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(54) **BLOWER**

(75) Inventor: **Kaoru Matsumoto**, Nagano-ken (JP)

(73) Assignee: **Minebea Co., Ltd.**, Nagano (JP)

(*) Notice: This patent is subject to a terminal disclaimer.

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(22) Filed: **May 18, 2005**

Related U.S. Patent Documents

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Issued: **Apr. 9, 2002**
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Filed: **Jun. 26, 2000**

U.S. Applications:

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(30) **Foreign Application Priority Data**

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F04B 17/00 (2006.01)

(52) **U.S. Cl.** **417/423.15**; 417/423.1; 415/58.2; 416/181

(58) **Field of Classification Search** ..... 417/423.15, 417/423.1, 423.7, 423.12, 423.2; 415/58.2, 415/58.3, 58.6; 416/181, 185, 186 R, 187, 416/178
See application file for complete search history.

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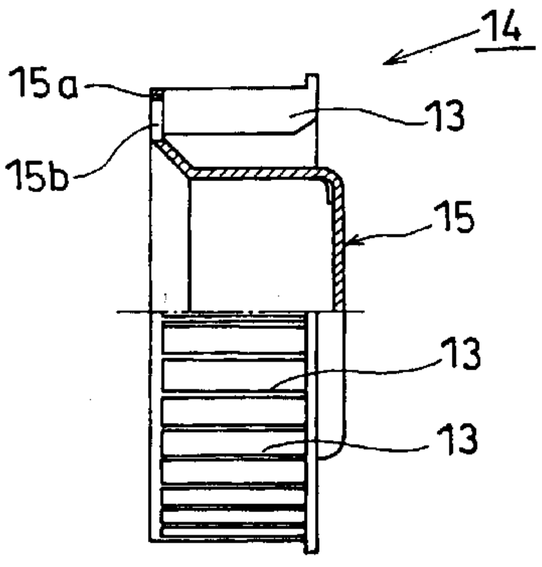
Primary Examiner—William H. Rodriguez
(74) *Attorney, Agent, or Firm*—Oliff & Berridge, PLC

(57) **ABSTRACT**

A blower with the improved P-Q characteristics is provided. A blower comprising a shaft rotatably supported in a tubular casing, a cup shaped motor yoke **11** fixed to the shaft, and a body portion **15** of an impeller **14** comprising a large number of blades **13** on an outer peripheral portion is fixed to the motor yoke **11**, wherein the blower is characterized in that substantially ring-like openings **15**b are provided at a portion where the blades **13** of the body portion **15** are mounted and on a circumference around the shaft. Since air flow is facilitated by the openings **15**b, the P-Q (pressure—flow rate) characteristics are improved.

22 Claims, 6 Drawing Sheets



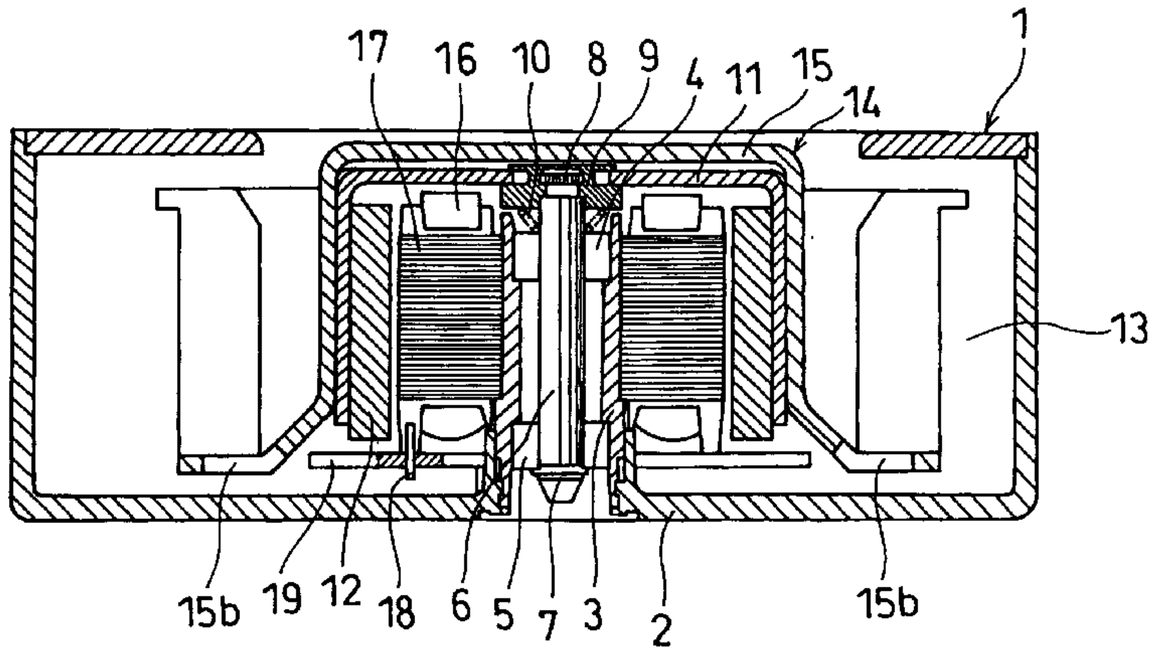


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FIG.1

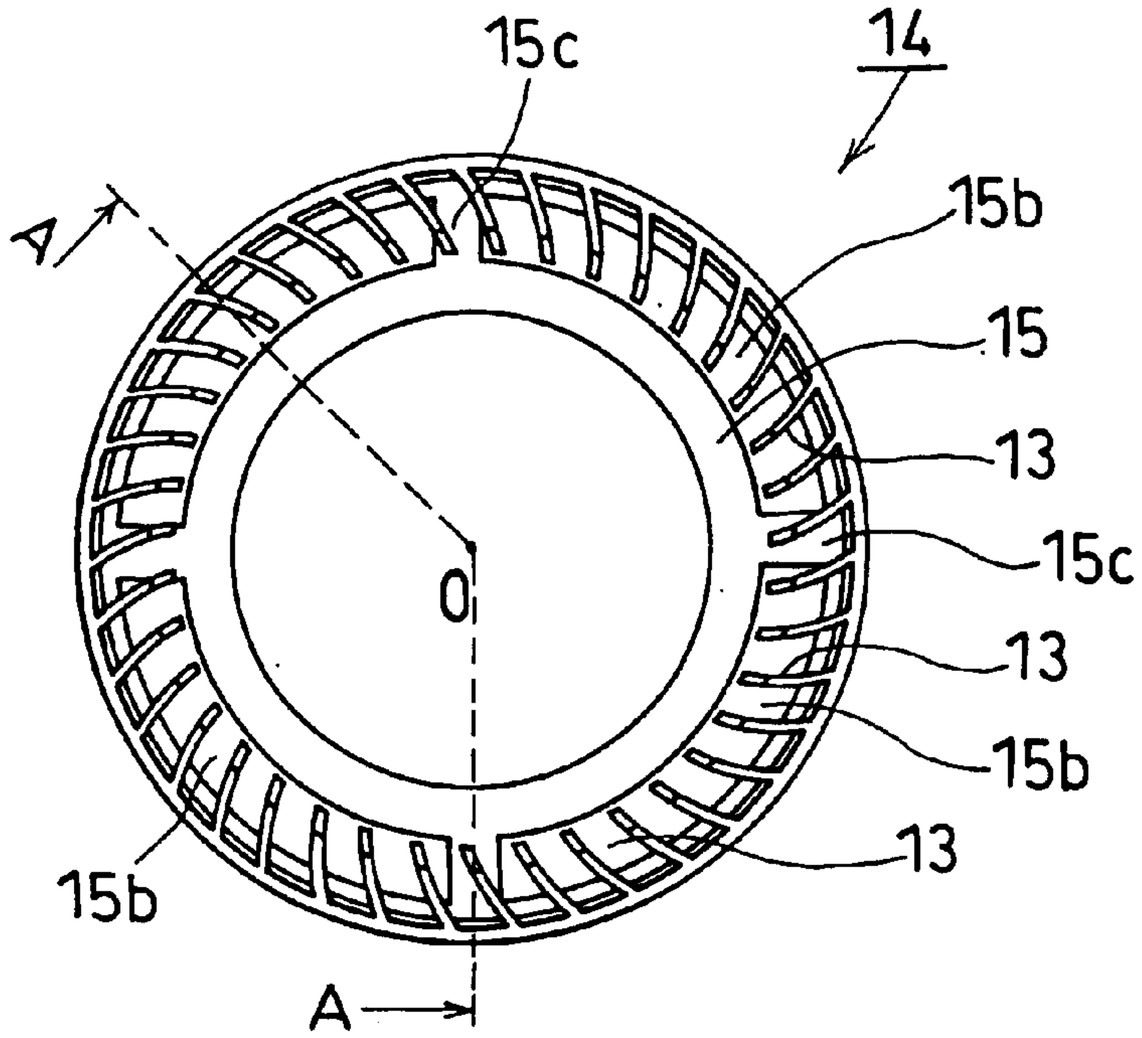


FIG.2

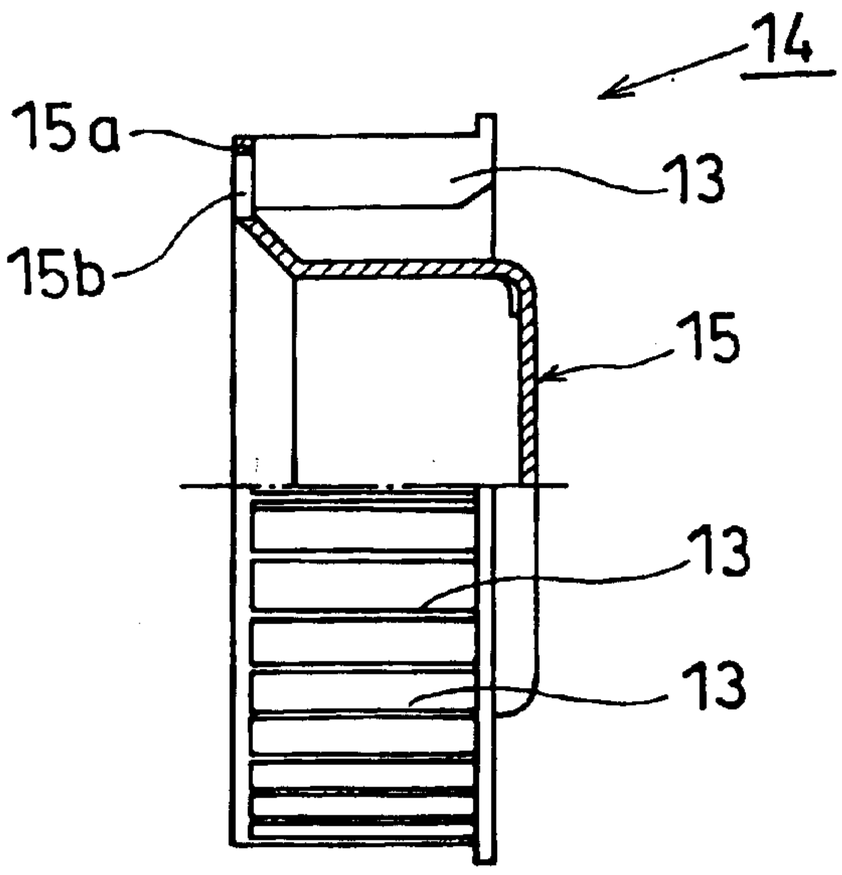


FIG. 3

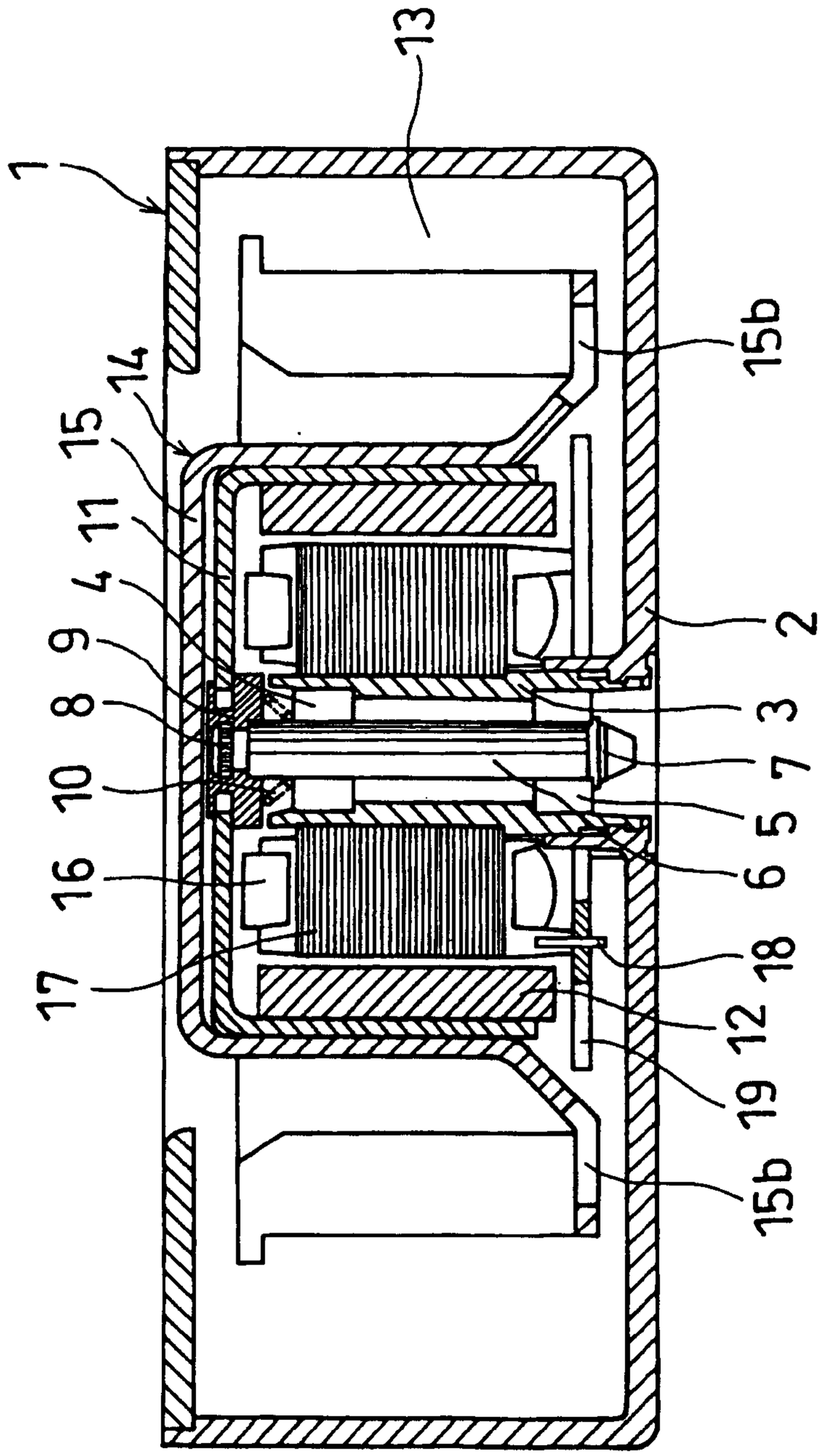


FIG.4 (Prior Art)

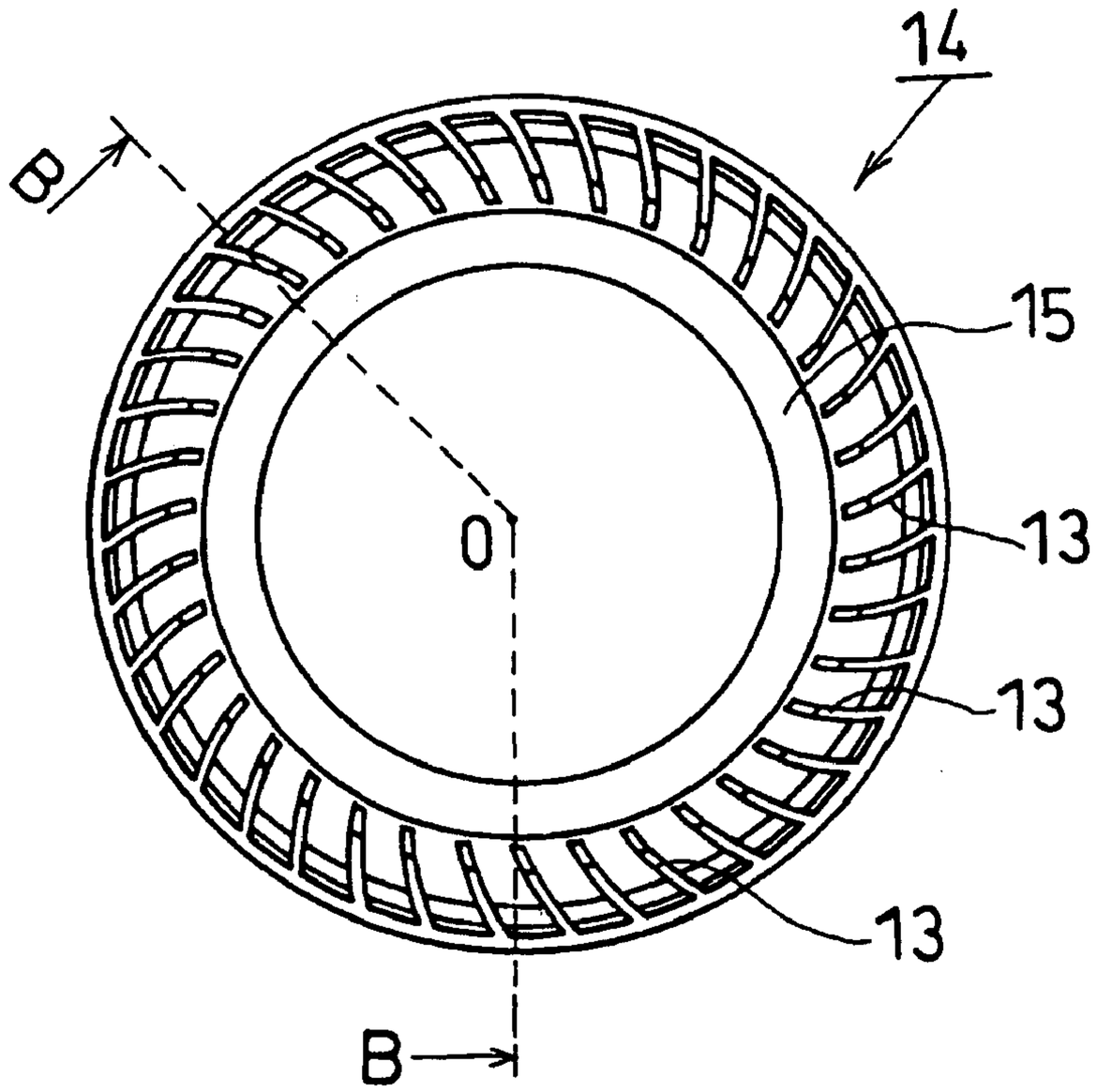


FIG.5 (Prior Art)

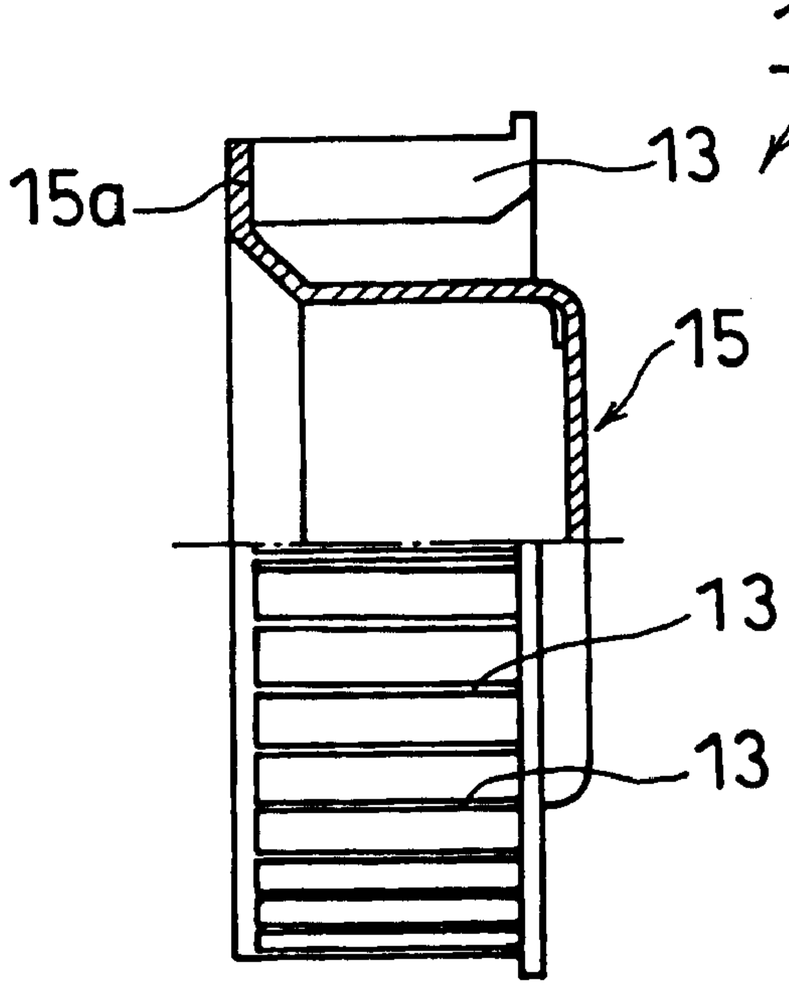


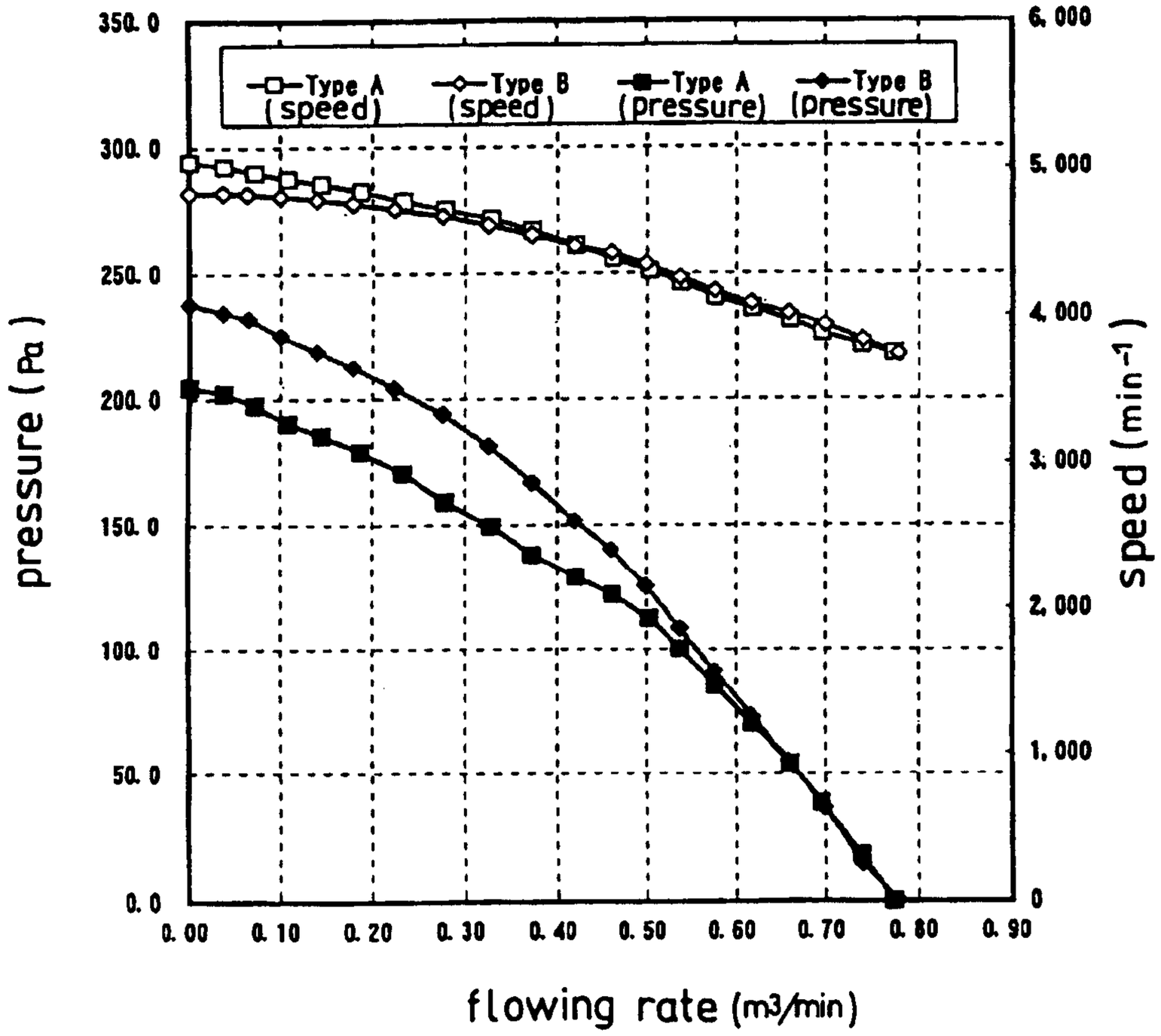
FIG.6

flowing rate m^3/min	pressure Pa	speed min^{-1}
0.000	238.3	4831
0.038	234.8	4832
0.063	232.5	4824
0.099	225.4	4806
0.139	219.1	4784
0.178	212.7	4759
0.223	204.2	4720
0.275	194.4	4675
0.325	181.7	4612
0.372	166.6	4546
0.419	151.8	4474
0.460	140.0	4429
0.499	124.9	4353
0.537	108.3	4257
0.575	90.7	4165
0.617	72.8	4086
0.658	55.1	4017
0.699	36.6	3938
0.740	14.8	3833
0.778	0.0	3739

FIG. 7

flowing rate m^3/min	pressure Pa	speed min^{-1}
0. 000	204. 8	5046
0. 038	202. 4	5015
0. 072	197. 7	4969
0. 108	190. 7	4923
0. 144	185. 8	4890
0. 187	179. 3	4840
0. 233	170. 4	4775
0. 278	159. 5	4719
0. 328	149. 5	4653
0. 372	137. 8	4578
0. 420	128. 7	4481
0. 461	121. 9	4390
0. 503	112. 2	4305
0. 538	100. 1	4223
0. 576	84. 7	4126
0. 617	69. 7	4051
0. 660	54. 1	3970
0. 695	38. 4	3882
0. 739	18. 2	3799
0. 773	0. 0	3743

FIG. 8


Type A (speed)
Type B (speed)
Type A (pressure)
Type B (pressure)
pressure (Pa)
Speed (min-1)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
6,000
5,000
4,000
3,000
2,000
1,000
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
flowing rate (m3/min)

BLOWER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is one of two (2) reissue applications directed to various aspects of a blower described in U.S. Pat. No. 6,368,081, which corresponds to U.S. patent application No. 09/603,973 filed Jun. 26, 2000. The first filed reissue application is application No. 10/807,229, filed Mar. 23, 2004. The second reissue application is the present application, which is a continuation of said application No. 10/807,229, filed Mar. 23, 2004 (and, as noted above, which is a reissue of U.S. Pat. No. 6,368,081, which corresponds to U.S. patent application No. 09/603,973 filed Jun. 26, 2000).

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improvement of a blower for use in various kinds of office automation apparatus.

2. Description of the Related Art

In various kinds of office automation apparatus, since a large number of electronic circuits are housed in a box of the apparatuses, it is difficult to discharge heat generated by electronic components forming the electronic circuits, and thus, there is a fear that a part of the electronic components may be broken or deteriorated. In particular, in the context of the recent trend toward miniaturization of office automation apparatuses, since the apparatuses are miniaturized while the quantity of heat generated almost remains the same, how to deal with the heat is an important technical problem to be solved. In order to solve the problem, an air vent for attaching a blower therein is provided in a side wall of an apparatus to discharge the heat inside to the outside of the apparatus, thereby preventing damage due to the heat generated inside.

An example of a conventionally often used blower is described with reference to FIG. **3**. Sign **1** shows a casing which is tubular. An integrally molded housing **2** is provided on the right in FIG. **3** inside the casing **1**. A bearing liner **3** is inserted into the housing **2**. Outer races of bearings **4** and **5** are supported by the inner side of the bearing liner **3**, and a shaft **6** is inserted into the inner races of the bearings **4** and **5**. A race **7** is attached to the lower end of the shaft **6** for preventing the shaft **6** from falling off and for axially positioning the shaft **6**.

Knurl **8** is provided on the upper end of the shaft **6**, and is fixed to a boss **9** formed by die casting zinc. Springs **10** are provided between the boss **9** and the inner race of the bearing **4** for providing thrust load on the bearing **4**. A center portion of a cup-like motor yoke **11** is fixed to the boss **9**. On the boss **9**, the central portion of a cup shaped yoke **11** is fixed, and on the inner peripheral portion, a ring shaped magnet **12** is fixed. A body portion **15** of an impeller **14** provided with blades **13** is fixed to the outer peripheral portion of the motor yoke **11**. The shaft **6**, the motor yoke **11** and the impeller **14** form a rotating portion.

A stater core **17** around which a stator winding **16** is wound, is provided in the inner peripheral portion of the motor yoke **11** to form a fixed portion. A pin-like connection terminal **18** is provided in a projected manner from the stator core **17** downwardly to pierce a PC board **19** supported by the housing **2**. An electronic circuit is mounted on the PC board **19** for controlling the current to be supplied to the stator winding **16**.

FIG. **4** is a front view of the impeller **14** shown separately from the other elements in FIG. **3**, and FIG. **5** is a half section of the impeller **14** taken along the line **5**—**5** in FIG. **4**. As shown in FIG. **4**, the blades **13** are arc-like. The large number of blades **13** are attached to the body portion **15** radially to form the impeller **14**. The configuration of the body portion **15** is, as shown in FIG. **5**, formed in an outwardly cup shape. To the radially extended portion **15**a the inner peripheral portions of the blades **13** are fixed.

The blower structured as described above is used by mounting on an air vent in a box of an office automation apparatus. The blower is attached such that the top in FIG. **3** is the outer side of the box of the office automation apparatus and the shaft **6** is horizontally oriented. In that state, when power is supplied through the control circuit on the PC board **19**, controlled current passes through the stator winding **16** to generate magnetic flux through the stator core **17**. Then, the magnetic interference between the magnetic flux and the magnetic flux generated by the magnet **12** rotates the rotating portion. Due to the rotation of the impeller **14**, the air sucked from the center of the impeller **14** flows radially by the centrifugal force. The air is then collected in the casing **1** and is discharged from an outlet (not shown) provided in the casing **1**. By this blowing, the inside of the box is cooled.

The required characteristics of a blower of this kind is represented as the relationship between the pressure P and the flowing rate Q, i.e., the P-Q characteristics. Among blowers of a given size, one with a high air flow pressure and with a large amount of air flow is determined to be one with satisfactory P-Q characteristics. When circumstances do not allow the blower to be larger and still the P-Q characteristics have to be improved, the improvement can be attained by increasing the number of rotations. However, there is a problem that merely increasing the number of rotations not only increases the noise when the blower is in operation but also shortens the lifetime of the blower.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above, and an object of the invention is to provide a blower suitable for use in severe circumstances.

In order to solve the above-mentioned problem, according to a first aspect of the present invention, there is provided a blower in which a shaft is rotatably supported in a tubular casing, a cup shaped motor yoke is fixed to the shaft, and a body portion of an impeller comprising a large number of blades on an outer peripheral portion is fixed to the motor yoke, characterized in that substantially ring-like openings are provided at a portion where the blades of the body portion are mounted and on a circumference around the shaft.

According to a second aspect of the present invention, in the blower as described in the first aspect of the present invention, it is characterized in that the openings substantially form a long opening in an arc along the direction of the arrangement of the large number of blades.

In a blower structured as mentioned in the above, when the impeller is rotating, air flows through the openings provided according to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is a front view of an impeller of a blower according to the present invention shown separately from other elements;

FIG. **2** is a partially sectional view of the impeller taken along the line **2**—**2** in FIG. **1**;

FIG. **3** is a partially sectional view of the blower according to the present invention;

FIG. **4** is a front view of a conventional impeller shown separately from other elements;

FIG. **5** is a partially sectional view of the impeller taken along the line **5**—**5** in FIG. **4**;

FIG. **6** is a table showing the characteristics of the blower according to the present invention;

FIG. **7** is a table showing the characteristics of the conventional blower; and

FIG. **8** is a graph showing the characteristics of the blower according to the present invention and of the conventional blower.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention is now described with reference to FIGS. **1** and **2**. FIG. **2** is a partially sectional view of the impeller taken along the line **2**—**2** in FIG. **1**. According to the present invention, substantially ring-like openings **15**b are provided at a portion where the blades **13** of the body portion **15** are mounted (in the radially extended portion **15**a) and on a circumference of a circle around the shaft **6**, the openings **15**b extending along the direction of the arrangement of the large number of blades **13** being extended along the axial direction of the shaft **6**. As shown in FIG. **1**, the openings **15**b are long, and provided almost all around the circumference with only four connecting portions **15**c remaining.

When the blower according to the present invention with the openings **15**b provided at the portion where the blades **13** of the body portion **15** are mounted (in the radially extended portion **15**a) is in operation, since the blades **13** suck air from the openings **15**b provided adjacent thereto, better air flowing can be obtained compared with a case where a conventional blower with no such openings (see FIGS. **4** and **5**).

Tables shown in FIGS. **6** and **7** are with respect to the blower according to the present invention and the conventional blower, respectively. The tables show changes in the pressure and the speed with the flowing rate of air as the parameter. The tables show that, with the blower according to the present invention, as the flow rate decreases, the pressure rises more steeply and the speed rises more gently compared with the case where the conventional blower is used. FIG. **8** plots the data shown in FIGS. **6** and **7**. In FIG. **8**, type A denotes the conventional blower while type B denotes the blower according to the present invention. The data was collected from actually manufactured blowers. It can be seen that, the flow rate when, for example, the static pressure is 150 Pa is, 0.328 m^3/min with regard to the conventional blower and 0.419 m^3/min with regard to the blower according to the present invention, which clearly shows the improvement attained by the present invention.

A blower according to the first aspect of the present invention has a simple structure only with the openings provided at a portion where the blades of the body portion are attached, and thus, the P-Q characteristics can be

improved without making the blower larger. Further, a blower according to the second aspect of the present invention defining the position and the shape of the openings can enhance the above effect.

What is claimed is:

[1. A blower comprising

a shaft which is supported rotatably in a tubular casing,

a cup shaped motor yoke fixed to said shaft, wherein the shaft extends from a closed end of the cup shaped motor yoke to an open end of the cup shaped motor yoke, and

a body portion of an impeller comprising a plurality of blades on an outer peripheral portion fixed to said motor yoke, wherein substantially ring-like openings are provided in the body portion at a mounting portion where said plurality of blades are mounted and on a circumference of a circle around said shaft, and wherein the mounting portion is located substantially adjacent, in a radially outward direction, the open end of the cup shaped motor yoke**]**.

[2. A blower according to claim **1**, wherein said openings substantially form a long opening in an arc extending along the direction of the arrangement of said plurality of blades.**]**

3. A blower comprising

a casing having a space that accommodates an impeller therein and including a portion that includes an air inlet opening therein, wherein the casing further includes an outlet for air discharge;

the impeller comprising a cup shaped central portion with a first end and an open second end opposite the first end, a plurality of blades peripherally surrounding the cup shaped central portion and being supported on a blades-mounting portion of the impeller; and

a driving motor,

wherein the impeller is rotated by the driving motor,

wherein the blades-mounting portion is located substantially adjacent, outwardly in a radial direction, the open second end of the cup shaped central portion; and

wherein the blades-mounting portion includes openings therein.

4. The blower according to claim 3, wherein the cup shaped central portion comprises a motor yoke.

5. The blower according to claim 3, wherein the cup shaped central portion comprises a body of the impeller.

6. The blower according to claim 3, wherein a portion of the casing, on a side opposite the portion including the air inlet therein, includes no air inlets therein such that the portion including the air inlet therein is the only air inlet for the blower.

7. The blower according to claim 3, wherein the openings in the blades-mounting portion are substantially annular.

8. The blower according to claim 3, wherein the outlet for air discharge in the casing comprises an opening in a side of the casing radial to the plurality of blades.

9. A blower comprising

a casing having a space that accommodates an impeller therein and including a first portion and a second portion, joined to the first portion, the second portion including an air inlet opening therein, wherein the casing further includes an outlet for air discharge;

the impeller comprising a cup shaped central portion with a first end and an open second end opposite the first end, a plurality of blades peripherally surrounding the cup shaped central portion and being supported on a blades-mounting portion of the impeller; and

a driving motor,

wherein the impeller is rotated by the driving motor,

wherein the first end of the impeller is located at a side of the casing adjacent the air inlet opening of the second portion;

wherein the blades-mounting portion is located at a side of the casing adjacent a bottom of the first portion, and opposite the second portion, and

wherein the blades-mounting portion includes openings therein.

10. The blower according to claim 9, wherein the cup shaped central portion comprises a motor yoke.

11. The blower according to claim 9, wherein the cup shaped central portion comprises a body of the impeller.

12. The blower according to claim 9, wherein the first portion of the casing includes no air inlets therein such that the air inlet in the second portion of the casing is the only air inlet for the blower.

13. The blower according to claim 9, wherein the openings in the blades-mounting portion are substantially annular.

14. The blower according to claim 9, wherein the outlet for air discharge in the casing comprises an opening in a side of the casing radial to the plurality of blades.

15. A blower comprising

a casing having a space that accommodates an impeller therein and including a first portion and a second portion, joined to the first portion, the second portion including an air inlet opening therein, wherein the casing further includes an outlet for air discharge;

the impeller comprising a cup shaped central portion with a first end and an open second end, a plurality of blades peripherally surrounding the cup shaped central portion and being supported on a blades-mounting portion of the impeller, wherein the blades-mounting portion includes openings therein; and

a driving motor,

wherein the impeller is rotated by the driving motor; and

wherein the air inlet opening in the second portion of the casing and the closed end of the cup shaped central portion together form a continuous annular air inlet passageway.

16. The blower according to claim 15, wherein the cup shaped central portion comprises a motor yoke.

17. The blower according to claim 15, wherein the cup shaped central portion comprises a body of the impeller.

18. The blower according to claim 15, wherein the outlet for air discharge in the casing comprises an opening in a side of the casing radial to the plurality of blades.

19. A blower comprising:

a casing comprising a first side and an opposite second side, the second side including an air inlet opening therein, wherein the casing further includes an outlet for air discharge;

an impeller housed within the casing and supported rotatably in the casing via a shaft, the impeller comprising a cup shaped central portion having a first end side and an open second end side, opposite the first end side, and a side wall portion extending in an axial direction from the first end side to the open second end side in an axial direction, and a plurality of blades peripherally surrounding the cup shaped central portion and being supported on a blades-mounting portion of the impeller that extends radially outward from the side wall portion at the open end side of the side wall portion; and

a driving motor,

wherein the impeller is rotated by the driving motor,

wherein the first end side of the central portion of the impeller is located substantially adjacent, in an axial direction, the second side of the casing;

wherein the blades-mounting portion is located substantially adjacent, in an axial direction, the first side of the casing; and

wherein the blades-mounting portion includes openings therein.

20. The blower according to claim 19, wherein the outlet for air discharge in the casing comprises an opening in a side of the casing radial to the plurality of blades.

21. The blower according to claim 19, wherein the cup shaped central portion comprises a motor yoke.

22. The blower according to claim 19, wherein the cup shaped central portion comprises a body of the impeller.

23. The blower according to claim 19, wherein the first side of the casing includes no air inlet openings therein.

24. The blower according to claim 19, wherein the openings in the blades-mounting portion are substantially annular.

* * * * *