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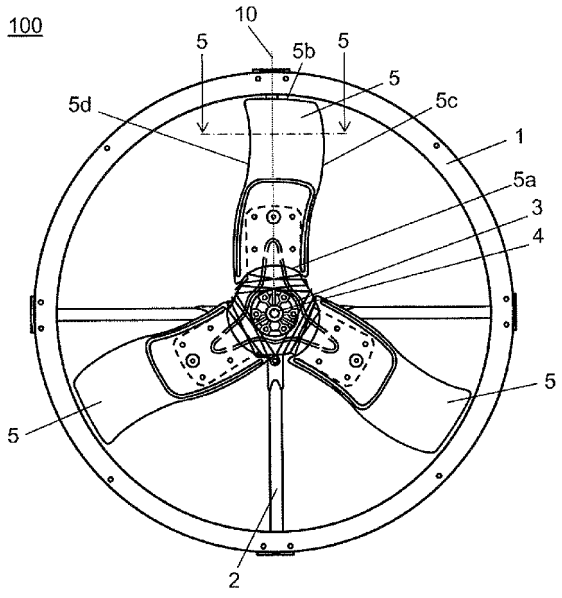
(54) AIR BLOWING DEVICE

(57) An air blowing device has rectangular blades whose inner sides are disposed facing a motor shaft and outer sides are disposed to the side of an orifice at an outer periphery. A front side linking the inner side and the outer side in each rectangular blade has a first protrusion protruding in the rotating direction at its middle part. The blade is moderately curved to the side opposite to the rotating direction from the first protrusion to the inner side and the outer side. A rear side linking the inner side and the outer side of the blade has a second protrusion protruding in the rotating direction at its middle part. The blade is moderately curved to the side opposite to the rotating direction from the second protrusion to the inner side and the outer side.

FIG. 1



EP 2 511 533 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to large-scale air blowing devices typically used for agricultural affairs.

BACKGROUND ART

[0002] A conventional structure of this type of air blowing devices is described below. An air blowing device includes a cylindrical orifice, a motor provided on a central axis of the orifice, and multiple blades disposed at predetermined intervals on an outer periphery of a motor shaft of the motor. Each blade has a rectangular shape, and its inner side is disposed facing the motor shaft. Its outer side is disposed facing orifice at the outer periphery. (For example, refer to PTL 1.)

[0003] A disadvantage of the conventional air blowing device as described above is its large power consumption. More specifically, this type of air blowing devices is used for feeding air to livestock barns, poultry houses, and greenhouses. Therefore, its power consumption typically reaches 600W.

[0004] Up to now, questions have not been raised about power consumption of the air blowing device because it is indispensable for the growth of living creatures.

[0005] Now, however, to suppress increase in a range of production costs, an air blowing device with small power consumption is demanded.

[Citation List]

Patent Literature

[0006]

PTL 1 Japanese Patent Unexamined Publication 2004-52709

SUMMARY OF THE INVENTION

[0007] An air blowing device of the present invention includes a cylindrical orifice, a motor provided on a central axis of the orifice, and multiple blades disposed on an outer periphery of a motor shaft of the motor at predetermined intervals. The blades have rectangular shapes whose inner sides are facing the motor shaft and outer sides are facing the orifice. A front side linking the inner side and outer side of each blade has a first protrusion protruding in a rotating direction at its middle part. The blade is curved to the side opposite to the rotating direction from the first protrusion to the inner side and the outer side. A rear side linking the inner side and the outer side of the blade has a second protrusion protruding in the rotating direction at its middle part. The blade is curved to the side opposite to the rotating direction from the second protrusion to the inner side and the outer side.

[0008] This reduces resistance that each blade receives during rotation. As a result, power consumption of the air blowing device can be reduced under the condition of securing the same air volume as before.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1 is a front view of an air blowing device in accordance with an exemplary embodiment of the present invention.

Fig. 2 is a sectional view of the air blowing device in accordance with the exemplary embodiment of the present invention.

Fig. 3 is a front view of an attachment plate of the air blowing device in accordance with the exemplary embodiment of the present invention.

Fig. 4 is a front view of a blade of the air blowing device in accordance with the exemplary embodiment of the present invention.

Fig. 5 is a sectional view taken along line 5-5 in Fig. 1.

Fig. 6 is a perspective view illustrating a method of forming the blade of the air blowing device in accordance with the exemplary embodiment of the present invention.

Fig. 7 is a front magnified view of a key part of the air blowing device in accordance with the exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0010] An exemplary embodiment of the present invention is described below with reference to drawings. Same components may be given same reference marks to omit their duplicate description.

(EXEMPLARY EMBODIMENT)

[0011] As shown in Fig. 1, air blowing device 100 in the exemplary embodiment at least includes cylindrical orifice 1, motor 3 shown in Fig. 2 that is fixed to a central axis of orifice 1 by its four attachment legs 2, and multiple blades 5 disposed on an outer periphery of motor shaft 4 of motor 3 at predetermined intervals.

[0012] In the exemplary embodiment, blades 5 are attached to attachment plate 6 shown in Fig. 3 that is provided on the outer periphery of motor shaft 4. More specifically, attachment plate 6 has multiple attachment parts 7 on its outer periphery at predetermined intervals, and each blade 5 is attached to each attachment part 7.

[0013] As shown in Fig. 4, blade 5 has a substantially-rectangular shape whose inner side 5a is facing motor shaft 4 and outer side 5b is facing orifice 1 at the outer periphery. In this substantially-rectangular blade 5, front side 5c linking inner side 5a and outer side 5b has first protrusion 12A in its middle part. First protrusion 12A protrudes in the rotating direction (a direction of arrow in

the drawing). Front side 5c is moderately curved from first protrusion 12A toward inner side 5a and outer side 5b in a direction opposite to the rotating direction. Still more, in this substantially-rectangular blade 5, rear side 5d linking inner side 5a and outer side 5b has second protrusion 12B in its middle part. Second protrusion 12B protrudes in the rotating direction. Rear side 5d is moderately curved from second protrusion 12B toward inner side 5a and outer side 5b in a direction opposite to the rotating direction. In the above description, the middle parts of front side 5c and rear side 5d are portions between a central part of inner side 5a and outer side 5b of blade 5 and outer side 5b. In addition, the substantially-rectangular shape in the above description intends to include shapes whose angles are not all right angles.

[0014] The moderately-curved shape is, in other words, a substantially-S shape like a waveform. More specifically, if blade 5 is seen from the direction of motor shaft 4, a portion of front side 5c facing outer side 5b, i.e., a curved portion including first protrusion 12A , is curved bulging in the rotating direction of blade 5. A portion of front side 5c facing inner side 5a is curved inward against the rotating direction of blade 5. Blade 5 is thus S shaped.

[0015] In this exemplary embodiment, as shown in Fig. 4, blade 5 has the next shape. When line 11 linking a corner of front side 5c and outer side 5b and a corner of front side 5c and inner side 5a of blade 5 is shifted in a parallel fashion to center 5e, line 11 is tilted at angle θ of about 5 ° in the blade rotating direction, relative to center line 10 linking the rotating center and center 5e of blade 5.

[0016] Furthermore, in this exemplary embodiment, as shown in Fig. 5, blade 5 is curved from center line 10 toward front side 5c and rear side 5d, i.e., facing motor 3 in Fig. 1 or Fig. 2.

[0017] A specific method of forming a curved shape of blade 5 shown in Fig. 5 is briefly described below with reference to Fig. 6.

[0018] First, substantially-rectangular blade 5 is placed on lower die 8 with a cylindrical surface shown in a right-hand drawing in Fig. 6 along center line 10 of blade 5 shown in a left-hand drawing in Fig. 6. Then, upper die 9 is pressed down from above to blade 5 placed on lower die 8.

[0019] This forms blade 5 into the surface shape of lower die 8. In other words, blade 5 is curved from center line 10 of blade 5 shown in the left-hand drawing of Fig. 5 toward front side 5c and rear side 5d.

[0020] In the same way, attachment part 7 of attachment plate 6 is formed such that its front side 7a is inclined more toward motor 3 shown in Fig. 1 or Fig. 2 than rear side 7b.

[0021] By attaching blade 5 to attachment part 7 with this inclined shape, blade 5 can be attached to motor shaft 4 such that its front side 5c is inclined more toward motor 3 shown in Fig. 1 or Fig. 2 than rear side 5d.

[0022] Still more, in this exemplary embodiment, as shown in Fig. 7, distance X between outer side 5b and orifice 1 at the side of front side 5c is set longer than distance Y between outer side 5b and orifice 1 at the side of rear side 5d. This achieves the air blowing device described in this exemplary embodiment of the present invention.

[0023] When power is applied to motor 3 and motor shaft 4 is rotated in the air blowing device as configured above, blades 5 attached to motor 3 rotate such that front side 5c moves ahead of rear side 5d in each blade 5. As a result, air is fed in the direction shown by an arrow in Fig. 2 (a direction opposite to motor 3).

[0024] As described above, the air blowing device in this exemplary embodiment has substantially-rectangular blades 5. The middle part of front side 5c linking inner side 5a and outer side 5b of blade 5 protrudes in the rotating direction, and the middle part of rear side 5d linking inner side 5a and outer side 5b of blade 5 protrudes in the rotating direction.

[0025] With this structure, resistance that each blade 5 of the air blowing device in this exemplary embodiment receives during rotation can be reduced under the condition that air volume same as that of a conventional air blowing device is secured.

[0026] Next is examined how the resistance that the blades receive is reduced in the air blowing device in the exemplary embodiment.

[0027] In the exemplary embodiment, both front side 5c and rear side 5d of blade 5 have first protrusion 12A and second protrusion 12B in their middle parts protruding in the rotating direction. Blade 5 is moderately curved from first protrusion 12A and second protrusion 12B toward inner sides 5a and outer side 5b to the side opposite to the rotating direction. In this shape, the rotating blades and air come into collision and separate gradually from first protrusion 12A and second protrusion 12B to inner side 5a and outer side 5b. Therefore, the air smoothly flows along the curved shape of blade. Furthermore, the front side of blade is inclined more toward the motor than the rear side. In this shape, the air flows in the rotating direction along the inclined shape of blade. Therefore, a disturbed flow is unlikely generated in the air. As a result, air resistance that each blade 5 receives during rotation can be reduced, and thus power consumption can be reduced.

[0028] Still more, the blades in this exemplary embodiment are formed setting distance X between outer side 5b and orifice 1 at the side of front side 5c longer than distance Y between outer side 5b and orifice 1 at the side of rear side 5d. Therefore, the blades gradually come into collision with air in the same way as described above. As a result, air resistance that each blade 5 receives during rotation can be reduced, and thus power consumption can be reduced.

[0029] Furthermore, distance Y between outer side 5b and orifice 1 at the side of rear side 5d is set shorter than distance X between outer side 5b and orifice 1 at the side of front side 5c. In other words, outer diameter of blade 5 is enlarged. This broadens a contact area of the blades

and air, and thus a large air blowing volume can be secured. Based on the above examination, air resistance that the blades receive is assumed to reduce.

[0030] In the air blowing device in the exemplary embodiment, outer side 7c of attachment part 7 in attachment plate 6 is disposed closer to inner side 5a of blade 5 than from first protrusion 12A in the middle part of front side 5c and second protrusion 12B in the middle part of rear side 5d of blade 5. With this structure, the action and effect achieved by the blade shape described above are not hindered by attachment parts 7 of attachment plate 6. As a result, an increase of power consumption of the air blowing device can be efficiently suppressed.

[0031] The power consumption of the air blowing device with the structure described above is about 400W compared to power consumption of 600 W needed for the conventional air blowing device, for example, with simple rectangular blades when their air blowing volumes are the same. In other words, the air blowing device with the blade shape in this exemplary embodiment can reduce power consumption for about 200 W.

[0032] As described above, the exemplary embodiment achieves the air blowing device with less power consumption.

[0033] The exemplary embodiment refers to the blades in which the front side is inclined more toward the motor than the rear side. However, the present invention is not limited to this structure. The front side may not be particularly inclined. This can improve productivity of blades, and reduce production costs.

[0034] Still more, the exemplary embodiment refers to an example of setting distance X between outer side 5b and orifice 1 at the side of front side 5c longer than distance Y between outer side 5b and orifice 1 at the side of rear side 5d of the blade. However, the present invention is not limited to this structure. For example, distance X and distance Y may be the same. This can reduce power consumption more than the conventional air blowing device.

[0035] Still more, the exemplary embodiment refers to an example of attaching the blades to the attachment plate and then attaching to the motor shaft of the motor. However the present invention is not limited to this structure. For example, the attachment plate and the blades may be integrally fabricated, and this may be attached to the motor shaft. This improves assembly productivity of the air blowing device, and can also reduce production costs. In addition, it can prevent attachment parts 7 of attachment plate 6 from hindering the action and effect achieved by the blade shape.

[0036] Furthermore, the exemplary embodiment refers to an example of making line 11 linking corners of the outer side and inner side at the side of the front side in the rotating direction tilted at about 5 ° relative to center line 10. However, the present invention is not limited to this angle. For example, the tilt angle may be about 2 ° to 10 °. The angle can be designed as required depending on a required shape or characteristics of an air blowing device.

INDUSTRIAL APPLICABILITY

[0037] The air blowing device of the present invention is broadly applicable to diversifying purposes typically in agricultural affairs.

REFERENCE MARKS IN THE DRAWINGS

[0038]

1	Orifice
2	Attachment leg
3	Motor
4	Motor shaft
5	Blade
5a	Inner side
5b, 7c	Outer side
5c, 7a	Front side
5d, 7b	Rear side
5e	Center
6	Attachment plate
7	Attachment part
8	Lower die
9	Upper die
10	Center line
11	Line
12A	First protrusion
12B	Second protrusion
100	Air blowing device

Claims

1. An air blowing device comprising a cylindrical orifice, a motor provided on a central axis of the orifice, and a plurality of blades disposed on an outer periphery of a motor shaft of the motor at predetermined intervals,
wherein:

each of the blades has a rectangular shape including an inner side facing the motor shaft and the outer side facing the orifice around the outer periphery; a front side linking the inner side and the outer side of the blade has a first protrusion protruding in a rotating direction at its middle part, the blade being curved to a side opposite to the rotating direction from the first protrusion to the inner side and the outer side; and a rear side linking the inner side and the outer side of the blade has a second protrusion protruding in the rotating direction at its middle part, the blade being curved to the side opposite to the rotating direction from the second protrusion to the inner side and the outer side.

2. The air blowing device of claim 1, wherein, for each of the blades, a distance between the outer side and the orifice at the front side is set longer than a distance between the outer side and the orifice at the rear side.

3. The air blowing device of claim 1, the rectangular blades are attached to the motor shaft such that their front sides are inclined more toward the motor than their rear sides.

4. The air blowing device of claim 1, wherein an attachment plate is provided on the outer periphery of the motor shaft, a plurality of attachment parts are provided on an outer periphery of the attachment plate at predetermined intervals, and the inner sides of the blades are attached to the plurality of attachment parts.

5. The air blowing device of claim 4, wherein an outer side of each of the attachment parts is disposed closer to the inner side of each of the blades than from the first protrusion and the second protrusion.

FIG. 1

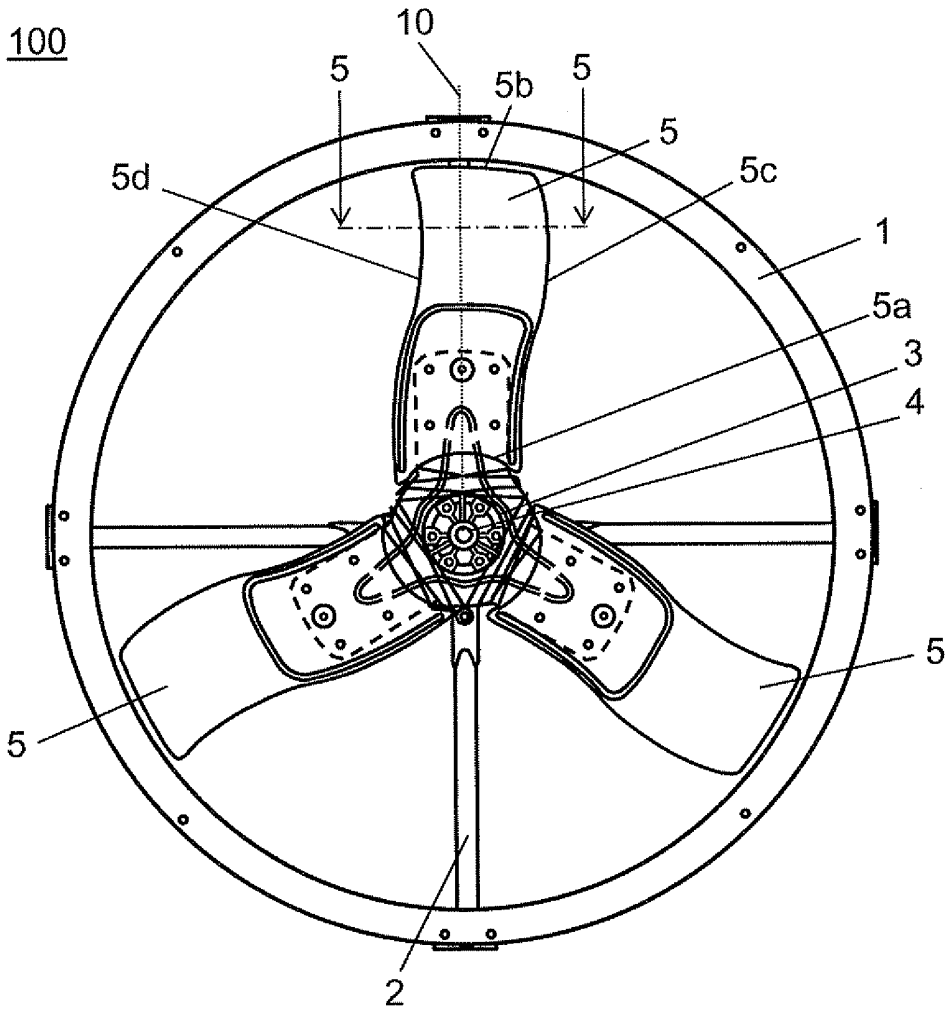


FIG. 2

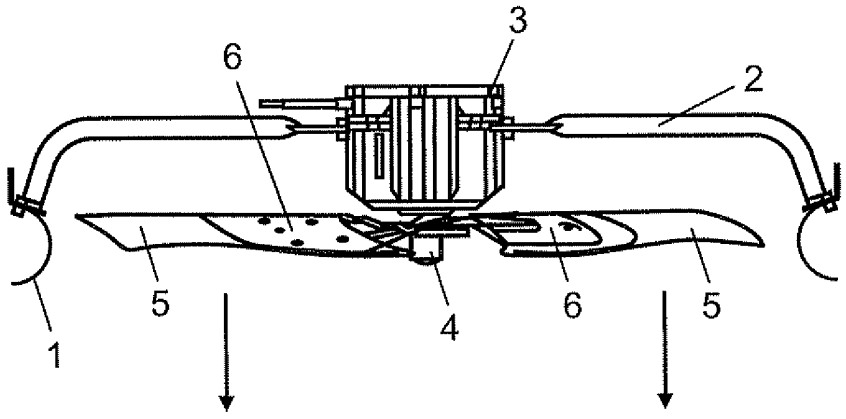


FIG. 3

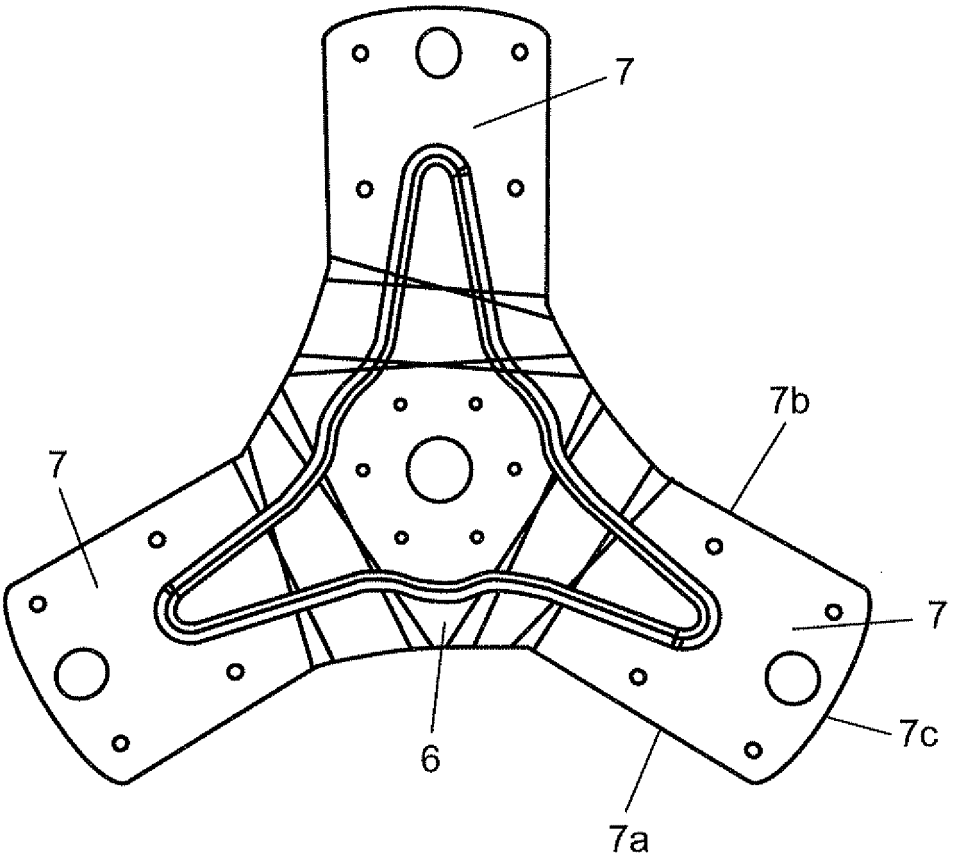


FIG. 4

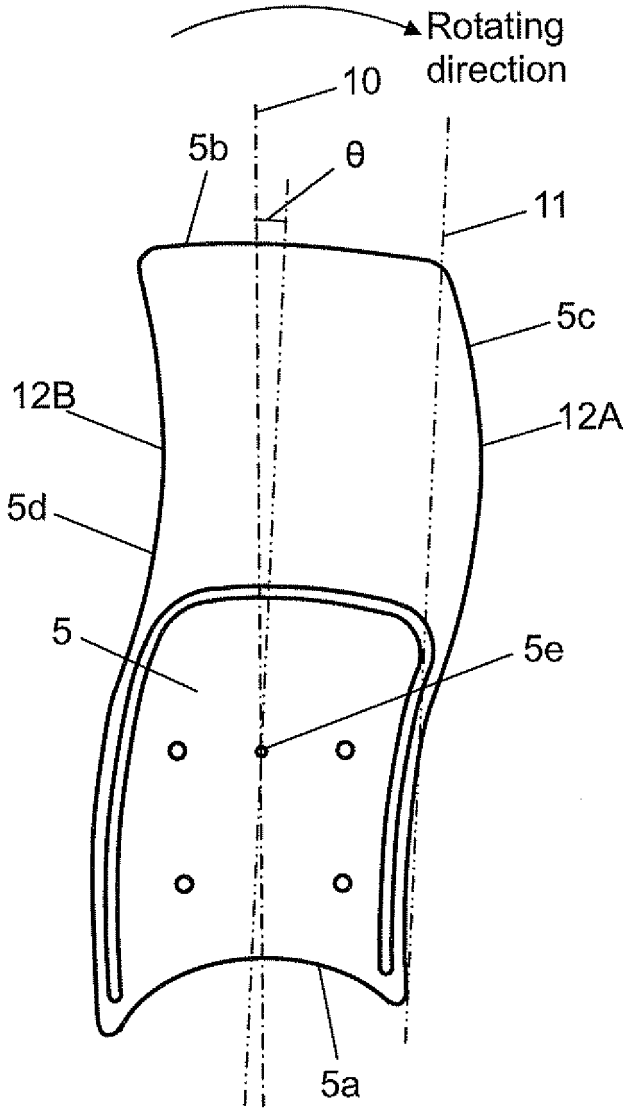


FIG. 5

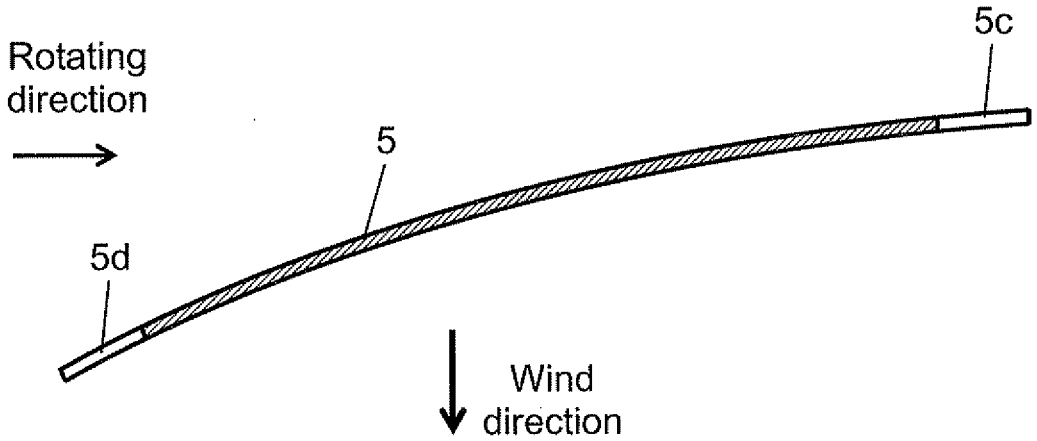


FIG. 6

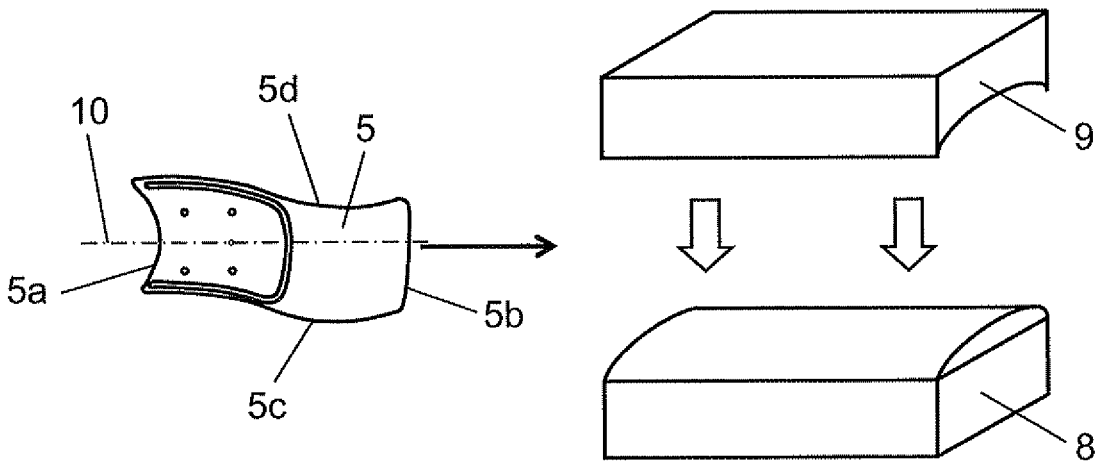
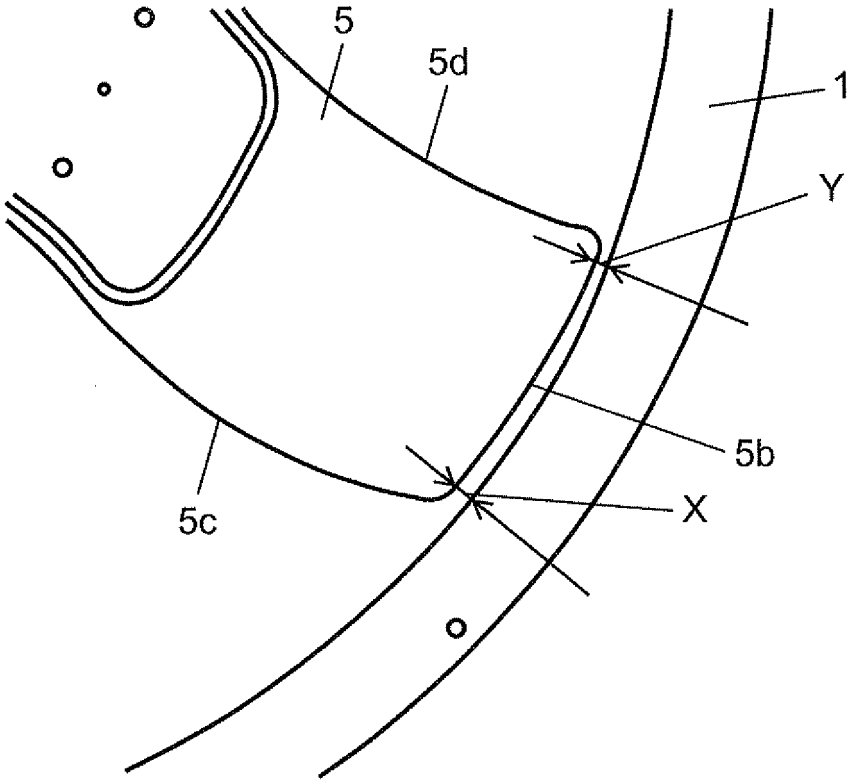


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/001731

A. CLASSIFICATION OF SUBJECT MATTER
F04D29/38(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04D29/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X Y A	JP 3-89000 A (Calsonic Corp.), 15 April 1991 (15.04.1991), page 5, upper left column, lines 3 to 7; fig. 6, 10 (Family: none)	1,3 2,4 5
X Y A	JP 2008-45442 A (Kubota Corp.), 28 February 2008 (28.02.2008), fig. 2, 3, 6 (Family: none)	1,3 2,4 5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search 29 March, 2010 (29.03.10)	Date of mailing of the international search report 13 April, 2010 (13.04.10)
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/001731

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 59-138800 A (Hitachi, Ltd.), 09 August 1984 (09.08.1984), page 4, upper left column, line 5 to upper right column, line 1; fig. 5 (Family: none)	2
Y	JP 11-93897 A (Nihon Spindle Mfg. Co., Ltd.), 06 April 1999 (06.04.1999), paragraph [0011]; fig. 1 (Family: none)	2
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 70660/1987(Laid-open No. 183395/1988) (Toyo Radiator Co., Ltd.), 25 November 1988 (25.11.1988), fig. 6 (Family: none)	4 5
A	JP 53-116513 A (Aisin Seiki Co., Ltd.), 12 October 1978 (12.10.1978), fig. 1 (Family: none)	1-5
A	JP 9-68200 A (Matsushita Electric Works, Ltd.), 11 March 1997 (11.03.1997), fig. 3 (Family: none)	2
A	JP 2001-82387 A (LG Electronics Inc.), 27 March 2001 (27.03.2001), fig. 1 to 2 & US 6325597 B1 & EP 1083391 A2 & KR 10-2001-0026488 A & KR 10-2001-0028256 A	2

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REFERENCES CITED IN THE DESCRIPTION

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