US 20150118054A1

(19) **United States**

(12) **Patent Application Publication**

ZERELLES

(10) **Pub. No.: US 2015/0118054 A1**

(43) **Pub. Date: Apr. 30, 2015**

(54) **RADIAL BLOWER**

(71) Applicant: **MAHLE BEHR GmbH & Co., KG**, Stuttgart (DE)

(72) Inventor: **Paul ZERELLES**, Stuttgart (DE)

(73) Assignee: **MAHLE BEHR GmbH & Co., KG**, Stuttgart (DE)

(21) Appl. No.: **14/528,058**

(22) Filed: **Oct. 30, 2014**

(30) **Foreign Application Priority Data**

Oct. 31, 2013 (DE) 10 2013 222 207.6

Publication Classification

(51) **Int. Cl.**

F04D 29/28 (2006.01)

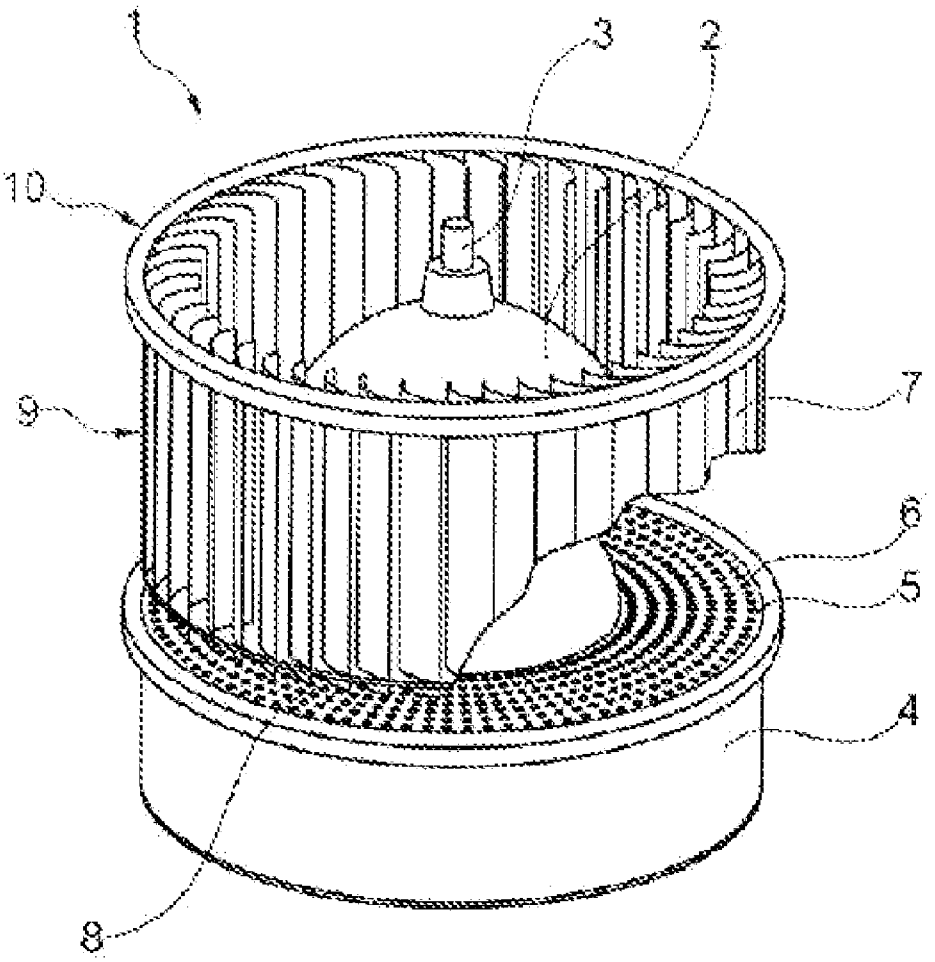
F04D 17/08 (2006.01)

(52) **U.S. Cl.**

CPC ***F04D 29/283*** (2013.01); ***F04D 17/08*** (2013.01)

(57) **ABSTRACT**

The invention relates to a radial blower for delivering an air flow, having a drive motor, having a motor holder and having a fan impeller which has a hub bell at least partially overlapping the drive motor, wherein the fan impeller can be driven by the drive motor via an axially running shaft, wherein a surface, which faces toward the fan impeller, of the motor holder has flow-manipulating elements.



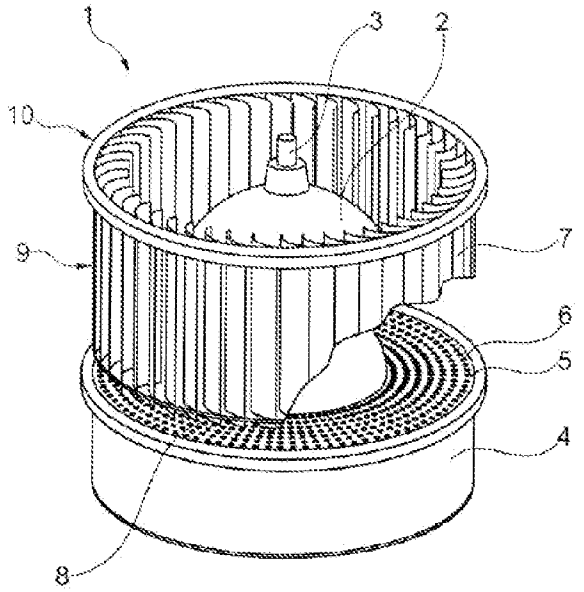


Fig. 1

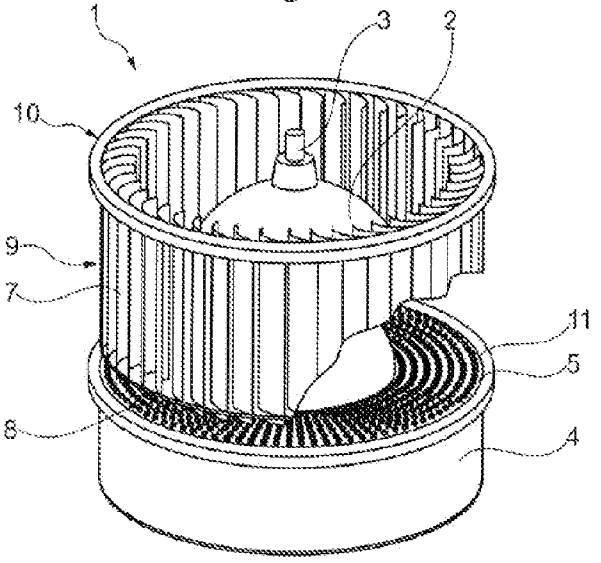


Fig. 2

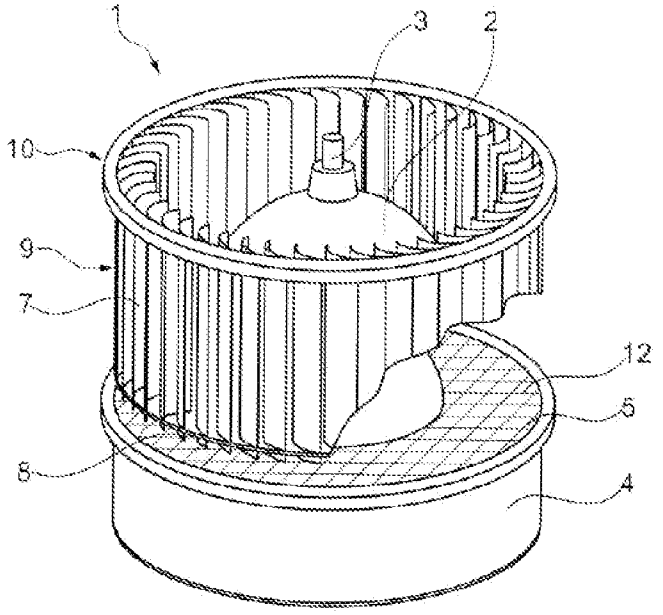


Fig. 3

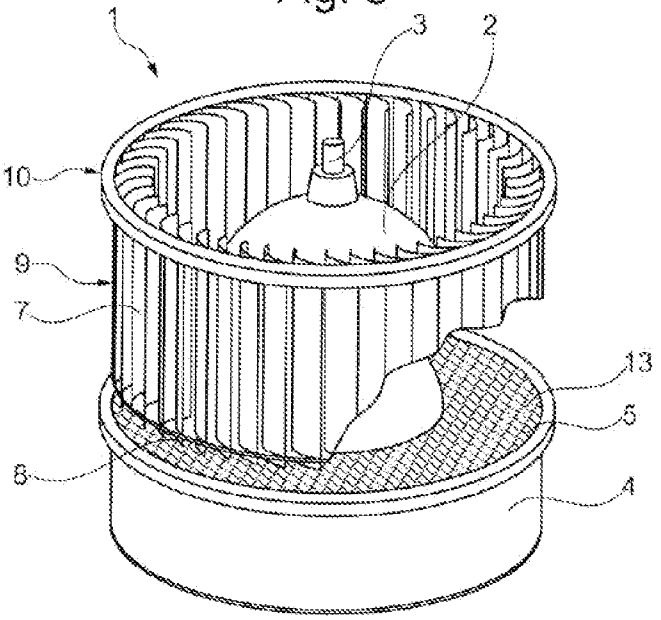


Fig. 4

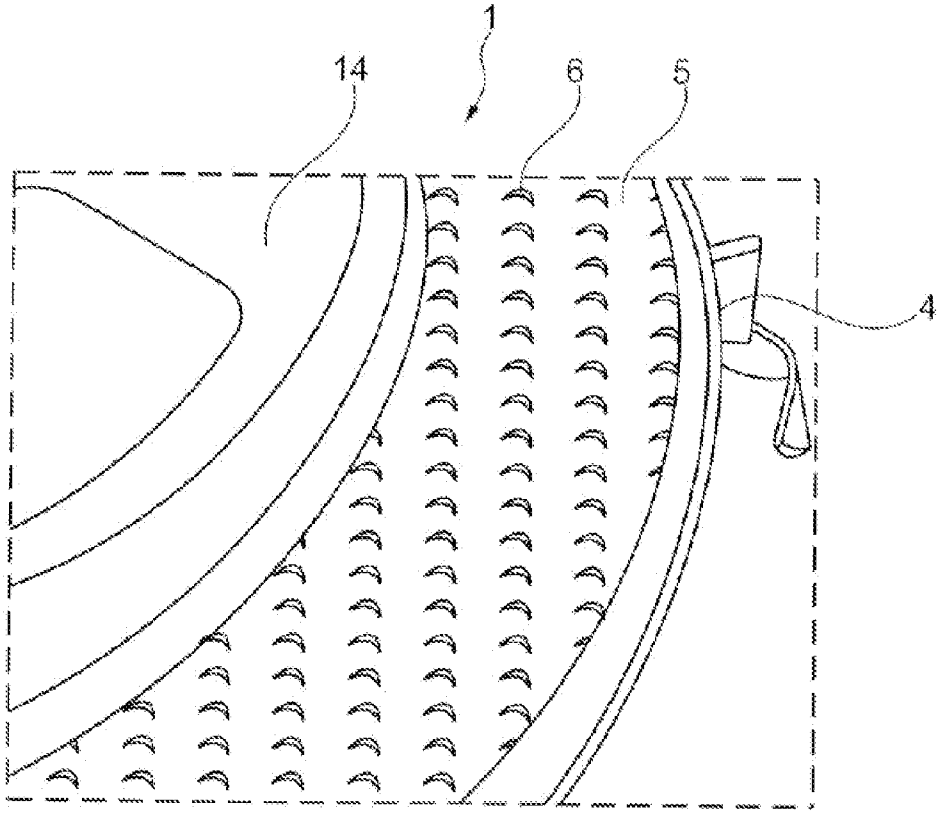


Fig. 5

RADIAL BLOWER

TECHNICAL FIELD

[0001] The invention relates to a radial blower for delivering an air flow, having a drive motor, having a motor holder and having a fan impeller which has a hub bell at least partially overlapping the drive motor, wherein the fan impeller can be driven by the drive motor via an axially running shaft.

PRIOR ART

[0002] For the delivery of air flows in motor vehicles, a variety of fans are used. In heating, ventilation and air conditioning systems in particular, radial blowers are used for delivering air. Radial blowers are characterized in that the delivered air is diverted through approximately 90° by being drawn in in an axial direction of the rotating fan impeller and being discharged from the fan impeller in a radial direction.

[0003] The drive motor of the fan may be arranged under a closed or partially open hub bell, whereby the drive motor is protected against influences such as dirt and moisture. At the same time, however, the cooling of the drive motor is adversely affected by the hub bell.

[0004] To nevertheless realize adequate cooling of the drive motor, it is possible for two-channel radial blowers to be provided which deliver not only the main air flow but also a secondary air flow that can be used for cooling the drive motor.

[0005] In the region of the fan that delivers the secondary air flow, disturbing noise is generated that can impair acoustic comfort. To reduce the disturbing noise, a ring may be provided which projects in an axial direction from the hub bell and which overlaps the region that delivers the secondary air flow.

[0006] The solutions in the prior art have the disadvantage in particular that, during the operation of the radial blower, noise can be generated that can impair acoustic comfort.

PRESENTATION OF THE INVENTION, PROBLEM, SOLUTION, ADVANTAGES

[0007] The problem addressed by the present invention is therefore that of providing a radial blower which is optimized in relation to the prior art and which in particular reduces the generation of disturbing noise.

[0008] The problem addressed by the present invention is solved by means of a radial blower having the features of claim **1**.

[0009] An exemplary embodiment of the invention relates to a radial blower for delivering an air flow, having a drive motor, having a motor holder and having a fan impeller which has a hub bell at least partially overlapping the drive motor, wherein the fan impeller can be driven by the drive motor via an axially running shaft, wherein a surface, which faces toward the fan impeller, of the motor holder has flow-manipulating elements.

[0010] A surface with flow-manipulating elements is advantageous in particular for preventing the formation of vortices and the occurrence of flow separation. Vortices and flow separation make a demonstrable contribution to the generation of disturbing noise, which adversely affects acoustic comfort.

[0011] It may furthermore be advantageous if the motor holder has an axially projecting ring which is arranged outside the radial extent of the fan impeller and which at least partially overlaps the fan impeller in an axial direction.

[0012] The axially projecting ring is particularly advantageous because it reduces the air flow through the lower region, facing toward the motor holder, of the fan impeller. In this way, the generation of noise in said region can be reduced.

[0013] It may also be expedient if the motor holder is formed by an annular body, wherein the radially inner end region surrounds the drive motor and the radially outer end region is at least partially connected to a housing surrounding the radial blower. The drive motor is advantageously fixed and oriented in the housing of the radial blower by the motor holder.

[0014] It may furthermore be particularly advantageous if the surface, which faces toward the fan impeller, of the motor holder runs in a descending and/or ascending and/or horizontal manner from the radially inner end region to the radially outer end region.

[0015] By means of an ascending or descending profile, it can be achieved that the gap formed between the fan impeller and the motor holder is of conically tapering or conically widening form. This reduces the occurrence of vortices and flow separation. Acoustic comfort is thus altogether increased. This is the case in particular if the fan impeller has a horizontally running, downwardly directed terminating edge. If the fan impeller has an obliquely running terminating edge, a horizontal profile of the surface of the motor holder may also be advantageous in order to reduce, or prevent entirely, the generation of disturbing noise.

[0016] A preferred exemplary embodiment is characterized in that the flow-manipulating elements are formed by axially protruding rib elements and/or by grooves and/or by studs and/or by depressions.

[0017] It is also preferable if the flow-manipulating elements form a regular and/or irregular pattern on the surface, which faces toward the fan impeller, of the motor holder.

[0018] In a particularly expedient refinement of the invention, it is also provided that the depressions and/or the studs have a diameter in a range from 1 mm to 15 mm, preferably in a range from 1 mm to 5 mm, and the depressions and/or the studs have a depth or height, respectively, of between 0.5 mm and 5 mm, wherein the distance between adjacent depressions and/or studs is in a range from 1 mm to 25 mm, preferably in a range from 1 mm to 15 mm.

[0019] In an alternative refinement of the invention, it may be provided that the rib elements and/or the grooves have a height or a depth, respectively, of 0.5 mm to 4 mm, wherein the width of the rib elements and/or of the grooves is preferably in a range from 1 mm to 3 mm, wherein the distance between adjacent rib elements and/or grooves is preferably between 1 mm and 25 mm, preferably in a range from 1 mm to 15 mm.

[0020] The dimensioning of depressions, studs, rib elements and grooves in these size ranges is particularly advantageous in order to be able to ensure the smallest possible gap dimensions between the moving components of the radial blower and nevertheless realize an adequate improvement in acoustic comfort.

[0021] It is furthermore preferable if the rib elements and/or the grooves form a rhomboidal structure, wherein individual rib elements and/or grooves intersect. A rhomboidal structure is particularly easy to produce from a manufacturing aspect and is particularly effective with regard to the suppression of noise.

[0022] It is particularly advantageous here if the surface, which faces toward the fan impeller, of the motor holder has an irregular structure, wherein the depressions have a depth of 0.5 mm to 5 mm and are distributed randomly along the surface.

[0023] An irregular structure composed of wave peaks and wave troughs which are preferably arranged in a random distribution along the surface of the motor holder is advantageous in order to realize the maximum possible suppression of noise. An irregular structure of said type can advantageously be realized by means of a plastics component which has been produced in an injection molding process.

[0024] It is also preferable if the studs are in the form of conical elements and/or pin-shaped elements and/or cylindrical elements.

[0025] It is particularly advantageous if the fan impeller has a multiplicity of axially running fan blades, wherein the fan blades are divided into a first region and a second region, wherein the first region of the fan blades is arranged at that end region of the fan blades which is remote from the drive motor, and the axially extending ring of the motor holder partially or completely overlaps the second region of the fan blades.

[0026] The second region of the fan blades serves for the delivery of cooling air through the drive motor. An axially projecting ring which overlaps the gap between the motor holder and the fan impeller, and if appropriate also the second region of the fan blades, is in this case particularly advantageous in order to achieve the most intense possible suppression of noise.

[0027] It is furthermore preferable if the fan blades have obstructive bodies and/or slots and/or notches in the second region.

[0028] By means of disruptive bodies and/or slots and/or notches, the generation of noise in the second region of the fan blades can be further reduced, because the generation of vortices and the occurrence of flow separation can be reduced. This contributes to greater acoustic comfort.

[0029] Advantageous refinements of the present invention are described in the subclaims and in the following description of the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The invention will be explained in detail below on the basis of exemplary embodiments and with reference to the drawings, in which:

[0031] FIG. **1** shows a schematic view of a radial blower having a fan impeller which is driven, via a shaft, by a drive motor arranged under a hub bell, wherein the drive motor is supported with respect to a housing by a motor holder and has a multiplicity of depressions along the surface facing toward the fan impeller,

[0032] FIG. **2** shows a view of a radial blower as per FIG. **1**, wherein the motor holder has a multiplicity of studs on the surface facing toward the fan impeller,

[0033] FIG. **3** shows a view of a radial blower as per FIGS. **1** and **2**, wherein the motor holder has a multiplicity of rib elements and/or grooves on its surface facing toward the fan impeller,

[0034] FIG. **4** shows a schematic view of a radial blower as per FIGS. **1** to **3**, wherein the surface, which faces toward the fan impeller, of the motor holder has a structured surface, and

[0035] FIG. **5** shows a photographic image of a radial blower, wherein the hub bell and the fan impeller are not assembled and the drive motor held in the motor holder is shown.

PREFERRED EMBODIMENT OF THE INVENTION

[0036] FIG. **1** shows a schematic view of a radial blower **1**. The radial blower **1** is composed substantially of a fan impeller **10** which is mounted rotatably, by way of a closed hub bell **2**, on a shaft **3**. Here, the hub bell **2** conceals the drive motor which is arranged underneath the hub bell **2** and which can drive the fan impeller **10** via the shaft **3**. Here, the fan impeller **10** has a multiplicity of fan blades **9** which have an upper, first region **7** and a lower, second region **8**. The first region **7** is separated from the lower, second region **8** by an encircling ring, which simultaneously serves as the connection point of the fan impeller **10** to the hub bell **2**. The fan blades **9** run in an axial direction and, in the exemplary embodiment in FIG. **1**, are of arcuately curved form.

[0037] The first region **7** of the fan blades **9** and the second region **8** of the fan blades **9** may, as illustrated in FIG. **1**, be designed as a direct elongation of one another or may also, in alternative embodiments, be designed to be offset with respect to one another along the circumference.

[0038] The first region **7** of the fan blades **9** serves substantially for the delivery of the main air stream through the radial fan **1**. The second region **8** of the fan blades **9** serves for the delivery of a cooling air stream for the drive motor that is concealed under the hub bell **2**. The cooling air stream that is delivered by the second region **8** is also referred to as secondary air stream.

[0039] This can be achieved in an advantageous manner in particular if the second region of the fan blades **9** is arranged below the lower end region, as viewed in the axial direction, of the hub bell **2**, such that the air stream delivered by the second region **8** can flow, via a cooling air pick-off arrangement, through the drive motor under the hub bell **2**.

[0040] Illustrated around the hub bell **2** is an annular motor holder **5** which serves for the mounting of the drive motor, which is arranged under the hub bell **2**, with respect to a housing **4**.

[0041] The components illustrated in FIG. **1** are advantageously arranged in a flow duct which advantageously has a circular cross section or a cross section adapted to the radial blower **1**. An air duct of said type is not illustrated in the embodiments of FIGS. **1** to **5**.

[0042] Between the motor holder **5** and the second region **8** of the fan blades **9** there is provided a gap which allows the free movement of the fan impeller **10**.

[0043] The basic design described above with regard to the exemplary embodiment of FIG. **1** is also maintained in the following FIGS. **2** to **5**. Therefore, in the following figures, the reference signs correspond to those in FIG. **1**.

[0044] In an alternative embodiment, the motor holder **5** may have an encircling ring projecting axially from the motor holder **5**, which ring runs outside the fan impeller **10**. Here, the ring may have an axial extent which in particular projects beyond the lower, second region **8** of the fan blades **9** and which thus influences the air flow through the second region **8**. An axially projecting ring of said type is advantageous in particular for the suppression of disturbing noises that can be generated owing to the flow through the second region **8**. An

axial ring is not illustrated in the figures but may be provided on the corresponding motor holder **5** at any time.

[0045] An axial ring of said type advantageously projects over the entire second region **8** of the fan blades **9** and not into the first region **7** of the fan blades **9**. In this way, the generation of noise owing to the flow through the second region **8** is suppressed, and at the same time, the main air flow through the first region **7** is not adversely affected.

[0046] The motor holder **5** illustrated in FIG. **1** has, on its surface which faces upward toward the fan impeller **10**, a multiplicity of depressions **6** which generate an irregular surface of the motor holder **5**. Said depressions serve for preventing the occurrence of vibratory formations such as, for example, vortices or instances of flow separation. Said vibratory formations can give rise to disturbing acoustic effects. Here, vibratory formations such as vortices and instances of flow separation are preferably generated in the case of an embodiment of the motor holder with an entirely smooth surface.

[0047] Here, the depressions provided in the motor holder **5** may be arranged either in a regular pattern or in an irregular pattern on the surface of the motor holder **5**. A randomly distributed pattern is particularly advantageous here. In this case, the individual depressions advantageously have a diameter of between 1 mm and 15 mm. Furthermore, the depressions advantageously have a depth of between 0.5 mm and 4 mm. The depressions **6** in this case do not extend through the motor holder **5**.

[0048] FIG. **2** shows a radial blower **1** such as has already been illustrated in FIG. **1**. By contrast to the exemplary embodiment of FIG. **1**, FIG. **2** has a motor holder **5** which, instead of the depressions **6**, has a multiplicity of studs **11**. Said studs may advantageously be in the form of conical or pin-shaped or cylindrical projections on the surface of the motor holder **5**.

[0049] Like the depressions **6** of FIG. **1**, the studs **11** may be distributed uniformly or non-uniformly along the surface of the motor holder **5**. The studs **11** likewise serve for preventing the occurrence of turbulence and instances of flow separation. The individual studs **11** advantageously have a diameter between 1 mm and 15 mm, and preferably a diameter between 0.5 mm and 5 mm.

[0050] In configuring the studs **11**, particular attention should be paid to the spacing between the motor holder **5** and the lower, second region **8** of the fan blades **9** in order to prevent collisions.

[0051] FIG. **3** shows a further alternative motor holder **5** which has rib elements **12** or grooves **12**. Said rib elements **12** may for example, as illustrated in FIG. **3**, be arranged along the surface of the motor holder **5** so as to generate a rhomboidal structure.

[0052] Here, it is possible for either rib elements **12** projecting upward from the surface of the motor holder **5**, or grooves **12** formed into the surface of the motor holder **5**, to be provided. A combination of upwardly projecting rib elements **12** and downwardly embossed grooves **12** may likewise be provided.

[0053] In an alternative embodiment, the rib elements **12** and/or the grooves **12** may also have non-rectilinear profiles.

[0054] The rib elements **12** and/or grooves **12** advantageously have a height or a depth, respectively, of 0.5 mm to 4 mm proceeding from the surface of the motor holder **5**, and are preferably between 1 mm and 3 mm thick. Furthermore, the rib elements **12** and/or the grooves **12** are advantageously arranged with a spacing of 1 mm to 15 mm to one another. As illustrated in FIG. **3**, the individual rib elements **12** and/or grooves **12** may also have points of intersection with one another.

[0055] In configuring the studs, rib elements and grooves **12**, too, particular attention should be paid to the spacing between the motor holder **5** and the lower, second region **8** of the fan blades **9** in order to prevent collisions.

[0056] FIG. **4** shows a radial blower **1**, wherein the radial blower **1** has a different motor holder **5**. The motor holder **5** in FIG. **4** has an irregular, uneven surface structure **13** which may be generated by a sequence of randomly distributed elevations and depressions. Such a structure may advantageously be generated by way of a plastics part produced in a casting process with a negative mold. The various structural elements arranged on the motor holder **5** are advantageously between 0.5 mm and 5 mm in depth.

[0057] FIG. **5** shows a photographic image of a radial blower **1**, with the fan impeller **10** and the hub bell **2** not mounted thereon. FIG. **5** shows in particular the drive motor **14**, which is arranged centrally in the radial blower **1** and which is held relative to the housing **4** by the motor holder **5**. In the embodiment of FIG. **5**, the motor holder **5** has depressions **6** such as are also indicated by way of example in FIG. **1**. As can be seen from FIG. **5**, the depressions **6** are distributed randomly along the surface of the motor holder **5**. In an alternative embodiment, a regular arrangement of the depressions, following a predefined pattern, may also be provided.

[0058] The individual features of the preceding exemplary embodiments 1 to 5 may be combined with one another. This relates in particular to the different implementations of the motor holder **5** with the depressions **6**, the studs **11**, the rib elements **12**, the grooves **12** and the irregular structural elements **13**.

[0059] The exemplary embodiments 1 to 5 are not of a limiting nature with regard to construction or geometric dimensions. They serve merely for illustrating the concept of the invention.

[0060] In alternative embodiments, it is possible in particular for different designs of the hub bell **2**, of the fan impeller **10** and/or of the fan blades **9** to be provided. It is likewise possible for the connection between the motor holder **5** and the drive motor **14**, between the motor holder **5** and the housing **4**, to be designed differently in alternative embodiments.

1. Radial blower for delivering an air flow, having a drive motor, having a motor holder and having a fan impeller which has a hub bell at least partially overlapping the drive motor, wherein the fan impeller can be driven by the drive motor via an axially running shaft, characterized in that a surface, which faces toward the fan impeller, of the motor holder has flow-manipulating elements.

2. Radial blower according to claim **1**, wherein the motor holder has an axially projecting ring which is arranged outside the radial extent of the fan impeller and which at least partially overlaps the fan impeller in an axial direction.

3. Radial blower according to claim **1**, wherein the motor holder is formed by an annular body, wherein the radially inner end region surrounds the drive motor and the radially outer end region is at least partially connected to a housing surrounding the radial blower.

4. Radial blower according to claim **1**, wherein the surface, which faces toward the fan impeller, of the motor holder runs

in a descending and/or ascending and/or horizontal manner from the radially inner end region to the radially outer end region.

5. Radial blower according to claim **1**, wherein the flow-manipulating elements are formed by axially protruding rib elements and/or by grooves and/or by studs and/or by depressions.

6. Radial blower according to claim **1**, wherein the flow-manipulating elements form a regular and/or irregular pattern on the surface, which faces toward the fan impeller, of the motor holder.

7. Radial blower according to claim **1**, wherein the depressions and/or the studs have a diameter in a range from 1 mm to 15 mm, preferably in a range from 1 mm to 5 mm, and the depressions and/or the studs have a depth or height, respectively, of between 0.5 mm and 5 mm, wherein the distance between adjacent depressions and/or studs is in a range from 1 mm to 25 mm, preferably in a range from 1 mm to 15 mm.

8. Radial blower according to claim **1**, wherein the rib elements and/or the grooves have a height or a depth, respectively, of 0.5 mm to 4 mm, wherein the width of the rib elements and/or of the grooves is preferably in a range from 1 mm to 3 mm, wherein the distance between adjacent rib elements and/or grooves is preferably between 1 mm and 25 mm, preferably in a range from 1 mm to 15 mm.

9. Radial blower according to claim **1**, wherein the rib elements and/or the grooves form a rhomboidal structure, wherein individual rib elements and/or grooves intersect.

10. Radial blower according to claim **1**, wherein the surface, which faces toward the fan impeller, of the motor holder has an irregular structure, wherein the depressions have a depth of 0.5 mm to 5 mm and are distributed randomly along the surface.

11. Radial blower according to claim **1**, wherein the studs are in the form of conical elements and/or pin-shaped elements and/or cylindrical elements.

12. Radial blower according to claim **1**, wherein the fan impeller has a multiplicity of axially running fan blades, wherein the fan blades are divided into a first region and a second region, wherein the first region of the fan blades is arranged at that end region of the fan blades which is remote from the drive motor, and the axially extending ring of the motor holder partially or completely overlaps the second region of the fan blades.

13. Radial blower according to claim **1**, wherein the fan blades have obstructive bodies and/or slots and/or notches in the second region.

* * * * *