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(54) Motor assembly and vacuum cleaner having the same

(57) A motor assembly (100) includes: a suction motor (110); at least one inner casing (120) adapted to enclose at least a part of the suction motor (110); and at least one outer casing (130) configured to enclose at least a part of the at least one inner casing (120), wherein a diffusion passage (P1) is formed between the at least one inner casing (120) and the at least one outer casing (130) and has an average cross-section that gradually increases to allow air to diffuse therein.

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority under 35 U.S.C. § 119 from Korean Patent Application No. 2005-40917, filed May 16, 2005, the entire contents of which are incorporated herein by reference. This application may also be related to commonly assigned U.S. Patent Application Serial No. 10/851,243, filed May 24, 2004, U.S. Patent Application Serial No. 11/206,905, filed August 19, 2005, as well as to attorney docket no. 116511-00204, entitled "MOTOR ASSEMBLY AND VACUUM CLEANER HAVING THE SAME." The contents of each of these three applications are incorporated herewith.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a vacuum cleaner, and more particularly, to a motor assembly adapted to reduce a noise generated in a suction motor and a vacuum cleaner having the same.

Description of the Related Art

[0003] A vacuum cleaner draws in dust using a suction force that is generated as a suction motor is driven. The dust is then collected in a dust-collecting chamber. Generally, a cleaner includes a high output motor having a high number of RPMs. However, such a high output motor causes a high level of noise when being driven.

[0004] Korean Patent Publication No. 1997-32650 describes a motor casing including a noise absorbing member and a noise blocking member, which encloses the noise absorbing member and has perforations formed on a surface thereof. Japanese Patent Publication No. H01-268524 describes a motor casing including a first penetrating hole formed on a side surface thereof, a second penetrating hole formed on a rear surface, and a noise absorbing member formed at the first and the second penetrating hole.

[0005] However, the devices of Korean Patent Publication No. 1997-32650 and Japanese Patent Publication No. H01-268524 require an extra noise absorbing member to reduce noise, and thus have a complicated structure and increases a manufacturing cost. Although both disclosures reduce a blade passing frequency (BPF) noise and an entire level of noise, they do not effectively reduce a low frequency band noise and a peak component.

SUMMARY OF THE INVENTION

[0006] The present invention has been developed in order to solve the above described problems in the related art.

[0007] To this end, a first aspect of the invention provides a motor assembly, including: a motor; at least one inner casing adapted to enclose at least a part of the motor; and at least one outer casing configured to enclose at least a part of the at least one inner casing, wherein a diffusion passage is formed between the at least one inner casing and the at least one outer casing and has an average cross-section that gradually increases to allow air to diffuse therein.

[0008] Another aspect provides a vacuum cleaner, including: a cleaner body having an air pipe and a discharge pipe; a motor disposed at the cleaner body; at least one inner casing configured to enclose at least a part of the suction motor and to enable fluid communication with the air suction pipe; and at least one outer casing enclosing at least a part of the inner casing and configured to enable fluid communication with the air discharge pipe, wherein a diffusion passage is formed between the at least one inner casing and the at least one outer casing and has an average cross-section that gradually increases to allow the air to diffuse therein.

[0009] Yet another aspect provides a motor assembly, including: at least one motor; at least one first casing configured to enclose at least a part of the at least one motor; at least one second casing configured to enclose at least a part of the at least one first casing; and means for diffusing air.

[0010] Still further, the invention provides a vacuum cleaner, including: a cleaner body; at least one motor disposed of the cleaner body; at least one first casing configured to enclose at least a part of the at least one motor; at least one second casing configured to enclose at least a part of the at least one first casing; and means for diffusing air.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] These and/or other aspects of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0012] FIG. I is a perspective view illustrating a motor assembly according to a non-limiting embodiment of the present invention;

[0013] FIG. 2 is a sectional view illustrating a cleaner body having the motor assembly of FIG. 1 mounted therein and a main part of the motor assembly;

[0014] FIG. 3 is a cross section view of FIG. 2 cut along a line III-III, illustrating the motor assembly and the cleaner body when being viewed from top;

[0015] FIG. 4 is a graph illustrating change in a cross section of a diffusion passage at points ①, ②, ③, ④, ⑤, ⑥, ⑦, ⑧ of FIG. 3;

[0016] FIG. 5 is a graph illustrating a noise reduction effect achieved by the motor assembly according to a non-limiting embodiment of the present invention; and

[0017] FIG. 6 is a graph illustrating a peak component reduction effect achieved by the motor assembly according to a non-limiting embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] Hereinafter, a motor assembly and a vacuum cleaner including the motor assembly according to a non-limiting embodiment of the present invention will now be described with reference to the accompanying drawings. Referring to FIGS. 1 and 2, a motor assembly 100 may include a motor, such as suction motor 110, an inner casing 120, and an outer casing 130. The suction motor 110 may be configured to generate a suction force and may be disposed in a vertical relation to cleaner body 10. The suction motor 110 may include an air discharge window 110a formed on a lower circumference thereof to discharge air therethrough. The air, which may be drawn in through a first air passing hole 121 a, may exit from the suction motor 110 through the air discharge window 110a.

[0019] The suction motor 110 may include a high output motor capable of generating a high number of revolutions per minute (RPMs). As a result, suction motor 110 may generate vibration. In order to prevent vibration and to support the suction motor 110 in a vertical direction (preferably opposite to the direction of load), a support member 140 may be provided. The support member 140 may be disposed at a center of the inner casing 120. The support member 140 may be made of rubber to prevent vibration while supporting the suction motor 110. The support member 140 may be approximately 20 mm to approximately 40 mm.

[0020] The inner casing 120 may include a first inner casing 121 and a second inner casing 122. The first inner casing 121 may be configured to enclose an upper side of the suction motor 110 and may include first air passing hole 121 a to guide the air toward the suction motor 110. The first air passing hole 121 a may fluidly communicate with a suction pipe 11.

[0021] A dust bag (not illustrated), which may serve as a dust collector, and a cyclone dust collecting device (not illustrated) may be provided proximate to the suction pipe 11. Air separated from dust in the dust collector may flow in through the first air passing hole 121 a after passing through the suction pipe 11.

[0022] The second inner casing 122 may be adapted to enclose at least a portion of the lower part of the suction motor 110 that is not enclosed by the first inner casing 121. The second inner casing 122 may also include a second air passing hole 122b formed on a circumference thereof to discharge the air to a diffusion passage P1.

[0023] The first and the second inner casings 121 and 122 may be detachably fastened to each other. In this non-limiting embodiment, they are fastened using a first fastener(e.g., a bolt) 20. Of course, there are other fastening methods such as hinge fastening or force fitting, which are other non-limiting examples considered to be in the scope of the present invention.

[0024] The outer casing 130 may include a first outer casing 131 and a second outer casing 132. The first outer casing 131 may be adapted to enclose an upper portion of the second inner casing 122.

[0025] The second outer casing 132 may be adapted to enclose at least a part of the lower portion of the second inner casing 122 which is not enclosed by the first outer casing 131. The first outer casing 131 and the second outer casing 132 may be fastened to each other to form a third air passing hole 130a to discharge the air from the diffusion passage P1 (see FIG. 3) to an air discharge pipe 12. Of course, the third air passing hole 130a may be formed on either the first outer casing 131 or the second outer casing 132, as well as partially in each.

[0026] The third air passing hole 130a may be formed opposite to the second air passing hole 122b. Accordingly, the air exiting through the second air passing hole 122b may not directly flow into the third air passing hole 130a. Instead, the air may turn in a circumferential direction along the diffusion passage P1 and then exit through the third air passing hole 130a. As such, there may be a change in an air flow direction such that noise can be reduced. The discharge pipe 12 may be disposed adjacent to the third air passing hole 130a so that the air exiting from the third air passing hole 130a can be promptly discharged.

[0027] The first outer casing 131 and the second outer casing 132 may be detachably fastened to each other. In this non-limiting embodiment, a second fastener (e.g., a bolt) 30 may be used to secure the first outer casing 131 and the second outer casing 132. Of course, there are other fastening methods such as hinge fastening and force fitting, which are non-limiting examples considered to be within the scope of the present invention.

[0028] Referring to FIG. 2 and FIG. 3, the diffusion passage P1 may be formed between the inner casing 120 and the outer casing 130 to diffuse the air. More specifically, the diffusion passage P1 may be a space formed by the outer casing 130 and the inner casing 120 and may have an average cross-section that gradually increases along the air flow direction.

[0029] The diffusion passage P1 will now be described in detail with reference to FIGS. 3 and 4. FIG. 3 is a cross-sectional view of the motor assembly and the cleaner body viewed from above, and FIG. 4 is a graph showing the changes in the cross-section of the diffusion passage P1 at points ①, ②, ③, ④, ⑤, ⑥, ⑦, ⑧ of FIG. 3.

[0030] Referring to FIGS. 3 and 4, the cross-section of the diffusion passage P1 irregularly repeats increasing and decreasing from the point ① where the second air passing hole 122b is located, the points ②, ③, ④, ⑤ where the air flows along the diffusion passage P1, the point ⑥ where the third air passing hole 130a is located, to the points ⑦, ⑧,

where the air exiting form the third air passing hole 130a is discharged to the air discharge pipe 12 (see FIG. 2), which is expressed by the dashed line in the graph of

FIG. 4. However, it turns out that the average cross-section gradually increases from the point ① to the point ⑧. The change in the average cross-section is expressed by a solid line.

[0031] Of course, it may be preferable to regularly increase the cross-section of the diffusion passage P1 from the first points ① to ⑧. However, in this non-limiting embodiment, the diffusion passage P1 may be configured to have the cross-section irregularly repeating increasing and decreasing while having the average cross-section gradually increasing.

[0032] The air exiting from the air discharge window 110a of the suction motor 110 diffuses when passing through the diffusion passage P1, the third air passing hole 130a, and the air discharge pipe 12. As a result, the air has a slow flux. Also, the air exiting from the air discharge window 110a may be diffused in a circumferential direction and discharged to the diffusion passage P1 through the second air passing hole 122b. The air may flow in a circumferential direction in the diffusion passage P1 while turning, and its flowing direction may change several times when ascending through the third air passing hole 130a and being discharged from the cleaner body 10 through the air discharge pipe 12.

[0033] Since the air flux becomes slow and the air flowing direction changes, noise is reduced. In particular, a low frequency band noise and a peak component may be effectively reduced. With reference to FIGS. 5 and 6, the noise reduction effect will be described in detail. FIG. 5 is a graph illustrating a noise reduction effect achieved by the motor assembly, and FIG. 6 is a graph illustrating a peak component reduction effect achieved by the motor assembly.

[0034] The noise is reduced by approximately 4.8dBA if the motor assembly 100 is employed, compared to the case that the motor assembly 100 is not employed. The noise is noticeably reduced in a low frequency area (0~2000Hz).

[0035] The noise is reduced by approximately 9.0dBA at the position 'a' where the first peak component appears, and reduced by approximately 20dBA at the position 'b' where the second peak component appears, and reduced by approximately 7.0dBA at the position 'c' where the third peak component appears. Accordingly, the peak component is greatly improved if the motor assembly 100 is employed compared to the case that the motor assembly 100 is not employed.

[0036] Hereinafter, the air flowing path in the motor assembly 100 and the cleaner body 10 will now be described. Referring to FIGS. 2 and 3, the air drawn in through the suction pipe I 1 and the first air passing hole 121 a may descend along an inside of the suction motor 110 and may then exit from the suction motor 110 through the air discharge window 110a.

[0037] The air discharged from the air discharge window 110a may be diffused and discharged to the diffusion passage P1 through the second air passing hole 122b. The air may flow in a circumferential direction in the diffusion passage P1 and may then exit from the diffusion passage P1 through the third air passing hole 130a. The air exiting through the third air passing hole 130a may vertically ascend and exit from the air discharge pipe 12.

[0038] In the motor assembly 100 and the vacuum cleaner having the same according to a non-limiting embodiment of the present invention as described above, the air is diffused, and thus has a slow flux and changes in direction while passing through the second air passing hole 122b, the diffusion passage P1, the third air passing hole 130a, and the air discharge pipe 12. Accordingly, the overall level of noise can be reduced. Especially, the low frequency band noise and the peak component can be effectively reduced. Accordingly, noise generated while cleaning with the vacuum cleaner is greatly reduced.

[0039] Also, since the motor assembly 100 has the diffusion passage P1 formed between the inner casing 120 and the outer casing 130, without having an extra noise absorbing member, the motor assembly 100 has a simplified configuration and its manufacturing cost is decreased.

[0040] The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the present invention. The present teachings can be readily applied to other types of devices. Also, the description of the embodiments of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art, and are considered to be within the scope of the present invention.

Claims

1. A motor assembly, comprising:

a motor;
at least one inner casing adapted to enclose at least a part of the motor; and
at least one outer casing configured to enclose at least a part of the at least one inner casing,

wherein a diffusion passage is formed between the at least one inner casing and the at least one outer casing and has an average cross-section that gradually increases to allow air to diffuse therein.

2. The motor assembly as claimed in claim 1, wherein the average cross-section gradually increases along a direction of air flow.

3. The motor assembly as claimed in any of claims 1 and 2, wherein the at least one inner casing comprises:

a first inner casing having a first air passing hole

through which air is drawn into the motor; and
a second inner casing having a second air passing hole through which air is discharged to the diffusion passage.

4. The motor assembly as claimed in claim 3, wherein a third air passing hole is formed in the at least one outer casing opposite to the second air passing hole, and air is discharged from the diffusion passage through the third air passing hole.

5. A vacuum cleaner, comprising:

a cleaner body having an air suction pipe and a discharge pipe;
a motor disposed at the cleaner body;
at least one inner casing configured to enclose at least a part of the motor and to enable fluid communication with the air suction pipe; and
at least one outer casing enclosing at least a part of the inner casing and configured to enable fluid communication with the air discharge pipe,

wherein a diffusion passage is formed between the at least one inner casing and the at least one outer casing and has an average cross-section that gradually increases to allow the air to diffuse therein.

6. The vacuum cleaner as claimed in claim 5, wherein the average cross-section gradually increases along a direction of air flow.

7. The vacuum cleaner as claimed in any of claims 5 and 6, wherein the at least one inner casing comprises:

a first inner casing having a first air passing hole through which air is drawn into the motor; and
a second inner casing having a second air passing hole through which air is discharged to the diffusion passage.

8. The vacuum cleaner as claimed in claim 7, wherein a third air passing hole is formed in the at least one outer casing opposite to the second air passing hole, and air is discharged from the diffusion passage through the third passing hole.

9. The vacuum cleaner as claimed in claim 8, wherein the air discharge pipe is disposed adjacent to the third air passing hole.

10. A motor assembly, comprising:

at least one motor;
at least one first casing configured to enclose at least a part of the at least one motor;
at least one second casing configured to enclose at least a part of the at least one first casing; and
means for diffusing air.

11. The motor assembly as claimed in claim 10, wherein the at least one first casing includes means for drawing air into the at least one motor.

12. The motor assembly as claimed in any of claims 10 and 11, wherein the at least one first casing includes means for discharging air to the means for diffusing.

13. The motor assembly as claimed in any of claims 10 to 12, wherein the at least one first casing includes means for discharging air to the means for diffusing.

14. A vacuum cleaner, comprising:

a cleaner body;
at least one motor disposed of the cleaner body;
at least one first casing configured to enclose at least a part of the at least one motor;
at least one second casing configured to enclose at least a part of the at least one first casing; and
means for diffusing air.

15. The vacuum cleaner as claimed in claim 14, wherein the at least one first casing includes means for drawing air into the at least one motor.

16. The vacuum cleaner as claimed in any of claims 14 and 15, wherein the at least one first casing includes means for discharging air to the means for diffusing.

FIG. 1

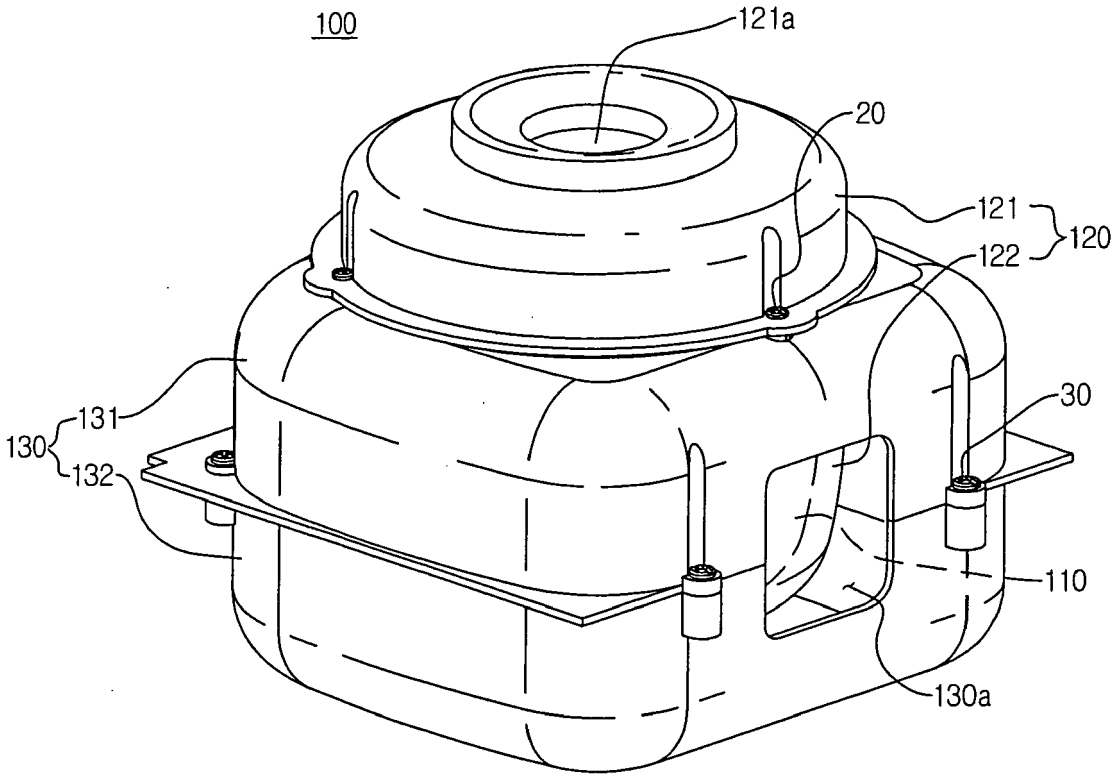


FIG. 2

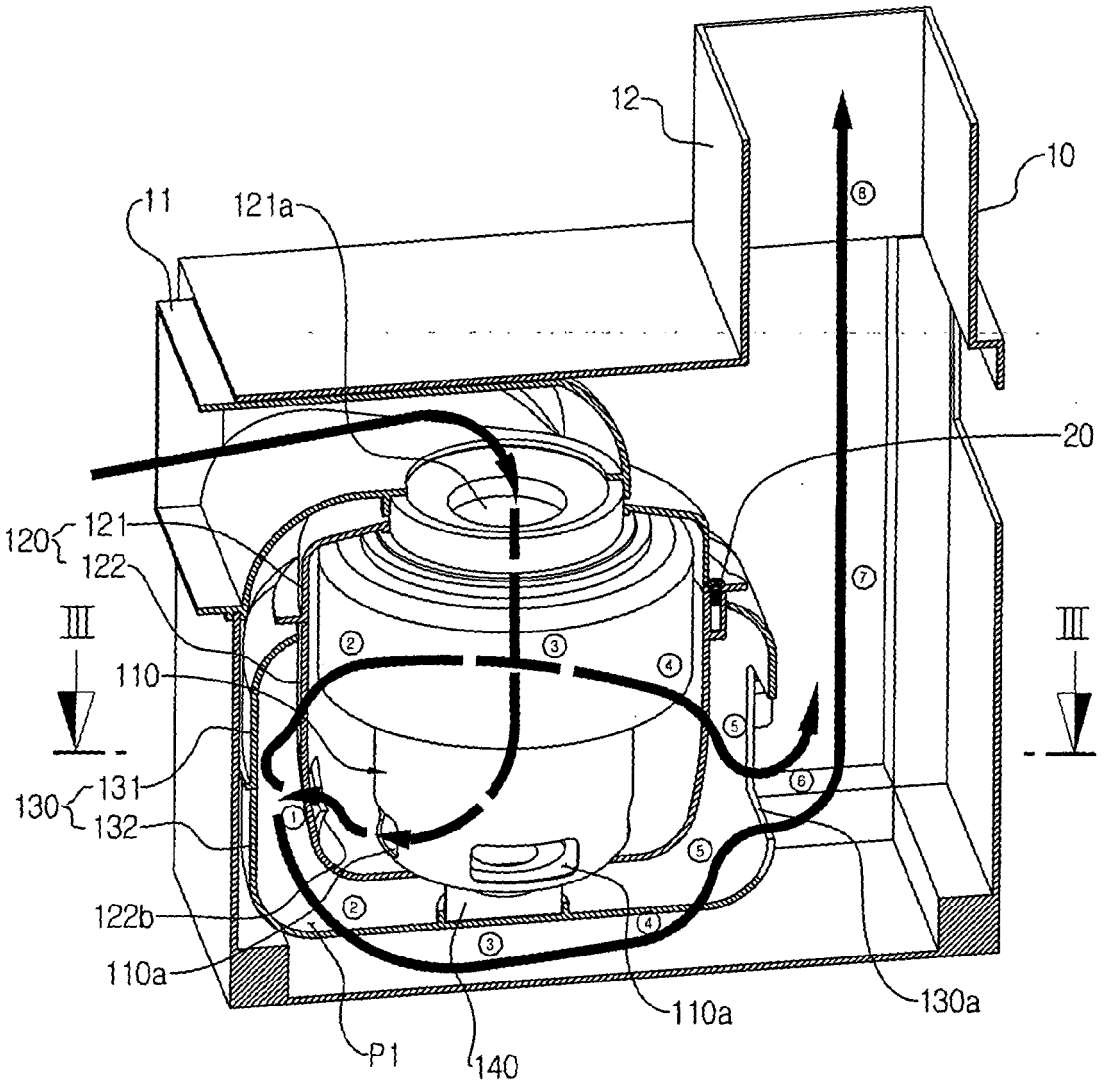

12
10
11
121a
20
120
121
122
III
110
131
130
132
122b
110a
P1
140
110a
130a
III

FIG. 3

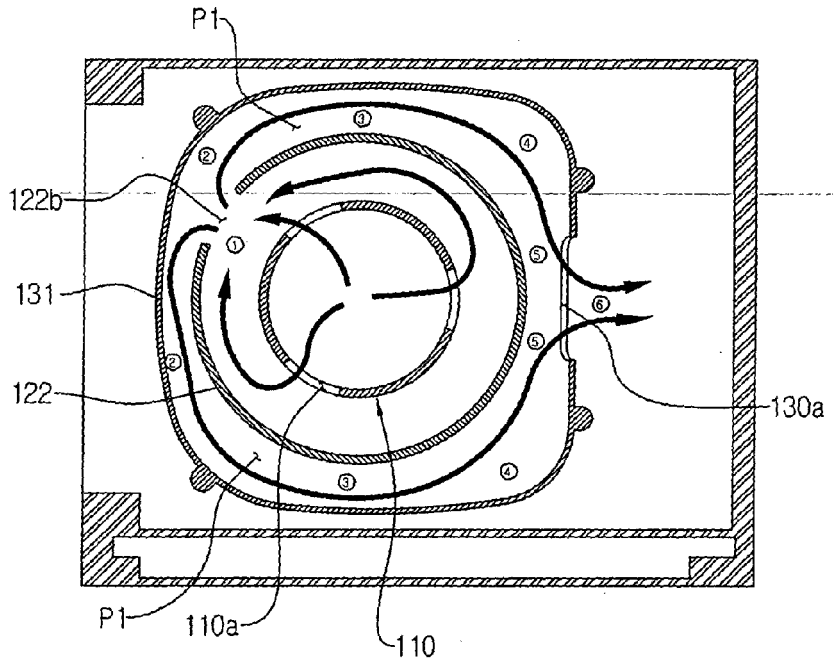


FIG. 4

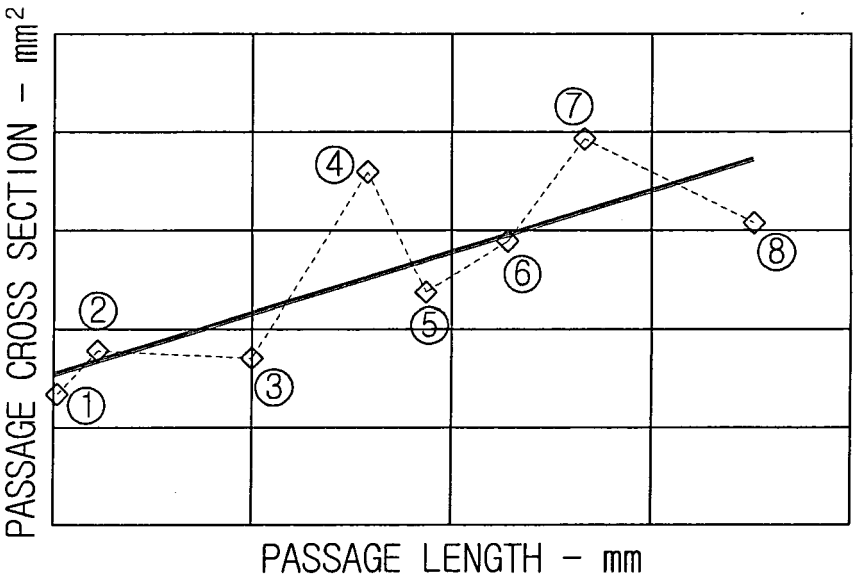


FIG. 5

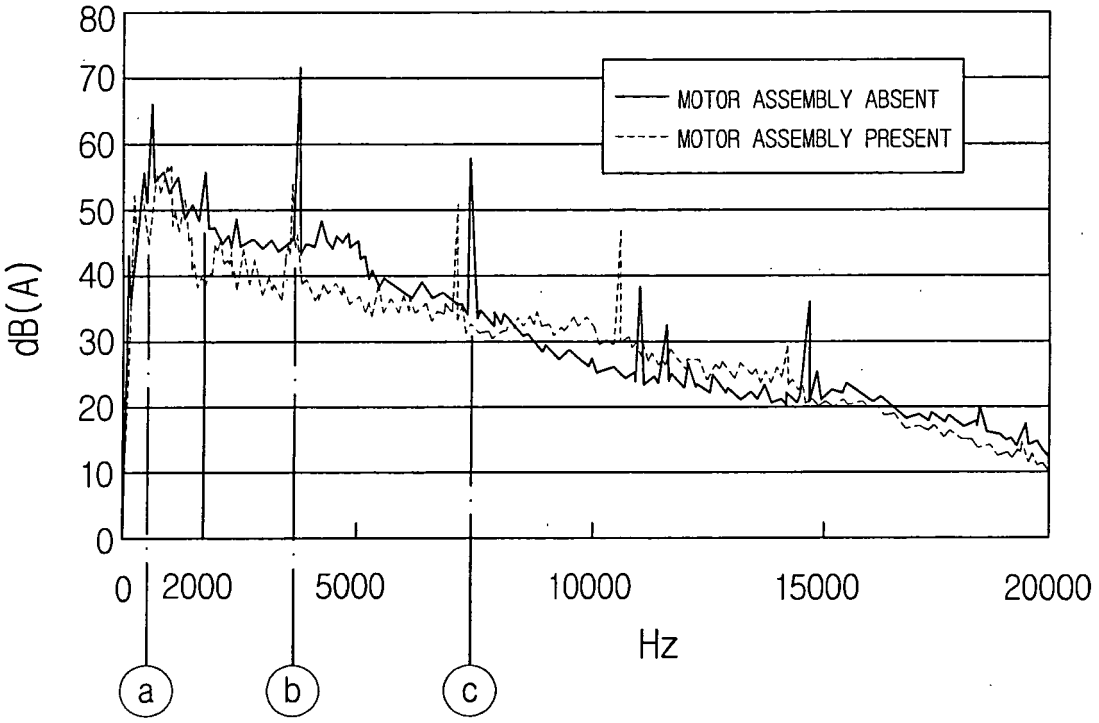
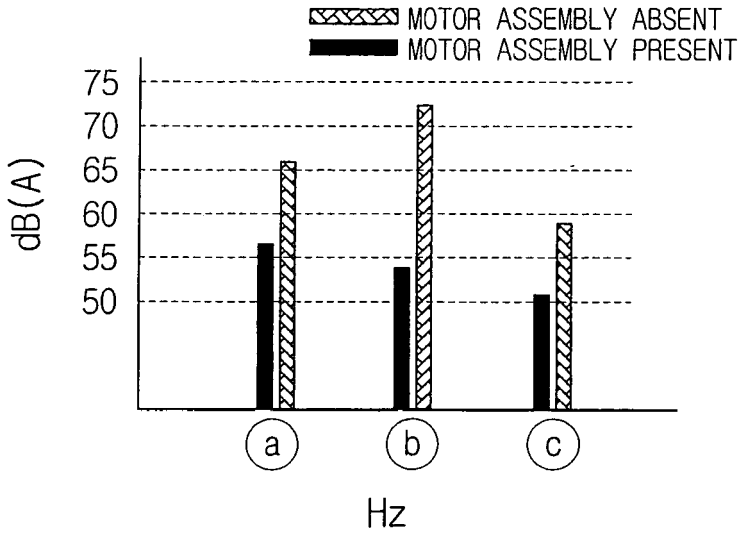

80
70
60
50
40
30
20
10
0
dB(A)
MOTOR ASSEMBLY ABSENT
MOTOR ASSEMBLY PRESENT
0
2000
5000
10000
15000
20000
Hz
a
b
c

FIG. 6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MOTOR ASSEMBLY PRESENT
dB(A)
75
70
65
60
55
50
a
b
c
Hz

REFERENCES CITED IN THE DESCRIPTION

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- US 85124304 A **[0001]**
- US 20690505 A **[0001]**
- KR 199732650 **[0004] [0005]**
- JP H01268524 B **[0004] [0005]**