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(54) LOW NOISE AIR MOVEMENT GENERATOR

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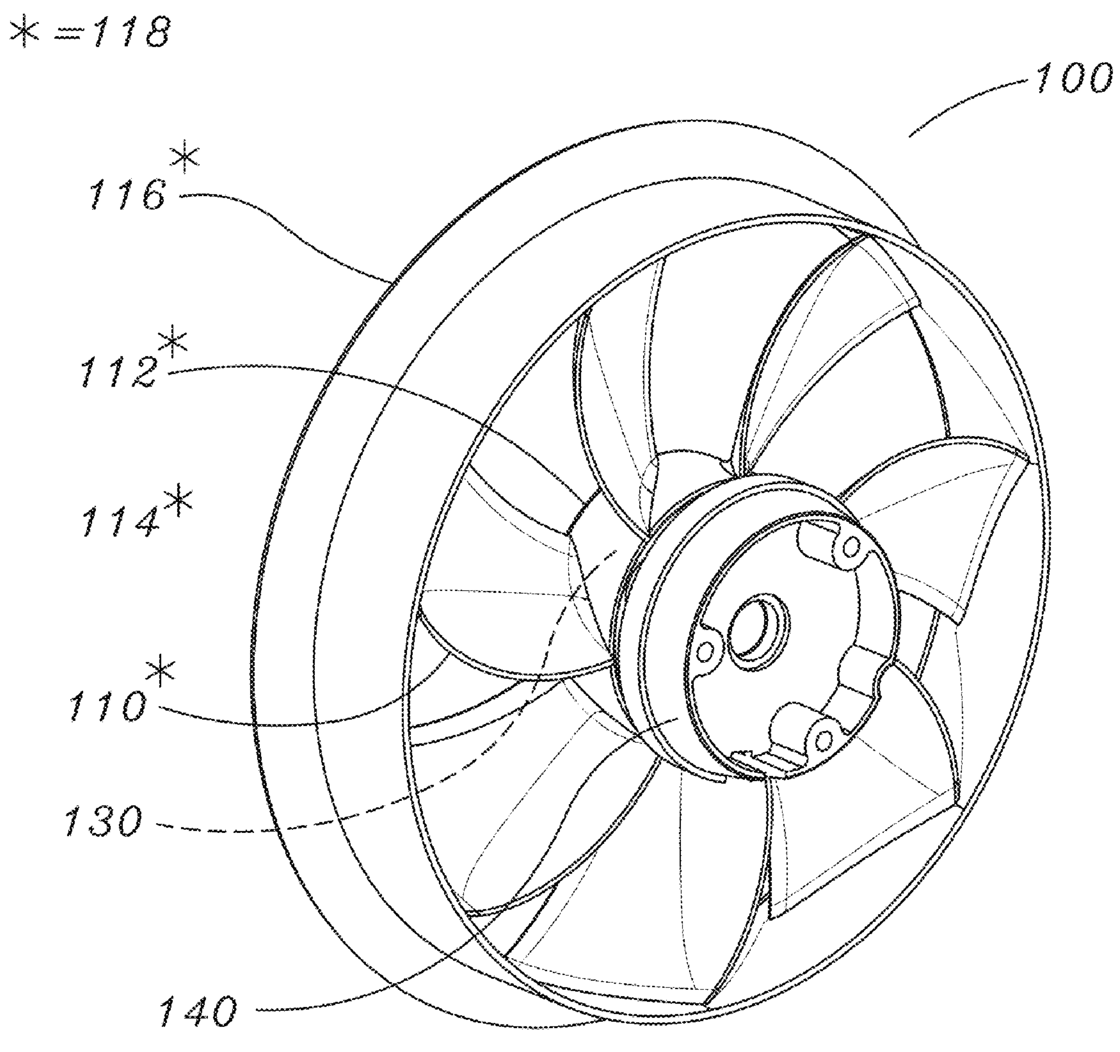
CPC ***F04D 29/666*** (2013.01); ***F04D 25/06*** (2013.01)
USPC .... **417/313**; 417/354; 416/170 R

(57) **ABSTRACT**

A low noise air generator possessing improved characteristics thereby reducing noise while maintaining or improving air flow generation and output is provided. The device may include an impeller with multiple blades, a noise reduction structure connected to a distal end of the multiple blades, an impeller housing, a tapered motor mounting surface, a heating element, a mechanical air filter, and/or an electrostatic precipitation air filter.



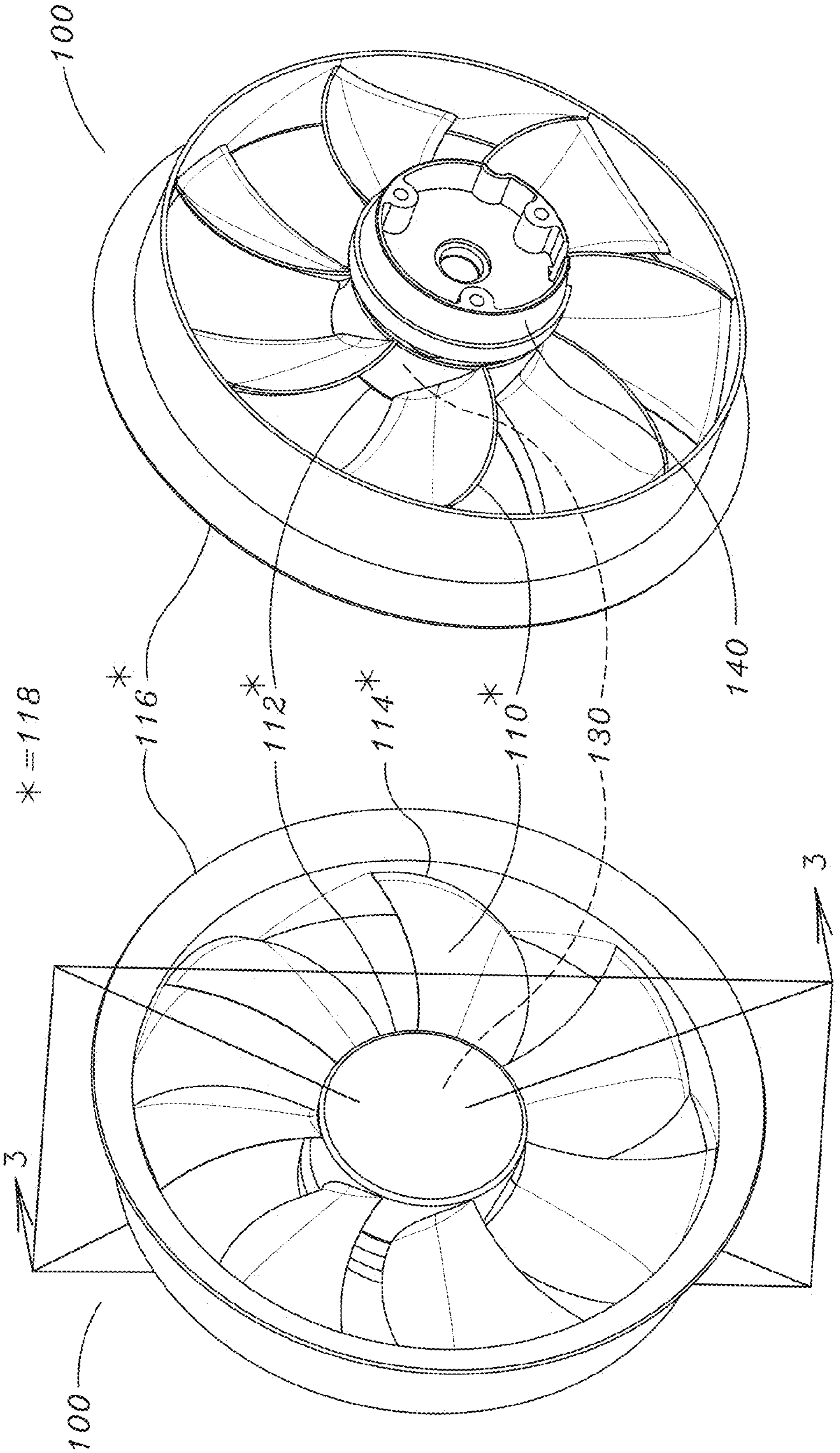


FIG. 1B

FIG. 1A

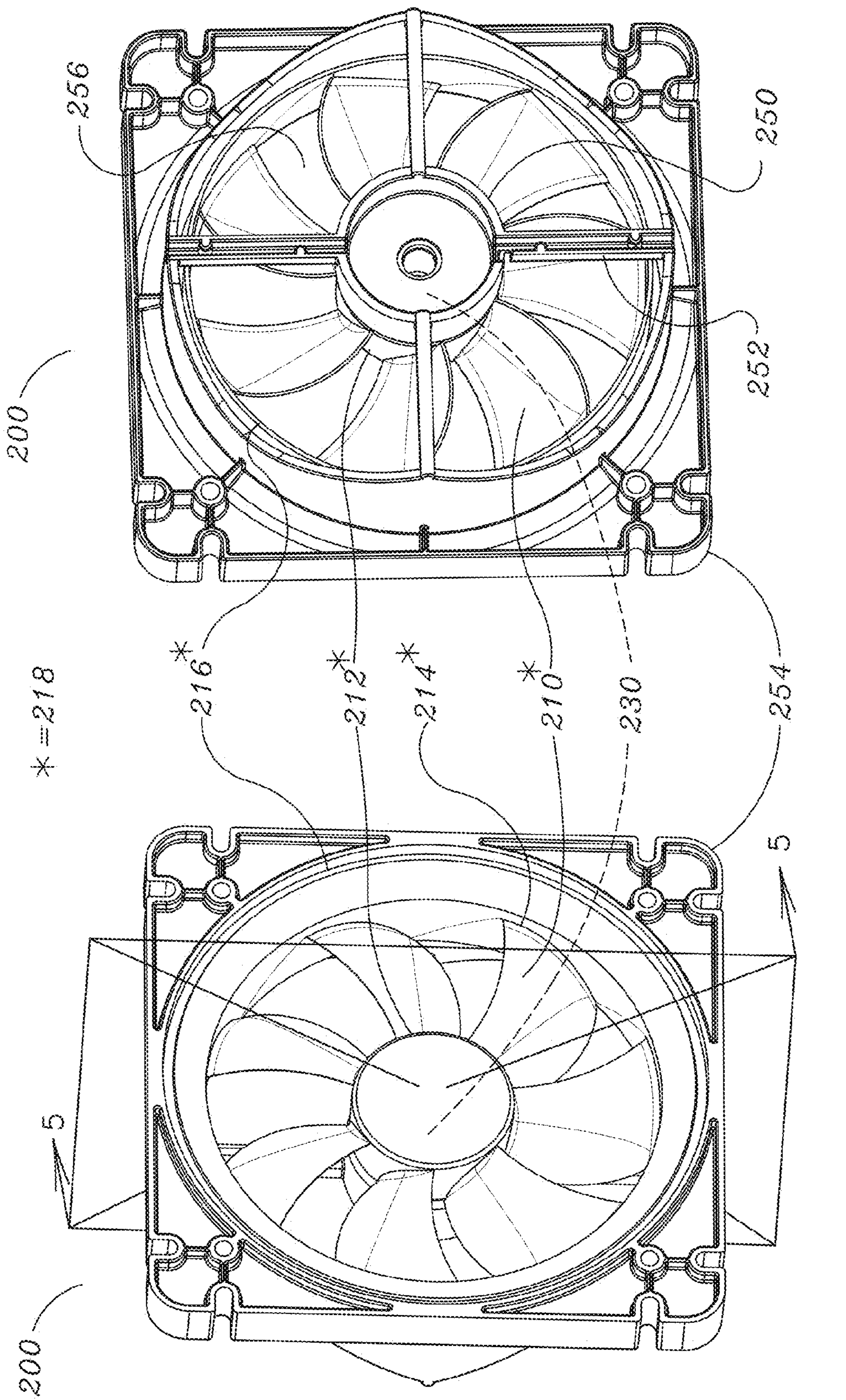
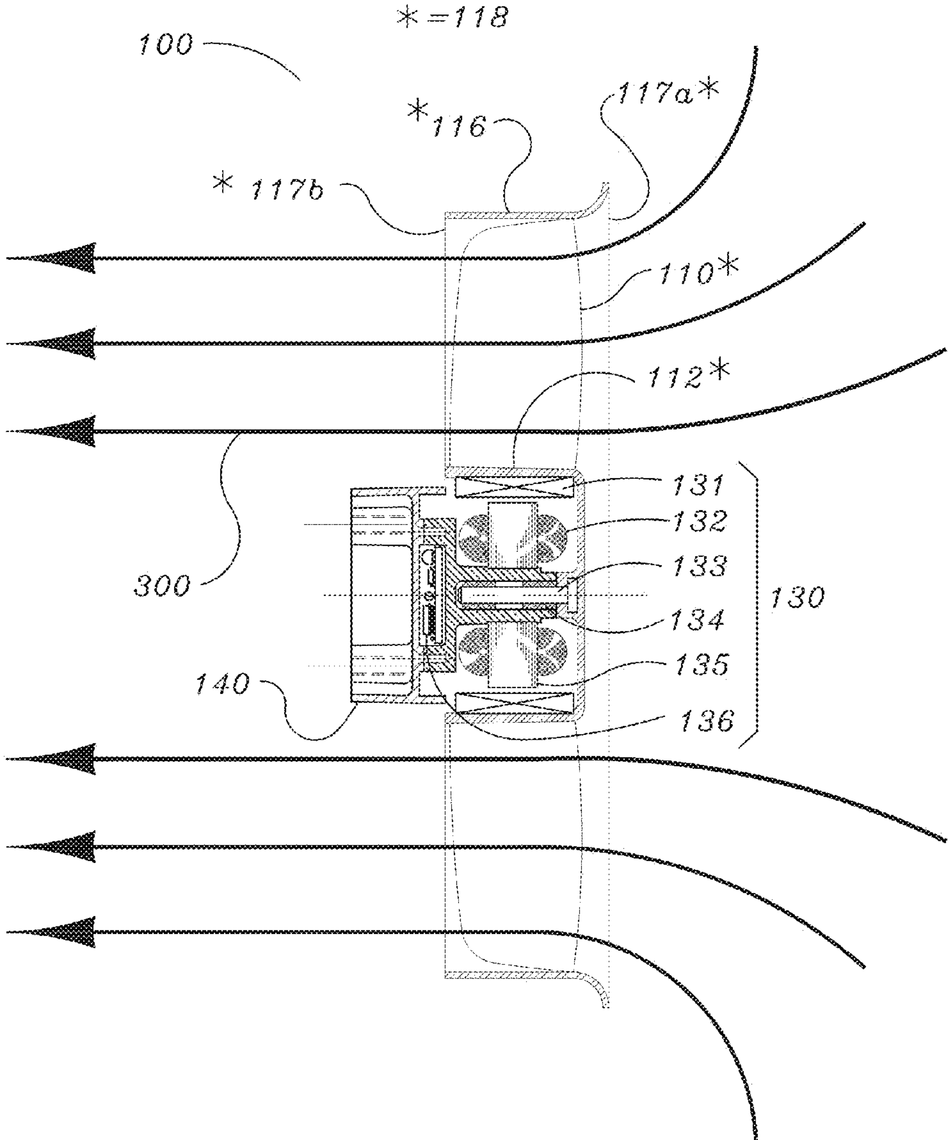


FIG. 2B

FIG. 2A



*=118
100
*116
117a*
* 117b
110*
112*
131
132
133
300
130
134
135
140
136

FIG. 3

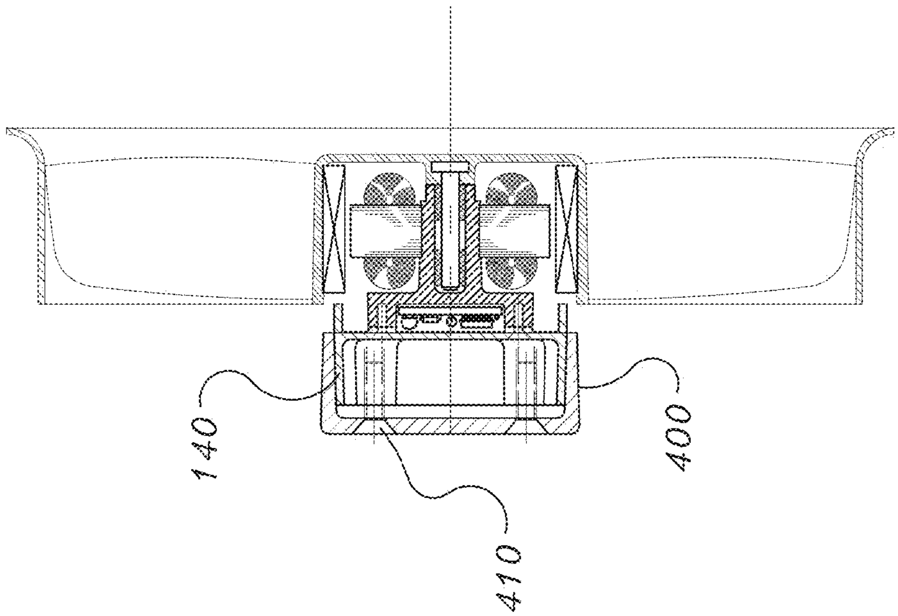


FIG. 4B

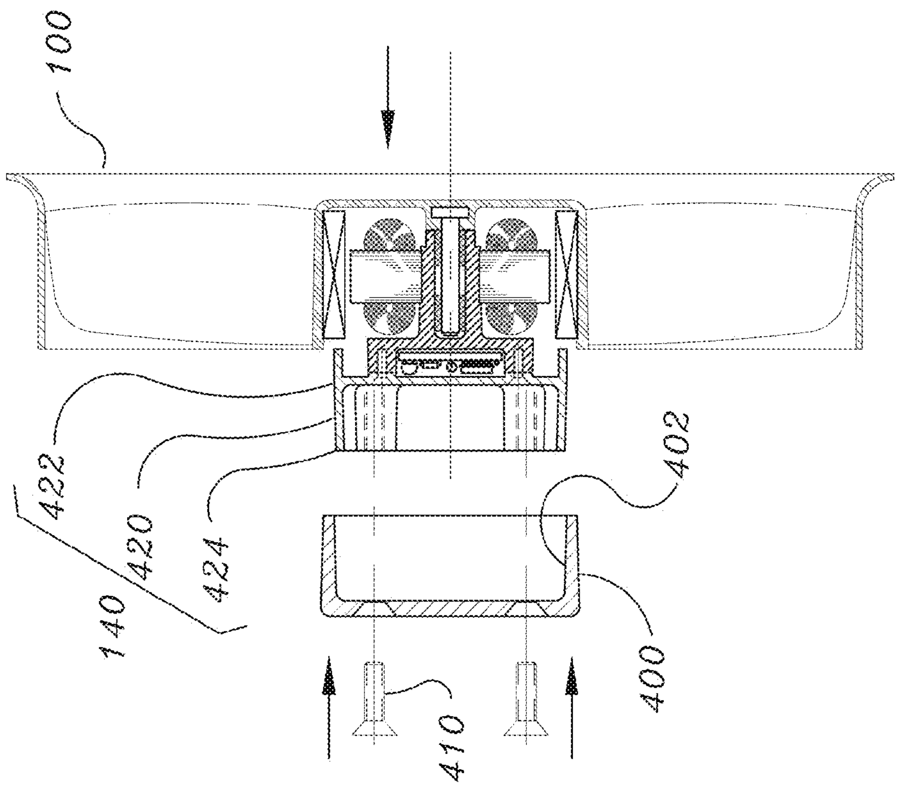
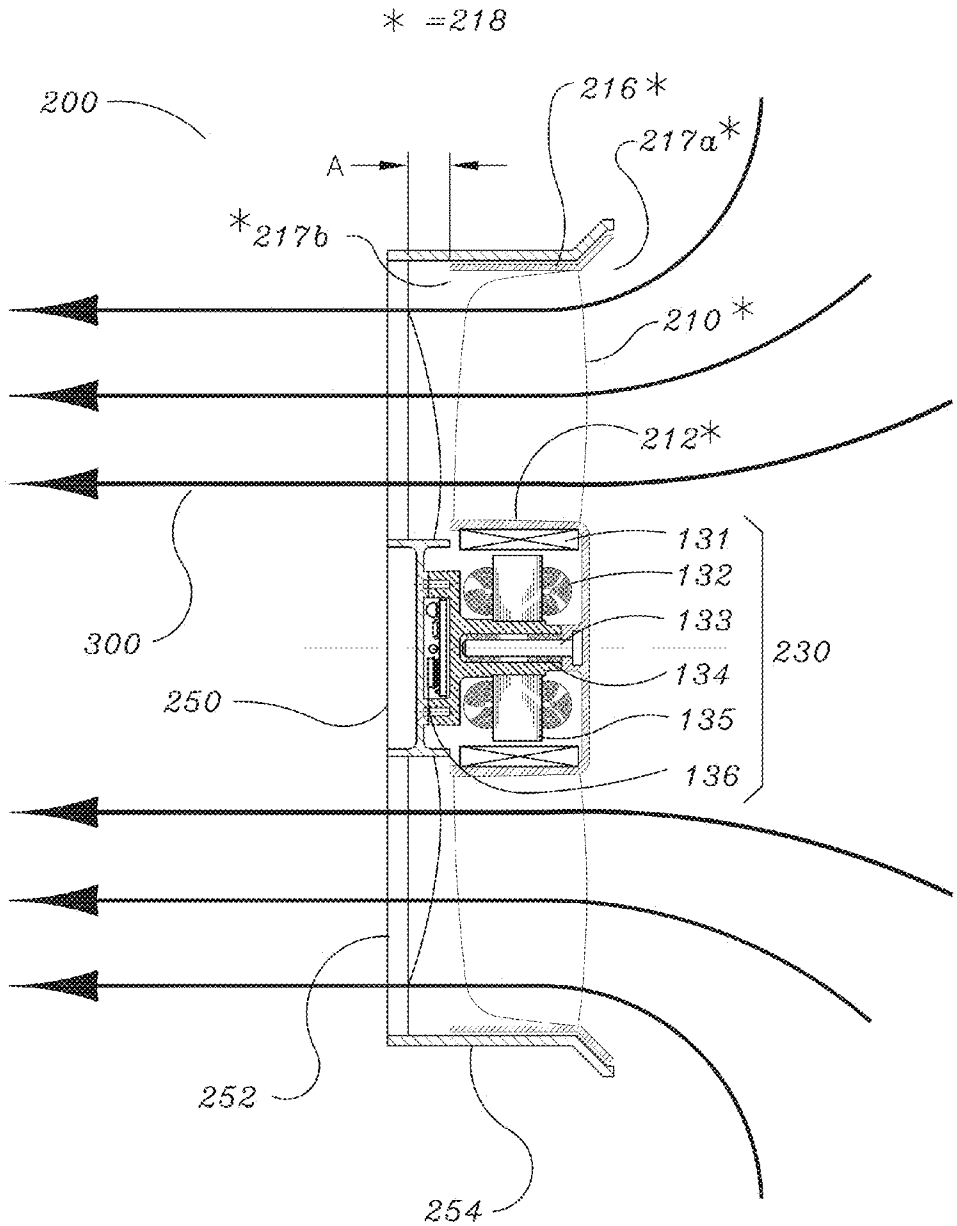
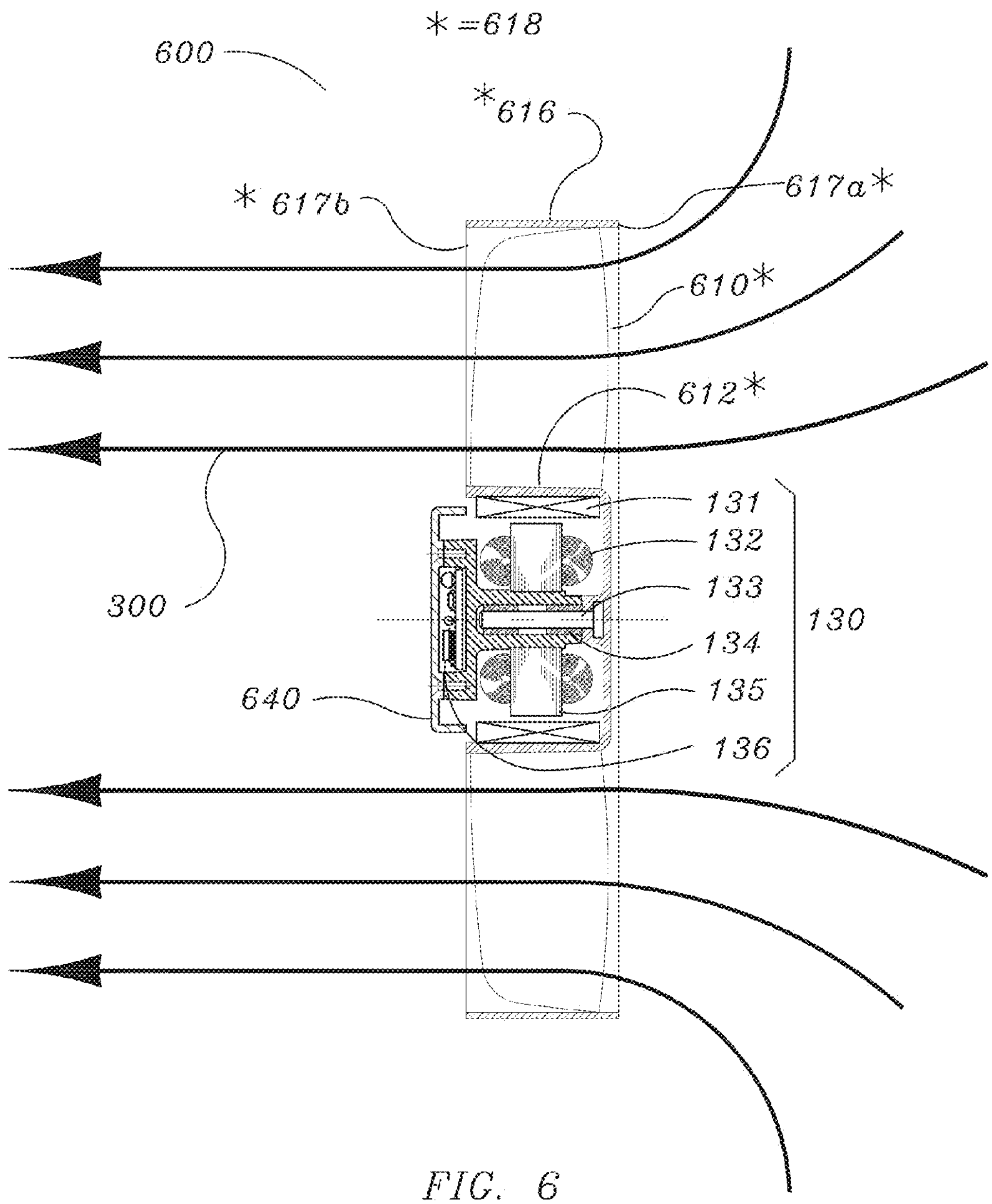


FIG. 4A



* =218
200
216*
217a*
A
*217b
210*
212*
131
132
133
134
135
136
230
300
250
252
254

FIG. 5



*=618
600
*616
*617b
617a*
610*
612*
300
131
132
133
130
134
640
135
136

FIG. 6

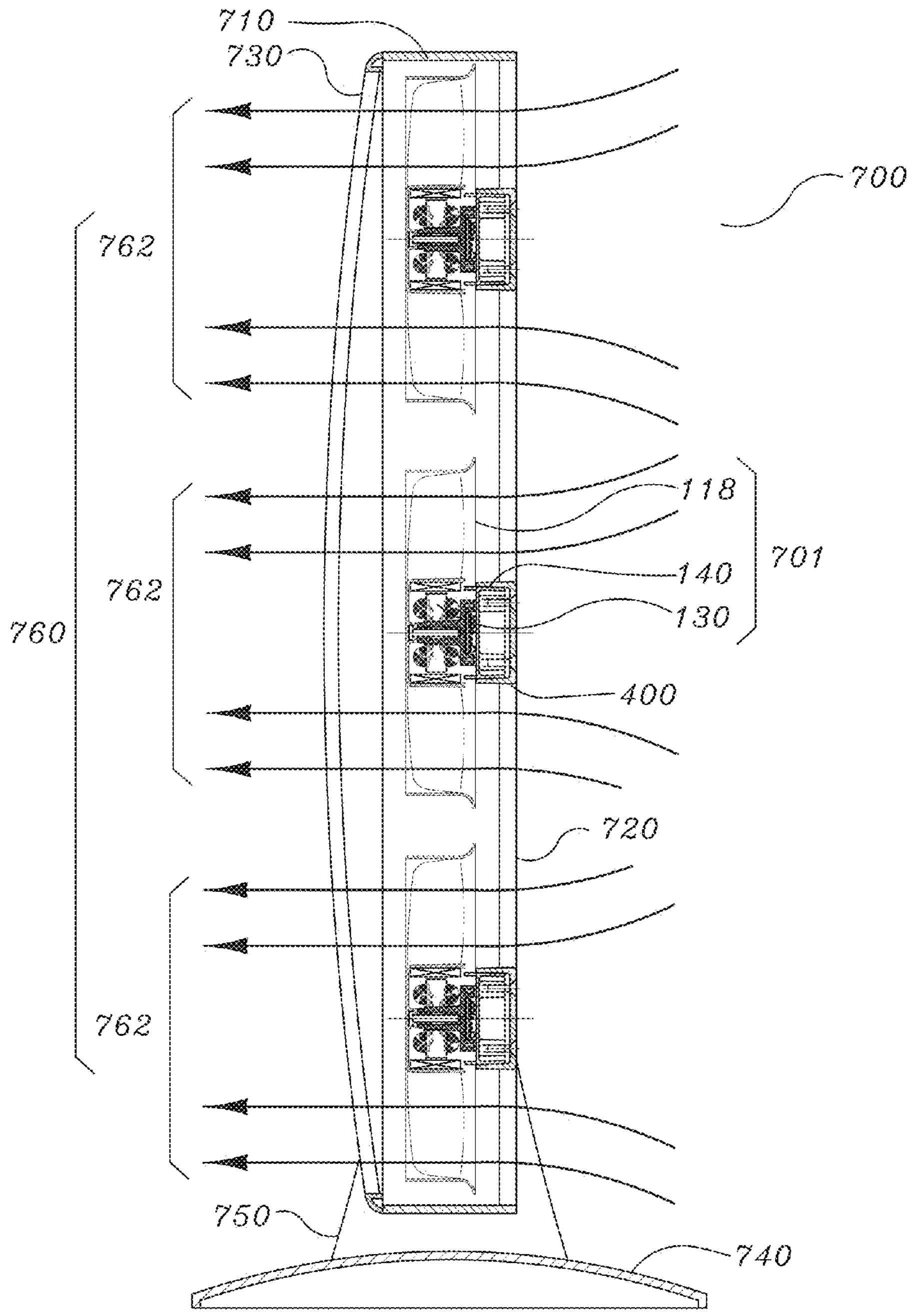


FIG. 7

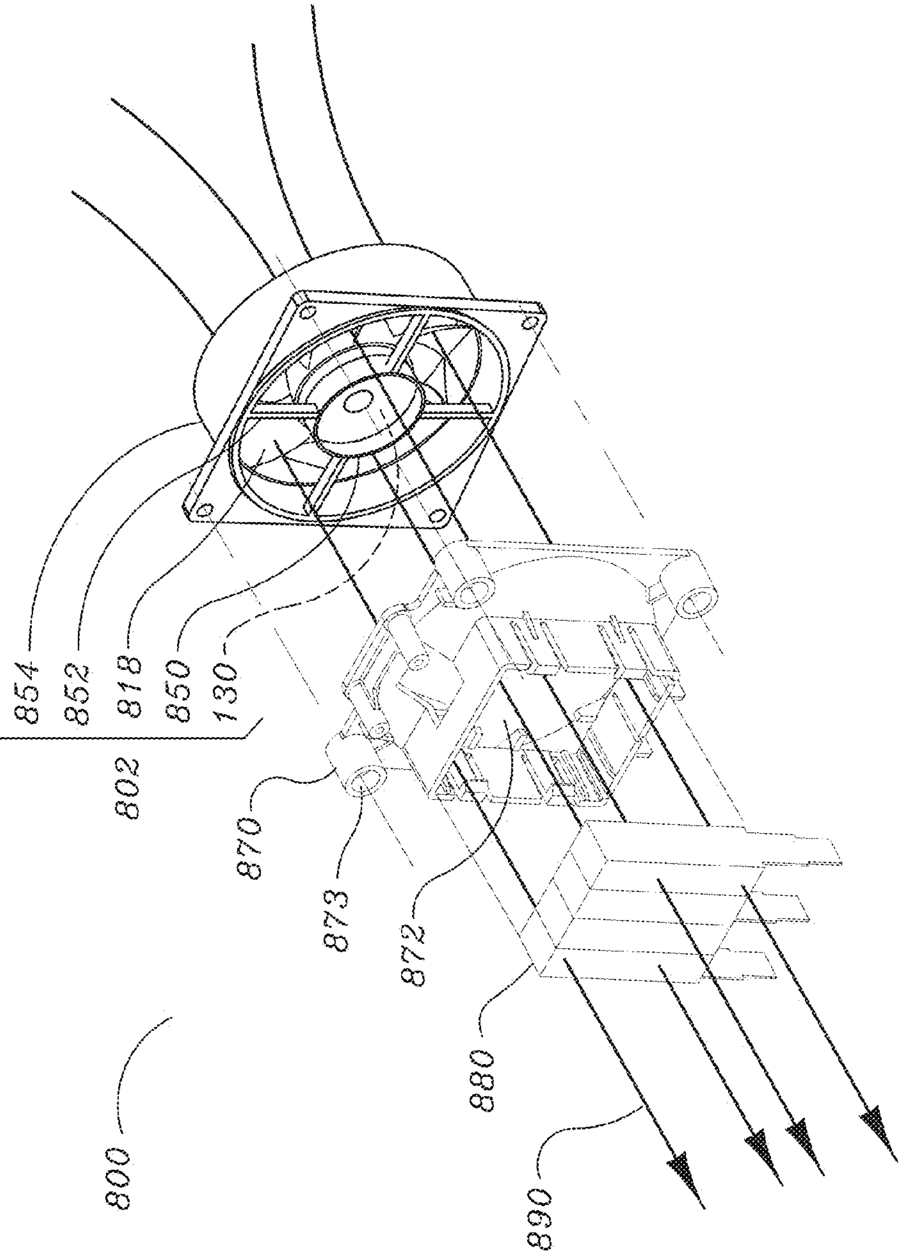


FIG. 8

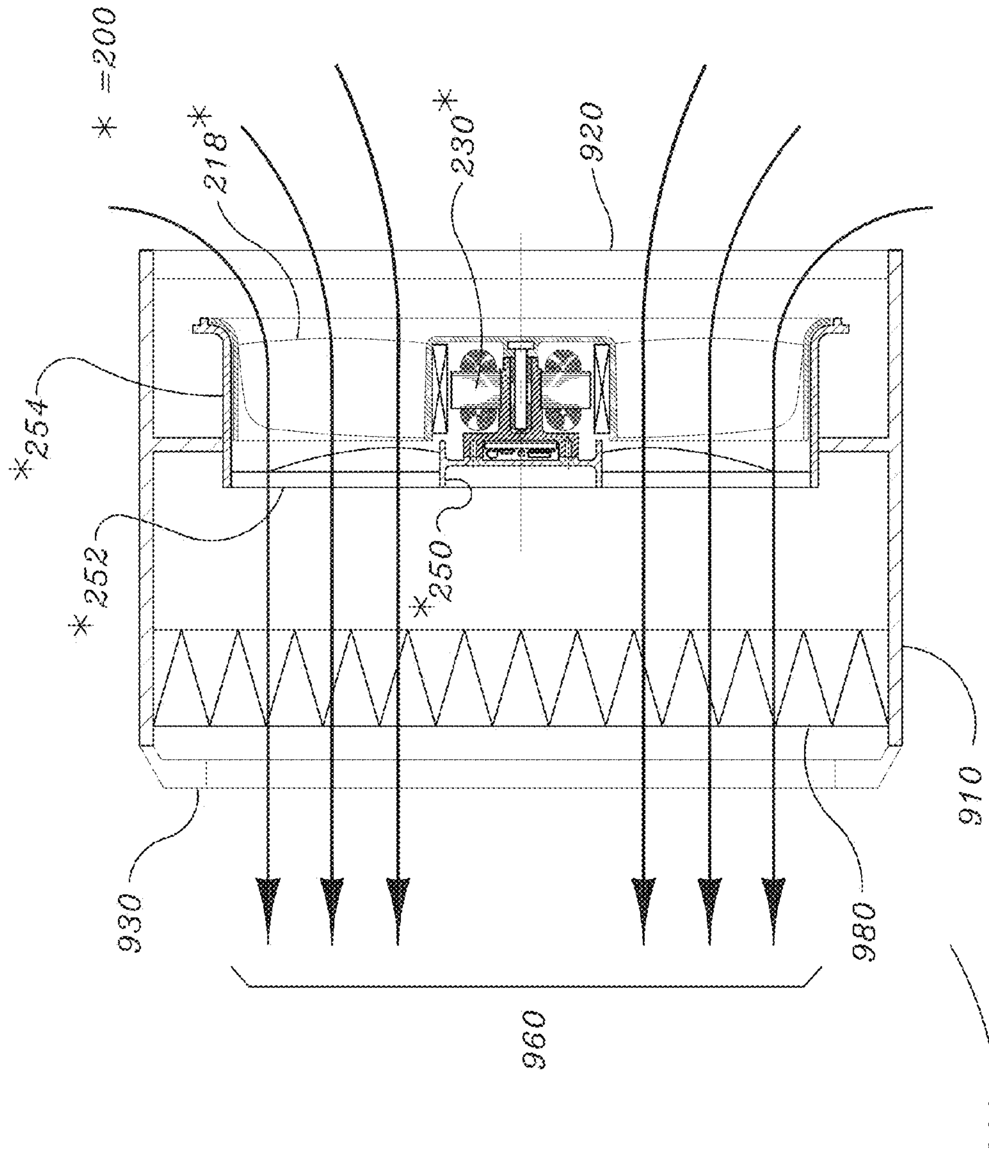


FIG. 9

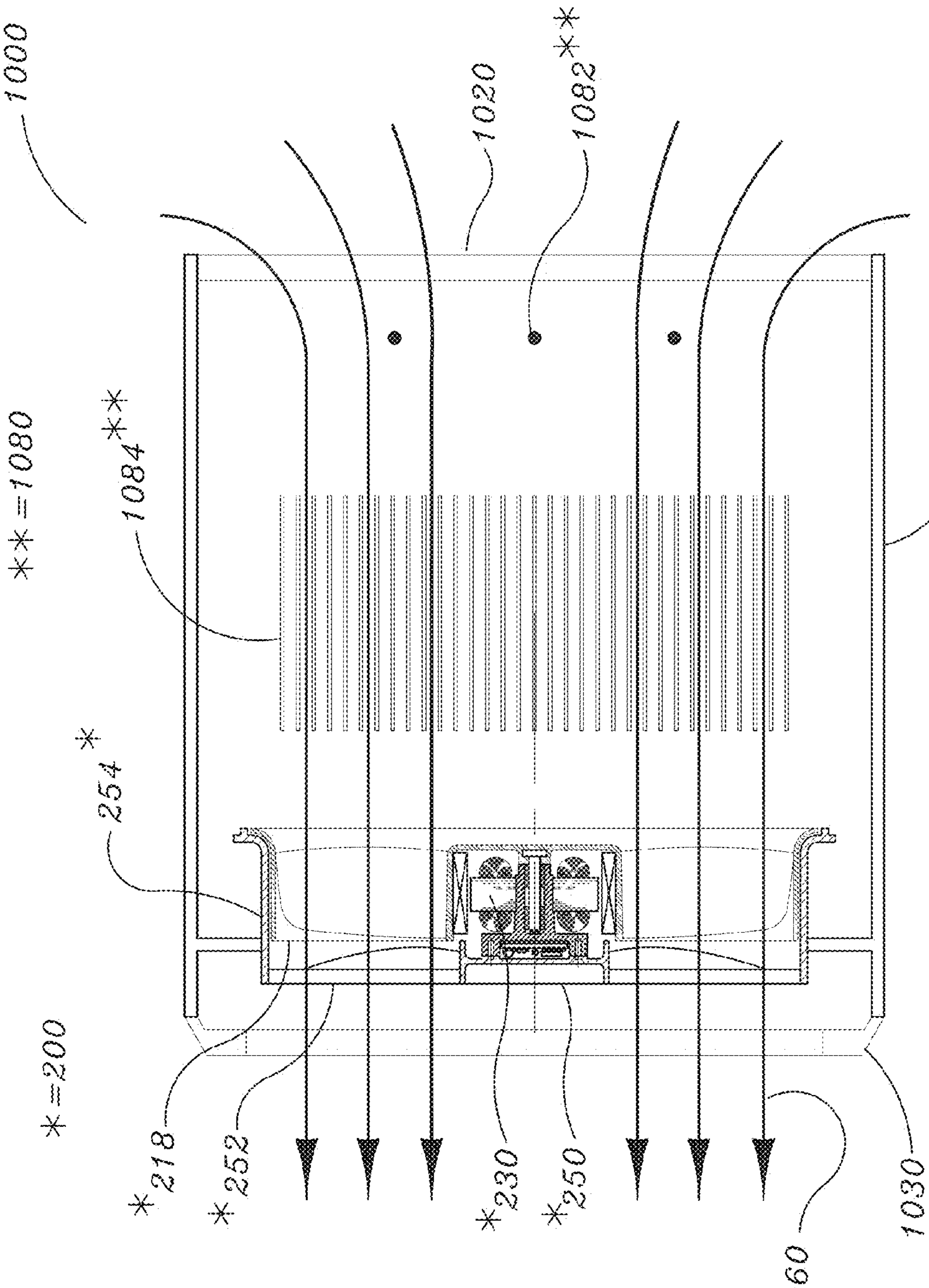

1000
1020
1082**
1010
**=1080
1084**
254*
*=200
*218
*252
*230
*250
1060
1030

FIG. 10

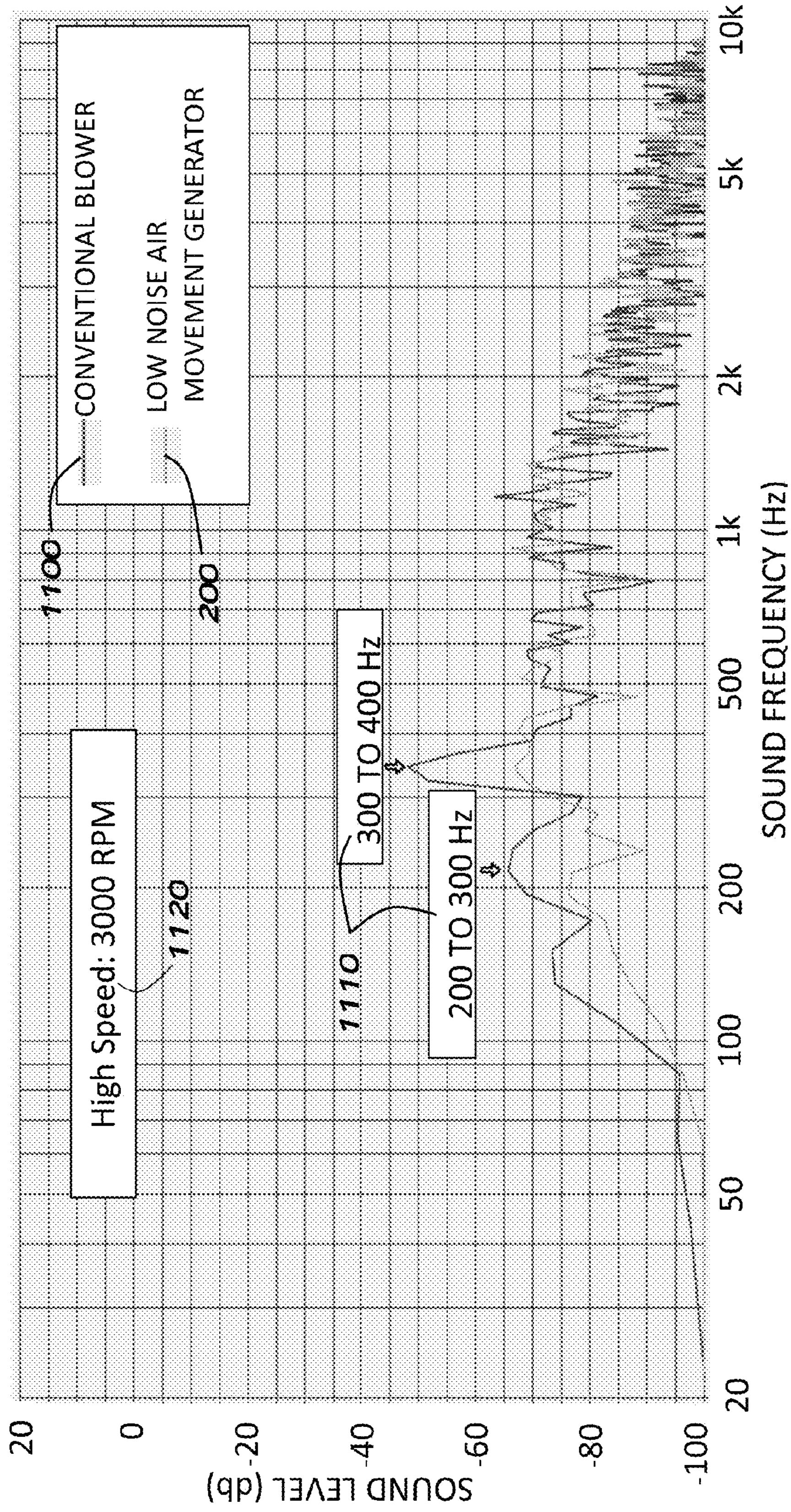

CONVENTIONAL BLOWER
LOW NOISE AIR MOVEMENT GENERATOR
1100
200
High Speed: 3000 RPM
1120
300 TO 400 Hz
200 TO 300 Hz
1110
SOUND LEVEL (db)
20
0
-20
-40
-60
-80
-100
20
50
100
200
500
1k
2k
5k
10k
SOUND FREQUENCY (Hz)

FIG 11

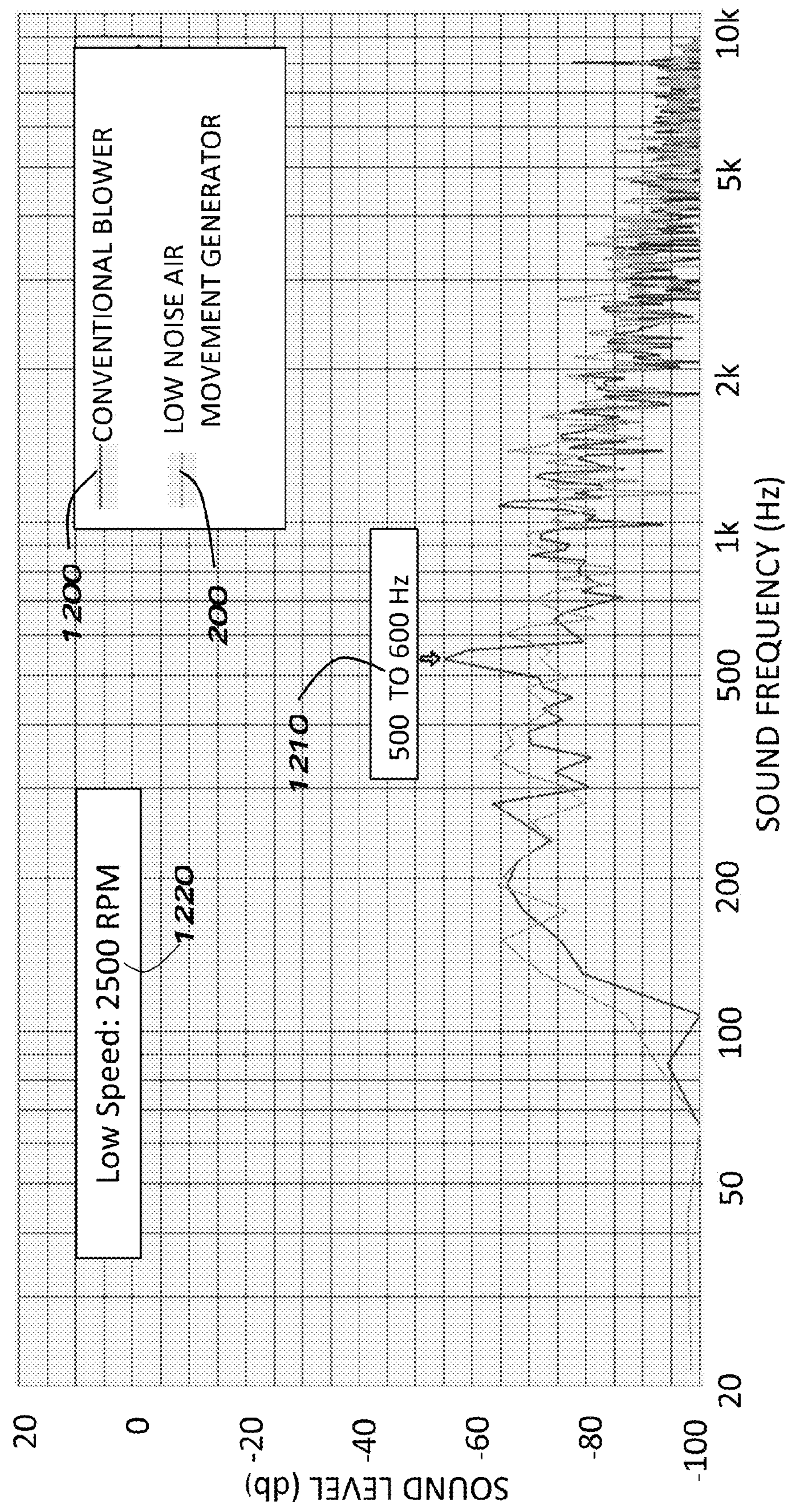

Low Speed: 2500 RPM
1220
CONVENTIONAL BLOWER
LOW NOISE AIR MOVEMENT GENERATOR
1200
200
1210
500 TO 600 Hz
SOUND LEVEL (db)
20
0
-20
-40
-60
-80
-100
SOUND FREQUENCY (Hz)
20
50
100
200
500
1k
2k
5k
10k

FIG 12

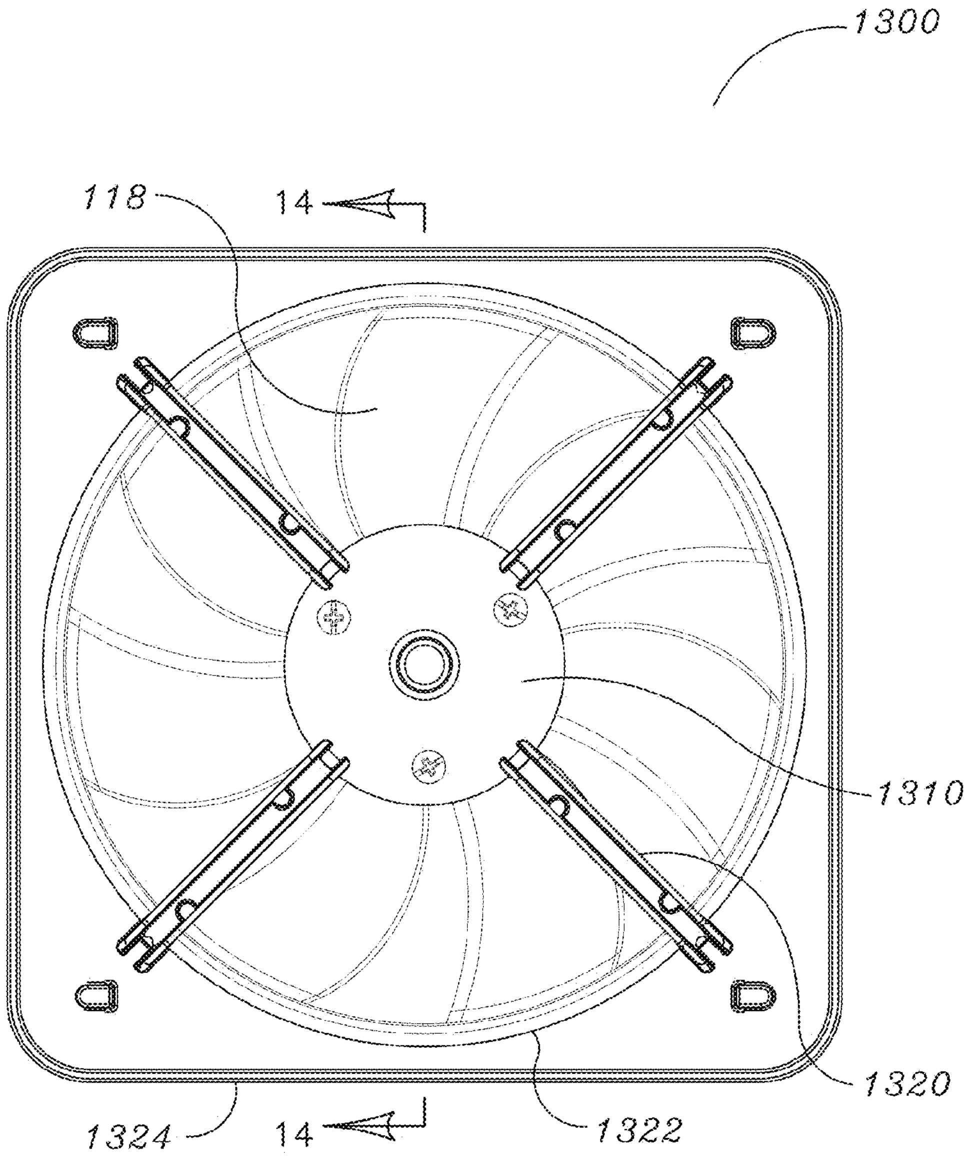


FIG. 13

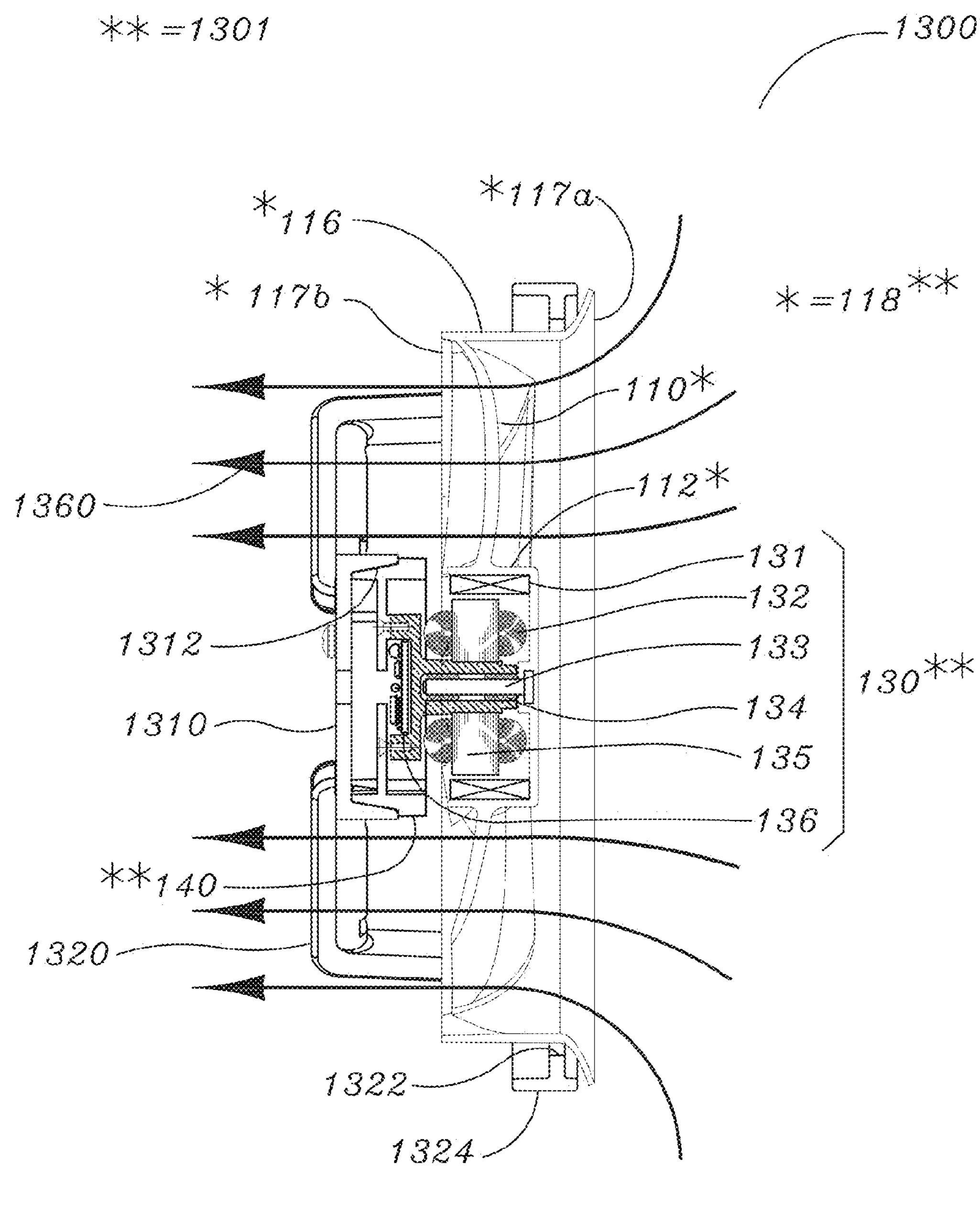

**=1301
1300
*116
*117a
*117b
*=118**
110*
1360
112*
131
132
1312
133
130**
1310
134
135
136
**140
1320
1322
1324

FIG. 14

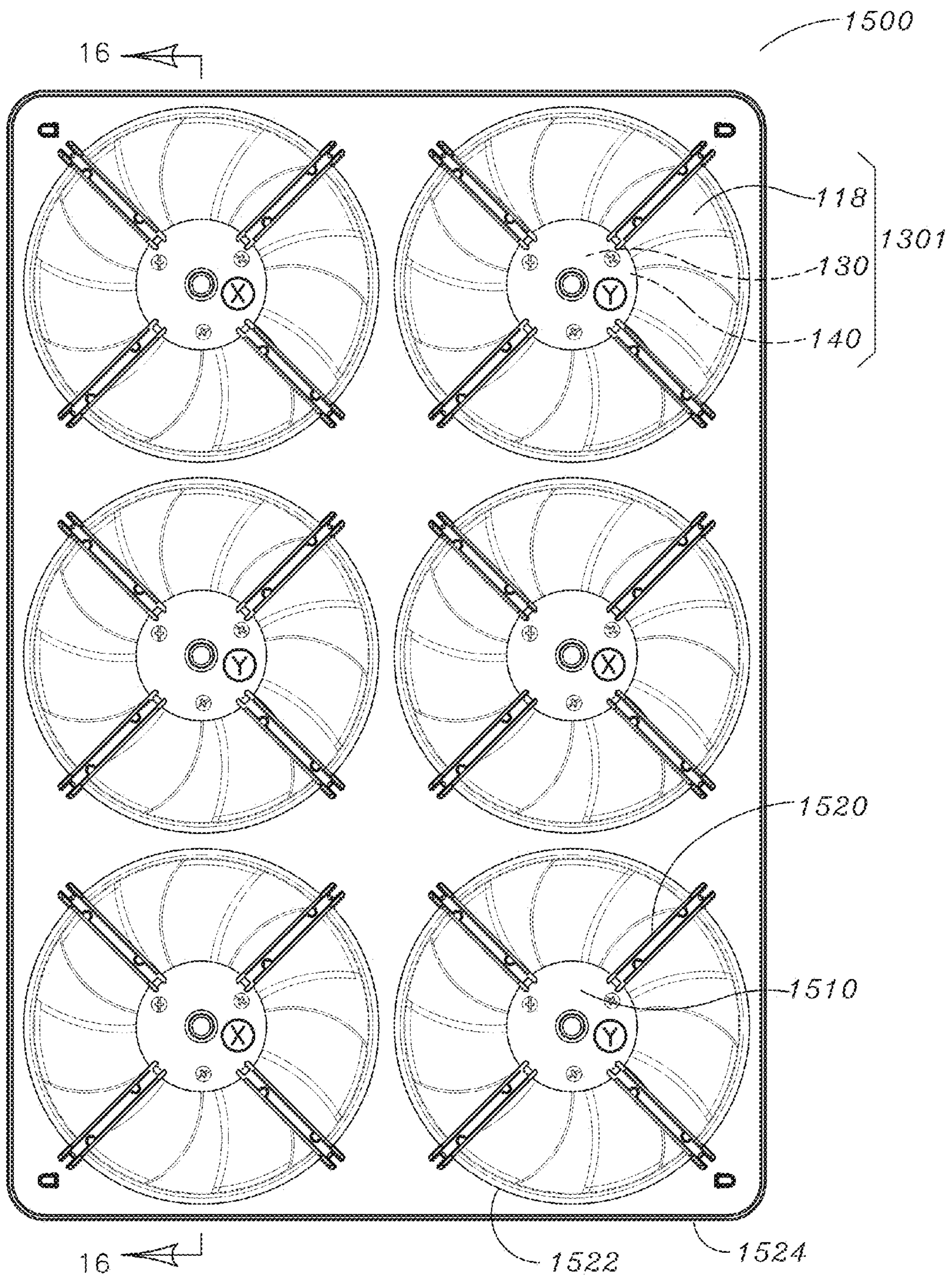


FIG. 15

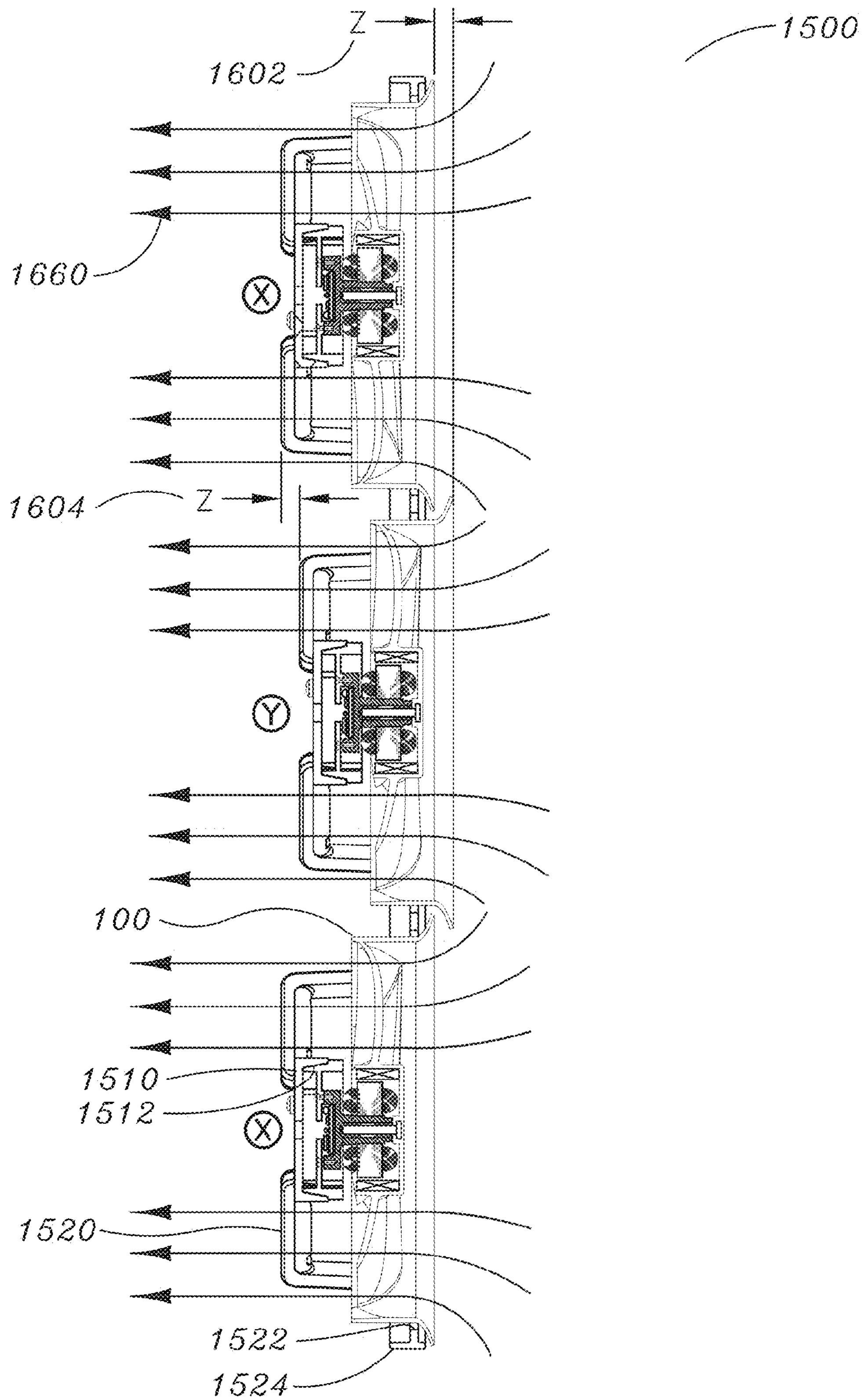


FIG. 16

LOW NOISE AIR MOVEMENT GENERATOR

RELATED APPLICATION DATA

[0001] This application claims priority to U.S. provisional application Ser. No. 61/632,356 filed Jan. 23, 2012, which is incorporated herein by reference in its entirety.

TECHNOLOGY FIELD

[0002] The present invention relates to air movement generators. More specifically, the present invention relates to a low noise air movement generator of compact size for use in portable air moving devices.

BACKGROUND

[0003] Whenever a mechanical system has been utilized to generate air movement one of the disadvantages is the noise produced by the device. This issue is especially acute for impellers that revolve at high revolutions per minute [RPM]. The noise produced can be unwanted and oftentimes uncomfortable to any person within hearing distance. Many times this noise is high pitched and difficult for the human mind to overlook.

[0004] The noise produced by the air generators in portable devices, such as for example, computers, cooling fans, heaters, air cleaners, air purifiers, and humidifiers, is a particularly difficult problem to address since the device to be effective must be located near the user. This problem is made worse if the portable device requires the use of more than one air generator.

[0005] Some conventional devices have responded to this problem in one of several manners. One manner is to reduce the RPM of the impeller. Although this mitigates the noise produced to some degree it also degrades the performance of the air flow generation.

[0006] Another response has been to construct the portable device with additional sound attenuation structures and the like. This solution can reduce the audible noise detected but the additional structure often increases the cost and reduces the air flow performance of the portable device. Increasing the cost of the portable device makes it less desirable to consumers and manufacturers alike.

[0007] Axial type impellers can produce and move large volumes of air efficiently; however axial impellers are especially disposed to produce noise because of the speed of the blade tips and the need for support structures that are often located near the blades. As a single blade passes the support structures the air flow between the blade and the support structure produces noise. This production of noise with an axial impeller increases as the RPM of the impeller increases.

[0008] In view of the deficiencies of conventional air movement generators, what is needed is a low noise air movement generator, especially configured for portable devices that are intended to be utilized while located near the user.

SUMMARY

[0009] The low noise air movement generator according to embodiments of the present invention provides a simple yet economical structure that preserves or improves the performance characteristics of axial type impeller air movement generator while significantly reducing the noise generated.

[0010] As described and shown, the low noise air movement generator uses a novel noise attenuation structure incorporated on the impeller. Additional noise reduction can be achieved by the inventive mounting structures that locate all motor support members at a sufficient distance from the rotating impeller to reduce the interaction of the impeller with the motor support members. One advantageous characteristic of the low noise air movement generator of the current invention is the compact design. The compact size increases the ability of the low noise air movement generator to be used in various portable devices.

[0011] Another aspect of the low noise air movement generator is ease of manufacturing, which requires no specialized equipment. This allows the low noise air movement generator to be economically fabricated, which further serves to applicability of the device.

[0012] One aspect of the invention includes an axial flow impeller including a hub, multiple blades, and a noise attenuation structure connected to the distal ends of the multiple blades.

[0013] Another aspect of the invention includes a motor disposed substantially within an internal cavity of the hub. The motor may include a permanent magnet rotor that is assembled in the hub and a stator rotatably connected to the rotor.

[0014] Yet another aspect is mounting a single or multiple low noise air movement generator(s) as part of the structure for a portable air moving device such as, for example, a portable space heater, a portable fan, a portable air cleaner, a portable air purifier or a portable humidifier.

[0015] Another aspect of the invention is a mounting structure connected to the motor having a conical surface in which the conical surface fits into a mounting socket of similar form.

[0016] Another aspect of the invention includes a housing the impeller is located within and connected to the housing by a support member, the support member being located at a predetermined distance from the impeller to reduce the noise produced by the rotation of the impeller.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The invention is best understood from the following detailed description when read in connection with the accompanying drawing. It is emphasized that, according to common practice, the various features of the drawing are not to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawing are the following Figures:

[0018] FIGS. **1**A and **1**B are front and rear perspective views respectively of an exemplary embodiment of a low noise air movement generator;

[0019] FIGS. **2**A and **2**B are front and rear perspective views respectively of another exemplary embodiment of a low noise air movement generator;

[0020] FIG. **3** is a cross section view of the low noise air movement generator of FIG. **1**A;

[0021] FIGS. **4**A and **4**B are cross section views of the low noise air movement generator of FIG. **3** with motor mounting structures un-mounted and mounted respectively;

[0022] FIG. **5** is a cross section view of the low noise air movement generator of FIG. **2**A;

[0023] FIG. **6** is a cross section view of another exemplary embodiment of a low noise air movement generator;

[0024] FIG. **7** is a view of a portable device with a low noise air movement generator;

[0025] FIG. **8** is an exploded perspective view of another embodiment of a portable device with a low noise air movement generator;

[0026] FIG. **9** is a horizontal cross section view of another embodiment of a portable device with a low noise air movement generator;

[0027] FIG. **10** is a view of another embodiment of a portable device with a low noise air movement generator;

[0028] FIG. **11** is a noise comparison chart showing a sonic analysis of a conventional fan and a low noise air movement generator of FIGS. **2**A and **2**B;

[0029] FIG. **12** is another noise comparison chart showing a sonic analysis of a conventional fan and a low noise air movement generator of FIGS. **2**A and **2**B;

[0030] FIG. **13** is front view of another embodiment of a low noise air movement generator;

[0031] FIG. **14** is a cross-sectional view of the low noise air movement generator of FIG. **13**;

[0032] FIG. **15** is a front view of a matrix mounting of multiple low noise air movement generators; and

[0033] FIG. **16** is a cross-sectional view of the matrix mounting of multiple low noise air movement generators of FIG. **15**.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0034] FIGS. **1**A and **1**B are a front and rear perspective view, respectively, of an exemplary embodiment of low noise air movement generator **100**. Impeller **118** may include multiple blades **110** extending outward from hub **112** toward distal ends **114**. Distal ends **114** of blades **110** are attached to noise attenuation structure **116**. Motor **130** is located substantially within hub **112** of the impeller **118**. Mounting structure **140** is attached to motor **130**. Also shown is cross section plane **3-3** that corresponds to FIG. **3**.

[0035] FIGS. **2**A and **2**B are front and rear perspective view respectively of an exemplary embodiment of low noise air movement generator **200**. Impeller **218** may include multiple blades **210** extending outward from hub **212** toward distal ends **214**. Distal ends **214** of blades **210** are attached to noise attenuation structure **216**. Motor **230** is located substantially within hub **212** of the impeller **218**. Impeller support adaptor **250** is attached to motor **130**. Impeller support members **252** are attached to impeller support adaptor **250** and extend outward to connect with impeller housing **254**. As can be seen, impeller housing **254** may include interior space **256** in which impeller **218** is located when assembled.

[0036] As shown interior space **256** defined by impeller housing **254** has a similar shape to noise attenuation structure **216** and is slightly larger to maintain a minimum clearance between noise attenuation structure **216** and the impeller housing **254**.

[0037] Also shown in FIGS. **2**A is cross section plane **5-5** that corresponds to FIG. **5**.

[0038] As shown in FIGS. **1**A, **1**B, **2**A, and **2**B, impeller **118** and **218** may be a unitary construction and formed of polymer, die cast metal, or welded construction. In a similar fashion, impeller housing **254**, impeller support members **252**, and impeller support adaptor **250** of FIGS. **2**A and **2**B may be a unitary construction and formed of polymer.

[0039] FIG. **3** is a cross section view of low noise air movement generator **100** of FIG. **1**A. As shown intake edge **117***a* of noise attenuation structure **116** is arcuate while exhaust edge **117***b* is straight. Motor **130** is located substantially within hub **112** of the impeller **118**. Motor **130** may include permanent magnet rotor **131** attached to hub **112**, shaft **133**, and bearings **134**. Also shown is power control board (PCB) **136**. When electrical power is supplied, PCB **136** conditions the power and energizes stator coils **132** and stator**135**. Magnetic rotor **131** rotates the impeller **118**. The rotation of impeller **118** generates air flow **300** between hub **112** and noise attenuation structure **116**. Mounting structure **140** is fixedly assembled to motor **130**.

[0040] It is contemplated that motor **130** may be a brushless direct current (DC) motor. Brushless DC motors have advantages over other motor types including for example: 10% to 50% higher efficiency depending on the application, longer operating life because there are no brushes to wear out, less friction, less noise and a lower weight to torque ration which is desirable and useful in portable devices.

[0041] FIGS. **4**A and **4**B are cross section views of low noise air movement generator **100** of FIG. **3** with mounting structure **140** in an un-mounted configuration (see FIG. **4**A) and mounted configuration (see FIG. **4**B). Mounting structure **140** attached to motor **130** has tapered surface **420** defined by first diameter **422** and second diameter **424**. First diameter **422** is larger than second diameter **424** and defines tapered surface **420**. Mounting socket **400** has corresponding tapered surface **402**. As shown in FIG. **4**B, mounting structure **140** is fit into the mounting socket **400** and held in place with at least fastener **410**. Although fastener **410** is shown as a flat head screw, the invention is not so limited. Assembly of mounting socket **400** to mounting structure **140** may be accomplished with snaps, Velcro, other threaded fasteners, adhesives, and the like without departing from the spirit of the invention.

[0042] FIG. **5** is a cross section view of low noise air movement generator **200** of FIG. **2**A. Low noise air movement generator **200** includes impeller housing **254**, at least one impeller support member **252**, and impeller support adaptor **250**. As shown intake edge **217***a* of noise attenuation structure **216** is conical. Impeller support members **252** are offset from exhaust edge **217***b* of the impeller **218** by a pre-determined distance “A”. Pre-determined distance “A” insures that air flow **300** does not create undesired noise when exiting impeller **218** as multiple blades **210** of impeller **218** passes impeller support member **252** during rotation.

[0043] Pre-determined distance “A” is shown as the minimum dimension measured from exhaust edge **217***b* to impeller support members **252** in the direction of air flow **300**; however, the invention is not so limited. It is contemplated that pre-determined distance “A” may be a minimum distance measured from intake edge **217***a* to impeller support members **252** in the opposite direction of flow of air flow **300**. In short, impeller support members **252** could be located on the opposite side of impeller **218** corresponding to intake edge **217***a*. In a preferred embodiment, pre-determined distance “A” is at least 25% of the axial distance measured between intake edge **217***a* and exhaust edge **217***b* of impeller **218**.

[0044] FIG. **6** is a cross section view of low noise air movement generator **600**, according to an additional embodiment. As shown, intake edge **617***a* of noise attenuation structure **616** does not include an arcuate or conical form but is instead straight or nearly straight as is exhaust edge **617***b*. Also shown is mounting structure **640** connected to motor **130**. Mounting structure **640** can be adapted with snaps, fasteners, adhesives, and the like for the purposes of mounting low noise air movement generator **600**. Other features of low noise air movement generator **600** of FIG. **6** are similar to those described in FIG. **3**. In particular, motor **130** is located substantially within hub **612** of the impeller **618**. The rotation of impeller **618** generates air flow **300** between hub **612** and noise attenuation structure **616**. Impeller **618** may include multiple blades **610** extending outward from hub **612** toward distal ends that are attached to noise attenuation structure **616**.

[0045] FIG. **7** is a vertical cross section view through portable air moving device **700** utilizing one or more low noise air movement generator **701**. Device **700** in FIG. **7** is a portable fan which may include multiple low noise air movement generators **701** arranged in a vertical configuration. Although shown in a vertical configuration, multiple low noise air movement generators **701** could be arranged horizontally or in a matrix without departing from the spirit of the invention. Multiple air generators **701** are similar to the embodiments shown in FIGS. **1**A, **1**B, **3**, **4**A and **4**B. As can be seen, the direction of air flows **762** relative to motor **130** and impeller **118** is in in the opposite direction of the previous embodiments. This facilitates the incorporation of mounting socket **400** into intake grill **720** of the device. Multiple air flows **762** combine to generate total air flow **760** exiting through exhaust grill **730**. Also shown are housing **710**, housing support **750**, and base **740**.

[0046] FIG. **8** is a view of an embodiment in which heater assembly **800** utilizes low noise air movement generator **802** used in combination with airflow transition **870** and heating element **880**. Similar to low noise air movement generator **200** of FIG. **5**, low noise air movement generator **802** may include impeller housing **854**, impeller support members **852**, impeller **818**, impeller support adaptor **850** and motor **130**. Airflow transition **870** is utilized to assemble low noise air movement generator **802** to heating element **880** and creates a smooth transition of the air flow **890** as it exits low noise air movement generator **802** and enters heating element **880**. Heating element **880** is assembled into cavity **872**, and low noise air movement generator **802** is assembled to airflow transition **870** via mounting holes **873** and fasteners (not shown).

[0047] Heater assembly **800** may include multiple low noise air movement generators **802**, multiple airflow transitions **870**, and more than one heating element **880**. As can be appreciated, one or more heater assembly **800** could be located in a portable electric heater.

[0048] According to another embodiment, FIG. **9** is a horizontal cross section view of portable air cleaning device **900** with a low noise air movement generator **200** used in combination with mechanical air filter **980**. Air is drawn into housing **910** of device **900** through intake grill **920** and forced through the mechanical air filter **980**. Filtered air **960** exits housing **910** through exhaust grill **930**. Mechanical air filter **980** may be a standard or non-standard pleated air filter and may include odor absorbing materials such as carbon or baking soda. As shown in FIG. **9**, low noise air movement generator **200** is located prior to the mechanical air filter **980** with respect to air flow direction. It is contemplated that the low noise air movement generator **200** may be located subsequent to the mechanical air filter **980** with respect to air flow direction without departing from the spirit of the invention.

[0049] FIG. **10** is a horizontal cross section view of portable air cleaning device **1000** with low noise air movement generator **200** used in combination with electro-static precipitator (ESP) type air filter **1080** which may include ion emitters **1082** and collector plates **1084**, according to an additional embodiment. Air is drawn into housing **1010** of device **1000** through intake grill **1020** and passes ion emitters **1082**. Particles in the air are charged with the ions. Subsequently, the air passes through collector plates **1084** that are charged so as to attract the charged particles in the air. The charged particles adhere to collector plates **1084** and clean air exits collector plates **1084** and subsequently passes though low noise air movement generator **200** and exits device **1000** via exhaust grill **1030**. As shown in FIG. **10**, low noise air movement generator **200** is located subsequent to ESP type air filter **1080** with respect to the air flow direction. It is contemplated that low noise air movement generator **200** may be located prior to the ESP type air filter **1080** with respect to the air flow direction without departing from the spirit of the invention.

[0050] It is also contemplated that multiple low noise air movement generators **200** could be used with mechanical filter **980** of FIG. **9** or ESP filter **1080** of FIG. **10** to achieve larger and more varied configurations. Such multiple low noise air movement generators **200** could be arranged in vertical or horizontal columns or a matrix having rows and columns.

[0051] In short, the low noise air movement generators **100**, **200** and **600** of the current invention are capable of reducing noise at high and low speeds. This noise reduction when utilized in air moving devices, as illustrated and described in FIGS. **7**, **8**, **9**, and **10**, is a distinct advantage for the end user.

[0052] FIG. **11** is a noise comparison chart showing a sonic analysis at a high speed RPM **1120** of 3000 of conventional fan **1100** and low noise air movement generator **200** similar to FIGS. **2**A, **2**B and **5**. Conventional fan **1100** does not include noise attenuation structure **216** or the pre-determined offset distance A for impeller support structure **252** as shown and described. As shown, conventional fan **1100** shows elevated noise levels **1110** between frequencies of 200 to 400 Hz. Low noise air movement generator **200** removes elevated noise levels **1110**. The human ear therefore does not register elevated noise levels **1110** with low noise air movement generator **200** as the noise levels are not present and perceives a less high pitched noise and buzzing, thereby creating a more pleasant ambient.

[0053] FIG. **12** is a noise comparison chart showing a sonic analysis of conventional fan **1200** and low noise air movement generator **200** similar to FIGS. **2**A, **2**B and **5**. Conventional fan **1200** does not include noise attenuation structure **216** or the pre-determined offset distance A for impeller support structure **252** as shown and described. The RPM **1220** of 2500 of the impeller for both conventional blower **1200** and low noise air movement generator **200** was slower than the RPM **1120** associated with the chart of FIG. **11**. Lowering the RPM of the impeller is a conventional method to mitigate noise. Regardless of the lower RPM, conventional fan **1200** shows elevated noise levels **1210** between frequencies of 500 to 600 Hz. Low noise air movement generator **200** removes elevated noise levels **1210**.

[0054] FIGS. **13** and **14** are a front view and a cross-sectional view respectively of low noise air movement generator **1300**, according to another embodiment. FIG. **14** is a cross-sectional view along cross section vertical plane **14**-**14** of FIG. **13**. Included in the embodiment are similar features of the embodiments shown in FIGS. **4**A, **4**B, and **5**. The inclusion of mounting structure **140** on a motor **130**, similar to FIGS. **4**A and **4**B, and incorporating mounting socket **1312**, similar to FIGS. **4**A and **4**B, into the impeller support adaptor **1310**, similar to FIG. **5**, has several advantages. As shown, the impeller **118**, motor **130** and mounting structure **140** can be mass produced as a sub-assembly coinciding with **1301**. Sub-assembly **1301** can subsequently be mounted into multiple mounting structures and configurations. In the embodiment shown, mounting plate **1324**, impeller hole **1322**, impeller support structure **1320**, impeller support adaptor **1310**, and mounting socket **1312** are a unitary construction. **1360** represents the direction of air flow.

[0055] FIG. **15** is a front view of a matrix mounting **1500** of multiple sub-assemblies **1301** similar to the embodiment shown in FIGS. **13** and **14**. As shown, the multiple sub-assemblies **1301** are arranged and mounted in close proximity relative to each other in positions labeled X and Y.

[0056] FIG. **16** is a cross-sectional view along cross section vertical plane **16-16** of FIG. **15**. As can be seen, sub-assemblies **1301** mounted in positions labeled X are offset by dimension "Z" **1602** in the direction of the air flow **1660**, while sub-assemblies **1301** mounted in positions labeled Y are offset by dimension "Z" **1604** in the opposite direction of the air flow **1660**. Offsetting subassemblies **1301** as shown allows the radial distances between positions X and Y to be minimized as shown in FIG. **15**.

[0057] As shown in the embodiment of FIGS. **15** and **16**, mounting plate **1524**, including multiple impeller holes **1522**, multiple impeller support structures **1520**, multiple impeller support adaptors **1510**, and multiple mounting sockets **1512**, may be of unitary construction. Multiple sub-assemblies **1301** can subsequently be mounted onto the single mounting plate **1524**.

[0058] Although the embodiment of FIGS. **15** and **16** show two columns and three rows, the invention is not so limited. It is contemplated that one or more columns may be used in combination with one or more rows without departing from the spirit of the invention. As can be appreciated, the embodiment of FIGS. **15** and **16** can be incorporated into various air moving devices, such as for example the devices illustrated by FIGS. **7**, **8**, **9**, and **10**.

[0059] Although the invention has been described with reference to exemplary embodiments, it is not limited thereto. Rather, it should be construed to include other variants and embodiments of the invention, which may be made by those skilled in the art without departing from the true spirit and scope of the present invention.

What is claimed:

1. A portable air moving device comprising;

a housing having an air intake opening and an air exit opening;

an interior space defined by said housing;

at least one air generator located within said housing comprising;

an impeller comprising;

a hub comprising;

an outer wall;

a front wall;

an internal cavity defined by said outer wall and said front wall;

multiple blades connected to said outer wall of said hub and extending radially outward from said hub toward a distal end;

a noise attenuation structure connected to said distal end of more than one of said multiple blades comprising;

a circumferential wall having a substantially cylindrical form;

an axis of said cylindrical form;

an intake edge of said cylindrical form;

an exhaust edge of said cylindrical form offset a distance from said intake edge along said axis of said cylindrical form;

a motor disposed substantially within said internal cavity of said hub, said motor comprising;

a permanent magnet rotor fixedly assembled to said hub;

a stator rotatably connected to said rotor, said hub, said multiple blades, and said noise attenuation structure;

wherein a rotation of said impeller of said at least one air generator induces an intake air flow into said air intake opening of said housing and simultaneously generates an exhaust air flow from said air exit opening of said housing.

2. The portable air moving device of claim **1**, further comprising an electric heating element located in said interior space of said housing, wherein a temperature of said exhaust air flow is greater than a temperature of said intake air flow.

3. The portable air moving device of claim **1**, further comprising an air filter located in said interior space of said housing, wherein substantially all of said intake air flow passes through said air filter prior to exiting said housing through said air exit opening as said exhaust air flow.

4. The portable air moving device of claim **3**, wherein said air filter utilizes a mechanical filter to clean the air.

5. The portable air moving device of claim **3**, wherein said air filter utilizes an electrostatic precipitator to clean the air.

6. The portable air moving device of claim **1**, wherein said hub, said multiple blades and said noise attenuation structure of said impeller comprise a unitary structure.

7. The portable air moving device of claim **1**, further comprising an impeller housing comprising;

an impeller housing wall defining an interior space;

an inlet opening;

an outlet opening;

at least one impeller support member; and

wherein said air generator is located substantially within said interior space defined by said impeller housing wall and connected to said impeller housing wall by said at least one impeller support member, said at least one impeller support member being connected to said motor and extending outwardly to said impeller housing wall.

8. The portable air moving device of claim **7**, wherein said impeller housing wall and said at least one impeller support member comprise a unitary structure.

9. The portable air moving device of claim **7**, further comprising an offset distance "A" of said at least one impeller support member defined by a minimum distance from said exhaust edge of said noise attenuation structure to said impeller support member measured in a direction of the air flow through said air generator, wherein said minimum distance is at least 25% of said offset distance between said intake edge and said exhaust edge of said noise attenuation structure.

10. The portable air moving device of claim **7**, further comprising an offset distance "A" of said at least one impeller support member defined by a minimum distance from said intake edge of said noise attenuation structure to said impeller support member measured in a direction opposite a direction of the air flow through said air generator, wherein said minimum distance is at least 25% of said offset distance between said intake edge and said exhaust edge of said noise attenuation structure.

11. The portable air moving device of claim **1**, wherein said intake edge further comprises an intake funnel including an arcuate surface extending radially outward relative to said hub.

12. The portable air moving device of claim **1**, wherein said intake edge further comprises an intake funnel including a conical surface extending radially outward relative to said hub.

13. The portable air moving device of claim **1**, wherein said motor comprises a brushless direct current motor.

14. An air generator comprising;

an impeller comprising;

a hub comprising;

an outer wall;

a front wall;

an internal cavity defined by said outer wall and said front wall;

multiple blades connected to said outer wall of said hub and extending radially outward from said hub toward a distal end;

a noise attenuation structure connected to said distal end of more than one of said multiple blades comprising;

a circumferential wall having a substantially cylindrical form;

an axis of said cylindrical form;

an intake edge of said cylindrical form;

an exhaust edge of said cylindrical form offset a distance from said intake edge along said axis of said cylindrical form;

a motor disposed substantially within said internal cavity of said hub, said motor comprising;

a permanent magnet rotor fixedly assembled to said hub;

a stator rotatably connected to said rotor, said hub, said multiple blades, and said noise attenuation structure;

wherein a rotation of said impeller generates an air flow radially confined by said outer wall of said hub and said circumferential wall of said noise attenuation structure; and

wherein said air flow has a direction of flow from said intake edge toward said exhaust edge of said noise attenuation structure and said direction of flow is substantially parallel to said rotational axis of said impeller.

15. The air generator of claim **14**, wherein said hub, said multiple blades and said noise attenuation structure of said impeller comprise a unitary structure.

16. The air generator of claim **14**, further comprising a mounting structure fixedly connected to said stator, said mounting structure comprising;

a first diameter located proximate said hub and a second diameter offset a specified distance from said first diameter and said hub;

an arcuate surface extending between said first diameter and said second diameter; and

wherein said first diameter is larger than said second diameter and said arcuate surface comprises a substantially conical surface.

17. The air generator of claim **16**, further comprising at least one fastener to attach said air generator to a portable air moving device, wherein a longitudinal length of said fastener is oriented substantially parallel to said rotational axis of said impeller.

18. The air generator of claim **14**, further comprising an impeller housing comprising;

an impeller wall defining an interior space;

an inlet opening;

an outlet opening;

at least one impeller support member; and

wherein said impeller is located within said interior space defined by said impeller housing wall and connected to said impeller housing wall by said at least one impeller support member, said impeller support member being connected to said motor and extending outwardly to said impeller housing wall.

19. The air generator of claim **18**, wherein said impeller housing wall and said impeller support member comprise a unitary structure.

20. The air generator of claim **18**, further comprising an offset distance "A" of said at least one impeller support member defined by a minimum distance from said exhaust edge of said noise attenuation structure to said impeller support member measured in a direction of the air flow through said air generator, wherein said minimum distance is at least **25**% of said offset distance between said intake edge and said exhaust edge of said noise attenuation structure.

21. The air generator of claim **18**, further comprising an offset distance "A" of said at least one impeller support member defined by a minimum distance from said intake edge of said noise attenuation structure to said impeller support member measured in a direction opposite a direction of the air flow through said air generator, wherein said minimum distance is at least 25% of said offset distance between said intake edge and said exhaust edge of said noise attenuation structure.

22. The air generator of claim **14**, wherein said intake edge further comprises an intake funnel including an arcuate surface extending radially outward relative to said hub.

23. The air generator of claim **14**, wherein said intake edge further comprises an intake funnel including a conical surface extending radially outward relative to said hub.

24. An impeller and motor assembly comprising;

a motor comprising;

a permanent magnet rotor;

a stator rotatably connected to said permanent magnet rotor;

a first axis defined by an axis of rotation of said rotor;

an impeller hub fixedly connected to said permanent magnet rotor comprising;

an outer wall having a cylindrical form;

a front wall;

an internal cavity defined by said outer wall and said front wall and said permanent magnet rotor located substantially within said cavity;

a second axis defined by an axis of said cylindrical form of said impeller hub;

a noise attenuation structure comprising;

a circumferential wall having a substantially cylindrical form;

an intake edge of said cylindrical form;

a third axis of said cylindrical form being defined by said circumferential wall;

an exhaust edge of said cylindrical form offset a distance from said intake edge along said third axis;

multiple impeller blades connected to said outer wall of said hub and extending radially outward from said hub toward and connected to said circumferential wall of said noise attenuation structure;

wherein said first, said second and said third axes are substantially co-axial relative to one another; and

wherein a rotation of said permanent magnetic rotor, said hub, said multiple blades, and said noise attenuation structure generates an air flow from said intake edge toward said exhaust edge and radially confined by said outer wall of said hub and said circumferential wall of said noise attenuation structure.

25. The impeller and motor assembly of claim **24**, wherein said hub, said multiple blades and said noise attenuation structure comprise a unitary structure.

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