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

(11) EP 2 292 984 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.03.2011 Bulletin 2011/10

(21) Application number: **10003179.8**

(22) Date of filing: **25.03.2010**

(51) Int Cl.:
F24F 1/00 *(2011.01)* ***F24F 13/15*** *(2006.01)*
F24F 13/14 *(2006.01)*

(84) Designated Contracting States:
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 SE SI SK SM TR
Designated Extension States:
AL BA ME RS

(30) Priority: **23.07.2009 JP 2009172016**

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

(72) Inventors:
- **Ishikawa, Masato**
  Tokyo 102-0073 (JP)
- **Ooishi, Masayuki**
  Tokyo 102-0073 (JP)
- **Suzuki, Akimoto**
  Tokyo 102-0073 (JP)
- **Ikeda, Hisanori**
  Tokyo 102-0073 (JP)
- **Kinami, Masahide**
  Tokyo 102-0073 (JP)
- **Yokota, Shuuhei**
  Tokyo 102-0073 (JP)
- **Koyanagi, Youhei**
  Tokyo 102-0073 (JP)

(74) Representative: **Pfenning, Meinig & Partner GbR**
Patent- und Rechtsanwälte
Theresienhöhe 13
80339 München (DE)

(54) Wind direction adjusting apparatus and indoor unit of air conditioner

(57) There is provided an wind direction adjusting apparatus in which an energy saving effect is obtained by restraining an increase in draft resistance, and an indoor unit of an air conditioner having the wind direction adjusting apparatus provided therein. An wind direction adjusting apparatus 200 includes a base member 40, a first wind direction plate 12 provided on the base member 40 so as to be rotatable about a reference center of rotation A, a second wind direction plate 22 provided on the first wind direction plate 12 so as to be rotatable about a coupled center of rotation B, a moving member 30 provided with the first wind direction plate 12 and the second wind direction plate 22 so as to be rotatable about a first center of rotation C and a second center of rotation D respectively, and driving means 50 configured to move the moving member 30 relatively with respect to the base member 40, and an angle formed between a first imaginary line L1 connecting the reference center of rotation A and the coupled center of rotation B and a second imaginary line L2 connecting the coupled center of rotation B and the second center of rotation D varies according to the amount of relative movement of the moving member 30.

EP 2 292 984 A2

Description

Technical Field

[0001] The present invention relates to a wind direction adjusting apparatus and an indoor unit of an air conditioner and, more specifically, to a wind direction adjusting apparatus provided in the indoor unit of the air conditioner and the indoor unit of the air conditioner in which the wind direction adjusting apparatus is provided therein.

Background Art

[0002] A wind direction adjusting apparatus configured to adjust the blowing direction of cooled or heated air is provided at a blowout port of an indoor unit of an air conditioner. As the wind direction adjusting apparatus as described above, there is the wind direction adjusting apparatus including a wind direction plate (the same as vertical flap) having a bendable soft portion, and being configured to adjust the blowing direction by bending the soft portion, which was disclosed long ago (for example, see Patent Literature 1).

[0003] There is also a disclosure of an wind direction adjusting apparatus including a drive arm and a driven arm arranged in parallel to each other, a plurality of wind direction plates (vanes) in a first row rotatably connected at both end portions to the drive arm and the driven arm, and a plurality of wind direction plates (vanes) in a second row rotatably connected at both end portions to the drive arm and the driven arm, and being configured to adjust the blowing direction by differentiating an angle of inclination of a parallelogram defined by the drive arm, the driven arm and the plurality of wind direction plate in the first row (an angl.e formed by a bottom side and an oblique side) and the angle of inclination of the parallelogram defined by the drive arm, the driven arm, and the plurality of wind direction plates in the second row (for example, see Patent Literature 2).

Citation List

Patent Literature

[0004]

[Patent Literature 1] JP-UM-A-3-37351 (pp. 6-8, Fig. 3)
[Patent Literature 2] JP-A-2007-132636 (p. 5, Fig. 6)

Summary of Invention

Technical Problem

[0005] According to the wind direction plate disclosed in Patent Literature 1, since the soft portion interposed between hard portions arranged at both ends is bendable and expandable, the materials for forming the wind direction plate are limited, and there is a fear of separation at a joint surface between the hard portion and the soft portion. Therefore, there are problems of increase in manufacturing cost and degradation of reliability.

[0006] In contrast, the wind direction plate in the first row and the wind direction plate in the second row disclosed in Patent Literature 2 are both integrally molded, and hence the above-described problem is solved. However, the wind direction plate in the first row and the wind direction plate in the second row are provided in a staggered arrangement, that is, are arranged at a predetermined interval in a plane vertical to the blowing direction. Therefore, there arises a problem that the air flow collides against both end surfaces of the wind direction plate in the first row on the windward side and end surfaces of the wind direction plate in the second row on the windward side, and hence the draft resistance is increased, whereby the energy loss is generated.

[0007] In order to solve the problems described above, it is an object of the present invention to provide an wind direction adjusting apparatus in which an energy saving effect is obtained by restraining an increase in draft resistance, and an indoor unit of an air conditioner having the wind direction adjusting apparatus provided therein. Solution to Problems

[0008] According to the present invention, there is provided an wind direction adjusting apparatus including:

a base member;
a first vane provided on the base member so as to be rotatable about a reference center of rotation;
a second vane provided on the first vane so as to be rotatable about a coupled center of rotation;
a moving member provided with the first vane and the second vane so as to be rotatable about a first center of

rotation and a second center of rotation, respectively;
driving means configured to move the moving member relatively with respect to the base member, wherein an angle formed between a first imaginary line connecting the reference center of rotation and the coupled center of rotation and a second imaginary line connecting the coupled center of rotation and the second center of rotation varies according to the amount of the relative movement of the moving member.

Advantageous Effect of the Invention

[0009] The wind direction adjusting apparatus according to the present invention is configured in such a manner that the first vane is rotated with the reference center of rotation as a fulcrum and with the first center of rotation as a point of lever where a force is applied by the movement of the moving member, and the coupled center of rotation is moved along an arc. In the same manner, the second vane is rotated with the coupled center of rotation as a fulcrum and the second center of rotation as a point of lever where a force is applied by the movement of the moving member.
At this time, since the first vane and the second vane both are coupled so as to be rotatable about the coupled center of rotation, the first vane and the second vane behave as if they were a single plate. In particular, since the first vane and the second vane overlap with each other like a single flat plate when the air is blown out in the front direction, the air only collides against an end surface of one of the first vane or the second vane, and does not collide against end surfaces of both of the first vane and the second vane as in the case of the staggered arrangement in the related art. Therefore, the air flow is smoothened, the increase in draft resistance is restrained, and the energy saving effect is obtained.
In the description above, the second vane is rotated with the coupled center of rotation as a fulcrum and the second center of rotation as a point of lever where a force is applied, it may be regarded such that it is rotated with the coupled center of rotation as a point of lever where a force is applied and the second center of rotation as a fulcrum.

Brief Description of Drawings

[0010]

Fig. 1 is an explanatory drawing showing an indoor unit of an air conditioner according to Embodiment 1 of the present invention, in which (a) is an appearance drawing viewed substantially from the front, and (b) is an appearance drawing viewed right upward from right below.
Fig. 2 is an explanatory exploded perspective view showing components of the indoor unit shown in Fig. 1.
Fig. 3 is an explanatory side cross-sectional view of the indoor unit shown in Fig. 1.
Fig. 4 is a side view schematically showing an wind direction adjusting apparatus according to Embodiment 2 of the present invention.
Fig. 5 is an explanatory exploded perspective view showing components of the wind direction adjusting apparatus shown in Fig. 4.
Fig. 6 is a perspective view showing an assembled state of the wind direction adjusting apparatus shown in Fig. 4.
Fig. 7 is an explanatory plan view showing a link mechanism of the wind direction adjusting apparatus shown in Fig. 4.

Description of Embodiments

Embodiment 1

(Indoor Unit of Air Conditioner)

[0011] Fig. 1 to Fig. 3 are explanatory drawings of an indoor unit of an air conditioner according to Embodiment 1 of the present invention. Fig. 1(a) is an appearance drawing viewed substantially from the front, Fig. 1(b) is an appearance drawing viewed right upward from right below, Fig. 2 is an exploded perspective view showing components, and Fig. 3 is a side cross-sectional view. The respective drawings are illustrated schematically, and the present invention is not limited to illustrated configurations.
[0012] In Fig. 1 to Fig. 3, the indoor unit of the air conditioner (hereinafter, referred to as "indoor unit") 100 includes a main body 110 having an inlet port 111 and a blowout port 112, blowing means 120 forming an air duct 113 extending from the inlet port 111 to the blowout port 112, heat exchanging means 130 arranged in the air duct 113, and a lateral wind direction adjusting apparatus (hereinafter, referred to as "wind direction adjusting apparatus") 200 arranged in the air duct 113.
[0013] The main body 110 includes a base member 114 to be fixed to a wall or the like in the indoors (hereinafter, the base member 114 side is referred to as the "rear surface"), a casing 115 to be fixed to the base member 114, and a

front design panel 116 detachably and rotatably attached to a front surface of the casing 115. The inlet port 111 is formed on an upper surface of the casing 115, the blowout port 112 is formed on a lower surface (including part of the upper surface) of the casing 115, and part of the base member 114 defines part (rear surface side) of the air duct 113.
A vertical wind direction adjusting apparatus 300 including a front vertical wind direction vane 301 and a bottom vertical wind direction vane 302 is provided at the blowout port 112.

[0014] The heat exchanging means 130 having a rear surface side portion and a front surface side portion is arranged on the upstream side of the air duct 113 with respect to the blowing means 120, and includes heat exchanger tubes 131 for allowing a refrigerant supplied from an outdoor unit to circulate therein, not shown and a plurality of radiating fins 132 through which the heat exchanger tubes 131 are penetrated.
Provided below the front surface side portion of the heat exchanging means 130 is a drain pan unit 140. The drain pan unit 140 includes an upper surface 141 of the drain pan 140 for receiving drainage dripped from the heat exchanging means 130, and a lower surface 142 of the drain pan 140 which defines part (a front surface or a lower surface side) of the air duct 113.

[0015] Then, the wind direction adjusting apparatus 200 is provided on the lower surface 142 of the drain pan 140. Since the wind direction adjusting apparatus 200 corresponds to the wind direction adjusting apparatus 200 which will be described in detail in Embodiment 2, it will be briefly described in Embodiment 1. The wind direction adjusting apparatus 200 includes a base member 40 provided on the lower surface 142 of the drain pan 140, a first member 10 rotatably provided on the base member 40 at a reference center of rotation A, and a second member 20 rotatably provided on the first member 10.
At this time, since an angle of the first member 10 with respect to the air duct 113 and an angle of the second member 20 with respect to the air duct 113 are different from each other, the air flow can be changed smoothly in the desired direction in the lateral direction, for example, by setting the angle of the second member 20 arranged on the upstream side to be small, and setting the angle of the first member 10 arranged on the downstream side to be large. Therefore, the increase in draft resistance is restrained, and an energy saving effect can be obtained (these points will be described in detail in Embodiment 2).

[0016] For the convenience of description, the direction of the reference center of rotation A is defined as "Z direction", the widthwise direction of the main body 110 vertical to the Z direction is defined as "X direction", and the direction vertical to the Z direction and substantially fore-and-aft direction of the main body 110 (more precisely, the direction inclining toward the front surface and the lower surface) is defined as "Y direction" (it is the same in Embodiment 2 as well). Therefore, Fig. 1 (a) is an appearance drawing viewed from the front side in the "-Y direction", and Fig. 1(b) is an appearance drawing viewed upward from the underside of the paper plane in Fig. 3 (from right below to right above of the main body 110).

[0017] The base member 114 is further provided with an electrical parts box 117. A filter 151 is detachably and movably provided near the inlet port 111 of the air duct 113. Since the indoor unit 100 is provided with an automatic filter cleaning device unit 150, a dust box 152 for storing dust dropped from the filter 151 is provided at a position close to the front surface.
The indoor unit 100 is provided with a display device 161 for displaying an operating state or the like on the front design panel 116, and an infrared ray sensor 162 for sensing the position of a person existing in the indoors (including absence of the person) provided at a substantially widthwise center.
Since the provision of the automatic filter cleaning device unit 150, the display device 161, and the infrared ray sensor 162 is not mandatory in the present invention, these members may be omitted.

Embodiment 2

(Wind direction Adjusting Apparatus)

[0018] Fig. 4 to Fig. 7 are explanatory drawings of the wind direction adjusting apparatus according to Embodiment 2 of the present invention. Fig. 4 is a schematic side view, Fig. 5 is an exploded perspective view of components, Fig. 6 is a perspective view showing an assembled state (front blowing, and oblique blowing), and Fig. 7 is an explanatory plan view of a link mechanism (front blowing, and oblique blowing).
The respective drawings are illustrated schematically, and the present invention is not limited to illustrated modes.
In Fig. 4 to Fig. 7, the wind direction adjusting apparatus 200 is an assembly of the first member 10, the second member 20, a moving member 30, the base member 40, and driving means 50. The base member 40 is to be provided on the lower surface 142 of the drain pan 140 of the indoor unit 100 (Embodiment 1).

(First Member)

[0019] The first member 10 includes a reference shaft 11 and a flat and panel-shaped first wind direction plate (the same as the first vane) 12 provided on a plane including a centerline of the reference shaft 11 (hereinafter, referred to

as "reference center of rotation A"). The first wind direction plate 12 is formed with a notched portion 14 which is depressed from one side edge 13 toward the reference center of rotation A.

The first member 10 is also provided with a lower coupling shaft 15a formed on a lower end edge 14a of the notched portion 14 near the one side edge 13 so as to project toward an upper end edge 14b and provided with a center line parallel to the reference center of rotation A (hereinafter, referred to as "coupled center of rotation B"), and an upper coupling shaft 15b formed on the upper end edge 14b of the notched portion 14 near the one side edge 13 so as to project toward the lower end edge 14a and provided with the same centerline as the lower coupling shaft (coupled center of rotation B). The lower coupling shaft 15a and the upper coupling shaft 15b may be referred to as "coupling shaft 15" collectively.

[0020] There is also provided a first moving shaft 16 formed on the lower end edge 14a of the notched portion 14 so as to project toward the upper end edge 14b and arranged between the reference shaft 11 and the lower coupling shaft 15a (hereinafter, the axial center of the first moving shaft 16 is referred to as a "first center of rotation C"). Also, the lower coupling shaft 15a and the upper coupling shaft 15b include a lower coupling seat 15c and an upper coupling seat 15d having an upper end surface and a lower end surface vertical to the coupled center of rotation B respectively, and the first moving shaft 16 includes a first moving seat 16c having an upper end surface vertical to the first center of rotation C. The thickness of the first wind direction plate 12 is not uniform over the entire area, and is thicker around the notched portion 14. Specifically, the upper end edge 14b of the notched portion 14 is formed into a table shape projecting vertically to a surface of the first wind direction plate 12 like a flange. In the present invention, the configuration of the first member 10 is not limited to those illustrated in the drawings, and is to be determined as design requirements on the basis of forces acting on respective portions of the first member 10 and the relationship with the air flow when being used after having assembled. The number of the first member 10 is not limited.

(Second Member)

[0021] The second member 20 includes a lower coupling bearing 25a and an upper coupling bearing 25b having the identical centerline (which is in agreement with the coupled center of rotation B in the assembled state) which rotatably supports the lower coupling shaft 15a and the upper coupling shaft 15b and a second wind direction plate (the same as the second vane) 22 having a plane including the centerline of the lower coupling bearing 25a and the upper coupling bearing 25b and being formed so as to project on one side of side surfaces of the lower coupling bearing 25a and the upper coupling bearing 25b. The lower coupling bearing 25a and the upper coupling bering 25b may be referred to as coupling bearing 25" collectively.

There is provided a projecting portion 24 projecting on the other side (the direction opposite from the second wind direction plate 22) of side surfaces of the lower coupling bearing 25a and the upper coupling bearing 25b, and a second moving shaft 26 (hereinafter, the axial center of the second moving shaft 26 may be referred to as "second center of rotation D") and an abutment projection 27 are provided on a lower surface and an upper surface of the projecting portion 24, respectively.

[0022] An upper end surface of the lower coupling bearing 25a, a lower end surface of the upper coupling bearing 25b, and a lower surface of the projecting portion 24 are formed vertically to the centerlines (which are in agreement with the coupled center of rotation B in the assembled state) of the both bearings.

Therefore, in the assembled state, an upper end surface of the lower coupling seat 15c and a lower end surface of the upper coupling seat 15d of the first member 10 come into abutment with the upper end surface of the lower coupling bearing 25a and the lower end surface of the upper coupling bearing 25b of the second member 20 respectively (in Fig. 4, these members which are to come into abutment with each other are illustrated with a gap provided therebetween for the sake of easy understanding of the assembled state of the respective members).

(Moving Member)

[0023] The moving member 30 includes a moving body portion 33 whose longitudinal direction agrees with the X direction in the assembled state and a moving arm portion 34 projecting in the vertical direction (Y direction in the assembled state) with respect to the moving body portion 33. The moving body portion 33 is formed with a first moving bearing 31, and the moving arm portion 34 is formed with a second moving bearing 32.

The first moving bearing 31 is configured to rotatably support the first moving shaft 16 of the first member 10 in the assembled state, and at least a range of a lower surface of the moving body portion 33, where the upper end surface of the first moving seat 16c comes into abutment with, is formed into a plane vertical to the axial center of the first moving bearing 31. Therefore, in the assembled state, the upper end surface of the first moving seat 16c of the first member 10 comes into abutment with the lower surface of the moving body portion 33 (in Fig. 4, these members which are to come into abutment with each other are illustrated with a gap provided therebetween for the sake of easy understanding of the assembled state of the respective members).

The first moving bearing 31 includes a penetrating slit-shaped moving groove 31a formed on both sides with respect to the longitudinal direction and allows easy attachment (fitting) of the first moving shaft 16 into the first moving bearing 31.

[0024] In contrast, the second moving bearing 32 is configured to support the second moving shaft 26 of the second member 20 rotatably and movably in the Y direction in the assembled state, and is an elongated hole extending in the Y direction. Also, in the assembled state, an upper surface of the moving arm portion 34, at least around the second moving bearing 32, is formed into a plane vertical to the axial center of the first moving bearing 31.

At this time, in the assembled state, the lower surface of the projecting portion 24 of the second member 20 comes into abutment with the upper surface of the moving arm portion 34 (in Fig. 4, these members which are to come into abutment with each other are illustrated with a gap provided therebetween for the sake of easy understanding of the assembled state of the respective members).

(Driving Means)

[0025] One end of a coupling rod 51 is rotatably connected to one end of the moving body portion 33, and a motor coupling member 52 is rotatably connected to the other end of the coupling rod 51.

The motor coupling member 52 includes a motor connecting portion 52a connected to an output shaft of a motor 53, and a motor coupling arm 52b fixed to the motor connecting portion 52a and connected at a distal end thereof to the coupling rod 51.

Therefore, when the motor 53 rotates, the motor connecting rod makes a translational motion. The motor coupling member 52 is not limited to the configuration described above, and may have a rack-and-pinion structure. It is also possible to provide an actuator such as solenoid instead of the motor 53.

[0026] In the assembled state shown in Fig. 4, since the first moving shaft 16 projects from an upper surface of the moving body portion 33 through the first moving bearing 31, the upper surface of the moving arm portion 34 is protruded from the upper surface of the moving body portion 33 by an amount slightly larger than the amount of projection of the first moving shaft 16 in order to avoid the interference between the first moving shaft 16 and the projecting portion 24 of the second member. In this case, configurations in which the thickness of the moving body portion 33 is equalized with that of the moving arm portion 34 (this results in formation of a step height between the lower surface of the moving body portion 33 and a lower surface of the moving arm portion 34), and the moving body portion 33 is formed to have a thickness which accommodates the entire length of the first moving shaft 16 (this eliminates the formation of a step height between an upper surface of the moving body potion 33 and the upper surface of the moving arm portion 34, and increases the weight).

(Base Member)

[0027] The base member 40 in the assembled state includes a supporting surface 41 configured to support an end surface of the reference shaft 11 vertically to the reference center of rotation A, and holding means configured to hold the reference shaft 11 so as not to come apart from the base member 40 and so as to be rotatable about the reference center of rotation A (a claw which surrounds a disk-shaped reference shaft flange 11a formed so as to project from a side surface of the reference shaft 11) 42.

The base member 40 is provided at one end thereof with a rotatably locking portion 43 which is rotatably locked with the lower surface 142 of the drain pan 140 and at the other end thereof with a fixedly locking portion 44 for fixing the base member 40 provided on the lower surface 142 of the drain pan 140 so as not to rotate.

In other words, as described later, the base member 40 is set up in the vertical direction (X direction) to the air duct 113 during the operation of the indoor unit 100, and may be set up in parallel to the air duct 113 so as to be capable of being partly projected to the outside of the main body 110 from the blowout port 112 when cleaning the indoor unit 100.

(Materials)

[0028] In the description given above, the base member 40 is formed of PP resin, the first member 10 is formed of ABS resin, the second member 20 is formed of POM resin, and the moving member 30 is formed of PP resin respectively, so that the coupled resins are of different types. In the present invention, the materials used for forming these members are not limited to the combination described above, and other combinations are also applicable. Alternatively, it is also applicable to couple the same materials (bring into abutment with each other), and provide lubricating means (applying lubricant) on coupled portions (abutted portions).

(Action - Front blowing)

[0029] In Figs. 6(a) and (b), the reference shaft 11 (the reference center of rotation A), the first moving shaft 16 (the

first center of rotation C) and the coupling shaft 15 (the coupled center of rotation B) of the each first member 10 on the wind direction adjusting apparatus 200 are aligned linearly in the Y direction. Also, the second moving shaft 26 (the second center of rotation D) and the coupling bearing 25 (the coupled center of rotation B) of the each second member 20 are aligned linearly in the Y direction.

[0030] Therefore, the first wind direction plate 12 and the second wind direction plate 22 are aligned linearly in the Y direction. In this state, since the one side edge 13 of the first wind direction plate 12 and the other side edge 23 of the second wind direction plate 22 are in proximity to each other, the both assume a form like one flat panel. Therefore, air collides only against a windward end surface of the second wind direction plate 22 and does not collide against end surfaces of both the first wind direction plate 12 and the second wind direction plate 22 as in the case of a staggered arrangement (arranged in parallel at predetermined intervals) in the related art. Therefore, the air flow is smoothened, the increase in draft resistance is restrained, and the energy saving effect is obtained.

[0031] In other words, by arranging the second wind direction plate 22 on the upstream side of the air duct 113 and arranging the first wind direction plate 12 on the downstream side of the air duct 113, the air flow does not collide against the side edges of the both or does not separate from the side edges of the both, whereby the increase in draft resistance is restrained, and the energy saving effect is obtained.

At this time, both of the first wind direction plate 12 and the second wind direction plate 22 are not defined clearly such that one surface (for example, the surface on the +X direction side) is a positive pressure surface (high in velocity of flow) and the other surface (for example, the surface on the -X direction side) is a negative pressure surface (low in velocity of flow). Therefore, vibrations may be creased in one or both of the first wind direction plate 12 and the second wind direction plate 22 due to variations of the flow. However, according to the configuration of the wind direction adjusting apparatus 200, since the abutment projection 27 of the second member 20 is in abutment with the upper end edge 14b of the notched portion 14 of the first member 10 in the case of the front blowing, the vibrations as described above are restrained.

(Operation - Oblique Blowing)

[0032] In Figs. 7(a) and (b), in the first member 10 of the wind direction adjusting apparatus 200, since the moving member 30 (the first moving bearing 31) is moved in the -X direction, the first moving shaft 16 (the first center of rotation C) and the coupling shaft 15 (the coupling center of rotation B) are moved mainly in the -X direction respectively depicting an arc locus about the reference shaft 11 (the reference center of rotation A) as a fixed point. A first imaginary line L1 which connects the reference shaft 11 (the reference center of rotation A), the first moving shaft 16 (the first center of rotation C) and the coupling shaft 15 (the coupled center of rotation B) is inclined with respect to the Y direction at "an angle of (hereinafter, referred to as "first angle of inclination") ϕ".

In contrast, as regards the second member 20, the coupling bearing 25 moves in the same manner as the coupling shaft 15. The second moving shaft 26 (the second center of rotation D) moves in the -X direction by the same distance as the first moving shaft 16, and moves in the -Y direction in the second moving bearing 32. Therefore, a second imaginary line L2 which connects the coupling bearing 25 (the second coupled center of rotation B) and the second moving shaft 26 (the second center of rotation D) is inclined against the Y direction at "an angle of (hereinafter, referred to as "second angle of inclination") θ".

[0033] Then, since the one side edge 13 of the first wind direction plate 12 and the other side edge 23 of the second wind direction plate 22 are in proximity to each other, the both assume a form like one flat panel being bent along the coupling shaft 15 (the coupling bearing 25).

In other words, by arranging the second wind direction plate 22 on the upstream side of the air duct 113 and arranging the first wind direction plate 12 on the downstream side of the air duct 113 as in the case of the front blowing, the air flow does not collide against the side edges of the both or does not separate from the side edges of the both, whereby the increase in draft resistance is restrained, and the energy saving effect is obtained.

At this time, although the abutment projection 27 of the second member 20 is apart from the upper end edge 14b of the notched portion 14 of the first member 10, both of the first wind direction plate 12 and the second wind direction plate 22 are defined clearly such that one surface (for example, the surface on the +X direction side) is a positive pressure surface (high in velocity of flow) and the other surface (for example, the surface on the -X direction side) is a negative pressure surface (low in velocity of flow). Therefore, even when there are variations in air flow, creation of vibrations in one or both of the first wind direction plate 12 and the second wind direction plate 22 is avoided (does not occur often).

[0034] In Fig. 7(b), a relationship; $m \cdot \sin(\phi) = n \cdot \sin(\theta)$ ... expression (1) is established, where "m" is a center-to-center distance between the first moving shaft 16 and the coupling shaft 15 of the first member 10, and "n" is a center-to-center distance between the second moving shaft 26 and the coupling bearing 25 of the second member 20.

Therefore, for example, in order to make the first angle of inclination ϕ with respect to the air duct 113 of the first wind direction plate 12 arranged on the downstream side "double" the second angle of inclination θ with respect to the air duct 113 of the second wind direction plate 22 arranged on the upstream side, it is essential only that the relationship of;

$$m \cdot \sin(2 \cdot \theta) = n \cdot \sin(\theta) \quad \ldots \text{Expression (2)}$$

$$n/m = 2 \cdot \cos(\theta) \quad \ldots \text{Expression (3)}$$

are established.

[0035] Therefore, when changing the angle θ by "-30° to +30° ($-3<\theta<+30$)", for example, "cos (20°) = 0.940" is substituted and the expression;

$$n/m = 1.88 \quad \ldots \text{Expression (4)}$$

is obtained.

[0036] Also, the length "p" of the second moving shaft 26 in the Y direction is;

$$p = n \cdot (\cos(0°) - \cos(30°)) \quad \ldots \text{Expression (5)}$$

$$p = n \cdot (1-0.866) = 0.13 \cdot n \quad \ldots \text{Expression (6)}$$

(when n/m is fixed, the value of ϕ/θ is slightly varied, Expression (6) is not accurate in the strictest sense).

[0037] In the wind direction adjusting apparatus 200 described thus far, descriptions are given such that the center of the coupling shaft 15 is in agreement with the center of the coupling bearing 25 in terms of the coupled center of rotation B, or that the lower coupling seat 15c and the upper coupling seat 15d having the upper end surface and the lower end surface vertical to the coupled center of rotation B are provided. However, the term "agreement" and "vertical" mentioned above do not mean geometrically strict "agreement" and "vertical", and include an allowable margin of error from the industrial point of view.

The place to dispose the shaft and the bearing which supports the shaft may be reversed. For example, instead of the configuration in which the coupling shaft 15 is provided on the first member and the coupling bearing 25 is provided on the second member, a configuration in which the coupling shaft is provided on the second member and the coupling bearing for supporting the coupling shaft is provided on the first member is also applicable.

Also, a configuration in which the first moving shaft 16 is provided on the upper end edge 14b of the notched portion 14 and the moving member 30 is arranged above the projecting portion 24 of the second member 20 is also applicable. In this case, the second moving shaft 26 is provided on the upper surface of the projecting portion 24.

[0038] In Fig. 1(b), the indoor unit 100 is stopped and the wind direction adjusting apparatus 200 projects outside from the blowout port 112. In other words, the fixedly locking portion 44 of the base member 40 is moved apart from the lower surface 142 of the drain pan 140 and is rotated about the rotatably locking portion 43. Therefore, a pair of the wind direction adjusting apparatuses 200 arranged on the left and right are opened like a set of double doors. Therefore, cleaning in the interior of the main body 110 or cleaning of the wind direction adjusting apparatuses 200 themselves is easily achieved.

Industrial Applicability

[0039] According to the present invention, since the blowing direction of air can be set (change) while restraining the increase in draft resistance, superior energy saving properties are provided. Therefore, the present invention can be applied widely as the various types of wind direction adjusting apparatuses to be provided at the air blowout port, and as the indoor unit of the various types of wind direction adjusting apparatuses in which the wind direction adjusting apparatus is provided.

Reference Signs List

[0040]

10...first member, 11...reference shaft, 11a...reference shaft flange, 12...first wind direction plate, 13...side edge, 14...notched portion, 14a...lower end edge, 14b...upper end edge, 15a...lower coupling shaft, 15b...upper coupling shaft, 15c...lower coupling seat, 15d...upper coupling seat, 16...first moving shaft, 16c...first moving seat, 20...second member, 22...second wind direction plate, 23...side edge, 24...projecting portion, 25a...lower coupling bearing, 25b...upper coupling bearing, 26...second moving shaft, 27....abutment projection, 30...moving member, 31...first moving bearing, 31a...m.oving groove, 32...second moving bearing, 33...moving body portion, 34...moving arm portion, 40...base member, 41...supporting surface, 43...rotatably locking portion, 44...fixedly locking portion, 50...driving means, 51...coupling rod, 52...motor coupling member, 52a...motor connecting portion, 52b...motor coupling arm, 53...motor, 100...indoor unit, 110...main body, 111...inlet port, 112...blowout port, 113...air duct, 114...base member, 115...casing, 116...front design panel, 117...electrical parts box, 120...blowing means, 130...heat exchanging means, 131...heat exchanger tube, 132...radiating fin, 140...drain pan unit, 141...upper surface of the drain pan, 142...lower surface of the drain pan, 150...automatic filter cleaning device unit, 151...filter, 152...dust box, 161...display device, 1.62...infrared ray sensor, 200...wind direction adjusting apparatus, 300...vertical wind direction adjusting apparatus, 301...front vertical wind direction vane, 302...bottom vertical wind direction vane, A...reference center of rotation, B...coupled center of rotation, C....first center of rotation, D...second center of rotation, L1...first imaginary line, L2...second imaginary line, ϕ...first angle of inclination, θ... second angle of inclination

Claims

1. An wind direction adjusting apparatus comprising:

a base member (40);
a first vane (12) provided on the base member (40) so as to be rotatable about a reference center (A) of rotation;
a second vane (22) provided on the first vane (12) so as to be rotatable about a coupled center (B) of rotation;
a moving member (30) provided with the first vane (12) and the second vane (22) so as to be rotatable about a first center (C) of rotation and a second center (D) of rotation, respectively; and
driving means (50) configured to move the moving member (30) relatively with respect to the base member (40), wherein
an angle formed between a first imaginary line (L1) connecting the reference center (A) of rotation and the coupled center (B) of rotation and a second imaginary line (L2) connecting the coupled center (B) of rotation and the second center (D) of rotation varies according to the amount of the relative movement of the moving member (30).

2. An wind direction adjusting apparatus comprising:

a first member (10) having a reference shaft (11), a first wind direction plate (12) having a notched portion (14) depressed from one side edge toward the centerline in a plane including a centerline of the reference shaft (11), a pair of coupling shafts (15a,15b) formed so as to project at the notched portion (14) near the one side edge and having a centerline parallel to the center line of the reference shaft (11), and a first moving shaft (16) formed so as to project from the notched portion (14) and arranged between the reference shaft (11) and the coupling shafts (15a,15b);
a base member (40) configured to rotatably support the reference shaft (11);
a second member (20) having a pair of coupling bearings (25a,25b) configured to rotatable support the pair of coupled shafts (15a,15b), a second wind direction plate (22) formed so as to project from one side of a side surface of the coupling bearing (25a,25b) in a plane including a centerline of the coupling bearing (25a,25b), a projecting portion (24) formed so as to project from the other side of the side surface of the coupled bearings (25a,25b), and a second moving shaft (26) formed on the projecting portion (24);
a moving member (30) having a first moving bearing (31) being movable relatively with respect to the base member (40) and being configured to rotatably support the first moving shaft (16), and a second moving bearing (32) for rotatably supporting the second moving shaft (26); and
driving means (50) configured to move the moving member (30) relatively with respect to the base member (40), wherein
the first moving bearing (31) and the second moving bearing (32) are provided at a predetermined distance

apart from each other in the direction vertical to the relative movement of the moving member (30) with respect to the base member (40).

3. The wind direction adjusting apparatus of claim 2, wherein the second moving bearing (32) is an elongated hole which is expanded in the direction vertical to the relative movement of the moving member (30) with respect to the base member (40).

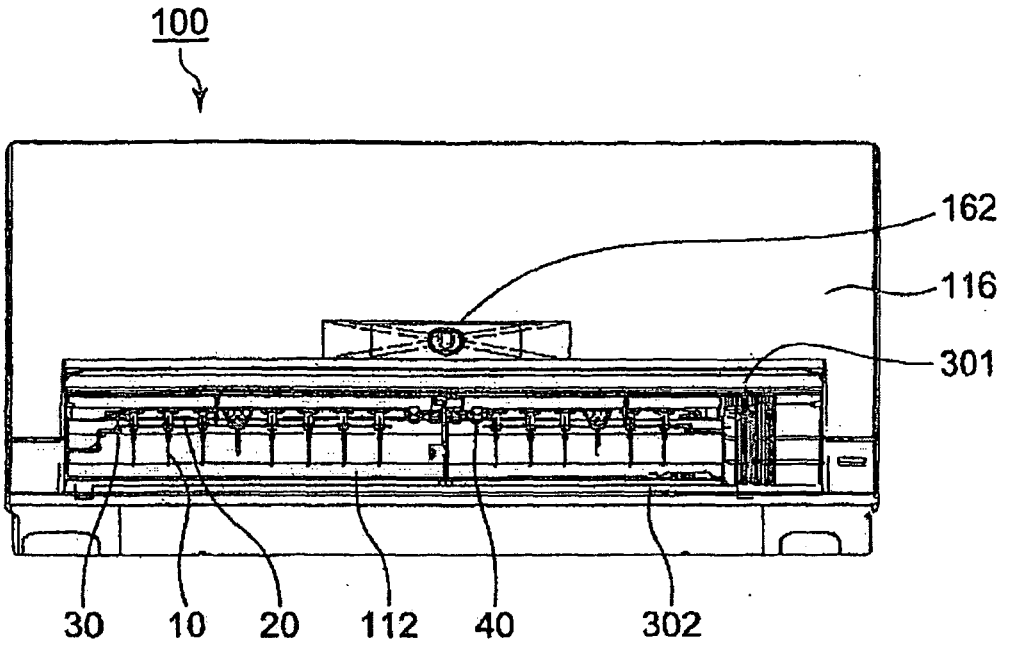
4. The wind direction adjusting apparatus of claim 2 or 3, wherein an abutment projection (27) is formed on the projecting portion (24), and the abutment projection (27) abuts on the notched portion (14) when the first wind direction plate (12) and the second wind direction plate (22) are positioned on a substantially identical plane.

5. An indoor unit of an air conditioner comprising:

a main body (110) having an inlet port (111) and a blowout port (112);
blowing means (120) which defines an air duct from the inlet port (111) to the blowout port (112);
heat exchanging means (130) arranged in the air duct;
and
an wind direction adjusting apparatus (200) of any one of claims 1 to 4 arranged in the air duct.

FIG. 1

(a)



(b)

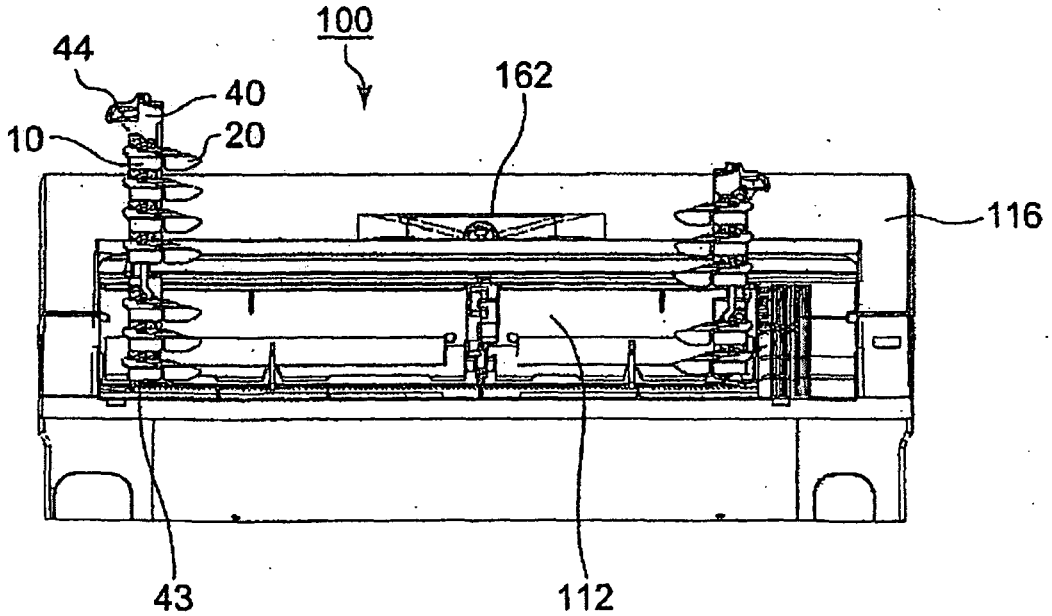


FIG. 2

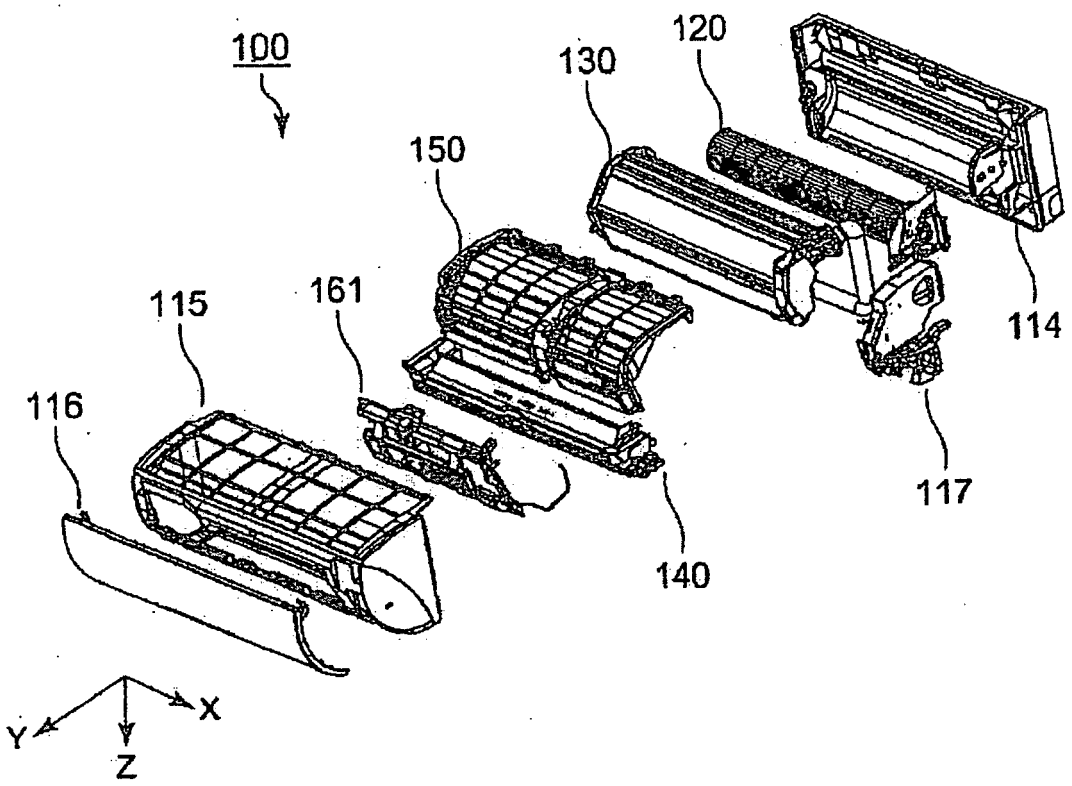


FIG. 3

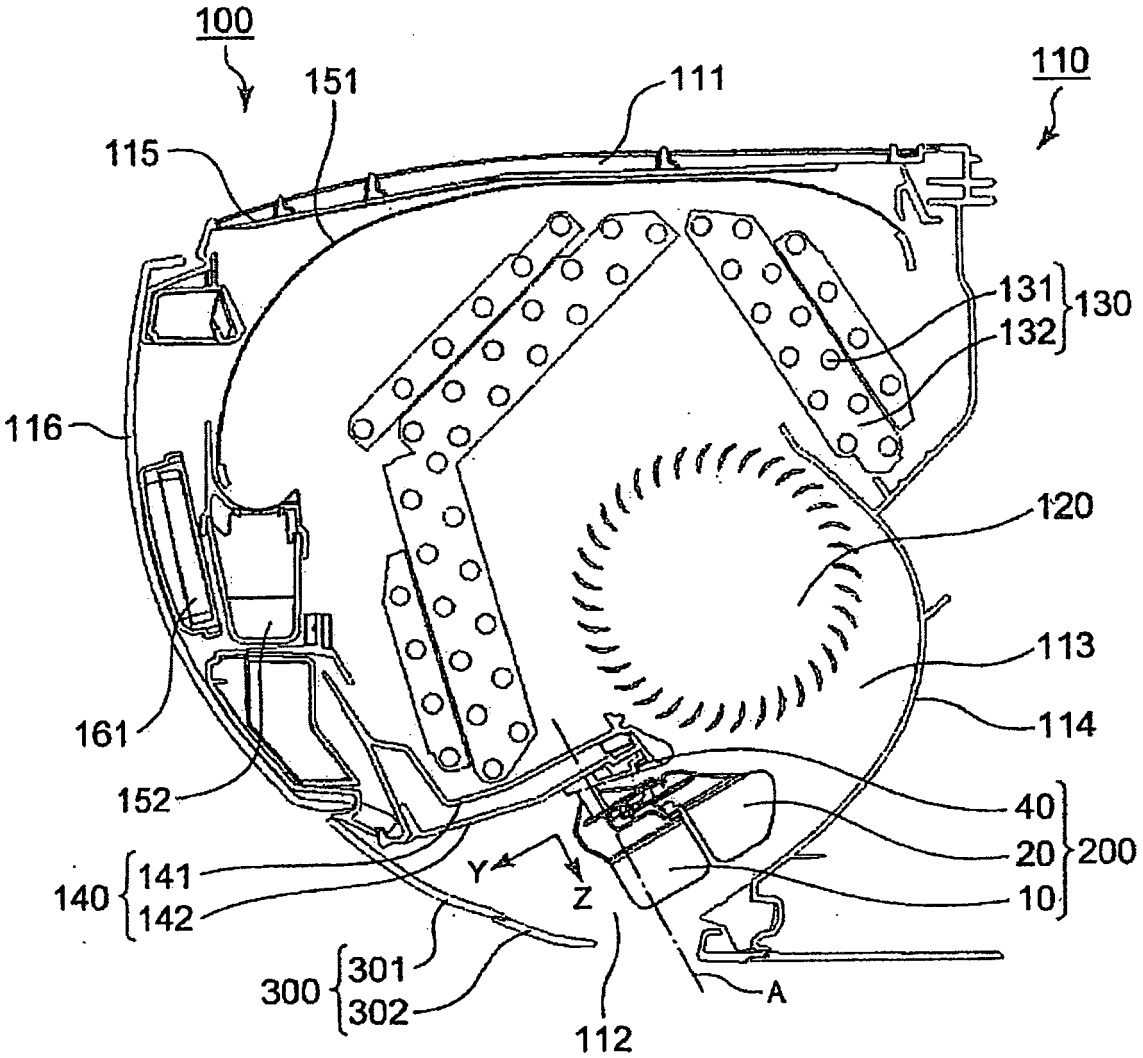

100
151
111
110
115
131
132
130
116
120
113
161
114
152
40
20
200
Y
Z
140
141
142
10
300
301
302
A
112

FIG. 4

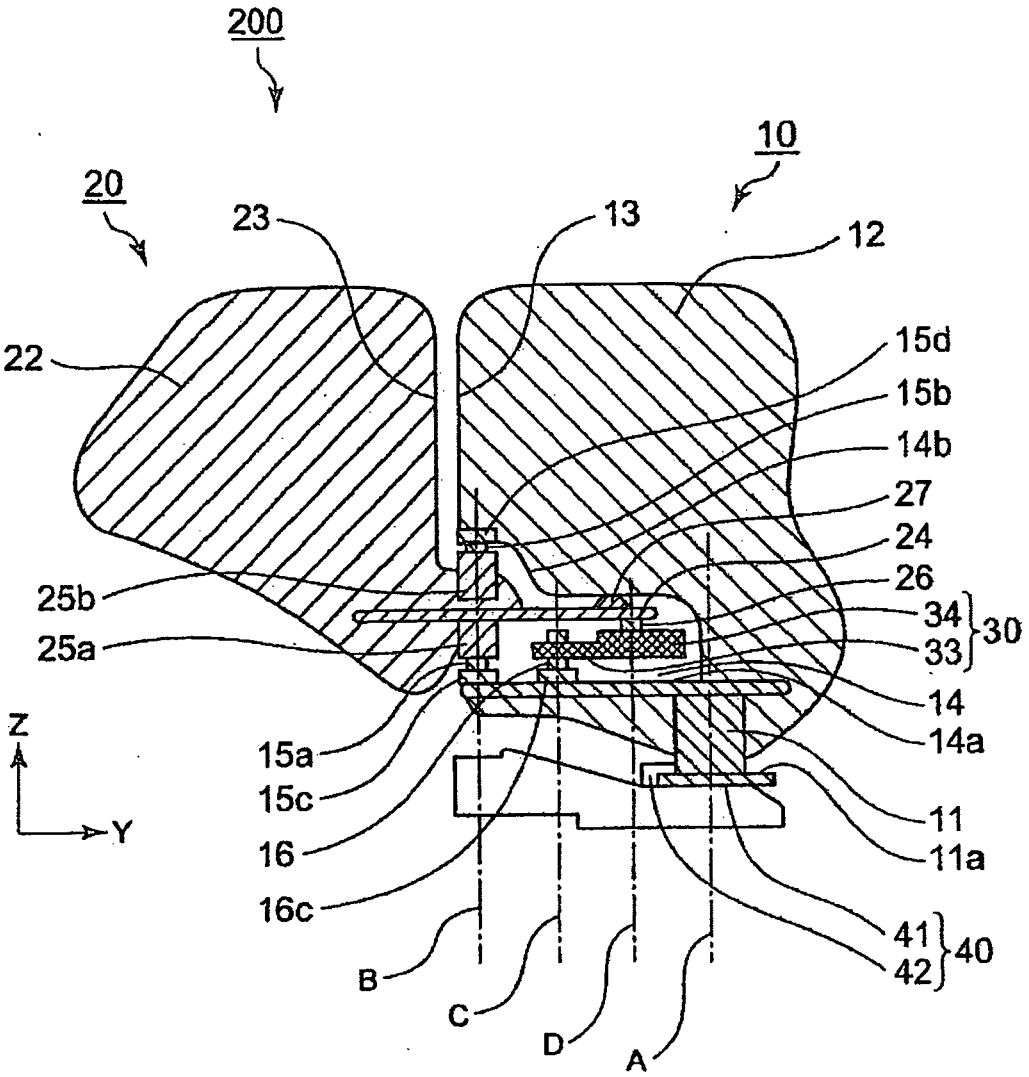

200
10
20
23
13
12
22
15d
15b
14b
27
24
26
25b
34
33
30
25a
14
14a
Z
Y
15a
15c
16
16c
11
11a
41
42
40
B
C
D
A

FIG. 5

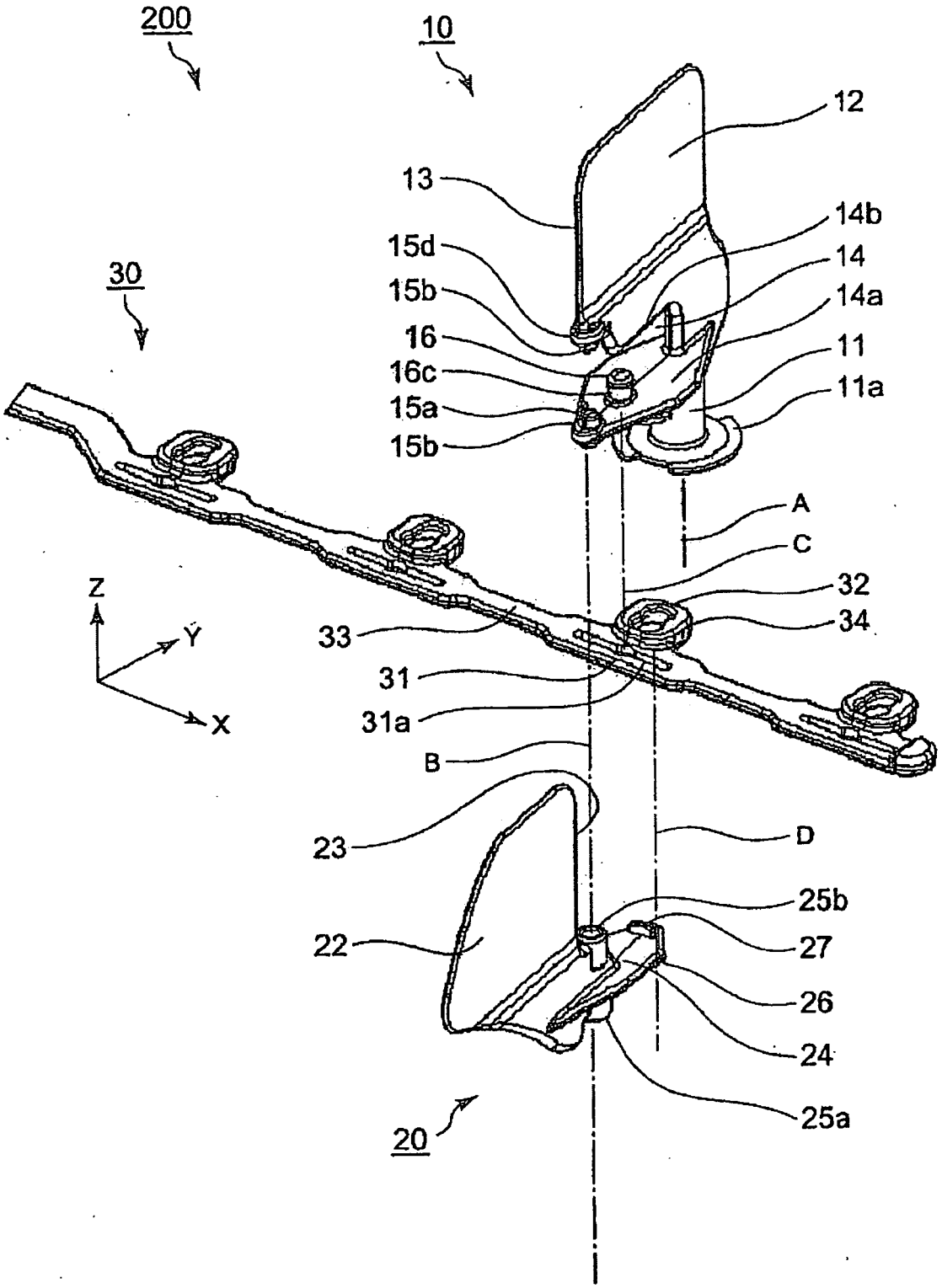
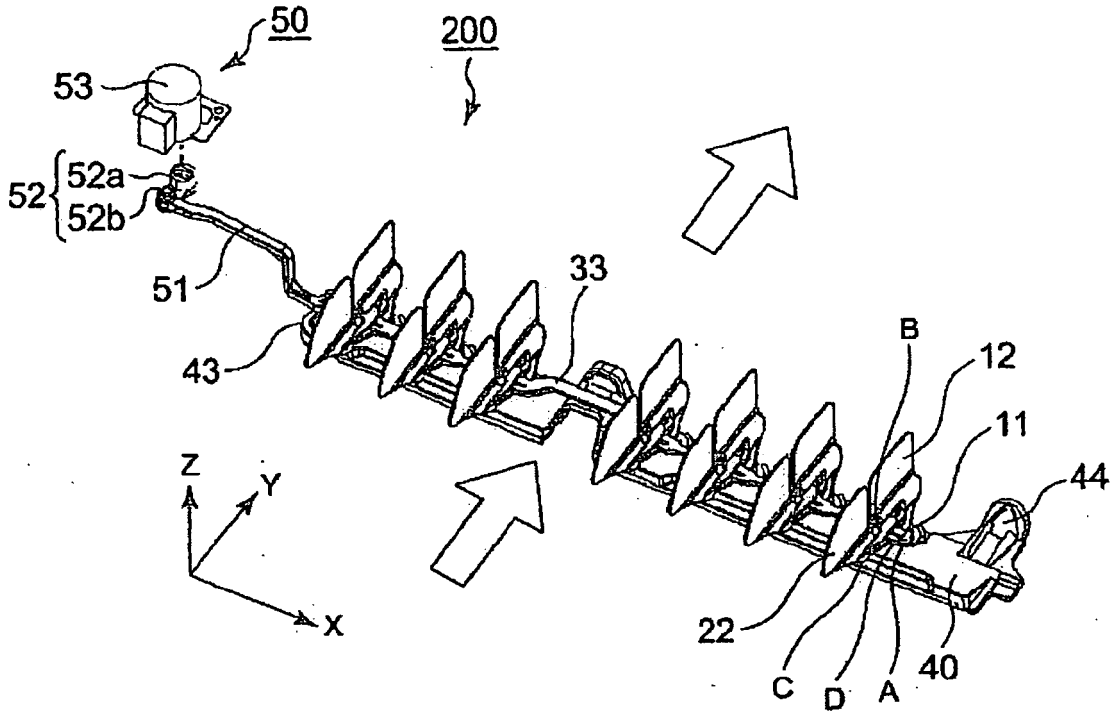

200
10
12
13
14b
15d
14
30
15b
14a
16
11
16c
11a
15a
15b
A
C
Z
32
Y
33
34
31
31a
X
B
23
D
25b
22
27
26
24
20
25a

FIG. 6

(a)


50
200
53
52
52a
52b
51
33
43
B
12
11
44
Z
Y
X
22
C
D
A
40

(b)

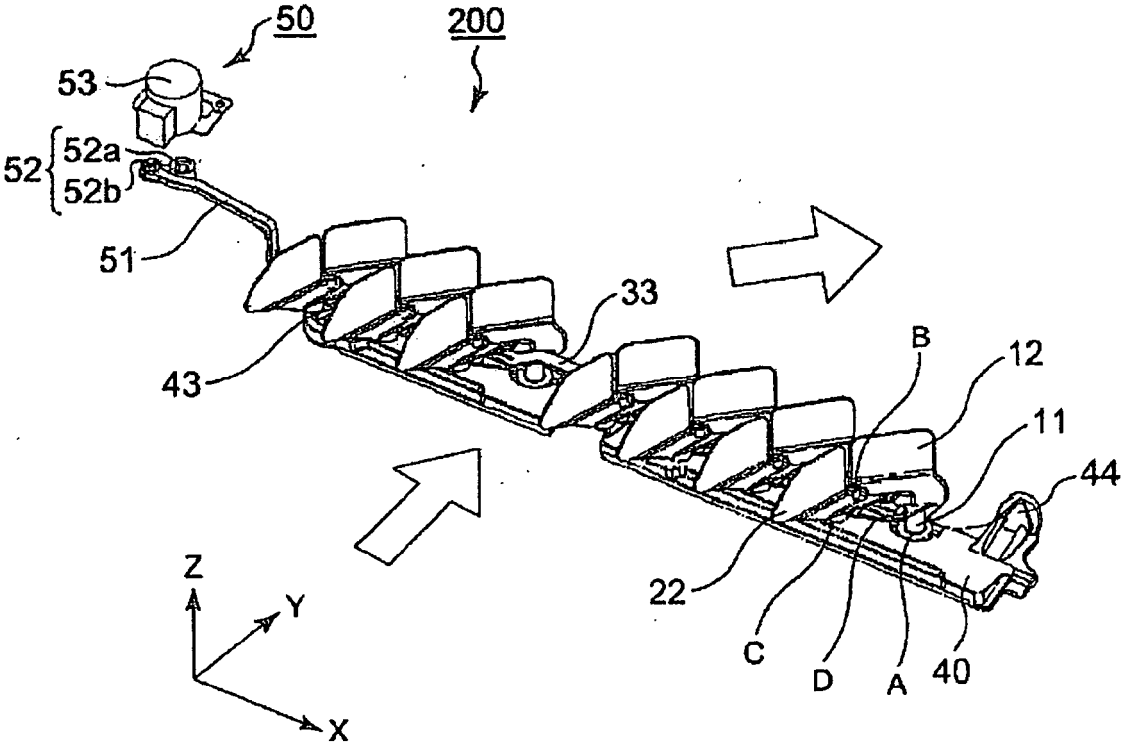
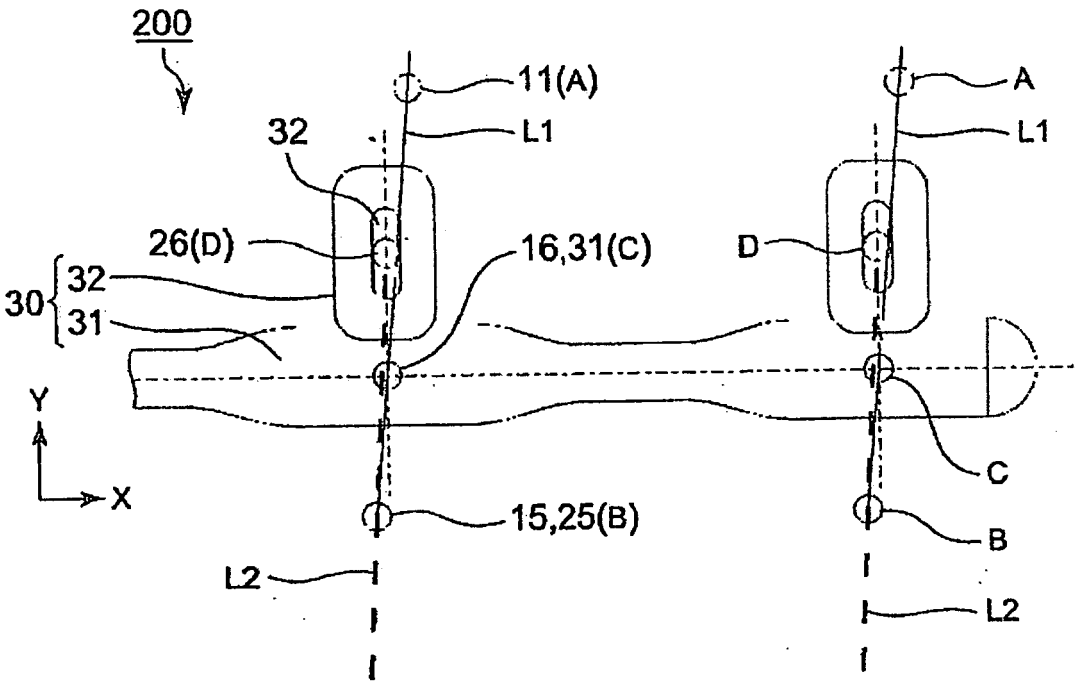
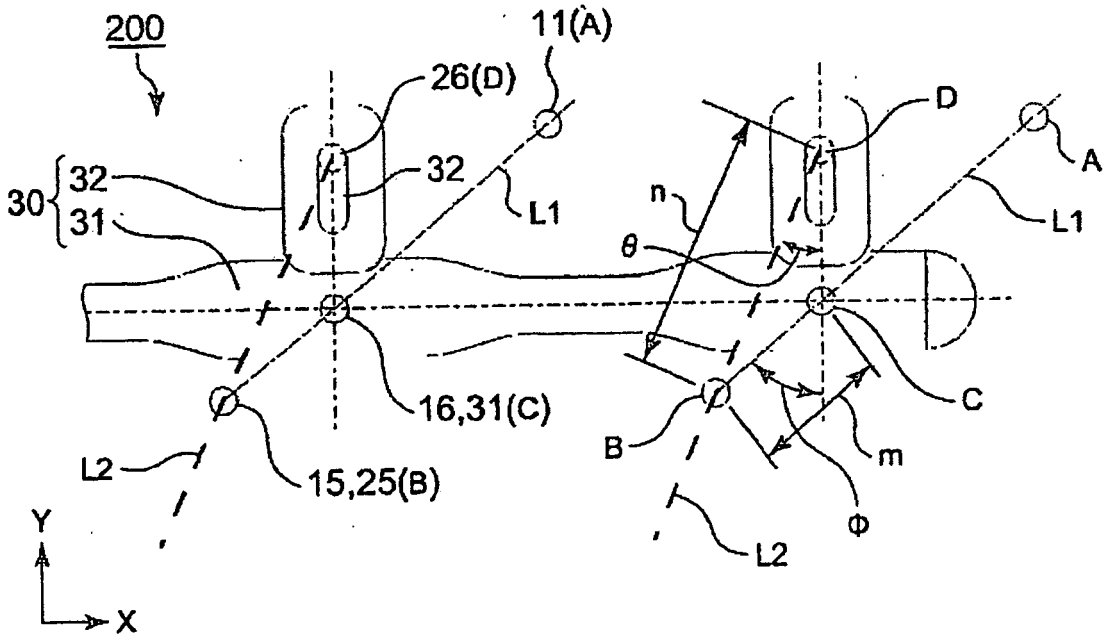

50
200
53
52
52a
52b
51
33
43
B
12
11
44
Z
Y
X
22
C
D
A
40

FIG. 7

(a)


200
11(A)
32
L1
26(D)
16,31(C)
30
32
31
Y
X
15,25(B)
L2
A
L1
D
C
B
L2

(b)


200
11(A)
26(D)
32
30
32
31
L1
16,31(C)
L2
15,25(B)
Y
X
D
A
L1
n
θ
C
B
m
Φ
L2

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 3037351 A **[0004]**
- JP 2007132636 A **[0004]**