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(54) **AIR BLOWER AND INDOOR UNIT OF AIR CONDITIONER**

(57) According to one embodiment, an air blower (3) comprises an impeller (5). The impeller (5) comprises a main plate (21) comprising a boss portion (21b) attached to an axis of rotation (4a) of a motor (4) and through-holes (21c) surrounding the boss portion (21b), a shroud (22) disposed opposite the main plate (21), and blades (23) which are formed of synthetic resin integrally with the main plate (21) between the main plate (21) and the shroud (22) and whose insides communicate with the through-holes (21c), the blades (23) including recesses (23f) recessed from the main plate (21) side to the shroud (22) side. The blades (23) have shapes twisted in an axial

direction of the axis of rotation (4a) from the main plate (21) side to the shroud (22) side. An area extending from a leading edge portion (23a) to a thickest portion (23c) having a greatest thickness of an area extending from the leading edge portion (23a) to a trailing edge portion (23b) is inclined from a pressure surface (23d) to a suction surface (23e) as the area extends from the main plate (21) side to the shroud (22) side. The thickness of the thickest portion (23c) is set to 15% to 25% of a chord length (L4) between the leading edge portion (23a) and the trailing edge portion (23b) in an interface with the main plate (21).

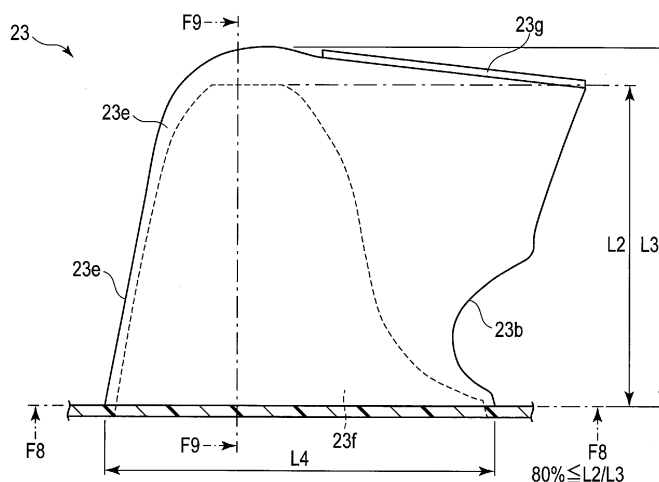


FIG. 7

Description

FIELD

5 **[0001]** Embodiments described herein relate generally to an air blower and an indoor unit of an air conditioner.

BACKGROUND

10 **[0002]** Ceiling-recessed indoor units hung in ceilings are equipped with air blowers which blow air subjected to heat exchange by heat exchangers into rooms. Impellers used in this kind of air blower comprise a main plate coupled to an axis of rotation of a motor, a shroud in the shape of a ring facing the main plate, and blades interposed between the main plate and the shroud as main elements.

[0003] In conventional impellers, main plates and blades have been integrally injection molded. In addition, to reduce the weight of the impellers, the blades are formed into hollow shapes opening toward the main plates.

15 **[0004]** The conventional impellers may fail to satisfy the dimensional tolerances of outer shapes, if shorts occur on the surfaces of the blades at the time of injection molding. In this case, air blowers comprising the impellers or indoor units of air conditioners comprising the air blowers may fail to achieve expected performance.

[0005] An object of the present invention is to obtain air blowers comprising impellers while preventing shorts.

20 BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 is a perspective view of a ceiling-recessed indoor unit used for an air conditioner.

25 FIG. 2 is a sectional view of the ceiling-recessed indoor unit.

FIG. 3 is a perspective view of an impeller.

FIG. 4 is a side view of the impeller.

FIG. 5 is a bottom view of the impeller.

FIG. 6 is a top view of the impeller.

30 FIG. 7 is a side view of a blade.

FIG. 8 is a bottom view along line F8-F8 of FIG. 7.

FIG. 9 is a sectional view along line F9-F9 of FIG. 7.

FIG. 10A is a schematic view showing the blade in which a distance between a leading edge portion and a thickest portion is set to 15% to 30% of a chord length according to an embodiment.

35 FIG. 10B is a schematic view showing a blade in which a distance between a leading edge portion and a thickest portion is set to 14% or less of a chord length according to a comparative example 3.

FIG. 10C is a schematic view showing a blade in which a distance between a leading edge portion and a thickest portion is set to 31% or more of a chord length according to a comparative example 4.

40 DETAILED DESCRIPTION

[0007] Embodiments provide an air blowers comprising impellers while preventing shorts.

45 **[0008]** In general, according to one embodiment, an air blower comprises an impeller. The impeller comprises a main plate comprising a boss portion attached to an axis of rotation of a motor and through-holes surrounding the boss portion, a shroud disposed opposite the main plate, and blades which are formed of synthetic resin integrally with the main plate between the main plate and the shroud and whose insides communicate with the through-holes, the blades including recesses recessed from the main plate side to the shroud side.

50 **[0009]** The blades have shapes twisted in an axial direction of the axis of rotation from the main plate side to the shroud side. An area extending from a leading edge portion to a thickest portion having a greatest thickness of an area extending from the leading edge portion to a trailing edge portion is inclined from a pressure surface to a suction surface as the area extends from the main plate side to the shroud side. The thickness of the thickest portion is set to 15% to 25% of a chord length between the leading edge portion and the trailing edge portion in an interface with the main plate.

[0010] Embodiments will be described hereinafter with reference to the accompanying drawings.

55 **[0011]** FIG. 1 is a perspective view of a ceiling-recessed indoor unit 1 used for an air conditioner. FIG. 2 is a sectional view of the indoor unit 1.

[0012] As shown FIG. 1 and FIG. 2, the indoor unit 1 comprises a main body 1a installed in a ceiling and a decorative panel 2 attached to the bottom of the main body 1a as main elements. The main body 1a is inserted in an opening portion a provided in the ceiling c from the room side, and hung from a beam in the ceiling by means of hanging bolts (not shown).

in the figures).

[0013] The main body 1a is a boxy element opening downward, and an air blower 3 is disposed in a central part inside the main body 1a. The air blower 3 comprises an impeller 5 driven by a motor 4. As the impeller 5, a so-called turbopan taking in air in an axial direction and blowing it in a circumferential direction is used. The top of the impeller 5 is covered by a top plate 1b of the main body 1a, and thus, the bottom of the impeller 5 is the intake side.

[0014] A heat exchanger 6 is disposed around the impeller 5 on the discharge side of the impeller 5. A drain pan 7 which receives drained water is provided under the heat exchanger 6. A bell mouth 8 is mounted inside the drain pan 7. The bell mouth 8 constitutes an intake port 9 facing the intake side of the impeller 5.

[0015] The decorative panel 2 covers the bottom of the main body 1a from the room. The decorative panel 2 is exposed to the room from the bottom surface of the ceiling c, and covers a gap between an outer peripheral surface of the main body 1a and the opening portion a of the ceiling c.

[0016] As shown in FIG. 1, the decorative panel 2 comprises an intake grille 10 and a panel main body 11. The intake grille 10 is provided in a central part of the decorative panel 2 to face the intake port 9.

[0017] The panel main body 11 of the decorative panel 2 is formed into a square frame having four sides surrounding the intake grille 10, and coupled to the bottom of the main body 1a. Moreover, the panel main body 11 comprises four discharge ports 12. The discharge ports 12 are elements which discharge air subjected to heat-exchange by the heat exchanger 6 in four directions, and are provided in the four sides of the panel main body 11, respectively.

[0018] The discharge ports 12 of the panel main body 11 are provided with flaps 13 changing the directions in which air is discharged, respectively. The flaps 13 are rotatably supported by the panel main body 11.

[0019] When the air conditioner stops operating, the discharge ports 12 are closed by the flaps 13. When the air conditioner starts operating, the flaps 13 rotate to a desired angle inside the discharge ports 12, and the discharge ports 12 are opened. Moreover, the air blower 3 is driven, and air in the room is taken into the impeller 5 from the intake grille 10 via the intake port 9. Air taken into the impeller 5 is discharged toward the heat exchanger 6, and is subjected to heat exchange with a refrigerant in the process of passing through the heat exchanger 6. Air subjected to heat exchange is guided from the discharge ports 12 by the flaps 13, and is discharged into the room.

[0020] The impeller 5 is a molding which is obtained by injection molding a heated and molded synthetic resin material into a mold and cooling and setting it, and comprises a main plate 21, a shroud 22, and blades 23.

[0021] As shown in FIG. 3 to FIG. 6, the main plate 21 comprises a support portion 21a formed into the shape of a disc. The support portion 21a supports the blades 23 in a concentric circle. A boss portion 21b is provided in the center of the support portion 21a. The boss portion 21b is attached to an axis of rotation 4a of the motor 4. Through-holes 21c are provided in the concentric circle of the support portion 21a to surround the boss portion 21b. The main plate 21 is injection molded integrally with the blades 23.

[0022] As shown in FIG. 3 to FIG. 5, the shroud 22 is disposed opposite the main plate 21, and covers the blades 23. The shroud 22 is formed into the shape of a ring, and is inclined in a radial direction. The shroud 22 is joined to protrusions 23g of the blades 23 provided on the opposite side to the main plate 21, for example, by ultrasonic welding.

[0023] The blades 23 are shown in FIG. 3 to FIG. 9, and blow air subjected to heat exchange by the heat exchanger 6 into the room. As shown in FIG. 3 to FIG. 5, the blades 23 are interposed between the main plate 21 and the shroud 22, and arranged at intervals in a circumferential direction of the impeller 5.

[0024] As shown in FIG. 6 to FIG. 9, the blades 23 have the shape of wings, and comprise recesses 23f recessed from the main plate 21 side to the shroud 22 side. The recesses 23f communicate with the through-holes 21c provided in the support portion 21a of the main plate 21. The recesses 23f are portions into which a mold for injection molding was inserted, and correspond to so-called lightening holes. Regarding the blades 23, as shown in FIG. 7 and FIG. 9, the depth L2 of the recesses 23f can be set to 80% or more of the height (total length) L3 by virtue of the structure described later. That is, the blades 23 can be provided with sufficient lightening holes.

[0025] Regarding each of the blades 23, as shown in FIG. 8, an area B extending from a leading edge portion 23a to a thickest portion 23c having a greatest thickness L1 of an area A extending from the leading edge portion 23a to a trailing edge portion 23b of the impeller 5 is inclined from a pressure surface 23d to a suction surface 23e as it extends from the main plate 21 side to the shroud 22 side. The pressure surface 23d of each of the blades 23 is a surface of each of the blades 23 located on the outer peripheral side of the impeller 5. The suction surface 23e of each of the blades 23 is a surface of each of the blades 23 located on the inner peripheral side of the impeller 5.

[0026] By virtue of the above-described structure, the blades 23 have shapes twisted in the axial direction of the axis of rotation 4a of the motor 4 from the main plate 21 side to the shroud 22 side. More specifically, an area C extending from the leading edge portion 23a to the trailing edge portion 23b in a portion contacting the main plate 21 and an area D extending from the leading edge portion 23a to the trailing edge portion 23b in a portion contacting the shroud 22 cross in the axial direction of the axis of rotation 4a of the motor 4.

[0027] Here, regarding each of the blades 23, as shown in FIG. 8, the thickness Lmax of the thickest portion 23c is set to 15% to 25% of a chord length L4 between the leading edge portion 23a and the trailing edge portion 23b in an interface with the main plate 21. Further, regarding each of the blades 23, a distance L5 between the leading edge

portion 23a and the thickest portion 23c is set to 15% to 30% of the chord length L4.

[0028] In the present embodiment, each of the blades 23 integrally formed with the main plate 21 is inclined from the pressure surface 23d to the suction surface 23e. Regarding each of the blades 23, the thickness L_{1max} of the thickest portion 23c is set to 15% to 25% of the chord length L4 between the leading edge portion 23a and the trailing edge portion 23b in an interface with the main plate 21.

[0029] By virtue of the above-described structure, the air blower 3 comprising the impeller 5 and the indoor unit 1 of the air conditioner comprising the air blower 3 can achieve expected performance. The expected performance relates to the amount of air blown by the impeller 5 when a predetermined amount of power is supplied to the motor 4, the upper limit values of noise and oscillation of the impeller 5 set when the motor 4 is rotated at a predetermined rate of rotation, a criterion value regarding the appearance of the impeller 5, etc. This will be specifically described with reference to Table 1.

[0030] Table 1 shows the percentage of the thickness L_{1max} of the thickest portion to the chord length L4 between the leading edge portion and the trailing edge portion, which relates to the performance of the blades. Excellent performance is denoted by ⊙, good performance is denoted by ○, sufficient performance is denoted by Δ, and insufficient performance is denoted by ×.

Table 1

		Present embodiment	Comparative example 1	Comparative example 2
L _{1max} /L4[%]		15% to 25%	Less than 15%	More than 25%
Performance	Blowing efficiency	⊙	○	× to Δ
	Outer shape	⊙	× to Δ	○
⊙: Excellent, ○: Good, Δ: Sufficient, ×: Insufficient				

[0031] Regarding the blades 23 of the present embodiment, as shown in Table 1, the thickness L_{1max} of the thickest portion 23c is set to 15% to 25% of the chord length L4. Thus, even though they have inclined shapes, the recesses 23f do not penetrate the pressure surfaces 23d or the suction surfaces 23e. As a result, the recesses 23f are not exposed to the outside, and the blades 23 can have outer shapes as designed and achieve expected performance.

[0032] The blades 23 comprise the recesses 23f corresponding to so-called lightening holes. Thus, the difference between relatively thin and thick portions is small. Accordingly, shorts can be prevented without setting a long hold time in injection molding. In particular, the blades 23 are sufficiently thick, considering that they are integrally formed with the main plate 21. Nevertheless, the difference between relatively thin and thick portions can be made small by providing the recesses 23f which can form sufficient lightening holes. The blades 23 thereby can satisfy dimensional tolerances of outer shapes without requiring great tact for manufacturing, that is, without setting a long hold time in injection molding. As a result, the blades 23 can achieve expected performance while their productivity is maintained.

[0033] In particular, the impeller 5 comprising the blades 23 is a so-called turbofan, and provided in the air blower 3 which blows a relatively large amount of air, and whose wind pressure is set high. It is therefore very important to use the blades 23 whose shorts are prevented.

[0034] Moreover, since the blades 23 comprise the recesses 23f, their volume can be reduced. Accordingly, the amount of synthetic resin material necessary to mold the impeller 5 can be reduced, and the weight of the air blower 3 comprising the impeller 5 and the weight of the air conditioner can be reduced. As a result, it is possible to improve the productivity of the air blower 3 comprising the impeller 5 and the indoor unit 1 of the air conditioner comprising the air blower 3 through a reduction in cost, and to moderate the required rigidity of an installation space such as a ceiling through a reduction in weight.

[0035] In a comparative example 1, as shown in Table 1, blades having the thickness L_{1max} that is less than 15% the chord length L4 are used. In this case, the leading edge portions on the shroud side protrude over the leading edge portions on the main plate side in design. Thus, recesses cannot be sufficiently formed to the tips on the shroud side. That is, sufficient lightening holes cannot be provided. As a result, if the blades of the comparative example 1 are used, shorts are likely to occur at the time of injection molding, and it is hard to achieve expected performance. In order to prevent shorts of the blades of the comparative example 1 at the time of injection molding, the hold time in injection molding needs to be set long, and their productivity declines greatly.

[0036] In a comparative example 2, as shown in Table 1, blades having the thickness L_{1max} that is more than 25% of the chord length L4 are used. In this case, the space between adjacent blades is narrow. Since the space between adjacent blades constitutes an air passage, the amount of air blown is reduced. As a result, when the blades of the comparative example 2 are used, the blowing efficiency declines. In order to maintain the amount of air blown by the blades of the comparative example 2, it is necessary to increase their rates of rotation. Thus, the amount of power

consumed increases, and noise and oscillation increase.

[0037] In the present embodiment, regarding the blades 23, the distance L5 between the leading edge portion 23a and the thickest portion 23c is set to 15% to 30% of the chord length L4 between the leading edge portion 23a and the trailing edge portion 23b.

[0038] By virtue of the above-described structure, the air blower 3 comprising the impeller 5 and the indoor unit 1 of the air conditioner comprising the air blower 3 can achieve expected performance. This will be specifically described with reference to Table 2 and FIG. 10A to FIG. 10C.

[0039] Table 2 shows the percentage of the distance L5 between the leading edge portion and the trailing edge portion to the chord length L4 between the leading edge portion and the trailing edge portion, which relates to the performance of the blades. Excellent performance is denoted by ⊙, good performance is denoted by ○, sufficient performance is denoted by Δ, and insufficient performance is denoted by ×.

Table 2

		Present embodiment	Comparative example 3	Comparative example 4
L5/L4[%]		15% to 30%	Less than 14%	More than 31%
Performance	Blowing efficiency	⊙	× to Δ	○
	Noise	⊙	○	× to Δ
⊙: Excellent, ○: Good, Δ: Sufficient, ×: Insufficient				

[0040] In the present embodiment, as shown in Table 2 and FIG. 10A, when the blades 23 having the distance L5 that is 15% to 30% of the chord length L4 are used. In this case, air flowing from the leading edge portion 23a can be speedily discharged from the trailing edge portion 23b. That is, if the blades 23 of the present embodiment are used, energy loss in an airflow R1 along the pressure surface 23d and an airflow R2 along the suction surface 23e can be sufficiently reduced. Accordingly, the noise of air flowing from the leading edge portion 23a can be suppressed while its blowing efficiency is maintained. As a result, if the blades 23 of the present embodiment are used, the air blower 3 comprising the impeller 5 and the indoor unit 1 of the air conditioner comprising the air blower 3 can achieve expected performance.

[0041] In a comparative example 3, as shown in Table 2 and FIG. 10B, blades 123 which are integrally formed with a main plate 121 and have the distance L5 that is 14% or less of the chord length L4 are used. In this case, the probability that air flowing from a leading edge portion 123a will collide with the leading edge portion 123a increases. That is, an airflow R11 along a pressure surface 123d and an airflow R12 along a suction surface 123e occur after great energy loss in the leading edge portion 123a. Accordingly, air flowing from the leading edge portion 123a is greatly reduced, and discharged from a trailing edge portion 123b. As a result, the blowing efficiency of an impeller 105 with the blades 123 of the comparative example 3 declines.

[0042] In a comparative example 4, as shown in Table 2 and FIG. 10C, blades 223 which are integrally formed with a main plate 221 and have the distance L5 that is 31% or more of the chord length L4 are used. In this case, air flowing from a leading edge portion 223a is widely divided to reach a trailing edge portion 223b. In particular, an airflow R21 along a pressure surface 223d and an airflow R22 along a suction surface 223e are widely separated after passing through the thickest portion. Accordingly, air flowing from the leading edge portion 223a causes a great trailing vortex at the trailing edge portion 223b. As a result, the noise of an impeller 205 with the blades 223 of the comparative example 4 increases because of the trailing vortex.

[0043] In the present embodiment, regarding the blades 23, the area C extending from the leading edge portion 23a to the trailing edge portion 23b in the portion contacting the main plate 21 and the area D extending from the leading edge portion 23a to the trailing edge portion 23b in the portion contacting the shroud 22 cross in the axial direction of the axis of rotation 4a.

[0044] In this manner, regarding the blades 23, the thickness Lmax of the thickest portion 23c is set to 15% to 25% of the chord length L4, even if the area C and the area D are twisted relatively greatly, such that they cross each other. Thus, when the blades 23 are manufactured, the recesses 23f do not penetrate the pressure surfaces 23d and the suction surfaces 23e. As a result, the recesses 23f are not exposed to the outside, and the blades 23 can have outer shapes as designed and achieve expected performance.

[0045] In the present embodiment, the shroud 22 and the blades 23 are joined.

[0046] Thus, the cost and the number of steps necessary to manufacture the impeller 5 can be reduced. That is, the impeller 5 can be manufactured simply by joining two components in secondary processing. The two components are the shroud 22 and the blades 23 which are integrally formed with the main plate 21. As a result, it is possible to manufacture the air blower 3 comprising the impeller 5 and the indoor unit 1 of the air conditioner comprising the air blower 3 at low

cost while improving their productivity.

[0047] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the
 5 embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

10 **Claims**

1. An air blower (3) **characterized by** comprising an impeller (5) comprising:

15 a main plate (21) comprising a boss portion (21b) attached to an axis of rotation (4a) of a motor (4) and through-holes (21c) surrounding the boss portion (21b);
 a shroud (22) disposed opposite the main plate (21); and
 blades (23) which are formed of synthetic resin integrally with the main plate (21) between the main plate (21) and the shroud (22) and whose insides communicate with the through-holes (21c), the blades (23) including
 20 recesses (23f) recessed from the main plate (21) side to the shroud (22) side,

characterized in that

the blades (23) have shapes twisted in an axial direction of the axis of rotation (4a) from the main plate (21) side to the shroud (22) side,

25 an area extending from a leading edge portion (23a) to a thickest portion (23c) having a greatest thickness of an area extending from the leading edge portion (23a) to a trailing edge portion (23b) is inclined from a pressure surface (23d) to a suction surface (23e) as the area extends from the main plate (21) side to the shroud (22) side, and the thickness of the thickest portion (23c) is set to 15% to 25% of a chord length (L4) between the leading edge portion (23a) and the trailing edge portion (23b) in an interface with the main plate (21).

30 2. The air blower (3) of Claim 1, **characterized in that** a distance (L5) between the leading edge portion (23a) and the thickest portion (23c) is set to 15% to 30% of the chord length (L4).

35 3. The air blower (3) of Claim 1, **characterized in that** an area extending from the leading edge portion (23a) to the trailing edge portion (23b) in a portion contacting the main plate (21) of the blades (23) and an area extending from the leading edge portion (23a) to the trailing edge portion (23b) in a portion contacting the shroud (22) cross in the axial direction of the axis of rotation (4a).

4. The air blower (3) of Claim 1, **characterized in that** the shroud (22) and the blades (23) are joined.

40 5. An indoor unit (1) of an air conditioner, **characterized by** comprising:

45 a boxy main body (1a);
 a heat exchanger (6) contained in the main body (1a); and
 the air blower (3) of any one of Claim 1 to Claim 4, the air blower (3) contained in the main body (1a) and blowing air to the heat exchanger (6).

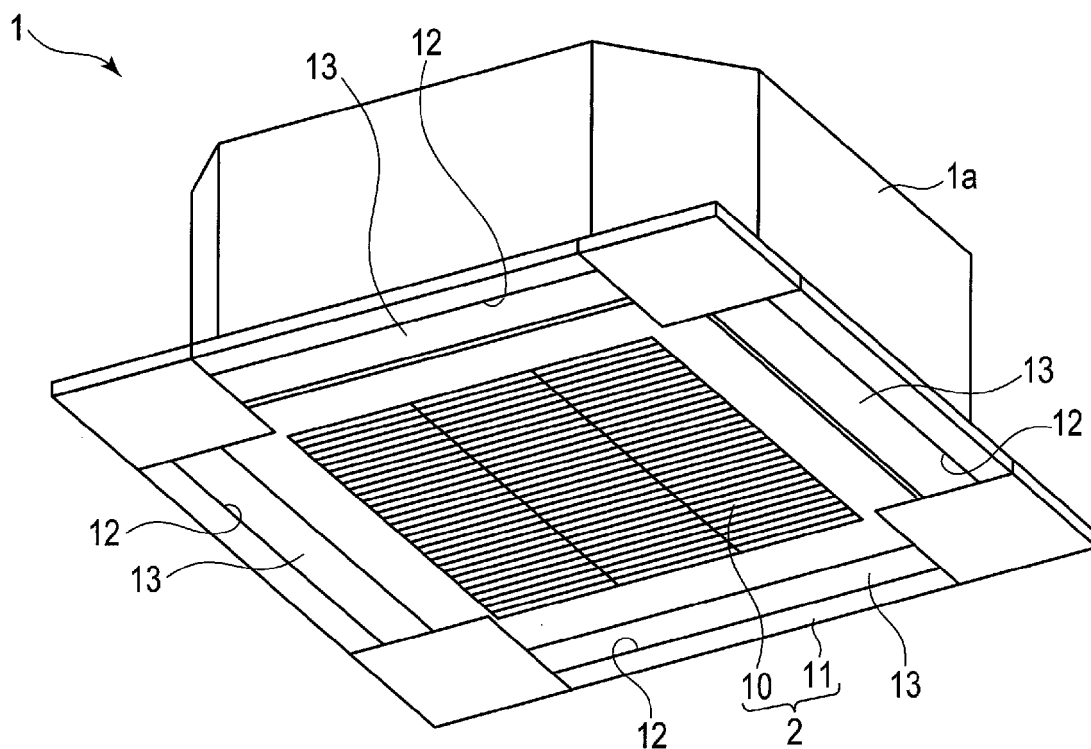


FIG. 1

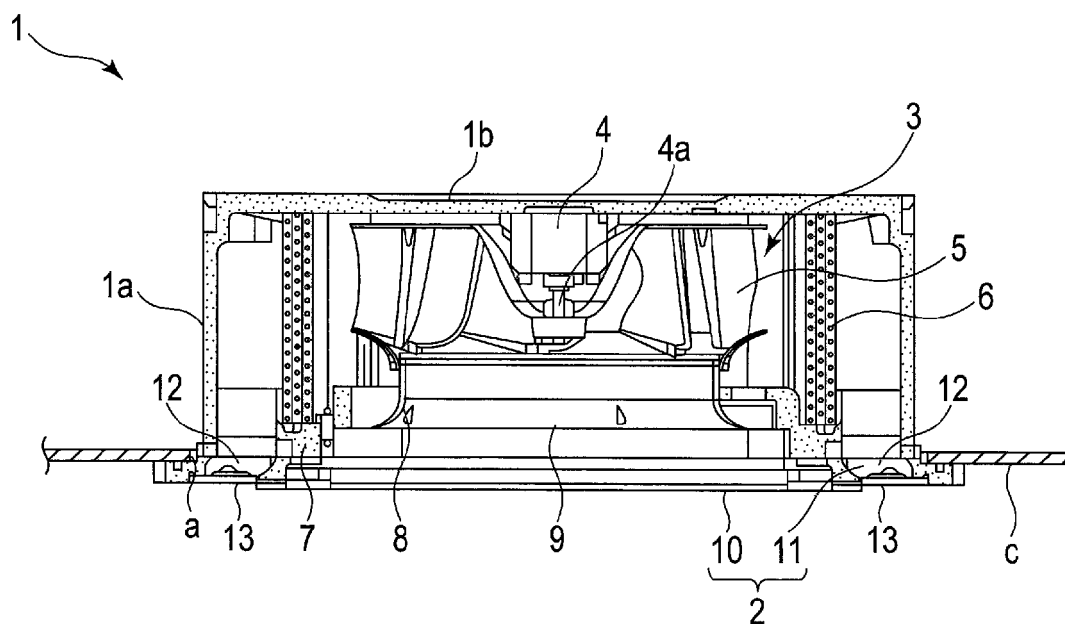


FIG. 2

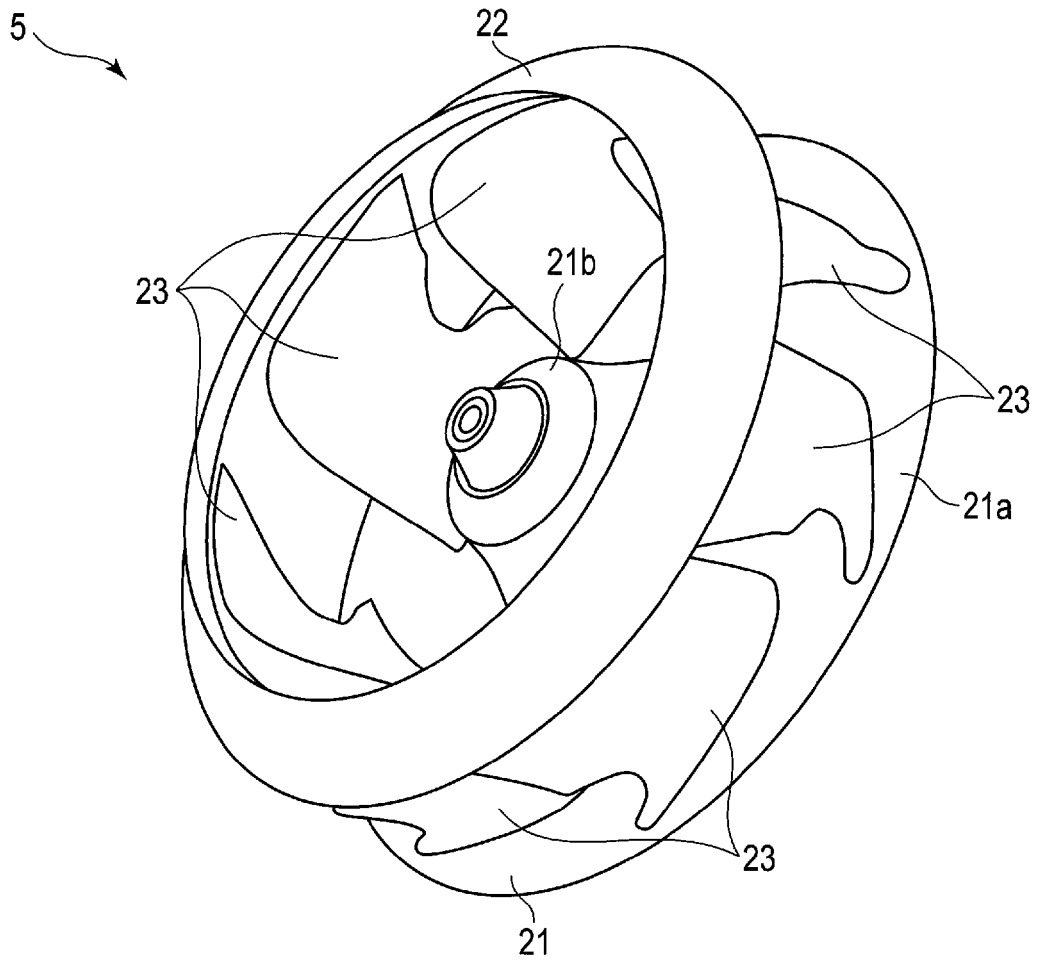


FIG. 3

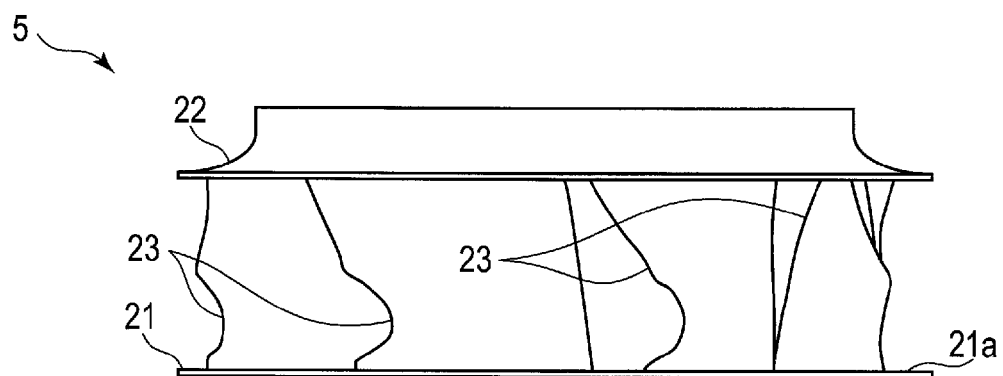


FIG. 4

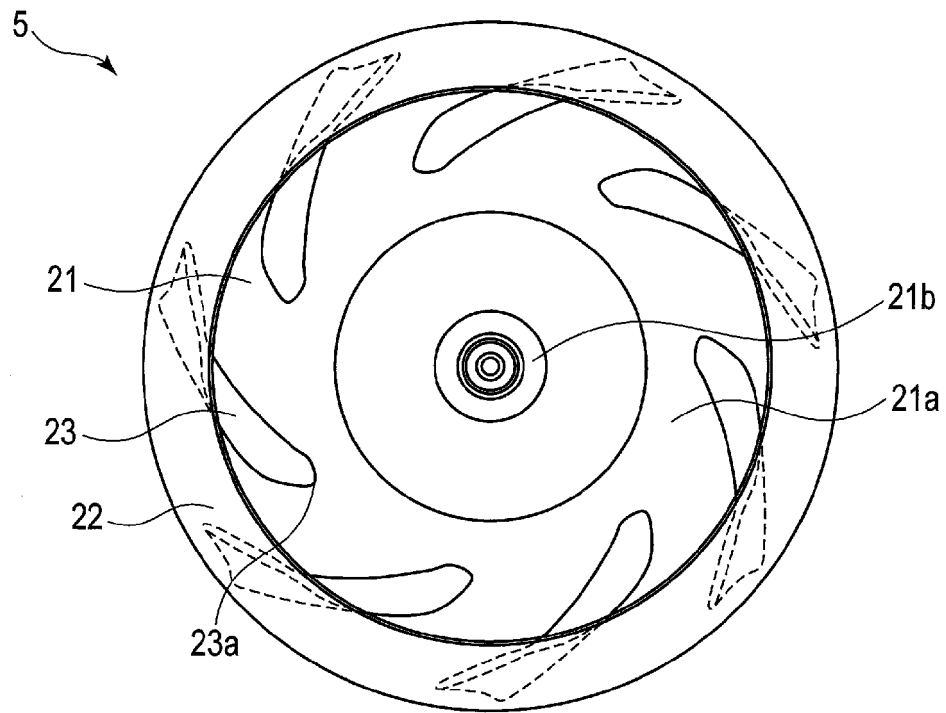


FIG. 5

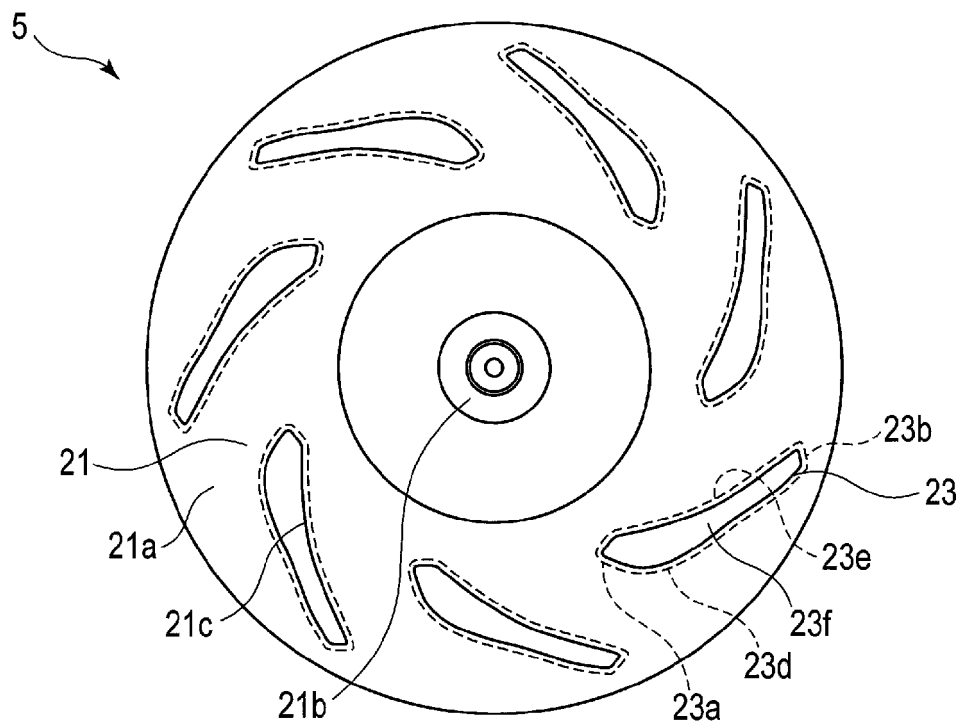
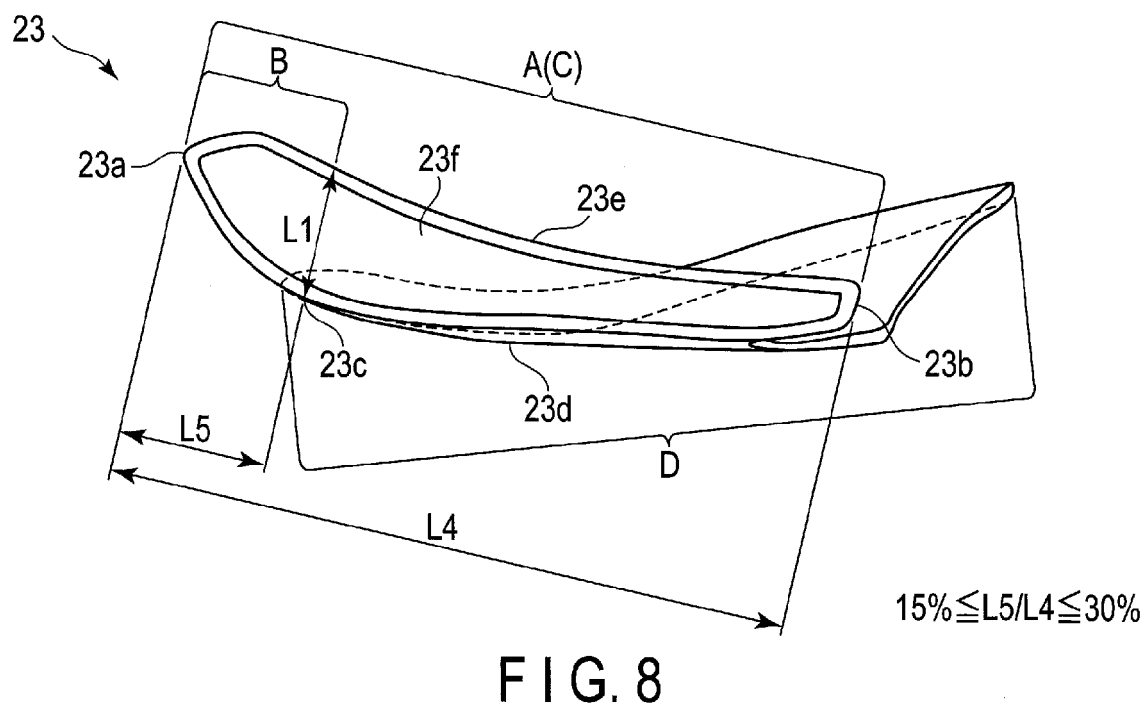
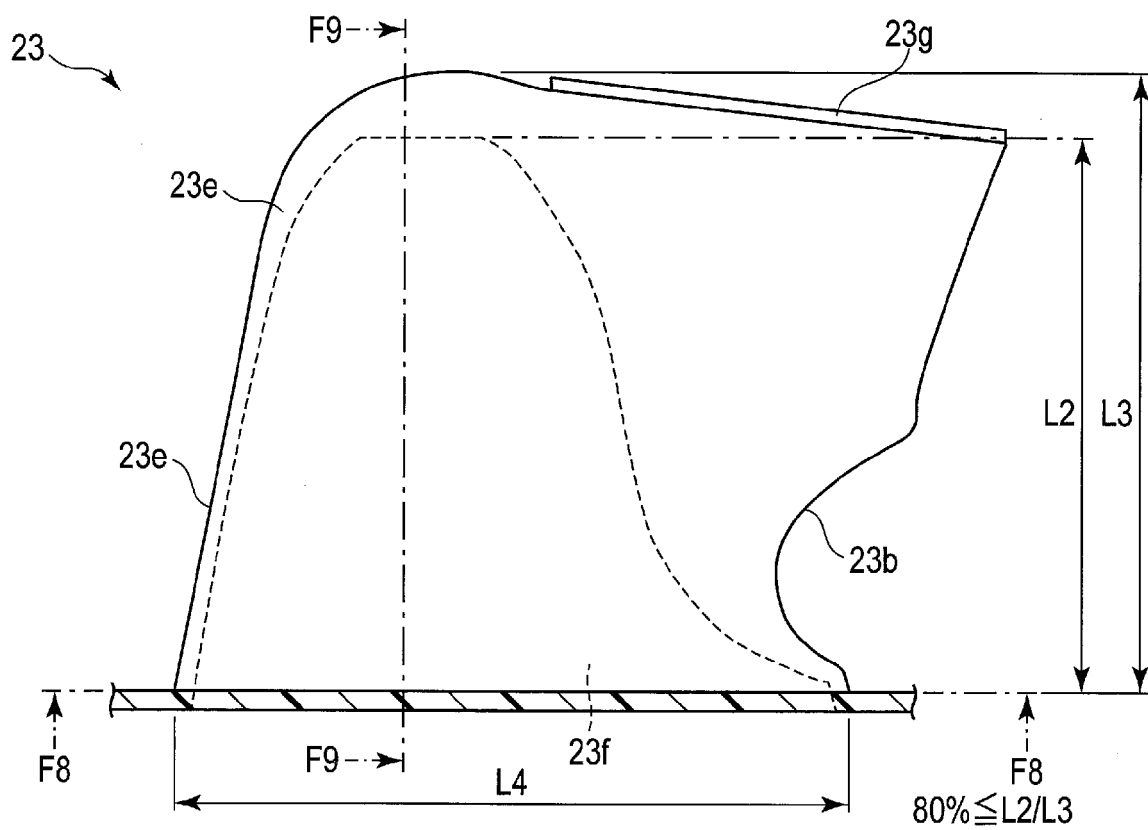


FIG. 6



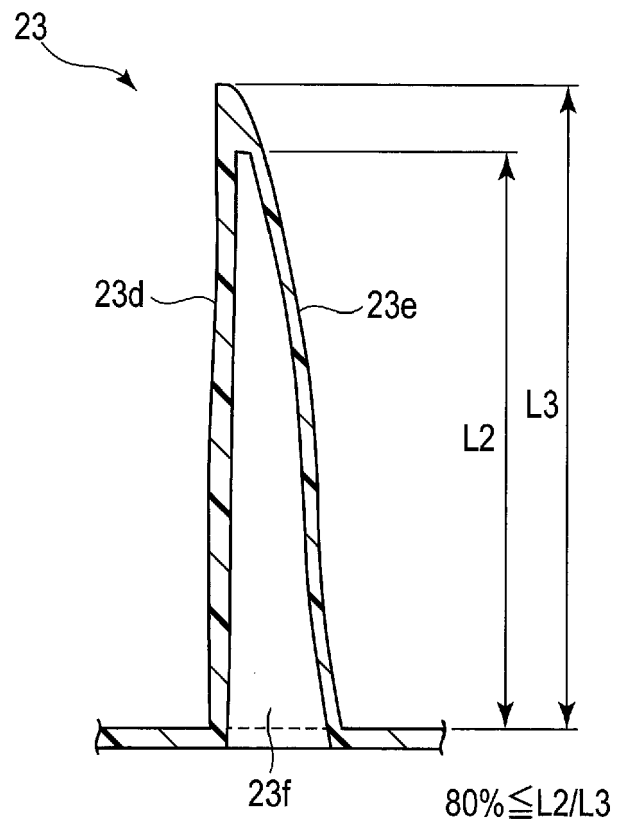


FIG. 9

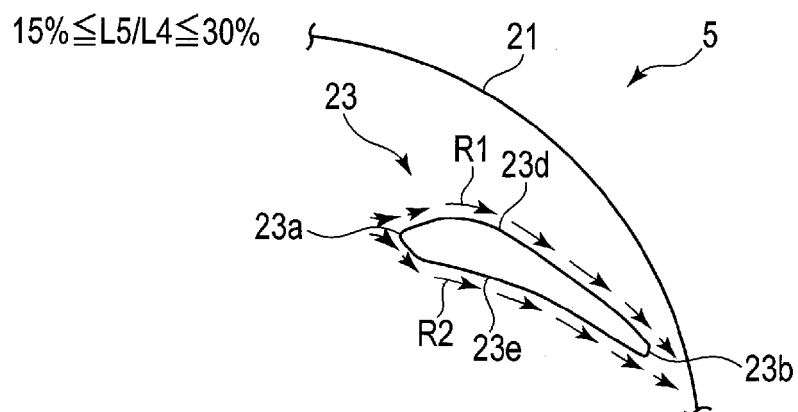


FIG. 10A

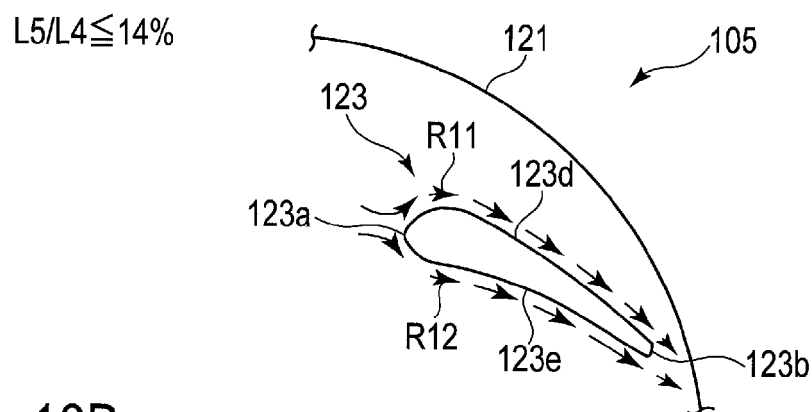


FIG. 10B

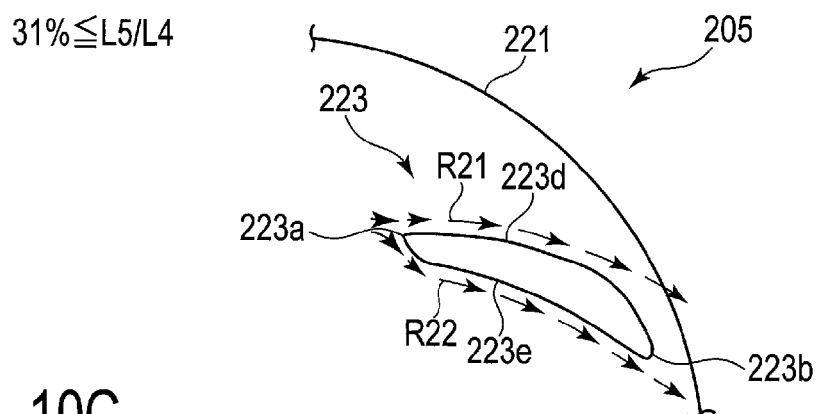


FIG. 10C



EUROPEAN SEARCH REPORT

Application Number
EP 19 16 4111

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 3 131624 B2 (DAIKIN IND LTD; SANKO GOSEI KK) 5 February 2001 (2001-02-05) * paragraphs [0001], [0002], [0006], [0008], [0013], [0014] * * figures 1a-1c, 2a, 2b *	1-5	INV. F04D29/02 F04D29/28 F04D29/30
A	US 2009/129933 A1 (KILIAN JORG [DE] ET AL) 21 May 2009 (2009-05-21) * paragraphs [0001], [0006], [0009], [0010], [0014], [0042] * * figures 1-14 *	1-5	
A	US 2015/176594 A1 (GEBERT DANIEL [DE] ET AL) 25 June 2015 (2015-06-25) * paragraphs [0007], [0010], [0042] * * figures 1-6 *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			F04D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 December 2019	Examiner De Tobel, David
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 16 4111

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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04-12-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 3131624 B2	05-02-2001	JP 3131624 B2	05-02-2001
		JP H08159091 A	18-06-1996
US 2009129933 A1	21-05-2009	CN 101213373 A	02-07-2008
		EP 1902220 A1	26-03-2008
		JP 5240926 B2	17-07-2013
		JP 2008545086 A	11-12-2008
		US 2009129933 A1	21-05-2009
		WO 2007003416 A1	11-01-2007
US 2015176594 A1	25-06-2015	CN 104728160 A	24-06-2015
		CN 204646777 U	16-09-2015
		DE 102013114609 A1	25-06-2015
		EP 2886874 A1	24-06-2015
		US 2015176594 A1	25-06-2015