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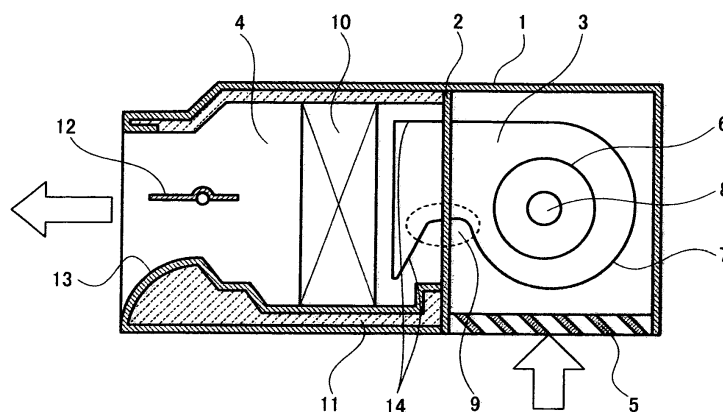
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(54) **Air conditioner**

(57) The present invention promotes a diffuser effect which is one of performance factors of a centrifugal air blower, and realizes a centrifugal air blower with high static pressure and high efficiency. An air conditioner according to the present invention has an indoor unit including an air inlet part, an air outlet part, and a partition plate 2 for dividing the indoor unit 1 into an air blower chamber 3 and a heat exchanger chamber 4. The air blower chamber includes a fan casing 7 in which a centrifugal fan 6 is located, and a motor 8 for driving the centrifugal fan 6. Herein, a tongue part 9 constituting a diffuser 14 of the fan casing 7 is formed from at least two arcs R1 and R2.

FIG. 1



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Description

TECHNICAL FILE OF THE INVENTION

5 **[0001]** The present invention relates to an indoor unit of a separate type air conditioner.

BACKGROUND OF THE INVENTION

10 **[0002]** In general, as for a conventional air conditioner of this type, for example, there has been known a configuration illustrated in Fig. 6 (see JP 01-98851 A).

[0003] More specifically, an air conditioner illustrated in Fig. 6 is of a duct type or a ceiling-hung type, which is mounted for use to an overhead location such as a ceiling or a roof space. In this air conditioner, a unit 101 has an air inlet 102 provided on its rearward bottom face, an air outlet 103 provided on its front face, and an air outlet 104 provided on its forward bottom face. A casing 105 which incorporates a fan 105A therein, a fan motor 105B which drives the fan 105A, and a heat exchanger 106 are arranged in the unit 101.

15 **[0004]** In the configuration of the conventional air conditioner, generally, the casing 105 has a spiral shape. A diffuser which constitutes an air outlet part of the casing 105 has a tongue part located in the vicinity of the fan 105A, and an opening part extending from the tongue part toward the heat exchanger 106.

20 **[0005]** The diffuser of the casing is an important constituent element for converting airflow velocity energy into air pressure energy. If a length of the diffuser is long, the energy conversion amount becomes large and resultant air-blowing performance is excellent with high static pressure. Heretofore, there has been desired to further improve the air-blowing performance of the diffuser.

DISCLOSURE OF THE INVENTION

25 **[0006]** The present invention has been made to solve the aforementioned problem. It is therefore an object of the present invention to provide an air conditioner which can further promote a diffuser effect of a casing of an air blower and can provide high air-blowing performance with high static pressure.

30 **[0007]** In order to achieve the aforementioned object, the present invention provides an air conditioner comprising an indoor unit which includes an air inlet part, an air outlet part, and a partition plate for dividing the indoor unit into an air blower chamber and a heat exchanger chamber, the air blower chamber including a fan casing which incorporates a centrifugal fan therein, and a motor which drives the centrifugal fan. Herein, a tongue part constituting a diffuser of the fan casing is formed from at least two arcs.

35 **[0008]** With the air conditioner according to the present invention, a shape of a tongue part which constitutes a diffuser makes it possible to extend a substantial length of the diffuser, to further promote a diffuser effect of a casing of an air blower, and to provide high air-blowing performance with high static pressure.

[0009] According to the first aspect of the present invention, a tongue part constituting a diffuser of a fan casing is formed from at least two arcs. Thus, it is possible to extend a substantial length of the diffuser, to further promote a diffuser effect of the fan casing of an air blower, and to realize high air-blowing performance with high static pressure.

40 **[0010]** According to the second aspect of the present invention, an angle formed by lines tangent to both ends of each of the two arcs constituting the tongue part is obtuse. Thus, it is possible to suppress separation and reverse flow of air in the vicinity of a fan.

[0011] According to the third aspect of the present invention, the two arcs constituting the tongue part are connected by a curve. Thus, it is possible to further make air flow along a tongue part and a diffuser, thereby to improve efficiency of an air blower.

45 **[0012]** According to the fourth aspect of the present invention, the diffuser of the fan casing is formed to have a tongue shape so as to gradually enlarge from an upstream side toward a downstream side. Thus, it is possible to smoothly convert airflow velocity energy of air discharged from a fan into air pressure energy, thereby to realize an air blower with high efficiency.

50 **[0013]** According to the fifth aspect of the present invention, there is provided an air blower in which a relation between a diameter D of the centrifugal fan and the arc R1 constituting the tongue part falls within a range of $0.025 \leq R1/D \leq 0.11$, and a relation between the diameter D of the centrifugal fan and the arc R2 constituting the tongue part falls within a range of $0.14 \leq R2/D \leq 0.22$. Thus, it is possible to optimize a shape for the purpose of achieving higher performance, resulting in realization of a high-performance air blower for a variety of uses.

55 **[0014]** According to the sixth aspect of the present invention, the tongue part is made of a porous material. Thus, it is possible to suppress pressure pulsation of air in the proximity of the tongue part, thereby to reduce noise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

- 5 Fig. 1 is a sectional view of an air conditioner according to a first embodiment of the present invention;
 Fig. 2 is an enlarged view of a main part of an air blower chamber of the air conditioner according to first and second
 embodiments of the present invention;
 Fig. 3 illustrates a main part of the air conditioner according to the first and second embodiments of the present
 invention;
 10 Fig. 4A is a graph showing a change in fan efficiency with respect to a ratio between a diameter D of a fan and an
 arc radius R1 of a tongue part according to the present invention;
 Fig. 4B is a graph showing a change in fan efficiency with respect to a ratio between the diameter D of the fan and
 an arc radius R2 of the tongue part according to the present invention;
 Fig. 5 is an enlarged view of a main part of the air blower chamber of the air conditioner according to a fourth
 15 embodiment of the present invention; and
 Fig. 6 is a sectional view of a conventional air conditioner.

DESCRIPTION OF PREFERRED EMBODIMENT

- 20 **[0016]** Hereinafter, description will be given of embodiments of the present invention with reference to the drawings.
 It is to be noted that the present invention is not limited to these embodiments.

(First Embodiment)

- 25 **[0017]** Fig. 1 is a sectional view of an air conditioner according to a first embodiment of the present invention. As
 illustrated in Fig. 1, an interior of an air conditioner main body 1 is divided by a partition plate 2 into an air blower chamber
 3 and a heat exchanger chamber 4.

- [0018]** The air blower chamber 3 includes a fan casing 7 which incorporates a centrifugal fan 6 therein. The centrifugal
 fan 6 is driven by a motor 8. The air blower chamber 3 has an air inlet part 5 provided on its rearward bottom face.
 30 Through the air inlet part 5, air flows into the air blower chamber 3. A tongue part 9 which constitutes a part of a diffuser
 14 of the fan casing 7 is arranged on a boundary between the air blower chamber 3 and the heat exchanger chamber
 4. A main part of the diffuser 14 is arranged in the heat exchanger chamber 4.

- [0019]** In the heat exchanger chamber 4, a heat exchanger 10 supported on a side plate is arranged so as to oppose
 an opening part of the diffuser 14. A drain pan 11 is provided beneath the heat exchanger 10.

- 35 **[0020]** The heat exchanger chamber 4 has, on its front face, an air outlet part 13 provided with a wind direction changer
 12.

- [0021]** Hereinafter, description will be given of action of the air conditioner configured as described above. When the
 motor 8 is driven, air in a room flows into the air blower chamber 3 through the air inlet part 5. The air in the air blower
 chamber 3 flows into the fan casing 7 along both air inlet sides of the fan casing 7. Herein, pressure is applied to the air
 40 by the centrifugal fan 6. Thereafter, airflow velocity energy is converted into air pressure energy by means of a spiral
 shape of the fan casing 7. Further, the air is discharged from the opening part of the diffuser 14 while the pressure
 thereof is increased by the diffuser 14. The discharged air passes through the heat exchanger 10 in which the air is
 heated. Then, the wind direction changer 12 changes a wind direction of the heated air. Finally, the air is fed into the
 room again through the air outlet part 13.

- 45 **[0022]** Fig. 2 is an enlarged view of a main part of the air conditioner according to first and second embodiments of
 the present invention. In Fig. 2, the opening part of the diffuser 14 of the fan casing 7 is not partially illustrated. Further,
 Fig. 2 illustrates a comparison between the shape of the tongue part 9 constituting a part of the diffuser 14 and a shape
 of a conventional tongue part (broken line). Fig. 3 illustrates the tongue part which is a main part of the air conditioner
 according to the embodiment of the present invention.

- 50 **[0023]** As illustrated in Figs. 2 and 3, the tongue part 9 is formed from two arcs R1 and R2, and an angle (θ_1 , θ_2)
 formed by lines tangent to both ends of each of the arcs is obtuse (see Fig. 3). This obtuse shape makes it possible to
 gradually enlarge the diffuser 14 and to extend the length of the tongue part 9 as much as possible.

- [0024]** In the present invention, as illustrated in Fig. 2, the tongue part 9 has the following shape. That is, an additional
 arc portion having a radius R2 is provided on the air outlet side at a location spaced slightly away from an arc portion
 55 having a radius R1 provided in the vicinity of the centrifugal fan 6 having a diameter D, in comparison with a shape of
 a conventional tongue part indicated by a broken line. With this configuration, when air is discharged from the fan casing
 7 in the present invention, first, the arc R1 suppresses separation and reverse flow of air toward the air inlet side, and
 the static pressure of the air is increased while the air flows along the tongue part 9 which is substantially longer than

the conventional tongue part. Next, the air flows along the diffuser 14 which is smoothly enlarged by the arc R2, so that a diffuser effect is further promoted. Thus, it is possible to realize high-efficient air-blowing performance with high static pressure.

[0025] As described above, according to the first embodiment, the tongue part 9 constituting the diffuser 14 of the fan casing 7 is formed from the at least two arcs R1 and R2. Thus, it is possible to extend a substantial length of the diffuser 14, to further promote a diffuser effect of the fan casing 7 of an air blower, and to realize high air-blowing performance with high static pressure.

[0026] In addition, according to the first embodiment, the angle formed by lines tangent to both ends of each of the two arcs R1 and R2 constituting the tongue part 9 is obtuse. Thus, it is possible to suppress separation and reverse flow of air in the vicinity of the centrifugal fan 6.

[0027] Further, according to the first embodiment, the two arcs R1 and R2 constituting the tongue part 9 are connected by a curve. Thus, it is possible to further make air flow along the tongue part 9 and the diffuser 14, thereby to improve efficiency of an air blower.

(Second Embodiment)

[0028] In a second embodiment of the present invention, as illustrated in Figs. 2 and 3, the tongue part 9 having the at least two arcs R1 and R2 gradually enlarges together with the diffuser 14 from an upstream side toward a downstream side. More specifically, an angle Θ_1 on the upstream side, which is formed by lines tangent to both ends of the arc R1 constituting the tongue part 9, is smaller than an angle Θ_2 on the downstream side, which is formed by lines tangent to both ends of the arc R2 constituting the tongue part 9.

[0029] As described above, according to the second embodiment, the tongue part 9 gradually enlarges from the upstream side toward the downstream side. Thus, it is possible to smoothly convert airflow velocity energy of air discharged from the centrifugal fan 6 into air pressure energy, thereby to realize an air blower with high efficiency.

(Third Embodiment)

[0030] Fig. 4A is a graph which shows a change in centrifugal fan efficiency with respect to a ratio between the diameter D of the centrifugal fan 6 and the arc radius R1 of the tongue part 9 according to the present invention, and Fig. 4B is a graph which shows a change in centrifugal fan efficiency with respect to a ratio between the diameter D of the centrifugal fan 6 and the arc radius R2 of the tongue part 9. From results of these graphs, a range of $R1/D$ is optimally set to $0.025 \leq R1/D \leq 0.11$ and a range of $R2/D$ is optimally set to $0.14 \leq R2/D \leq 0.22$, so that it is possible to design an air blower capable of maintaining high efficiency.

[0031] It is assumed herein that air discharged from the centrifugal fan 6 having the diameter D flows toward the R1 portion. In case of $R1/D < 0.025$, the arc of the R1 portion is small; therefore, separation occurs due to collision of airflow and a clearance between the centrifugal fan 6 and a middle point of the arc R1 becomes narrow, so that interference noise is easily generated. On the other hand, in case of $R1/D > 0.11$, the clearance between the centrifugal fan 6 and the middle point of the arc R1 becomes wide and leakage easily occurs, so that there is a possibility of reverse flow of air toward the air inlet side.

[0032] In addition, the diffuser is further enlarged by the R2 portion. Therefore, in case of $R2/D < 0.14$, the diffuser is suddenly enlarged at the R2 portion, so that there is a possibility of separation of airflow. In case of $R2/D > 0.22$, the length of the diffuser becomes short, so that there is a possibility of reduction of efficiency.

[0033] According to the third embodiment, there is provided an air blower in which a relation between the diameter D of the centrifugal fan 6 and the arc R1 constituting the tongue part 9 falls within a range of $0.025 \leq R1/D \leq 0.11$, and a relation between the diameter D of the centrifugal fan 6 and the arc R2 constituting the tongue part 9 falls within a range of $0.14 \leq R2/D \leq 0.22$. Thus, it is possible to optimize a shape for the purpose of achieving higher performance, resulting in realization of a high-performance air blower for a variety of uses.

(Fourth Embodiment)

[0034] Fig. 5 is an enlarged view of a main part of the air blower chamber 3 according to a fourth embodiment of the present invention. Herein, a tip end of the tongue part 9 is made of a porous material 15. This tongue part 9 is made of the porous material 15 while maintaining the arcs R1 and R2 of the tongue part 9 according to the first embodiment.

[0035] According to the fourth embodiment, the use of the porous material 15 makes it possible to suppress pressure pulsation of air in the proximity of the tongue part 9, thereby to reduce noise.

Industrial Applicability

[0036] According to the air conditioner of the present invention, since a tongue part which constitutes a diffuser of a fan casing is formed from at least two arcs, it is possible to extend a substantial length of the diffuser, to further promote a diffuser effect of the fan casing of an air blower, and to realize high air-blowing performance with high static pressure. Therefore, the present invention is applicable to not only equipment related to air conditioning, but also various equipment using a centrifugal fan.

Claims

1. An air conditioner comprising:

an indoor unit including an air inlet part (5) and an air outlet part (13);
a partition plate (2) for dividing the indoor unit into an air blower chamber (3) and a heat exchanger chamber (4), the airblowerchamber (3) including a fan casing (7), andacentrifugal fan (6) provided in the fan casing (7); and
a motor (8) for driving the centrifugal fan (6), wherein
a tongue part (9) constituting a diffuser (14) of the fan casing (7) is formed from at least two arcs.

2. The air conditioner according to claim 1, wherein an angle formed by lines tangent to both ends of each of the two arcs forming the tongue part (9) is obtuse.

3. The air conditioner according to claim 1, wherein the two arcs forming the tongue part (9) are connected by a curve.

4. The air conditioner according to claim 1, wherein the diffuser (14) or the tongue part (9) of the fan casing (7) gradually enlarges from an upstream side toward a downstream side.

5. The air conditioner according to claim 1, wherein a relation between a diameter (D) of the centrifugal fan (6) and one of the arcs, R1, forming the tongue part (9) falls within a range of $0.025 \leq R1/D \leq 0.11$, and a relation between the diameter (D) of the centrifugal fan (6) and the other of the arcs, R2, forming the tongue part (9) falls within a range of $0.14 \leq R2/D \leq 0.22$.

6. The air conditioner according to claim 1, wherein the tongue part (9) is made of a porous material.

FIG. 1

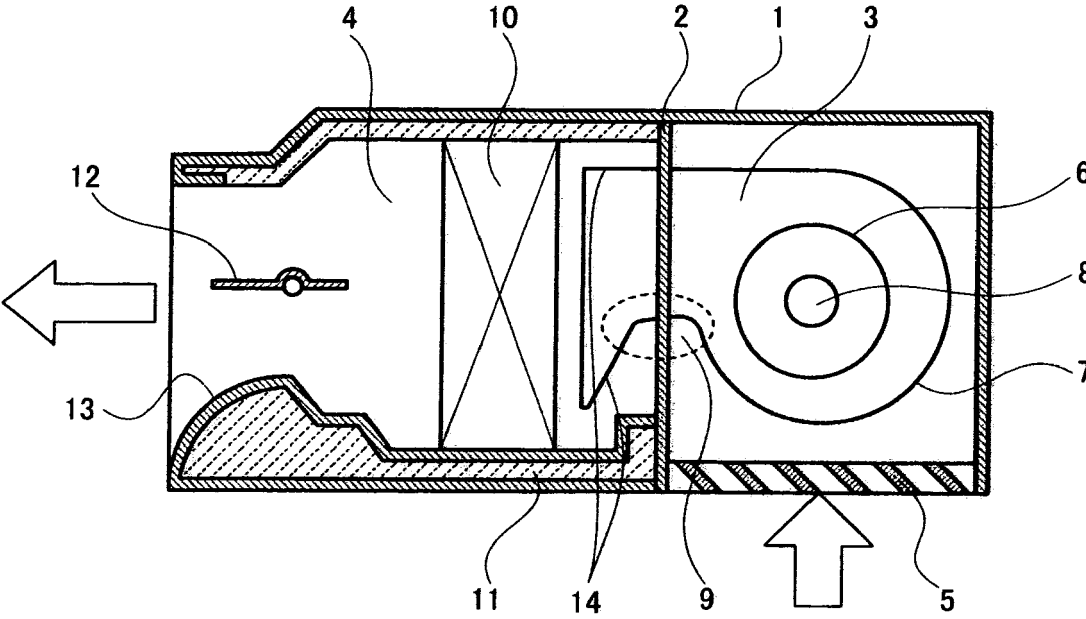


FIG. 2

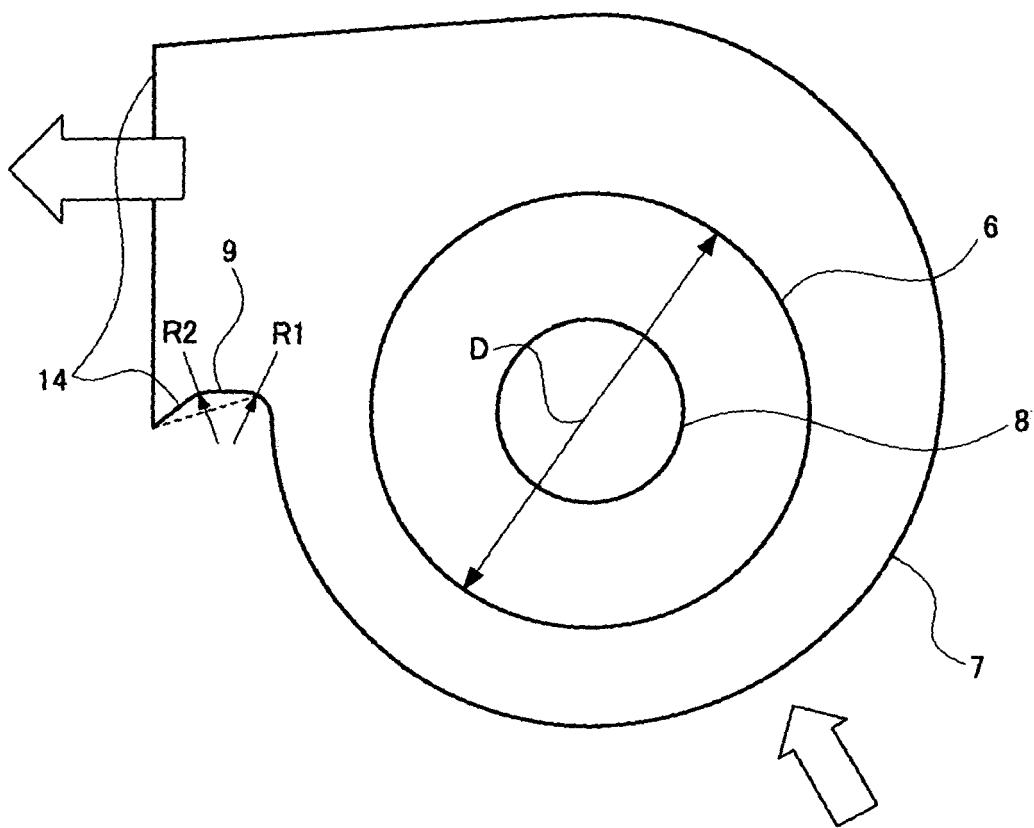


FIG. 3

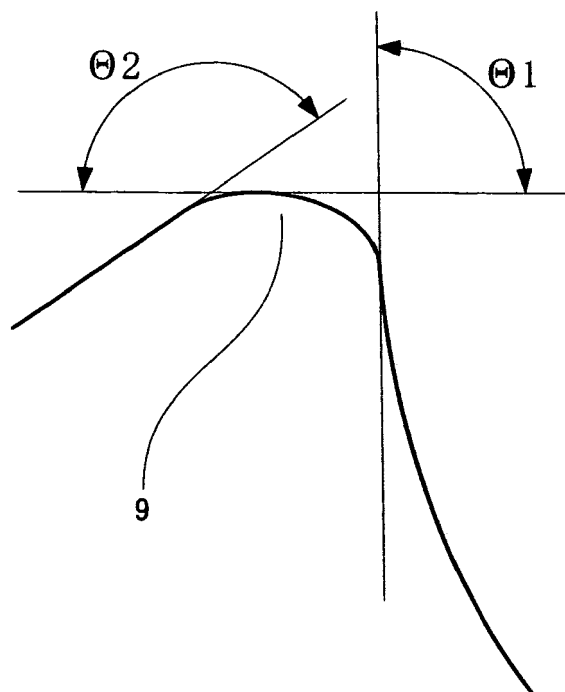


FIG. 4A

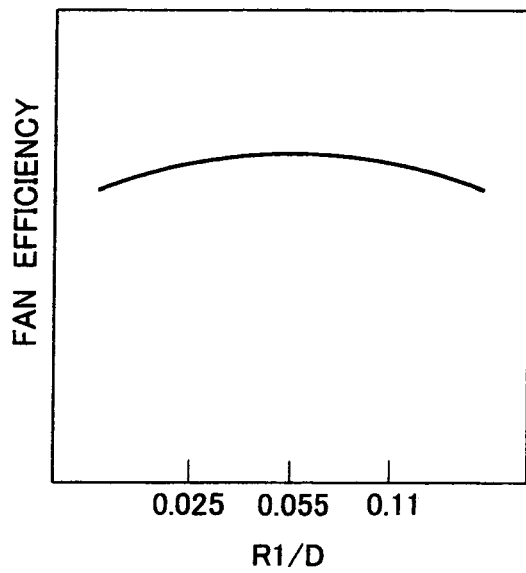


FIG. 4B

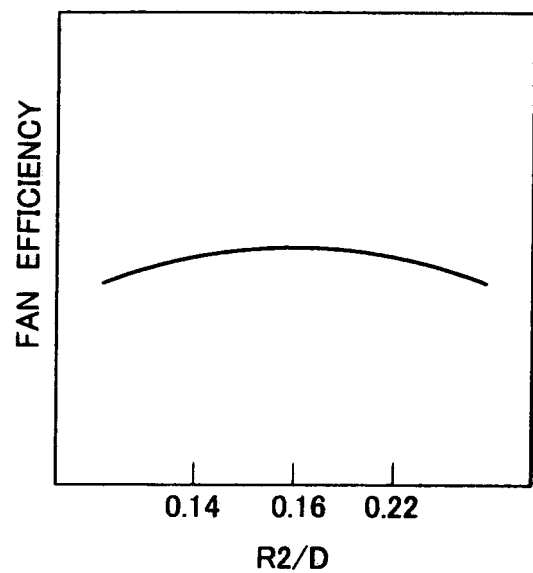


FIG. 5

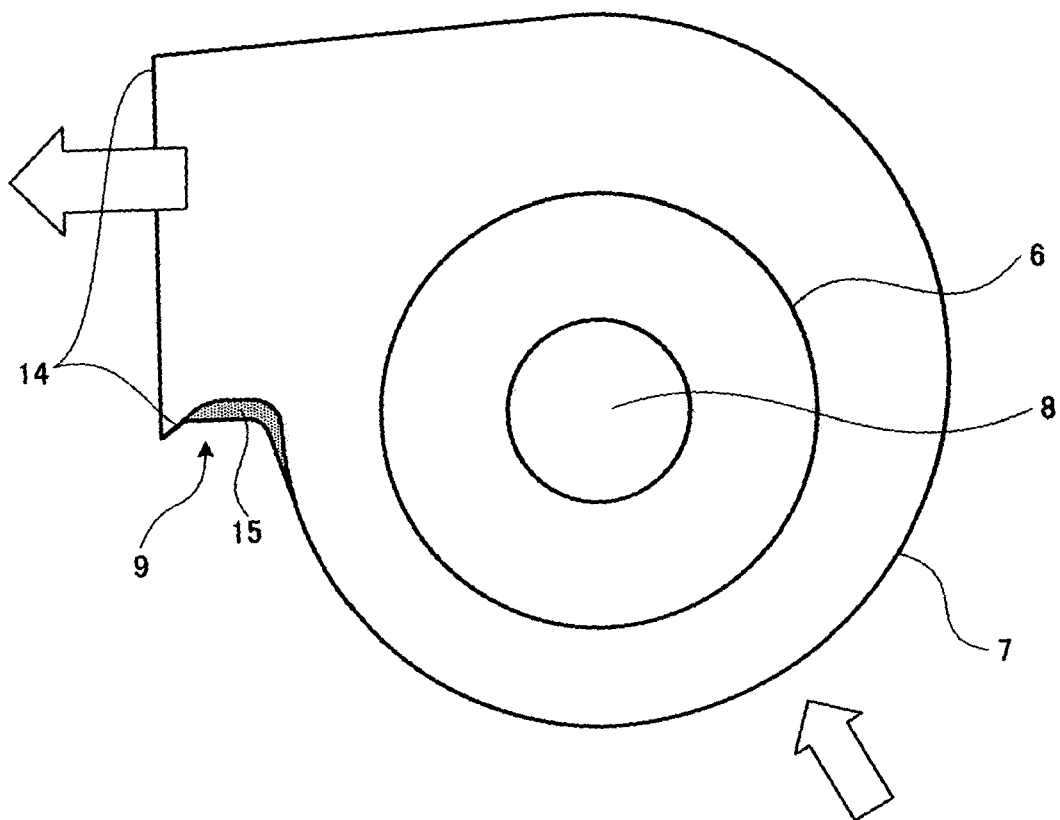


FIG. 6

