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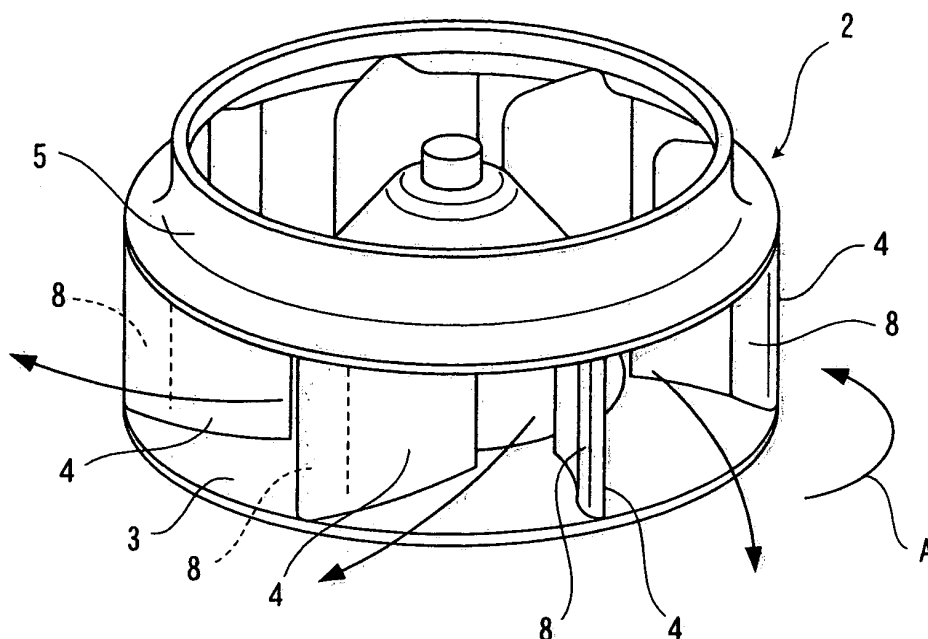
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(54) **Blower**

(57) It is an object of the present invention to provide a blower having a plurality of blades (4) radially disposed between a hub (3) and a shroud (5), in which a separation region of air from a negative pressure surface of the blade (4) can further be reduced. An outer periphery of

the negative pressure surface of the blade (4) is formed with a substantially half-wing shaped projection (8). Air-flow which is once separated again adheres to the projection (8) and flows along the blade (4), turbulence on the discharge side is reduced, noise is reduced, and volume of air is increased.

F I G. 1



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Description

TECHNICAL BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a centrifugal turbo type blower.

Description of the Related Art

[0002] Centrifugal turbo type blowers are used for ceiling type or cassette type air conditioners and various ventilators.

[0003] A conventional blower is shown in FIGS. 20 to 23 (Japanese Patent Application Laid-open No. 2001-263294).

[0004] As shown in FIG. 20, in a general blower of this kind, a rotation body 2 is rotated by a motor 1, and the rotation body 2 includes a hub 3, a plurality of blades 4 which are radially mounted on an outer periphery of the hub 3, and a shroud 5 disposed on an opposite side from the hub 3 for connecting the blades 4 to one another.

[0005] According to this structure, when the rotation body 2 is rotates in a direction of the arrow A, separation of airflow is generated around a negative pressure surface of the blade 4 in the vicinity of the connection portion between the blade 4 and the shroud 5 as shown with hatchings B in FIG. 21 and thus, noise is high.

[0006] Thereupon, as shown in FIGS. 22 and 23, the shroud 5 is formed into such a shape that a portion between the adjacent blades 4 becomes an inclined surface 6 in a stepwise manner, the separation region of air from the negative pressure surface of the blade 4 is reduced, thereby reducing the noise.

[0007] If the rotating body is formed as shown in FIGS. 22 and 23, the noise can be reduced, but since the shroud 5 is formed in the stepwise manner to form the inclined surface 6, air turbulence 7 is generated at that portion.

SUMMARY OF THE INVENTION

[0008] The present invention has been achieved to solve the conventional problem, and has object to provide a blower capable of further reducing a separation region of air from a negative pressure surface of a blade.

[0009] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof to extend from the shroud side to the hub side.

[0010] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof

to extend from the shroud side to the hub side, the projection having a height being reduced from the shroud side toward the hub side.

[0011] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof to extend from the shroud side to the hub side, the projection having a height being the same from the shroud side to the hub side and a width being reduced from the shroud side toward the hub side, the width being in a direction from an inner peripheral side to an outer peripheral side of the hub.

[0012] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof to extend from the shroud side to a midpoint toward the hub side.

[0013] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof to extend from the shroud side to a midpoint toward the hub side, the projection having a height being reduced from the shroud side toward the hub side.

[0014] The present invention provides a blower in which a plurality of blades are radially disposed between a hub and a shroud, wherein each blade has a substantially half-wing shaped projection formed on a negative pressure surface of an outer periphery portion thereof to extend from the shroud side to a midpoint toward the hub side, and the projection has a height being reduced from the shroud side toward the hub side and a width being reduced from the shroud side toward the hub side, the width being in a direction from an inner peripheral side to an outer peripheral side of the hub.

[0015] According to the present invention, a plurality of blades are radially disposed between a hub and a shroud, and each blade has a substantially half-wing shaped projection formed on a negative pressure surface of its outer periphery portion. Airflow which is once separated again adheres to the projection and flows along the blade, turbulence on the discharge side is reduced, noise is reduced, and volume of air is increased.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a perspective view of a blower according to a first embodiment of the present;

FIG. 2 is a sectional view of the blade of the embodiment;

FIG. 3 is an enlarged view of an essential part of

FIG. 1;
 FIGS. 4A, 4B, 4C and 4D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 5 is a perspective view of a blower according to a second embodiment of the present invention;
 FIG. 6 is an enlarged view of an essential part of FIG. 5;
 FIGS. 7A, 7B, 7C and 7D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 8 is a perspective view of a blower according to a third embodiment of the present invention;
 FIG. 9 is an enlarged view of an essential part of FIG. 8;
 FIGS. 10A, 10B, 10C and 10D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 11 is a perspective view of a blower according to a fourth embodiment of the present invention;
 FIG. 12 is an enlarged view of an essential part of FIG. 11;
 FIGS. 13A, 13B, 13C and 13D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 14 is a perspective view of a blower according to a fifth embodiment of the present invention;
 FIG. 15 is an enlarged view of an essential part of FIG. 14;
 FIGS. 16A, 16B, 16C and 16D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 17 is a perspective view of a blower according to a sixth embodiment of the present invention;
 FIG. 18 is an enlarged view of an essential part of FIG. 17;
 FIGS. 19A, 19B, 19C and 19D are a front view, a sectional view of an upper portion, a sectional view of a central portion and a sectional view of a lower portion, respectively of the blower of the embodiment;
 FIG. 20 is a sectional view of a conventional blower;
 FIG. 21 is a front view of the conventional blower;
 FIG. 22 is a perspective view of another conventional example;
 FIG. 23 is a front view of FIG. 22; and
 FIGS. 24A, 24B and 24C are a front view, a sectional view of an upper portion and a sectional view of a central portion, respectively of a blower according to a seven embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Embodiments of the present invention will be explained based on FIGS. 1 to 19, and 24.

(First Embodiment)

[0018] FIGS. 1 to 4 show a blower according to the first embodiment of the present invention.

[0019] As shown in FIG. 1, a rotation body 2 is rotated by a motor 1, and the rotation body 2 includes a hub 3, a plurality of blades 4 which are radially mounted on an outer periphery of the hub 3, and a shroud 5 disposed on an opposite side from the hub 3 for connecting the blades 4 to one another.

[0020] The arrow A shows a rotation direction. Substantially one-wing shaped projections 8 are formed on an outer periphery of negative pressure surfaces of the blades 4. FIG. 2 is a sectional view of the blade 4. A phantom line 9 shows a shape of the conventional blade formed with no projection 8. A maximum height portion of the projection 8 is disposed at outer side of a substantially central portion 10 of the projection 8.

[0021] FIGS. 3 and 4 show detailed shapes of the blade 4 and the projection 8 formed on the blade 4. The projection 8 of each blade 4 is formed such that a width of the projection 8 from an inner peripheral side to an outer peripheral side of the hub 3 are the same ($W1=W2=W3$) over the entire height of the blade 4, and a height of the projection 8 is the same ($H1=H2=H3$). FIG. 4A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 4B, 4C and 4D are sectional views of an upper portion, a central portion and a lower portion of the blade 4.

[0022] According to this structure, since the projections 8 are formed on the blades 4 on the side of the negative pressure surface, airflow which is once separated adheres again and flows along the blade 4. Therefore, even if the shroud 5 is not formed in the stepwise manner as in the conventional technique, the separation region of air from the negative pressure surface of the blade 4 can extremely be reduced, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased.

(Second Embodiment)

[0023] FIGS. 5 to 7 show a blower according to the second embodiment of the present invention.

[0024] FIG. 5 is a perspective view of the blower, and a portion of the shape of the projection 8 is different from that of the first embodiment. Other portions are the same. FIG. 6 is an enlarged view of an essential portion of the blower.

[0025] FIG. 7A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 7B, 7C and 7D are sectional views of an upper portion, a central por-

tion and a lower portion of the blade 4, respectively.

[0026] The projection 8 of the blade 4 of the second embodiment is formed such that a width of the projection 8 from an inner peripheral side to an outer peripheral side of the hub 3 are the same ($W1=W2=W3$) over the entire height of the blade 4, but a height of the projection 8 is gradually reduced toward the hub 3 ($H1>H2>H3$).

[0027] With this structure, airflow which is once separated again adheres to the substantially one-wing shaped projection 8 in which its maximum height is located at the outer side of the substantially central portion over the entire height of the blade on the side of the negative pressure surface of the blade 4, and the airflow flows along the projection 8. Therefore, the separation region of air from the negative pressure surface of the blade 4 is reduced, and the height of the projection 8 on the side of the hub 3 is lowered and thus, reduction in the volume of air can be suppressed. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. With this, noise can be reduced.

(Third Embodiment)

[0028] FIGS. 8 to 10 shows a blower according to the third embodiment of the present invention.

[0029] FIG. 8 is a perspective view of the blower, and a portion of the shape of the projection 8 is different from that of the first embodiment. Other portions are the same. FIG. 9 is an enlarged view of an essential portion of the blower.

[0030] FIG. 10A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 10B, 10C and 10D are sectional views of an upper portion, a central portion and a lower portion of the blade 4, respectively.

[0031] The projection 8 of the blade 4 of the third embodiment is formed such that the maximum height over the entire height of the blade is the same ($H1=H2=H3$), but the width of the projection 8 from the inner peripheral side toward the outer peripheral side is reduced toward the hub 3 ($W1>W2>W3$).

[0032] With this structure, airflow which is once separated again adheres to the substantially one-wing shaped projection 8 in which its maximum height is located at the outer side of the substantially central portion over the entire height of the blade on the side of the negative pressure surface of the blade 4, and the airflow flows along the projection 8. Therefore, the separation region of air from the negative pressure surface of the blade 4 can extremely be reduced. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. Since the width of the projection 8 on the side of the hub 3 is reduced, the reduction of volume of air can be suppressed. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. With this, noise can be reduced.

(Fourth Embodiment)

[0033] FIGS. 11 to 13 show a blower according to the fourth embodiment of the present invention.

[0034] FIG. 11 is a perspective view of the blower, and a portion of the shape of the projection 8 is different from that of the first embodiment. Other portions are the same. FIG. 12 is an enlarged view of an essential portion of the blower.

[0035] FIG. 13A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 13B, 13C and 13D are sectional views of an upper portion, a central portion and a lower portion of the blade 4, respectively.

[0036] The projection 8 of the blade 4 of the fourth embodiment is formed such that the projection 8 is not formed over the entire height of the blade but is formed to a midpoint from the side of the shroud 5, and the width of the projection 8 from the inner peripheral side to the outer peripheral side of the hub 3 is the same ($W1=W2$), and the maximum height of the projection 8 is the same ($H1=H2$).

[0037] With this structure, airflow which is once separated from the projection 8 on the side of the negative pressure surface again adheres and flows along the projection 8. Thus, the separation region of air from the negative pressure surface of the blade 4 can be reduced. Further, the length of the projection 8 on the side of the shroud 5 is set to an appropriate position. With this, the reduction in the volume of air can be suppressed. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. With this, noise can be reduced.

(Fifth Embodiment)

[0038] FIGS. 14 to 16 show a blower according to the fifth embodiment of the present invention.

[0039] FIG. 14 is a perspective view of the blower, and a portion of the shape of the projection 8 is different from that of the first embodiment. Other portions are the same. FIG. 15 is an enlarged view of an essential portion of the blower.

[0040] FIG. 16A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 16B, 16C and 16D are sectional views of an upper portion, a central portion and a lower portion of the blade 4, respectively.

[0041] The projection 8 of the blade 4 of the fifth embodiment is formed such that the projection 8 is not formed over the entire height of the blade but is formed to a midpoint from the side of the shroud 5, and the width of the projection 8 from the inner peripheral side to the outer peripheral side of the hub 3 is the same ($W1=W2$), and the maximum height of the projection 8 is reduced toward the hub 3 ($H1>H2$).

[0042] With this structure, airflow which is once separated on the side of the negative pressure surface

again adheres to the projection 8 and flows along the projection 8. Thus, the separation region of air from the negative pressure surface of the blade 4 can be reduced. Further, the length of the projection 8 on the side of the shroud 5 is set to an appropriate position, and the height of the projection 8 on the side of the hub 3 is reduced. With this, the reduction in the volume of air can be suppressed. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. With this, noise can be reduced. Thus, the effect of the first to fourth embodiments is enhanced, whereby noise can be reduced and the volume of air is increased.

(Sixth Embodiment)

[0043] FIGS. 17 to 19 show a blower according to the sixth embodiment of the present invention.

[0044] FIG. 17 is a perspective view of the blower, and a portion of the shape of the projection 8 is different from that of the first embodiment. Other portions are the same. FIG. 18 is an enlarged view of an essential portion of the blower.

[0045] FIG. 19A is a front view of the blade 4 on the side of the negative pressure surface. FIGS. 19B, 19C and 19D are sectional views of an upper portion, a central portion and a lower portion of the blade 4, respectively.

[0046] The projection 8 of the blade 4 of the sixth embodiment is formed such that the projection 8 is not formed over the entire height of the blade but is formed to a midpoint from the side of the shroud 5, and the width of the projection 8 from the inner peripheral side to the outer peripheral side of the hub 3 is reduced toward the hub 3 ($W1 > W2$), and the maximum height of the projection 8 is the same ($H1 = H2$).

[0047] With this structure, airflow which is once separated on the side of the negative pressure surface again adheres to the projection 8 and flows along the projection 8. Thus, the separation region of air from the negative pressure surface of the blade 4 can be reduced. Further, the length of the projection 8 on the side of the shroud 5 is set to an appropriate position, and the width of the projection 8 on the side of the hub 3 is reduced. With this, the reduction in the volume of air can be suppressed. That is, turbulence is not generated almost at all on the discharging side of the blower, and the volume of air is increased. With this, noise can be reduced. Thus, the effect of the first to fourth embodiments is enhanced, whereby noise can be reduced and the volume of air is increased.

(Seventh Embodiment)

[0048] FIGS. 24 show another concrete example according to the fourth embodiment shown in FIGS. 11 to 13.

[0049] As in the side of the negative pressure surface

of the blade 4 shown in FIG. 24A, a cross sectional shape of the blade taken along the line K1-K1 passing through the projection 8 which is formed from the shroud 5 to a midpoint is formed such that the wing thickness is gently increased from a front edge F1 of the blade 4 along a rear edge E1 as shown in FIG. 24B, the blade wing thickness becomes maximum at a point P1 and then, is reduced on the opposite side gently to a point P2. At the point P2, the wing thickness on the side of the negative pressure surface is increased, and the wing thickness becomes maximum at the rear edge E1 from the point P2 in a point P3. The cross sectional shape of the blade taken along the line K2-K2 passing through the projection 8 which is formed from the shroud 5 to the midpoint is formed as shown in FIG. 24C.

[0050] The blade 4 of the seventh embodiment is formed such that the wing thickness becomes constricted at the point 2 which is a boundary with respect to the projection 8 to the midpoint to the rear edge E1 from the front edge F1.

[0051] That is, the projection 8 extends from the point P2 to the rear edge E1, and the position of the maximum wing thickness point (point P3) is located (outside of the blower) closer to the rear edge E1 than the substantially central portion of the projection 8.

[0052] With this shape, even if air which flows along the surface of the blade 4 separates, the air reliably adheres to the surface of the blade 4 and thus, swirl is prevented from being generated and noise can be reduced.

[0053] Although the seventh embodiment is a different example from the fourth embodiment, the shape of the projection 8 of the blade 4 shown FIG. 4 in the first embodiment, the shape of the projection 8 of the blade 4 shown in FIG. 7 in the second embodiment, and the shape of the projection 8 of the blade 4 shown in FIG. 10 in the third embodiment can also be employed.

INDUSTRIAL APPLICABILITY

[0054] The present invention can be applied to blowers of ceiling type or cassette type air conditioners and various ventilators.

Claims

1. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub and the shroud (5), **characterized in that** each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) extending from the shroud side toward the hub side.
2. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub (3) and the shroud (5), **characterized in that**

each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) extending from the shroud side toward the hub side and being reduced in height from the shroud side toward the hub side. 5

3. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub (3) and the shroud (5), **characterized in that** 10

each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) being the same in height from the shroud side toward the hub side and being reduced in width from the shroud side toward the hub side, the width being in a direction from an inner peripheral side to an outer peripheral side of the hub. 15

4. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub (3) and the shroud (5), **characterized in that** 20

each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) extending from the shroud side to a midpoint toward the hub side. 25

5. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub (3) and the shroud (5), **characterized in that** 30

each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) extending from the shroud side to a midpoint toward the hub side and being reduced in height from the shroud side toward the hub side. 35

6. A blower comprising a hub (3), a shroud (5), and a plurality of blades (4) radially disposed between the hub (3) and the shroud (5), **characterized in that** 40

each blade (4) has a substantially half-wing shaped projection (8) formed on a negative pressure surface of an outer periphery portion thereof, the projection (8) extending from the shroud side to a midpoint toward the hub side, the projection (8) being reduced in height from the shroud side toward the hub side and being reduced in width from the shroud side toward the hub side, the width being in a direction from an inner peripheral side toward an outer peripheral side of the hub. 45 50

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FIG. 1

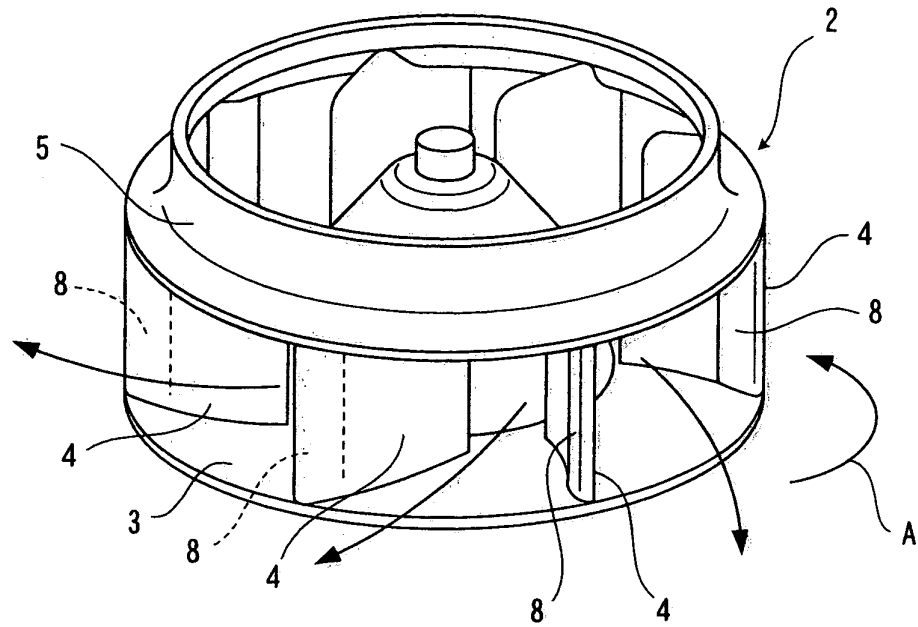


FIG. 2

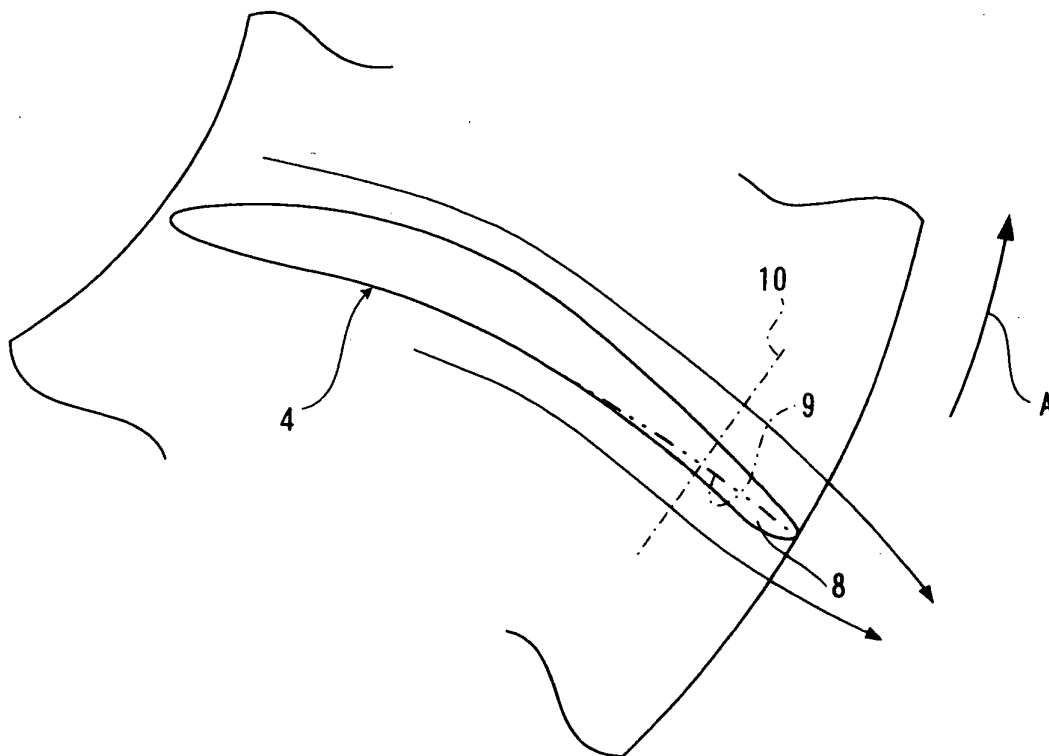


FIG. 3

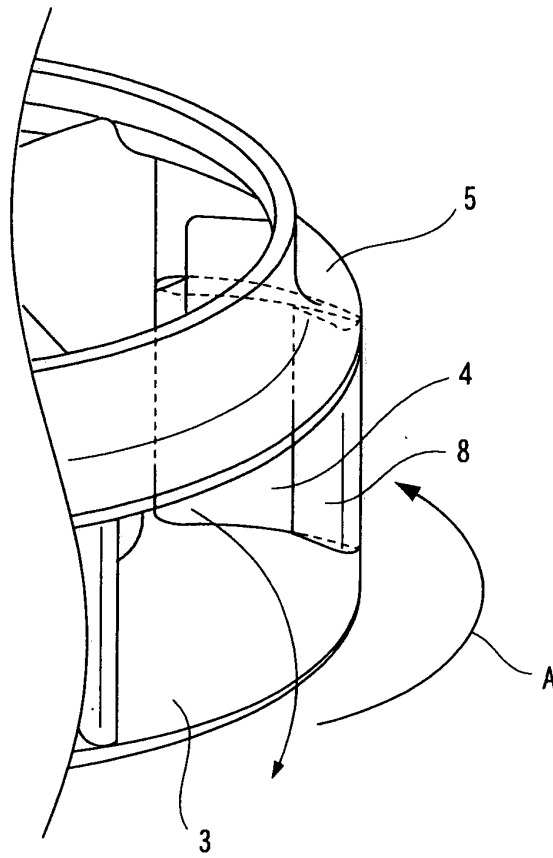


FIG. 4 A

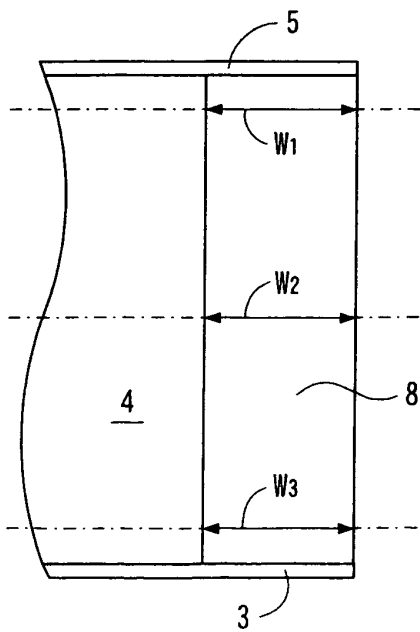


FIG. 4 B

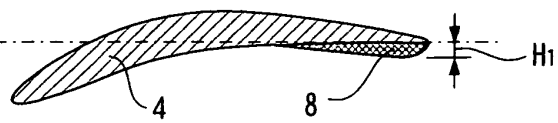


FIG. 4 C

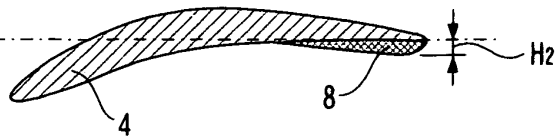


FIG. 4 D

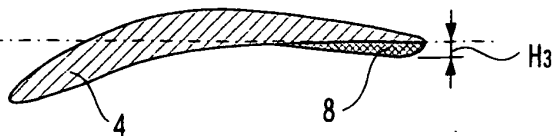


FIG. 5

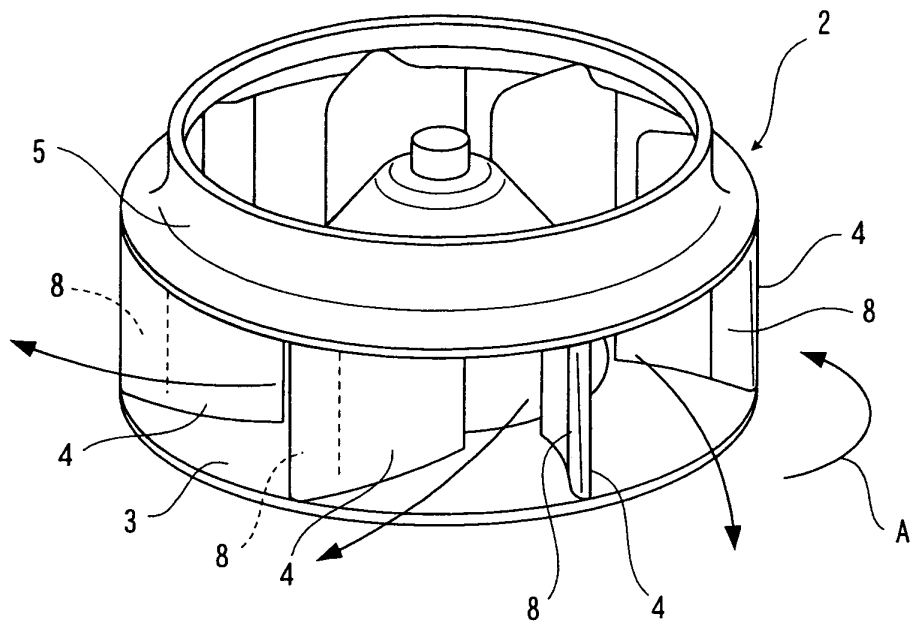


FIG. 6

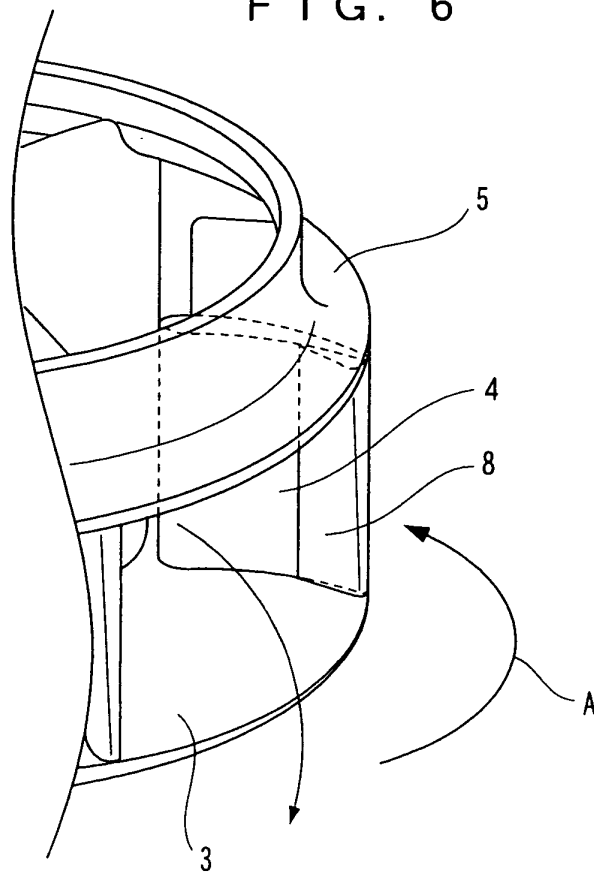


FIG. 7A

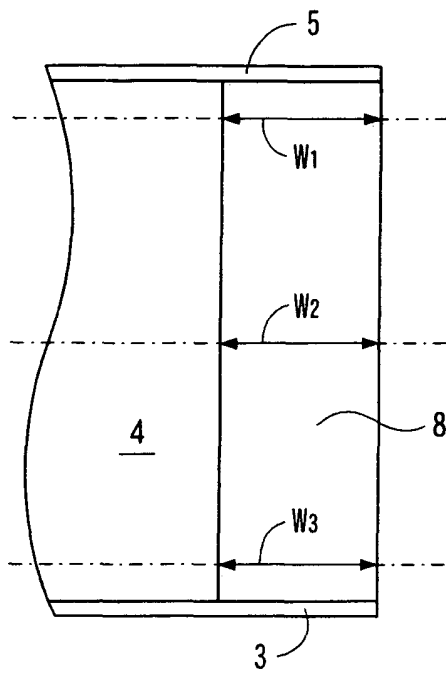


FIG. 7B

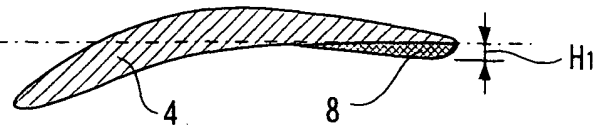


FIG. 7C

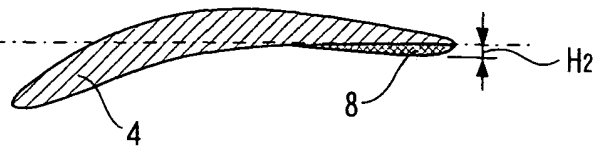


FIG. 7D

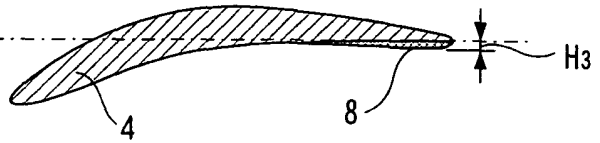


FIG. 8

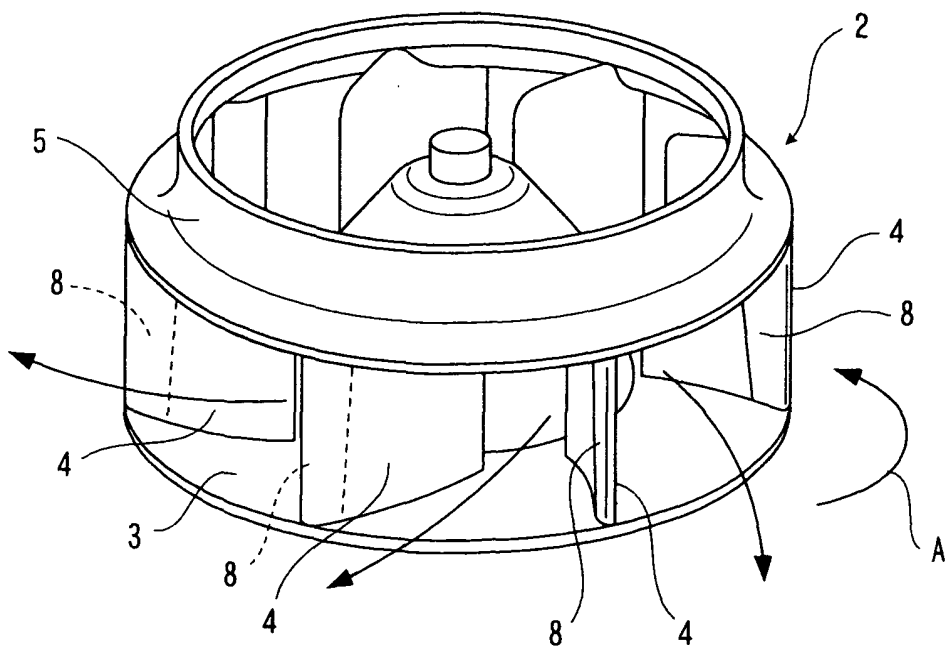


FIG. 9

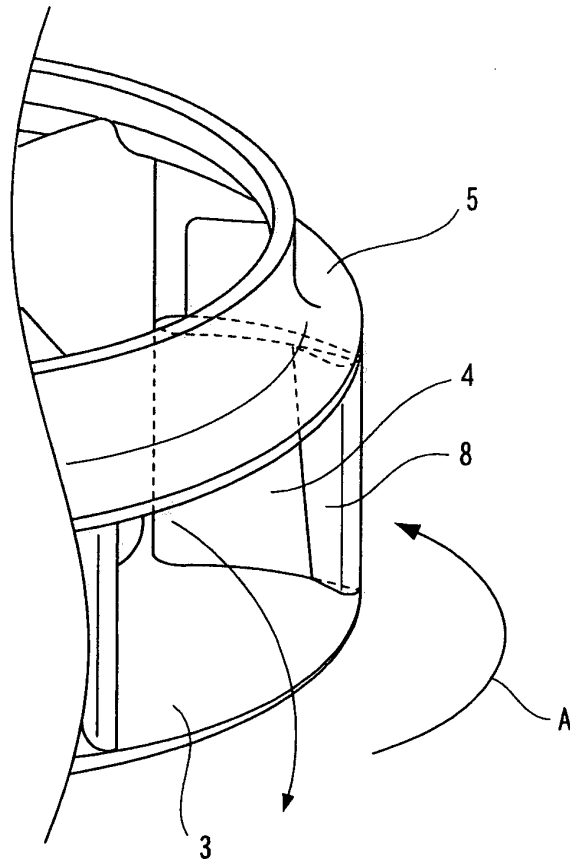


FIG. 10 A

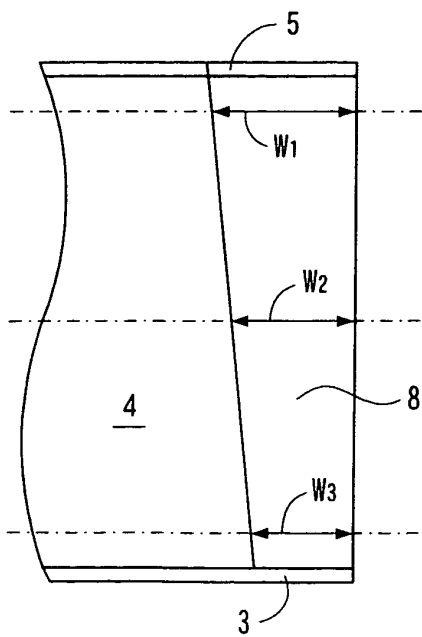


FIG. 10 B

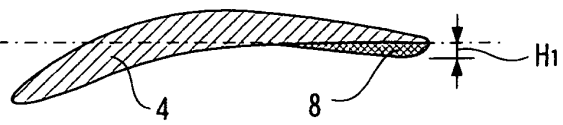


FIG. 10 C

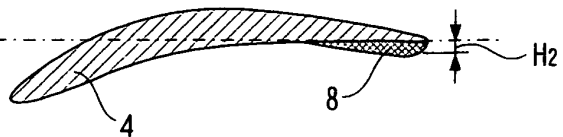


FIG. 10 D

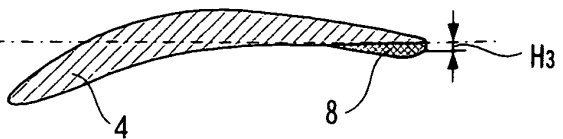


FIG. 11

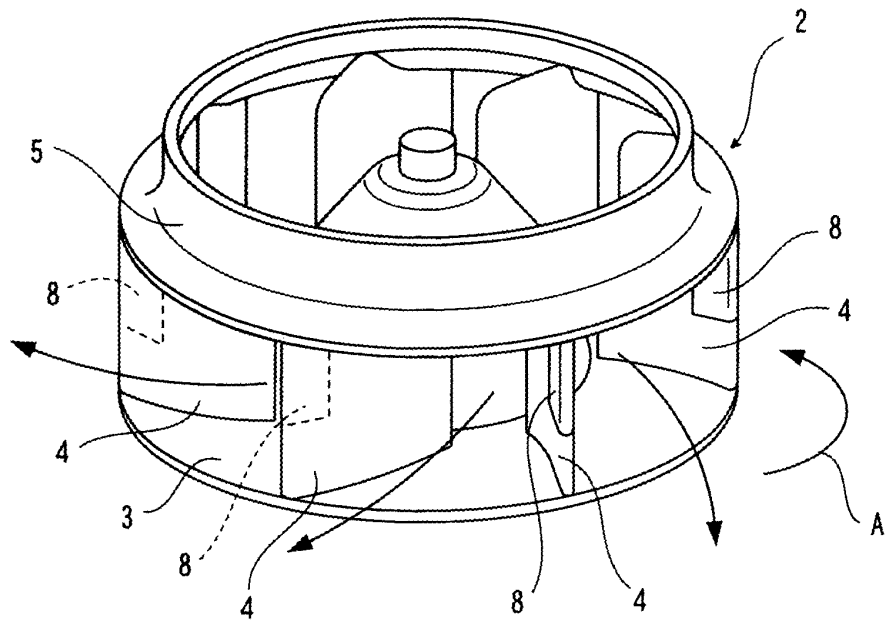


FIG. 12

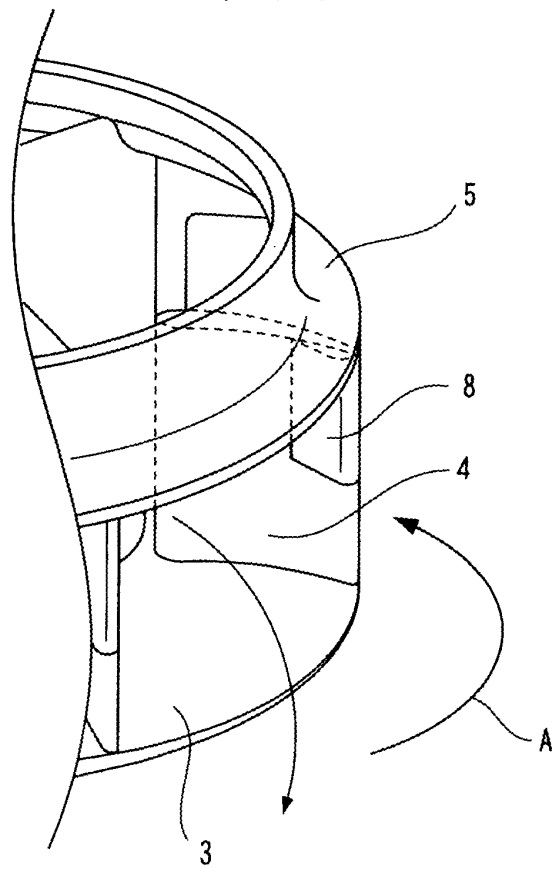


FIG. 13 A

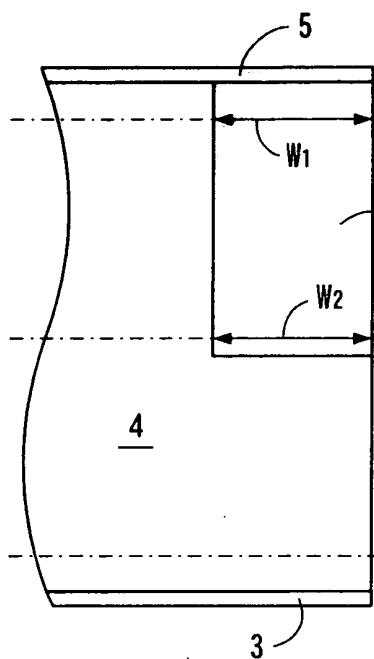


FIG. 13 B

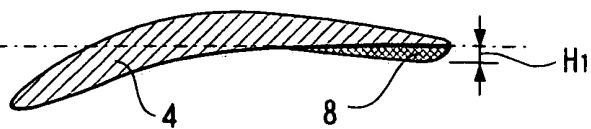


FIG. 13 C

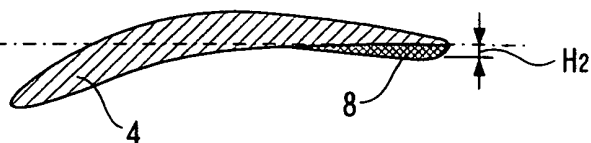


FIG. 13 D

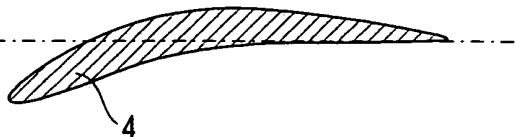


FIG. 14

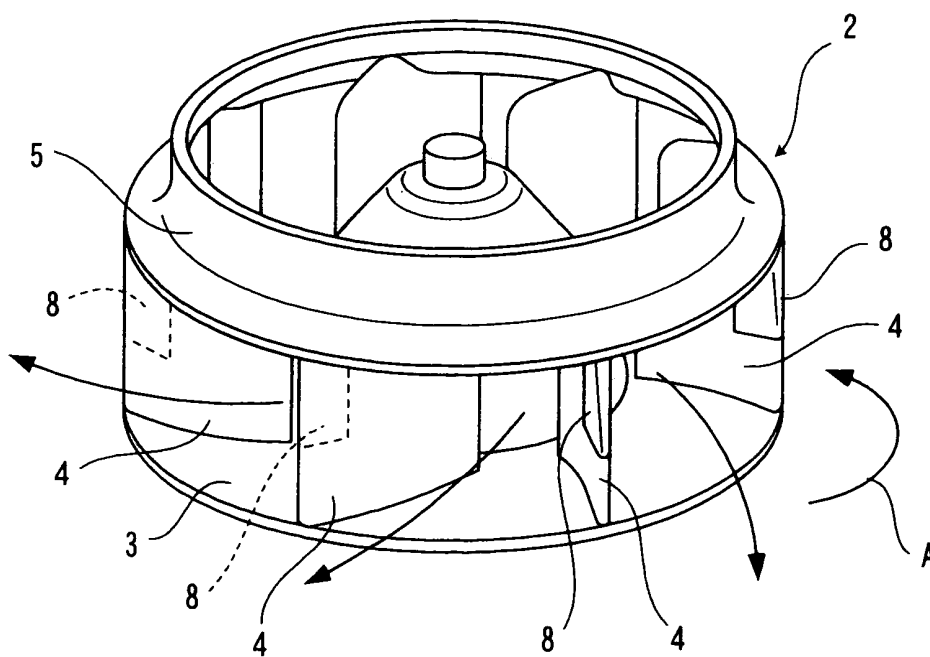


FIG. 15

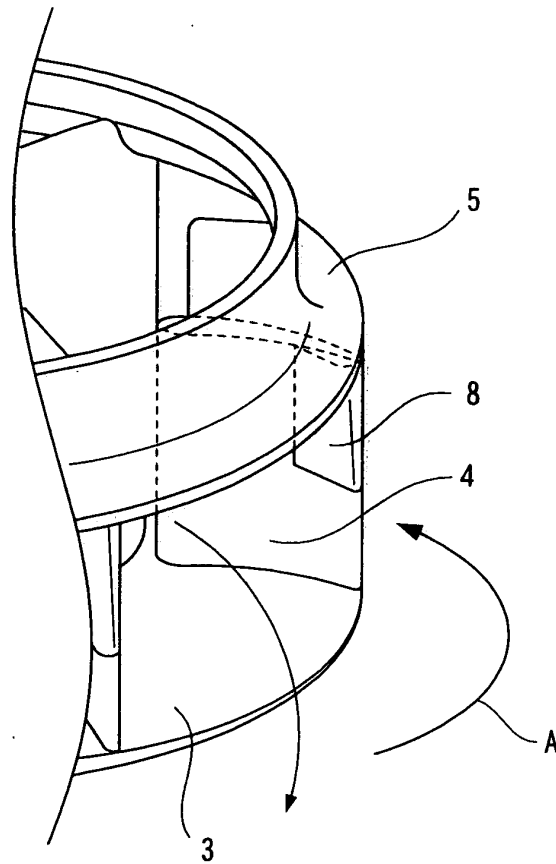


FIG. 16 A

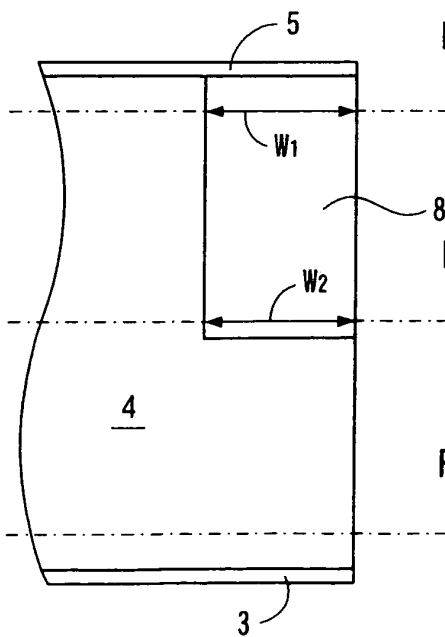


FIG. 16 B

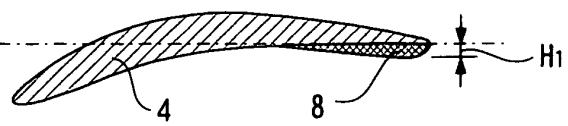


FIG. 16 C

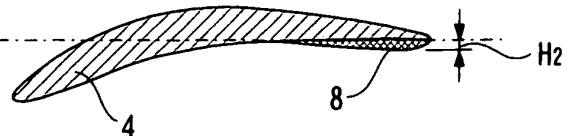


FIG. 16 D

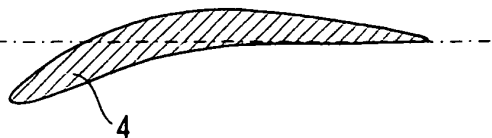


FIG. 17

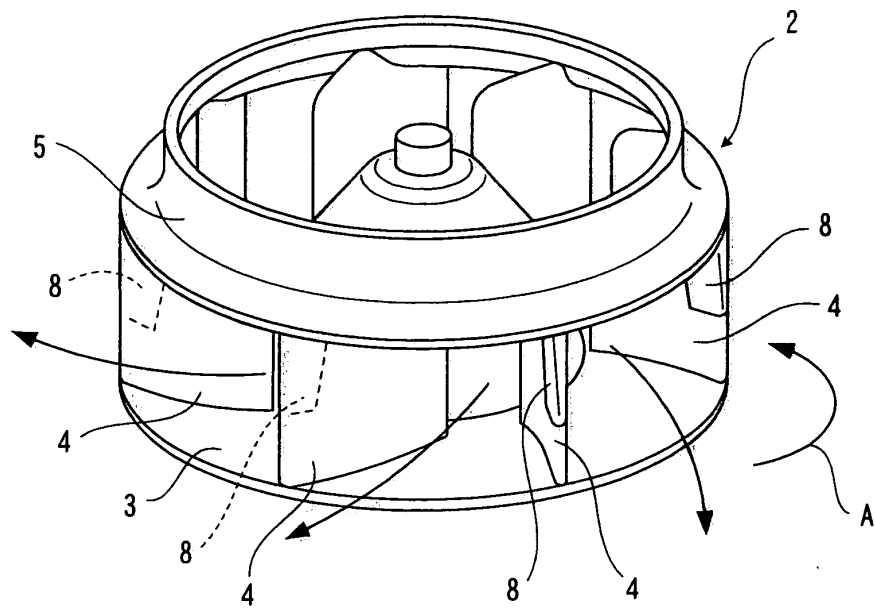


FIG. 18

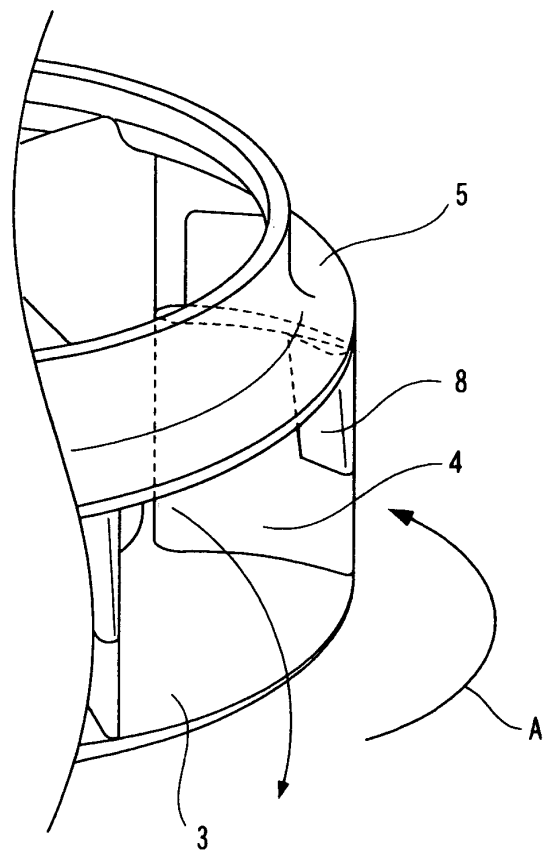


FIG. 19 A

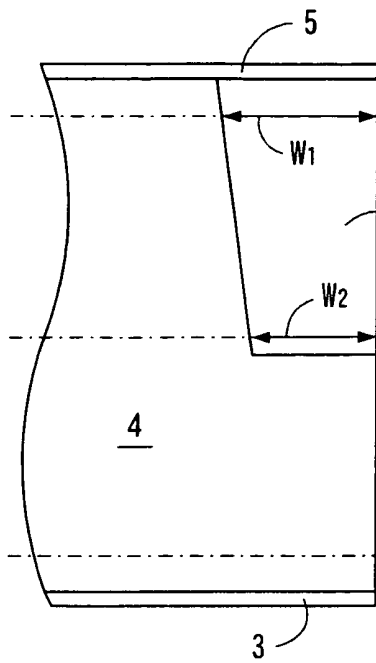


FIG. 19 B

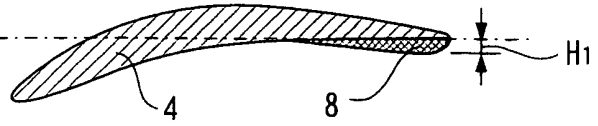


FIG. 19 C

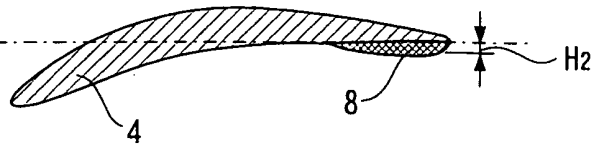


FIG. 19 D

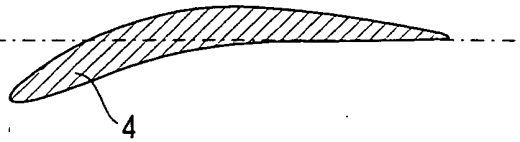


FIG. 20

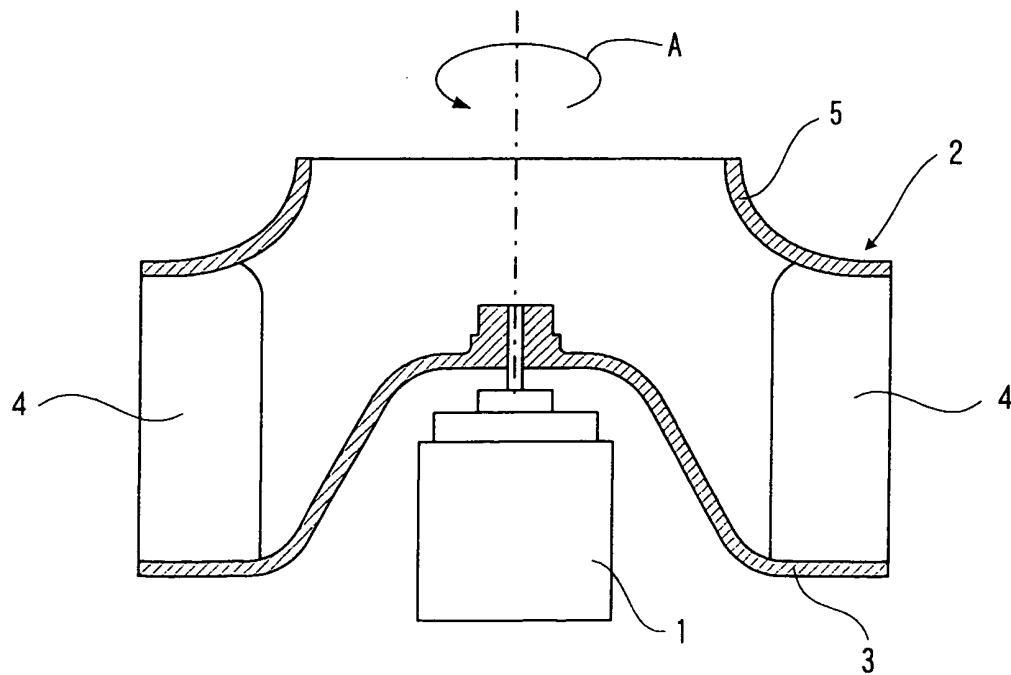


FIG. 21

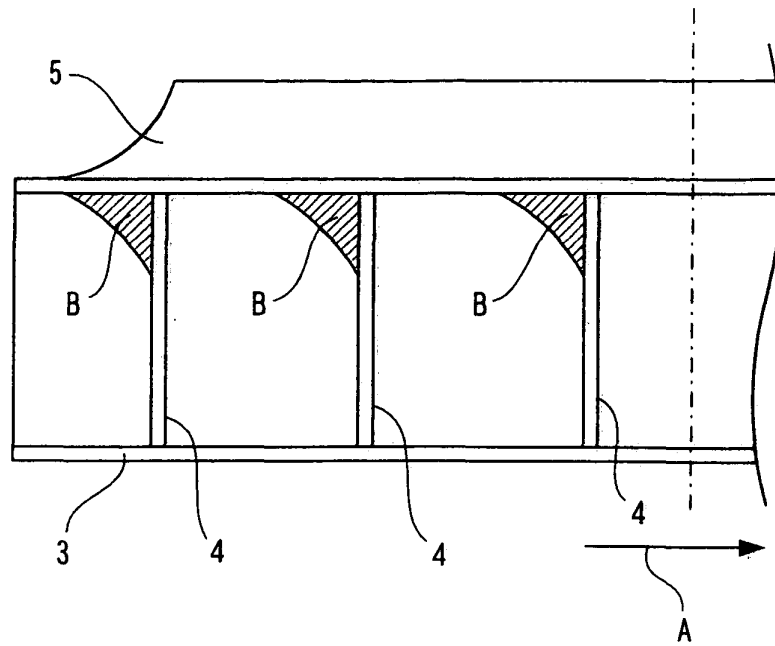


FIG. 22

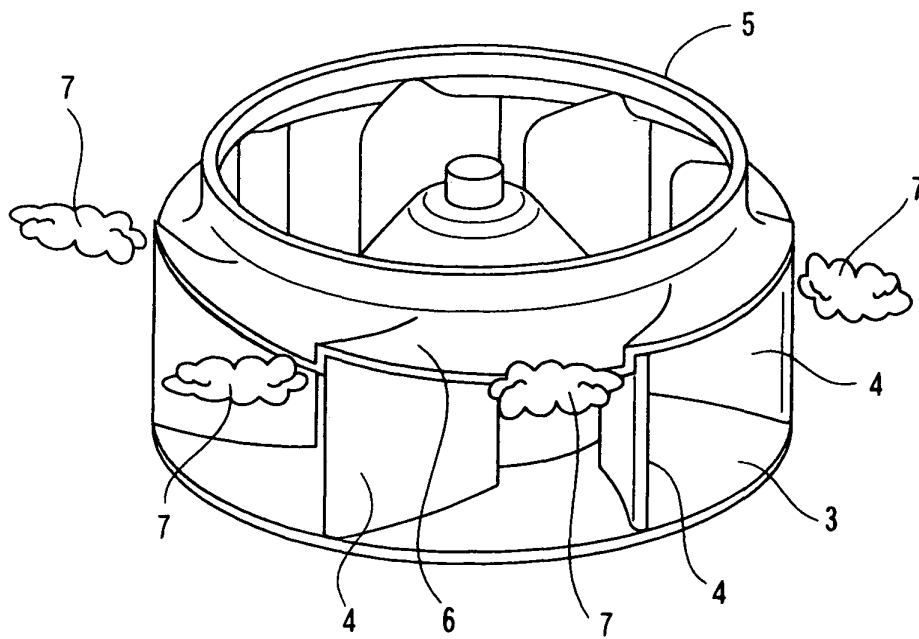


FIG. 23

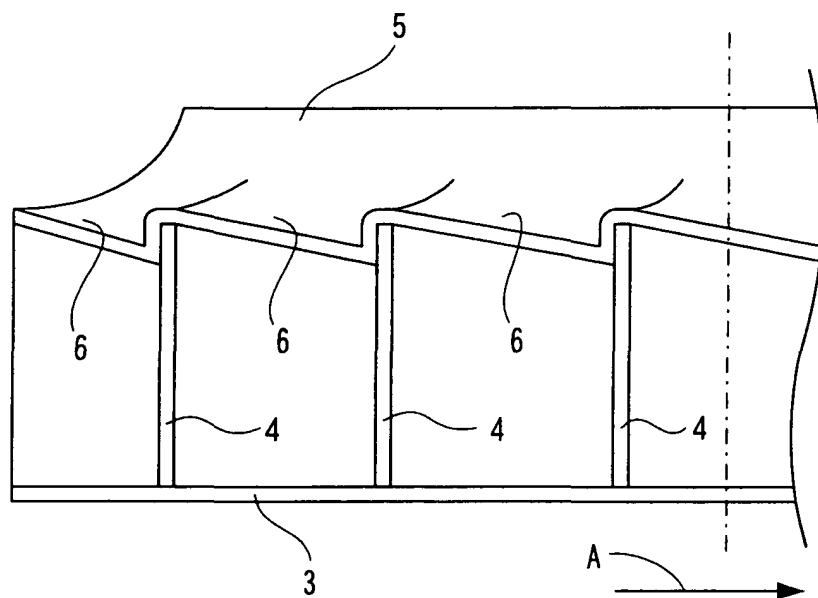


FIG. 24 A

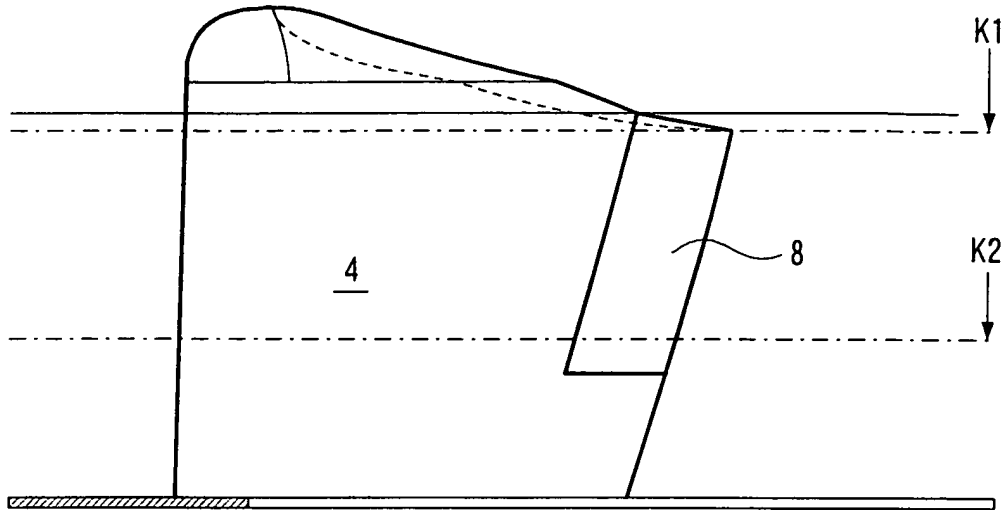


FIG. 24 B

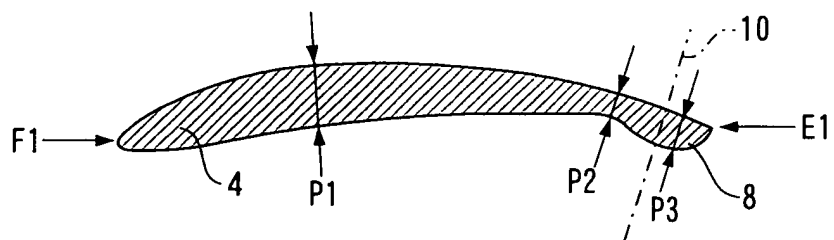
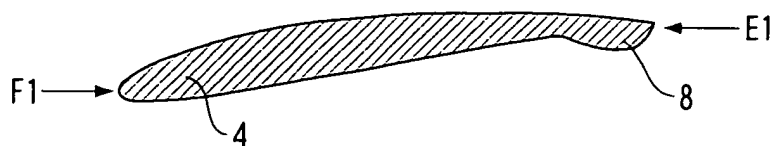


FIG. 24 C





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 23 May 2005	Examiner Giorgini, G
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