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(54) **ELECTRIC CENTRIFUGAL BLOWER**

(57) An electric centrifugal blower (10) comprises an impeller (3) having an orthogonal rotation z axis coincident with the z axis of an xyz coordinate system. The impeller (3) has a diameter D1 and is inside a blower volute (20) that has a discharge mouth (4) parallel to a

plane passing through the z axis and perpendicular to the xy-plane. The blower volute (20) has a baffle (6) in the vicinity of the end cross-section (5) of said discharge mouth (4).

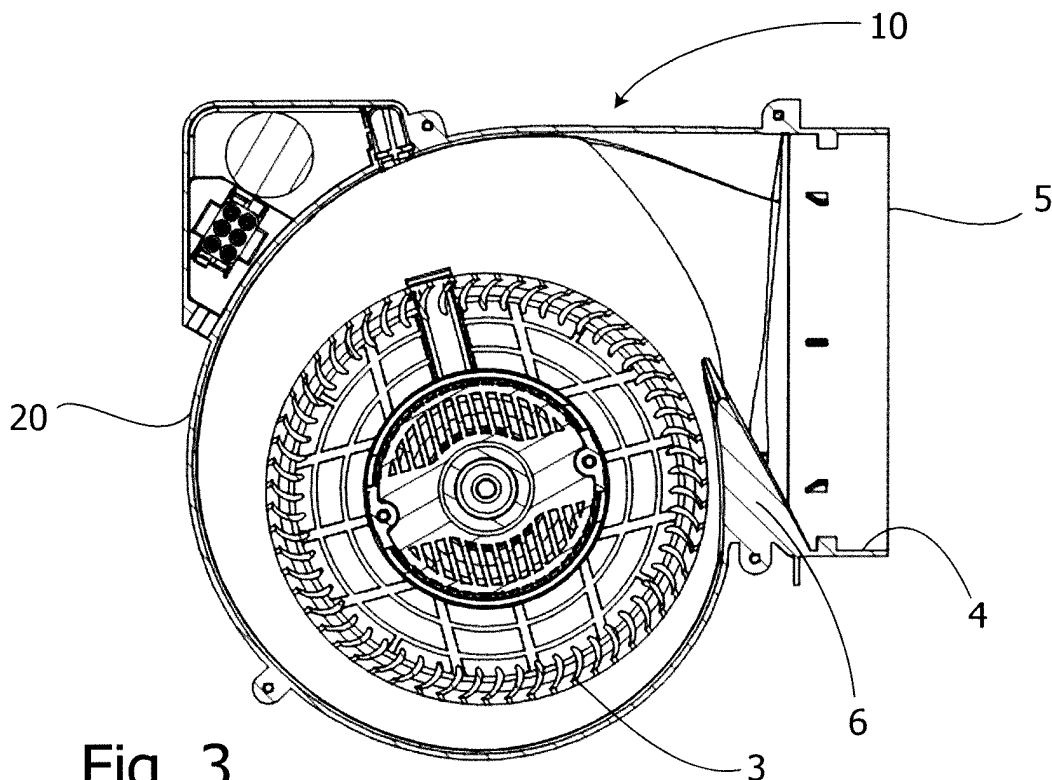


Fig. 3

Description

[0001] The present invention relates to an electric centrifugal blower, in particular a volute for an electric blower able to optimize the air suction efficiency.

[0002] In fact, with reference to new regulations, each blower is classified in the respective energetic efficiency class on the base of the Fluid Dynamic Efficiency (FDE) parameter calculated in the Best Efficiency Point (BEP). In particular, IEG 61591 provides for the terms and types of instruments for the execution of tests to verify the performance of the electric blower. Its overall efficiency descends from the aerodynamic efficiency, that is from the handling of air flow defined by the measured values of the static pressure and the volumetric flow rate of the blower volute, and from the electromechanical efficiency of the motor.

In order to improve the electric blower efficiency, studies were carried out oriented to the optimization of the suction process and, more generally, to the air flow analysis to improve the aerodynamic aspects of the aspirated air flow by acting on the volute of the electric blower.

[0003] So, in general, an object of the invention is to identify the best conformation of an aspirating blower volute, able to optimize the suction process of electric centrifugal blowers.

In particular, an object of the invention is to really enhance the air suction aerodynamic process of electric centrifugal blowers in suction hoods, which represent the final product into which such electric centrifugal blowers are assembled.

The mentioned and other objects are achieved by an electric centrifugal blower comprising an impeller having an orthogonal rotation z axis coincident with the z axis of an xyz coordinate system, the impeller having a diameter D1 and being within a blower volute that has a discharge mouth parallel to a plane passing through the z axis and perpendicular to the xy-plane, wherein the blower volute has a baffle in the vicinity of the end cross-section of the discharge mouth.

[0004] Advantageously the baffle is inclined by an angle of 8 degrees towards the inside with respect to the plane of the end cross-section of the discharge mouth.

[0005] The blower volute has an outer radius R1 at an angle of 172.66 degrees in the xy-plane, an outer radius R2 at an angle of 256.02 degrees in the xy-plane, an outer radius R3 at an angle of 372.34 degrees in the xy-plane, the ratios of said radii R1, R2, R3 to the diameter D1 of the impeller being $R1/D1 = 0.79 \pm 5\%$, $R2/D1 = 0.70 \pm 5\%$ and $R3/D1 = 0.57 \pm 5\%$, respectively.

[0006] Furthermore, in correspondence of the centre of said baffle, the blower volute has an outer radius R4 at an angle of 386.35 degrees in the xy-plane, the ratio of said outer radius R4 to the diameter D1 of the impeller being $R4/D1 = 0.84 \pm 5\%$.

[0007] From above it should be understood that the present invention, which aims to optimize the air suction process, refers exclusively to the shape of the electric

blower volute. The advantages arising from the shape and size of the electric blower volute have been highlighted by a comparison of the electric blower aerodynamic performance according to the present invention with those resulting from the use of the same electric motor assembled in other volutes of electric blowers available on the market. In this way it was possible to study and analyse separately the different configurations of the blower volute by identifying the correct improvements to be made to optimize the aerodynamic efficiency of the entire casing.

[0008] According to the invention a baffle is realized on the discharge mouth of the blower volute. In this way the load torque on the motor shaft is decreased. Since the motor itself, being an asynchronous motor, increases its rotational speed when the load torque decreases, the speed of the impeller is greater as compared to a configuration of a blower volute without baffle. In this regard, however, it is well to specify that the increase of the rotating speed of the impeller does not allow a clear improvement of the aerodynamic suction process automatically, without suitable and proper placement and sizing of the introduced baffle. In fact, such a baffle, if not properly analyzed, risks creating an obstruction to output air flow without making any improvement, indeed creating only a worsening of fluid-dynamic efficiency. Then, in order to achieve the hypothesized improvements the various vector components of the air flow vector have been taken into consideration; in fact, through empirical tests performed directly on various prototypes of blower volutes examined, it was possible to identify the correct conformation and size of the baffle to be used in order to achieve the hypothesized improvements.

[0009] The present invention will be now described, for an illustrative but not limitative example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an electric blower of the prior art without cover;

Figure 2 is a perspective view of an electric blower according to the present invention without cover;

Figure 3 is a plan view of the interior of the electric blower in Figure 2; and

Figure 4 is a view similar to that of Figure 3 that represents the geometry of the blower volute.

[0010] First referring to Figure 1, which is a perspective view of an electric blower 1 of the prior art shown without cover, for convenience of illustration, a blower volute generally indicated as 2 and an impeller generally indicated as 3 can be seen.

[0011] The blower volute 2 has a discharge mouth 4. Shown in Figure 2 is a perspective view of an electric blower 10 according to the present invention without cover. By using the same numbers in Figure 1 to indicate identical parts, the blower volute 10 is indicated as 20, the impeller as 3 and the discharge mouth as 4. The discharge mouth 4 of the electric blower 10 has an end

cross-section 5 as shown in Figure 3. The electric blower 10 according to the present invention has a baffle 6 in the vicinity of the end cross-section 5 of the discharge mouth 4.

[0012] The baffle 6 is inclined by an angle of 8 degrees inwardly with respect to the plane of the end cross-section 5 of the discharge mouth 4.

[0013] In order to define the other design features of the electric blower volute according to the present invention, the impeller 3 has a z orthogonal rotation axis coincident with the z axis of an xyz coordinate system, whose xy-plane is represented in Figure 4, which is a view similar to that of Figure 3. Shown in Figure 4 are the points P1, P2, P3, P4, which represent the curvature centre of tracts of the blower volute 20 with relative radii R1, R2, R3, R4, used for the construction of the blower volute spiral. The points P5, P6, in addition to the angle of 8.2 degrees mentioned above, serve to define the configuration of the baffle 6.

[0014] In an embodiment, the diameter D1 of the impeller of the electric blower 10 is 147 mm as calculated at the ends of the blades of the impeller itself, having the point P0 (0; 0) as centre of the circumference.

[0015] For the calculation of the blower volute spiral the three different external geometric radii above mentioned were taken into consideration, applied in the points which have as coordinates the following values expressed in mm:

Radius R1 = 116 applied at the point P1 (15.2; 8.8)
 Radius R2 = 103 applied at the point P2 (2.2; 9.3)
 Radius R3 = 84.5 applied at the point P3 (-2.2; -8.6)

[0016] The outer radius R1 is measured at an angle of 172.66 degrees in the xy-plane, the outer radius R2 at an angle of 256.02 degrees in the same plane, the outer radius R3 at an angle of 372.34 degrees. In order to make independent such radii from the sizes of the blower volute, the ratios of these radii R1, R2, R3 to the impeller diameter D1 are shown. These ratios are, respectively:

$R1/D1 = 0.79 \pm 5\%$,
 $R2/D1 = 0.70 \pm 5\%$, and
 $R3/D1 = 0.57 \pm 5\%$,

said blower volute 20 has an outer radius R1 at an angle of 172.66 degrees in the xy-plane, an outer radius R2 at an angle of 256.02 degrees in the xy-plane, an outer radius R3 at an angle of 372.34 degrees in the xy-plane, the ratios of said radii R1, R2, R3 to the diameter D1 of the impeller being $R1/D1 = 0.79 \pm 5\%$, $R2/D1 = 0.70 \pm 5\%$, and $R3/D1 = 0.57 \pm 5\%$, respectively.

[0017] It is also considered the radius R4 = 124.2 applied at the point P4 (-40.1; -20.7) which corresponds to the centre of the baffle 6 at an angle of 386.35 degrees in the xy-plane. The ratio of the radius R4 to the diameter D1 of the impeller is $R4/D1 = 0.84 \pm 5\%$.

[0018] A further point P5 (70.9; 35.1) indicates where

the arc of the circumference with radius R4 ends.

[0019] The point P5 is used to define the point of application of the angle of incidence of 8.2 degrees that is used to connect the upper portion of the baffle 6. Finally, the point P6 (69.7; 49.5) indicates the vertex of the baffle 6. This point is referred to the arc of circumference of the upper connection of the baffle 6; the tangent to this point of circumference arc has a direction parallel to the air flow outgoing from the blower volute. All of these mentioned points are represented in Figure 4 referred to the point P0 that is the centre of the impeller circumference in the xy-plane.

[0020] Briefly, the circumferences related to the various radii are internally tangent between them. In detail, the circumference of radius R2 is internally tangent to the circumference of radius R1; the circumference of radius R3 is tangent internally to the circumference of radius R2, and the circumference of radius R3 is internally tangent to the circumference of radius R4. The circumference of radius R4 ends at the point P5. The cut-off ends at the point P6 connected to the point P5 by means of the angle of incidence of 8.2 degrees.

[0021] If one compares the electric blower of the prior art without baffle with the electric blower with baffle according to the present invention, in the latter, the vector of the air flow exiting the blower has a direction almost perpendicular to the cross-section of the discharge mouth, thus ensuring a reduction of losses of the air flow with the increasing of the flow speed, as compared with the case of the electric blower without baffle. Furthermore, according to the Bernoulli principle, if the air density is supposed constant in the various input and output points of the electric blower, since the air flow speed is inversely proportional to the pressure, it results that the blower impeller, with the insertion of the baffle, has a higher speed than that of an electric blower without baffle. Both the increase of the impeller speed and the presence of the baffle allow the output air flow to impact directly on the baffle which, being built following the tangential direction of the impeller blade curvature, allows to cut the air flow perpendicularly to the outlet cross-section therefore ensuring the decrease of losses of the air flow itself within the blower volute. Also the part of the air flowing between the impeller and the baffle is the centrifugal air flow generated by the impeller; such flow in the indicated blower volute portion has a very high speed; therefore, according to the Bernoulli principle the pressure value will be very low in this air flow. This can improve the suction process since the air flow moves from a high pressure zone to a low pressure zone. Therefore, the presence of the baffle, in addition to improving the direction of the air flow vector in the output, also improves the air suction process, generally assuring a clear improvement compared to the electric blower without baffle of the prior art.

[0022] Thanks to the geometry of the baffle 6 described above, the air flow is cut better permanently, increasing the fluid-dynamic efficiency value of the entire blower volute and avoiding the creation of vortices of the centrifugal

air flow that are likely causes of noise.

[0023] The current FDE value fully matches its target. It was possible to reach a fluid-dynamic efficiency value FDE equal to about 36% thus obtaining a marked improvement of about 8% with respect to the electric blower without baffle. 5

Claims

1. An electric centrifugal blower (10) comprising an impeller (3) having an orthogonal rotation z axis coincident with the z axis of an xyz coordinate system, the impeller (3) having a diameter D1 and being within a blower volute (20) that has a discharge mouth (4) parallel to a plane passing through the z axis and perpendicular to the xy-plane, **characterized in that** said blower volute (20) has a baffle (6) in the vicinity of the end cross-section (5) of said discharge mouth (4). 10 20
2. The electric centrifugal blower (10) according to claim 1, wherein said baffle (6) is inclined inwards by 8.2 degrees with respect to the plane of the end cross-section (5) of said discharge mouth (4). 25
3. The electric centrifugal blower (10) according to claim 1, wherein said blower volute (20) has an outer radius R1 at an angle of 172.66 degrees in the xy-plane, an outer radius R2 at an angle of 256.02 degrees in the xy-plane, an outer radius R3 at an angle of 372.34 degrees in the xy-plane, the relationships of said radii R1, R2, R3 to the diameter D1 of the impeller being respectively $R1/D1 = 0.79 \pm 5\%$, $R2/D1 = 0.70 \pm 5\%$ and $R3/D1 = 0.57 \pm 5\%$. 30 35
4. The electric centrifugal blower (10) according to claim 3, wherein said outer radius R1 at an angle of 172.66° in the xy-plane has the point P1 (15.2; 8.8) as its centre and a length of 116 mm, said outer radius R2 at an angle of 256.02° in the xy-plane has the point P2 (2.2; 9.3) as its centre and a length of 103 mm, and said outer radius R3 at an angle of 372.34° in the xy-plane has the point P3 (-2.2; -8.6) as its centre and a length of 84.5 mm. 40 45
5. The electric centrifugal blower (10) according to claim 2, wherein in correspondence of the centre of said baffle (6) said blower volute (20) has an outer radius R4 at an angle of 386.35° in the xy-plane, the ratio of said radius R4 to the diameter D1 of the impeller being $R4/D1 = 0.84 \pm 5\%$. 50
6. The electric centrifugal blower (10) according to claim 5, wherein said outer radius $R4=124.2$ at an angle of 386.35° in the xy-plane, is applied in the point P4 (-40,1; -0,7). 55

Fig. 1

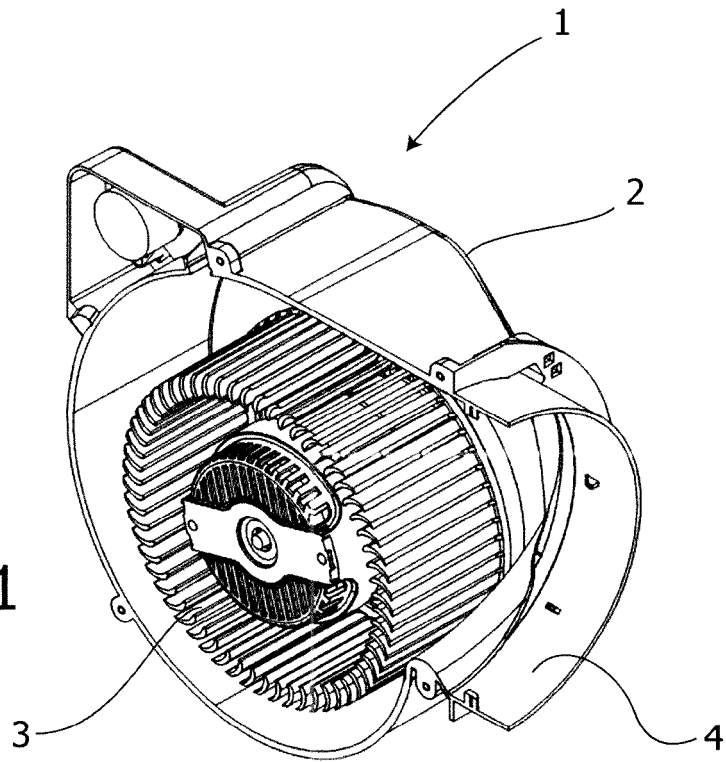


Fig. 2

