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(54) **Shroud and blower using the same**

Haube und Lüfter mit dieser Haube

Buse et ventilateur utilisant cette buse

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EP 1 624 196 B1

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Description

[0001] The present invention relates to a shroud and an axial flow blower using the same, which are suitably used for a radiator of a vehicle, for example.. More specifically, the present invention relates to a shroud having an airflow regulating plate, which effectively reduces rotation noise caused by an axial flow fan.

[0002] IP 2003 343394 A discloses an airflow regulating plate 19 which is provided on both sides of a ring portion 16 in a light-left direction which regulating plate has a circular-arc shape extending continuously from the top end to the bottom end of the shroud.

[0003] JP 56 162 469 U3 shows a center of a ring portion in an eccentric position with respect to the center of the shroud.

[0004] As a shroud of an axial flow blower used for a heat exchanger, the one described in JP-A-6-42498 is known. In this shroud, since the center of an axial flow fan is arranged eccentrically with respect to a heat exchanger, an opening is provided in a smaller-area part of the air introducing part in the shroud, at an upstream side of the axial flow fan.

[0005] Normally, when the center of the axial flow fan is eccentric with respect to the heat exchanger, rotation noise of the axial flow fan, especially in a first frequency range (a first noise component) becomes obvious. In this kind of shroud, by introducing atmosphere from the opening, pressures in the upstream part of the axial flow fan become balanced at the smaller-area and larger-area parts of the shroud air introducing part As a result, the rotation noise of the axial flow fan in the first and the third frequency ranges (the first and the third noise components) can be reduced.

[0006] In this shroud, however, because the atmosphere is introduced through the opening, the amount of air passing through the heat exchanger decreases. Therefore, the performance of the heat exchanger worsens.

[0007] JP-A-6-42498 further proposed a shroud in which an airflow regulating plate projects radially towards the inside. This airflow regulating plate is installed in the smaller-area part of the air introducing part of the shroud. This structure is effective for decreasing the rotational noise in the second and fourth frequency ranges (the second and the fourth noise components), but is not effective for decreasing the rotation noise in the first frequency range (the first noise component).

[0008] In view of the foregoing problem, it is an object of the present invention to provide a shroud which enables to reduce the fan rotation noise in the first frequency range (the first noise component) without decreasing the air amount flowing to the heat exchanger. It is another object of the present invention to provide a blower using the shroud.

[0009] This object is achieved by the features in claim 1.

[0010] According to the present invention, a shroud includes a ring portion (210) for surrounding a radial outer rim of an axial flow fan (100) for blowing air, and an air introducing part (220) for introducing air to the ring portion (210). The fan (100) is located opposite to a heat exchanger (1) positioned upstream of the fan (100) in an airflow, and the air introducing part (220) is enlarged from the ring portion (210) towards upstream in the airflow. Furthermore, a center of the ring portion (210) is eccentric with respect to a center of the air introducing part (220).

[0011] In the shroud, the air introducing part (220) has a large-area part (220a) and a small-area part (220b) which are formed due to the eccentrically located ring portion (210) with respect to the air introducing part (220), and an airflow regulating plate (221) is provided on the large-area part (220a) to project toward an upstream side of the airflow and has a circular-arc shape concentric with the ring portion (210). Accordingly, the airflow regulating plate (221) restricts the air from flowing to the ring portion along the wall surface of the larger-area part (220a) of the air introducing part (220). Therefore, an interference of an axial airflow with the air flowing along the wall surface of the larger-area part can be suppressed. As a result, the fan rotation noise in the first frequency range (the first noise component) can be reduced. In the present invention, no opening is provided in the air introducing part (220). Therefore, when this shroud is used for a blower for cooling a heat exchanger, the noise can be effectively reduced without reducing the amount of air flowing towards the heat exchanger.

[0012] When an inner diameter of the ring portion (210) is set as D and a length in a circumferential direction of the circular-arc shaped airflow regulating plate (221) is set as L, L/D can be set such that $0.34 \leqq L/D \leqq 0.44$. In this case, the fan rotation noise can be further reduced.

[0013] Further, when an inner diameter of the ring portion (210) is set as D and a curvature radius of the circular-arc shaped airflow regulating plate (221) is set as R, R/D can be set such that $0.57 \leqq R/D \leqq 0.74$. Furthermore, a projecting length (h) of the airflow regulating plate (221) can be set within a range of 7 mm and 12 mm. In this case, the fan rotation noise can be effectively reduced.

[0014] In the present invention, a plurality of the airflow regulating plates (221) are arranged to be concentric with the ring portion (210).

[0015] Additional objects and advantages of the present invention will be more readily apparent from the following detailed description of preferred embodiments when taken together with the accompanying drawings, in which:

Fig. 1A is a front view showing a structure of an axial flow blower, and Fig. 1B is a schematic sectional view of Fig. 1A;

Fig. 2 is a schematic sectional view showing a functional effect of an airflow regulating plate in the axial flow blower;

Fig. 3 is a graph showing the relationship between fan rotation noise in a first frequency range (a first

noise component) and L/D, when a curvature radius *R* is changed within a standard range;

Fig. 4 is a graph showing the relationship between fan rotation noise in the first frequency range (first noise component) and L/D, when a projecting length *h* is changed within a standard range;

Fig. 5 is a graph showing the fan rotation noise level (sound level) with respect to a frequency in a state before the present invention is applied; and

Fig. 6 is a schematic sectional view showing an air flow in an axial flow blower without an airflow regulating plate.

[0016] A preferred embodiment of the present invention will be described hereinafter with reference to the appended drawings.

[0017] In this embodiment, a shroud 200 of the present invention is used for an axial flow blower 10 (an electric fan) for a radiator 1 (heat exchanger). The axial flow blower 10 is formed by assembling an axial flow fan 100 and a motor 300. Figs. 1A and 1B show the structure of the axial flow blower 10.

[0018] The axial flow blower 10 (hereinafter blower 10) is fixed to the radiator 1 for a vehicle at an engine side with mounting members 230 provided at four corners of the shroud 200. The blower 10 sends cool air to a core portion la of the radiator 1. The blower 10 is an air-intake type blower 10, which draws air from the side of a vehicle grill to the engine side, that is, from the core portion 1a of the radiator 1 to the axial flow fan 100.

[0019] The axial flow fan 100 (hereinafter fan) is made of polypropylene containing about 20% of glass fiber. A fan boss 110 and blades 120 are integrally formed by an injection molding.

[0020] The fan boss 110 is cylindrical-shaped with one closed end. A metal insert 111 made of aluminum is insert-formed at the center area of the closed end of the fan boss 110. Further, a shaft slit 112 for receiving a shaft 310 of the motor 300 is provided at the center of the metal insert 111.

[0021] Several blades 120 (e.g., seven blades, in this embodiment) extending radially are provided on the outer circumference of the fan boss 110. Here, the outer diameter of the fan 100 is set at 360mm. As to the outer diameter of the fan 100, it is generally set in a range between 250mm and 400mm in accordance with its mountability to the vehicle or required air blowing capabilities.

[0022] The shroud 200 is made of polypropylene containing about 25% to 30% of glass fiber and is integrally formed with a ring portion 210, an air introducing part 220, the mounting portions 230, etc.

[0023] The ring portion 210 is provided for surrounding the radial outer rim of the fan 100. A motor supporting portion (not shown) for supporting the motor 300 is provided downstream of the ring portion 210 in the airflow, at the inner diameter side of the ring portion 210. A clearance (e.g., 4mm) is ensured between the fan 100 and the ring portion 210 so as to prevent interference therebetween. In this embodiment, the inner diameter *D* of the ring portion 210 is set at 368mm, as an example.

[0024] The air introducing part 220 is enlarged smoothly from the ring portion 210 towards the upstream side of the airflow (to the side of the radiator 1). The outline (the outer shape) of the air introducing part 220 is rectangular-shaped to correspond to the shape of the core portion 1a of the radiator 1. The center of the ring portion 210 is eccentrically arranged (here, it is eccentrically arranged at the right part in Fig. 1) with respect to the center of the air introducing part 220, so that the shroud 200 is prevented from interfering with other parts provided in the vehicle when it is mounted to the vehicle.

[0025] The air introducing part 220 is divided into a larger-area part 220a (the left part in Fig. 1A) and a smaller-area part 220b (the right part in Fig. 1A), due to the eccentric arrangement of the ring portion 210. As shown in Fig. 1B, the airflow regulating plate 221 is provided on an inner surface of this larger-area part 220a of the air introducing part 220.

[0026] The airflow regulating plate 221 is circular-arc shaped to be concentric with the ring portion 210. The airflow regulating plate 221 is a plate member having a thickness of 2mm and projects towards upstream in the airflow. For example, the airflow regulating plate 221 can be integrally formed with the larger-area part 220a of the air introducing part 220. In this embodiment, the airflow regulating plate 221 is divided into two parts, one is provided upper and the other is provided below in the vertical direction of Fig. 1A. For easier understanding of the explanations to follow, the dimensions of the airflow regulating plate 221 are indicated such that, a length in the circumferential direction is as *L*, a curvature radius (a length from the center of the ring portion 210 to the outer periphery of the airflow regulating plate 221) is as *R* and a projecting length is as *h*.

[0027] The motor 300 is fixed to the motor supporting portion of the ring portion 210, and shaft 310 of the motor 300 is inserted into the shaft slit 112 of the fan 100 so that the motor 300 is fixed to the fan 100. Here, the motor 300 is a generally known DC ferrite motor and is connected to a controller (not shown). The controller varies an average current value by changing a ratio between ON period and OFF period during which the current is running through the motor 300. In accordance with the required cooling capability of the radiator 1, an amount of airflow is controlled by varying the rotational speed of the fan 100 which is directly connected to the controller. In the normal use range of the blower 10, the rotational speed is set approximately at 1700 rpm.

[0028] In the blower 10 structured as described, the fan 100 is rotated by the function of the motor 300 and sends air for cooling towards the core part 1a of the radiator 1 thereby heat radiation from the cooling water of the radiator 1 is promoted.

[0029] The eccentricity of the ring portion 210 of the shroud 200 divides the air introducing part 220 into the larger-area part 220a and the smaller-area part 220b.

Fig. 5 shows a confirmation result when the blower 10 is attached to the radiator 1 in a state in which the airflow regulating plate 221 is not provided. As shown in Fig. 5, the fan rotation noise in the first frequency range of approximately 200 Hz (first noise component) occurs noticeably. The first noise component is calculated such that, rotational frequency (28 Hz) of the fan 100 X blade numbers (7) ≒ the first noise component (200Hz region). That is, 28 Hz X 7 ≒ 200Hz region. This fan rotation noise becomes a problem when amplified at the time of being transmitted to the vehicle. This is considered to happen, as shown in Fig. 6, because the airflow along the larger-area part 220a of the air introducing part 220 runs against (interferes) the airflow along the rotational axis direction of the fan 100 in the region of the ring portion 210.

[0030] In the present invention, as shown in Fig. 2, the airflow regulating plate 221 restricts the air from flowing along the wall surface of the larger-area part 220a of the air introducing part 220 into the ring portion 210. Therefore, the interference in the airflow can be reduced thereby the fan rotation noise in the first frequency range (the first noise component) can be reduced.

[0031] In Fig. 3, the length in the circumferential direction of the airflow regulating plate 221 is set as *L*, the inner diameter of the ring portion 210 is set as *D* and the curvature radius of the airflow regulating plate 221 is set as *R*. The fan rotation noise in the first frequency range (the first noise component) has been examined by varying *R* with respect to a ratio *L*/*D*. Here, a projecting length *h* of the airflow regulating plate is 7mm. A sufficient noise reduction effect is obtained when *L*/*D* is within the range of 0.34 and 0.44, as shown in Fig. 3.

[0032] As to the curvature radius R of the airflow regulating plate 221, the closer the airflow regulating plate 221 is to the ring portion 210, the better effect in the reduction of the rotation noise is obtained. When *R* is set at 211mm, the maximum reduction in the noise, which is around 4.5 dB, is obtained. This effect is obtained even *R* up to 271mm. When this effect is considered in view of the ratio (*R*/*D*) of the curvature radius R to the inner diameter *D* of the ring portion 210, the sufficient effect can be obtained when *R*/*D* is within the range of 0.57 and 0.74.

[0033] Also, as shown in Fig. 4, when the projecting length *h* is changed from 7mm to 12mm (R = 231mm, 251mm), the interference, caused by the airflow along the larger-area part 220a of the air introducing part 220 running against the airflow into the ring portion 210, is suppressed. As a result, the noise can be greatly reduced (Δ2.5 to Δ4 dB).

[0034] In the present invention, since no opening is provided in the air introducing part 220, the air amount passing through the core portion 1a of the radiator 1 is not decreased.

(Other Preferred Embodiments)

[0035] In the above-described embodiment, the airflow regulating plate 221 is explained as the one integrally provided with the larger-area part 220a of the air introducing part 220. However, the airflow regulating plate 221 also can be formed independently from the air introducing part 220, and can be integrated with the air introducing part 220.

[0036] The outline shape of the air introducing part 220 is not limited to rectangular, but can be modified to other shapes such as circular or elliptical shape.

[0037] The airflow regulating plate 221 can be formed by plural parts more than two.

[0038] The fan 100 is used for the electric blower 10 rotated by the motor 300. However, an engine fan rotated by driving force of a vehicular engine can be also used.

[0039] The above embodiment has been explained with the fan 100 for supplying air to the radiator 1. However, the fan 100 can be a subject for use in other heat exchangers such as a condenser for condensing refrigerant of an air-conditioner, an oil cooler for cooling oil or an intercooler for cooling drawn air.

[0040] Such changes and modifications are to be understood as being within the scope of the present invention as defined by the appended claims.

Claims

1. A shroud comprising:

a ring portion (210) for surrounding a radial outer rim of an axial flow fan (100) for blowing air, the fan (100) being located opposite to a heat exchanger (1) positioned upstream of the fan (100) in an airflow; and

an air introducing part (220), for introducing air to the ring portion (210), enlarged from the ring portion (210) towards upstream in the airflow, wherein a center of the ring portion (210) is eccentric with respect to a center of the air introducing part (220), the shroud **characterized in that**;

the air introducing part (220) has a large-area part (220a) and a small-area part (220b) which are formed due to the eccentrically located ring portion (210) with respect to the air introducing part (220); and

an airflow regulating plate (221) is provided on the large-area part (220a) to project toward an upstream side of the airflow, and has a plurality of divided parts each having a circular-arc shape concentric with the ring portion (210).

2. A shroud according to claim 1, wherein:

the center of the ring portion (210) is arranged eccentrically in a right-left direction with respect to the center of the air introducing part (220), and the airflow regulating plate (221) is divided into

two parts in a vertical direction perpendicular to the right-left direction.

3. A shroud according to claim 1 or 2, wherein:

when an inner diameter of the ring portion (210) is set as *D* and a length in a circumferential direction of the circular-arc shaped airflow regulating plate (221) is set as *L*, $0.34 \leqq L/D \leqq 0.44$.

4. A shroud according to any one of claims 1 to 3, wherein:

when an inner diameter of the ring portion (210) is set as *D* and a curvature radius of the circular-arc shaped airflow regulating plate (221) is set as *R*, $0.57 \leqq R/D \leqq 0.74$.

5. A shroud according to any one of claims 1-4, wherein:

a projecting length (h) of the airflow regulating plate (221) is within a range of 7 mm and 12 mm.

6. A blower comprising:

an axial flow fan (100) for blowing air, the fan (100) being located opposite to a heat exchanger (1) positioned upstream of the fan (100) in an airflow;
a shroud according to any of claims 1 to 5.

Patentansprüche

1. Haube, umfassend:

einen Ringabschnitt (210) zum Umschließen eines radial äußeren Randes eines Axialströmungslüfters (100) zum Blasen von Luft, wobei der Lüfter (100) gegenüber einem Wärmetauscher (1) angeordnet ist, welcher stromaufwärts des Lüfters (100) in einer Luftströmung positioniert ist; und
einen Lufteinleitteil (220) zum Einleiten von Luft in den Ringabschnitt (210), erweitert von dem Ringabschnitt (210) zu dem Stromaufwärtigen in der Luftströmung, wobei ein Zentrum des Ringabschnitts (210) bezüglich einem Zentrum des Lufteinleitteils (220) exzentrisch ist, wobei die Haube **dadurch gekennzeichnet ist, dass**:

der Lufteinleitteil (220) einen großflächigen Teil (220a) und einen kleinflächigen Teil (220b) aufweist, welcher durch den exzentrisch angeordneten Ringabschnitt (210) bezüglich des Lufteinleitteils (220) ausgebildet ist; und

eine Luftströmungs-Regulierungsplatte (221) auf dem großflächigen Bereich (220a) vorgesehen ist, um zu einer stromaufwärtigen Seite der Luftströmung herauszuragen, und mehrere abgeteilte Teile aufweist, welche alle eine Kreisbogenform aufweisen, welche mit dem Ringabschnitt (210) konzentrisch ist.

2. Haube nach Anspruch 1, wobei:

das Zentrum des Ringabschnitts (210) exzentrisch in einer Rechts-/Linksrichtung bezüglich des Zentrums des Lufteinleitteils (220) angeordnet ist, und
die Luftströmungs-Regulierungsplatte (221) in zwei Teile in einer Vertikalrichtung senkrecht zu der Rechts-/Linksrichtung unterteilt ist

3. Haube nach Anspruch 1 oder 2, wobei:

wenn ein innerer Durchmesser des Ringabschnitts (210) als D gewählt ist und
eine Länge in einer Umfangsrichtung der kreisbogenförmigen Luftströmungs-Regulierungsplatte (221) als L gewählt ist, $0{,}34 \leq L/D \leq 0{,}44$ gilt.

4. Haube nach irgendeinem der Ansprüche 1 bis 3, wobei:

wenn ein innerer Durchmesser des Ringabschnitts (210) als D gewählt ist und
ein Krümmungsradius der kreisbogenförmigen Luftströmungs-Regulierungsplatte (221) als R gewählt ist, $0{,}57 \leq R/D \leq 0{,}74$ gilt.

5. Haube nach irgendeinem der Ansprüche 1 bis 4, wobei:

eine vorstehende Länge (h) der Luftströmungs-Regulierungsplatte (221) innerhalb eines Bereichs von 7 mm und 12 mm ist.

6. Gebläse, umfassend:

einen Axialströmungslüfter (100) zum Blasen von Luft, wobei der Lüfter (100) gegenüber einem Wärmetauscher (1) angeordnet ist, welcher stromaufwärts des Lüfters (100) in einer Luftströmung positioniert ist;
eine Haube nach irgendeinem der Ansprüche 1 bis 5

Revendications

1. Buse comprenant :

une partie en anneau (210) pour entourer une bordure extérieure radiale d'un ventilateur à flux axial (100) pour souffler de l'air, le ventilateur (100) étant localisé en face d'un échangeur de chaleur (1) positionné en amont du ventilateur (100) dans un flux d'air ; et
une section d'introduction d'air (220), pour introduire de l'air dans la partie en anneau (210), élargie à partir de la partie en anneau (210) vers l'amont dans le flux d'air, dans laquelle un centre de la partie en anneau (210) est excentré par rapport à un centre de la section d'introduction d'air (220), la buse **caractérisée en ce que** :

la section d'introduction d'air (220) a une section de grande zone (220a) et une section de petite zone (220b) qui sont formées en raison de la localisation excentrée de la partie en anneau (210) par rapport à la section d'introduction d'air (220) ; et
une plaque de régulation de flux d'air (221) est prévue sur la section de grande zone (220a) pour projeter vers un côté amont du flux d'air, et a une pluralité de sections divisées, chacune ayant une forme en arc de cercle concentrique à la partie en anneau (210).

2. Buse selon la revendication 1, dans laquelle :

le centre de la partie en anneau (210) est disposé de manière excentrée dans une direction gauche-droite par rapport au centre de la section d'introduction d'air (220), et
la plaque de régulation de flux d'air (221) est divisée en deux sections dans une direction verticale perpendiculaire à la direction gauche-droite..

3. Buse selon la revendication 1 ou 2, dans laquelle :

quand un diamètre intérieur de la partie en anneau (210) est défini en tant que D et une longueur dans une direction circonférentielle de la plaque de régulation de flux d'air (221) en forme d'arc de cercle est définie en tant que L, $0{,}34 \leq L/D \leq 0{,}44$.

4. Buse selon l'une quelconque des revendications 1 à 3, dans laquelle :

quand un diamètre intérieur de la partie en anneau (210) est défini en tant que D et un rayon de courbure de la plaque de régulation de flux d'air (221) en forme d'arc de cercle est défini en tant que R, $0{,}57 \leq R/D \leq 0{,}74$.

5. Buse selon l'une quelconque des revendications 1-4, dans laquelle :

une longueur de projection (h) de la plaque de régulation de flux d'air (221) est comprise entre 7 mm et 12 mm

6. Ventilateur comprenant :

un ventilateur à flux axial (100) pour souffler de l'air, le ventilateur (100) étant localisé en face d'un échangeur de chaleur (1) positionné en amont du ventilateur (100) dans un flux d'air ;
une buse selon l'une quelconque des revendications 1 à 5.

FIG. 1A

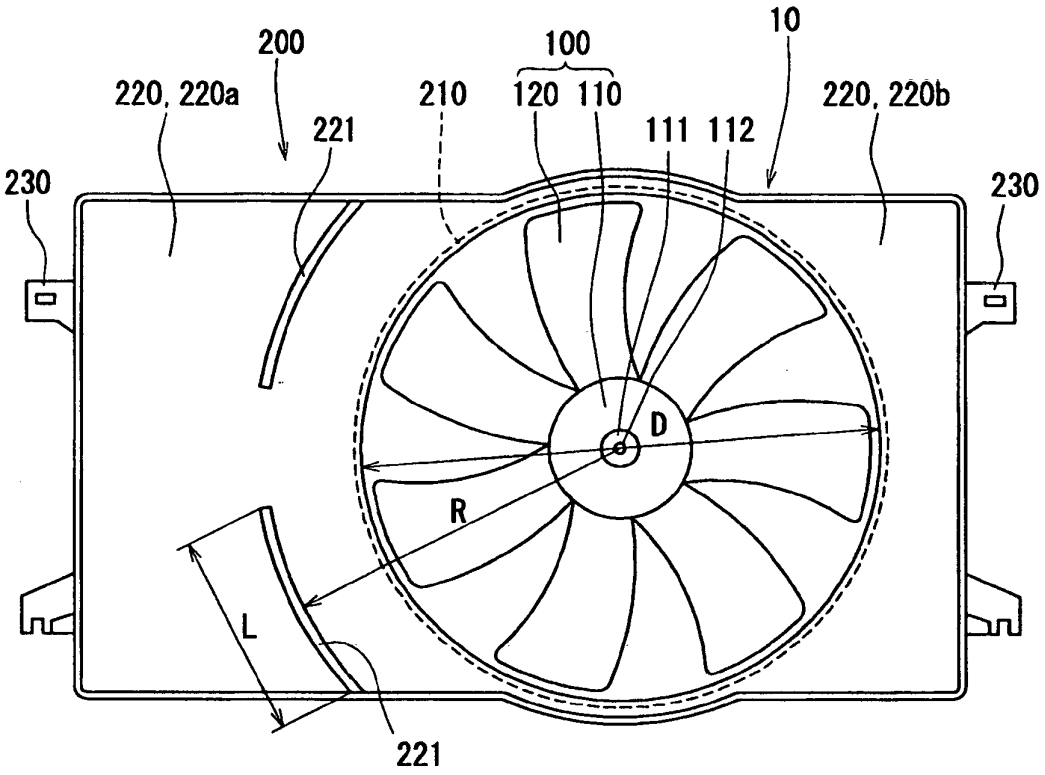

200
100
10
220, 220a
210
120 110
220, 220b
221
111 112
230
230
D
R
L
221

FIG. 1B

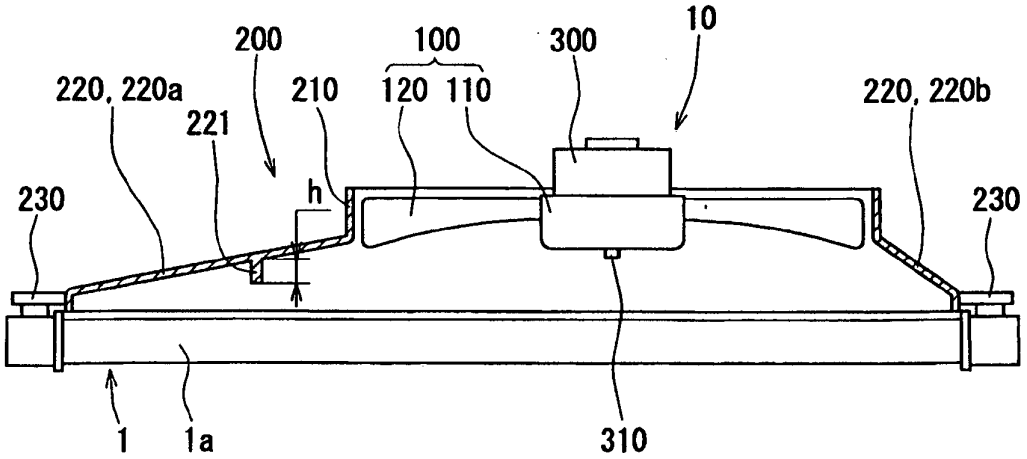

200
100
300
10
220, 220a
210
120 110
220, 220b
221
230
h
230
1
1a
310

FIG. 2

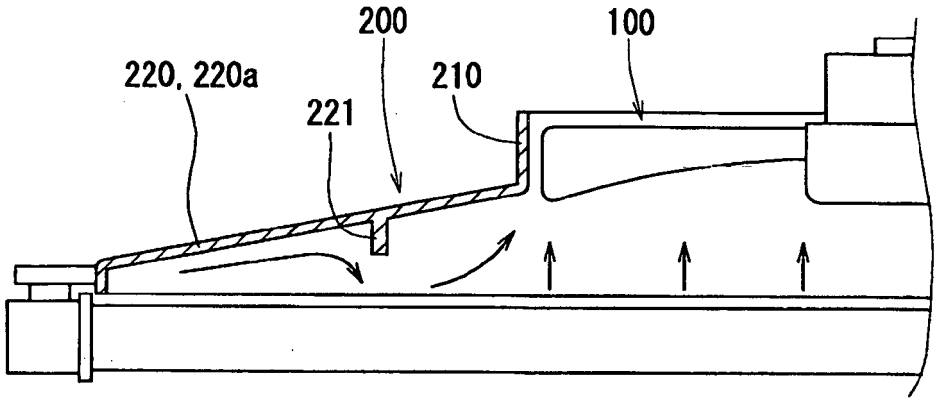


FIG. 3

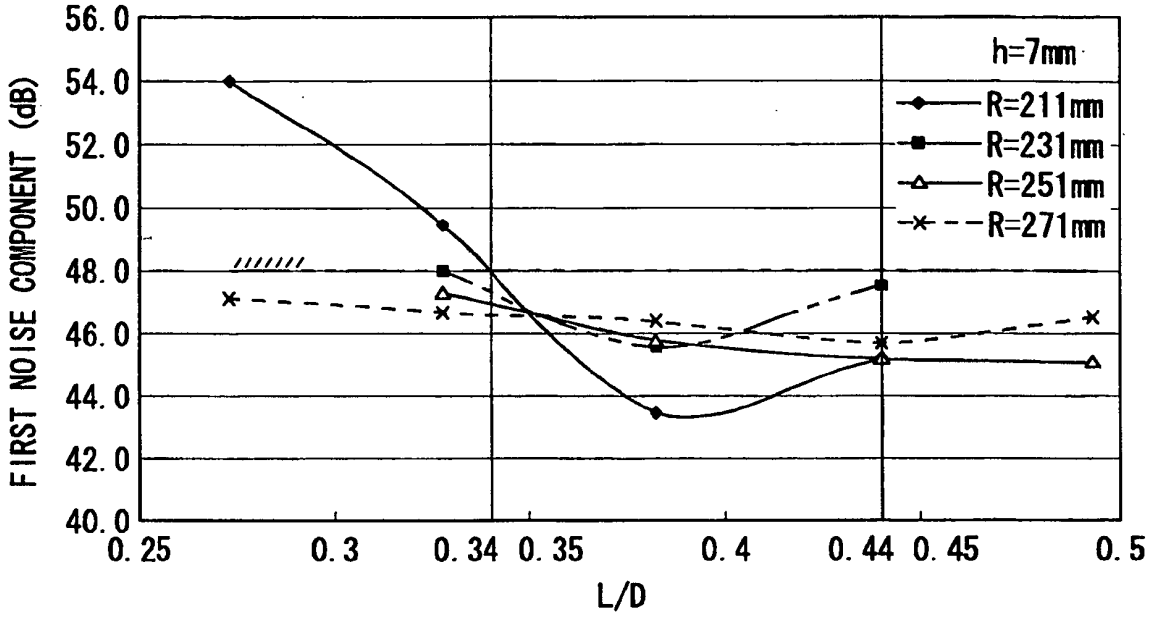

56.0
54.0
52.0
50.0
48.0
46.0
44.0
42.0
40.0
FIRST NOISE COMPONENT (dB)
0.25
0.3
0.34
0.35
0.4
0.44
0.45
0.5
L/D
h=7mm
R=211mm
R=231mm
R=251mm
R=271mm

FIG. 4

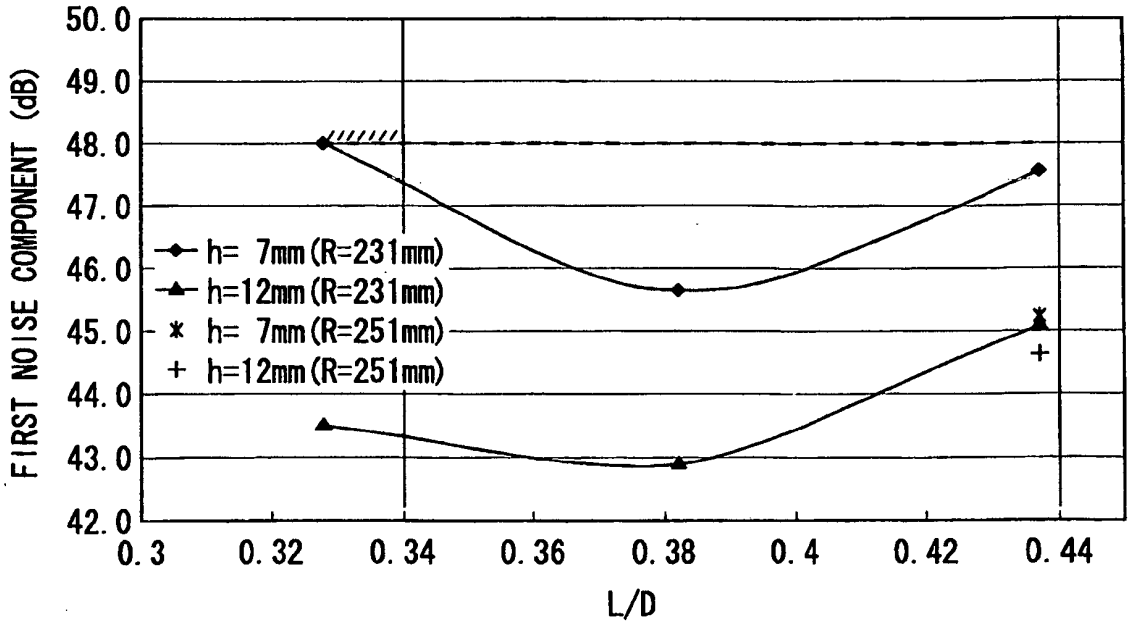

50.0
49.0
48.0
47.0
46.0
45.0
44.0
43.0
42.0
FIRST NOISE COMPONENT (dB)
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
L/D
h= 7mm (R=231mm)
h=12mm (R=231mm)
h= 7mm (R=251mm)
h=12mm (R=251mm)

FIG. 5

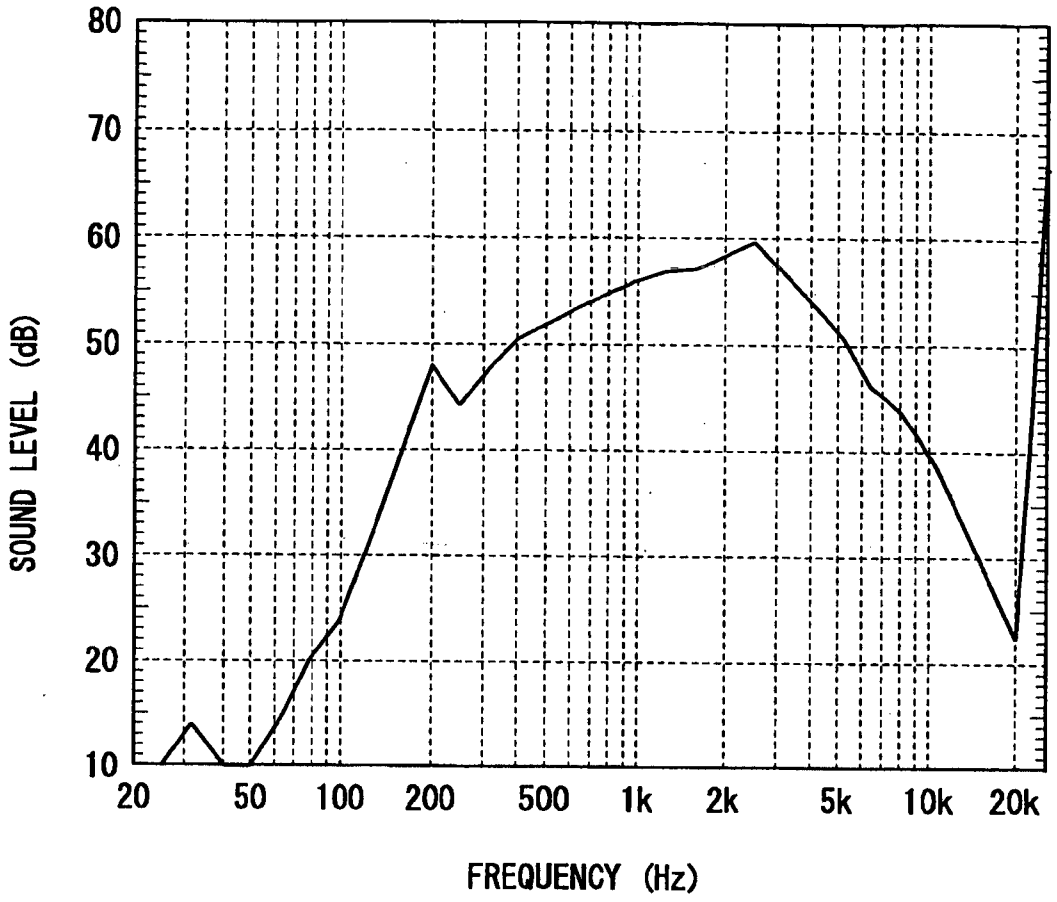
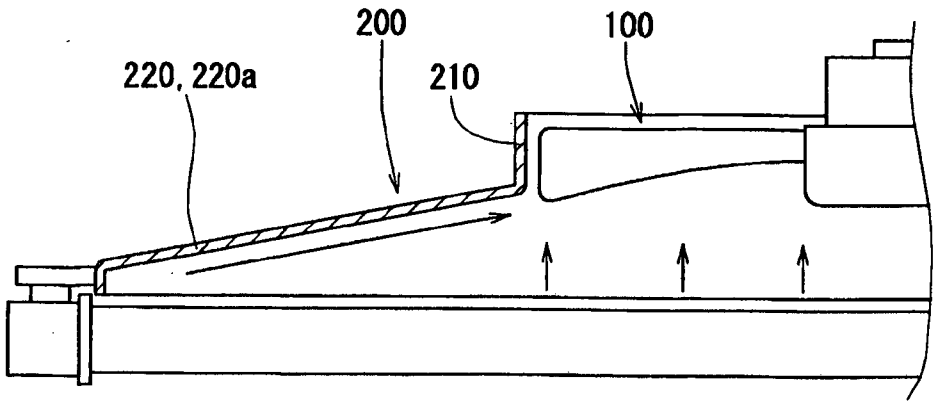

80
70
60
50
40
30
20
10
SOUND LEVEL (dB)
20
50
100
200
500
1k
2k
5k
10k
20k
FREQUENCY (Hz)

FIG. 6


200
100
220, 220a
210

REFERENCES CITED IN THE DESCRIPTION

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