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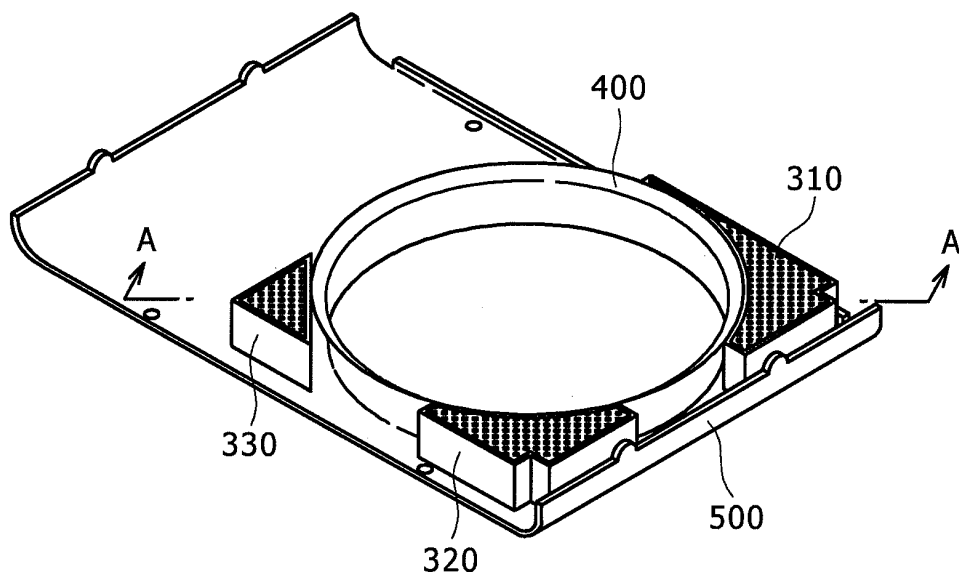
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(54) **Noise reducing structure in fan device**

(57) A noise reducing structure in a fan device is provided which can reduce noise generated in the interior of a housing of the fan device without deteriorating the air feed capacity of the fan device. In the noise reducing structure in a fan device, a fan (200) is rotated by a drive

motor (600) to create an air flow. The air flow is introduced and uniformed by a bell-mouth-like shroud (400). Sound absorbing structures (310, 320, 330) are formed on a surface intersecting the outer periphery surface of the shroud (400).

FIG. 3



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a noise reducing structure in a fan device provided with a fan for creating an air flow, the noise reducing structure being capable of reducing noise generated in the interior of a housing of the fan device.

2. Description of the Related Art

[0002] In a conventional fan device there is provided a drive unit for creating an air flow and there is formed a bell-mouth-like shroud for improving the air feed capacity. In the fan device, noise attributable to the air flow and noise from the drive unit are generated in the interior of the housing. As examples of devices using the fan device there are known a cooling device for a vehicle engine, a cooling device for a computer, a ventilating device in a bathroom, and an outdoor machine of an air conditioner.

[0003] In Patent Literature 1 there is disclosed a compressor unit noise reducing device, the noise reducing device comprising compressor unit noise reducing means using a fan cover which functions to reduce noise generated in an outer fan portion of a compressor driving motor forming a compressor unit noise source and further functions to absorb and damp the associated vibration, and additional noise reducing means including intervention of a vibration damping material to a mounting surface and affixing of a vibration damping member to a vibrating member, thereby making a required noise reduction possible even in the absence of an enclosure.

[0004] In the compressor unit noise reducing device disclosed in Patent Literature 1, the fan cover constitutes the noise reducing means of a non-explosionproof type motor of the compressor unit, is made up of an aperture cover, a sound absorbing material lined through soft rubber to an inner vibrating portion, and a woven wire mesh material and a vibration damping material both covering a front side of the aperture.

[0005] In Patent Literature 2 there is disclosed a fan device noise reducing mechanism capable of damping an impact sound and an air flow sound effectively and thereby capable of reducing noise positively.

[0006] According to the fan device noise reducing mechanism disclosed in Patent Literature 2, a porous sound absorbing material is affixed to the whole of the inner periphery surface of a fan shroud opposed to the front end side of the fan in an exposed state into the opposed space without using the conventional punching metal. Therefore, an air flow sound which is attributable to a strong rotating flow between the fan and the fan shroud can be absorbed by the sound absorbing material; besides, it is possible to make the generation of an impact sound difficult. Thus, both impact sound and air

flow sound can be damped effectively and thus it is possible to attain the reduction of noise positively.

[0007] Further, in Patent Literature 3 there is disclosed a bell-mouth of a blower having a pressure variation absorbing structure difficult for dust to adhere on an air flow guide surface and capable of maintaining a pressure variation absorbing effect even with the elapse of time.

[0008] The blower bell-mouth disclosed in Patent Literature 3 is mounted in corresponding relation to an outer periphery of a blower impeller to guide air present on a suction side of the impeller to a blow-off side. The interior of the bell-mouth is formed as a hollow tubular structure, a large number of small holes are formed in an inner periphery wall portion which constitutes the air flow guide surface, and the interior hollow space is brought into communication with an outer air feed passage through those small holes. According to this construction, by forming the inner periphery wall portion with use of synthetic resin or metal, the air flow guide surface can be formed smooth to make the adherence of dust difficult; besides, dust which has entered the small holes is sucked into the interior space without staying within the small holes, thus making it possible to prevent the deposition of dust.

[0009]

[Patent Literature 1]

Japanese Patent Laid-Open Publication No. 2003-343495

[Patent Literature 2]

Japanese Patent Laid-Open Publication No. 2001-003750

[Patent Literature 3]

Japanese Patent Laid-Open Publication No. 2001-107899

[0010] However, in the compressor unit noise reducing device disclosed in Patent Literature 1, since a porous sound absorbing material is disposed in the intake aperture portion, the resistance to the air flow increases, resulting in decrease of the flow rate and deterioration of the air feed capacity of the fan device.

[0011] In the fan device noise reducing mechanism disclosed in Patent Literature 2, since a porous sound absorbing material having concaves and convexes on the surface thereof is disposed at a position facing the air flow, the resistance to the air flow increases, with consequent decrease of the flow rate and deterioration of the air feed capacity of the fan device. Moreover, the sound absorbing effect attained by the porous sound absorbing material is generally limited to a high frequency region and the sound absorbing effect attained by holes, resonance pipes and a sound deadening room is limited

to a narrow frequency band, thus making it impossible to obtain a noise reducing effect over a wide range of frequency band. Further, for protecting the porous sound absorbing material against water and dust it is necessary to apply a scientific water repelling treatment and surface coating to the material, thus resulting in increase of cost.

[0012] In the bell-mouth disclosed in Patent Literature 3, since a large number of small holes are formed in the guide surface of the bell-mouth, the resistance to the air flow increases, so that the flow rate decreases and the air feed capacity of the fan device is very likely to be deteriorated.

SUMMARY OF THE INVENTION

[0013] It is an object of the present invention to provide a noise reducing structure in a fan device capable of reducing noise released from the interior of a housing of the fan device to the exterior without deteriorating the air feed capacity of the fan device.

[0014]

(1) According to the present invention there is provided a noise reducing structure in a fan device including a fan for creating an air flow, a housing for accommodating the fan therein, and a shroud provided in part of the housing, further includes a sound absorbing structure disposed in the interior of the housing and on an outer periphery side of the shroud.

[0015] When the fan rotates and an air flow is created in the noise reducing structure in a fan device according to the present invention, the air flow is introduced and uniformed by the shroud. The sound absorbing structure is disposed on the outer periphery side of the shroud.

[0016] In this case, noise generated in the interior of the fan device housing can be reduced by the sound absorbing structure. In this case, since the sound absorbing structure is not disposed at the shroud position facing the fan, the air flow is not disturbed and the noise released from the interior of the fan device housing to the exterior can be reduced without deteriorating the air feed capacity of the fan device.

[0017] (2) The sound absorbing structure may be formed integrally with the housing.

[0018] In this case, since the sound absorbing structure is integral with the housing, the number of assembling steps becomes smaller and hence it is possible to reduce the manufacturing cost.

[0019] (3) The sound absorbing structure may be formed as an independent member.

[0020] In this case, since the sound absorbing structure is formed as an independent member, the sound absorbing structure can be provided even at a position where integral molding with the housing is difficult.

[0021] (4) The sound absorbing structure may be formed by one perforated plate and an air layer, or plural perforated plates arranged in a layered fashion and plural

air layers.

[0022] In this case, since the sound absorbing structure is constituted by one perforated plate or a plurality of layered, perforated plates, vibration of the air present within the housing is damped by viscous damping which is induced by vibration of air within each of the holes of the perforated plate, thus making it possible to reduce noise. Besides, since the sound absorbing structure is constituted by a plate member, the environmental resistance of the sound absorbing structure according to the present invention can be maintained high and the performance and structure of the sound absorbing structure do not change over a long period. Therefore, even if the sound absorbing material is used for a long period, its noise reducing performance is not deteriorated. Moreover, since there is no scattering of the sound absorbing structure in comparison with the conventional sound absorbing materials, it is possible to prevent a bad influence on the ambient environment or devices. In case of forming concaves and convexes on the perforated plate(s) by embossing, the rigidity of the perforated plate(s) is improved and hence it is possible to prevent the generation of a solid sound.

[0023] (5) The perforated plate(s) may be disposed so as to face toward the interior of the housing.

[0024] In this case, since the perforated plate(s) is (are) disposed so as to face toward the interior of the housing, the sound absorbing structure can efficiently reduce the noise generated in the interior of the housing. Besides, since the sound absorbing structure is not disposed at the position where the shroud faces the fan, the air flow is not disturbed and the noise released from the interior of the fan device housing to the exterior can be reduced without deteriorating the air feed capacity of the fan device.

[0025] (6) The shroud may be constituted by a cylindrical wall, the cylindrical wall being formed so as to be spaced a predetermined distance from a fan shaft which is formed perpendicularly to a front panel as a constituent of the housing, and the perforated plate(s) may be disposed substantially perpendicularly to the fan shaft.

[0026] In this case, the sound absorbing structure is attached to the front panel which constitutes a part of the housing. The position where the sound absorbing structure is mounted is on the outer periphery side of the shroud and in an empty area of the housing. The sound absorbing structure is disposed so that its perforated surface is perpendicular to the fan shaft. That is, the perforated surface faces toward the interior of the housing. Consequently, the noise generated in the interior of the housing can be reduced efficiently. Moreover, since no sound absorbing structure is formed on the inner periphery surface of the shroud, the air flow is not obstructed and it is possible to prevent deterioration of the air feeding capacity of the fan device.

(7) The plural perforated plates may be different in the porosity in such a manner that the porosity becomes smaller in order from the outermost surface layer toward

an inner layer(s).

[0027] In this case, since the plural perforated plates are different in the porosity in such a manner the porosity becomes smaller in order from the outermost layer toward an inner layer(s), the noise generated in the interior of the fan device can be reduced stepwise and effectively.

[0028] (8) One or more partition plates are disposed in the one or plural air layers so as to divide the one or plural air layers in-plane direction of the perforated plate (s) at a spacing of half or less of the wavelength of noise concerned which is generated in the interior of the housing.

[0029] In this case, since partition plates are formed so as to divide the one or plural air layers at a spacing of half or less of the wavelength of noise concerned which is generated in the interior of the housing, there occurs resonance in an air chamber formed behind each perforated plate, whereby it is possible to prevent an increase of the noise in the interior of the housing. As a result, the sound absorbing structure can reduce noise effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Fig. 1 is a schematic diagram showing the appearance of an air conditioner outdoor machine to which is applied a noise reducing structure in a fan device according to an embodiment of the present invention;

Fig. 2 is a schematic plan view showing a back side of a front panel of the air conditioner outdoor machine of Fig. 1;

Fig. 3 is a schematic perspective view showing the back side of the front panel of the air conditioner outdoor machine of Fig. 2;

Fig. 4 is a schematic sectional view showing a section of the air conditioner outdoor machine;

Fig. 5 is a schematic sectional view showing an example of a line A-A section of the air conditioner outdoor machine;

Fig. 6 is a schematic sectional view showing a structural example of the noise reducing structure;

Fig. 7 is a schematic sectional view showing another structural example of the noise reducing structure shown in Fig. 6;

Fig. 8 is a schematic sectional view showing another example of a line A-A section of the air conditioner outdoor machine;

Fig. 9 is a schematic sectional view showing a further example of a line A-A section of the air conditioner outdoor machine;

Fig. 10 shows a simulation result of a sound absorption coefficient in Example 1;

Fig. 11 shows changes in sound pressure level in Example 2 and Comparative Example 1; and

Fig. 12 shows an example of power consumption of a drive motor used in the air conditioner outdoor machine.

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DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0031] An embodiment of the present invention will be described hereinafter. In this embodiment the noise reducing structure in a fan device of the present invention is applied to an air conditioner outdoor machine. However, no limitation is made to the air conditioner outdoor machine. The present invention is applicable also to a vehicular engine cooling device, a computer cooling device, a bathroom ventilating device and any other fan device.

[0032] Fig. 1 is a schematic diagram showing the appearance of an air conditioner outdoor machine to which is applied the noise reducing structure in a fan device according to the present invention, Fig. 2 is a schematic plan view showing a back side of a front panel of the air conditioner outdoor machine of Fig.1, Fig. 3 is a schematic perspective view showing the back side of the front panel of the air conditioner outdoor machine of Fig.2, and Fig. 4 is a schematic sectional view showing a section of the air conditioner outdoor machine.

[0033] An air conditioner outdoor machine 100 with the noise reducing structure in a fan device of Figs. 1 to 4 applied thereto includes a fan 200, noise reducing structures 310, 320, 330, a bell-mouth-like shroud 400, a front panel 500 and a drive motor 600.

[0034] As shown in Fig. 1, in the air conditioner outdoor machine 100, which is in the shape of a rectangular parallelepiped, a shaft of the fan 200 is disposed along a horizontal axis and the bell-mouth-like shroud 400 is formed in the front panel 500 so that the outside air can be allowed to flow forward from the back with rotation of the fan 200.

[0035] As shown in Figs. 2 and 3, the noise reducing structures 310, 320 and 330 are disposed on the back side of the front panel 500 along the outer periphery surface of the bell-mouth-like shroud 400. The noise reducing structures 310, 320 and 330 are formed at a height almost equal to the length of the shroud 400 formed in the front panel 500. In each of the noise reducing structures 310, 320 and 330 a large number of holes are formed so as to open in the direction opposite to the front panel 500.

[0036] In this case, in the internal structure of the air conditioner outdoor machine 100, as shown in Fig. 4, the noise reducing structures 310, 320 and 330 are not formed in the portion where they exert an influence on an air flow created by both fan 200 and bell-mouth-like shroud 400. The shaft of the fan 200 is connected to the drive motor 600 so that the fan 200 can be rotated by operation of the drive motor 600.

[0037] Fig. 5 is a schematic sectional view showing an example of a line A-A section of the air conditioner outdoor machine 100 shown in Figs. 2 and 3.

[0038] As shown in Fig. 5, the shroud 400 is disposed

symmetrically with respect to an axis CL of the fan 200 of the air conditioner outdoor machine 100 and the noise reducing structures 310 and 330 are disposed on the back side of the front panel 500. A description will be given below about an example of the noise reducing structures 310, 320 and 330.

[0039] Fig. 6 is a schematic sectional view showing a structural example of the noise reducing structures 310, 320 and 330.

[0040] As shown in Fig. 6, the noise reducing structures 310, 320 and 330 are formed by perforated plates 301, 302, a side plate 304 and a flat plate 305. Apart of them may be formed by the front panel 500. More particularly, the noise reducing structures 310, 320 and 330 may be formed by molding integrally with the front panel 500. The perforated plate 301 (surface layer) and the perforated plate 302 are spaced a distance L1 from each other and an air layer corresponding to the distance L1 is formed. Likewise, the perforated plate 302 and the flat plate 305 are spaced a distance L2 from each other and an air layer corresponding to the distance L2 is formed.

[0041] In the perforated plates 301 and 302 there are formed a large number of through holes. It is preferable that the holes of the perforated plates 301 and 302 be in at least one shape selected from among small hole, circular hole, deformed hole, slit-like hole, louver fin-like hole, crossed hole, and any other arbitrary shape.

[0042] In this embodiment the holes are assumed to be circular holes. In this embodiment the perforated plate 301 has a thickness of 0.15 mm, a percentage holes of 0.3% and a hole diameter of 0.5 mm.

[0043] In this embodiment the perforated plate 302 has a thickness of 0.29 mm, a percentage holes of 0.1% and a hole diameter of 0.5 mm.

[0044] From the standpoint of recycling and strength it is preferable that the perforated plates 301 and 302 be formed by an aluminum plate, a steel plate, or a plastic plate. It is optional whether the holes of the perforated plates 301 and 302 are formed by punching or by embossing.

[0045] In this embodiment the distance L1 between the perforated plates 301 and 302 is 20 mm and the distance L2 between the perforated plate 302 and the flat plate 305 is 45 mm.

[0046] Fig. 7 is a schematic sectional view showing another structural example of the noise reducing structures 310, 320 and 330 shown in Fig. 6.

[0047] As shown in Fig. 7, the noise reducing structures 310, 320 and 330 are made up of perforated plates 301, 302, 303, side plate 304, flat plate 305 and partition plate 308. A part of them may be formed by the front panel 500. More particularly, the noise reducing structures 310, 320 and 330 may be formed by molding integrally with the front panel 500. The perforated plates 301 and 302 are spaced a distance L1 from each other and an air layer corresponding to the distance L1 is formed. The perforated plates 302 and 303 are spaced a distance L2 from each other and an air layer corresponding to the

distance L2 is formed. The perforated plate 303 and the flat plate 305 are spaced a distance L3 from each other and an air layer corresponding to the distance L3 is formed. The partition plate 308 is disposed in each air layer. The distance L5 between adjacent partition plates 308 is set to a value of half or less of a main frequency of the noise generated in the air conditioner outdoor machine 100. As a result, there occurs resonance in air chambers formed behind the perforated plates 301, 302 and 303 and it is thereby possible to prevent an increase of noise in the interior of the housing.

[0048] Thus, the noise generated in the interior of the air conditioner outdoor machine 100 can be reduced by the noise reducing structures 310, 320 and 330. Besides, since the noise reducing structures 310, 320 and 330 are not disposed in the portion of the shroud 400 facing the air flow, the air flow is not disturbed and it is possible to attain the reduction of noise without deteriorating the air feed capacity of the fan 200. Moreover, in the case where the noise reducing structures 310, 320 and 330 are formed by molding integrally with the front panel 500, the number of assembling steps decreases, thus permitting the reduction of cost. In the case where the noise reducing structures 310, 320 and 330 are formed as independent members, the noise reducing structures 310, 320 and 330 can be disposed also in the portion where integral molding with the front panel 500 is difficult.

[0049] Moreover, since the noise reducing structures 310, 320 and 330 are each constituted by one or plural perforated plates 301, 302 and 303, vibration of the air present within the air conditioner outdoor machine 100 is damped by viscous damping which is induced by vibration of air within the perforated plates 301, 302 and 303, thus permitting the reduction of noise. Besides, since it is a plate member that constitutes each noise reducing structure, the environmental resistance of the sound absorbing structure according to the present invention can be kept high and the performance and structure of the sound absorbing structure do not undergo a change over a long period. Therefore, even in long-term use thereof, the noise reducing performance is not deteriorated.

[0050] In this case, in the noise reducing structures 310, 320 and 330, since the perforated plates 301, 302 and 303 are formed in a direction perpendicular to the air flow direction (motor axis direction) and toward the interior of the front panel 500, it is possible to efficiently reduce the noise generated in the interior of the air conditioner outdoor machine 100.

[0051] The plural perforated plates 301, 302 and 303 are different in the porosity in such a manner that the porosity becomes smaller in order from the outermost layer toward inner layers, more particularly, the perforated plate 301 is the largest and the perforated plate 303 is the smallest in the porosity. Consequently, the noise generated in the interior of the fan 200 can be reduced stepwise and effectively.

[0052] In this case, since partition plates 308 are

formed in the noise reducing structures 310, 320 and 330 so that the spacing between the adjacent partition plates 308 is half or less of the wavelength of noise generated in the interior of the air conditioner outdoor machine 100, the noise generated in the interior of the air conditioner outdoor machine 100 can be prevented from increase in the air chambers formed behind the perforated plates 301, 302 and 303. As a result, the noise reducing structures 310, 320 and 330 can reduce noise effectively.

[0053] Fig. 8 is a schematic sectional view showing another example of a line A-A section of the air conditioner outdoor machine 100 shown in Fig. 5.

[0054] As shown in Fig. 8, the shroud 400 is disposed symmetrically with respect to the axis CL of the fan 200 of the air conditioner outdoor machine 100 and noise reducing structures 310a and 330a are disposed on the back side of the front panel 500. The noise reducing structures 310a and 330a shown in Fig. 8 are constituted by perforated plates 301a and 302a. The perforated plate 301a is disposed substantially in parallel with the fan axis CL, while the perforated plate 302a is disposed at an acute angle (0° to 90°) relative to the perforated plate 301a.

[0055] With this arrangement, the noise reducing structures 310a, 320a and 330a can reduce noise effectively.

[0056] Fig. 9 is a schematic sectional view showing a further example of a line A-A section of the air conditioner outdoor machine 100 shown in Fig. 5.

[0057] As shown in Fig. 9, the shroud 400 is disposed symmetrically with respect to the axis CL of the fan 200 of the air conditioner outdoor machine 100 and noise reducing structures 310b and 330b are disposed on the back side of the front panel 500. The noise reducing structures 310b and 330b shown in Fig. 9 are constituted by perforated plates 301b and 302b. The perforated plate 301b is disposed in a smoothly contiguous manner from an end of the shroud 400, while the perforated plate 302b is disposed in parallel with the front panel 500 and perpendicularly to the axis CL.

[0058] With this arrangement, the noise reducing structures 310b, 320b and 330b can reduce noise effectively.

(Example 1)

[0059] In this Example there was performed simulation of a sound absorption coefficient with respect to a structural example of the noise reducing structures 310, 320 and 330 shown in Fig. 6.

[0060] Fig. 10 shows a simulation result of a sound absorption coefficient in Example 1. In the same figure, a sound absorption coefficient is plotted along the axis of ordinate and frequency is plotted along the axis of abscissa.

[0061] The noise reducing structures 310, 320 and 330 shown in Fig. 6 were designed so as to permit reduction of noises at frequencies near 250 Hz and 1000 Hz. The

effect thereof was checked by simulation. As a result, high sound absorption coefficients were observed at frequencies near 250 Hz and 1000 Hz as shown in Fig. 10. Moreover, since sound absorption coefficients obtained in the frequency range of 250 Hz to 1500 Hz are not smaller than 0.3, it is seen that the reduction of noise can be attained over a wide frequency band.

(Example 2)

[0062] The noise reducing structures 310, 320 and 330 described in Example 1 were applied to the air conditioner outdoor machine 100 shown in Fig. 1. In accordance with JIS C9612 the air conditioner outdoor machine 100 was installed within a semi- anechoic room and the measurement of noise was conducted at a distance of 1 m from the front face of the outdoor machine.

(Comparative Example 1)

[0063] In this Comparative Example the measurement of noise was conducted for the air conditioner outdoor machine 100 not using the noise reducing structures 310, 320 and 330. As in Example 2, the measurement of noise was performed in accordance with JIS C9612.

[0064] Fig. 11 shows sound pressure level in Example 2 and Comparative Example 1. The sound pressure level (dBA) is plotted along the axis of ordinate and 1/3 Oct. Band center frequency (Hz) is plotted along the axis of abscissa. In Fig. 11, a solid line A shows the result of Example 2 and a dotted line B shows the result of Comparative Example 1.

[0065] Fig. 11 shows that in the 1/3 Oct. Band center frequency (Hz) range of 160 Hz to 250 Hz a sound pressure level of a solid line A in Example 2 is much lower than that of a dotted line B in Comparative Example 1. Further, it is seen that the sound pressure level drops also in the range from 1000 Hz to 1600 Hz. Thus, it turned out that the noise level (the sum of all frequency bands) could be reduced 1 dB in Example 2 as compared with Comparative Example 1.

[0066] Next, in order to check whether the air feed capacity of the fan device was influenced or not, power consumption of the drive motor 600 in the air conditioner outdoor machine 100 was measured.

[0067] Fig. 12 shows an example of power consumption of the drive motor 600 in the air conditioner outdoor machine 100. In Fig. 12, power consumption (W) is plotted along the axis of ordinate and time (sec) is plotted along the axis of abscissa. In the same figure, a solid line A represents the state of Example 2 and a dotted line B represents the state of Comparative Example 1.

[0068] As shown in Fig. 12, there occurred no significant difference between the state of Example 2 indicated by the solid line A and that of Comparative Example 1 indicated by the dotted line B.

[0069] Thus, because of no difference in power consumption of the drive motor 600, the air feed capacity of

the fan 200 was also presumed to have undergone no change. As a result, it turned out that the air feed capacity in the air conditioner outdoor machine 100 was not deteriorated.

[0070] In the above embodiment of the present invention, the fan 200 corresponds to the fan defined in the present invention, and likewise the front panel 500 corresponds to a part of the housing, the shroud 400 corresponds to the shroud formed by a bell-mouth-like inner surface, the noise reducing structures 310, 320 and 330 corresponds to the sound absorbing structure, the perforated plates 301, 302 and 303 correspond to one or plural perforated plates and the partition plates 308 correspond to one or plural partition plates.

[0071] The present invention is as described in the above preferred embodiment, but no limitation is made thereto. It will be understood that various other embodiments may be made within the scope not departing from the spirit and scope of the present invention. Further, although in the above embodiment reference has been made to the function and effect attained by the construction of the present invention, such function and effect are a mere example and do not limit the present invention. A noise reducing structure in a fan device is provided which can reduce noise generated in the interior of a housing of the fan device without deteriorating the air feed capacity of the fan device. In the noise reducing structure in a fan device, a fan (200) is rotated by a drive motor (600) to create an air flow. The air flow is introduced and uniformed by a bell-mouth-like shroud (400). Sound absorbing structures (310, 320, 330) are formed on a surface intersecting the outer periphery surface of the shroud (400).

Claims

1. A noise reducing structure in a fan device including:

a fan for creating an air flow;
a housing for accommodating said fan therein;
and
a shroud provided in part of said housing,
said noise reducing structure, comprising:

a sound absorbing structure disposed in the interior of said housing and on an outer periphery side of said shroud.

2. A noise reducing structure in a fan device according to claim 1, wherein said sound absorbing structure is formed integrally with said housing.

3. A noise reducing structure in a fan device according to claim 1, wherein said sound absorbing structure is formed as an independent member.

4. A noise reducing structure in a fan device according

to any of claims 1 to 3, wherein said sound absorbing structure is formed by one perforated plate and an air layer, or a plurality of perforated plates arranged in a layered fashion and a plurality of air layers.

5. A noise reducing structure in a fan device according to claim 4, wherein said perforated plate(s) is (are) disposed toward the interior of said housing.

6. A noise reducing structure in a fan device according to claim 4 or claim 5, wherein said shroud is constituted by a cylindrical wall, said cylindrical wall being formed so as to be spaced a predetermined distance from a fan shaft which is formed perpendicularly to a front panel as a constituent of said housing, and said perforated plate(s) is (are) disposed substantially perpendicularly to said fan shaft.

7. A noise reducing structure in a fan device according to any of claims 4 to 6, wherein said plural perforated plates are different in the porosity in such a manner that the porosity becomes smaller in order from the outermost surface layer toward an inner layer(s).

8. A noise reducing structure in a fan device according to any of claims 4 to 7, wherein one or more partition plates are disposed in said one or plural air layers so as to divide the one or plural air layers in-plane direction of said perforated plate(s) at a spacing of half or less of the wavelength of noise concerned which is generated in the interior of said housing.

FIG. 1

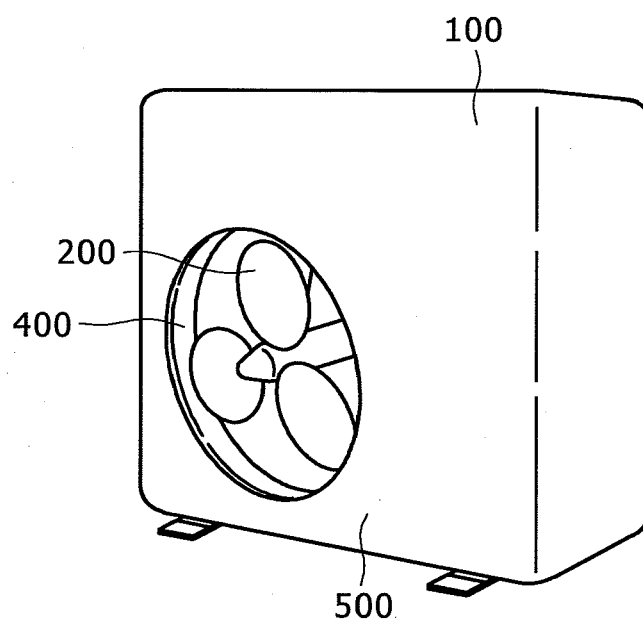


FIG. 2

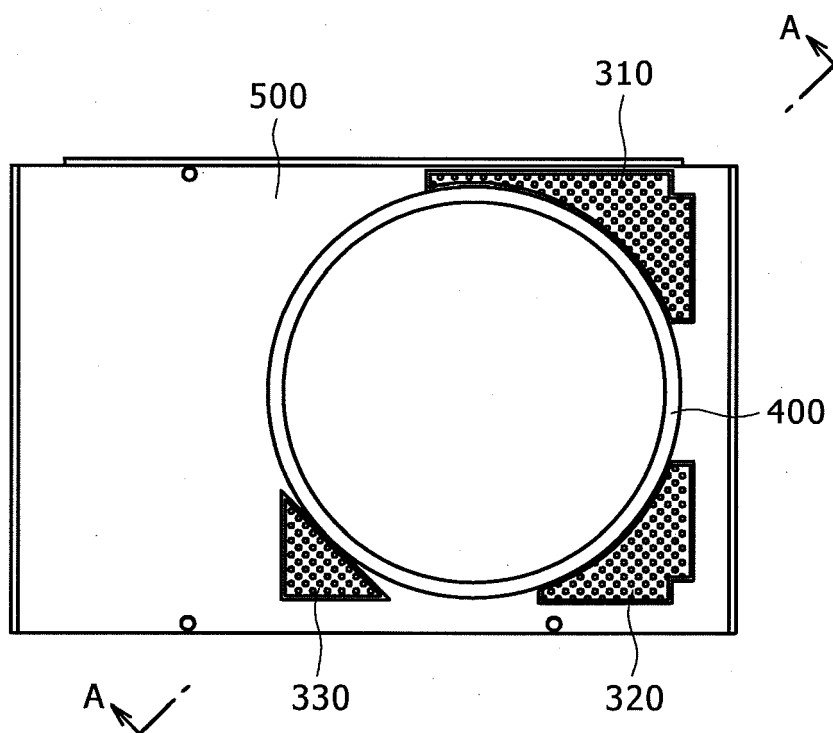


FIG. 3

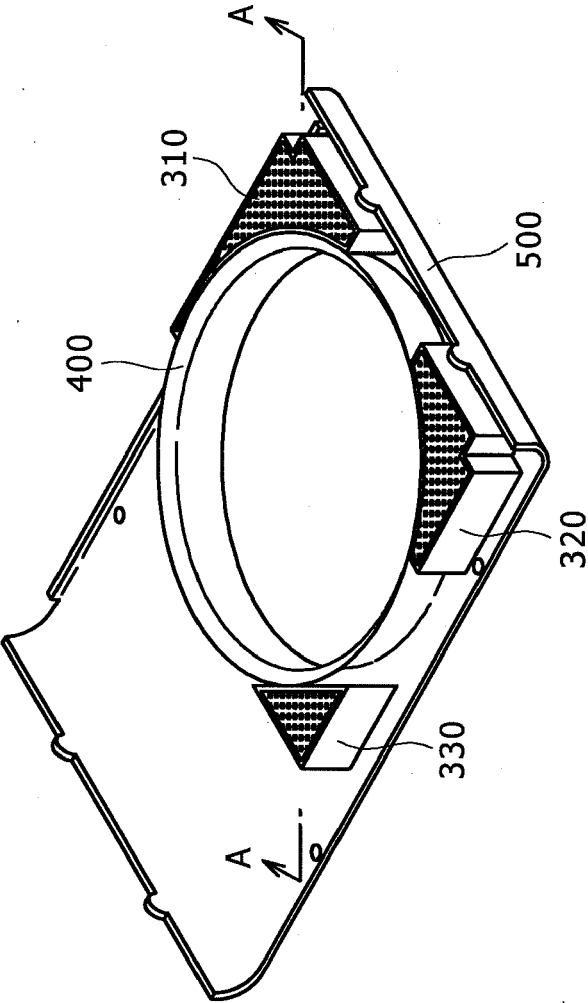


FIG. 4

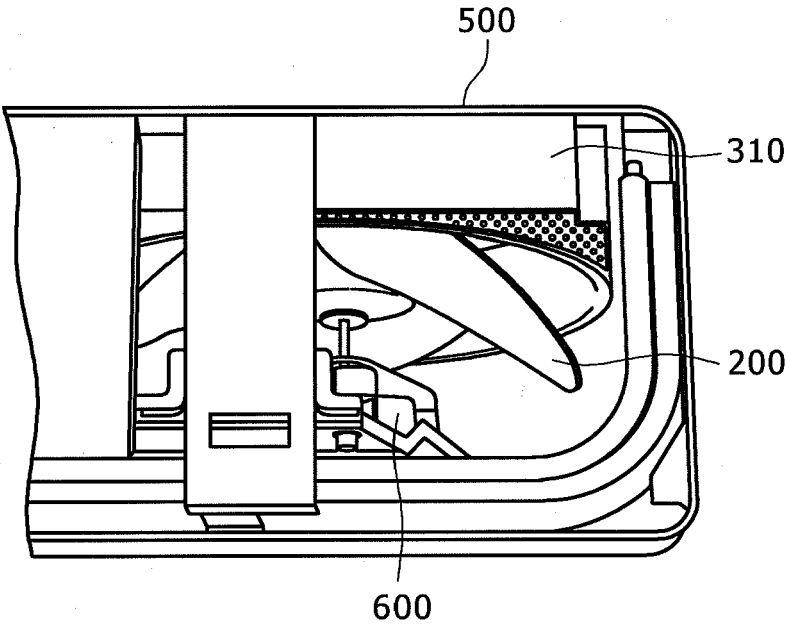


FIG. 5

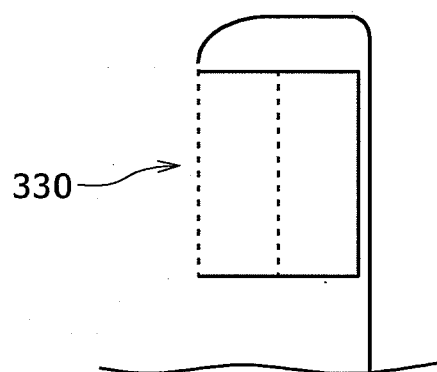
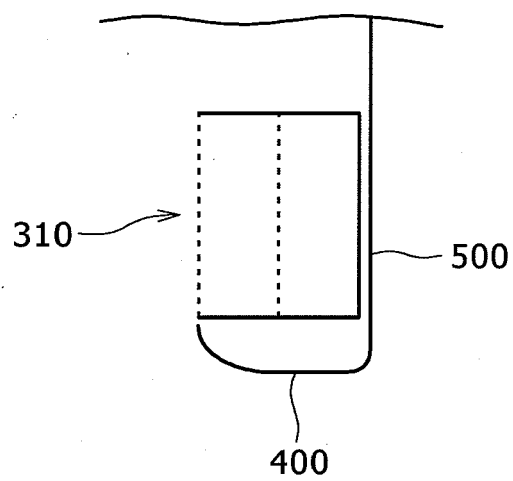


FIG. 6

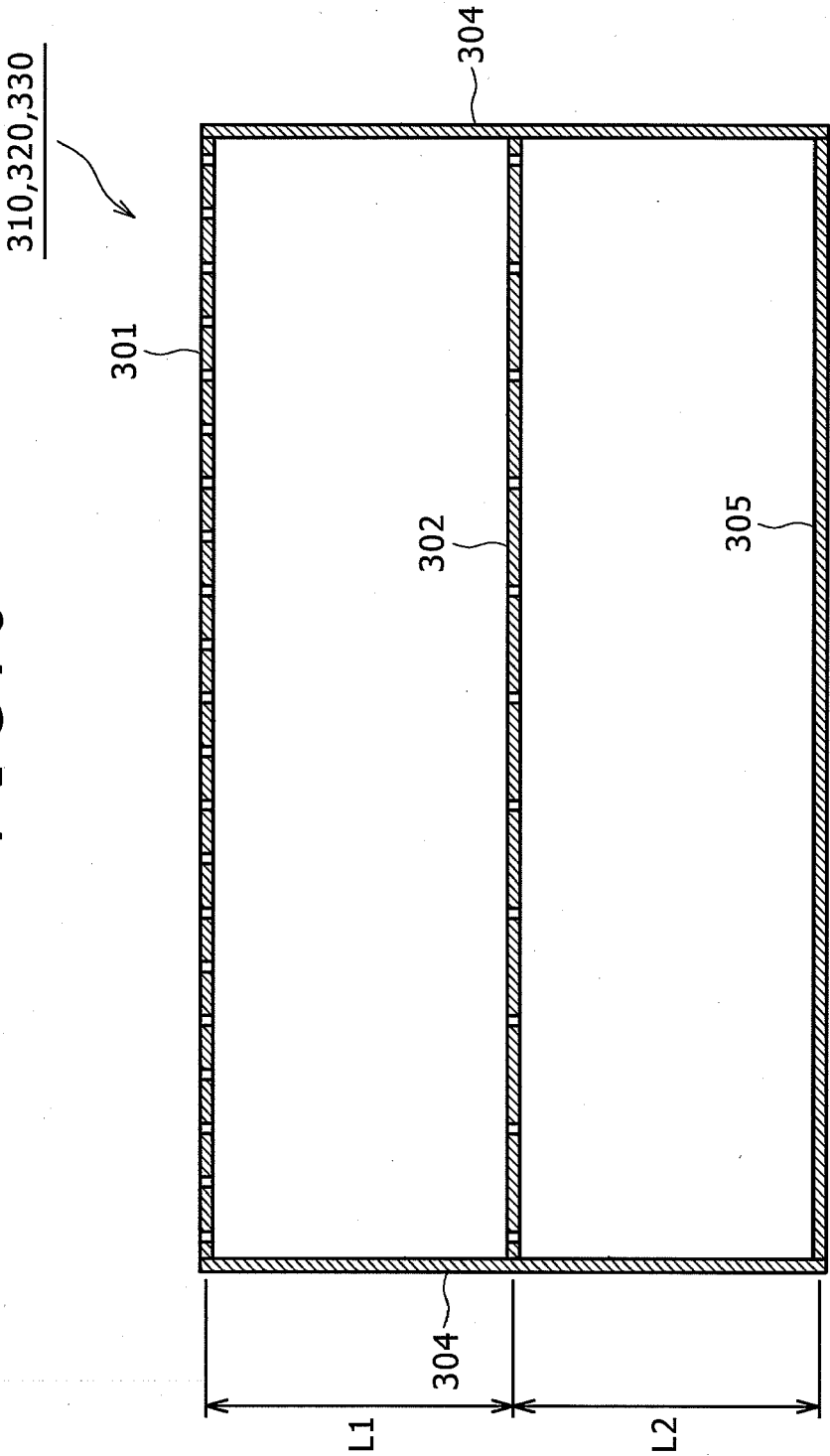


FIG. 7

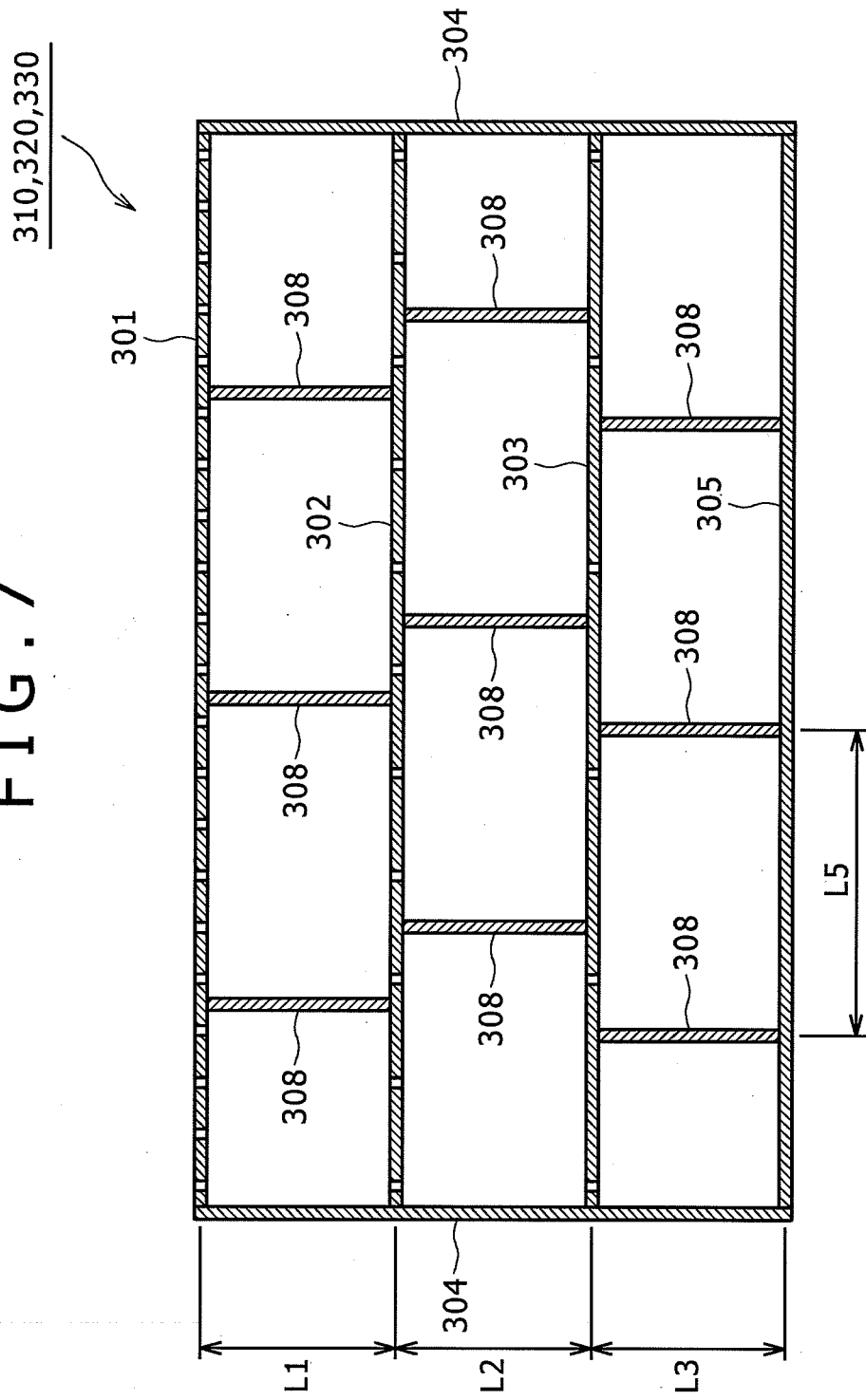


FIG. 8

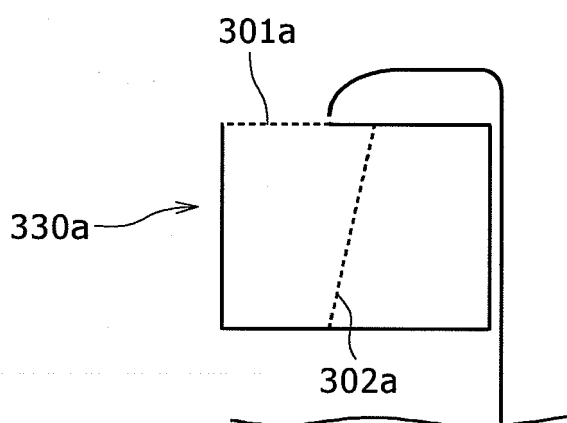
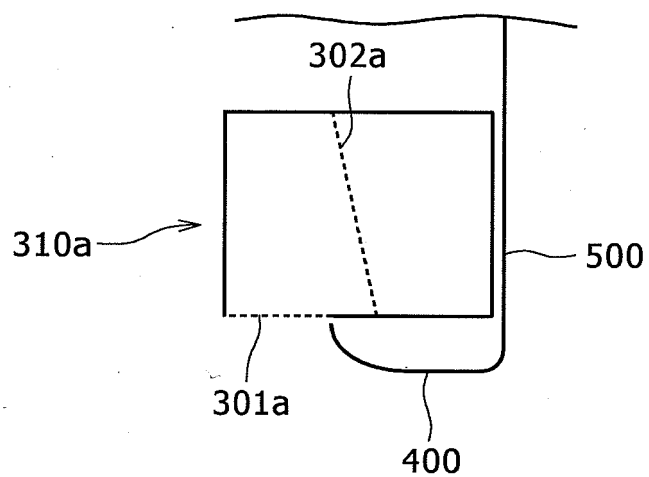


FIG. 9

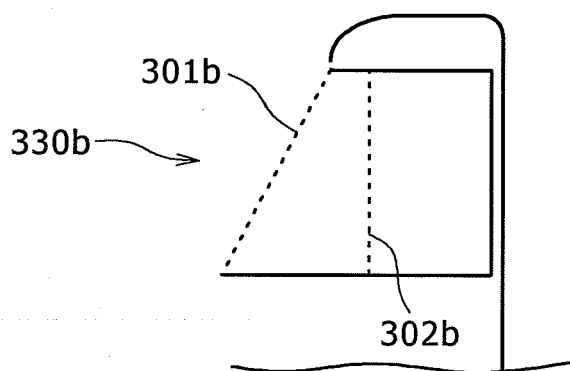
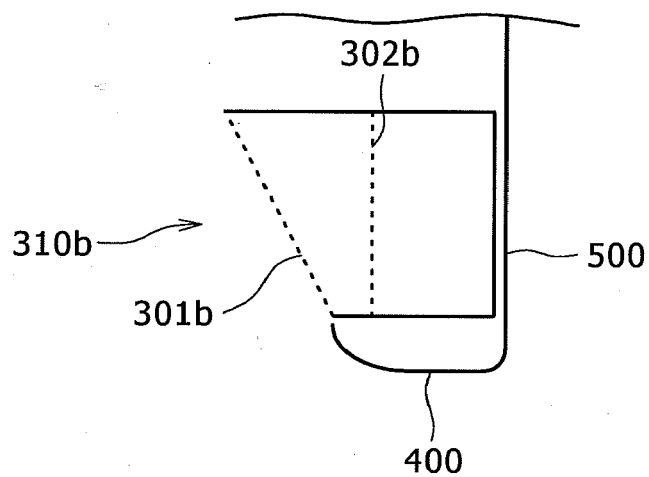


FIG. 10

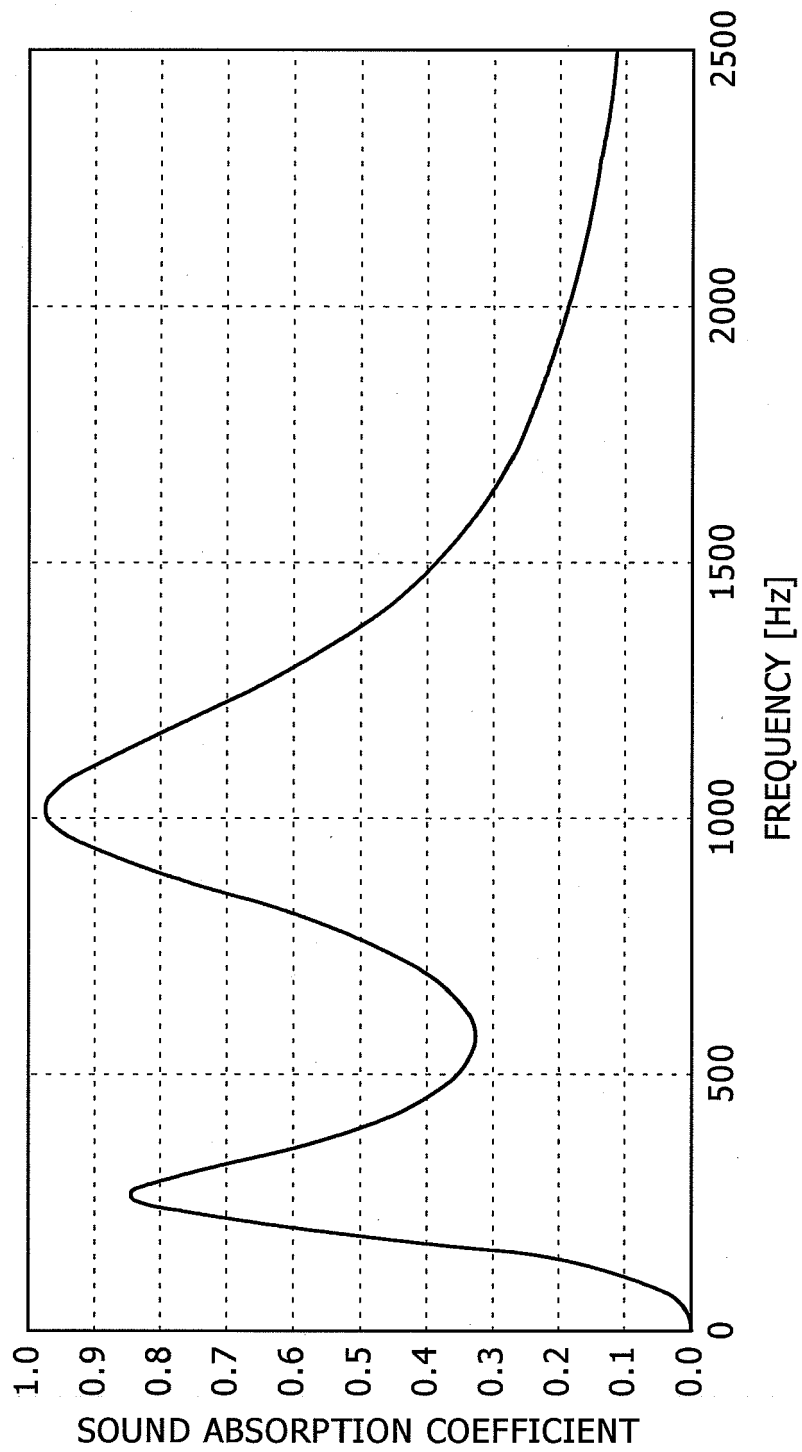


FIG. 11

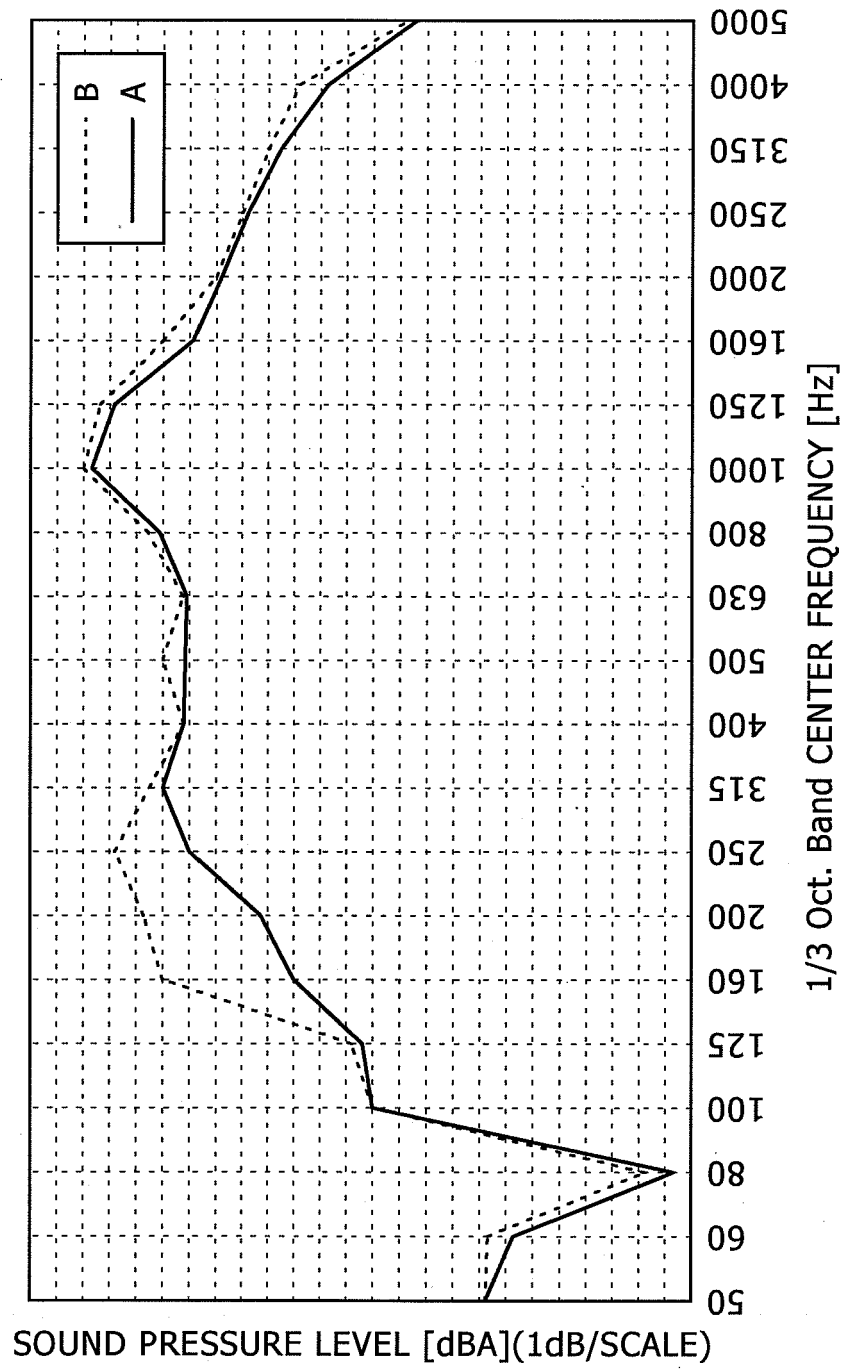
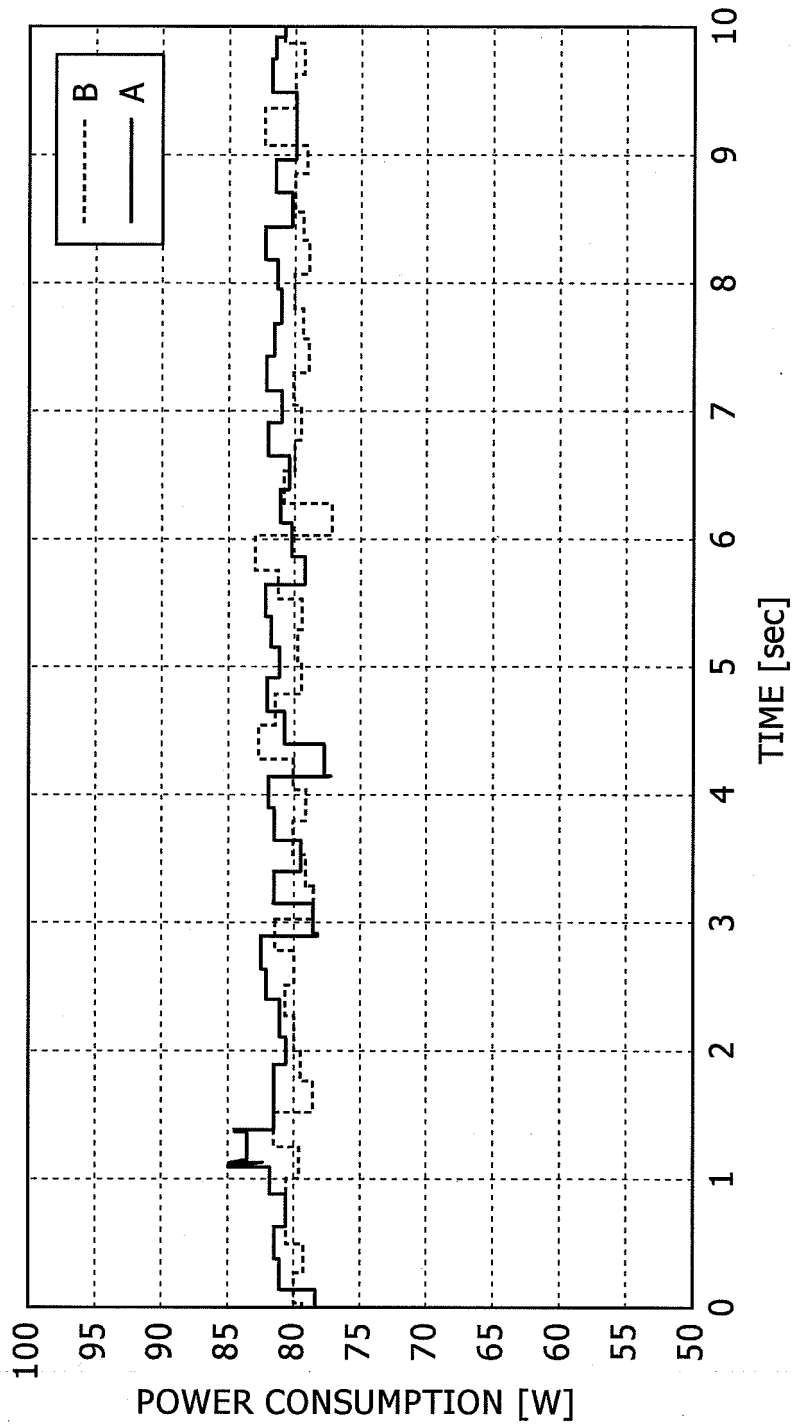


FIG. 12



REFERENCES CITED IN THE DESCRIPTION

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