



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.05.2023 Bulletin 2023/19

(51) International Patent Classification (IPC):
F04D 29/64^(2006.01)

(21) Application number: **21382993.0**

(52) Cooperative Patent Classification (CPC):
**F04D 19/002; F04D 29/522; F04D 29/646;
F04D 29/664; F05D 2260/36**

(22) Date of filing: **03.11.2021**

(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:
KH MA MD TN

(72) Inventors:
• **TORRE JUERA, Javier**
33211 GIJON (ES)
• **OMS ESCURA, Albert**
33211 GIJON (ES)

(74) Representative: **Del Valle Valiente, Sonia**
C/ Miguel Angel Cantero Oliva, 5,53
28660 Boadilla del Monte-Madrid (ES)

(71) Applicant: **Talleres Zitrón, S.A.**
33392 Gijón (Asturias) (ES)

Remarks:
Amended claims in accordance with Rule 137(2)
EPC.

(54) **AXIAL FAN WITH AN INTEGRATED SILENCER**

(57) Axial fan (1) with an integrated silencer comprising a motor (2) mechanically connected to an impeller (3) and supported by a support base (4) inside a cylindrical housing (5). The axial fan (1) further comprises an

inner lining made of a plurality of adjacent sections (6) having a noise absorbing material and fixed to the inner surface of the cylindrical housing (5).

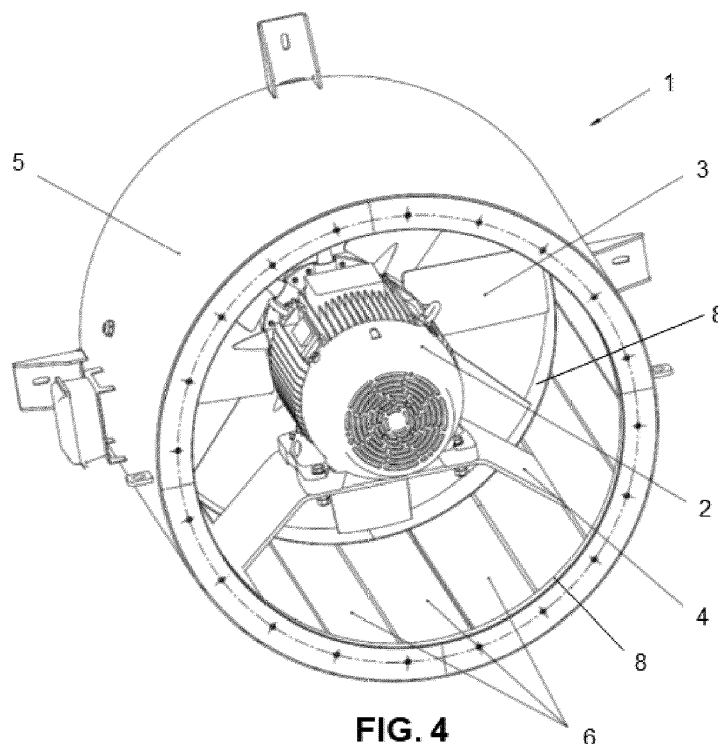


FIG. 4

Description

OBJECT OF THE INVENTION

[0001] The present invention belongs to the field of air conditioning in industrial environments, and more particularly in ships.

[0002] The object of the present invention is a new axial fan having an integrated silencer.

PRIOR ART

[0003] Air conditioning in industrial environments, such as in railway tunnels, mines, ships and the like, requires propelling very large volumes of air from/to the environment. Thereto, large axial fans are known having a propeller actuated by an electric motor and a normally cylindrical housing where the propeller is provided. The propeller comprises a number of blades that, when moving rotationally, draw air from an end of the cylindrical housing and push said air towards an opposite end of said cylindrical housing.

[0004] A known application of these large fans is the ventilation of the engine room of ships. In this case, the fans are placed in cylindrical passages in the hull of the ship for expelling hot and stale air from the engine room towards the outside. However, the engine room of a ship is naturally a very noisy room due to the engines operating therein, and the fans themselves are also quite noisy. In this context, it is desirable provide the fans with a silencer for minimising the noise escaping outwards through said passages.

[0005] To solve this problem, silencers for axial fans are known. A known fan silencer is mainly a portion of tubular duct having an inner lining made of a noise absorbing material, such as rock wool or the like. The silencer is connected directly to an end of the fan housing, thereby damping the noise transmitted through said end of the fan housing. Fig. 1 shows an example of such a prior art silencer (100) comprising a cylindrical housing (101) open at both ends and having an internal rock wool lining (102). In order to prevent the internal rock wool lining (102) from detaching from the inner surface of the housing (101), a cylindrical frame (103) consisting of a perforated metal plate is provided inside the housing (101). The cylindrical frame (103), shown in Fig. 2, is connected to the housing (101), thereby providing a cylindrical cavity where the rock wool lining (102) is compressed against the inner surface of the cylindrical housing (101). The housing (101) further comprises a flange (104) for connecting the silencer (100) to the fan (200). The silencer (100) is connected to the fan (200) using connecting means such as bolts, screws or the like. The resulting combination of silencer (100) and axial fan (200) is shown in Fig. 3.

[0006] A drawback of this configuration is connected to the large space requirements. Indeed, the silencer (100) and the fan (200) are connected one after the other

in the axial direction, i.e. the airflow direction. The volume needed for the combination of both elements can be twice or more the volume of the fan (200) alone.

[0007] This is disadvantageous in many applications, and therefore there is a need in this field for a combination of fan and silencer having a reduced size.

BRIEF DESCRIPTION OF THE INVENTION

10 [0008] The invention discloses an axial fan having a noise absorbing material provided on the inner surface of the cylindrical housing. The axial fan of the invention therefore comprises an integrated silencer not requiring more space than a conventional axial fan.

15 [0009] A number of common terms employed throughout the present description are now briefly disclosed.

[0010] Tangential/axial: These terms are to be interpreted according to a cylindrical coordinate system. In particular, the axial direction refers to a direction contained in the central axis of the cylindrical housing, while the tangential direction refers to a direction tangential to the cylindrical housing and contained in a plane perpendicular to the fan axial direction.

[0011] Inner/outer: Terms such as "inner", "inside", etc. refer to the side or portion of a particular element that is closest to the central axis of the cylindrical housing. Accordingly, terms such as "outer", "outside", etc. refer to the side or portion of a particular element that is farthest from the central axis of the cylindrical housing.

20 [0012] The axial fan of the invention comprises a motor mechanically connected to an impeller and supported by a support base inside a cylindrical housing. The impeller is normally made by a plurality of blades, for example eight blades, protruding from a hub connected to the shaft of the motor such that, when the motor causes the shaft to rotate, the blades propel air through the cylindrical housing from an air-drawing end towards an air-expelling end. The motor is normally an electric motor fed by an electrical current transmitted through electrical wires. 25 The support base can adopt a number of configurations. For example, the support base may comprise a plate positioned within the cylindrical housing in a position such that, when the motor is fixed thereto by means of bolts, screws or the like, the shaft of the motor is positioned along the axial axis of the cylindrical housing. The support base can be attached to the cylindrical housing by means of two or more connection arms or plates.

30 [0013] The above paragraph discloses the features of a conventional axial fan. Now, the axial fan of the invention differs from said known axial fans by comprising an inner lining made of a plurality of adjacent sections made of a noise absorbing material and fixed to the inner surface of the cylindrical housing. Naturally, the inner lining sections are provided side-by-side to cover essentially all the inner surface of the cylindrical housing without leaving voids through which noise can escape the axial fan. In that manner, the noise caused by the axial fan is dampened by said inner lining, and there is no need to 35 40 45 50 55

use a silencer as a separate body attached to the cylindrical housing.

[0014] This configuration is advantageous in that the silencer does not take additional space. In addition, in case the lining is damaged, only the damaged sections need be replaced.

[0015] In principle, the inner lining sections may have any shape provided they cover essentially all the inner surface of the cylindrical housing. Normally, the inner lining sections will have a parallelepipedic shape fitting ones with the others to render an essentially continuous lining covering the whole inner surface of the cylindrical housing, such as e.g. a squared shape or a rectangular shape. In a particularly preferred embodiment of the invention, the inner lining sections are tangentially adjacent longitudinal sections having a rectangular shape with two long axial sides and two short tangential sides. The length of the long axial sides of the inner lining sections is essentially the same as the length of the cylindrical housing in the axial direction. Said inner lining sections are provided such that the long axial sides of tangentially adjacent longitudinal sections are placed side-by-side in parallel to said axial direction.

[0016] This configuration is advantageous in that inner lining sections fit naturally and easily ones with the others and also with the inner surface of the cylindrical housing, thus covering said inner surface of the cylindrical housing completely and without leaving voids.

[0017] In another preferred embodiment of the invention, the inner lining sections are fixed to the inner surface of the cylindrical housing by means of metal rims attached to the ends of the cylindrical housing that press the ends of the inner lining sections against the cylindrical housing. That is, at least two metal rims are attached to the ends of the cylindrical housing over the respective ends of the inner lining sections, thereby holding said inner lining sections against said inner surface of the cylindrical housing. Optionally, a third additional metal rim can be provided at a middle section of the cylindrical housing for further ensuring that the inner lining sections are duly attached to the inner surface of the cylindrical housing. The connection between these rims and the inner surface of the cylindrical housing may be e.g. through bolts or screws.

[0018] This configuration is advantageous in that a fast and simple, yet reliable manner to attach the sections to the cylindrical housing is provided, dispensing with the need to attach each of the sections individually by means of a multiplicity of screws or the like.

[0019] In still another particularly preferred embodiment of the invention, the inner surface of the inner lining sections comprises a cover preventing the noise absorbing material from detaching. As mentioned above, the inner surface of the inner lining sections refers to the side closest to the central axis of the cylindrical housing. In this context, note that the noise absorbing material is usually a fragile material which can very easily deteriorate with the strong air currents passing through the axial

fan. By providing each of the inner lining sections with a separate, dedicated cover, the need to employ a cylindrical frame enclosing the whole lining, like that used in the prior art, is dispensed with.

[0020] This configuration is advantageous in that, by dispensing with the use of a cylindrical frame, replacement of inner lining sections is faster and more convenient. Furthermore, the axial fan is made simpler and lighter.

[0021] The cover may be made of any material provided the noise absorbing material is duly enclosed. For example, in a particularly preferred embodiment the cover can be made of a suitably durable and flexible material, such as e.g. glass fibre.

[0022] This configuration is advantageous in that these materials are sufficiently resistant and, at the same time, economic and easily obtainable.

[0023] The noise absorbing material can be any material having high noise dampening properties and suitable to be shaped as a lining for a cylindrical surface. For example, in still a further preferred embodiment, the noise absorbing material is rock wool.

[0024] The use of rock wool is advantageous because it is commonly used in this field and therefore economic and easily obtainable.

[0025] Depending on the circumstances, noise dampening may be needed at a particular end of the axial fan, i.e. at the air drawing end or at the air propelling end. When using the prior art separate silencer, the silencer was connected to the cylindrical housing at one or the other end of the fan. However, in the present invention, preferably the impeller is provided at an end of the cylindrical housing, thereby providing a noise dampening effect towards the opposite end of the axial fan.

[0026] This configuration is advantageous in that a higher noise dampening effect can be provided at a particularly desired end of the axial fan.

BRIEF DESCRIPTION OF THE FIGURES

[0027]

Fig. 1 shows a perspective view of a prior art silencer.

Fig. 2 shows a perspective view of a cylindrical frame used in a prior art silencer.

Fig. 3 shows a combination of prior art axial fan and prior art silencer.

Fig. 4 shows a perspective view of an axial fan with integrated silencer according to the present invention.

Fig. 5 shows a perspective sectional view of an axial fan with integrated silencer according to the present invention.

Fig. 6 shows an schematic view of an inner lining section of an axial fan with integrated silencer according to the present invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0028] A particular example of an axial fan (1) according to the invention is now disclosed with reference to the figures.

[0029] The axial fan (1) comprises an electrical motor (2) with an impeller (3) mechanically connected to the shaft. The electric motor (2) is fixed to a support base (4) by means of screws. The support base (4) is formed by a central metal plate, to which the electric motor (2) is fixed, and two side metal plates connected to a cylindrical housing (5). The cylindrical housing (5) therefore encloses the motor (2) such that the shaft thereof is positioned along an axial axis of the cylindrical housing (5). The impeller (3) is positioned at an end of the cylindrical housing (5), therefore dampening the noise emitted by the axial fan (1) towards the opposite end of the cylindrical housing (5).

[0030] A noise dampening inner lining formed by a plurality of rectangular sections (6) is attached to the inner surface of the cylindrical housing (5). Fig. 6 shows a schematic view of an inner lining section (6) having two long axial sides (61) and two short tangential sides (62). The inner lining section (6) is made of a noise dampening material such as rock wool. To prevent portions of the rock wool from detaching, the inner lining section (6) further comprises a cover (63) provided at the inner side and the two long sides. In this particular example, the cover (63) is made of glass fibre, e.g. type E glass fibre having about 53-54% SiO₂ and 14-15.5% Al₂O₃. Type E glass fibre is fire resistant as well as essentially dielectric.

[0031] In the axial fan (1) shown in Figs. 4 and 5, a plurality of these inner lining sections (6) is attached to the inner surface of the cylindrical housing (5). The sections (6) are positioned with their long sides (61) in an axial direction and tangentially adjacent each other such that no voids are left between them. The length of the sections (6) is coincident with the length of the cylindrical housing (5). To hold the sections (6), a pair of cylindrical rims (8) are attached to the ends of the cylindrical housing (5) over the corresponding ends of said sections (6). That is, the rims (8) compress the ends of the sections (6) against the inner surface of the cylindrical housing (5). The attachment between the rims (8) and the cylindrical housing (5) is carried out e.g. by means of screws.

[0032] By providing the sections (6) all around the inner surface of the cylindrical housing (5), no voids are left. The inner lining provides a suitable noise dampening effect by covering all of said inner surface of the cylindrical housing (5). Since only the inner side of the sections (6) is exposed, the cover (63) protects the rock wool and prevents it from detaching when the axial fan (1) is in use.

Claims

1. Axial fan (1) with an integrated silencer, comprising a motor (2) mechanically connected to an impeller (3) and supported by a support base (4) inside a cylindrical housing (5), **characterized by** further comprising an inner lining made of a plurality of adjacent sections (6) having a noise absorbing material and fixed to the inner surface of the cylindrical housing (5).
2. Axial fan (1) according to claim 1, where the inner lining sections (6) are tangentially adjacent longitudinal sections (6) having a rectangular shape having two long axial sides (61) and two short tangential sides (62), where the length of the long axial sides (61) is essentially the same as the length of the cylindrical housing (5) in the axial direction, and where said inner lining sections (6) are provided such that the long axial sides (61) of tangentially adjacent sections (6) are provided side-by-side in parallel to said axial direction.
3. Axial fan (1) according to any of the previous claims, where the inner lining sections (6) are fixed to the inner surface of the cylindrical housing (5) by means of metal rims (8) attached to the ends of the cylindrical housing (5) that press the ends of the inner lining sections (6) against the cylindrical housing (5).
4. Axial fan (1) according to any of the previous claims, where an inner surface of the inner lining sections (6) comprises a cover (63) preventing the noise absorbing material from detaching.
5. Axial fan (1) according to claim 4, where the cover (63) is made of glass fibre.
6. Axial fan (1) according to any of the previous claims, where the noise absorbing material is rock wool.
7. Axial fan (1) according to any of the previous claims, where the impeller (3) is provided at an end of the cylindrical housing (5).

Amended claims in accordance with Rule 137(2) EPC.

1. Axial fan (1) with an integrated silencer, comprising a motor (2) mechanically connected to an impeller (3) and supported by a support base (4) inside a cylindrical housing (5), further comprising an inner lining made of a plurality of adjacent sections (6) having a noise absorbing material and fixed to the inner surface of the cylindrical housing (5),

where the inner lining sections (6) are tangen-

tially adjacent longitudinal sections (6) having a rectangular shape each having two long axial sides (61) and two short tangential sides (62), where the length of the long axial sides (61) is essentially the same as the length of the cylindrical housing (5) in the axial direction, and where said inner lining sections (6) are provided such that the long axial sides (61) of tangentially adjacent sections (6) are provided side-by-side in parallel to said axial direction

characterized in that the inner lining sections (6) are fixed to the inner surface of the cylindrical housing (5) only by means of a pair of cylindrical metal rims (8) attached to the ends of the cylindrical housing (5) that press the ends of the inner lining sections (6) against the cylindrical housing (5).

2. Axial fan (1) according to claim 1, where an inner surface of each of the inner lining sections (6) comprises a dedicated cover (63) preventing the noise absorbing material from detaching.
3. Axial fan (1) according to claim 2, where the cover (63) is made of glass fibre.
4. Axial fan (1) according to any of the previous claims, where the noise absorbing material is rock wool.
5. Axial fan (1) according to any of the previous claims, where the impeller (3) is provided at an end of the cylindrical housing (5).

35

40

45

50

55

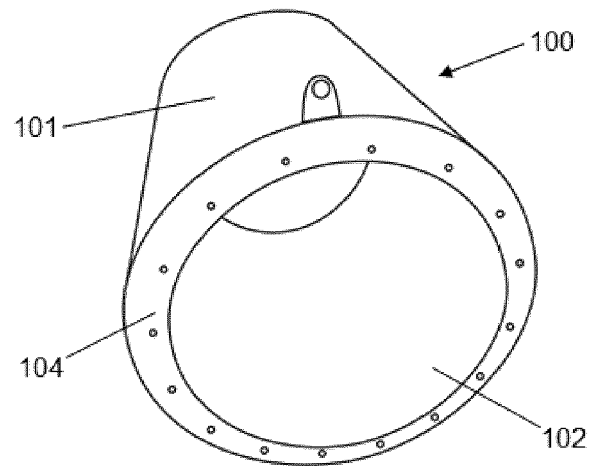


FIG. 1
PRIOR ART

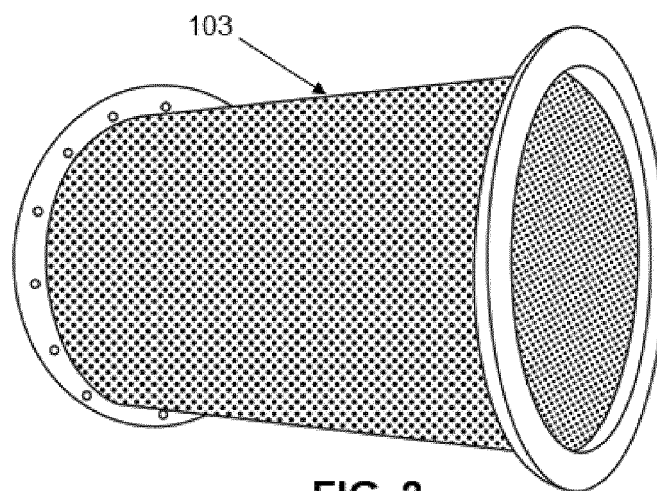


FIG. 2
PRIOR ART

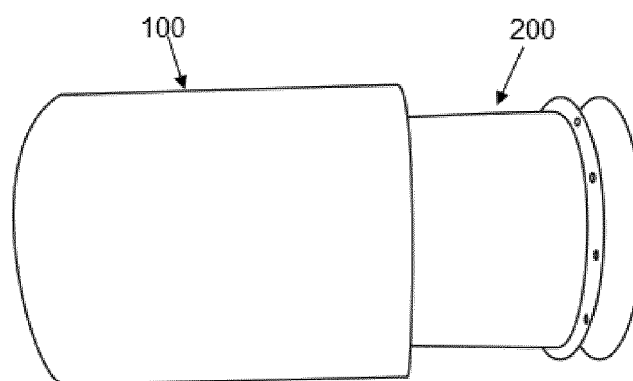
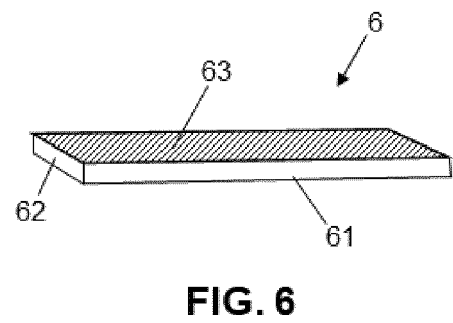
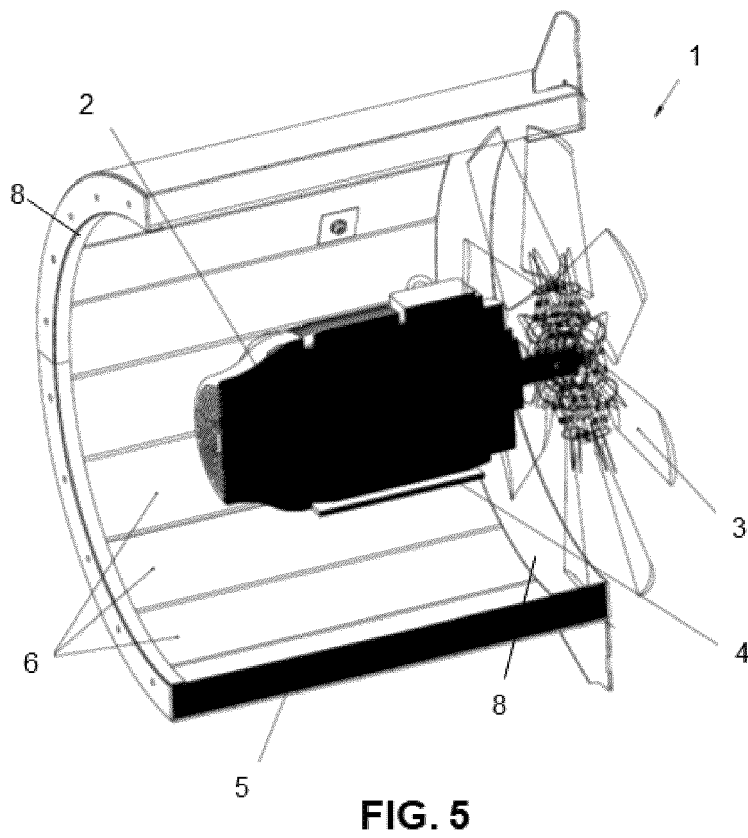
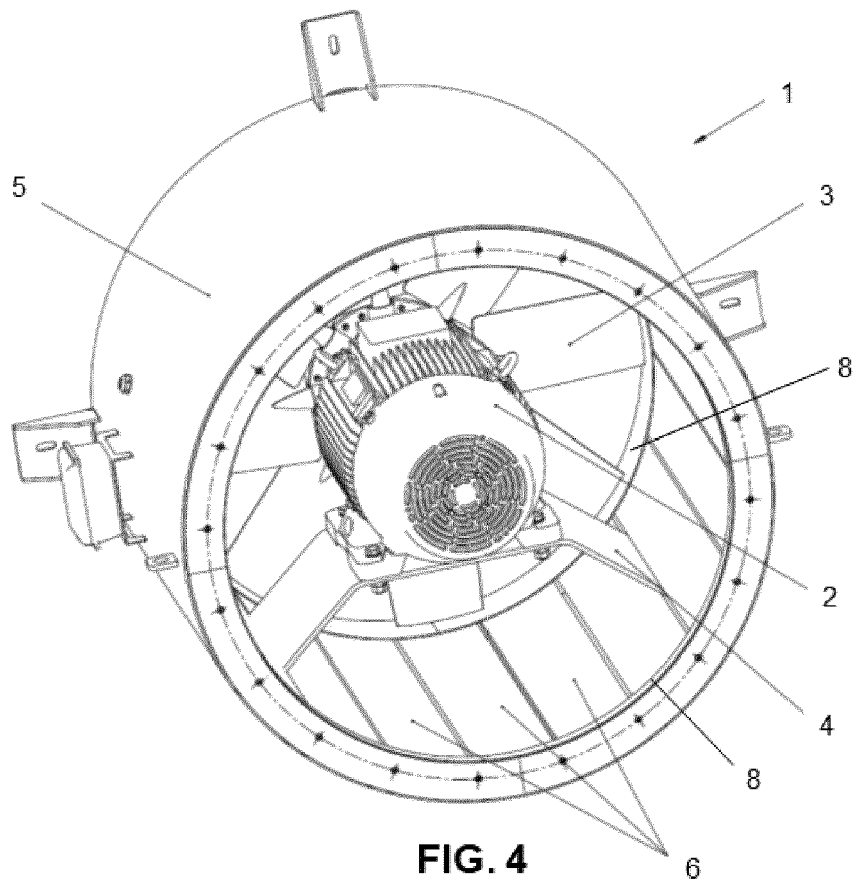


FIG. 3
PRIOR ART





EUROPEAN SEARCH REPORT

Application Number

EP 21 38 2993

5

10

15

20

25

30

35

40

45

50

55

2

EPO FORM 1503 03.82 (F04C01)

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	CN 111 577 665 A (SHANGHAI JINXIAN M & E CO LTD) 25 August 2020 (2020-08-25) * figures 1,2 *	1, 2	INV. F04D29/64
X	WO 2013/053342 A1 (CFT GMBH [EC]; CECCALDI FRANCOIS [FR]) 18 April 2013 (2013-04-18) * figure 2 *	1, 3, 4	
X	US 2009/220334 A1 (VOUCHE MICHEL [BE]) 3 September 2009 (2009-09-03) * figures 5-8 *	1, 4, 5	
Y	JP S53 80106 U (UNKNOWN PATENTEE) 4 July 1978 (1978-07-04) * figures 1,2 *	1-7	
Y	JP 2020 165355 A (PANASONIC IP MAN CORP) 8 October 2020 (2020-10-08) * abstract; figures 2,3,5 * * paragraphs [0017], [0018] *	1-7	
X	DE 14 28 051 A1 (BAUER EUGEN) 28 November 1968 (1968-11-28) * figure 2 *	1, 2, 6	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 13 April 2022	Examiner Brouillet, Bernard
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	

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

EP 21 38 2993

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

13-04-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 111577665 A	25-08-2020	NONE	
WO 2013053342 A1	18-04-2013	CA 2851745 A1	18-04-2013
		DE 102011115530 A1	11-04-2013
		EP 2766610 A1	20-08-2014
		WO 2013053342 A1	18-04-2013
US 2009220334 A1	03-09-2009	EP 2255073 A1	01-12-2010
		ES 2712718 T3	14-05-2019
		JP 2011513688 A	28-04-2011
		TR 201902448 T4	21-03-2019
		TW 200946859 A	16-11-2009
		US 2009220334 A1	03-09-2009
		WO 2009108477 A1	03-09-2009
JP S5380106 U	04-07-1978	NONE	
JP 2020165355 A	08-10-2020	NONE	
DE 1428051 A1	28-11-1968	NONE	