowing" state is seen in a direction from the inside of the air path 6 to a lower surface 8b of a drain pan 8 (i.e., in the -Z direction). Accordingly, the planar portion 12 (illustrated in section) is visually recognized in the foreground, the connecting rod 20 is visually recognized as being positioned between the planar portion 12 and the base central face 13x, and the base central face 13x is visually recognized as being behind the planar portion 12. In this state, since the connecting rod 20 is placed in the notch 14 of the right-left deflector 10, the base end face 13z is hidden by the rod body extending portion 22.

For convenience of explanation, the contact center D on a surface (face facing in the +Z direction which may be referred to as an "upper surface"), which is not visually recognized, of the rod body extended portion 22 is indicated by "solid circle". It is therefore apparent that the connection protrusion center B of the right-left deflector 10 coincides with the connection hole center C of the connecting rod 20 and a line (hereinafter, referred to as a "right-left deflector center line L10" which is not illustrated) connecting the rotation center A and the connection protrusion center B of the right-left deflector 10 and the connecting rod contact center line L20 (line connecting the connection hole center C and the contact center D of the connecting rod 20) are positioned in the same "X-Z plane".

[0022] Fig. 8(a) is a partly sectional enlarged view of the right-left deflector 10 in the "frontward air blowing" state as seen in the Y direction. Accordingly, the base portion 13 is illustrated as extending horizontally and the connection protrusion center B is illustrated as extending vertically (in an up-down direction). Since the right-left deflector center line L10 and the connecting rod contact center line L20 are positioned in the same plane, the contact center D, serving as the top of the contact raised part 23 of the connecting rod 20, is in contact with the base central face 13x of the right-left deflector 10.

In this state, the connecting rod 20 (rod body 21) is supported by the connection conical portion 15z while being prevented from detaching from the right-left deflector 10. The relationship between the connection protrusion height H15 of the right-left deflector 10 and the rod body height H21 and the securing protrusion height H23 of the connecting rod 20 is expressed as "H21 < H15 < H23".

[0023] Consequently, a contact point G at which the rod body lower surface 21 b contacts the bottom surface of the connection conical portion 15z of the connection protrusion 15 functions as a fulcrum, a contact point H at which the other side edge 21 a (precisely, a point near the side edge 21 a) of the rod body upper surface 21 c contacts the base end face 13z functions as the point of effort (or the point of load), and a contact point F at which the contact center D (the top of the contact raised part 23) contacts the base central face 13x functions as the point of load (or the point of effort), so that the rod body 21 undergoes three-point bending in a position corresponding to the rod body extended portion 22 (or the portion corresponding to the rod body extended portion 22 is bent and deformed in the "X-Z plane").

Specifically, since the rod body 21 undergoes bending deformation in the position corresponding to the rod body extended portion 22 in the "X-Z plane", the right-left deflector 10 and the connecting rod 20 are substantially integrated by friction caused by force necessary for such bending deformation (or forces pressing against each other). Thus, the occurrence of vibrations of the right-left deflector 10 which tend to occur upon frontward air blowing can be suppressed. Advantageously, the indoor unit 300 provided with the right-left air flow direction control device 100 achieves a quiet operation.

(Action: Rightward Air Blowing)

[0024] Fig. 6(b) illustrates the "rightward air blowing" state in which the connecting rod 20 in Fig. 6(a) has been translated to the left (or moved in the Y direction) in the figure. Accordingly, the planar portion 12 seen in the foreground is visually recognized as having a width. While the connection protrusion 15 seen in the background is not hidden by the planar portion 12, the connection conical portion 15z of the connection protrusion 15 is visually recognized. Note that a "leftward air blowing" state and the "rightward air blowing" state are symmetric with respect to the plane and exhibit the same action. Accordingly, explanation of the "leftward air blowing" state is omitted.

[0025] Fig. 7(b) illustrates the "rightward air blowing" state in which the connecting rod 20 in Fig. 7(a) has been translated to the left (or moved in the Y direction) in the

figure. In this state, the connecting rod contact center line L20 (the line connecting the connection hole center C and the contact center D) of the connecting rod 20 is positioned in the "X-Z plane" and the right-left deflector center line L10 (the line connecting the rotation center A and the connection protrusion center B) of the right-left deflector 10 is at a predetermined angle with the "X-Z plane".

In other words, the contact center D (the top of the contact raised part 23) is positioned away from the base central face 13x.

[0026] Fig. 8(b) illustrates the "rightward air blowing" state in which the connecting rod contact center line L20 and the right-left deflector center line L10 form a predetermined angle (θ) therebetween and the contact center D (the top of the contact raised part 23) is positioned away from the base central face 13x. Although the rod body 21 is supported by the connection conical portion 15z such that it is prevented from detaching therefrom, therefore, the rod body 21 does not undergo bending deformation, contrary to the frontward air blowing, in the position corresponding to the rod body extended portion 22.

[0027] Fig. 8(b) illustrates the state in which any point in the contact raised part 23 (or any point between the extending start points E1 and E2) is not in contact with the base central face 13x. Accordingly, the rod body 21 undergoes no bending deformation. Specifically, the right-left deflector 10 and the connecting rod 20 are merely connected by engagement between the connection protrusion 15 and the connection hole 25 such that no friction acts between the right-left deflector 10 and the connecting rod 20.

If vibrations of the right-left deflector 10 occur upon rightward air blowing, therefore, the vibrations will not be suppressed by the connecting rod 20 but blown air will cause a positive pressure acting on one surface of the planar portion 12 and a negative pressure acting on the other surface thereof in the rightward air blowing such that a force allowing rotation in one direction (for further rightward air blowing) acts on the planar portion 12. Consequently, vibrations as in the frontward air blowing will not occur.

[0028] Advantageously, vibrations will not occur in the rightward air blowing even under conditions that no friction acts between the right-left deflector 10 and the connecting rod 20 (the same applies to the leftward air blowing).

When the air blowing direction is changed from the rightward air blowing direction to the frontward air blowing direction, the blown air causes the force allowing rotation in one direction (for further rightward air blowing) to act on the right-left deflector 10 and no friction acts between the right-left deflector 10 and the connecting rod 20. Consequently, the right-left deflector 10 is easily rotated.

[0029] Shift from the rightward air blowing state illustrated in Fig. 8(b) to the frontward air blowing state illustrated in Fig. 8(a) will be described below.

The angle (θ) between the connecting rod contact center line L20 and the right-left deflector center line L10 gradually decreases as the state approaches to the frontward air blowing state. A point near the extending start point E1 in the contact raised part 23 is first come into contact with the base central face 13x (while the rod body upper surface 21c is in contact with the base end face 13z). The point of contact between the contact raised part 23 and the base central face 13x gradually shifts toward a point near the maximum extending point E3 in the contact raised part 23.

Since the height of the contact raised part 23 gradually increases with approach to the maximum extending point E3, the contact raised part 23 is gradually more tightly pressed against the base central face 13x as the state approaches to the frontward air blowing state. Consequently, the rod body 21 undergoes greater three-point bending (in the position corresponding to the rod body extended portion 22 in the "X-Z plane") as the state approaches to the frontward air blowing state.

[0030] Specifically, as the state approaches to the rightward air blowing state (the angle (θ) between the connecting rod contact center line L20 and the right-left deflector center line L10 is larger), the force (allowing the right-left deflector 10 to rotate in one direction (for rightward air blowing)), caused by the blown air, acting on the right-left deflector 10 gradually increases, while the friction acting between the right-left deflector 10 and the connecting rod 20 gradually decreases.

For shift from a state approaching to the rightward air blowing state to the frontward air blowing state, even if the blown air causes a large force, resistance caused by friction is low. Advantageously, the right-left deflector 10 can be rotated (or the connecting rod 20 can be translated) without increase in capacity of the driving motor 31.

[0031] In addition, as the state approaches to the frontward air blowing state (the angle (θ) between the connecting rod contact center line L20 and the right-left deflector center line L10 is smaller), the force (allowing the right-left deflector 10 to rotate in one direction (for rightward air blowing)), caused by the blown air, acting on the right-left deflector 10 gradually decreases, while friction acting between the right-left deflector 10 and the connecting rod 20 gradually increases.

In the frontward air blowing state, therefore, the force caused by the blown air is small under conditions that resistance caused by friction is high. The right-left deflector 10 can be rotated (or the connecting rod 20 can be translated) without increase in capacity of the driving motor 31.

The above description relates to the case where the right-left air flow direction control device 100 is installed in the indoor unit 300 (Embodiment 3). The present invention is not limited to this case. The right-left air flow direction control device 100 may be installed in an indoor unit of a different type from the indoor unit 300. In the case where the right-left air flow direction control device 100 is installed in a different posture, the directions, such as the

up-down direction, may be interpreted as appropriate directions.

(Modifications of Contact Raised Part)

[0032] Fig. 9 includes partly sectional perspective views of components (connecting rods) according to modifications of the right-left air flow direction control device according to Embodiment 1 of the present invention. Fig. 9(a) illustrates a connecting rod 20r in which the height of each contact raised part 23 is increased from a point between the extending start point E1 and the maximum extending point E3 as compared with the contact raised part 23 of the connecting rod 20 (refer to Fig. 5). Specifically, the contact raised part 23 is not provided in a region near the extending start point E1. Accordingly, the value of "the angle (θ) formed by the connecting rod contact center line L20 and the right-left deflector center line L10" when the contact raised part 23 is in contact with the base central face 13x of the right-left deflector 10 is smaller.
Consequently, since the above-described friction acts in a narrower range (corresponding to a smaller angle (θ)) in which the state approaches to the frontward air blowing state, vibrations of the right-left deflector 10 are suppressed. In addition, since the above-described friction does not act in a wider range in which the state approaches to the rightward or leftward air blowing state, the connecting rod 20r is more easily translated.
The present invention does not limit any way of increasing the height. The height may be increased from any point between the extending start point E1 and the maximum extending point E3. Furthermore, the height may be linearly increased. Alternatively, the rate of increase in height may be set to low in a range near each of the extending start point E1 and the maximum extending point E3 and may be set to high in a range located midway between the extending start point E1 and the maximum extending point E3.
[0033] Fig. 9(b) illustrates a connecting rod 20s in which the top (positioned at the highest level) of each contact raised part 23 has a flat face having a predetermined area as compared with the contact raised part 23 of the connecting rod 20 (refer to Fig. 5). According to this modification, the plane of contact between the top of the contact raised part 23 and the base central face 13x has the predetermined area, thus preventing partial wear of the top of the contact raised part 23. Consequently, the above-described friction will not decrease with long-term use. Advantageously, the occurrence of vibrations of the right-left deflectors 10 can be suppressed even after long-term use.
[0034] Fig. 9(c) illustrates a connecting rod 20t in which the height of each contact raised part 23 is constant in the whole range (between the extending start points E1 and E2) as compared with the contact raised part 23 of the connecting rod 20 (refer to Fig. 5). Accordingly, the top of the contact raised part 23 is in contact with the base central face 13x in any air blowing direction from the frontward air blowing direction to the rightward air blowing direction (or the leftward air blowing direction). Consequently, friction acts between the right-left deflector 10 and the connecting rod 20 even in the rightward air blowing (or the leftward air blowing). If force, causing the right-left deflector 10 to vibrate, acts on the right-left deflector 10 for some reason, the vibrations can be suppressed. Note that this friction acts therebetween at all times. For shift from a state approaching to the rightward air blowing state to the frontward air blowing state, the right-left deflector 10 has to overcome a high resistance caused by friction and a large force caused by blown air. The capacity of the driving motor 31, therefore, has to be increased.

[Embodiment 2: Right-left Air Flow Direction Control Device]

[0035] Figs. 10 to 12 explain a right-left air flow direction control device according to Embodiment 2 of the present invention. Fig. 10(a) is a sectional view of the structure of the device when viewed from the side. Fig. 10(b) is a partly enlarged sectional view thereof when viewed from the side. Fig. 11 is a perspective view of a component (second connecting rod). Fig. 12 includes plan views of components (a first right-left deflector and a second right-left deflector), Fig. 12 schematically explaining a rotating state of the components. The same or equivalent portions as those in Embodiment 1 are designated by the same reference numerals and explanation is partly omitted.
[0036] Referring to Fig. 10(a) and (b), the right-left air flow direction control device 200 is installed in the indoor unit 300 (Embodiment 3) instead of the right-left air flow direction control device 100 (Embodiment 1) and includes first right-left deflectors 40, second right-left deflectors 50 rotatably connected to the first right-left deflectors 40, a second connecting rod 60 that is translated to rotate the first right-left deflectors 40, and driving means 30 translating the second connecting rod 60.

(First Right-left Deflector)

[0037] Referring to Fig. 10, each first right-left deflector 40 includes a component similar to the right-left deflector 10 and further includes support protrusions 16 and 17 to rotatably support the second right-left deflector 50.
Specifically, the base portion 13 of the right-left deflector 10 is extended, the support protrusion 16 is placed so as to extend from a position closer to one end (in the +X direction) of the base portion 13 than the base end face 13z, the opening of the notch 14 is expanded to form a notch second horizontal edge 14w which is parallel to the notch horizontal edge 14x, and the support protrusion 17 is placed so as to extend from the notch second horizontal edge 14w. In this case, a line (the center P of folding which will be referred to as the "folding center P"

hereinafter) connecting the support protrusions 16 and 17 is parallel to the rotation center A.

(Second Right-left Deflector)

[0038] Each second right-left deflector 50 includes a base portion 53, a connection shaft 51 positioned at one end (in the -X direction) of the base portion 53 such that the shaft extends upward (in the -Z direction), and a planar portion 52 positioned at the other end (in the +X direction) of the base portion 53.
The base portion 53 has a support recess 56 and another support recess 57, in which the support protrusions 16 and 17 are placed, respectively, near the planar portion 52 such that the support recess 56 is positioned in the upper surface (facing in the -Z direction) of the base portion 53 and the support recess 57 is positioned in the lower surface (facing in the +Z direction) thereof. The base portion 53 further includes a second contact raised part 54, which is in contact with the notch horizontal edge 14x of the first right-left deflector 40, on the lower surface thereof such that the second contact raised part 54 is positioned near the connection shaft 51.

(Second Connecting Rod)

[0039] The second connecting rod 60 includes the rod body extended portions 22 of which the extent to which the rod body extended portion 22 extends is greater than that in the connecting rod 20, and further includes second connection holes 27, in each of which the connection shaft 51 of the second right-left deflector 50 is detachably placed, such that the holes are arranged in the rod body extended portions 22, respectively. Each second connection hole 27 is an elongated hole having a length extending in the X direction.
Specifically, the second connecting rod 60 is translated while being linked to the second right-left deflectors 50. For example, when let "M" denote the distance between the folding center P and each connection shaft 51 and it is assumed that the second connecting rod 60 is moved in the Y direction by "Δy", the second connecting rod 60 can be moved in the X direction by "$\Delta x = \sqrt{(M^2 - \Delta y^2)}$".

(Action: Frontward Air Blowing)

[0040] Fig. 10(a) and (b) illustrate the first right-left deflector 40 and the second right-left deflector 50 in the "frontward air blowing" state when seen in a direction from the air path 6 to the air outlet 7 (i.e., in the +X direction). Accordingly, the planar portion 12 and the planar portion 52 are parallel to the "X-Z plane".
The right-left deflector center line L10 (i.e., the line connecting the rotation center A and the connection protrusion center B, the line being not illustrated) of the first right-left deflector 40 and the connecting rod contact center line L20 (i.e., the line connecting the connection hole center C and the contact center D, the line being not illustrated) are positioned in the same "X-Z plane".

[0041] In this case, since the contact center D, serving as the top of the contact raised part 23 of the second connecting rod 60, is in contact with the base central face 13x of the first right-left deflector 40 as in Embodiment 1, the rod body 21 undergoes three-point bending in a position corresponding to the rod body extended portion 22. Consequently, the first right-left deflector 40 and the second connecting rod 60 are substantially integrated by friction caused by force necessary for such bending deformation (or forces pressing against each other). Accordingly, the occurrence of vibrations of the first right-left deflector 40 which tend to occur upon frontward air blowing can be suppressed.
Furthermore, the second contact raised part 54 of the second right-left deflector 50 is in contact with the notch horizontal edge 14x of the first right-left deflector 40. In other words, since the first right-left deflector 40 and the second right-left deflector 50 are connected to each other in a substantially integrated fashion by the above-described contact, the first right-left deflector 40 suppresses vibrations of the second right-left deflector 50.

[0042] Specifically, upon frontward air blowing in the right-left air flow direction control device 200, the contact between the base central face 13x of the first right-left deflector 40 and the contact center D of the contact raised part 23 of the second connecting rod 60 and the contact between the second contact raised part 54 of the second right-left deflector 50 and the notch horizontal edge 14x of the first right-left deflector 40 enable substantially integrated connection between the first right-left deflector 40, the second right-left deflector 50, and the second connecting rod 60. If the first right-left deflector 40 and the second right-left deflector 50 tend to vibrate due to the flow of air blown frontward, therefore, the occurrence of vibrations will be suppressed.
Advantageously, the indoor unit provided with the right-left air flow direction control device 200 can achieve a quiet operation.

(Action: Rightward Air Blowing)

[0043] Shifting from the "frontward air blowing (refer to Fig. 12(a))" state to the "rightward air blowing (refer to Fig. 12(b))" or "leftward air blowing" state of the right-left air flow direction control device 200 will be described in brief below.
When the second connecting rod 60 is translated (or moved in the Y direction), that is, the connection hole center C (or the connection protrusion center B) is translated, the first right-left deflector 40 rotates about the rotation center A (which does not move) by a predetermined angle "α". At this time, as in Embodiment 1, the point of contact between the base central face 13x of the first right-left deflector 40 and the contact raised part 23 of the second connecting rod 60 gradually shifts from the contact center D to the extending start point E1 or E2, so that bending deformation on the rod body 21 is grad-

ually reduced. After a while, the base central face 13x of the first right-left deflector 40 is separated from the contact raised part 23 of the second connecting rod 60, so that the planar portion 12 enters a bending-free state in which no friction acts on this portion.

[0044] Furthermore, since the distance between the folding center P and the rotation center A is longer than the distance between the connection protrusion center B and the rotation center A, the distance of movement of the folding center P in the Y direction is longer than that of the connection protrusion center B in the Y direction.

Since the connection shaft 51 of the second right-left deflector 50 (extending through the second connection hole 27 of the second connecting rod 60) moves in the Y direction by the same distance as that of the second connecting rod 60 (the connection protrusion center B), the second right-left deflector 50 rotates about the folding center P in the opposite direction of the rotation of the first right-left deflector 40.

The second right-left deflector 50 therefore rotates from the frontward air blowing state by an angle "$\beta(<\alpha)$", so that the first right-left deflector 40 and the second right-left deflector 50, which are substantially continuously connected, serve as a folded deflector assembly having a substantially V-shaped cross-section (refer to Fig. 12 (b)).

[0045] Since an upstream edge of the first right-left deflector 40 is substantially continuous with a downstream edge of the second right-left deflector 50, air disturbance (e.g., flow separation) on the edges can be suppressed as compared with the first right-left deflector 40 and the second right-left deflector 50 arranged apart from each other in the Y direction. Accordingly, smooth air flow is achieved to facilitate air sending. Advantageously, the power consumption of a fan 5 can be reduced.

In the rightward air blowing state, the second contact raised part 54 of the second right-left deflector 50 is positioned away from the notch horizontal edge 14x of the first right-left deflector 40. Accordingly, no friction acts between the second right-left deflector 50 and the first right-left deflector 40.

[0046] As described above, in the "rightward air blowing" or "leftward air blowing" state, the contact raised part 23 of the second connecting rod 60 is positioned away from the base central face 13x of the first right-left deflector 40 and the second contact raised part 54 of the second right-left deflector 50 is positioned away from the notch horizontal edge 14x of the first right-left deflector 40. Although the first right-left deflector 40, the second right-left deflector 50, and the second connecting rod 60 are not connected substantially integrally by friction, therefore, the first right-left deflector 40 and the second right-left deflector 50 do not vibrate because force allowing rotation in one direction acts on the first right-left deflector 40 and the second right-left deflector 50.

The case where the right-left air flow direction control device 200 is installed in the indoor unit 300 (Embodiment 3) has been described above. The present invention is not limited to this case. The right-left air flow direction control device 200 may be installed in an indoor unit of a different type from the indoor unit 300. In the case where the right-left air flow direction control device 200 is installed in a different posture, the directions, such as the up-down direction, may be interpreted as appropriate directions.

[Embodiment 3: Indoor Unit of Air-conditioning Apparatus]

[0047] Figs. 13 to 15 explain an air-conditioning apparatus indoor unit according to Embodiment 3 of the present invention. Fig. 13 is a front view of the indoor unit. Fig. 14 is a sectional view thereof when viewed from the side. Fig. 15 is a perspective view of part (including and surrounding an air outlet) of the indoor unit. Note that the figures are schematically illustrated and the present invention is not limited to the illustrated embodiment.

Referring to Figs. 13 to 15, the air-conditioning apparatus indoor unit (hereinafter, referred to as the "indoor unit") 300 includes a body 1 having an air inlet 3 positioned in upper part of the body and the air outlet 7 positioned in lower part thereof, a front panel 2 openably covering the front of the body 1, the fan 5 which sucks indoor air through the air inlet 3 and provides the air path 6 leading to the air outlet 7, and a heat exchanger 4 positioned upstream of the fan 5 (i.e., adjacent to the air inlet 3).

[0048] In addition, the right-left air flow direction control device 100 that controls the air blowing direction for indoor air (hereinafter, referred to as "conditioned air") conditioned by the heat exchanger 4 relative to the horizontal direction (right-left direction) is placed near the air outlet 7 of the air path. The air outlet 7, serving as an end of the air path 6, is provided with up-down deflectors 9 (including a front up-down deflector 9a and a rear up-down deflector 9b, which are collectively referred to as the "up-down deflectors 9") that control the air blowing direction for the conditioned air relative to the vertical direction (up-down direction).

The heat exchanger 4 includes a front heat exchanging portion 4a positioned parallel to the front panel 2, a front upper heat exchanging portion 4b positioned above the front of the fan 5, and a rear upper heat exchanging portion 4c positioned above the rear of the fan 5.

The drain pan 8 is placed under the front heat exchanging portion 4a. The upper surface 8a of the drain pan 8 serves as a drain pan face that actually receives drain water. The lower surface (corresponding to an "air path member") 8b of the drain pan 8 serves as the front surface of the air path 6.

[0049] The right-left air flow direction control device 100 includes the right-left deflectors 10a, 10b, ..., 10n (collectively or individually referred to as the "right-left deflectors 10") rotatably arranged on the lower surface 8b of the drain pan 8, the connecting rods 20a and 20b (collectively or individually referred to as the "connecting

rods 20") rotating the right-left deflectors 10, and the driving means 30 translating the connecting rods 20.
Since the right-left air flow direction control device 100 has a structure in which vibrations of the right-left deflectors 10 are suppressed upon frontward air blowing, a quiet operation can be achieved (which has been described in detail in Embodiment 1).
For convenience of explanation, the horizontal direction when the indoor unit 300 is seen from the front (refer to Fig. 13) is referred to as the "right-left direction" or the "Y direction", a direction in which each rotation shaft 11 of the right-left air flow direction control device 100 extends and which extends substantially downward is referred to as the "downward direction" or the "Z direction", and the direction which is perpendicular to the Y direction and the Z direction and extends substantially downward is referred to as the "frontward direction" or the "X direction".
The common description has been made with omission of the subscripts "a, b, ..., n" and those "a, b".

[Reference Signs List]

[0050] 1, body; 2, front panel; 3, air inlet; 4, heat exchanger; 4a, front heat exchanging portion; 4b front upper heat exchanging portion; 4c rear upper heat exchanging portion; 5 fan; 6 air path; 7 air outlet; 8 drain pan; 8a upper surface; 8b, lower surface; 9, up-down deflector; 9a, front up-down deflector; 9b, rear up-down deflector; 10, right-left deflector; 11, rotation shaft; 12, planar portion; 12z, side edge; 13, base portion; 13x, base central face; 13z, base end face; 14, notch; 14w, notch second horizontal edge; 14x, notch horizontal edge; 14z, notch vertical edge; 15, connection protrusion; 15x, connection cylindrical portion; 15z, connection conical portion; 16, support protrusion; 17, support protrusion; 20, connecting rod; 21, rod body; 21 a, rod body side edge; 21 b, rod body lower surface; 21 c, rod body upper surface; 21d, rod body side edge; 22, rod body extended portion; 23, contact raised part; 25, connection hole; 26, slit; 27, second connection hole; 28, engaging means; 29, engaging means; 30, driving means; 31, driving motor; 32, first link rod; 33, second link rod; 40, first right-left deflector; 50, second right-left deflector; 51, connection shaft; 52, planar portion; 53, base portion; 54, second contact raised part; 56, support recess; 57, support recess; 60, second connecting rod; 100, right-left air flow direction control device (Embodiment 1); 200, right-left air flow direction control device (Embodiment 2); 300, air-conditioning apparatus indoor unit (Embodiment 3); A, rotation center; B, connection protrusion center; C, connection hole center; D, contact center; F, contact point; G, contact point; H, contact point; P, folding center; E1, extending start point; E2, extending start point; E3, maximum extending point; H15, connection protrusion height; H21, rod body height; H23, securing protrusion height; L10, right-left deflector center line; and L20, connecting rod contact center line.

Claims

1. A right-left air flow direction control device (100, 200) placed in an air path (6) of an air-conditioning apparatus indoor unit (300), the device comprising a plurality of right-left deflectors (10) rotatably arranged on an air path member providing the air path (6), a connecting rod (20) connected to the right-left deflectors (10) to provide a link mechanism, the connecting rod (20) being capable of being translated, and driving means (30), placed in the indoor unit, translating the connecting rod (20),
wherein each right-left deflector (10) includes a rotation shaft (11), a base portion (13) which is integrated with the rotation shaft (11) and defines a plane perpendicular to the center of rotation of the rotation shaft (11), a planar portion (12) which is integrated with the base portion (13) and includes the rotation center (A) of the rotation shaft (11), and a connection protrusion (15) which extends from the base portion (13) and is parallel to the rotation shaft (11),
wherein the connecting rod (20) includes a rod body (21) provided with engaging means for connection to the driving means (30) at one end of the rod body (21) in the longitudinal direction of the connecting rod (20), connection holes (25) arranged in the rod body (21) such that the connection protrusions (15) of the right-left deflectors (10) extend through the connection holes (25) while being prevented from detaching from the holes, rod body extended portions (22) which are arranged in one side edge (12z) of the connecting rod (20) so as to correspond to the connection holes (25) in the longitudinal direction, respectively, and project outwardly from the side edge (12z), and contact raised parts (23) arranged along the edges of the rod body extended portions (22), respectively, the contact raised parts (23) being higher than the rod body (21), and
wherein in a frontward air blowing state in which the angle which the extending direction of the planar portion (12) of each right-left deflector (10) forms with the longitudinal direction of the connecting rod (20) is approximately a right angle, the top of each contact raised part (23) of the connecting rod (20) is in contact with a point in the base portion (13) closer to the rotation center (A) than the connection protrusion (15) extending from the base portion (13) and the other side edge (12z) of the connecting rod (20) is in contact with a point in the base portion (13) distant from the rotation center (A) such that friction acts between the right-left deflector (10) and the connecting rod (20) at the contact points.

2. The right-left air flow direction control device (100, 200) of claim 1, wherein when the right-left air flow direction control device (100, 200) shifts from the frontward air blowing state such that the angle which the extending direction of the planar portion (12) of

each right-left deflector (10) forms with the longitudinal direction of the connecting rod (20) is greater than the right angle, the top of each contact raised part (23) is separated from the base portion (13) such that no friction acts between the top of the contact raised part (23) and the base portion (13).

3. The right-left air flow direction control device (100, 200) of claim 1 or 2,
wherein each rod body extended portion (22) extends outwardly from the one edge so as to have a generally arcuate outline, and
wherein each contact raised part (23) gradually increases in height from a extending start point at which the rod body extended portion (22) starts extending to a maximum extending point (E3) at which the extent to which the portion extends is the greatest.

4. The right-left air flow direction control device (100, 200) of any one of claims 1 to 3, wherein the top, positioned at the highest level, of each contact raised part (23) has a flat face having a predetermined area.

5. The right-left air flow direction control device (100, 200) of claim 1 or 2, wherein each contact raised part (23) is a flat face at a constant level, the flat face extending along the entire edge of the rod body extended portion (22) or in a predetermined range of the edge of the rod body extended portion (22).

6. An air-conditioning apparatus indoor unit (300) comprising a body (1) provided with an air inlet (3) positioned in upper part of the body (1) and an air outlet (7) positioned in lower part thereof, a fan (5) which sucks indoor air through the air inlet (3) and provides an air path (6) leading to the air outlet (7), a heat exchanger (4) placed closer to the air inlet (3) than the fan (5), and the right-left air flow direction control device (100, 200) of any one of claims 1 to 5.

FIG. 1

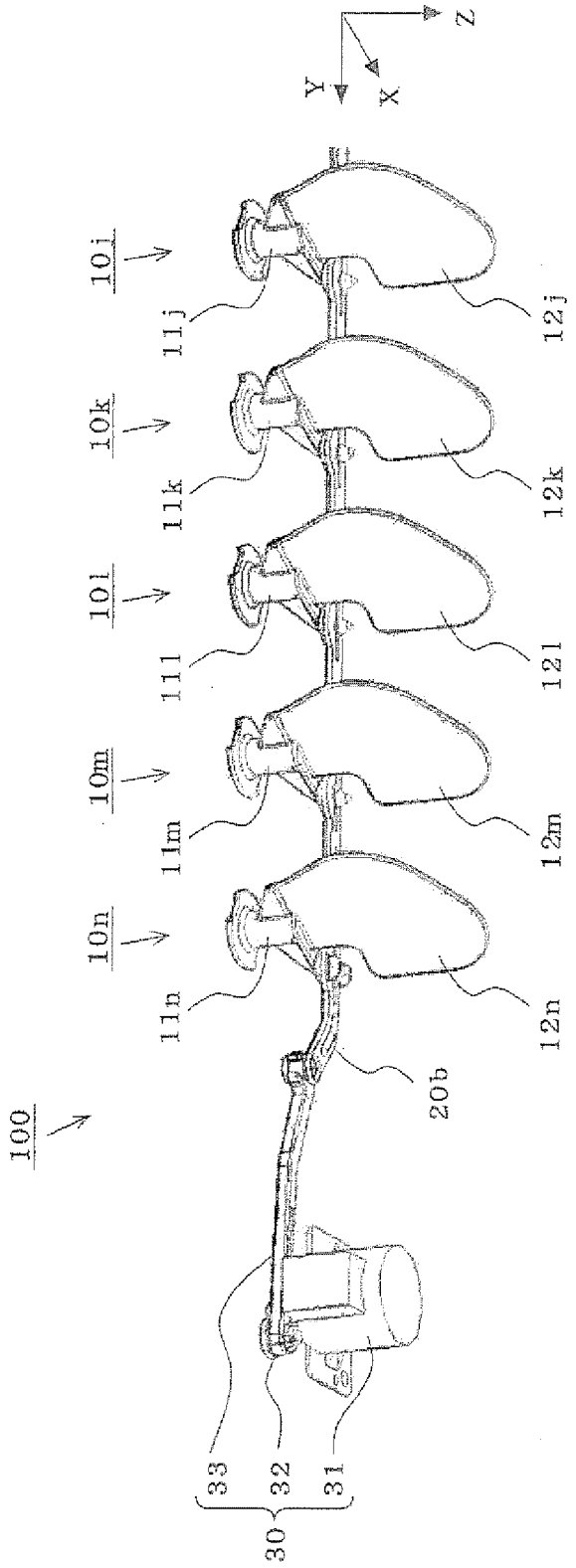
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FIG. 2

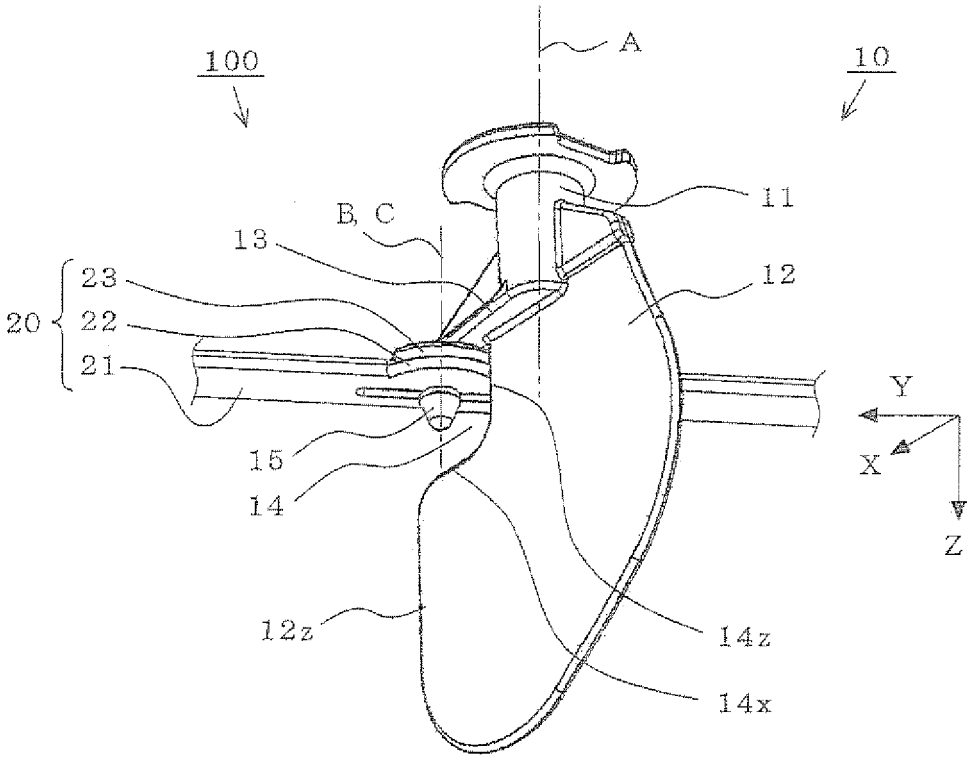
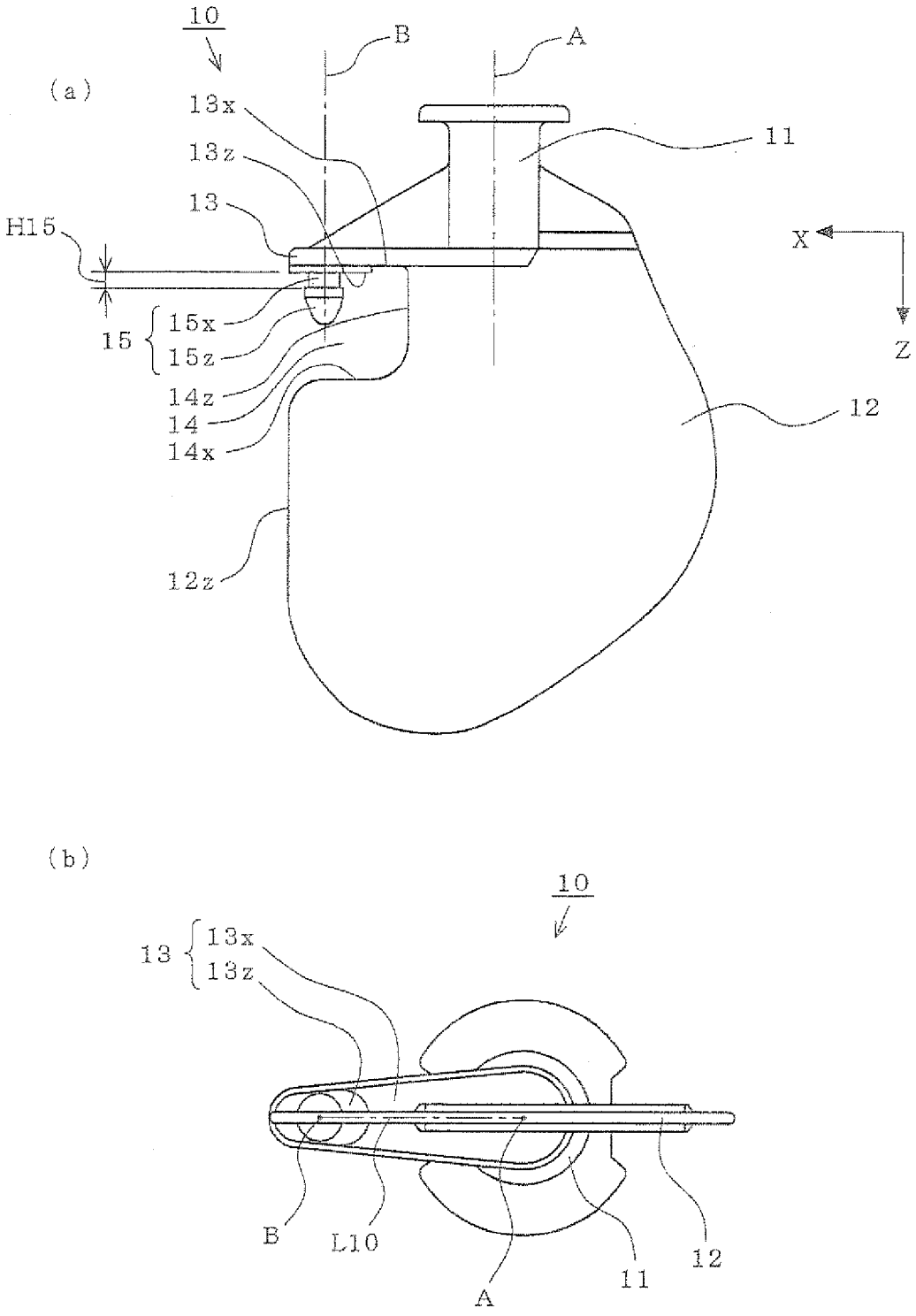


FIG. 3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12

FIG. 4

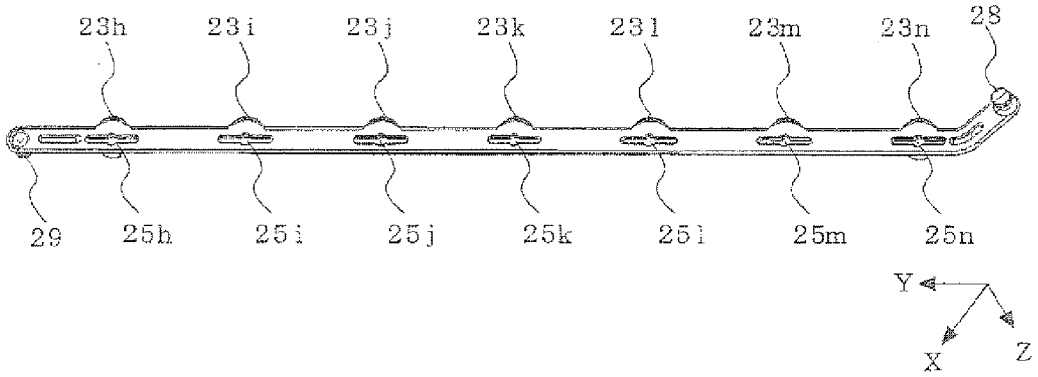
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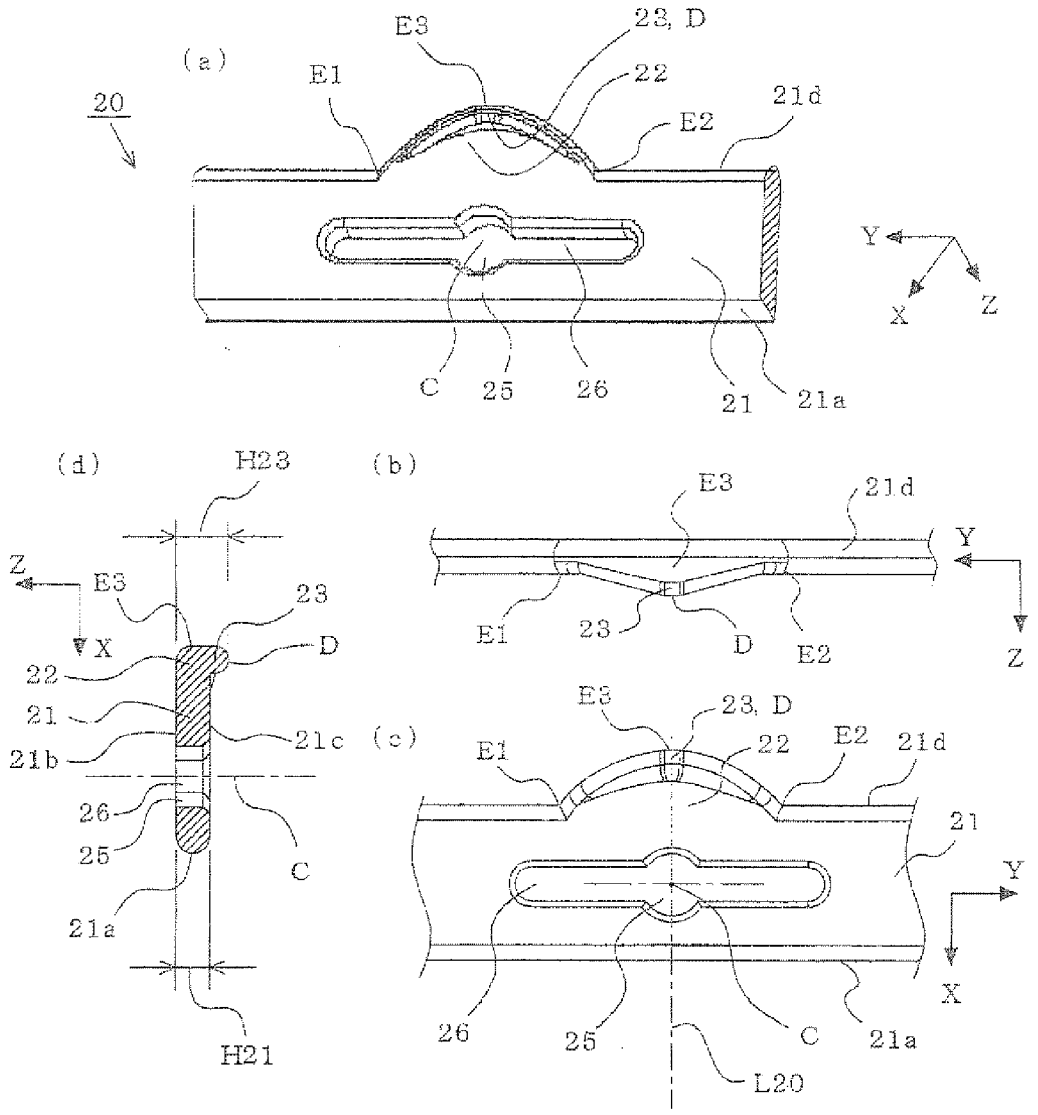
FIG. 5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D
E2
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(c)
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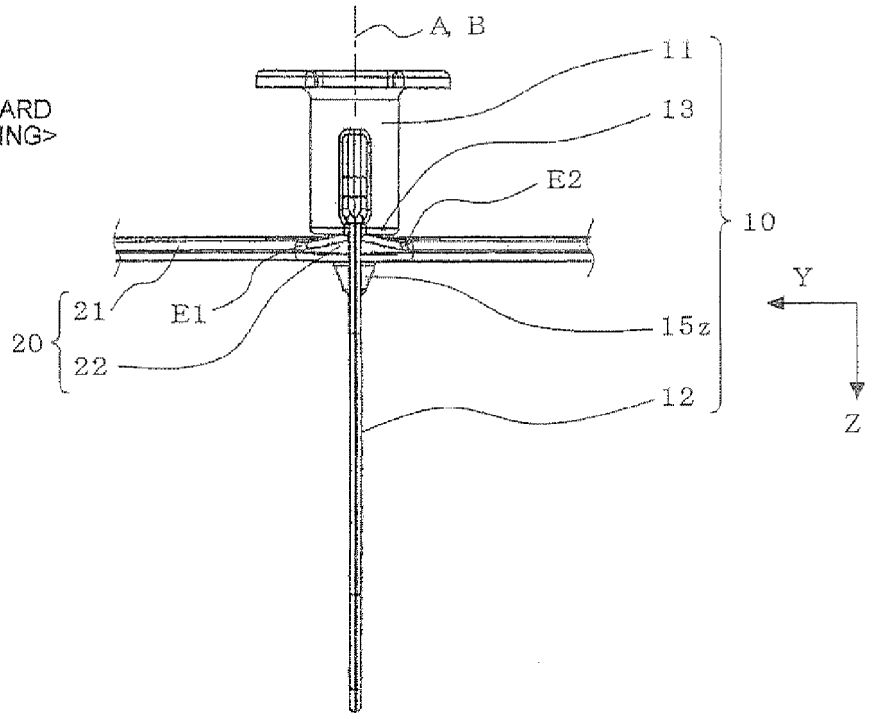
FIG. 6

(a)

<FRONTWARD AIR BLOWING>



(b)

<RIGHTWARD AIR BLOWING>

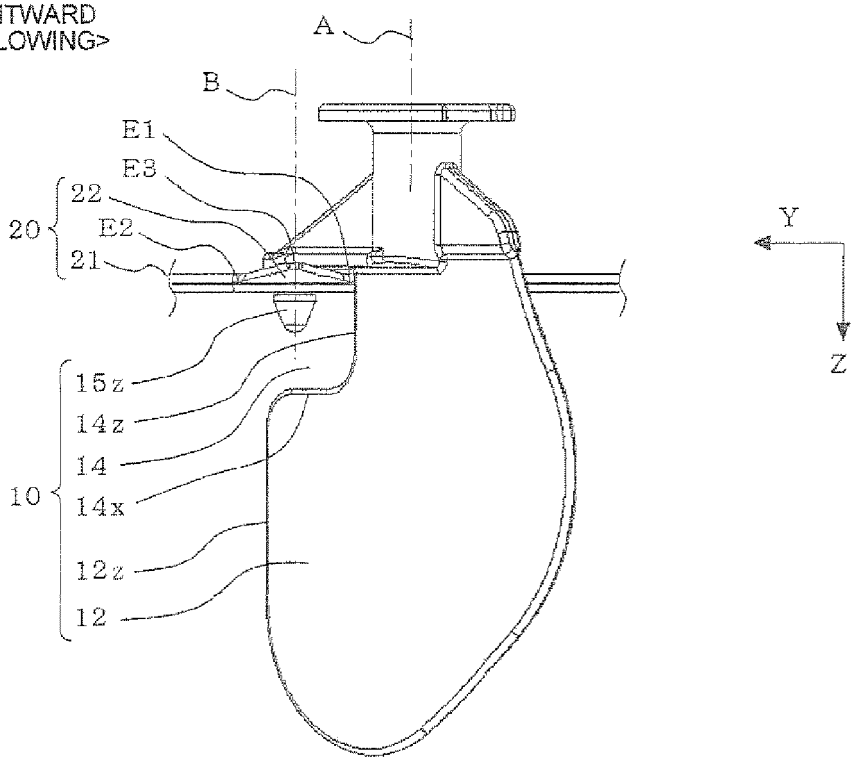
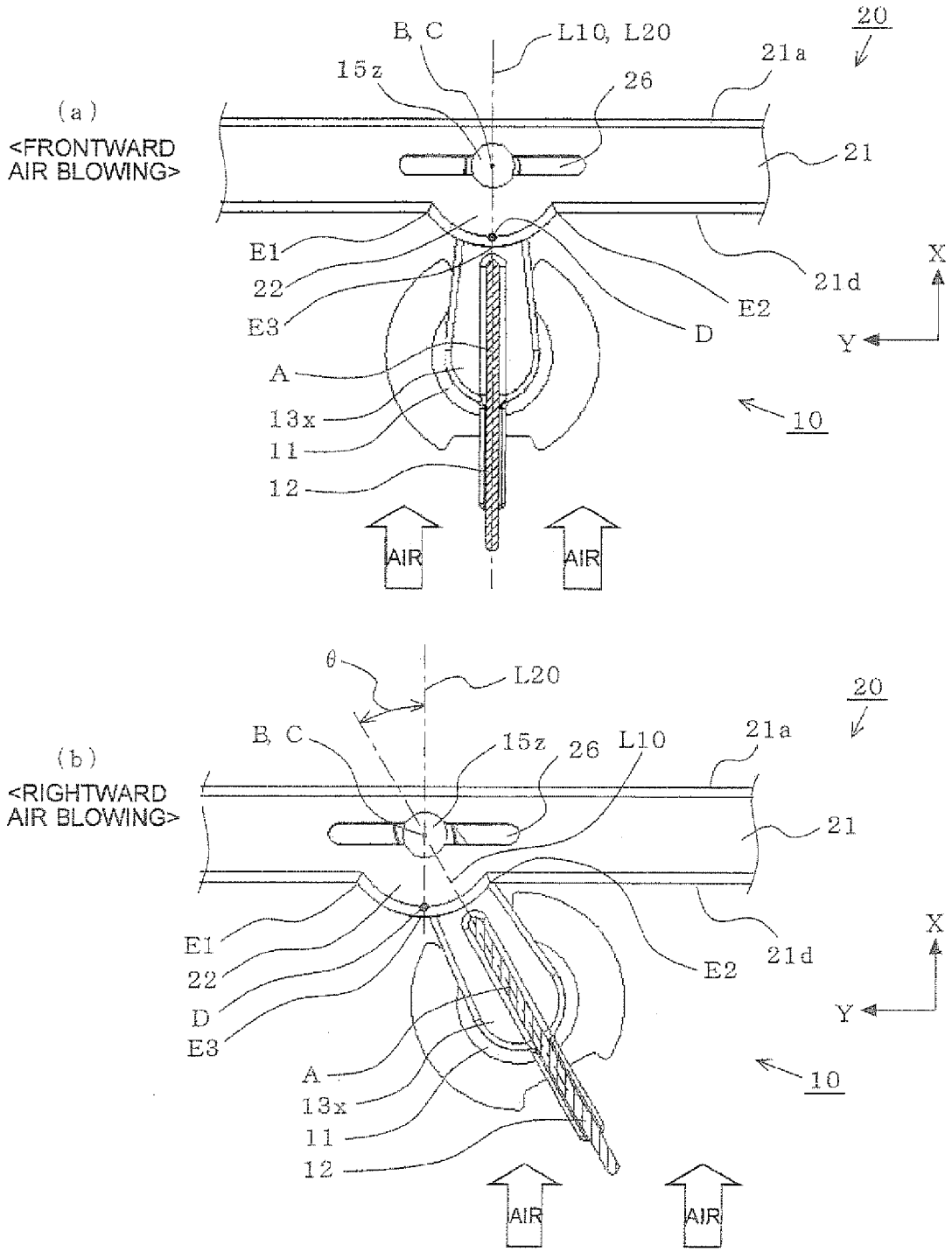


FIG. 7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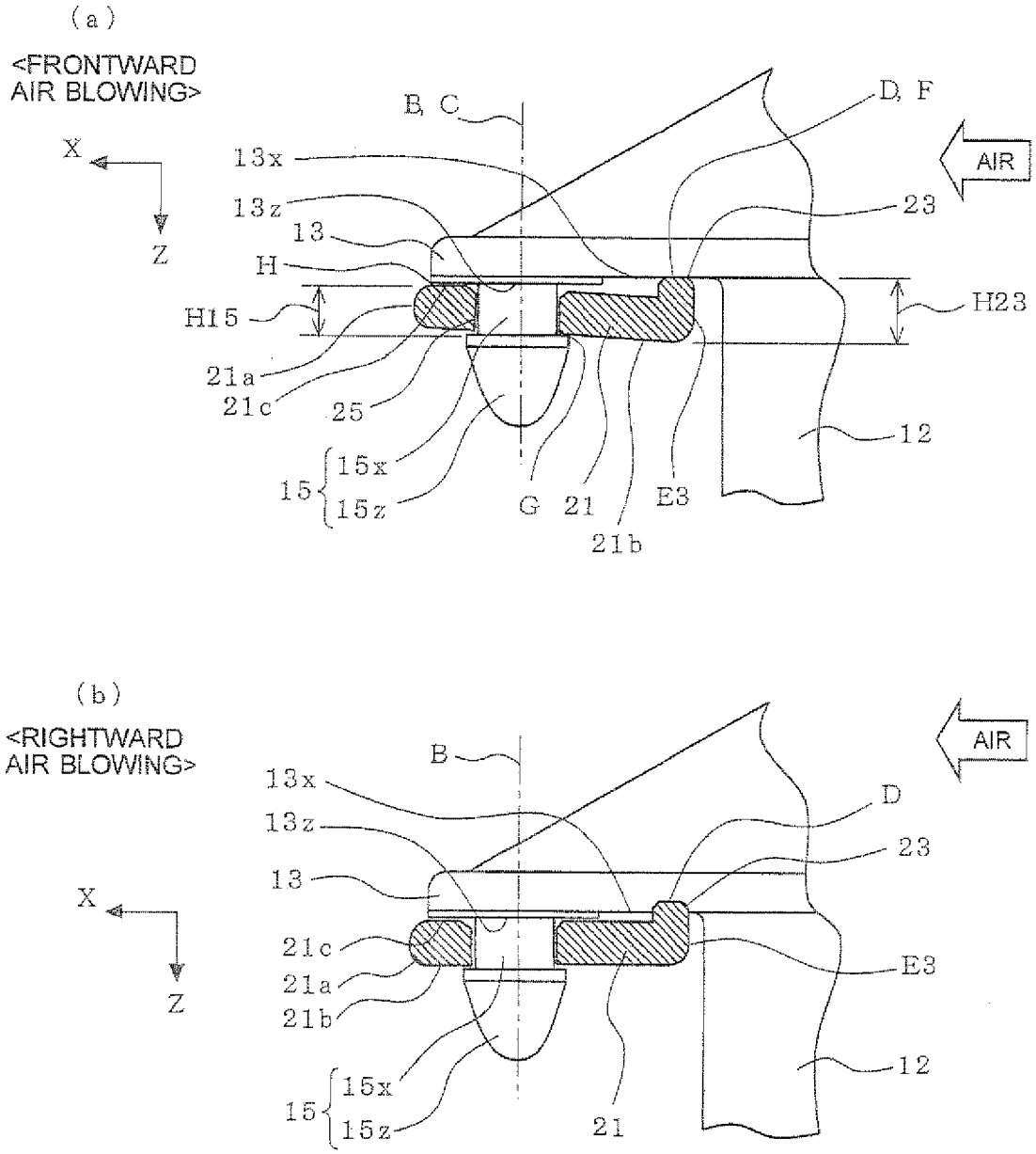
AIR

FIG. 8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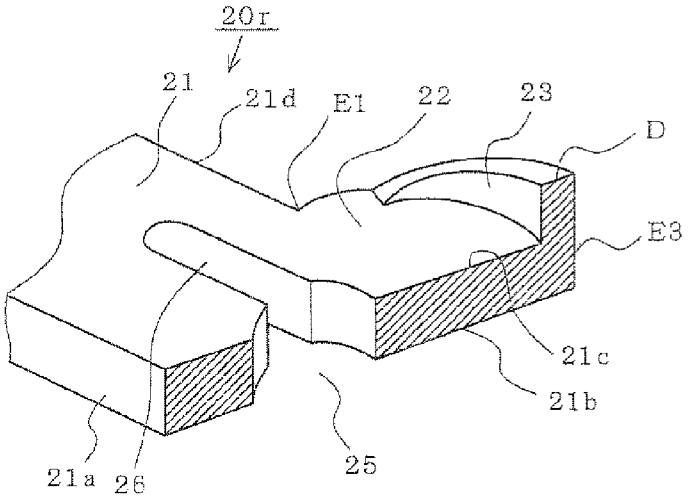
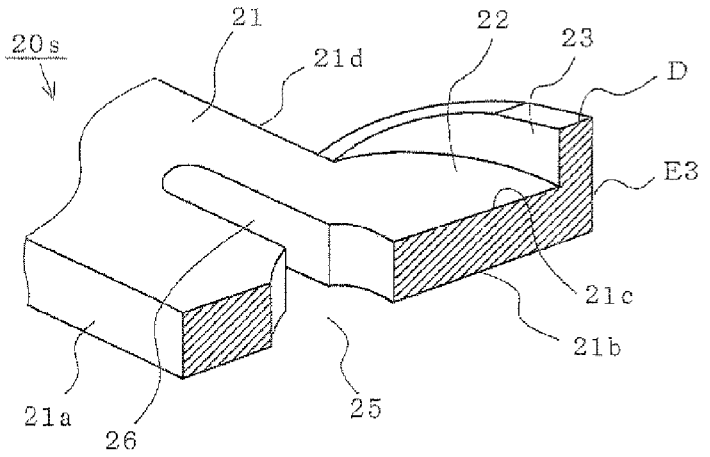
B, C
D, F
AIR
13x
13z
13
H
23
H15
H23
21a
21c
25
12
15
15x
15z
G
21
E3
21b
(b)
<RIGHTWARD AIR BLOWING>
X
Z
B
AIR
13x
13z
13
D
23
21c
21a
21b
E3
12
15
15x
15z
21

FIG. 9

(a)


20r
21
21d
E1
22
23
D
E3
21c
21b
21a
26
25

(b)


20s
21
21d
22
23
D
E3
21c
21b
21a
26
25

(c)

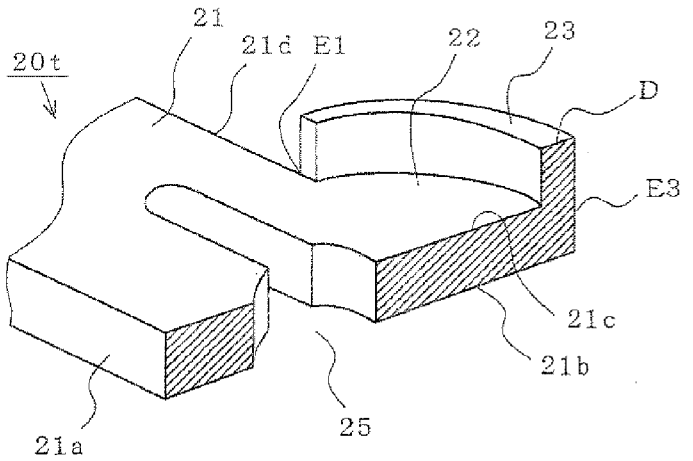

20t
21
21d
E1
22
23
D
E3
21c
21b
21a
25

FIG. 10

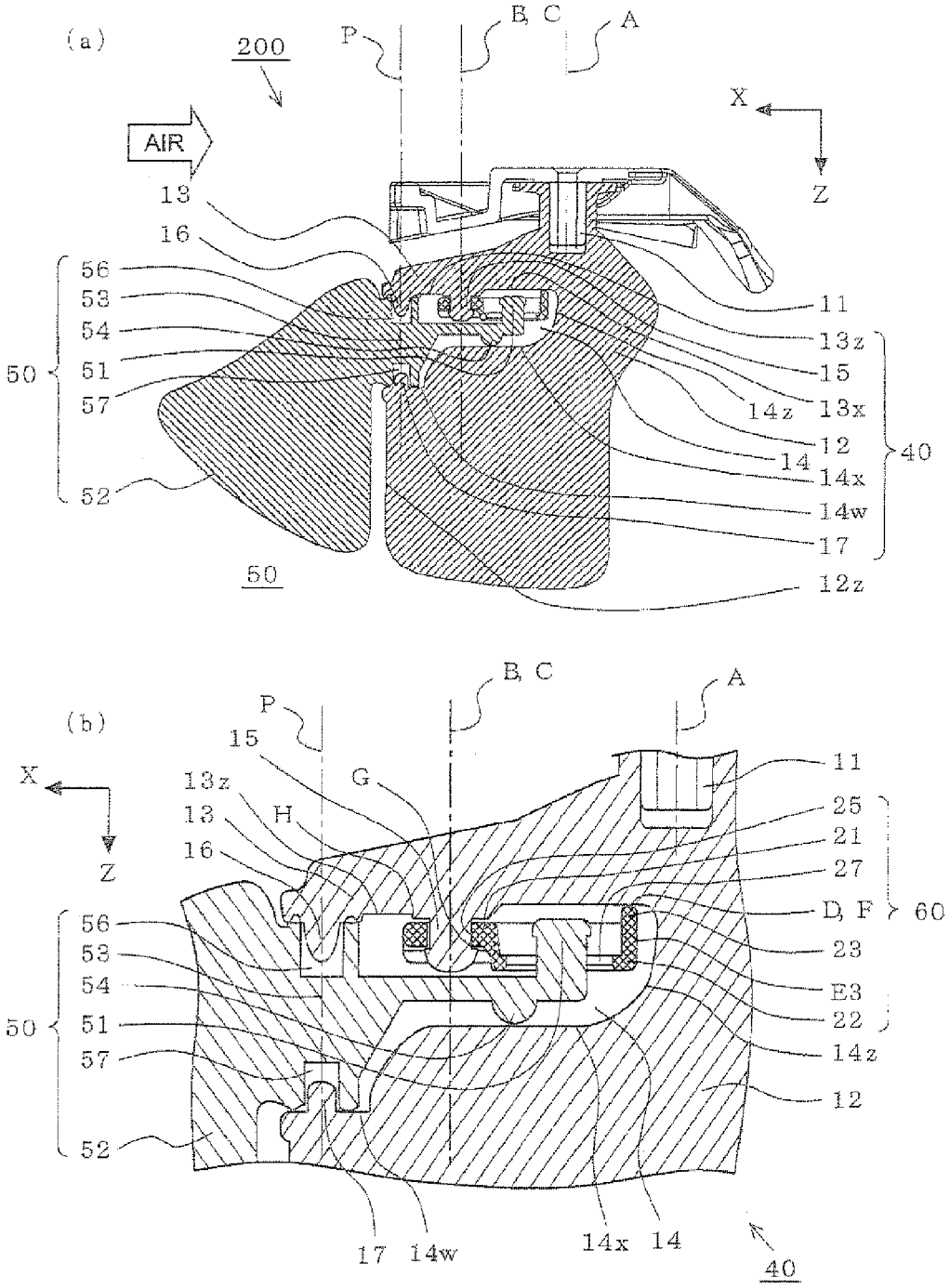

(a)
200
P
B, C
A
AIR
X
Z
13
16
56
53
54
50
51
57
52
11
13z
15
14z
13x
12
14
14x
14w
17
40
50
12z
(b)
P
B, C
A
15
13z
13
16
G
H
X
Z
11
25
21
27
D, F
60
56
53
54
50
51
57
52
23
E3
22
14z
12
17
14w
14x
14
40

FIG. 11

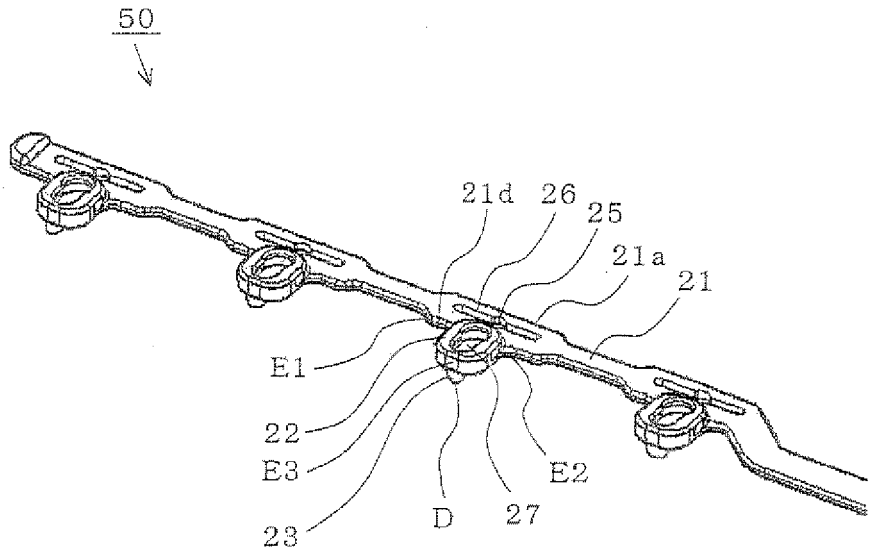


FIG. 12

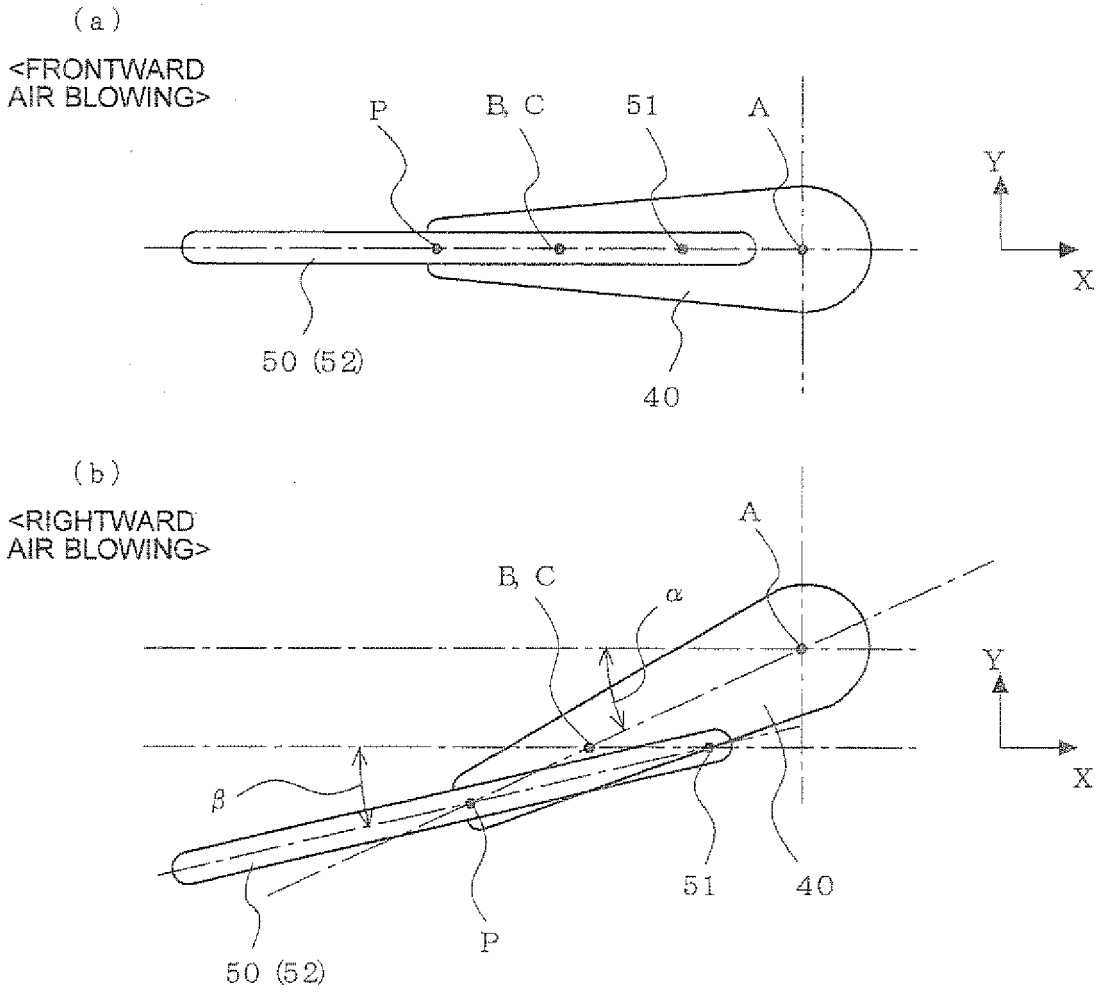

(a)
<FRONTWARD AIR BLOWING>
P
B, C
51
A
Y
X
50 (52)
40
(b)
<RIGHTWARD AIR BLOWING>
A
B, C
α
Y
X
β
51
40
P
50 (52)

FIG. 13

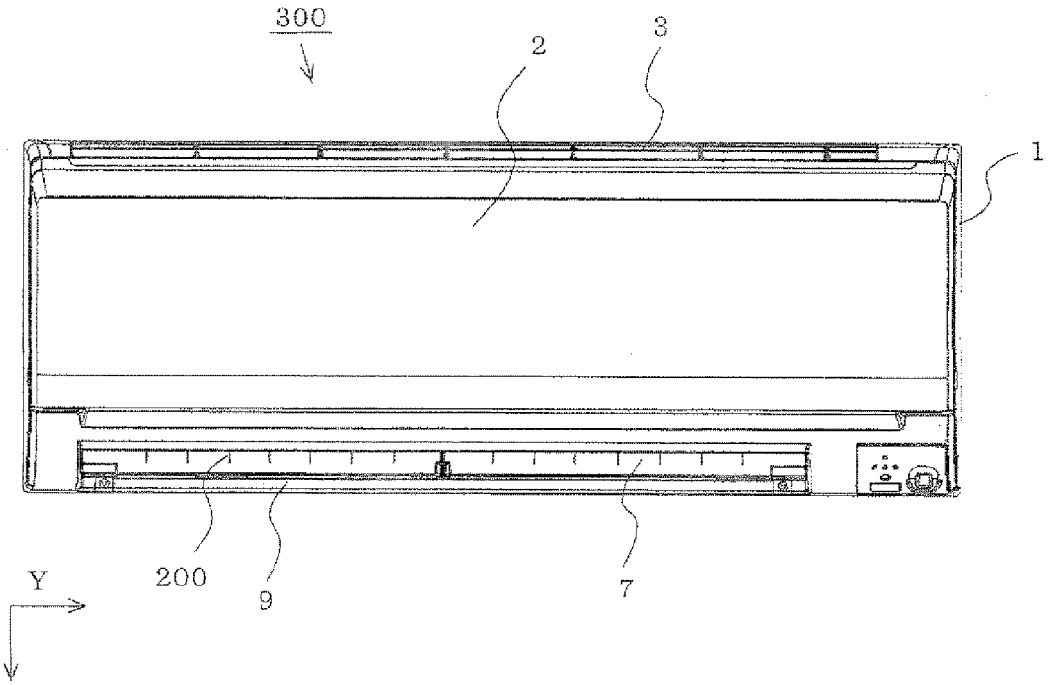


FIG. 14

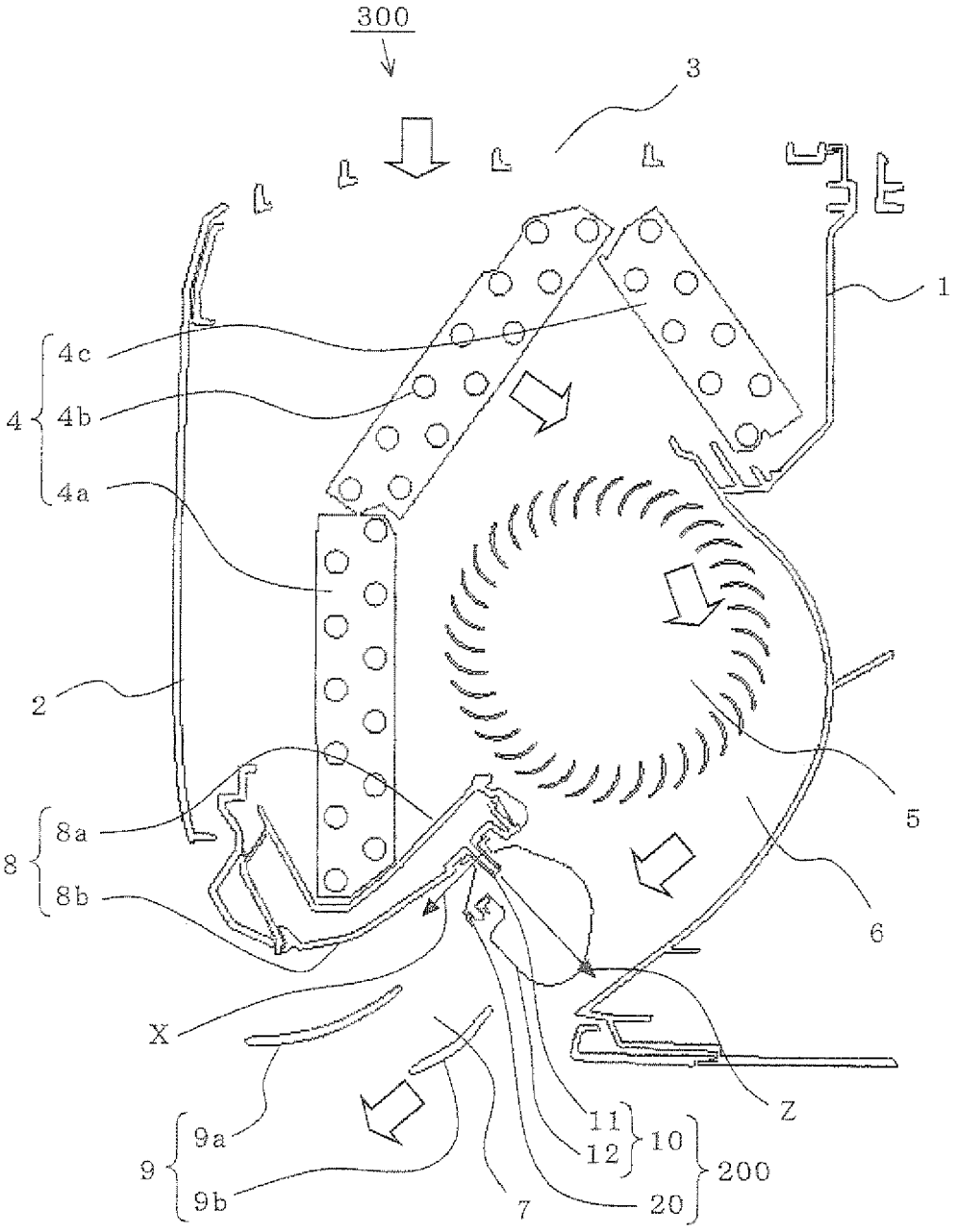
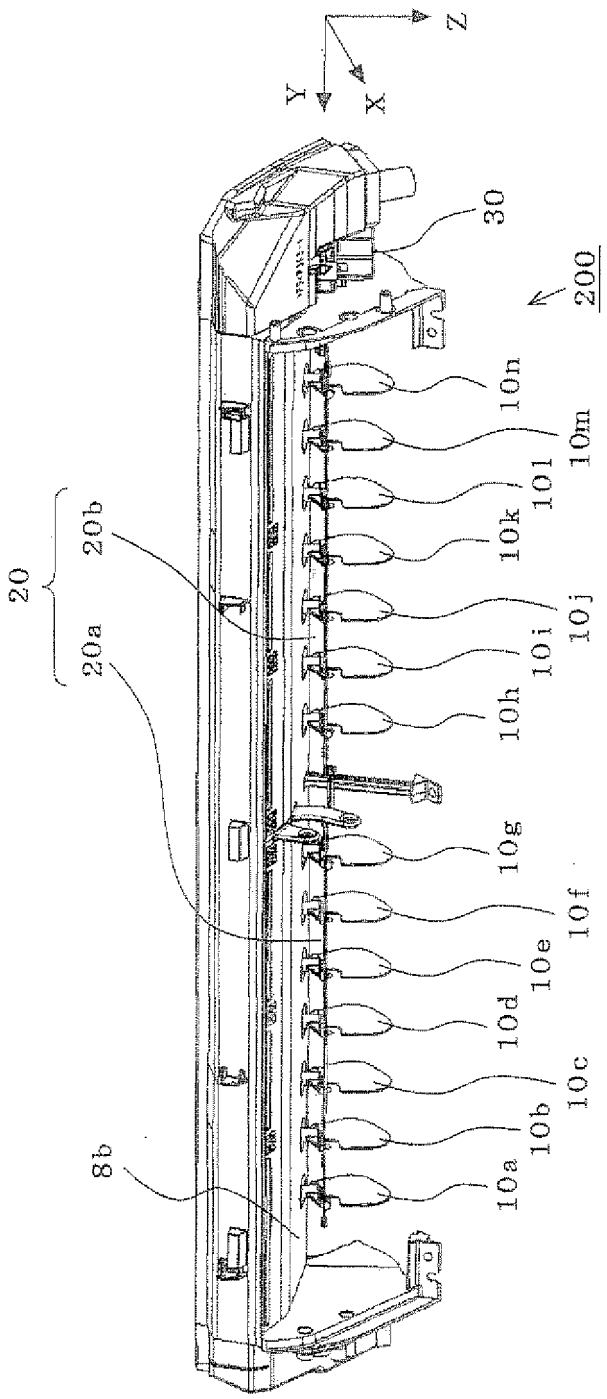


FIG. 15


Z
Y
X
30
200
10n
10m
101
10k
10j
10i
10h
10g
10f
10e
10d
10c
10b
10a
20
20b
20a
8b

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8313043 A **[0003]**