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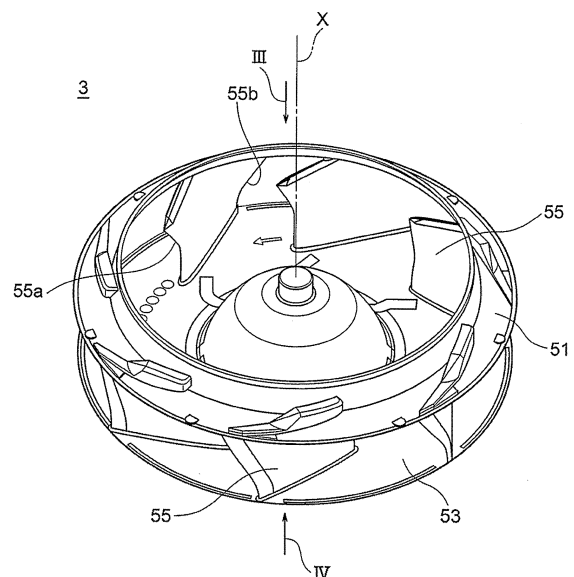
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(54) **FAN, CENTRIFUGAL FAN, AND AIR CONDITIONING DEVICE**

(57) A centrifugal fan 3 includes a shroud 51, a main plate 53, and a plurality of vanes 55, wherein the shroud 51 and the main plate 53 are separated in the direction of the rotational axis of the centrifugal fan, the plurality of vanes 55 are provided between the shroud 51 and the main plate 53, the plurality of vanes 55 are welded to at least one of the shroud 51 and the main plate 53, and at least one of the shroud 51 and the main plate 53 is a member having a visible light transmissivity of no less than 30 percent.

FIG. 2



Description

[Technical Field]

[0001] The present invention relates to a fan and to an air-conditioning device provided with the fan.

[Background Art]

[0002] PTL 1 discloses a centrifugal fan provided in an air-conditioning device of a ceiling-embedded type. This centrifugal fan is provided with a main plate, a side plate and a plurality of vanes. The main plate is separated from the side plate in the direction of the rotational axis of the fan, and the plurality of vanes are provided between the main plate and the side plate.

[Citation List]

[Patent Literature]

[0003] [PTL 1] Japanese Patent Application Publication No. 2005-155510

[Summary of Invention]

[Technical Problem]

[0004] In each of the plurality of vanes, the end surface on one side is connected to the main plate, and the end surface on the other side is connected to the side plate, and it is desirable for each of the plurality of vanes to maintain a satisfactory state of connection with the main plate or the side plate.

[0005] The present invention was devised in view of the foregoing, an object thereof being to provide a fan and an air-conditioning device wherein the state of connection between a plurality of vanes and vane supporting members can be confirmed easily.

[Solution to Problem]

[0006] In order to achieve the object described above, the fan according to the present invention is a fan, comprising a first supporting member, a second supporting member and a plurality of vanes; wherein the first supporting member and the second supporting member are separated in the direction of a rotational axis of the fan; the plurality of vanes are provided between the first supporting member and the second supporting member; the plurality of vanes are welded to at least one of the first supporting member and the second supporting member; and the at least one of the first supporting member and the second supporting member is a member having a visible light transmissivity of no less than 30 percent.

[0007] The vanes may be members having a visible light transmissivity of less than 30 percent.

[0008] The negative pressure surface sides of both

ends of each of the vanes may be welded to the corresponding first supporting member and the second supporting member.

[0009] The present invention may be a centrifugal fan which is the fan described above, wherein the first supporting member is a shroud and the second supporting member is a main plate; a plurality of receiving sections are formed in the shroud; the receiving sections each project in a direction away from the main plate, and have a recess on the inner side of the receiving section; and one end of each of the vanes is fitted into the recess of the corresponding receiving section of the shroud, and the negative pressure surface side of the one end is welded to a bottom surface of the corresponding recess.

[0010] The receiving sections may have a first step section, a second step section and an inclined surface section; the recess depth of the first step section may be greater than the recess depth of the second step section; and the inclined surface section may be situated between the first step section and the second step section and may extend obliquely with respect to the direction in which the first step section and the second step section extend.

[0011] A first round section may be formed on the one end side of the vane that is welded to the shroud, on the positive pressure surface of the vane; a second round section may be formed on the one end side of the vane that is welded to the shroud, on the negative pressure surface of the vane; and as one aspect of the invention, when taking the radius of curvature of the first round section to be R1 and taking the radius of curvature of the second round section to be R2, then $R1 > R2$. A third round section may be formed on a front edge side of the positive pressure surface of the vane; a fourth round section may be formed on a front edge side of the negative pressure surface of the vane; and as one aspect of the invention, when taking the radius of curvature of the third round section to be R3 and taking the radius of curvature of the fourth round section to be R4, then $R3 > R4$.

[0012] An air-conditioning device according to the present invention which achieves the object includes a heat exchanger and a fan, the fan being the fan or centrifugal fan of the present invention described above.

[Advantageous Effects of Invention]

[0013] According to the present invention, the state of connection between a plurality of vanes and vane supporting members can be confirmed easily.

[Brief Description of Drawings]

[0014]

[Fig. 1]

Fig. 1 is a drawing showing the internal structure of an air-conditioning device relating to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a perspective diagram of a centrifugal fan according to the first embodiment.

[Fig. 3]

Fig. 3 is a diagram showing a peripheral portion of one vane as viewed from the direction of the arrow III in Fig. 2.

[Fig. 4]

Fig. 4 is a diagram showing a peripheral portion of one vane as viewed from the direction of the arrow IV in Fig. 2.

[Fig. 5]

Fig. 5 is a cross-sectional diagram along line V-V in Fig. 3.

[Fig. 6]

Fig. 6 is a perspective diagram showing the peripheral portion of one vane.

[Fig. 7]

Fig. 7 is a diagram showing a connecting portion between a shroud and a vane, in the direction of the cross-section in Fig. 5.

[Fig. 8]

Fig. 8 is a diagram showing a schematic view of the shape relationship of a weld portion between the shroud and a vane, as viewed in the direction of the arrow VIII in Fig. 7.

[Fig. 9]

Fig. 9 is an enlarged diagram of portion Y in Fig. 7.

[Fig. 10]

Fig. 10 is an enlarged diagram of portion Z in Fig. 3.

[Fig. 11]

Fig. 11 is a perspective diagram of a cross-flow fan according to a second embodiment of the present invention.

[Description of Embodiments]

[0015] Below, embodiments of the present invention are described with reference to the drawings. In the drawings, parts which are the same or corresponding are labelled with the same reference numerals.

First Embodiment

[0016] Fig. 1 is a schematic drawing showing the internal structure of an air-conditioning device relating to a first embodiment of the present invention. More specifically, the air-conditioning device according to the first embodiment is an indoor unit of a so-called package air-conditioner, and Fig. 1 illustrates a state where the major part of the air-conditioning device is embedded in the ceiling of a room, and the lower portion of a main body faces into the room.

[0017] An air-conditioning device 100 is provided with a case 1 which is embedded in the ceiling 15a of the space (room 15) that is the object of air conditioning. The case 1 is formed, for example, in substantially a cuboid shape. The case 1 includes an upper surface part 1a, a

side surface part 1b and a decorative panel 2, which is a lower surface part.

[0018] The side surface part 1b is formed in a cylindrical shape extending vertically, when observed in plan view, and the upper portion of the side surface part 1b is enclosed by the upper surface part 1a, and the decorative panel 2 is provided below the side surface part 1b. The case 1 is formed in substantially a box shape by the upper surface part 1a, the side surface part 1b and the decorative panel 2.

[0019] An inlet port 2a is provided in the center of the decorative panel 2, and four outlet ports 2b are provided about the periphery of the inlet port 2a in the decorative panel 2 so as to correspond to the four surfaces of the side surface part 1b.

[0020] A centrifugal fan 3, a fan motor 4, a bell mouth 5 and a heat exchanger 6 are accommodated inside the case 1. The centrifugal fan 3 creates a flow of air which is sucked inside the case 1 from the inlet port 2a and is discharged into the object space from the outlet ports 2b. The heat exchanger 6 is arranged in this flow path of the air, and adjusts the temperature of the air. There are no particular restrictions on the configuration and mode of the bell mouth 5 and heat exchanger 6, and the first embodiment employs a commonly used configuration and mode.

[0021] In the configuration of this kind, when the centrifugal fan 3 rotates, the air in the room 15 is sucked into the inlet port 2a of the decorative panel 2, is guided by the bell mouth 5, and is sucked into the centrifugal fan 3. Moreover, in the centrifugal fan 3, the air sucked in from the bottom to the top is discharged horizontally, and radially outwards. Upon passing through the heat exchanger 6, the air discharged in this way is subjected to heat exchange and humidity adjustment, and the flow direction thereof is then changed to a downward direction, and the air is discharged into the room 15 from the respective outlet ports 2b.

[0022] Next, the details of the centrifugal fan will be described on the basis of Fig. 3 to Fig. 6. Fig. 3 is a diagram showing a peripheral portion of one vane as viewed from the direction of the arrow III in Fig. 2. Fig. 4 is a diagram showing a peripheral portion of one vane as viewed from the direction of the arrow IV in Fig. 2. Fig. 5 is a cross-sectional diagram along line V-V in Fig. 3. Fig. 5 illustrates a very small portion of the thickness, and therefore the hatching is omitted. Fig. 6 is a perspective diagram showing the peripheral portion of one vane. Fig. 7 is a diagram showing a connecting portion between a shroud and a vane, in the direction of the cross-section in Fig. 5. Fig. 8 is a diagram showing a schematic view of the shape relationship of a weld portion between the shroud and the vane, as viewed in the direction of the arrow VIII in Fig. 7. Fig. 8 is essentially a diagram for the purpose of showing the relationship between the shapes of the shroud and the vanes, and therefore priority has been given to making the diagram easy to read and the gap between the shroud and the vane (the presence of

a gap and the size of the gap), and the thickness of the shroud material, and the shape of the connecting oblique surface portion of the shroud, etc. do not illustrate an actual mode.

[0023] The centrifugal fan 3 is provided with a shroud 51, which is a first supporting member, a main plate 53 which is a second supporting member, and a plurality of vanes 55. The shroud 51 and the main plate 53 are separated in the X direction of the rotational axis of the centrifugal fan 3. The plurality of vanes 55 are provided between the shroud 51 and the main plate 53.

[0024] A corresponding plurality of vanes 55 are welded respectively to the shroud 51 and the main plate 53. The vanes 55 are welded to the corresponding shroud 51 or main plate 53, by laser welding. Note that the present invention is not limited to laser welding, and can also use ultrasonic welding, for example.

[0025] The vanes 55 each have at least one internal hollow section, and are made by integral molding or by combining a plurality of parts. In each of the vanes 55, a front edge 55a is positioned further on an inner side than a rear edge 55b in the radial direction.

[0026] The main plate 53 has a round disk shape. On the other hand, the shroud 51 has a circular ring shape in plan view. As shown by the longitudinal cross-sections in Fig. 1 and Fig. 5, the shroud 51 has a curved surface which is recessed radially outwards and towards the upstream side of the flow of air which is sucked into the centrifugal fan 3.

[0027] As illustrated in Fig. 2, Fig. 3, Fig. 5 and Fig. 6, one end of the vane 55 in the direction of the rotational axis is welded to the shroud 51. More specifically, as shown in Fig. 6, a plurality of receiving sections 61 of the same number as the plurality of vanes 55 are formed on the curved surface of the shroud 51. The receiving section 61 projects in a direction away from the main plate 53, and has substantially the same thickness. Consequently, on the main plate 53 side (the vane 55 side), the receiving section 61 has a recess of a shape that substantially corresponds to a shape projecting in a direction away from the main plate 53. One end of a corresponding vane 55 is fitted into this recess.

[0028] As shown in Fig. 6, the receiving section 61 projects in a two-step fashion and includes a first step section 61a and a second step section 61b. The first step section 61a is situated on the side of the front edge 55a of the vane 55 and the second step section 61b is situated on the side of the rear edge 55b of the vane 55. The recess depth on the inner side (main plate side) of the first step section 61a is greater than the recess depth on the inner side (main plate side) of the second step section 61b. The first step section 61a and the second step section 61b are flat surfaces which extend substantially in parallel with the main plate 53 (flat surfaces which are perpendicular to the rotational axis X of the centrifugal fan 3).

[0029] Furthermore, the receiving sections 61 each have a connecting inclined surface section 61c between

the first step section 61a and the second step section 61b. The connecting inclined surface section 61c connects the first step section 61a and the second step section 61b which have different projection heights, and extends in an inclined fashion with respect to the direction in which the first step section 61a and the second step section 61b extend. The receiving section 61 has substantially the same material thickness, and therefore a recess of corresponding shape to the outside which appears in Fig. 2 or Fig. 6 is formed on the inner side of the receiving section 61 (on the main plate 53 side or the vane 55 side).

[0030] As shown in Fig. 8, one end of the vane 55 (the end on the side of the shroud 51) has a first end surface 71 and a second end surface 73, so as to correspond to the first step section 61a and the second step section 61b of the receiving section 61. The first end surface 71 is situated on the side of the front edge 55a of the vane 55 and the second end surface 73 is situated on the side of the rear edge 55b of the vane 55. The first end surface 71 is further separated from the main plate 53 than the second end surface 73. The first end surface 71 and the second end surface 73 are flat surfaces which extend substantially in parallel with the main plate 53 (flat surfaces which are perpendicular to the rotational axis X of the centrifugal fan 3).

[0031] Furthermore, each vane 55 has a rising portion 75 between the first end surface 71 and the second end surface 73. The rising portion 75 extends substantially along the direction of the rotational axis X of the centrifugal fan 3, and connects the first end surface 71 and the second end surface 73.

[0032] As shown in Fig. 3, the vanes 55 and the shroud 51 configured in this way are welded together, between the first end surface 71 of the vane 55 and the inner side of the first step section 61a of the shroud 51 (the bottom surface seen from the recess), and between the second end surface 73 of the vane 55 and the inner side of the second step section 61b of the shroud 51 (the bottom surface seen from the recess). More specifically, as shown in Fig. 3, from the perspective of the relationship between the positive pressure surface 81 and the negative pressure surface 83 of the vane 55, only the negative pressure surface 83 side on one end of the vane 55 (the surface of the vane 55 nearer to the rotational axis X of the centrifugal fan 3) is welded to the inner side of the receiving section 61 of the shroud 51. In other words, in the first embodiment, the portion of the first end surface 71 of the vane 55 on the side of the negative pressure surface 83, and the portion of the second end surface 73 on the side of the negative pressure surface 83 are respectively welded to the inner side of the receiving section 61 (the bottom surface seen from the recess). The cross-hatched portion in Fig. 3 indicates the portion that is welded. The same applies to Fig. 4 below.

[0033] Fig. 9 is an enlarged diagram of portion Y in Fig. 7 and Fig. 10 is an enlarged diagram of portion Z in Fig. 3. As shown in Fig. 9, a first round section 85 is formed

on the first end surface 71 side and the second end surface 73 side of the positive pressure surface 81 of the vane 55. A second round section 87 is also formed on the first end surface 71 side and the second end surface 73 side of the vane 55. When taking the radius of curvature of the first round section 85 to be R1 and taking the radius of curvature of the second round section 87 to be R2, then $R1 > R2$.

[0034] Furthermore, as shown in Fig. 10, a third round section 91 is formed on the side of the front edge 55a of the positive pressure surface 81 of the vane 55. A fourth round section 93 is formed on the front edge 55a side of the negative pressure surface 83 of the vane 55. When taking the radius of curvature of the third round section 91 to be R3 and taking the radius of curvature of the fourth round section 93 to be R4, then $R3 > R4$.

[0035] By providing, on the positive pressure surface 81 side of the vane 55, the round sections 85, 93 which have a larger radius of curvature than the negative pressure surface 83 side of the vane 55, it is possible to provide a configuration having little air resistance.

[0036] As illustrated in Fig. 2, Fig. 4 and Fig. 5, the other end of the vane 55 in the direction of the rotational axis is welded to the main plate 53. More specifically, a plurality of recesses of the same number as the plurality of vanes 55 are formed in the inner-side surface of the main plate 53 (the surface on the side of the shroud 51), and the other ends of the vanes 55 are fitted into and welded to these recesses. The recesses on the inner-side surface of the main plate 53 are only slightly recessed. Furthermore, the bottom surface of the recess on the inner-side surface of the main plate 53, and the other end of the vane 55 are both flat surfaces which extend substantially in parallel with the main plate 53 (flat surfaces perpendicular to the rotational axis X of the centrifugal fan 3).

[0037] As shown in Fig. 4, in terms of the positive pressure surface 81 and the negative pressure surface 83 of the vanes 55, the vanes 55 and the main plate 53 are welded only by welding the negative pressure surface 83 side of the other end of the vane 55 (the surface of the vane 55 nearer to the rotational axis X of the centrifugal fan 3) to the bottom of the recess on the inner-side surface of the main plate 53.

[0038] In this way, in each of the vanes, the negative pressure surface sides of both ends (one end and the other end) of the vane are welded to the corresponding shroud 51 or main plate 53.

[0039] Furthermore, the shroud 51 and the main plate 53 are both made from a member having a visible light transmissivity of no less than 30 percent (for example, resin having a visible light transmissivity of no less than 30 percent). In the present invention, at least one of the first supporting member and the second supporting member should be made from a member having a visible light transmissivity of no less than 30 percent, and it is not necessary for both the first supporting member and the second supporting member to be made from a member

having a visible light transmissivity of no less than 30 percent. On the other hand, the vanes 55 are made from a member having a lower visible light transmissivity than either of the shroud 51 and the main plate 53, or from a member having a visible light transmissivity lower than 30 percent. Furthermore, at least one of the first supporting member and the second supporting member is made from a member having a laser light transmissivity of no less than 50 percent.

[0040] According to the centrifugal fan and the air-conditioning device of the first embodiment of the invention which is configured as described above, since the vane supporting members are members having a visible light transmissivity of no less than 30 percent, then it is possible to determine the suitability or non-suitability of the welded state of the vanes (the presence or absence of connection defects, etc.), after the plurality of vanes have been welded to the vane supporting members, easily and reliably, by external inspection. More specifically, it is possible to confirm, by an external inspection, any fan assembly defects, infiltration of foreign material into the bonding surface, and the welded state of the vanes (identification of a gasification phenomenon (wherein the heat of the vane supporting members which have relatively high laser light transmissivity is not transmitted suitably to the side of the vanes which have a relatively high low laser light transmissivity, and the vane supporting members become too hot and foam) and identification of the weld width). Furthermore, in the case of a centrifugal fan, it is possible to identify, by external inspection, the presence or absence of fan motor or wiring installation defects, and the presence or absence of infiltration of foreign material into the rear side of the main plate, with the centrifugal fan installed on the air-conditioning device.

[0041] Moreover, in the first embodiment, the vanes are respectively welded to the vane supporting members on the negative pressure surface side of the end portions of the vanes, and therefore even if a centrifugal force due to the rotation of the fan acts on the vanes, since there are no gaps in the connecting portion between the vane supporting members and the vanes on the negative pressure surface side, then it is possible to prevent noise caused by the passage of an air flow through the gap.

[0042] Moreover, in the first embodiment, the respective ends of the vanes are fitted into a recess of a corresponding receiving section on the shroud, and therefore in relation to twisting in the direction of rotation, in addition to support by the weld surface, support is also provided by the recess surface on the front pressure surface side and the recess surface on the rear pressure surface side, and therefore high-strength vane support is achieved. Furthermore, it is possible to improve the bond of the contact surface between the vane supporting members and the vanes, and thus to reduce welding defects, by configuring the weld surface to face in a plane that is perpendicular to the direction of the rotational axis of the centrifugal fan. Moreover, the weld surface between the shroud and the vane is configured by two surfaces having

different distances from the main plate, and therefore it is possible to reduce the height of the receiving section in the direction of the rotational axis, and noise due to separation of the air flow caused by the projection shape. Furthermore, since the receiving sections in the shroud have a first step section and a second step section which project in a two-step fashion, and have a connecting inclined surface section which extends obliquely with respect to the direction in which the first step section and the second step section extend, then there is no sudden step difference in the receiving section which projects, and therefore it is possible to reduce the noise due to separation of the air flow generated by the step difference.

Second Embodiment

[0043] Next, a second embodiment of the present invention will be described on the basis of Fig. 11. Fig. 11 is a perspective diagram of a cross-flow fan according to a second embodiment.

[0044] The cross-flow fan 203 is provided with a plurality of vane supporting members 253 arranged separately in the direction of the rotational axis X of the fan, and a corresponding plurality of vanes 255 which are welded between the corresponding two vane supporting members. At least one (and possibly all) of the plurality of vane supporting members 253 is a member having a visible light transmissivity of no less than 30 percent. Furthermore, one or more of the vanes 255 which are welded to vane supporting members 253, which are members having a visible light transmissivity of no less than 30 percent, is made from a member having a lower visible light transmissivity than the vane supporting members 253, or is made from a member having a visible light transmissivity of less than 30 percent.

[0045] In a cross-flow fan of this kind, it is also possible to determine the suitability or non-suitability of the welded state of the vanes, easily and reliably, by external observation.

[0046] The contents of the present invention have been described above with reference to preferred embodiments, but it would be obvious to a person skilled in the art that various modifications can be made on the basis of the basic technical concepts and teachings of the present invention.

[0047] For example, besides an indoor unit of a refrigeration cycle device, such as the indoor unit of an air-conditioning device, the present invention can also be applied widely to various devices and equipment in which a fan is installed.

[Reference Signs List]

[0048]

3 Centrifugal fan
51 Shroud

53 Main plate
55 Vane
55a Front edge
55b Rear edge
5 61 Receiving section
61a First step section
61b Second step section
61c Connecting inclined surface section
71 First end surface
10 73 Second end surface
75 Rising section
81 Positive pressure surface
83 Negative pressure surface
85 First round section
15 87 Second round section
91 Third round section
93 Fourth round section
100 Air-conditioning device
203 Cross-flow fan
20

Claims

1. A fan, comprising a first supporting member, a second supporting member and a plurality of vanes; wherein the first supporting member and the second supporting member are separated in a direction of a rotational axis of the fan; the plurality of vanes are provided between the first supporting member and the second supporting member; the plurality of vanes are welded to at least one of the first supporting member and the second supporting member; and the at least one of the first supporting member and the second supporting member is a member having a visible light transmissivity of no less than 30 percent.
2. The fan according to claim 1, wherein the vanes are members having a visible light transmissivity of less than 30 percent.
3. The fan according to claim 1 or 2, wherein negative pressure surface sides of both ends of each of the vanes are welded to the first supporting member and the second supporting member.
4. A centrifugal fan, being the fan according to claim 1 or 2, wherein the first supporting member is a shroud and the second supporting member is a main plate; a plurality of receiving sections are formed in the shroud; the receiving sections each project in a direction away from the main plate, and have a recess on an inner side of the receiving section; and one end of each of the vanes is fitted into the recess of the corresponding receiving section of the shroud, and the negative pressure surface side of the one

end is welded to a bottom surface of the corresponding recess.

5. The centrifugal fan according to claim 4,
 wherein the receiving section has a first step section, 5
 a second step section and an inclined surface section;
 a recess depth of the first step section is greater than
 a recess depth of the second step section; and 10
 the inclined surface section is situated between the
 first step section and the second step section and
 extends obliquely with respect to a direction in which
 the first step section and the second step section
 extend. 15

6. The centrifugal fan according to claim 4 or 5,
 wherein a first round section is formed on one end
 side of the vane that is welded to the shroud, on a
 positive pressure surface of the vane;
 a second round section is formed on the one end 20
 side of the vane that is welded to the shroud, on the
 negative pressure surface of the vane; and
 when taking a radius of curvature of the first round
 section to be R1 and taking a radius of curvature of
 the second round section to be R2, then $R1 > R2$. 25

7. The centrifugal fan according to any one of claims 4
 to 6, wherein a third round section is formed on a
 front edge side of a positive pressure surface of the
 vanes; 30
 a fourth round section is formed on a front edge side
 of the negative pressure surface of the vanes; and
 when taking a radius of curvature of the third round
 section to be R3 and taking a radius of curvature of
 the fourth round section to be R4, then $R3 > R4$. 35

8. An air-conditioning device, comprising:

 a heat exchanger; and
 the fan according to any one of claims 1 to 3 or 40
 the centrifugal fan according to any one of claims
 4 to 7. 45

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FIG. 1

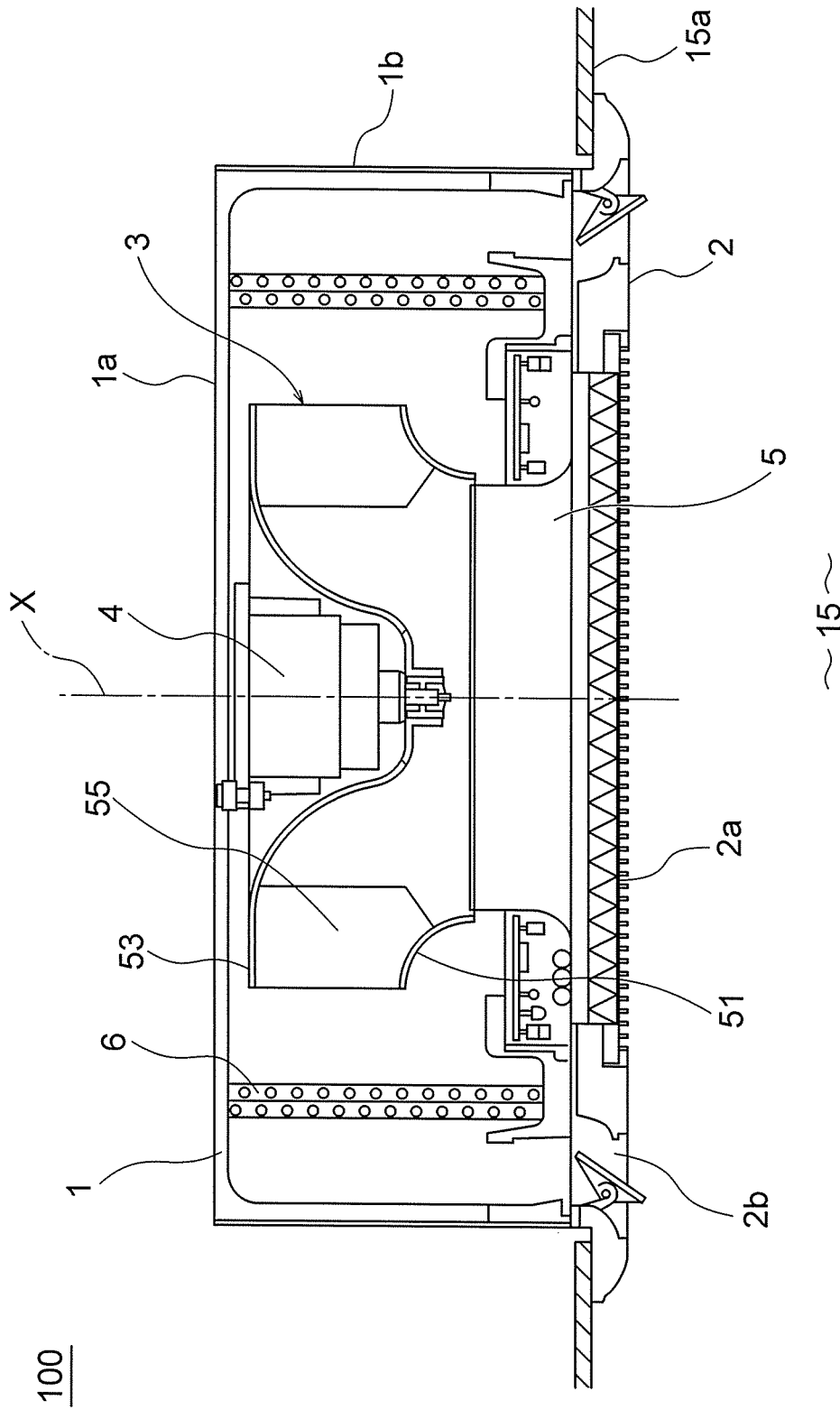


FIG. 2

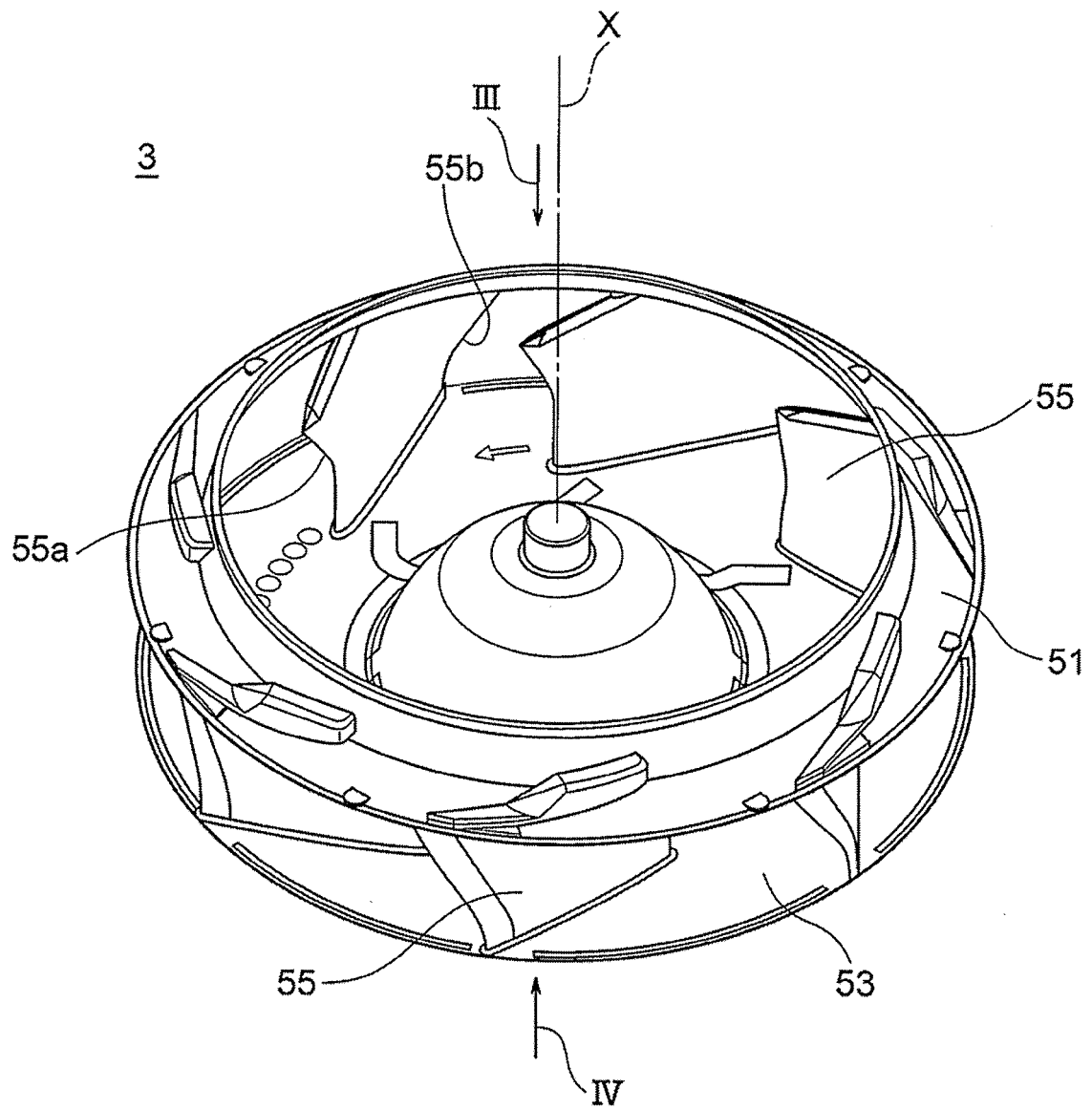


FIG. 3

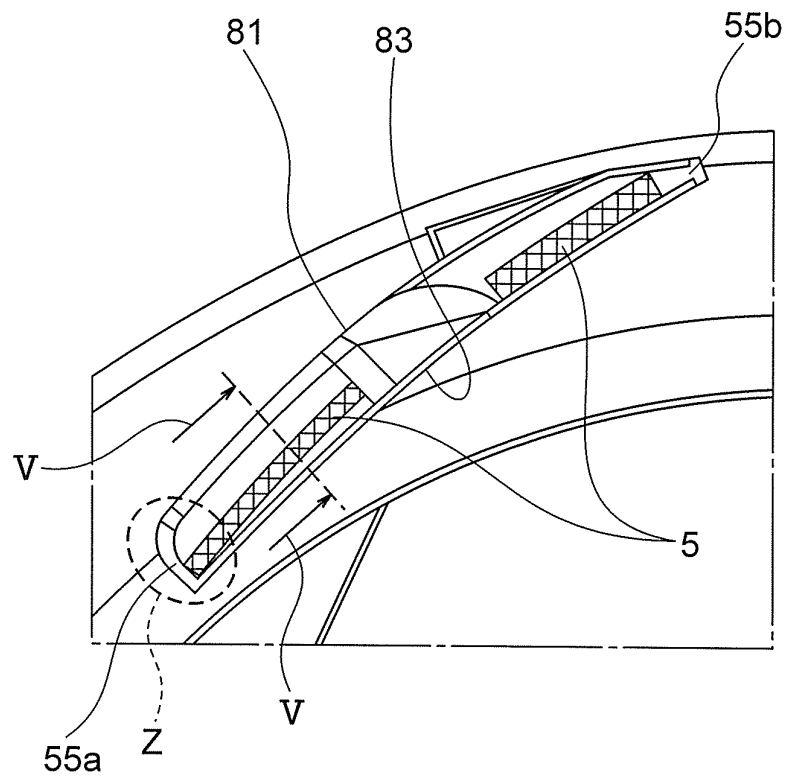


FIG. 4

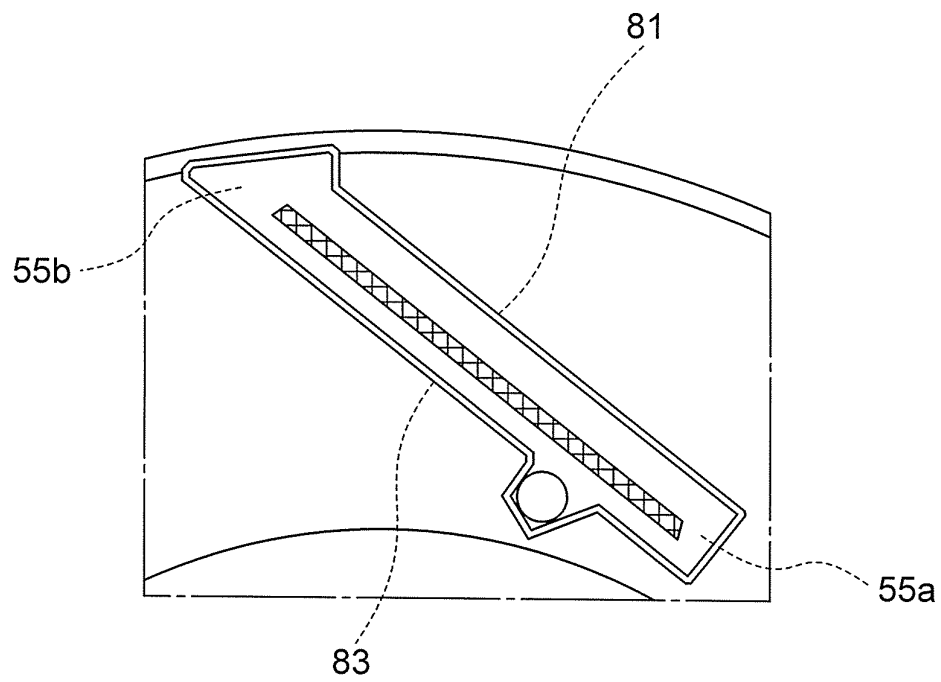


FIG. 5

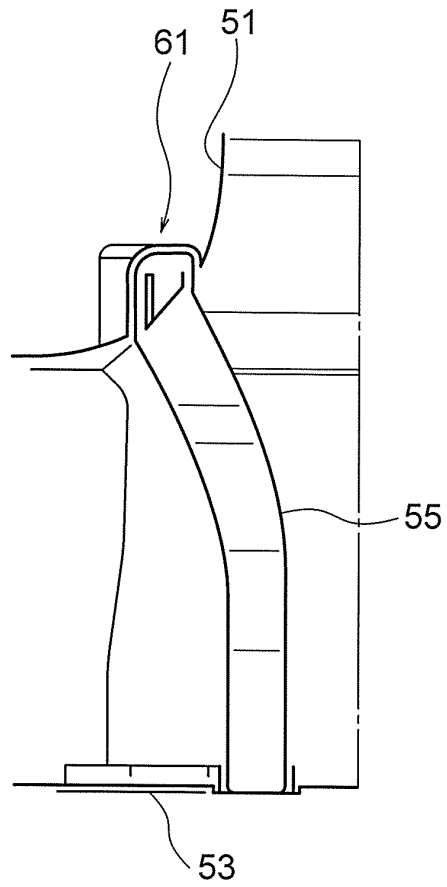


FIG. 6

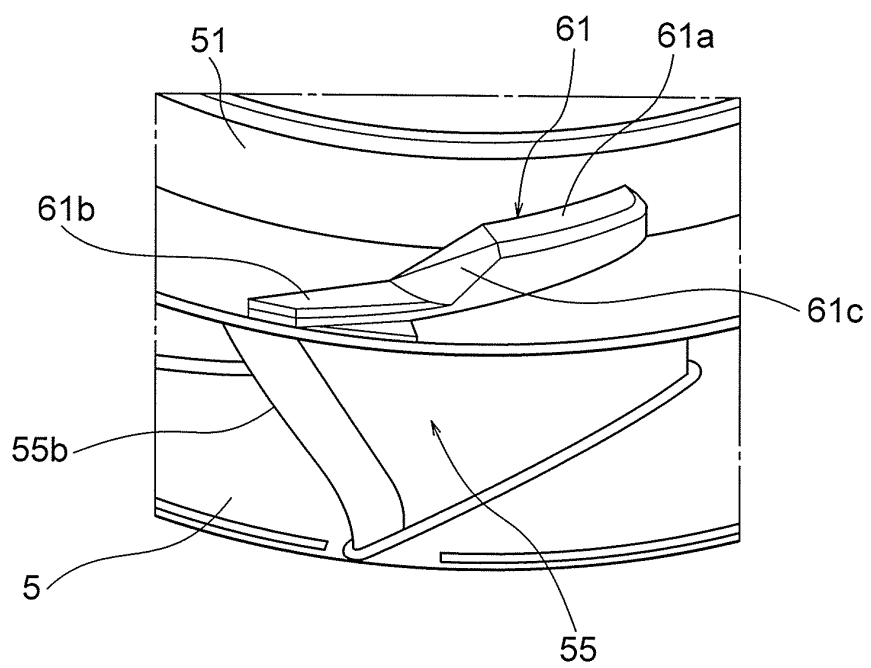


FIG. 7

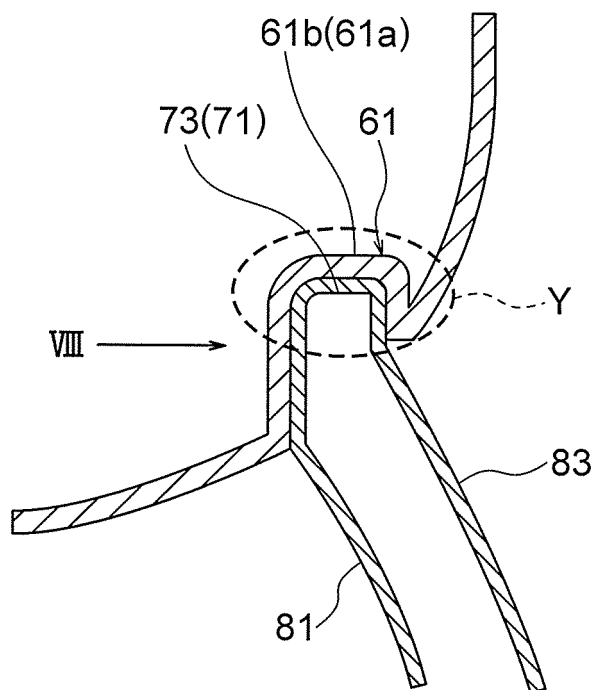


FIG. 8

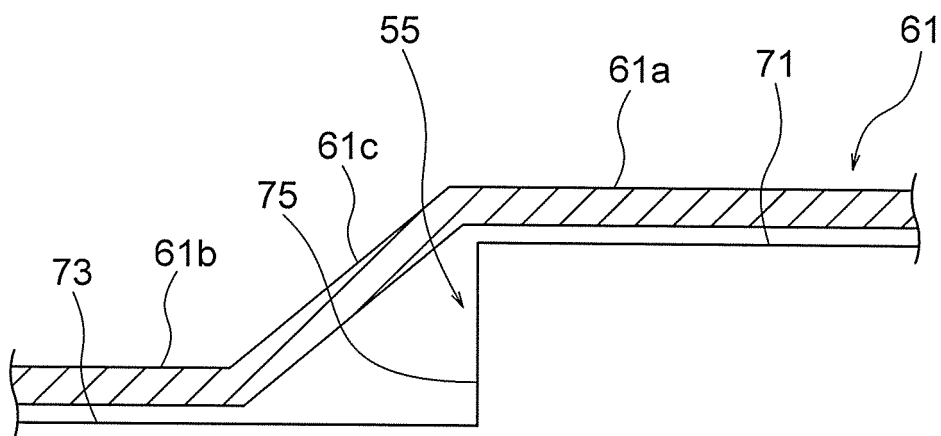


FIG. 9

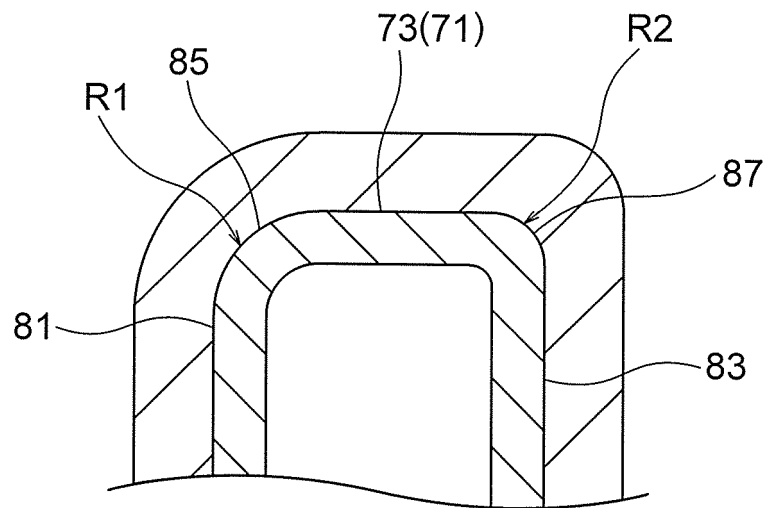


FIG. 10

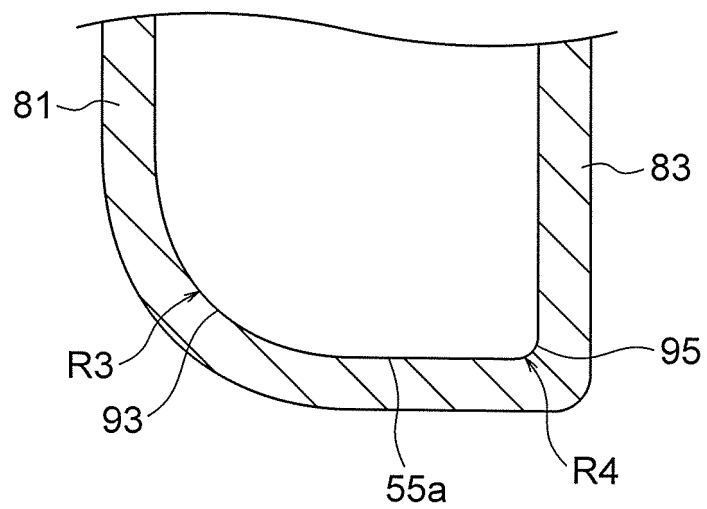
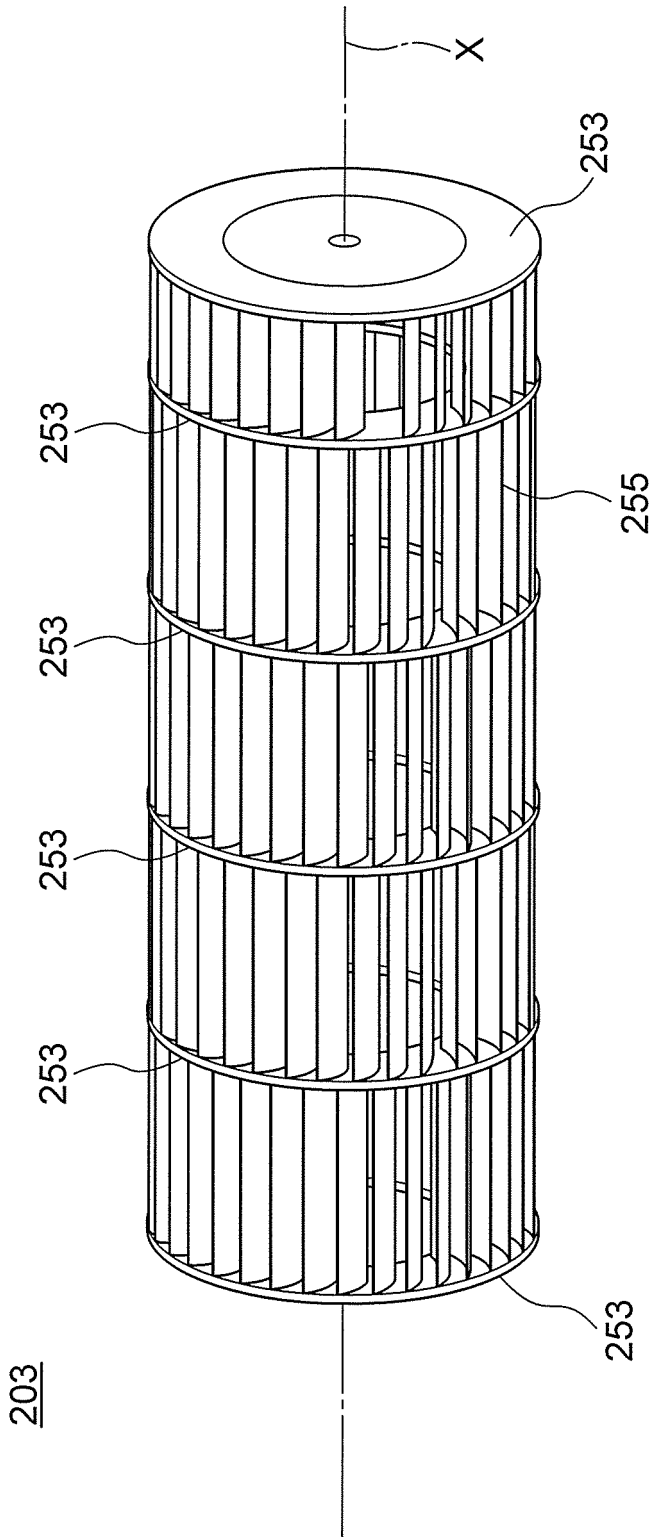


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/050336

A. CLASSIFICATION OF SUBJECT MATTER

F04D29/28(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)

F04D29/28

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 1996-2014

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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.
Y	JP 4432474 B2 (Daikin Industries, Ltd.), 17 March 2010 (17.03.2010), paragraphs [0094], [0097], [0115], [0116]; fig. 3, 6, 16, 17 & JP 2005-155510 A & US 2007/0098556 A1 & EP 1688623 A1 & WO 2005/052377 A1 & KR 10-2006-0008988 A & CN 1802512 A	1-8
Y	JP 2005-88355 A (Toyota Machine Works, Ltd.), 07 April 2005 (07.04.2005), paragraph [0021] (Family: none)	1-8
Y	JP 2009-257132 A (Fujitsu General Ltd.), 05 November 2009 (05.11.2009), paragraph [0020]; fig. 4 (Family: none)	5-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search
26 March, 2014 (26.03.14)Date of mailing of the international search report
08 April, 2014 (08.04.14)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/050336

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 2010-216486 A (Mitsubishi Electric Corp.), 30 September 2010 (30.09.2010), fig. 11 & JP 4559472 B2 & EP 1933040 A1 & WO 2007/040236 A1 & CN 101099044 A	6-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005155510 A [0003]