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

(11) **EP 3 415 768 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.12.2018 Bulletin 2018/51

(21) Application number: **17175765.1**

(22) Date of filing: **13.06.2017**

(51) Int Cl.:
F04D 29/42 *(2006.01)* ***F04D 29/66*** *(2006.01)*
F04D 29/28 *(2006.01)*

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

(71) Applicant: **Lumileds Holding B.V.**
1118 BG Schiphol (NL)

(72) Inventor: **The designation of the inventor has not yet been filed**

(74) Representative: **Rüber, Bernhard Jakob**
Lumileds Germany GmbH
Intellectual Property
Philipsstraße 8
52068 Aachen (DE)

(54) A FAN ASSEMBLY WITH ECCENTRIC ROTOR

(57) The invention relates to a fan assembly (10). The fan assembly (10) comprises a volute casing (1) with a volute tongue (16); a rotor (2) mounted in the volute casing (1) and rotatable around a rotor axis (23); and a cover (3) fixed to the volute casing (1) and defining an inlet opening (31) therein. The rotor axis (23) is closer to the volute tongue (16) than an axis (311) of the inlet opening (31). The fan assembly (10) can provide higher air pressure and higher air flow under the same noise level, or provide lower noise under the same air flow and air pressure.

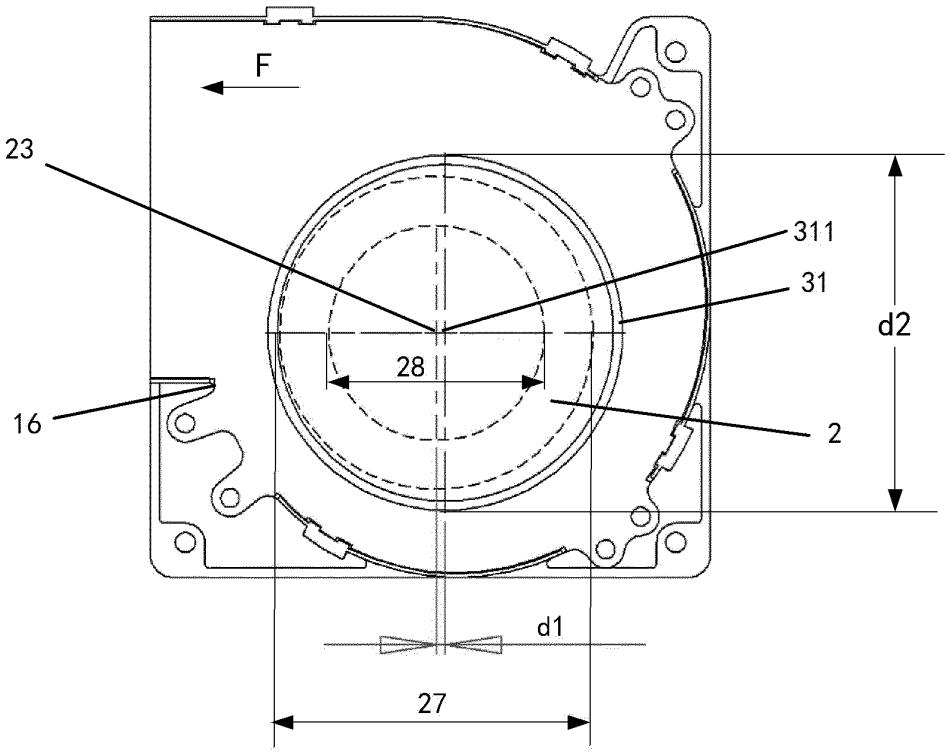

Fig. 3

EP 3 415 768 A1

Description

TECHNICAL FIELD

[0001] The invention generally relates to a fan assembly, and more particularly to a centrifugal fan assembly.

BACKGROUND

[0002] A centrifugal fan assembly is widely used for cooling, ventilating, and air-conditioning in automobiles, household electrical appliances, office equipment and industrial equipment, etc. A centrifugal fan assembly includes: a volute casing including an outlet section defining an outlet channel; a rotor mounted in the volute casing and rotatable around a rotor axis; and a cover fixed to the volute casing and defining an inlet opening therein.

[0003] When the fan assembly operates, air or other gas is drawn from the inlet opening by rotating the rotor, is compressed by the rotor, and is discharged via the outlet channel as high-pressure air or gas. Such fan assembly generally generates a considerable noise level, which significantly limits automotive usage or other similar usage. For automotive passenger cabin usage, GBT18801-2015 has a limitation for noise at 55dBA. This greatly limits the air flow or air pressure of the fan assembly.

SUMMARY

[0004] It is an object of the invention to propose a fan assembly which provides higher air pressure and higher air flow under the same noise level, or provides lower noise under the same air flow and air pressure.

According to an aspect of the invention, a fan assembly is provided. The fan assembly comprises: a volute casing with a volute tongue; a rotor mounted in the volute casing and rotatable around a rotor axis; and a cover fixed to the volute casing and defining an inlet opening therein. The rotor axis is closer to the volute tongue than an axis of the inlet opening.

[0005] By disposing the rotor closer to the volute tongue which is the region of highest compression, the air backflow from the outlet channel will be reduced, thereby increasing the efficiency of the outlet flow and reducing the blade resistance. Thus, the fan assembly can provide higher air pressure and higher air flow under the same noise level, or provide lower noise under the same air flow and air pressure.

[0006] Preferably, the rotor axis is spaced from the axis of the inlet opening in a direction parallel to the outlet flow direction by a distance equal to 2.0%-5.0% of the diameter of the inlet opening. More preferably, the distance is equal to 2.5%-2.7% of the diameter of the inlet opening. Most preferably, the distance is equal to 2.6% of the diameter of the inlet opening.

[0007] With the above features, the fan assembly achieves at least 2 dBA noise reduction under a defined air flow.

The volute casing includes an outlet section defining an outlet channel, and the volute casing further includes a spiral sidewall, extending spirally around the rotor, and a bottom wall opposite to the cover. Preferably, the width of the outlet channel is larger than 50% of a diameter of the volute casing as measured between opposing parts of the spiral sidewall in the direction of the width of the outlet channel. More preferably, the width of the outlet channel is between 52% and 60% of such diameter of the volute casing. Most preferably, the width of the outlet channel is between 54% of such diameter of the volute casing.

[0008] By providing a wider outlet channel, the area of the outlet channel increases, the air backflow from the outlet channel will be further reduced, thereby further increasing the efficiency of the outlet flow and reducing the blade resistance. Thus, the fan assembly can provide higher air pressure and higher air flow under the same noise level, or provide lower noise under the same air flow and air pressure.

[0009] Preferably, the volute casing comprises a flange with a plurality of mounting holes outside of the spiral sidewall. Thus, the fan assembly can be easily mounted to the components to be provided with the air flow.

[0010] Preferably, the volute tongue may include a concave portion with a plurality of different curvatures. Thus, noises of different frequencies are counteracting each other at the concave portion by the plurality of different curvatures.

[0011] Other exemplary embodiments of the invention will be apparent from the detailed description provided below. It should be understood that while the detailed description and the particular examples disclose the exemplary embodiments, they are for the purpose of illustration and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] At least one embodiment will be described hereafter with reference to the following drawings, wherein similar elements are indicated with like reference numbers.

- Fig. 1 is an exploded perspective view of an illustrative fan assembly according to an embodiment of the invention.
- Fig. 2 is a perspective view of an illustrative fan assembly according to an embodiment of the invention in an assembled state.
- Fig. 3 is a schematic top view of an illustrative fan assembly according to an embodiment of the invention.
- Fig. 4 is a schematic side view of an illustrative fan assembly according to an embodiment of the invention.

Fig. 5 is a top view of an illustrative fan assembly according to an embodiment of the invention.

Fig. 6 is a perspective view of an illustrative rotor of the fan assembly according to Fig. 1.

Fig. 7 is a schematic front view of an illustrative rotor of the fan assembly according to Fig. 1.

Fig. 8 shows comparative performance curves of the fan assembly according to an embodiment of the invention and a conventional fan assembly.

DETAILED DESCRIPTION

[0013] Reference will now be made to embodiments of the disclosure, one or more examples of which are illustrated in the Figures. The embodiments are provided by way of explanation of the disclosure, and are not meant as a limitation of the disclosure. For example, features illustrated or described as part of one embodiment may be used with another embodiment to yield still a further embodiment. It is intended that the disclosure encompass these and other modifications and variations as come within the scope and spirit of the disclosure.

[0014] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms used herein should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0015] Referring to Fig. 1, in one embodiment, a fan assembly 10 is provided that includes a volute casing 1, a rotor 2, and a cover 3. The volute casing 1 can be of a variety of shapes, sizes, and materials. For example, volute casing 1 can be made of plastic, metal, or a combination thereof. The volute casing 1 can be small to enclose a small rotor design, or can be larger to accommodate an industrial-sized rotor. The fan assembly 10 may be in a horizontal orientation facing upward or facing downward. The fan assembly can alternatively be positioned in a vertical orientation, a tilted orientation, and a wide variety of other orientations. The fan assembly 10 of Fig. 1 is shown in a horizontal orientation facing upward, however, the fan assembly 10 may be used in other orientations.

[0016] As shown in more detail in Fig. 2, the volute casing 1 includes an outlet section 11 defining an outlet channel 12. The volute casing 1 further includes a spiral sidewall 13, extending spirally around the rotor 2, and a bottom wall 14 opposite to the cover 3. The spiral sidewall 13 is shaped such that the air flow is optimally guided so as to reduce unnecessary resistance. The bottom wall 14 delimits a groove 15 for a cable 5 and a printed circuit board assembly 4, see Fig. 1. As shown for example in Fig. 5, a volute tongue 16 is located at a transition region between the outlet section 11 and the spiral sidewall 13. The volute tongue 16 is the region of the spiral sidewall 13 that bears the highest compression. The volute tongue 16 may include noise reduction features. As an example, the volute tongue 16 may include a concave portion with a plurality of different curvatures, so as to counteract noises of different frequencies at the concave portion by the plurality of different curvatures. The volute tongue 16 can utilize any other suitable shape to reduce the noise.

[0017] As shown in more detail in Fig. 3, the rotor axis 23 is closer to the volute tongue 16 than an axis 311 of the inlet opening 31. According to an embodiment, the rotor axis 23 is spaced from the axis 311 of the inlet opening 31 in a direction parallel to an outlet flow direction F by a distance d1 equal to 2.0%-5.0% of the diameter d2 of the inlet opening 31. More preferably, the distance d1 is equal to 2.5%-2.7% of the diameter d2 of the inlet opening 31. Most preferably, the distance d1 is equal to 2.6% of the diameter d2 of the inlet opening 31.

[0018] By disposing the rotor 2 closer to the volute tongue 16 which is the region of highest compression, the air backflow from the outlet channel 12 will be reduced, thereby increasing the efficiency of the outlet flow and reducing the blade resistance. Thus, the fan assembly 10 can provide higher air pressure and higher air flow under the same noise level, or provide lower noise under the same air flow and air pressure.

[0019] The rotor 2 can be any type of rotor or impeller, including but not limited to a radial impeller and an axial impeller. The rotor can be a wide variety of sizes depending in part on the size of the volute casing and/or the intended use or location of the fan assembly. According to an embodiment, shown in Fig. 2, the rotor 2 is a radial impeller and includes at least one blade 22. In some embodiments, as depicted in Fig. 1, the rotor 2 may include a hub 21 and a plurality of blades 22 disposed around and connected to the hub 21.

[0020] In the embodiment in Fig. 1, each of the plurality of blades 22 is attached to the body of rotor 2 at the bottom of the blade 22 to form a basket-like impeller design. The impeller can be any of a variety of other shapes, with the blades 22 only attached at the top or bottom, or an alternating design. The blades 22 can be curved forward or curved backward, or can be a mixture of directions.

[0021] In the embodiment in Fig. 1, the hub 21 is shaped as a dome, with the apex of the dome facing the direction of the incoming air. The hub 21 can have a solid construction, or can include spokes 24 as depicted in Fig. 6 in order to reduce the sound radiated from the bottom of the fan assembly 10. According to an embodiment such as that depicted in Fig. 7, the rotor 2 has a maximum height 26 that is defined by the blades 22. The dome of the hub 21 has a maximum height 25 that can be equal to or less than the maximum height 26 of the rotor 2. According to an embodiment, the maximum height 25 of the dome of the hub 21 is between 1%-100% of the maximum height 26 of the rotor 2, and preferably in the range of 1% to 75%. According to another embodiment, the maximum height 25 of the dome of the hub 21 is 10% to

60% of the maximum height 26 of the rotor 2, and preferably in the range of 30% to 40%.

[0022] Further, according to an embodiment and as shown in Fig. 7, the rotor 2 has an outer diameter 27 that is defined by the outermost tips of opposing blades 22. The rotor 2 also has an inner diameter 28 that is defined by the innermost tips of opposing blades 22. According to an embodiment, the outer diameter 29 of the hub 21 is between 1%-99% of such inner diameter 28, and preferably in the range of 20%-80%.

[0023] Both the height and the diameter of the rotor 2 and the hub 21 can be designed or predetermined to maximize rotational speed and/or air flow, as well as to minimize noise, among many other design goals. According to an embodiment, the hub 21 of the rotor 2 co-rotates with the blades 22 of the rotor 2. In embodiments where the inlet opening 31 is positioned above the rotor 2, air pulled into the rotor region will first encounter the hub 21 of the rotor 2 or the space just above the hub 21 of the rotor 2. The hub 21 with a dome shape causes the entering air to have a rotational component, which improves efficiency of the fan assembly 10.

[0024] The rotor 2 may be manufactured from many metal alloys, including (but not limited to) steel, aluminum, nickel, copper, etc. It may be advantageous, according to an embodiment, to construct rotor 2 from an alloy of titanium, which may provide an optimal combination of weight to strength ratio, heat resistance, durability, etc. According to some embodiments, rotor 2 and/or blades 22 may be machined from AMS4928 titanium, or an alloy having substantially similar properties. According to other embodiments, rotor 2 and/or blades 22 may be heat treated to a particular hardness, such as, for example 30-50 HRC. It is contemplated that other materials and heat treatments may accomplish substantially similar structural and operational properties. Embodiments described herein are not intended to be limiting. As shown in Fig. 1, the rotor 2 is mounted to the volute casing 1 by means of ball bearings 6. It is contemplated that the rotor 2 may be mounted to the volute casing 1 by means of any other suitable means.

[0025] The cover 3 can be of corresponding shape and size to the volute casing 1. The cover 3 can be made of same or different materials from the volute casing 1. For example, the cover 3 can be made of plastic, metal, or a combination thereof. The cover 3 defines an inlet opening 31 therein. The inlet opening 31 can be of a variety of shapes and sizes. In some embodiments, as depicted in Fig. 1, the inlet opening 31 may be circular shaped in cross-section, but in any case defines an axis 311. It is contemplated that the inlet opening 31 may also have other shapes, such as oval. The inlet opening 31 can be tapered from the outside to the inside, so as to facilitate the introduction of the air.

[0026] The hub 21 of the rotor 2 is fixed to a motor (not shown), and is driven by the motor. The motor may be any motor or drive sufficient to cause a desired rotation of the rotor 2. According to an embodiment, the motor includes a drive shaft that attaches to the hub 21 of the rotor 2 at a rotor axis 23 of the rotor 2. The motor can also be connected to the rotor 2 indirectly, such as through a coupling element. The motor can operate at a single rotational speed, or can operate at a variety of different speeds. The motor may also include operation profiles that provide predetermined variable speeds, or other variations. The motor can be positioned entirely on the side of the rotor facing away from the inlet opening 31, which prevents the motor from interfering with the air flow within the fan assembly. However, other configurations of the rotor 2 and the motor are possible. The motor may also be integrated with the printed circuit board assembly 4.

[0027] Referring back to Fig. 1, the fan assembly 10 may optionally include a label 7. The label 7 may be of various forms and may be adhered to the hub 21 of the rotor 2.

[0028] Fig. 4 is a schematic side view of an illustrative fan assembly according to an embodiment of the invention. In Fig. 4, the outlet channel 12 is shown to have a rectangular cross-section with height H and width W. According to an embodiment of the invention, the outlet channel 12 extends horizontally in the outlet flow direction F. According to another embodiment of the invention, the outlet channel 12 may also extend at an angle relative to the horizontal direction.

[0029] According to an embodiment of the invention, the width W of the outlet channel 12 is larger than 50% of a diameter d3 of the volute casing 1 as measured between opposing parts of the spiral sidewall 13 in the direction of the width W of the outlet channel 12, preferably between 52% and 60% of such diameter d3, more preferably 54% of such diameter d3.

[0030] Fig. 5 is a top view of an illustrative fan assembly 10 according to an embodiment of the invention. As shown in Fig. 5, the volute casing 1 further comprises a flange 18 with a plurality of mounting holes 17 outside of the spiral sidewall 13. Thus, the fan assembly 10 can be easily mounted to the components to be provided with the air flow. The flange 18 is also provided with a plurality of mounting holes 19, which align with corresponding mounting holes 32 of the cover 3, for fixing the cover 3 to the volute casing 1 by means of suitable fasteners (not shown).

[0031] Fig. 8 shows comparative performance curves of the fan assembly 10 according to an embodiment of the invention and a conventional fan assembly. In the fan assembly 10 according to an embodiment of the invention, the distance d1 that the rotor axis 23 is spaced from the axis 311 of the inlet opening 31 in a direction parallel to the outlet flow direction F direction is 1.85 mm, the diameter d2 of the inlet opening 31 is 72 mm, thus, the ratio of the distance d1 to the diameter d2 of the inlet opening 31 is 2.6%. In addition, the width W of the outlet channel 12 is 74.39 mm, the diameter d3 of the volute casing 1 as measured between opposing parts of the spiral sidewall 13 in the direction of the width W of the

outlet channel 12 is 137.5 mm, thus, the ratio of the width W of the outlet channel 12 to the diameter d3 of the volute casing 1 is 54%. The conventional fan assembly used in the comparative tests of Fig. 8 has the same basic sizes as the fan assembly 10, that is, the diameter of the inlet opening is 72 mm, and the diameter of the volute casing is 137.5 mm; however, in the conventional fan assembly, the rotor axis coincides with the axis of the inlet opening (that is, there is no distance between the rotor axis and the axis of the inlet opening), and the width of the outlet channel is 44.68 mm, thus, the ratio of the width of the outlet channel 12 to the diameter of the volute casing is 32%.

[0032] In Fig. 8, performance curve C1 shows the noise level (in dBA) of the conventional fan assembly versus inlet air flow (in CFM), and performance curve C2 shows the noise level (in dBA) of the fan assembly 10 according to the above embodiment versus inlet air flow (in CFM). In addition, performance curve C3 shows the air pressure (in mmAq) of the conventional fan assembly versus inlet air flow (in CFM), and performance curve C4 shows the air pressure (in mmAq) of the fan assembly 10 according to the above embodiment versus inlet air flow (in CFM).

[0033] As can be seen by comparing the performance curves C1, C2, C3, and C4 , the fan assembly 10 according to the above embodiment produces about 3 dBA noise reduction under 30 CFM air flow, while producing an air pressure raised by 2 mmAq.

[0034] Having described the invention in detail, those skilled in the art will appreciate that, given the present disclosure, modifications may be made to the invention without departing from the spirit of the inventive concept described herein. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments illustrated and described.

LIST OF REFERENCE SIGNS:

[0035]

1	volute casing
2	rotor
3	cover
4	printed circuit board assembly
5	cable
6	ball bearings mounting the rotor to the volute casing
7	label
10	fan assembly
11	outlet section of volute casing
12	outlet channel of outlet section
13	spiral sidewall of volute casing
14	bottom wall of volute casing
15	groove in bottom wall
16	volute tongue
17	mounting holes in flange for mounting the fan assembly
18	flange of volute casing
19	mounting holes in flange for mounting the cover to the flange
21	hub of rotor having a dome shape
22	blades of rotor
23	rotor axis
24	spokes of hub of rotor
25	maximum height of dome of hub of rotor
26	maximum height of rotor defined by its blades
27	outer diameter of rotor
28	inner diameter of rotor
29	outer diameter of hub of rotor
31	inlet opening
32	mounting holes of cover to mount cover to the flange
311	axis of inlet opening
C1	performance curve for noise level of conventional fan assembly
C2	performance curve for noise level of an inventive fan assembly
C3	air pressure of conventional fan assembly
C4	air pressure of an inventive fan assembly
d1	distance of rotor axis to inlet opening in a direction parallel to the outlet flow direction
d2	diameter of inlet opening
d3	diameter of volute casing measured parallel to width dimension of outlet channel
H	height of outlet channel
W	width of outlet channel
F	outlet flow direction

Claims

1. A fan assembly (10) comprising:

a volute casing (1) with a volute tongue (16);
a rotor (2) mounted in the volute casing (1) and rotatable around a rotor axis (23); and
a cover (3) fixed to the volute casing (1) and defining an inlet opening (31) therein;
wherein the rotor axis (23) is closer to the volute tongue (16) than an axis (311) of the inlet opening (31).

2. The fan assembly (10) according to claim 1, wherein the rotor axis (23) is spaced from the axis (311) of the inlet opening (31) in a direction parallel to an outlet flow direction (F) by a distance (d1) equal to 2.0%-5.0% of the diameter (d2) of the inlet opening (31).

3. The fan assembly (10) according to claim 2, wherein the distance (d1) is equal to 2.5%-2.7% of the diameter (d2) of the inlet opening (31).

4. The fan assembly (10) according to claim 3, wherein the distance (d1) is equal to 2.6% of the diameter (d2) of the inlet opening (31).

5. The fan assembly (10) according to claim 1 or 2, wherein the volute casing (1) includes an outlet section (11) defining an outlet channel (12), and the volute casing (1) further includes a spiral sidewall (13), extending spirally around the rotor (2), and a bottom wall (14) opposite to the cover (3).

6. The fan assembly (10) according to claim 5, wherein the width (W) of the outlet channel (12) is larger than 50% of a diameter (d3) of the volute casing (1) as measured between opposing parts of the spiral sidewall (13) in the direction of the width (W) of the outlet channel (12).

7. The fan assembly (10) according to claim 6, wherein the width (W) of the outlet channel (12) is between 52% and 60% of such diameter (d3) of the volute casing (1).

8. The fan assembly (10) according to claim 7, wherein the width (W) of the outlet channel (12) is 54% of such diameter (d3) of the volute casing (1).

9. The fan assembly (10) according to claim 5, wherein the volute tongue (16) is located at a transition region between the outlet section (11) and the spiral sidewall (13).

10. The fan assembly (10) according to claim 9, wherein the volute tongue (16) includes a concave portion with a plurality of different curvatures.

11. The fan assembly (10) according to claim 5, wherein the volute casing (1) comprises a flange (18) with a plurality of mounting holes (17) outside of the spiral sidewall (13).

12. The fan assembly (10) according to claim 1 or 2, wherein the rotor (2) is mounted to the volute casing (1) by means of ball bearings (6).

13. The fan assembly (10) according to claim 1 or 2, wherein the rotor (2) includes a hub (21) of a dome shape and a plurality of blades (22) disposed around and connected to the hub (21).

14. The fan assembly (10) according to claim 13, wherein a maximum height (25) of the dome of the hub (21) is 10% to 60% of a maximum height (26) of the rotor (2) defined by the blades (22).

15. The fan assembly (10) according to claim 14, wherein the maximum height (25) of the dome of the hub (21) is 30% to 40% of the maximum height (26) of the rotor (2).

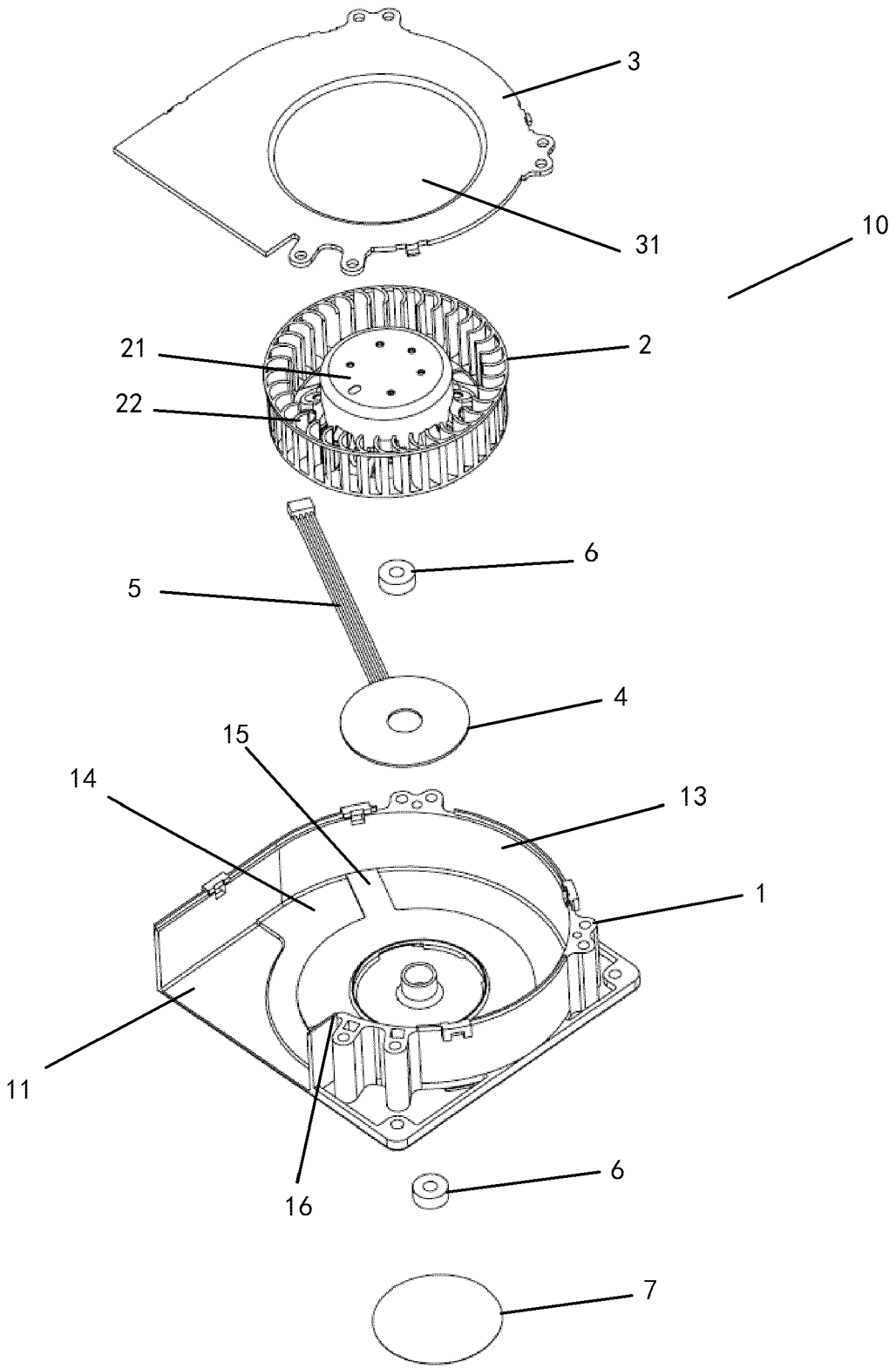

Fig. 1

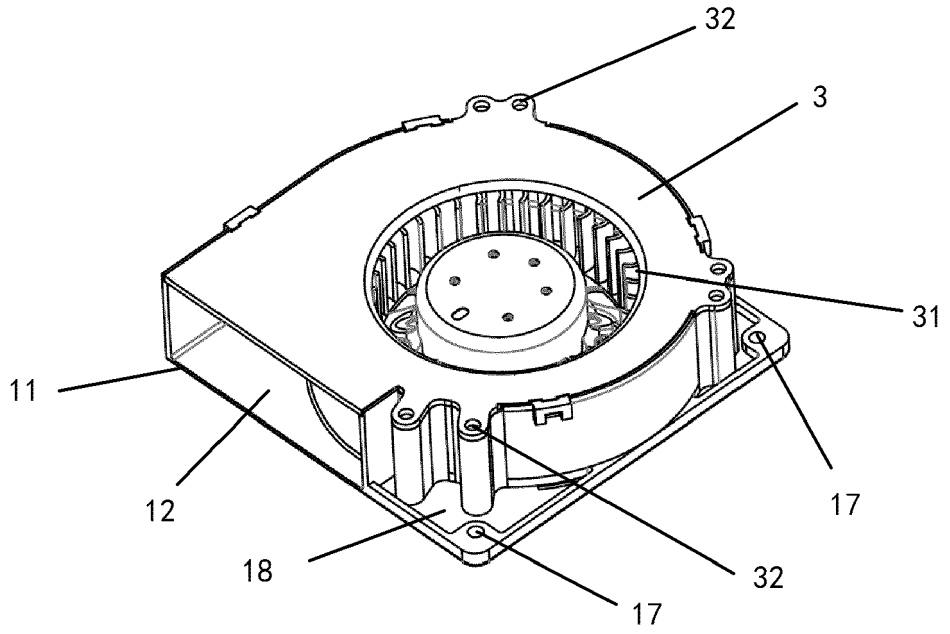

Fig. 2

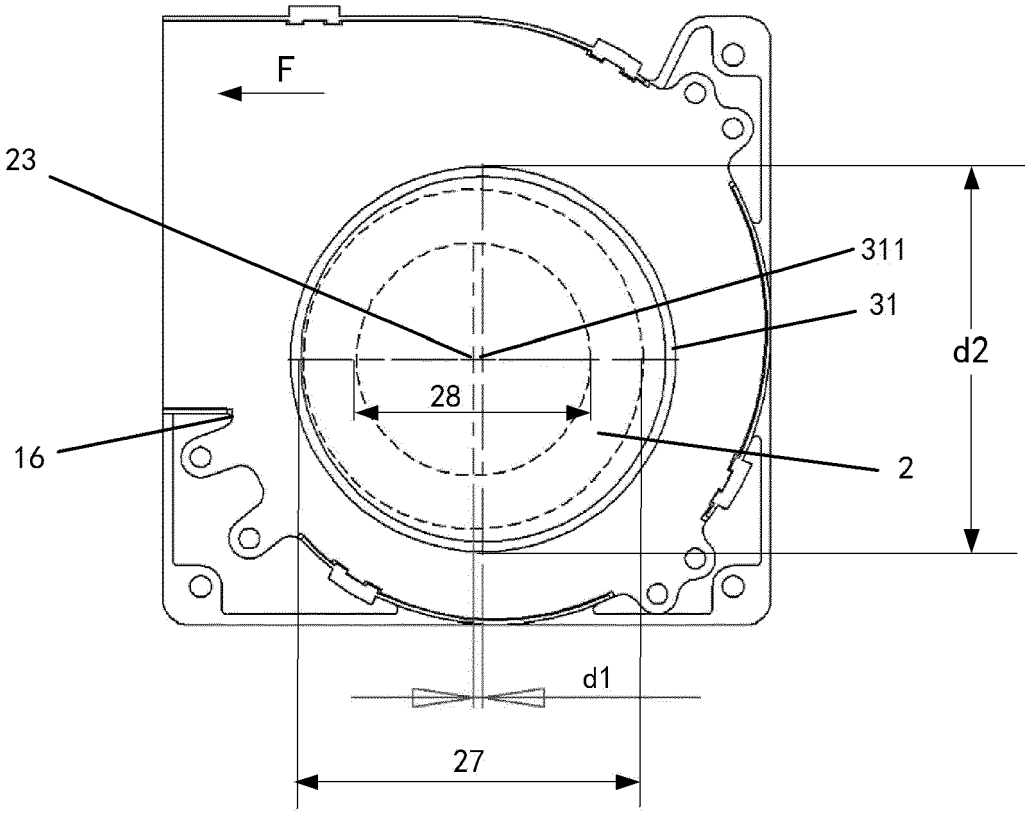

Fig. 3

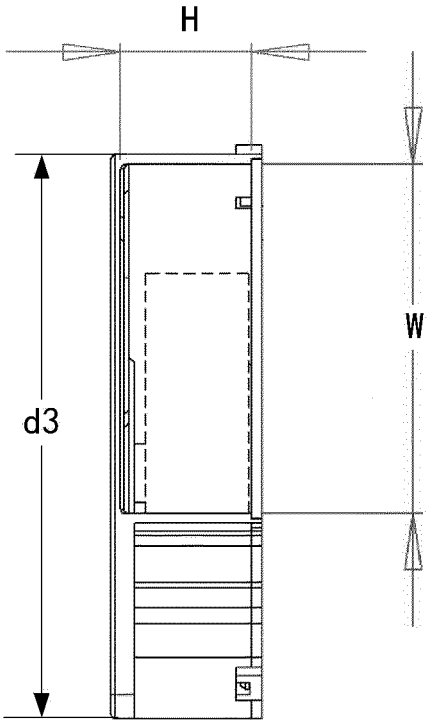

Fig. 4

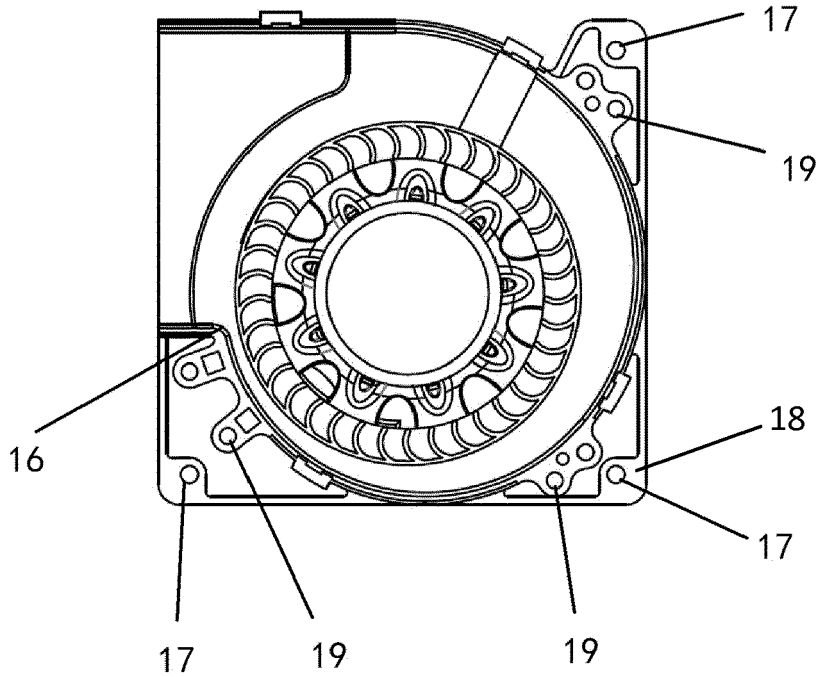

Fig. 5

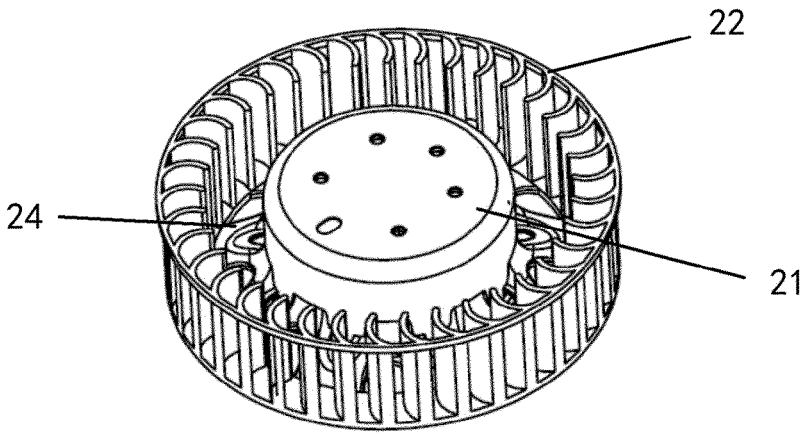

Fig. 6

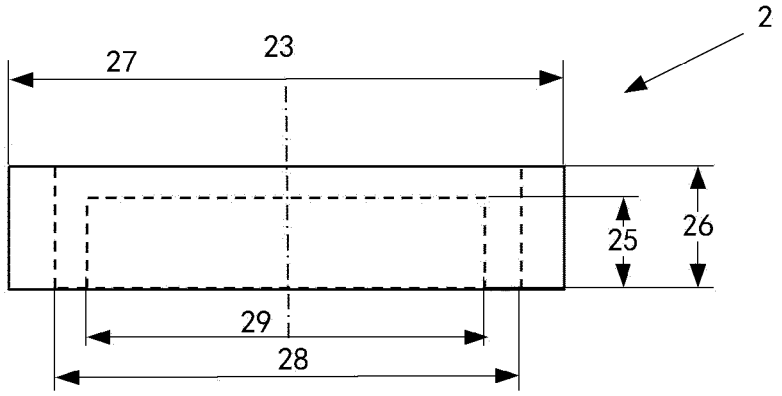

Fig. 7

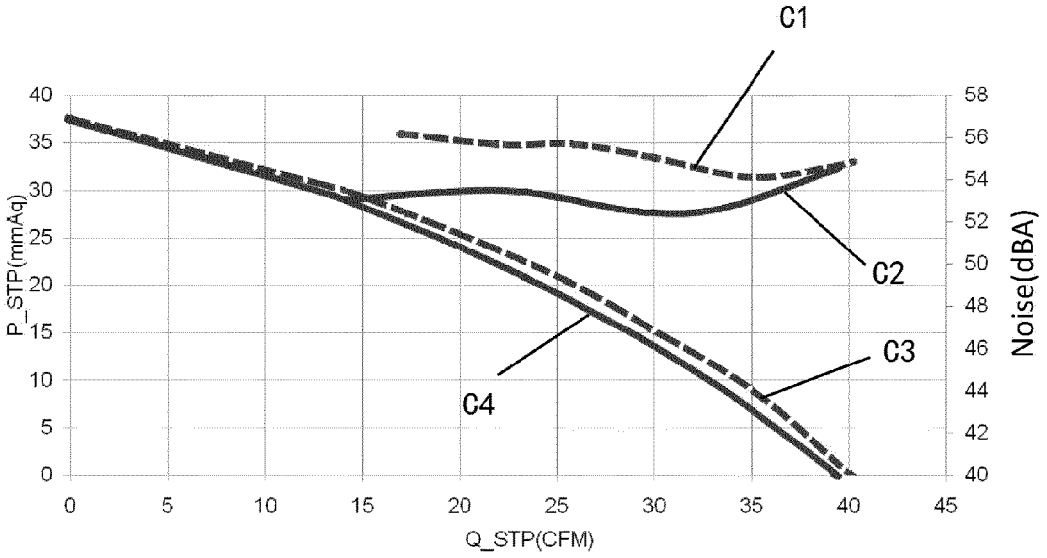

Fig. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 17 5765

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	DE 33 10 376 A1 (MULFINGEN ELEKTROBAU EBM [DE]) 27 September 1984 (1984-09-27) * page 9, line 28 - page 10, line 33 * * page 14, line 4 - page 15, line 14 * * figures 1,2,4 *	1-15	INV. F04D29/42 F04D29/66 ADD. F04D29/28
X	US 2005/069410 A1 (LIAO DENNI [TW]) 31 March 2005 (2005-03-31) * paragraphs [0014] - [0017] * * figures 1-3 *	1-6,9-15	
X	US 820 399 A (DAVIDSON SAMUEL CLELAND [IE]) 15 May 1906 (1906-05-15) * page 1, line 59 - page 2, line 4 * * figures 1-4 *	1-9, 13-15	
X	JP H05 149297 A (DAIKIN IND LTD) 15 June 1993 (1993-06-15) * abstract * * figures 1,2 *	1-10,12	

TECHNICAL FIELDS SEARCHED (IPC)

F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	5 December 2017	Gombert, Ralf

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 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 17 5765

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-12-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3310376 A1	27-09-1984	NONE	
US 2005069410 A1	31-03-2005	NONE	
US 820399 A	15-05-1906	NONE	
JP H05149297 A	15-06-1993	JP 3092267 B2	25-09-2000
		JP H05149297 A	15-06-1993

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82