

(19)



(11)

EP 3 064 778 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.09.2016 Bulletin 2016/36

(51) Int Cl.:
F04D 17/16 (2006.01) **F04D 29/42** (2006.01)
F23D 14/62 (2006.01) **F04D 29/62** (2006.01)

(21) Application number: **16158639.1**

(22) Date of filing: **04.03.2016**

(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

(72) Inventors:
• **TRABALZI, Francesco**
I-60044 Fabriano, ANCONA (IT)
• **PALLOTTA, Marco**
I-60044 Fabriano, ANCONA (IT)
• **VITALETTI, Leonardo**
I-60044 Fabriano, ANCONA (IT)
• **TORREGIANI, Stefano**
I-60044 Fabriano, ANCONA (IT)

(30) Priority: **06.03.2015 IT MI20150336**

(71) Applicant: **ELICA S.p.A.**
60044 Fabriano (AN) (IT)

(74) Representative: **Leihkauf, Steffen Falk et al**
Jacobacci & Partners S.p.A.
Via Senato, 8
20121 Milano (IT)

(54) RADIAL FAN WITH AIR-GAS MIXING ARRANGEMENT

(57) A housing (3) for a fan (1) forms an impeller space (6) for rotationally accommodating an impeller (2) rotatable about a rotation axis (A), an air intake opening (20) in direct communication with the impeller space (6), an exhaust opening (21) for an air-gas mixture, a gas

inlet opening (25) spaced apart from the air intake opening (20) and in direct communication with the impeller space (6), so that the impeller space (6) forms a space for mixing an air flow (31) from the air intake opening (20) with a gas flow (32) from the gas inlet opening (25).

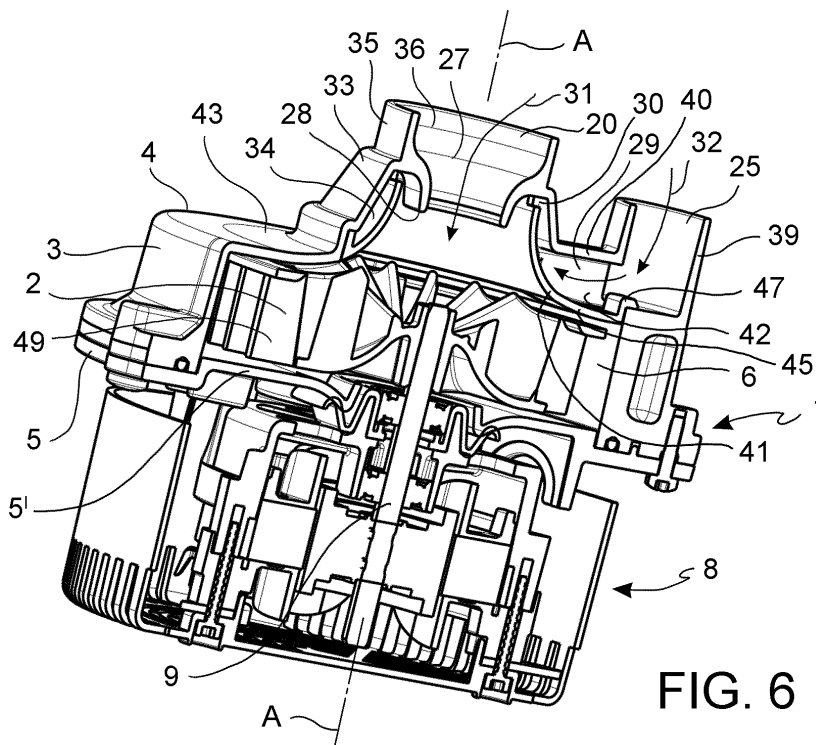


FIG. 6

EP 3 064 778 A1

Description

[0001] The present invention relates to a housing for a radial fan and to a radial fan provided with such a housing.

[0002] In particular, radial fans intended to send a mixture of air and gas to boilers, such as for example condensation boilers, comprise a housing provided with an air intake opening and an air exhaust opening. An impeller is arranged inside the housing, capable of rotating about a rotation axis. The air enters into the housing through the intake opening in axial direction, crosses the impeller, and is exhausted therefrom in radial direction into a spiral portion of the housing, from where the air reaches the exhaust opening. In order to convey the air according to said path, the impeller is provided with a plurality of blades arranged about the rotation axis of the impeller and having an arc-shaped profile in transverse direction to the rotation axis.

[0003] Radial fans must be able to make available suitable heads in clearly defined intervals (the so-called "working curves") in order to ensure the correct operation of the condensation boiler, for example, to which they are connected.

[0004] A further particularly felt need, to which the research in the radial fan industry dedicates considerable efforts, is to obtain size reductions without worsening performance. In other words, it is particularly desirable for radial fans to obtain efficient working curves while maintaining not excessively large overall dimensions.

[0005] Furthermore, the aforesaid performance is required for modern radial fans in a wide range of conveyed gas flow modulation.

[0006] In the case of an intake of a mixture of premixed gas and air by the radial fan, the overall dimensions are further increased by the presence of a premixing assembly, e.g. a Venturi effect mixer, arranged upstream of the intake opening of the housing and in all cases necessarily inside e.g. a boiler.

[0007] It is the object of the present invention to provide a housing for a radial fan and a radial fan which allow to reduce the overall dimensions of the mixing and conveying system.

[0008] It is a further object of the invention to simplify the structure and operation of the mixing and conveying system.

[0009] It is a yet further object of the invention to eliminate the premixing assembly upstream of the radial fan intake opening.

[0010] It is a yet further object of the invention to allow a wide modulation range of the heating power of an air-gas mixture conveyed by the radial fan, in particular, with the possibility of downward modulation, i.e. relatively slow flows and low pressures.

[0011] These and other objects are achieved by a housing for a radial fan according to claim 1 and a radial fan according to claim 15. The dependent claims relate to advantageous embodiments.

[0012] In order to better understand the invention and appreciate the advantages thereof, some non-limitative exemplary embodiments will be described with reference to the accompanying drawings, in which:

figure 1 is a perspective view of a radial fan according to the invention;

figure 2 is a perspective view, from the outside, of a half-shell of a housing of the radial fan in figure 1;

figure 3 is a perspective view, from the inside, of the half-shell of the housing in figure 2;

figure 4 is a perspective section view of the half-shell of the housing in figure 2;

figure 5 is a perspective exploded view of the radial fan according to an embodiment;

figures 6 and 7 are section views taken along different section plans of the radial fan according to an embodiment;

figures 8, 9, 10 show a front view, a side view and a perspective view of a distributor insert in the housing of the radial fan according to an embodiment.

[0013] With reference to the figures, a radial fan is indicated by reference numeral 1. Fan 1 is adapted to convey air and gas towards a burner or a boiler or a general heating system. Fan 1 is particularly suited for conveying a mixture of air and gas towards a condensation boiler.

[0014] Fan 1 comprises a housing 3 adapted to accommodate an impeller 2 capable of rotating about a rotation axis A. In the present description and in the appended claims, the words "axial" and "radial" refer to the rotation axis A of impeller 2, unless otherwise specified.

[0015] Housing 3 preferably comprises two mutually distinct, connectable parts, e.g. a half-shell 4, which delimits an impeller space 6 adapted to accommodate the impeller 2 therein and a lid 5 adapted to close the impeller space 6. The half-shell 4 and the lid 5 can be connected to each other by means of connecting members, e.g. screws 7. Lid 5 may further comprise a protruding portion 5' adapted to be inserted with shape connection into the impeller space 6 delimited by the half-shell 4, advantageously substantially complementary thereto.

[0016] Lid 5 is adapted to support a motor 8, preferably an electric motor, intended to move impeller 2 by means of a shaft 9 thereof which, in the assembled condition of fan 1, is coaxial to the rotation axis A. Motor 8 may be connected to lid 5 by means of an intermediate support 10 arranged for connecting the lid 5, e.g. by means of screws 11 to be inserted into corresponding screw seats 12 of lid 5. The screw seats 12 are preferably arranged along a circumference at constant angular distances. For example, the screw seats 12 may be three in number and spaced apart by 120°. In order to align the screws 11 and the screw seats 12, the intermediate support 10 may be provided with a corresponding number of radial brackets 15 distributed in a manner corresponding to the screw seats 12 of lid 5.

[0017] Fan 1 may comprise vibration damping means

in order to limit the vibration transmission between motor 8 and lid 5. According to a possible embodiment, such vibration damping means comprise first dampers 13 adapted to act between the intermediate support 10 and the lid 5, e.g. rubber elements provided with a through opening for allowing the screws 11 to extend there-through, so as to damp the vibrations parallel to the rotation axis A. Either alternatively or additionally to the first dampers 13, fan 1 may further comprise second dampers 14 acting between the intermediate support 10 and the lid 5 which are oriented and shaped so as to damp the vibrations which are transmitted from motor 8 to housing 3 along radial directions. The second dampers 14, e.g. rubber elements, may be inserted into shelves 16 either consisting of or connected to lid 5 and preferably arranged along a circumference inside the circumference along which the screw seats 12 are arranged. Even more preferably, such shelves 16 are three in number and arranged at 120° with respect to one another. For example, the second dampers 14 may be arranged laterally in contact with the intermediate support 10, so as to act radially between the latter and the shelves 16.

[0018] In order to ensure a protection of the motor 8 during the operation of fan 1, the latter may comprise a covering element 17 connectable to motor 8, e.g. by means of screws 18. Such a covering element 17 is preferably cup-shaped so as not to make motor 8 accessible once fan 1 has been assembled. The covering element 17 may have the function of protecting one or more auxiliary elements 48, such as for example electronic control circuits of motor 8, in addition to the motor 8 itself.

[0019] Lid 5 advantageously comprises a passage opening 19 in order to allow the shaft 9 of motor 8 to pass through lid 5 and to be connected to the impeller 2 accommodated in the impeller space 6.

[0020] The housing 3 of fan 1 forms an air intake opening 20 and an exhaust opening 21 for the air-gas mixture. According to an embodiment, the intake opening 20 and the exhaust opening 21 are formed in the half-shell 4. In particular, the intake opening 20 is preferably arranged in the half-shell 4 and shaped so that the incoming air enters into the impeller space 6 and reaches the impeller 2 along a substantially axial direction. The exhaust opening 21 is preferably formed by an end 23 of an exhaust portion 22 of the half-shell 4 which is developed in a direction substantially tangential to housing 3 (figures 1, 2, 3), so that the mixed air and gas (or mixed generic fluids) conveyed by impeller 2 circulate in the impeller space 6 according to flow lines which are substantially tangential, and are exhausted by fan 1 through the exhaust opening 21 without their motion being excessively diverted.

[0021] At the end 23 of the exhaust portion 22 may be provided a flange 24 adapted to connect fan 1 to outer support elements (not shown in the figures), e.g. by means of threaded connecting members.

[0022] According to an aspect of the invention housing 3 forms, in addition to the air intake opening 20, a gas intake opening 25 which is separate (and preferably

spaced apart) from the air intake opening 20 and in direct communication with the impeller space 6.

[0023] Thereby, the impeller space 6 inside housing 3 may be utilized for mixing the gas with the air, so as to completely avoid the need for a premixing assembly positioned upstream of the intake opening 20, and to connect (the gas tube to) the gas valve 26 directly at the gas inlet opening 25 of housing 3. This considerably reduces the dimensions of the entire mixing and conveying assembly of the fuel mixture in a boiler or in another similar application.

[0024] According to an embodiment, the air intake opening 20 and the gas inlet opening 25 are both formed (in one piece) in the same portion of housing 3, preferably in the half-shell 4.

[0025] Housing 3, in particular the half-shell 4, forms an air intake duct 27 extending from the air intake opening 20 (which opens to the outside of housing 3) to an inner end 28 which opens in the impeller space 6, as well as a gas inlet duct 29 extending from the gas inlet opening 25 (which opens to the outside of housing 3) to an inner opening zone 30 which opens into the impeller space 6 at a distance from the inner end 28 of the air intake channel 27.

[0026] In an embodiment, the air intake duct 27 is parallel or concentric to the rotation axis A and the gas inlet duct 29 has an annular portion 34 extending all around the air intake duct (27) and which forms the inner opening zone 30.

[0027] The inner opening zone 30 is advantageously formed by one or more openings 31 passing from the inside of the gas inlet duct 29 directly into the impeller space 6 (bypassing the air intake duct 27) and extending or distributed along a circumference around the air intake duct 27, possibly along a circumference which is coaxial to the rotation axis A.

[0028] This allows a uniform distribution of the gas flow about the air flow and promotes a strong and uniform mixing by the impeller 2 of fan 1.

[0029] In an embodiment, the inner end 28 of the air intake duct 27 axially protrudes into the impeller space 6 and faces the impeller 2, while the inner opening zone 30 is formed in a portion of the gas inlet duct 29 protruding towards the outside of housing 3 and/or facing away from impeller 2. Furthermore, the inner opening zone 30 of the gas inlet duct 29 is axially spaced apart from the inner end 28 of the air intake duct 27 and more retracted (more distant) with respect to impeller 2 (figures 4, 6, 7). More in general, the gas inlet duct (29) and the air intake duct (27) are configured (e.g. an inner end 28 of the air intake duct 27 and the inner opening zone 30 are dimensioned and spaced apart in the flow direction and in a direction transversal to the flow direction) so as to prevent the establishment of a Venturi effect between the air flow (31) and the gas flow (32) entering into the impeller space (6).

[0030] This particular configuration prevents or at least considerably reduces the establishment of a Venturi effect between the intake air flow 31 and the gas flow 32

entering into the impeller space 6. On the contrary, the flow rates of both flows 31, 32 are mainly controlled by the rotation speed of impeller 2, the flow resistance (back-pressure) downstream of the fan, and the individual and independent flow resistances of the two pipes, air duct 27 and gas duct 29. This allows to control and modulate the air and gas mixture in a wide modulation range and to operate at low pressures and with slow air flow speeds which would not be suitable for a primary air intake by means of Venturi effect.

[0031] A front wall 43 of housing 3 (e.g. of the half-shell 4 or alternatively of the lid 5) forms a truncated-cone-shaped portion 33 which protrudes towards the outside of housing 3 and externally delimits (with reference to housing 3) the annular portion 34 of the gas inlet duct 29. To the smaller base (outer end) of the truncated-cone-shaped portion 33 is connected a first externally cylindrical tubular portion 35 protruding towards the outside of housing 3, wherein the first externally cylindrical tubular portion 35 delimits the air intake opening 20 and an axially outer portion 36 of the air intake duct 27. To the smaller base of the truncated-cone-shaped portion 33 there is further connected a second tubular portion 37 which protrudes and converges towards the inside of housing 3, wherein the second converging portion 37 delimits an inner portion 38 of the air intake duct 27 and forms the inner end 28. Thereby, the air intake duct 27 has a converging profile in the direction of the impeller space 6. Moreover, such a convergence is characterized by a concave curve-shape or progression in the outer portion 36 and by a convex curve-shape or progression in the inner portion 38 of the air intake duct 27 (figures 4, 6, 7). The aforesaid convergence, concavity and convexity refer to the shape of the inner surface of duct 27 on a longitudinal section plane which comprises the longitudinal axis A of the air intake duct 27. Such a converging shape with double curvature is optimal (according to experimental tests and numeric simulations) to connect the diameter of the outer cylindrical portion 35 (indispensable for connecting an air duct and/or a possible muffler, e.g. of a boiler) to the diameter of the inner end 28. The diameter of the inner end 28 has a two-fold function: it determines the required amount of air which must transit for a correct combustion in the entire operating range and also forms a maximal local vacuum zone within the impeller space 6 which contributes to the required intake and mixing of the gas in an operating range that is as wide as possible.

[0032] The front wall 43 of housing 3 further forms a third tubular portion 39 spaced apart from the truncated-cone-shaped portion 33 and protruding towards the outside of housing 3, and a connecting portion 40 shaped as a channel which is open towards the inside of housing 3 which connects the third tubular portion 39 and the truncated-cone-shaped portion 33 and externally delimits a corresponding intermediate portion 42 of the gas inlet channel 29. The third tubular portion 39 forms the gas inlet opening 25 and may be preferably cylindrical and substantially parallel to the longitudinal axis A of the

air intake duct 27. The connecting portion 40 may have an arc-shaped or rectangular cross section (open channel section) and may extend in a radial direction to the longitudinal axis A of the air intake duct 27 (figures 2, 6).

[0033] The distance between the first tubular portion 35 and the third tubular portion 39 facilitates the assembly of the gas valve 26 to the gas inlet opening 25 (figure 1) without obstructing the feeding of air to the air intake opening 20.

[0034] Housing 3 further comprises an inner wall 41 which delimits the annular portion 34 and the intermediate portion 42 of the gas inlet duct 29 from the inside of housing 3 so as to embody the gas inlet duct 29 as a closed channel (figure 6).

[0035] The inner opening zone 30 of the gas inlet channel 29 is formed along a first meeting line between the inner wall 41 and the front wall 43 at the smaller base of the truncated-cone-shaped portion 33. The opening zone 30 is thus formed along the bottom of a groove formed between the annular portion 34 of the gas inlet duct 29 and the converging inner portion 37 of the air intake duct 27.

[0036] An annular part 44 of the inner wall 41 preferably extends from the inner opening zone 30 in a diverging manner towards a second meeting line with the front wall 43 at the larger base of the truncated-cone-shaped portion 33. Thereby, an annular surface of the inner wall 41 facing towards the inside of housing 3 forms a guide or diffusion surface which is diverging in the direction of impeller 2. In the embodiment shown in figure 2, the guide surface has a rotational symmetry shape with respect to the longitudinal axis A of the air intake duct 27 which may be parallel or identical to the rotation axis A of the impeller. Such a rotational symmetry shape may be, for example, similar to a cone (substantially straight generatrix line), a bell (generatrix line with double curvature) or a trumpet (arcuate generatrix line with simple curvature).

[0037] The inner wall 41 also forms a side appendix 45 which protrudes, e.g. in radial direction, from the annular part 44 and covers the intermediate portion 42 of the gas inlet duct 29 from the inside of housing 3, and possibly also at least part of the third tubular portion 39.

[0038] In a preferred embodiment, the inner wall 41 is an insert which is separately manufactured (figures 8, 9, 10) and then applied to the front wall 43, from the inside of housing 3, to jointly delimit the gas inlet duct 29.

[0039] Alternatively, the front wall 43 is an insert separately manufactured and then applied to the inner wall 41 from the outside of housing 3, to jointly delimit the gas inlet duct 29.

[0040] This facilitates the manufacturing of housing 3, e.g. by making the plastic insert by injection molding and the wall of housing 3 by means of aluminum molding, casting or die-casting.

[0041] The insert forming the inner wall 41 may have a fitting edge 46 formed along the annular part 44 and configured to engage by force fitting, press fitting or snap fitting a corresponding annular seat (e.g. a negative step)

of the front wall 43 at the larger base of the truncated-cone-shaped portion 33. Furthermore, the insert forming the inner wall 41 may have a detent or retaining hook 47 adapted to engage a bottom of the third tubular portion 39 formed by the front wall 43.

[0042] In order to facilitate the creation of the through openings in the inner opening zone 30, the insert forming the inner wall 41 has a crenellation 50 or notching formed along the annular part 44 (at the annular edge opposite to the fitting edge) and resting (freely or with elastic engagement, press-fitting or snap-fitting) against the front wall 43 so as to jointly delimit said through openings for the release of the gas (figures 6, 9, 10). By virtue of a careful choice of the distances between the crenellations 50 or teeth and their length, it is possible to select the flow section of the gas passages and thus influence the mixing parameters.

[0043] In order to ensure the movement of air and gas in fan 1, impeller 2 comprises a plurality of blades 49 arranged in sequence about the rotation axis A (figure 5). Each of the blades 49 has a radially outermost inlet end and a radially outermost outlet end. The inlet end has the function of taking in and capturing the air and gas coming in axial direction from the intake opening 20 and from the gas inlet opening 25, and the outlet end has the function of guiding the gas-air mixture from impeller 2 radially outwards and tangentially towards the exhaust opening 21.

[0044] The total ratio of the axial extension L_a to the diametrical or radial extension L_d of housing 3 is $L_a/L_d < 0.75$, preferably $0.38 < L_a/L_d < 0.75$, even more preferably $0.42 < L_a/L_d < 0.46$.

[0045] The fan 1 thus configured is able to achieve the objects of the invention.

[0046] The overall dimensions of the fan-mixer, on which the axial and radial dimensions of the housing depend, are suited to the applications for which the fans according to the invention are intended, in particular for feeding air and/or gas to condensation boilers.

[0047] From the above description, those skilled in the art may appreciate that the housing and fan according to the invention allow to obtain small dimensions, wide modularity ranges, and high gas-air mixing efficiency.

[0048] Those skilled in the art may make several adaptations and changes to the described embodiments of the impeller and radial fan, or replacements of parts with others which are functionally equivalent, without departing from the scope of the appended claims.

Claims

1. A housing (3) for a fan (1), wherein the housing (3) forms:

- internally an impeller space (6) accommodating an impeller (2) rotatable about a rotation axis (A),

- an air intake opening (20) in direct communication with the impeller space (6),
- an exhaust opening (21) for exhausting an air-gas mixture from the impeller space outside the housing (3),
- a gas inlet opening (25) spaced apart from the air intake opening (20) and in direct communication with the impeller space (6), so that the impeller space (6) forms a space for mixing an air flow (31) from the air intake opening (20) with a gas flow (32) from the gas inlet opening (25),
- an air intake duct (27) extending from the air intake opening (20) which opens outside the housing (3) to an inner end (28) which opens in the impeller space (6),
- a gas inlet duct (29) extending from the gas inlet opening (25) which opens outside the housing (3) to an inner opening zone (30) which opens in the impeller space (6) at a distance from the inner end (28) of the air intake channel (27),

wherein the gas inlet duct (29) and the air intake duct (27) are configured so as to prevent the establishment of a Venturi effect between the air flow (31) and the gas flow (32) entering into the impeller space (6).

2. A housing (3) according to claim 1, wherein the air intake opening (20) and the gas inlet opening (25) are both formed in one piece in a same front wall (43) of the housing (3).

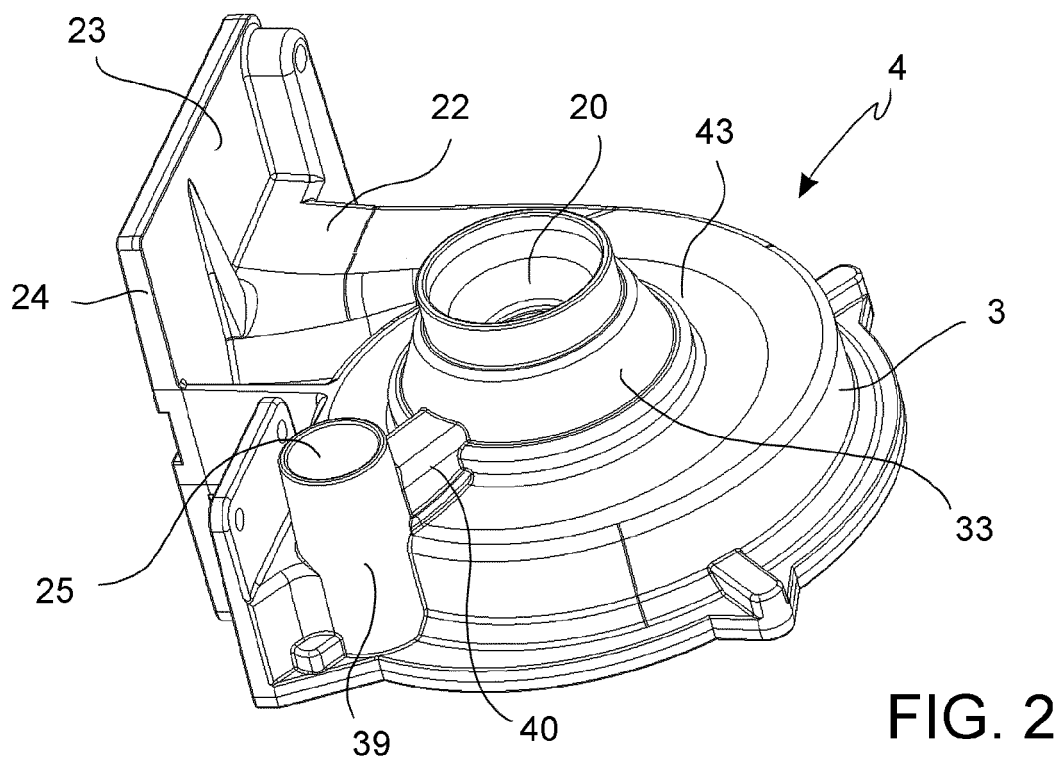
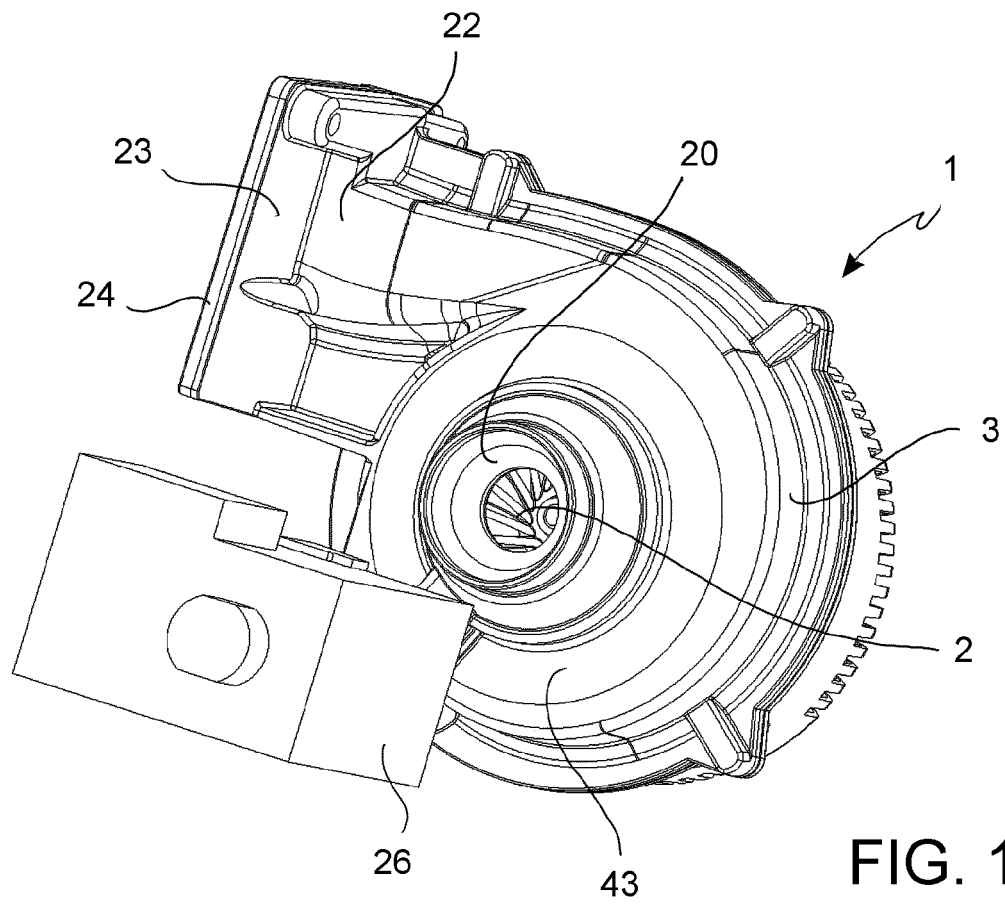
3. A housing (3) according to claim 1 or 2, wherein:

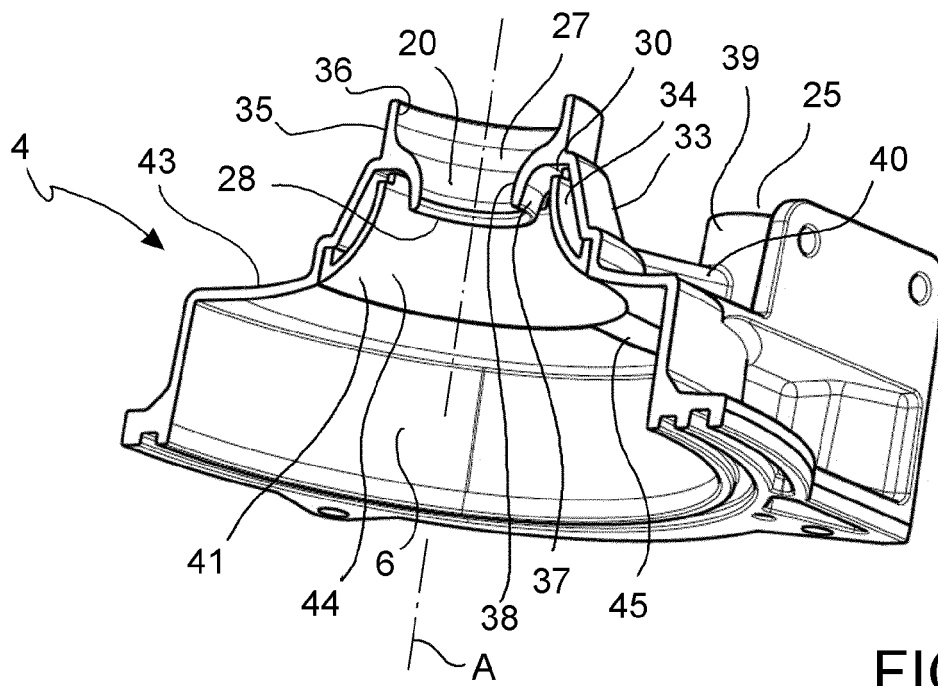
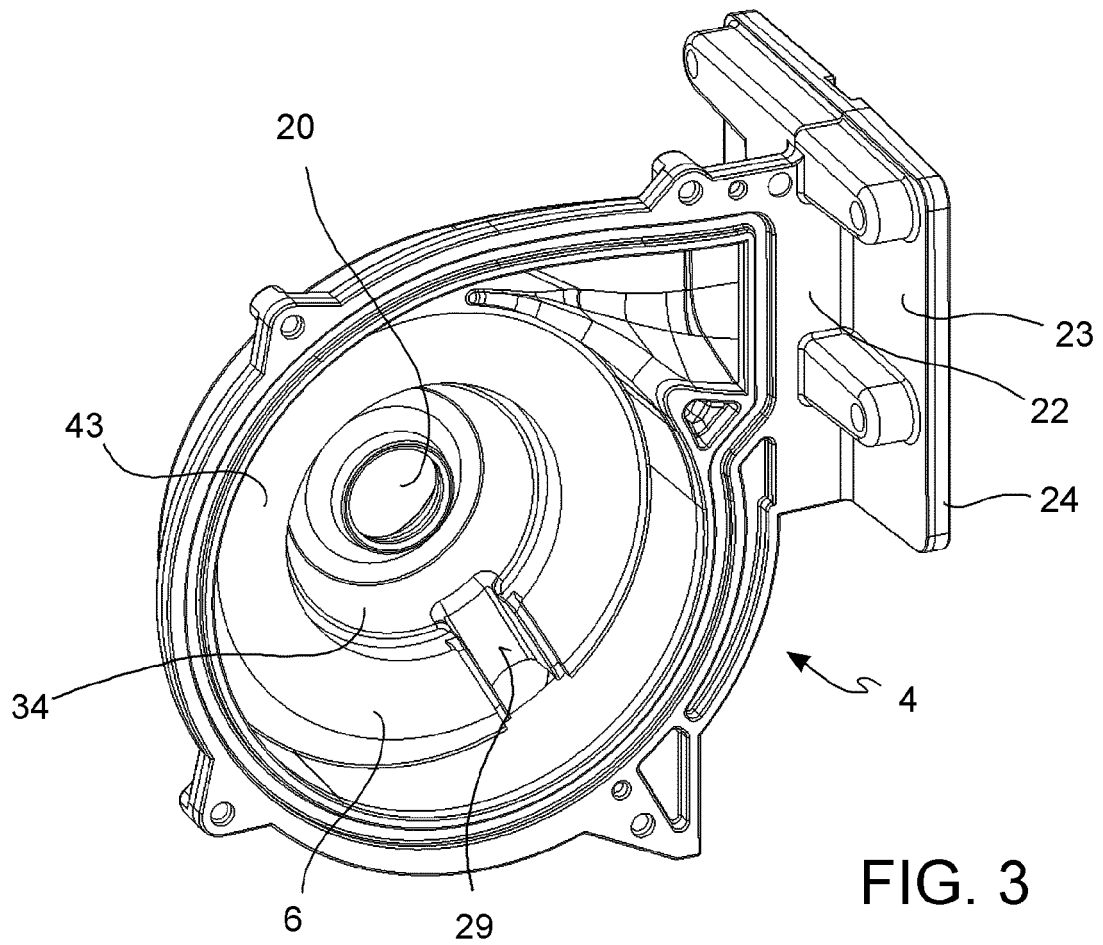
- the air intake duct (27) is either parallel or concentric to the rotation axis (A), and
- the gas inlet duct (29) has an annular portion (34) extending all about the air intake duct (27) and which forms the inner opening zone (30),
- said inner opening zone (30) comprising one or more gas openings (31) extending or distributed along a circumference about the air intake duct (27).

4. A housing (3) according to any one of the preceding claims, wherein the inner end (28) axially protrudes into the impeller space (2), while the inner opening zone (30) is formed in a gas inlet portion (29) axially facing away from the impeller space (2).

5. A housing (3) according to any one of the preceding claims, wherein the inner opening (30) of the gas inlet duct (29) is axially spaced apart from the inner end (28) of the air intake duct (27) and more distant from the impeller (2) with respect to said inner end (28).

6. A housing (3) according to one of the claims from 3 to 5, wherein the inner opening zone (30) of the gas inlet channel (29) is formed along the bottom of a groove formed between the annular portion (34) of the gas inlet duct (29) and an inner tubular portion (37) of the air intake duct (27). 5
7. A housing (3) according to claim 3, wherein a front wall (43) of the housing (3) forms: 10
- a truncated-cone-shaped portion (33) protruding towards the outside of the housing (3) and externally delimiting the annular portion (34) of the gas inlet duct (29),
 - a first externally cylindrical tubular portion (35), protruding from a smaller base of the truncated-cone-shaped portion (33) towards the outside of the housing (3) and delimiting the air intake opening (20) and an axially inner portion (36) of the air intake duct (27), 20
 - a second protruding tubular portion (37) converging from said smaller base of the truncated-cone-shaped portion (33) towards the inside of housing 3 and forming an inner portion (38) of the air intake duct (27) and said inner end (28), 25
 - a third tubular portion (39) spaced apart from the truncated-cone-shaped portion (33) and protruding towards the outside of the housing (3), said third tubular portion (39) forming the gas inlet opening 25,
 - a connecting portion (40) shaped as a channel open towards the inside of the housing (3) which connects the third tubular portion (39) to the truncated-cone-shaped portion (33) and externally delimits an intermediate portion (42) of the gas inlet channel (29). 30
8. A housing (3) according to any one of the preceding claims, wherein the air intake duct (27) has a profile converging in the direction of the impeller space (6) with a concave converging shape in an outer portion (36) and a convex converging shape in an inner portion (38) of the air intake duct (27) observed on a longitudinal section plan which comprises a longitudinal axis (A) of the air intake duct (27). 40
9. A housing (3) according to any one of the preceding claims, further comprising an inner wall (41) which delimits the gas inlet duct (29) from the inside of the housing (3). 45
10. A housing (3) according to claim 7 and 9, wherein:
- the inner opening zone (30) of the gas inlet channel (29) is formed along a first meeting line between the inner wall (41) and the front wall (43) at the smaller base of the truncated-cone-shaped portion (33), 50
 - an annular part (44) of the inner wall (41) extends from the inner opening zone (30) in a diverging manner towards a second meeting line with the front wheel (43) at the larger base of the truncated-cone-shaped portion (33) and forms a guide surface with rotational symmetry and diverging in the direction of the impeller (2),
 - the inner wall (41) forms a side appendix (45) which laterally protrudes from the annular part (44) and covers an intermediate portion (42) of the gas inlet duct (29) from the inside of the housing (3). 55
11. A housing (3) according to claim 9 and 10, wherein the inner wall (41) is an insert which is separately manufactured and then applied to a front wall (43) of the housing (3).
12. A housing (3) according to one of the claims from 9 to 11, wherein the inner wall (41) is made of plastic and the front wall (43) of the housing (3) is made of die-cast aluminum.
13. A housing (3) according to one of the claims from 9 to 12, wherein the insert forming the inner wall (41) has a crenellation (50) resting against the front wall (43) and which forms the through openings in the inner opening zone (30).
14. A housing (3) according to one of the preceding claims, wherein the ratio (La/Ld) of an axial extension (La) to a diametrical extension (Ld) of the housing (3) is lower than 0.75, preferably $0.38 < (La/Ld) < 0.75$, even more preferably $0.42 < (La/Ld) < 0.46$.
15. A radial fan (1) comprising a housing (3) according to any one of the preceding claims, an electric motor and said impeller (2).





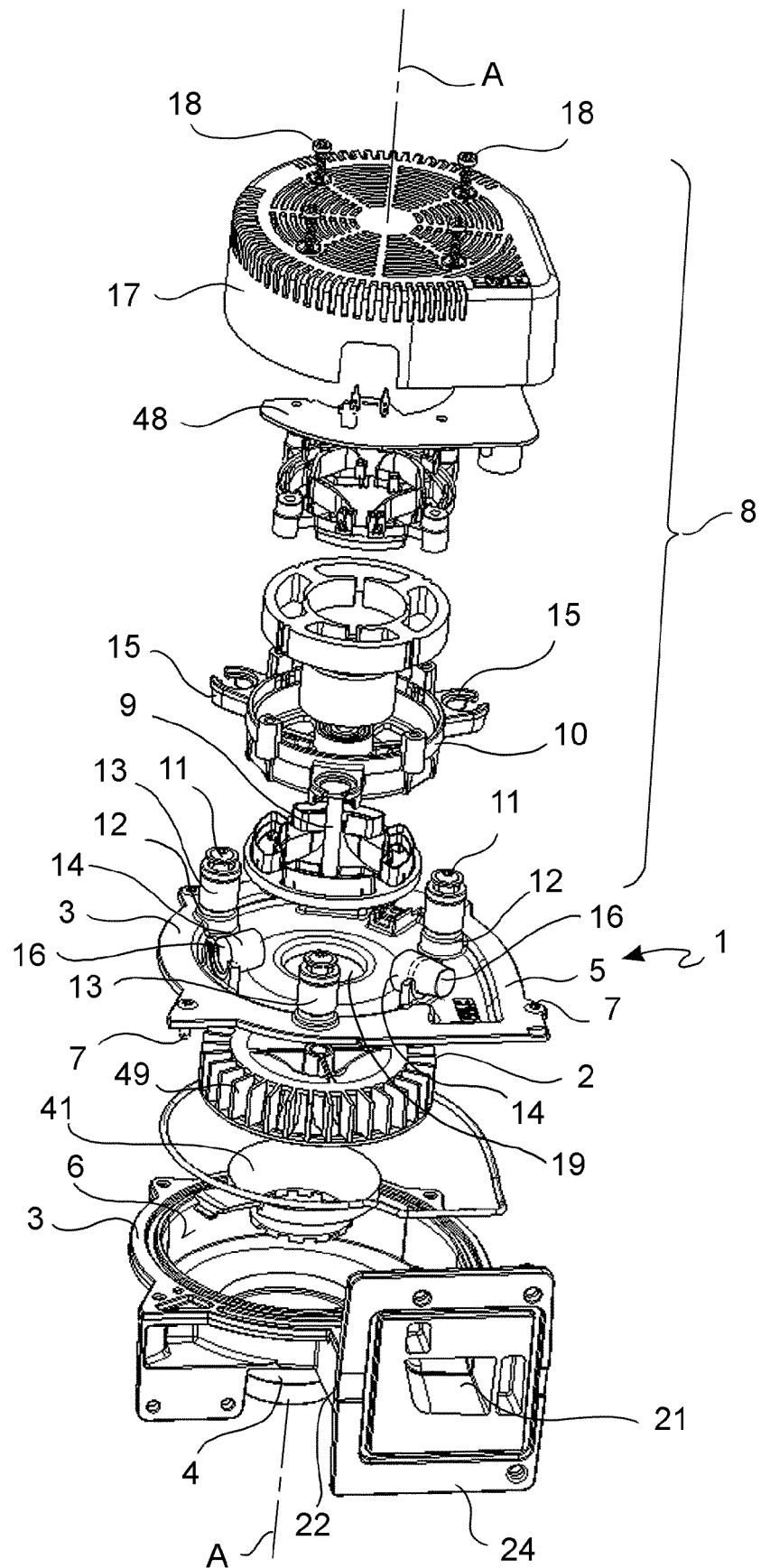
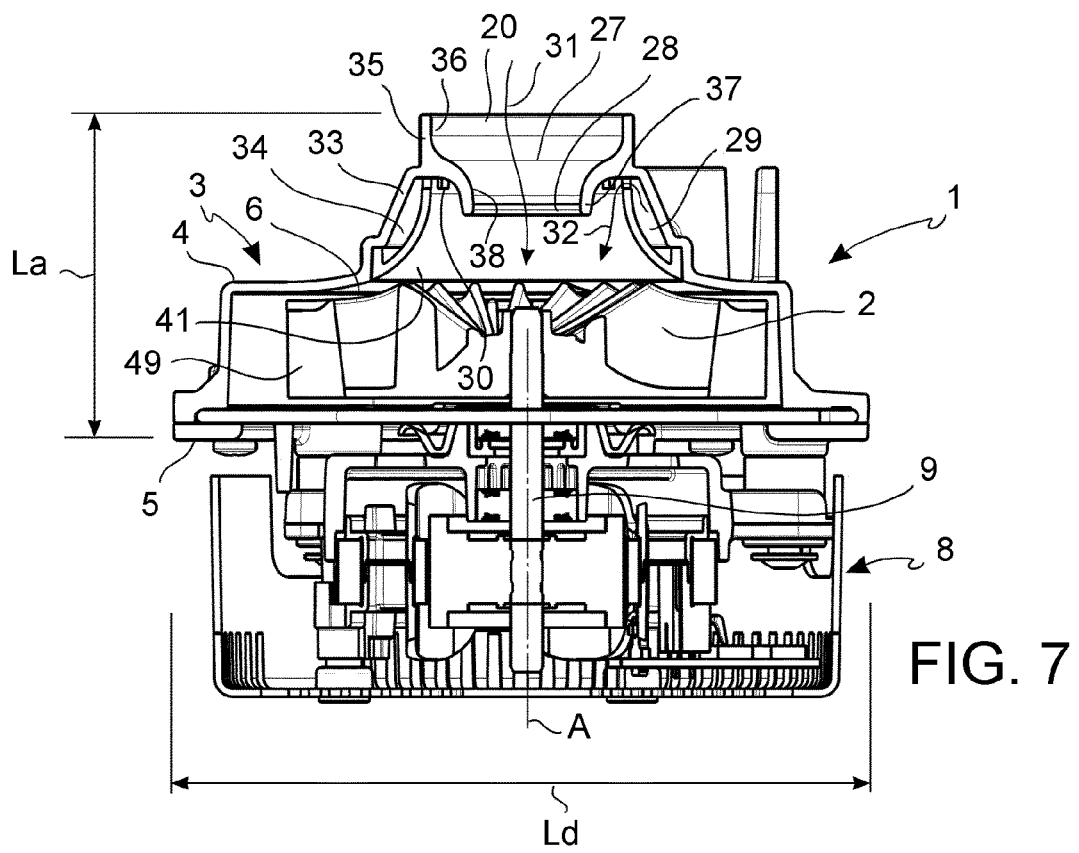
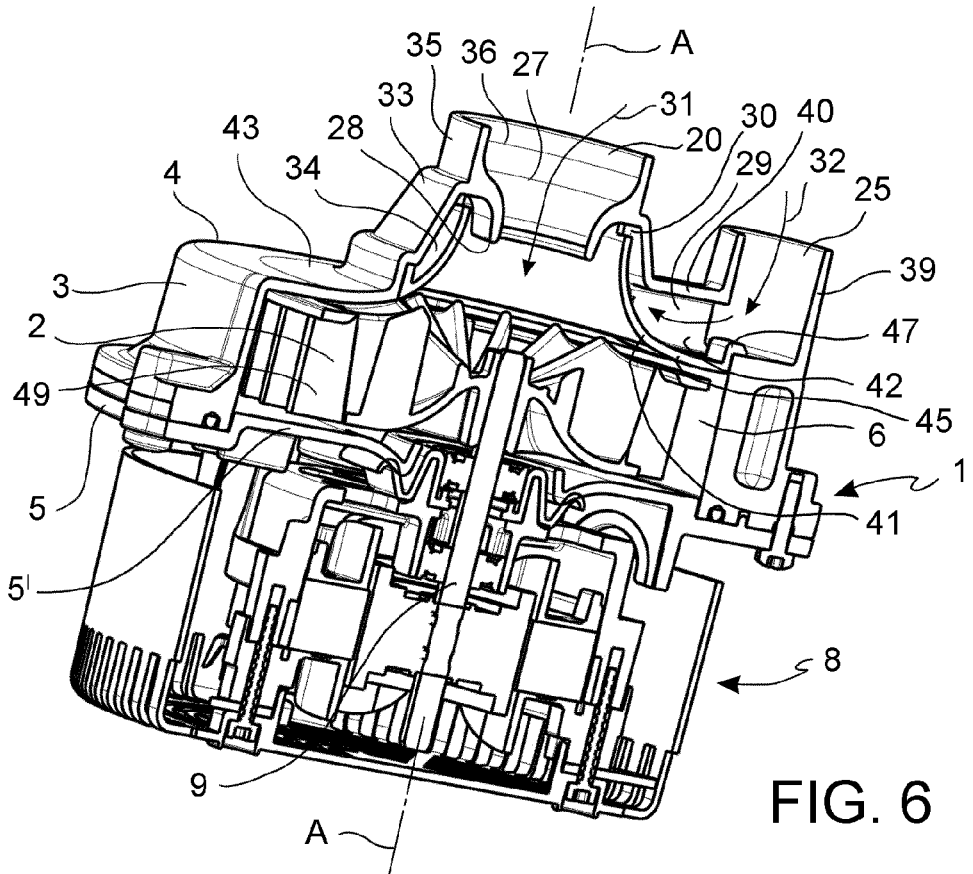


FIG. 5



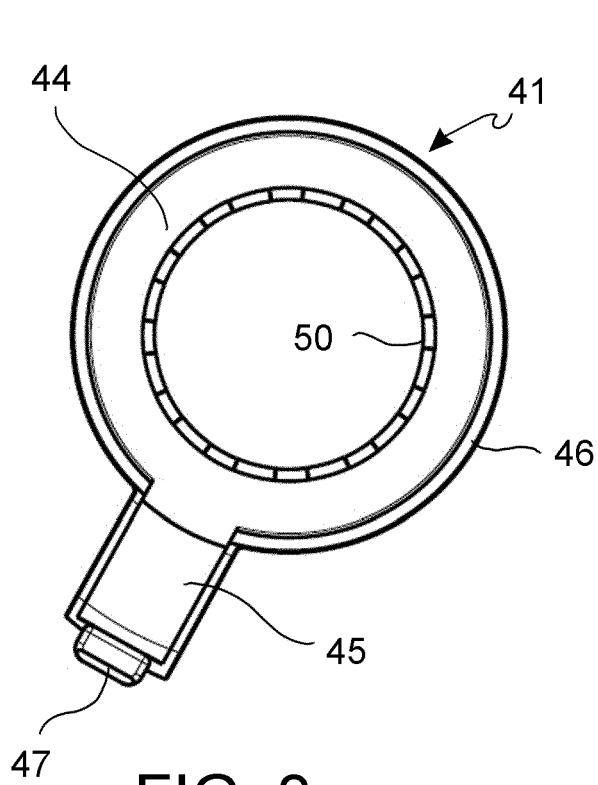


FIG. 8

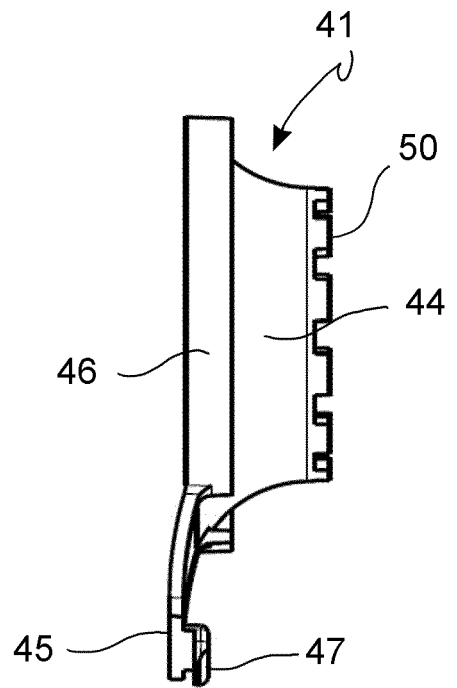


FIG. 9

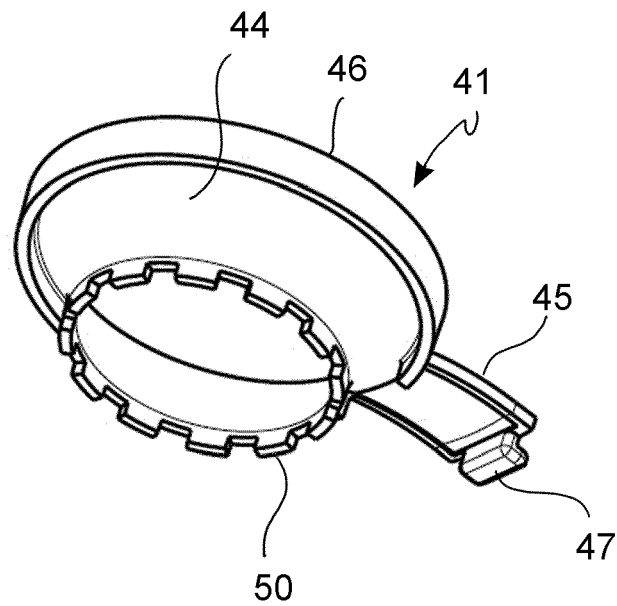


FIG. 10



EUROPEAN SEARCH REPORT

Application Number
EP 16 15 8639

5

10

15

20

25

30

35

40

45

50

55

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 10 2011 014117 A1 (EBM PAPST LANDSHUT GMBH [DE]) 20 September 2012 (2012-09-20) * figure 1 * * figure 3 * * paragraph [0024] * * paragraph [0027] *	1-7,9-15	INV. F04D17/16 F04D29/42 F23D14/62 ADD. F04D29/62
X	EP 2 597 370 A1 (LN 2 SRL SOCIO UNICO [IT]) 29 May 2013 (2013-05-29) * figures 1, 2 * * paragraphs [0015] - [0016] * * paragraphs [0021] - [0022] *	1-15	
X,P	EP 2 927 584 A1 (HONEYWELL TECHNOLOGIES SARL [CH]) 7 October 2015 (2015-10-07) * paragraphs [0015] - [0016] * * paragraphs [0019] - [0020] * * paragraphs [0033] - [0038] * * figures 2, 3, 7 *	1-7,9,14,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			F23D F04D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 July 2016	Examiner de Verbigier, L
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 16 15 8639

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.

15-07-2016

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102011014117 A1	20-09-2012	DE 102011014117 A1	20-09-2012
		EP 2686609 A2	22-01-2014
		WO 2012123207 A2	20-09-2012
EP 2597370 A1	29-05-2013	NONE	
EP 2927584 A1	07-10-2015	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

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