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Description

[0001] The invention relates to an axial fan with a flow rectifier.

[0002] In this context, the term flow rectifier refers to an air-conducting element wherein this air-conducting element arranged, as a flow rectifier behind an axial fan, redirects the air induced to flow by the axial fan into an as axial and uniform as possible flow. To that end, the flow rectifier comprises at least one correspondingly shaped air guide vane or blade.

[0003] Large fan diameters require large flow rectifiers. Such large flow rectifiers, with component diameters of 350 mm, in particular of more than 500 mm are costly: for cost reasons, these components are usually produced from synthetic material, for example in an injection-molding process. Injection molding tools are needed for this process, which mean high tool costs, in particular in large components. Moreover, the production, in synthetic material injection-molding, is difficult, especially in larger parts, due to the thin wall thicknesses. The components are essentially weak when it comes to load and problematic with regard to packaging, storage, transport and handling.

[0004] The international patent application WO 2014/056657 of the applicant discloses a flow rectifier as well as an axial fan in particular for evaporators in cold-storage rooms. The flow rectifier downstream of the axial fan significantly increases the thrust of the axial fan, wherein said rectifier transforms the swirling exhaust flow of the fan into a uniform axial flow. Here, a thrust is to be understood as a distance, up to which a limit speed of the air flow is observed. The flow rectifier is configured integrally as a synthetic injection-molded part. It can be retrospectively releasably mounted, as a distinct component, on a wall ring, or on a protective or support grating of a fan.

[0005] Depending on the operating point of the fan, it is advantageous, with respect to throughput and efficacy, to employ flow rectifiers with different numbers of air guide vanes, wherein the air guide vanes advantageously have different geometries, depending on the operating point of the fan. The required unit quantity of a particular flow rectifier is thereby smaller than that of the corresponding fan and is too small, in particular for an economical production, as a distinct injection-molding tool is required for each variant of the flow rectifier.

[0006]The documents EP 1 408 238 A2, US 3 883 264, US 6 409 472 B1 and JP 2012031750 each disclose a flow rectifier for an axial fan comprising a hub and at least one vane, wherein the at least one vane can be operatively connected with the hub in a releasable manner. It is further disclosed that the hub forms a cup with a hub bottom, an inner circumferential wall and an outer circumferential wall, wherein the cup comprises an opening in the hub bottom.

[0007]The object of the invention lies in the making available of an axial fan with a flow rectifier, wherein the geometry of the cost-effectively producible flow rectifier is to be optimizable for different operating points.

[0008]This object is achieved by an axial fan according to claim 1. Advantageous embodiments of the axial fan result from the sub-claims 2 to 6.

[0009]A flow rectifier of an axial fan according to the invention, with a hub and at least one vane, is characterized by that the at least one vane is releasably operatively connectable with the hub. Through the releasable connection option of vane and hub, the flow rectifier is modularly constructed. Depending on an operating point of the axial fan, more or fewer vanes can be employed. The flow rectifier can here also comprise a plurality of vanes. The vane geometry can also be simply changed. Moreover, different flow rectifiers are required for different construction sizes of fans, i.e. for fans with different impeller diameters. Through the modular construction, the hub of the flow rectifier can be used for different construction sizes of fans, in that different flow rectifier vanes are fastened to the hub. The unit quantity of hubs is thus increased, which, through the effects of higher unit quantity volume, leads to lower parts costs and investment costs. Due to the multiple parts of the flow rectifier, the size of the individual parts is reduced, which leads to lower tool costs, and makes the injection-molding process easier. Packaging, storage, transportation, and handling are made considerably easier.

[0010]It is provided according to the invention that the hub forms a cup with a hub bottom, an inner circumferential wall and an outer circumferential wall, wherein the cup comprises an opening in the hub bottom. In particular, if the opening is located in the deepest point in the cup, the accumulation of water in the cup is prevented. Moreover, it can be visually checked through the opening if the, for example, form-fitting

connection between the at least one flow rectifier vane and the hub was correctly joined.

[0011]It has proven to be of advantage if the at least one vane can be operatively connected with the hub without tools. Here, the at least one vane can be force- and/or form-fittingly operatively connectable with the hub. For example, an operative connection of the at least one vane with the hub is possible via a special geometry on the hub-sided end side of the at least one vane and the corresponding counter-piece of this geometry, on the outer periphery of the hub, is possible. This special geometry can advantageously be configured as a dovetail guide.

[0012]It has proven to be of particular advantage if the operative connection of the at least one vane can be additionally secured to the hub. For example, the at least one vane can be additionally latchable to the hub. This can, for example, be configured in that the vane comprises a guide, with which it is insertable into the hub. To that end, the hub comprises, on its outer periphery, likewise corresponding guides. This guide, on its inner side, i.e. its side facing the central axis of the axial fan, can comprise a latch hook directed towards this side, which hook is latchable behind a corresponding edge of the hub. The guide can comprise a slit to increase flexibility, whereby the required joining force is minimized. Through the latching, a secure connection is produced between the vane and the hub of the flow rectifier.

[0013]According to the invention, the hub, on the inner circumferential wall, comprises a stop directed towards the central axis, i.e. towards the rotational axis of the impeller.

[0014]An axial fan according to the invention comprises an impeller powerable by an electric motor, a diffusor, a flow rectifier, a support structure, and at least one circumferential ring, wherein the support structure and the at least one circumferential ring are arranged behind the impeller in the flow direction, and wherein the flow rectifier is fastenable to the at least one circumferential ring. The axial fan can be built into a corresponding opening in a wall via a wall ring. The support structure then establishes the connection between the wall ring and the electric motor, and holds the electric motor, and thusly the impeller, in the wall ring. One or multiple circumferential concentric rings or at least one spiral-shaped ring can be fastened to the support structure, whereby a contact protection in the form of a protective grating is specified

for the impeller and/or electrical parts of the motor. Alternatively, the contact protection, if necessary, can be ensured through a separate protection means.

[0015]A flow rectifier increases the peak efficiency of an axial fan in the high-pressure region of the characteristic curve of the fan. In low counter-pressures and high volume flows, the efficiency of a fan with a flow rectifier is lower, however. The flow rectifier according to the invention is optionally integratable if it is useful for the respective field of application. No change is necessary to the existing components in order to be able to fasten the flow rectifier.

[0016]According to the invention, the at least one vane comprises a connection element in a region facing away from the hub. The flow rectifier is fastenable to the support structure and/or to the protective grating via the connection element. The support structure and/or the protective grating here contributes to the stability of the flow rectifier.

[0017]Advantageously, the flow rectifier is fastenable, in a tool-free manner, to the at least one circumferential ring. The flow rectifier can thereby be particularly simply attached to the axial fan if it is necessitated by the operating point and can also be removed again if the wheel guide is not required in a different operating point. In a preferred embodiment, the flow rectifier can be form and/or force-fittingly fastenable to the at least one circumferential ring. Such a fastening is possible, for example via an elastic-plastic deformation of the connection element. Here, the connection element is in part deformed elastically, but also in part plastically.

[0018]According to the invention, the support structure comprises a flange ring on its side facing the rotary axis of the impeller, wherein the flow rectifier is force- and/or form-fittingly operatively connectable with the flange ring. More specifically, the flow rectifier is operatively connected with the flange ring via a latch hook. The resistance to deformation of the flow rectifier is additionally increased by this connection.

[0019] It is furthermore provided according to the invention that the stop of the hub, in the installed state, cooperates with the flange ring of the support structure and the latch hook in such a manner that the axial position of the flow rectifier is fixed. The stop can be configured in a labyrinthine manner. The stop thereby reduces the leakage flow in

the connection region. The stop is only interrupted, in the region of the latch hook, for production-related reasons.

[0020]Moreover, it has proved to be particularly advantageous if a gap is formed, in the circumferential direction, between the diffusor and the at least one vane. Alternatively, the at least one vane can also touch the diffusor with its end face facing in the circumferential direction.

[0021]Further advantages, features and appropriate further developments of the invention result from the dependent claims and the following illustration of preferred exemplary embodiments by means of the illustrations.

[0022] The illustrations show:

Figure 1 a flow rectifier of an axial fan according to the invention in a three-dimensional illustration;

Figure 2 a detail of a flow rectifier of an axial fan according to the invention in a sectional view;

Figure 3 a detail of an axial fan according to the invention with mounted flow rectifier in a sectional illustration;

Figure 4 a further detail of an axial fan according to the invention with mounted flow rectifier in a sectional illustration.

[0023] Figure 1 shows a flow rectifier 20 in a three-dimensional illustration. The flow rectifier 20 comprises a hub 5 and a plurality of vanes 4. The hub 5, on its inner periphery, comprises a circumferential stop 14 and latch hooks 12 distributed over the periphery. The vanes 4, on their end face facing the central axis 2a of the hub, comprise guides 4a, with which the vanes, at the outer periphery of the hub 5, are inserted in guides 5e present there (not discernible in this Figure). In particular, the vanes 4 can be connected with the hub 5 in a tool-free manner in this way. Moreover, the vanes 4 respectively comprises a connection element 10 in a region on their side facing away from the central axis 2a of the hub.

[0024]Figure 2 shows a detail of a flow rectifier in a sectional view. A vane 4 is inserted, with its guide 4a, into the corresponding counter-geometry, the guide 5e of the hub 5. The guides 4a and 5e are configured as dovetail guides. The hub 5 comprises a hub bottom 5b, an inner circumferential wall 5c, and an outer circumferential wall 5d, and

forms a cup 5a. An opening 6 is located in the bare bottom 5b, through which water, which could accumulate in the bare cup 5a, can drain. The guide 5e is located in the outer circumferential wall 5d. The guide 4a of the vane 4 comprises a slit 4b opened towards the hub bottom 5b. The flexibility of the guide 4a is increased through this slit 4b. The guide 4a comprises a latch hook 9 on its end facing the hub bottom 5b. Upon complete insertion of the guide 4a of the vane 4 into the guide 5e of the hub, the latch hook 9 snaps behind the wall of the guide 5e and thus secures the vane 4 in the hub 5. The inner circumferential wall 5c comprises a stop 14 facing to the central axis 2a.

[0025]Figure 3 shows a detail of an axial fan according to the invention with mounted flow rectifier 20 in a sectional illustration. The axial fan comprises an impeller 2 drivable by an electric motor, a diffusor 3, a flow rectifier 20, a support structure 11b and at least one circumferential ring 11a1, wherein the support structure 11b and the at least one circumferential ring 11a1 are arranged behind the impeller in flow direction and wherein the flow rectifier 20 can be fastened on the at least one circumferential ring 11a1. The axial fan can be installed into a corresponding opening in a wall via the wall ring 1. The support structure 11b then produces the connection between the wall ring 1 and the electric motor, and holds the electric motor and thusly the impeller 2 in the wall ring 1. One or multiple circumferential concentric rings 11a are fastened to the support structure 11b, whereby a contact protection, in the form of a protective grating is provided for the impeller 2 and/or electric parts of the motor.

[0026]The flow rectifier 20 can be optionally integrated, i.e. it can be attached to the axial fan, if it is useful for the respective field of application. The flow rectifier 20 can also, however, be easily removed again for a different operating point. In particular, the flow rectifier 20 can be attached and removed again, in a tool-free manner. No change is necessary to the existing components to be able to fasten the flow rectifier 20. Via the connection element 10, the flow rectifier 20 is fastenable to the support structure 11b, via the at least one circumferential ring 11a1. Here, the support structure 11b contributes to the stability of the flow rectifier 20. The flow rectifier 20 is form- and/or force-fittingly fastenable to the at least one circumferential ring 11a1 by means of the connection element 10, in that the fork-shaped fastening element 10 is pushed onto

the at least one circumferential ring 11a1. The connection element 10 here is deformed partly elastically, but also plastically.

[0027]Figure 4 shows a further detail of an axial fan according to the invention with mounted impeller 20 in a sectional representation.

[0028]The support structure 11b comprises a flange ring 11c on its side facing to the rotatory axis 2a of the impeller 2, wherein the flow rectifier 20 is operatively connected with the flange ring via a latch hook 12. Through this connection, the form strength of the impeller 20 is additionally increased.

[0029]The hub 5 is pressed onto the support structure 11b up to the stop 14 of the inner circumferential wall 5c, wherein the inner circumferential wall 5c snaps on the flange ring 11c of the support structure 11b. The axial position of the flow rectifier 20 is thereby fixed. The stop 14 is configured in a labyrinthine manner, whereby the leakage flow is reduced in the connection region. The stop 14 is interrupted only in the region of the latch hook 12 due to production-related reasons.

[0030]A gap 13 is formed in the peripheral direction between the diffusor 13 and the at least one vane 4.

[0031]The embodiments shown here only constitute examples for the present invention and therefore must not be understood as limiting. Alternative embodiments taken into consideration by a person skilled in the art are likewise included within the scope of the present invention, which is exclusively defined by the following claims.

List of Reference Characters

[0032]

1	wall ring
2	impeller
2a	rotational axis of the impeller, central axis
3	diffusor
4	vane
4a	guide
4b	slit
5	hub
5a	cup
5b	hub bottom
5c	inner circumferential wall
5d	outer circumferential wall
5e	guide
6	opening
7	rotor
8	stator
9	latch hook
10	connection element
11a	ring
11a1	circumferential ring
11b	support structure
11c	flange ring
12	latch hook
13	gap
14	stop
20	flow rectifier

Patentkrav

1. Aksialventilator, som har et hjul (2), der kan drives af en elektromotor, en diffusor (3), et efterledehjul (20), som har et nav (5) og mindst en skovl (4), hvor den mindst ene skovl (4) kan funktionsforbindes løsbart med navet (5), og navet (5) udgør en navpotte (5a) med en navbund (5b), en indre væg (5c), som er omløbende i radial retning, og en ydre væg (5d), som er omløbende i radial retning, hvor navpotten (5a) har en åbning (6) i navbunden (5b), hvor aksialventilatoren endvidere har en bærestruktur (11b) og mindst en omløbende ring (11a1), hvor bærestrukturen (11b) og den mindst ene omløbende ring (11a1) er anbragt i strømningsretning bag hjulet (2), hvor efterledehjulet (20) kan fastgøres på den mindst ene omløbende ring (11a1), og hvor bærestrukturen (11b) på sin side, der vender mod midteraksen (2a) af hjulet (2), har en flangering (11c), hvor efterledehjulet (20) kan funktionsforbindes med flangeringen (11c) på en kraft- og/eller formsluttende måde, og efterledehjulet (20) via en indgrebskrog (12) kan funktionsforbindes med flangeringen (11c), og hvor navet (5) på den indre omløbende væg (5c) har et anslag (14), der er orienteret mod midteraksen (2a), hvor navets (5) anslag (14) samvirker med bærestrukturens (11b) flangering (11c) og indgrebskrogen (12) i indbygget tilstand på en sådan måde, at den aksiale position af efterledehjulet (20) er fikseret,
kendetegnet ved, at
den mindst ene skovl (4) har et forbindelseselement (10) i et område, der vender bort fra navet (5).

2. Aksialventilator ifølge krav 1, **kendetegnet ved,**
at den mindst ene skovl (4) kan funktionsforbindes med navet (5) på en kraft- og/eller en formsluttende måde.

3. Aksialventilator ifølge krav 2,
kendetegnet ved,
at funktionsforbindelsen af den mindst ene skovl (4) på navet (5) kan sikres yderligere.

4. Aksialventilator ifølge et af de foregående krav,
kendetegnet ved,

at efterledehjulet (20) ved hjælp af forbindelseselementet (10) kan fastgøres på den mindst ene omløbende ring (11a1) på en form- og/eller kraftsluttende måde.

5. Aksialventilator ifølge et af de foregående krav, **kendetegnet ved,**
at der mellem diffusoren (13) og den mindst ene skovl (4) er formet en spalte (13) i omkredsretningen.

6. Aksialventilator ifølge et af kravene 1 til 4, **kendetegnet ved,**
at den mindst ene skovl (4) med sin frontside, der peger i omkredsretningen, berører diffusoren (13).

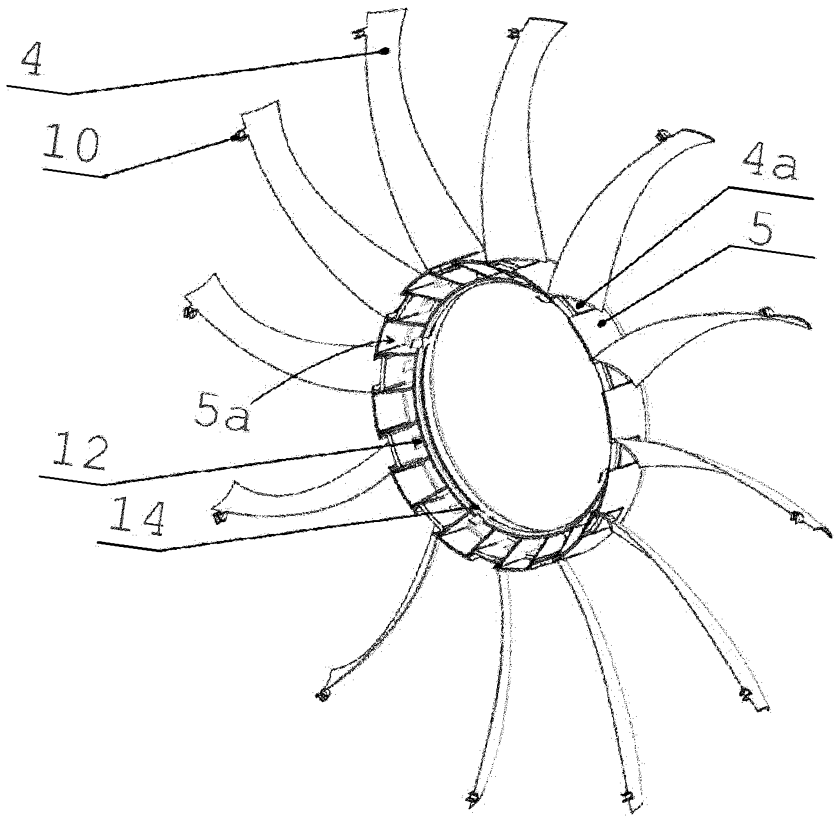

Fig. 1

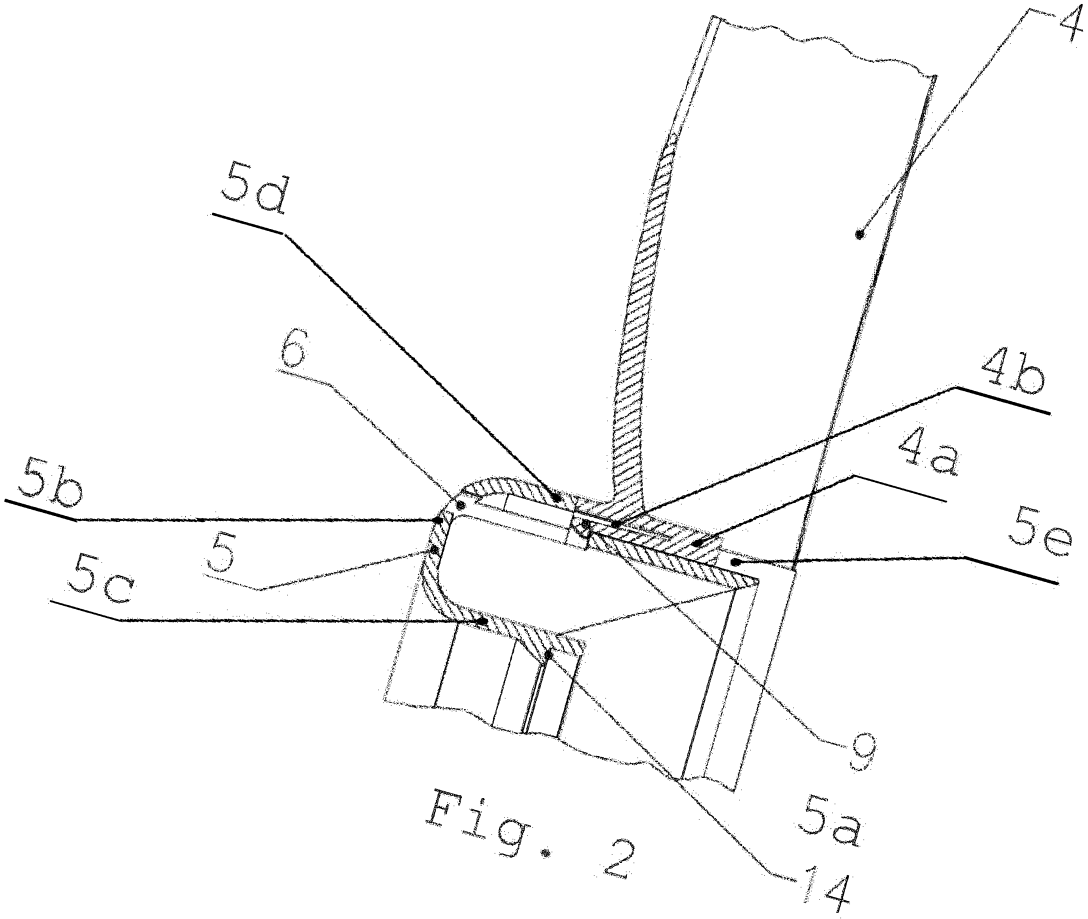

Fig. 2

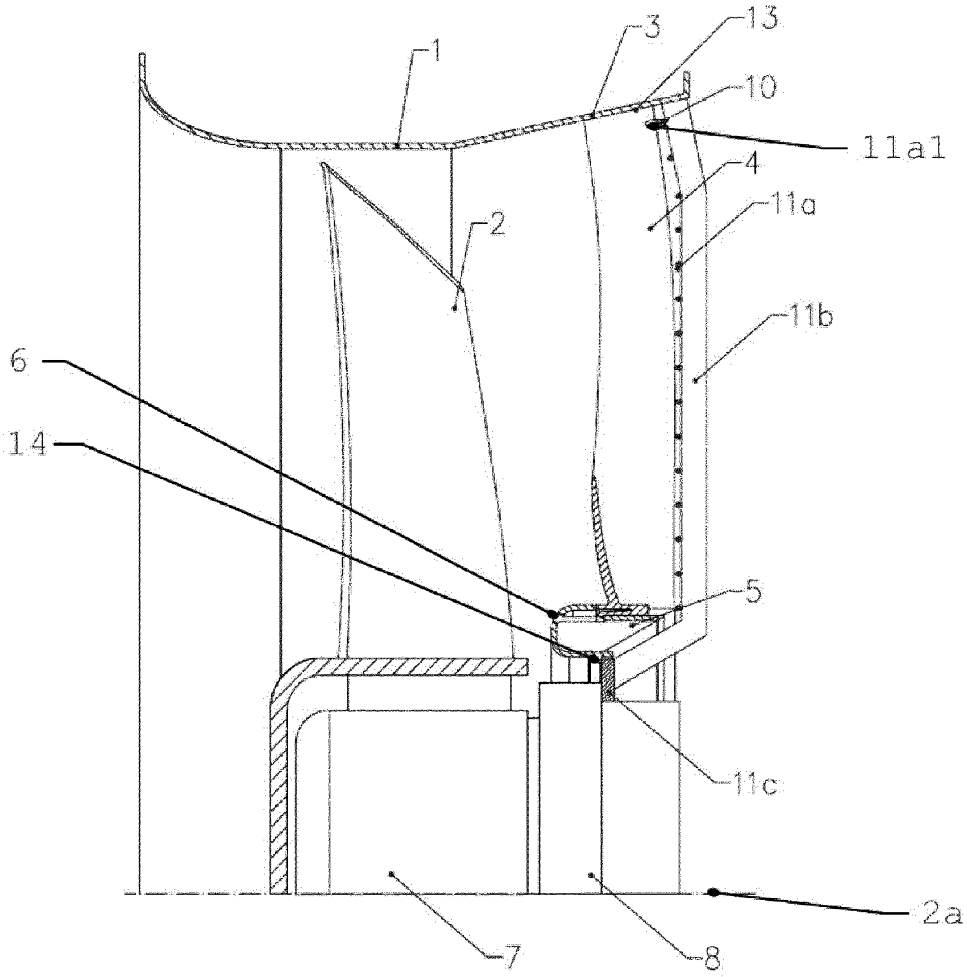

Fig. 3

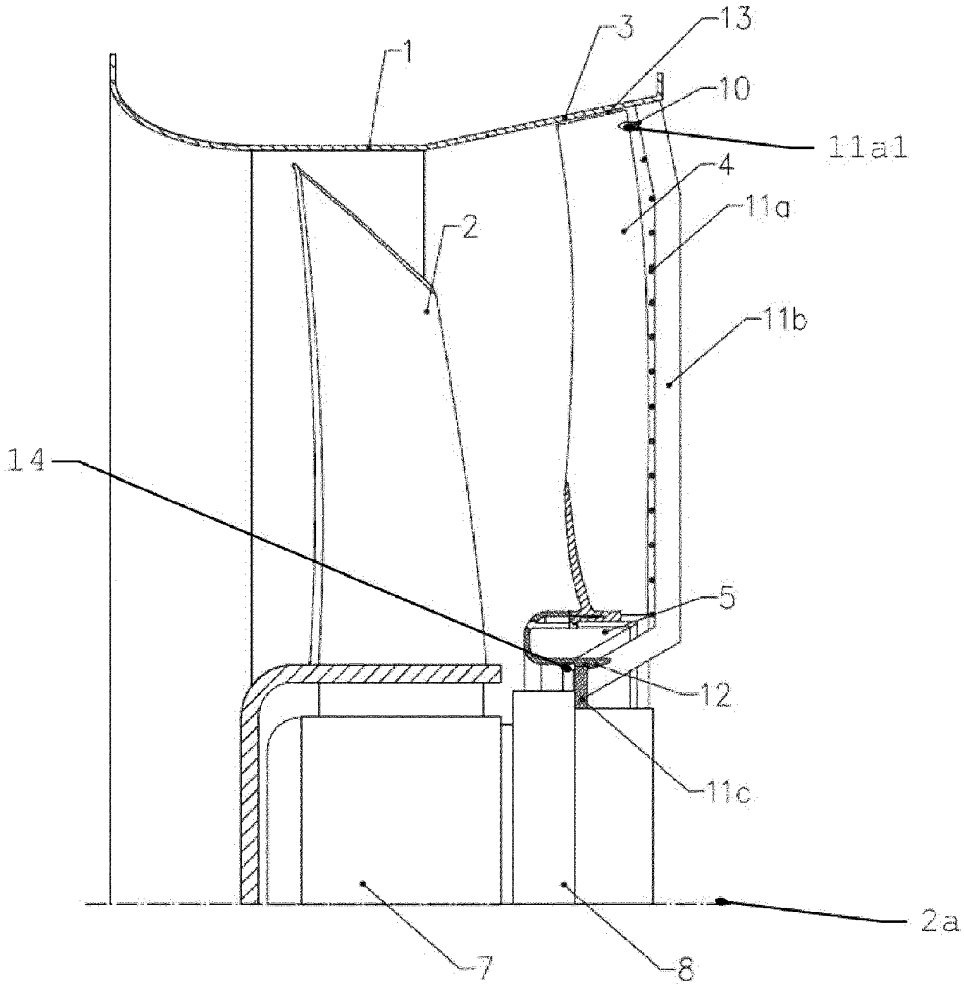

Fig. 4