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(54) **MOTOR-FAN GROUP**

(57) A motor-fan assembly (1) for a heat pump comprises an electric motor (2) having a peripheral connection wall (5), and defining a rotation axis (6), a fan impeller (7) made of polymer material, having a hub wall (8) connected to the connection wall (5) of the motor by inserting one onto the other, a plurality of keys (10) radially protruding from one of said connection (5) and hub (8) walls, a plurality of key seats (11) formed in the other of said connection (5) and hub (8) walls to accommodate the keys (10) upon the insertion of the hub wall (8) onto the connection wall (5) in an axial insertion direction (12), one or more first stop surfaces (13) formed in one of said connection (5) and hub (8) walls and configured to abut against one or more corresponding second stop surfaces (14) formed in the other of said connection (5) and hub (8) walls, upon reaching an axial insertion end-of-stroke between the hub wall (8) and the connection wall (5), one or more first side surfaces (15) formed by each of the keys (10) and engaging corresponding second side surfaces (16) of the key seats (11), so as to achieve an anti-rotation coupling between the hub wall (8) and the connection wall (5) about the rotation axis (6).

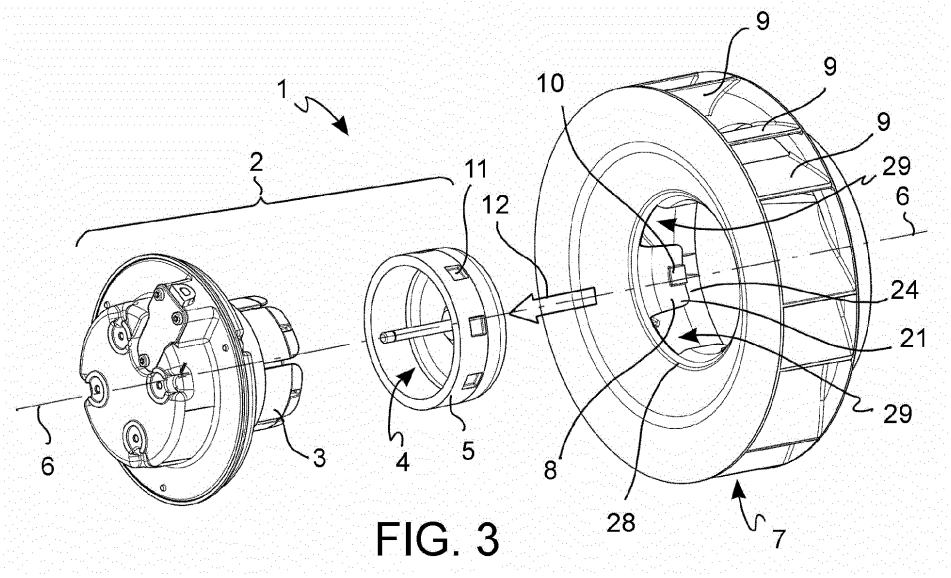

FIG. 3

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Description

Object of the invention

[0001] The present invention relates to a motor-fan assembly, in particular for heat pumps, according to the preamble of claim 1.

[0002] As it is known, heat pumps are used for both cooling and heating in the industrial and domestic fields, for example, for the air conditioning and ventilation of environments, for heating and/or cooling substances, materials, fluid flows, etc. To this end, in heat pumps, an adiabatic fluid is compressed on the one side, thus heating up and generating heat, and on the other side, the previously compressed adiabatic fluid is expanded and evaporated, thus cooling and generating cold. To dispose of or transport the heat generated by the compression of the adiabatic fluid or the cold generated by the expansion and evaporation of the adiabatic fluid, the use of electric fans generating an air flow which brushes, for example, a heat exchanger associated with the compressor and/or evaporator of the heat pump is known.

Description of the prior art

[0003] The electric fans of the prior art comprise an electric motor with a stator being connectable to the specific utility, in particular to the heat pump, and with a rotor having a peripheral wall to which a fan impeller, usually made of polymer material, is connected. The connection between the impeller and the rotor of the electric motor is achieved by an interference coupling between an annular hub wall of the impeller and the peripheral wall of the rotor of the motor. For this purpose, the impeller is axially inserted and fitted onto the peripheral wall of the rotor.

[0004] In order to ensure the stability of the interference coupling between the impeller and the motor over the whole life of the fan and to avoid a breakage of the hub wall made of polymer material, it is known to strengthen the hub wall by a metal ring co-molded with the impeller hub wall.

[0005] The motor-fan assemblies for heat pumps of the prior art have some disadvantages which have not been overcome to date. The connection between the motor and the impeller by interference insertion does not ensure the reliable and repeatable relative positioning thereof, in particular the impeller cannot be perfectly concentric with the rotation axis of the motor. Furthermore, manufacturing the impeller of two different materials (metal ring, polymer impeller body) involves undesirably high material and manufacturing costs.

General description of the invention

[0006] Therefore, it is the object of the present invention to provide a motor-fan assembly, in particular for heat pumps, having such features as to obviate the disadvantages discussed with reference to the prior art.

[0007] It is a particular object of the invention to achieve a coupling between an impeller made of polymer material and a rotor of an electric motor, with reliable and repeatable relative positioning, in particular with reference to a concentric positioning of the impeller with respect to the rotation axis of the electric motor.

[0008] It is a further particular object of the invention to provide a motor-fan assembly, in particular for heat pumps, having lower manufacturing costs as compared to the manufacturing costs of the motor-fan assemblies of the prior art.

[0009] These and other objects are achieved by a motor-fan assembly, in particular for a heat pump, according to claim 1. Advantageous and preferred embodiments are the subject of the dependent claims.

[0010] In accordance with an aspect of the invention, a motor-fan assembly, in particular for a heat pump, comprises:

an electric motor with a stator connectable to a use and a rotor having a peripheral connection wall, the electric motor defining a rotation axis,
a fan impeller made of polymer material, having a hub wall connected to the connection wall of the rotor by inserting one onto the other, as well as a plurality of blades connected to the hub wall,
characterized in that it comprises:

- a plurality of keys radially protruding from one of said connection and hub walls,
- a plurality of key seats formed in the other of said connection and hub walls, and configured to accommodate each respectively one of the keys, upon the insertion of the hub wall onto the connection wall in an axial insertion direction,
- one or more stop surfaces formed in one of said connection and hub walls and configured to abut against one or more corresponding stop surfaces formed in the other of said connection and hub walls, upon reaching an axial insertion end-of-stroke between the hub wall and the connection wall,
- one or more side surfaces formed by each of the keys and engaging corresponding guide surfaces of the key seats, so as to achieve an anti-rotation coupling between the hub wall and the connection wall with respect to the rotation axis,
- one or more coupling portions formed by one of said connection and hub walls and one or more counter-coupling portions formed by the other of said connection and hub walls, where the coupling portions and the counter-coupling portions mutually elastically yield in a radial direction with respect to the rotation axis and snap-engage upon reaching the axial insertion end-of-stroke so as to prevent the hub wall from slipping off the connection wall in an opposite direction to the

insertion direction.

[0011] By virtue of the connection and hub walls thus configured, the impeller is coupled to the rotor of the motor with a concentric, reliable and repeatable relative positioning, being suitable for automated industrial assembly and such as to obviate the need to integrate a metal ring into the impeller.

[0012] Furthermore, by virtue of the connection and hub walls thus configured, both the impeller and the connection wall of the motor can be easily made of polymer material by injection molding.

Brief description of the drawings

[0013] In order to better understand the invention and appreciate the advantages thereof, some embodiments thereof will be described below with reference to the Figures, in which:

Figure 1 shows a perspective side-rear view of a motor-fan assembly according to an embodiment of the invention,
Figure 2 shows a perspective side-front view of the motor-fan assembly in Figure 1,
Figure 3 shows an exploded perspective side-rear view of the motor-fan assembly in Figure 1,
Figure 4 shows an exploded perspective side-front view of the motor-fan assembly in Figure 1, without the stator of the motor,
Figures 5 and 6 show enlarged views of details in Figure 4,
Figure 7 shows a sectional view of a part of the motor-fan assembly according to a section plane orthogonal to a rotation axis of the motor-fan assembly, according to an embodiment,
Figure 8 shows sectional view of a part of the motor-fan assembly according to a radial plane with respect to a rotation axis of the motor-fan assembly, according to an embodiment,
Figure 9 shows an enlarged view of a detail in Figure 8,
Figure 10 shows an enlarged view of a detail in Figure 7,
Figure 11 shows geometry and shape features of the impeller of the motor-fan assembly according to an embodiment.

Detailed description of embodiments

[0014] With reference to the Figures, a motor-fan assembly 1, in particular for a heat pump, comprises:

an electric motor 2 with a stator 3 connectable to a use (for example, the heat pump) and a rotor 4 having a peripheral connection wall 5, the electric motor 2 defining a rotation axis 6,
a fan impeller 7 made of polymer material, having a hub wall 8 connected to the connection wall 5 of the rotor 4 by inserting one onto the other, as well as a plurality of conveying blades 9 connected to the hub wall 8,

- a plurality of keys 10 radially protruding from one of said connection 5 and hub 8 walls,
- a plurality of key seats 11 formed in the other of said connection 5 and hub 8 walls, and configured to accommodate each respectively one of the keys 10 upon the insertion of the hub wall 8 onto the connection wall 5 in an axial insertion direction 12,
- one or more first stop surfaces 13 formed in one of said connection 5 and hub 8 walls and configured to abut against one or more corresponding second stop surfaces 14 formed in the other of said connection 5 and hub 8 walls, upon reaching an axial insertion end-of-stroke between the hub wall 8 and the connection wall 5,
- one or more first side surfaces 15 formed by each of the keys 10 and engaging corresponding second side surfaces 16 of the key seats 11, so as to achieve an anti-rotation coupling between the hub wall 8 and the connection wall 5 about the rotation axis 6,
- one or more coupling portions 17 formed by one of said connection 5 and hub 8 walls and one or more counter-coupling portions 18 formed by the other of said connection 5 and hub 8 walls, where the coupling portions 17 and the counter-coupling portions 18 mutually elastically yield in a radial direction with respect to the rotation axis 6 and mutually snap-engage upon reaching the axial insertion end-of-stroke so as to prevent the hub wall 8 from slipping off the connection wall 5 in an opposite direction to the insertion direction 12.

[0015] By virtue of the connection 5 and hub 8 walls thus configured, the impeller 7 is coupled to the rotor 4 of the motor 2 with a concentric, reliable and repeatable relative positioning, being suitable for automated industrial assembly and such as to obviate the need to integrate a metal ring into the impeller.

[0016] Furthermore, by virtue of the connection 5 and hub 8 walls thus configured, both the impeller 7 and the connection wall 5 of the electric motor 2 can be easily made of polymer material by injection molding.

Detailed description of the keys 10

[0017] According to an embodiment, the key or keys 10 have a flattened, substantially plate-like shape with two first opposite longitudinal edges 19, extending substantially parallel to the rotation axis 6 or substantially in the insertion direction 12, preferably but not necessarily parallel to one another, and forming the aforesaid first

side surfaces 15, as well as with at least a first transverse edge 20 extending in a direction transverse to the insertion direction 12 and forming the aforesaid first stop surface 13.

[0018] In accordance with an embodiment (Figure 9), the first longitudinal edges 19, thus the first side surfaces 15 of the key 10, approach one another going towards the first transverse edge 20.

[0019] The first longitudinal edges 19 can substantially be rectilinear and the first transverse edge 20 can have a rectilinear shape or a curved extension along a circumference with respect to the rotation axis 6.

[0020] Advantageously, the first transverse edge 20 connects the first longitudinal edges 19 to one another and, along with the first longitudinal edges 19, results in a U-shaped outer contour of the key 10 (Figure 5).

[0021] This shape of the key 10 eases a manufacturing thereof by injection molding and facilitates a guided insertion of the key 10 into the key seat 11 in the direction of the rotation axis 6.

[0022] According to a preferred embodiment, the keys 10 are formed directly from the hub wall 8 of the impeller 7 and protrude radially inwards (Figures 3, 4, 5, 9, 10). Alternatively, the keys 10 can be made separately from the impeller 7 and then connected to the hub wall 8.

[0023] Considering the insertion direction 12 as the movement direction of the impeller 7 with respect to the motor 2, the first transverse edge 20 and the first stop surface 13 formed thereon face the insertion direction 12.

[0024] In accordance with an embodiment, a radial thickness 22 of the keys 10 protruding from the hub wall 8 is thinner than the radial thickness 23 of the connection wall 5 at the key seats 11, so that the keys 10 can be inserted into the key seats 11 without radially passing through the connection wall 5 (Figures 9, 10).

[0025] The hub wall 8 is preferably formed by a plurality of segments or flaps 21 of a substantially circular cylindrical wall, alternated and spaced apart from one another by gaps or first widening slits 29, and the keys 10 are preferably positioned at a constant angular pitch, for example, four keys 10 are arranged at a 90° pitch, preferably a key 10 positioned at one of the segments or flaps 21 of the substantially circular cylindrical wall, respectively.

[0026] The first widening slits 29 weaken or interrupt the hub wall 8 to allow an elastic widening thereof in the circumferential and/or radial direction with respect to the rotation axis 6.

[0027] This allows accommodating the key 10 in the key seat 11 with an elastic preload, and/or inserting the hub wall 8 onto the connection wall 5 with an elastic preload in a radial direction with respect to the rotation axis 6, and/or the wall forming the key seats 11 to yield elastically, this being useful for the aforesaid snap engagement of the coupling portions 17 with the counter-coupling portions 18.

[0028] The first widening slits 29 can preferably extend in an axial direction, in regions spaced apart from the keys 10 and from the key seats 11, for example, substantially halfway between two consecutive keys 10, respectively.

[0029] With a further advantage, the keys 10 can be arranged flush with a rear edge 24 of the hub wall 8 opposite to the transverse edge 20 of the keys 10 (Figures 4, 5).

[0030] According to an embodiment, the hub wall 8 can form a tubular lead-in portion 28 (Figure 9) which widens radially, preferably by means of a gradual continuous curvature, on one side of the impeller 7 facing the insertion direction 12 or, in other words, on the same side as the first transverse edges 20 of the keys 10. This lead-in (or flaring) portion 28 of the hub wall 8 forms a lead-in for a guided insertion of the hub wall 8 onto the connection wall 5 of the rotor 1.

[0031] Advantageously, the keys 10 have a plate-like shape with a thickness (measured in the radial direction with respect to the rotation axis 6) tapered in the insertion direction 12 (Figure 9), thus facilitating the insertion of the hub wall 8 of the impeller 7 onto the connection wall 5 of the rotor 1.

Detailed description of the key seats 11

[0032] According to an embodiment, the key seats 11 can be non-through cavities or through openings (in the radial direction) delimited by two second opposite longitudinal edges 25, extending substantially parallel to the rotation axis 6 or substantially in the insertion direction 12, preferably but not necessarily parallel to one another, and which form the aforesaid second side surfaces 16, as well as with at least a second transverse edge 26 extending in a direction transverse to the insertion direction 12 and forming the aforesaid second stop surface 14.

[0033] In accordance with an embodiment (Figures 4, 6), the second longitudinal edges 25, and therefore the second side surfaces 16 of the key seat 10 approach each other going towards the second transverse edge 26 or extend along parallel directions with respect to the rotation axis 6.

[0034] The second longitudinal edges 25 can substantially be rectilinear and the second transverse edge 26 can be planar and arc-shaped along a circumference with respect to the rotation axis 6.

[0035] Advantageously, the second transverse edge 26 connects to the second longitudinal edges 25 and, along with the second longitudinal edges 25, results in a U-shaped inner contour of the key seat 11 (Figures 4, 5), which is substantially complementary to the shape of the U-shaped outer contour of the key 10.

[0036] This shape of the key seat 11 can be easily achieved by injection molding and facilitates the insertion of the key 10 into the key seat 11 in the direction of the rotation axis 6.

[0037] According to a preferred embodiment, the key seats 11 are formed by the connection wall 5 of the rotor 4 (Figures 3, 4, 9).

[0038] Considering the insertion direction 12 as the movement direction of the impeller 7 with respect to the motor 2, the second transverse edge 26 and the second stop surface 14 formed thereon are positioned on one side of the key seat 11 opposite to the insertion direction 12 but facing the insertion direction 12.

[0039] The key seats 11 can be formed in a portion of the connection wall 5 which is preferably circular cylindrical. The key seats 11 can be positioned at a constant angular pitch, for example four key seats 11 arranged at a 90° pitch.

Detailed description of the coupling portions 17 and of the counter-coupling portions 18

[0040] According to an embodiment, the coupling portions 17 comprise a plurality of flanges 31 protruding from the hub wall 8 radially inwards, so as to snap-engage corresponding counter-flanges 30 of the connection wall 5 which form the counter-coupling portions 18 (Figure 9).

[0041] Advantageously, the flanges 31 are formed directly on the keys 10 on an opposite side to the first transverse edge 20 of the first stop surface 13, and facing in the opposite direction to the insertion direction 12. The counter-flanges 30 are instead formed directly in the key seats 11 on an opposite side to the second transverse edge 26 or the second stop surface 14, and facing the insertion direction 12.

[0042] According to a preferred embodiment (Figure 10), the connection wall 5 and the hub wall 8 are mutually engaged in pressing contact with an elastic preload due to an elastic deformation of the hub wall 8.

[0043] According to a further preferred embodiment, the impeller 7 forms a plurality of main blades 27 arranged in a circumferential sequence and alternated to secondary blades (splits) 27' of a shorter length than the length of the main blades 27 (Figures 7, 11).

[0044] The length of the main blades 27 is equal to or greater than twice the length of the secondary blades (splits) 27'.

[0045] Both the main blades 27 and the secondary blades (splits) 27' extend up to the same outer diameter (or circumference) 32 of the impeller 7, but a radially inner end of the primary blades 27 is positioned at a first radial distance 33 from the rotation axis 6 while a radially inner end of the secondary blades 27' is positioned at a second radial distance 34 from the rotation axis 6 which is greater than the first radial distance 33.

[0046] Furthermore, the secondary blades (splits) 27' are not equally spaced apart from the two adjacent primary blades 27 (Figure 11). With respect to a central, equally spaced apart position 35, the secondary blade 27' is offset or moved towards the adjacent frontal main blade 36 with reference to the rotation direction 37 (Figure 11).

[0047] The invention also relates to a heat pump (not shown in the Figures since it is known per se) comprising the motor-fan assembly 1, in particular associated with a heat exchanger of a compressor and/or evaporator of the heat pump.

Claims

1. A motor-fan assembly (1), in particular for a heat pump, comprising:

   - an electric motor (2) with a stator (3) and a rotor (4) having a peripheral connection wall (5), the electric motor (2) defining a rotation axis (6),
   - a fan impeller (7) made of polymer material, having a hub wall (8) connected to the connection wall (5) of the rotor (4) by inserting one onto the other, as well as a plurality of conveying blades (9) connected to the hub wall (8),
   - a plurality of keys (10) radially protruding from one of said connection (5) and hub (8) walls,
   - a plurality of key seats (11) formed in the other of said connection (5) and hub (8) walls, and configured to accommodate each respectively one of the keys (10) upon the insertion of the hub wall (8) onto the connection wall (5) in an axial insertion direction (12),
   - one or more first stop surfaces (13) formed in one of said connection (5) and hub (8) walls and configured to abut against one or more corresponding second stop surfaces (14) formed in the other of said connection (5) and hub (8) walls, upon reaching an axial insertion end-of-stroke between the hub wall (8) and the connection wall (5),
   - one or more first side surfaces (15) formed by each of the keys (10) and engaging corresponding second side surfaces (16) of the key seats (11), so as to achieve an anti-rotation coupling between the hub wall (8) and the connection wall (5) about the rotation axis (6),
   - one or more coupling portions (17) formed by one of said connection (5) and hub (8) walls and one or more counter-coupling portions (18) formed by the other of said connection (5) and hub (8) walls, wherein the coupling portions (17) and the counter-coupling portions (18) mutually elastically yield in a radial direction with respect to the rotation axis (6) and mutually snap-engage upon reaching the axial insertion end-of-stroke so as to prevent the hub wall (8) from slipping off the connection wall (5) in an opposite direction to the insertion direction (12).

2. A motor-fan assembly (1) according to claim 1, wherein the key or keys (10) has/have a flattened, plate-like shape, with:

   - two first opposite longitudinal edges (19), substantially extending in the insertion direction

(12), and forming the first side surfaces (15), and
- at least a first transverse edge (20) extending in a transverse direction with respect to the insertion direction (12) and forming the first stop surface (13),

wherein the first longitudinal edges (19) are substantially rectilinear and the first transverse edge (20) is substantially rectilinear or extending along a circumference with respect to the rotation axis (6),
wherein the first transverse edge (20) connects the first longitudinal edges (19) to one another and, along with the first longitudinal edges (19), results in a U-shaped outer contour of the key (10),
wherein the keys (10) are formed in a single piece with the hub wall (8) of the impeller (7) and protrude radially inwards,
wherein, considering the insertion direction (12) as the movement direction of the impeller (7) with respect to the motor (2), the first transverse edge (20) and the first stop surface (13) formed thereon face the insertion direction (12).

3. A motor-fan assembly (1) according to any one of the preceding claims, wherein a radial thickness (22) of the keys (10) protruding from the hub wall (8) is thinner than a radial thickness (23) of the connection wall (5) at the key seats (11), so that the keys (10) can be inserted into the key seats (11) without fully radially passing through the connection wall (5).

4. A motor-fan assembly (1) according to claim 2, wherein the hub wall (8) is formed by a plurality of flaps (21) of a substantially circular cylindrical wall, alternated and spaced apart from one another by first widening slits (29), and wherein the keys (10) are positioned at a constant angular pitch, wherein four keys (10) are arranged at a 90° pitch, with a key (10) positioned at one of the flaps (21) of the substantially circular cylindrical wall, respectively.

5. A motor-fan assembly (1) according to one of claims 2 to 4, wherein the keys (10) are arranged flush with a rear edge (24) of the hub wall (8) opposite to the transverse edge (20) of the keys (10).

6. A motor-fan assembly (1) according to one of the preceding claims, wherein the hub wall (8) forms a tubular lead-in portion (28) which widens radially, by means of a gradual continuous curvature, on one side of the impeller (7) facing the insertion direction (12), said lead-in portion (28) forming a lead-in for a guided insertion of the hub wall (8) onto the connection wall (5).

7. A motor-fan assembly (1) according to one of the preceding claims, wherein the keys (10) are plate-shaped with a radial thickness tapered in the insertion direction (12) to facilitate the insertion of the hub wall (8) onto the connection wall (5).

8. A motor-fan assembly (1) according to any one of the preceding claims, wherein the key seats (11) comprise non-through cavities or through openings in the radial direction, delimited by:

- two second opposite longitudinal edges (25), substantially extending in the insertion direction (12), and forming the second side surfaces (16),
- at least a second transverse edge (26) extending in a transverse direction with respect to the insertion direction (12) and forming the second stop surface (14), wherein the second longitudinal edges (25) of the key seat (10) approach each other going towards the second transverse edge (26) or extend along parallel directions with respect to the rotation axis 6.

9. A motor-fan assembly (1) according to claim 8, wherein the second longitudinal edges (25) are substantially rectilinear and the second transverse edge (26) is planar and arc-shaped along a circumference with respect to the rotation axis (6), wherein the second transverse edge (26) connects to the second longitudinal edges (25) and, along with the second longitudinal edges (25), results in a U-shaped inner contour of the key seat (11) which is complementary to the shape of the U-shaped outer contour of the key (10).

10. A motor-fan assembly (1) according to any one of the preceding claims, wherein the key seats (11) are formed by the connection wall (5) of the rotor (4).

11. A motor-fan assembly (1) according to any one of claims 8 to 10, wherein the second transverse edge (26) and the second stop surface (14) formed by the former are positioned on one side of the key seat (11) opposite to the insertion direction (12) but facing the insertion direction (12).

12. A motor-fan assembly (1) according to claim 2, wherein:

- the key seats (11) are formed in a circular cylindrical portion of the connection wall (5),
- the key seats (11) are positioned at a constant angular pitch, or four key seats (11) are arranged at a 90° angular pitch,
- the coupling portions (17) comprise a plurality of flanges (31) protruding from the hub wall (8) radially inwards, so as to snap-engage corresponding counter-flanges (30) of the connection

wall (5) which form the counter-coupling portions (18),
- the flanges (31) are formed directly on the keys (10) on an opposite side to the first transverse edge (20) and facing in the opposite direction to the insertion direction (12),
- the counter-flanges (30) are instead formed directly in the key seats (11) on an opposite side to the second transverse edge (26) and facing the insertion direction (12).

13. A motor-fan assembly (1) according to any one of the preceding claims, wherein the connection wall (5) and the hub wall (8) are mutually engaged in pressing contact with an elastic preload due to an elastic deformation of the hub wall (8).

14. A motor-fan assembly (1) according to any one of the preceding claims, wherein:

- the conveying blades (9) comprise a plurality of main blades (27) arranged in a circumferential sequence and alternated with secondary blades (27') of a shorter length than the length of the main blades (27),
- both the main blades (27) and the secondary blades (27') extend up to the same outer circumference (32) of the impeller (7),
- a radially inner end of the primary blades (27) is positioned at a first radial distance (33) from the rotation axis (6) while a radially inner end of the secondary blades (27') is positioned at a second radial distance (34) from the rotation axis (6) which is greater than the first radial distance (33).

15. A motor-fan assembly (1) according to claim 14, wherein the secondary blades (27') are not equally spaced apart from the two adjacent primary blades (27), wherein, with respect to an equally spaced apart position (35), the secondary blade (27') is moved towards the adjacent frontal main blade (36) with reference to the rotation direction (37).

16. A heat pump comprising the motor-fan assembly (1) according to any one of the preceding claims, associated with a heat exchanger of a compressor or evaporator of the heat pump.

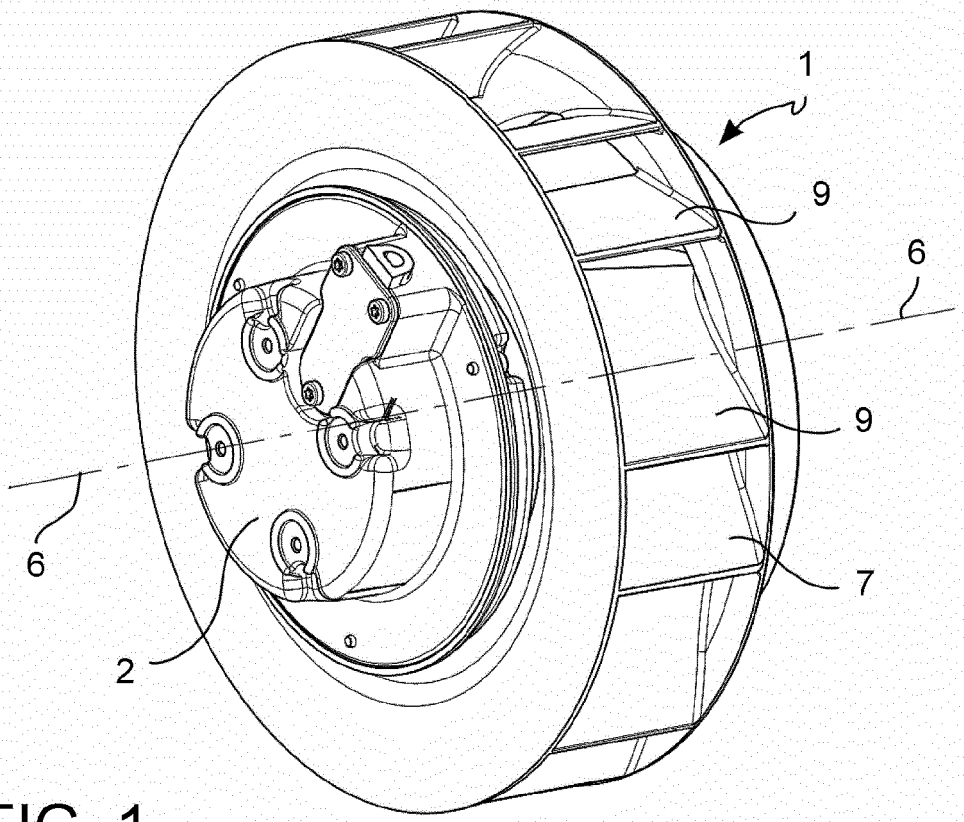


FIG. 1

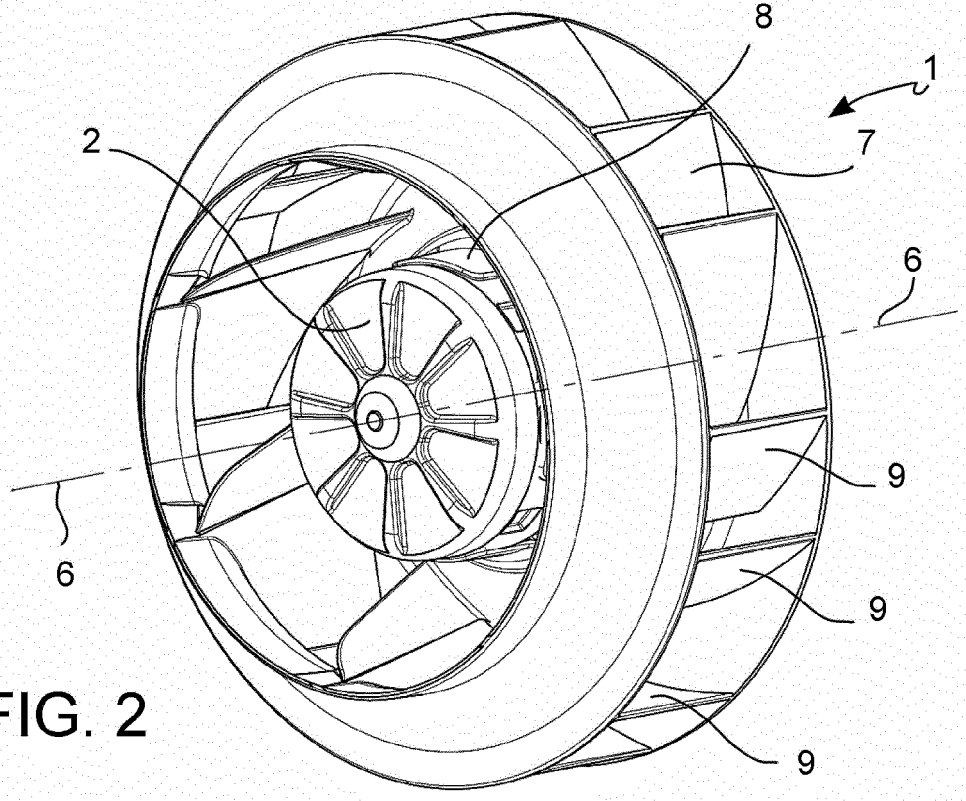


FIG. 2

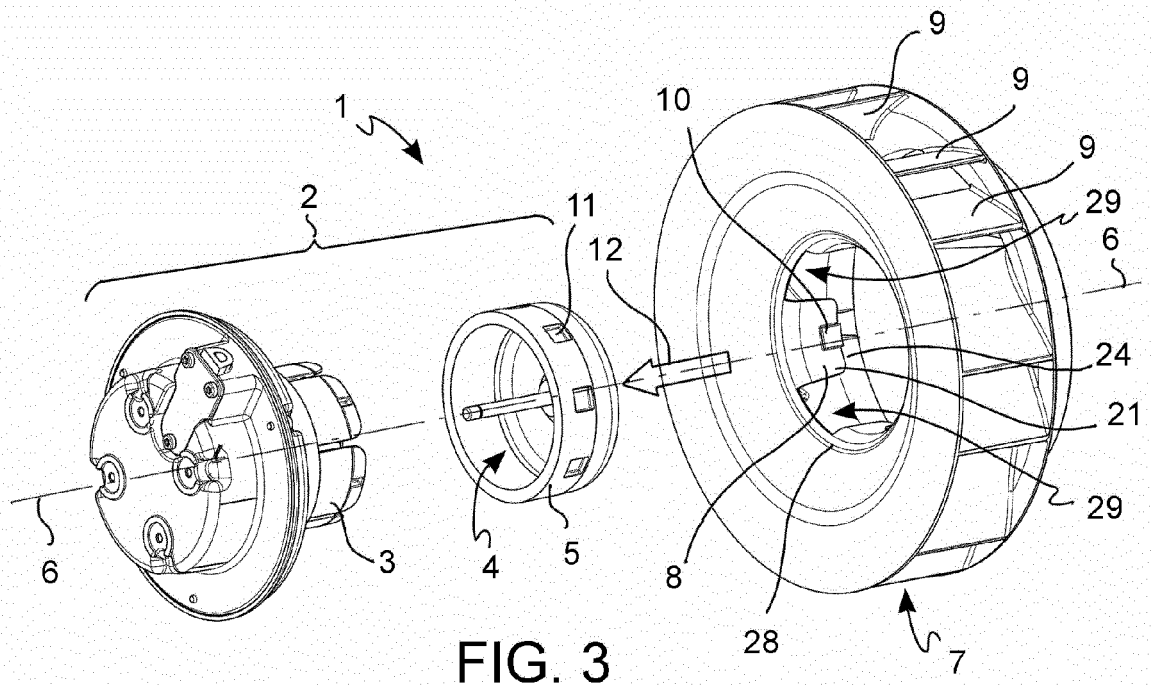


FIG. 3

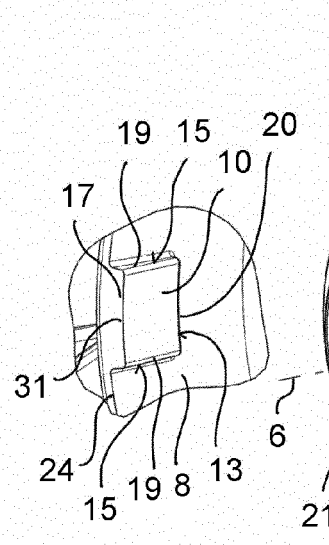
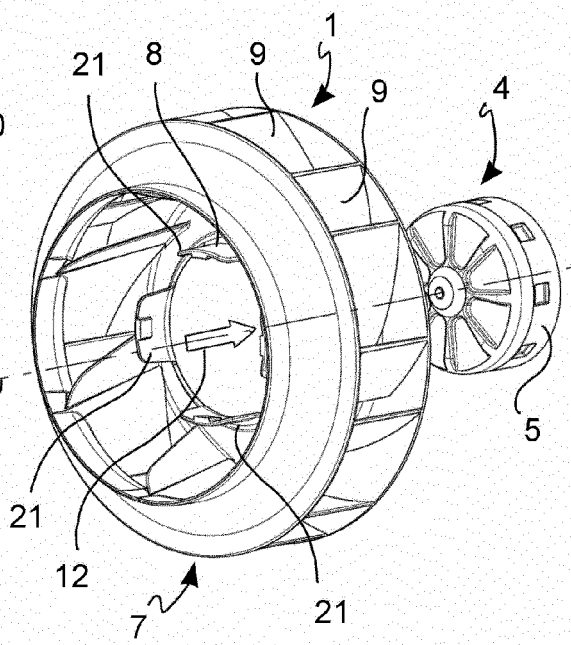


FIG. 5



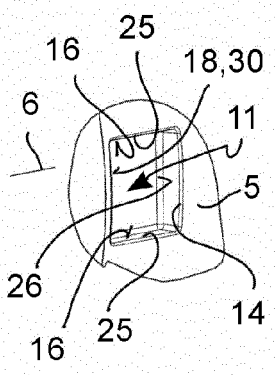


FIG. 6

FIG. 4

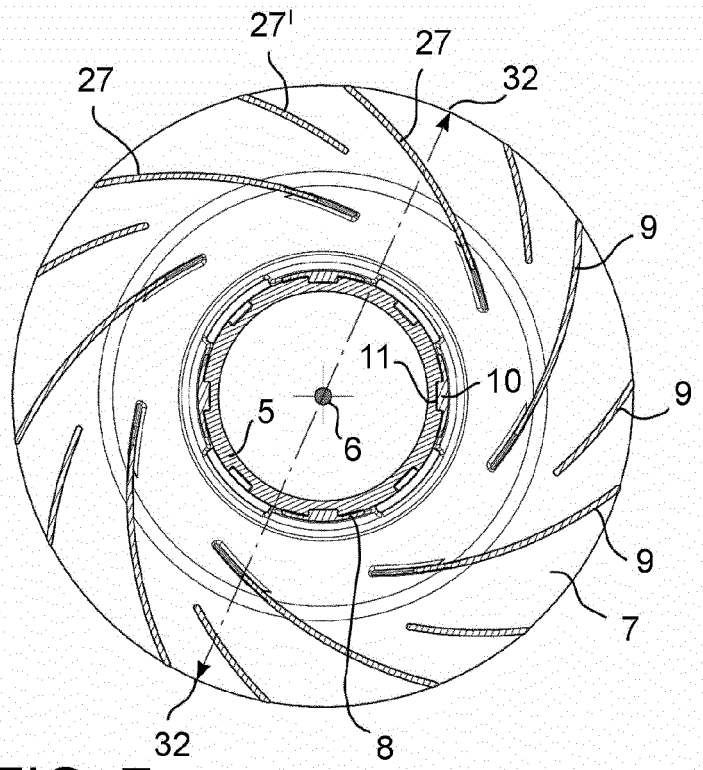


FIG. 7

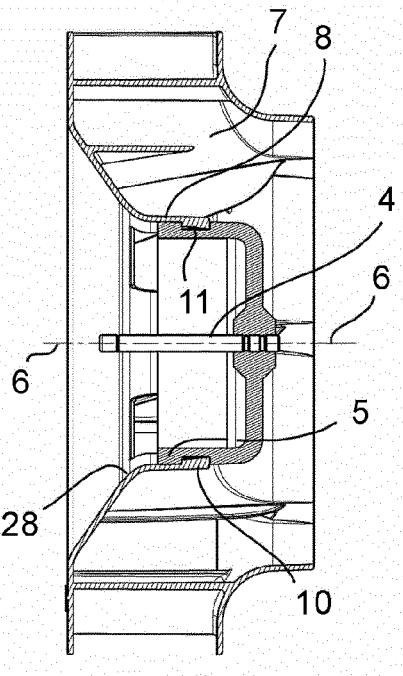


FIG. 8

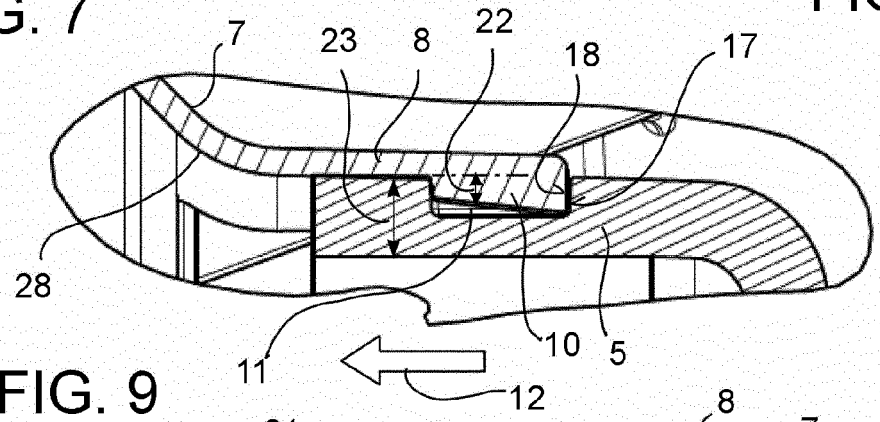


FIG. 9

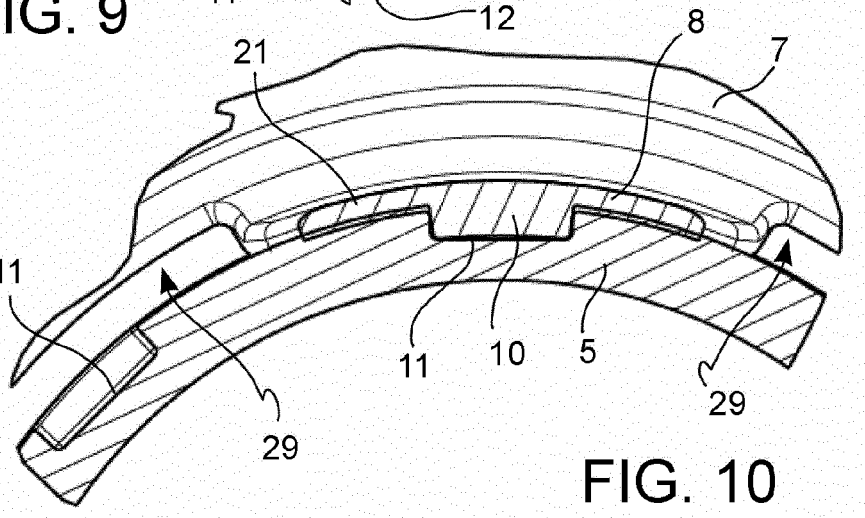


FIG. 10

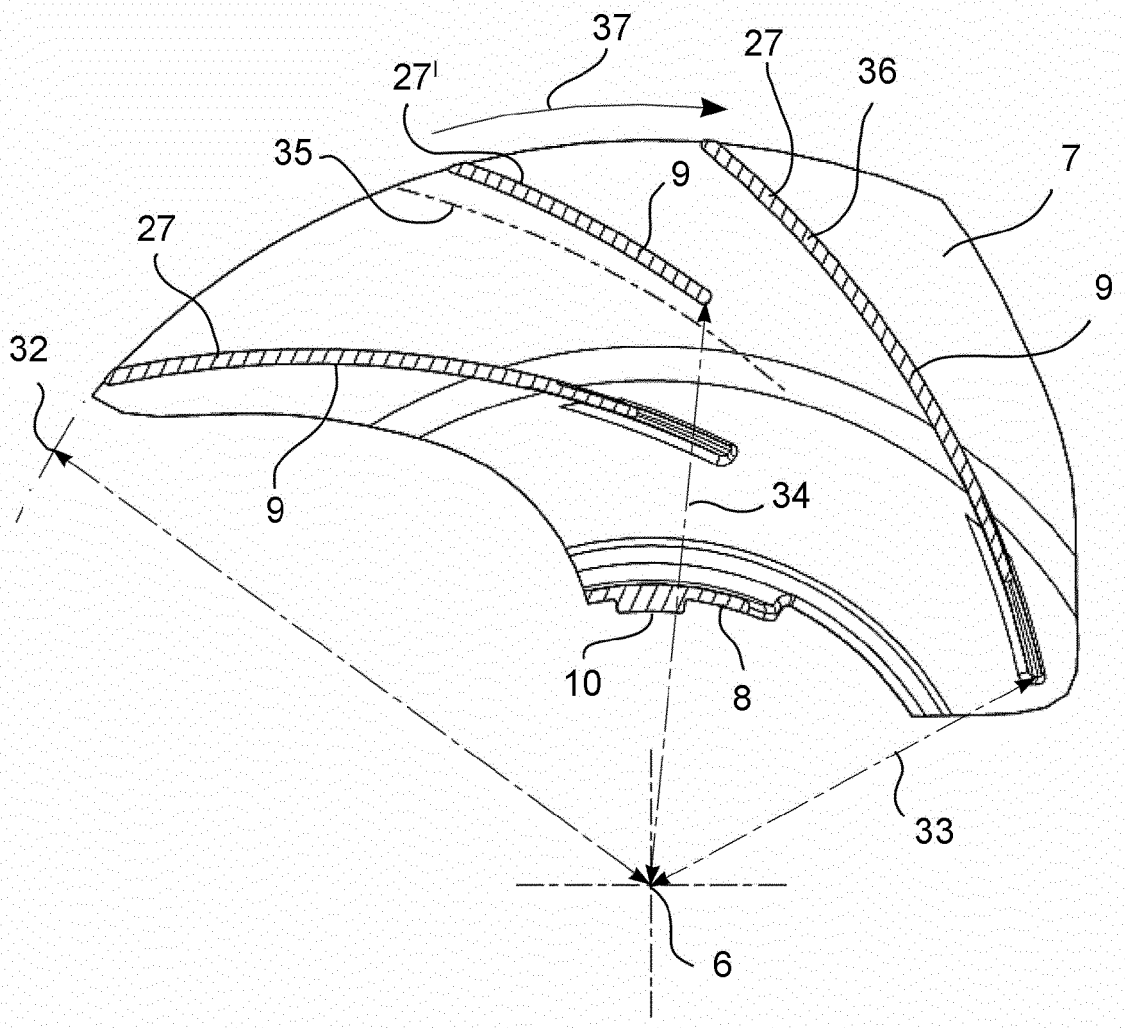


FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 8355

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	US 2015/125326 A1 (LEVASSEUR ANTOINE [FR]) 7 May 2015 (2015-05-07) * paragraphs [0059] - [0084]; figures 4a,4b,5a,5b,7a,7b *	1,2,5,6, 10,13	INV. F04D25/06 F04D29/28 F04D29/62
Y	US 2015/176587 A1 (TAMAOKA TAKEHITO [JP] ET AL) 25 June 2015 (2015-06-25) * paragraph [0057]; figures 8,12 *	4,7,12	
X	DE 198 29 070 A1 (ATLAS COPCO ELECTRIC TOOLS [DE]) 5 January 2000 (2000-01-05)	1-3,10, 13-16	
Y	* paragraphs [0017] - [0025]; figures 1-8 *	4,7-9,11	
Y	CN 205 744 589 U (NINGBO FOTILE KITCHEN WARE CO) 30 November 2016 (2016-11-30) * paragraphs [0040] - [0066]; figures 1-8 *	8,9,11, 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	19 December 2022	Nobre Correia, S

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19-12-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015125326 A1	07-05-2015	CN 104619993 A	13-05-2015
		EP 2828532 A1	28-01-2015
		FR 2988337 A1	27-09-2013
		US 2015125326 A1	07-05-2015
		WO 2013139981 A1	26-09-2013
US 2015176587 A1	25-06-2015	CN 104728133 A	24-06-2015
		JP 6459338 B2	30-01-2019
		JP 2015121212 A	02-07-2015
		US 2015176587 A1	25-06-2015
DE 19829070 A1	05-01-2000	NONE	
CN 205744589 U	30-11-2016	NONE	

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