US Patent & Trademark Office
Patent Public Search | Text View

United States Patent	12385493
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Chang; Shun-Chen et al.

Fan

Abstract

A fan includes a fan frame and a driving device. The fan frame includes a base, a frame shell and static blades arranged on the periphery of the base. The driving device includes a stator structure and a rotor structure. The stator structure includes a stator magnetic pole group and a bushing. The rotor structure includes a bearing, a shaft, a rotor shell, a magnetic structure, a magnetic shell and blades. The shaft is connected with the rotor shell and disposed through the bearing. The stator magnetic pole group magnetically drives the magnetic structure to rotate the rotor shell. Two ends of the frame shell are configured with two turning portions, respectively. The two turning portions are disposed between parts of the frame shell with different curvatures. A curvature of the first turning portion is larger than a curvature of the second turning portion.

Inventors: **Chang; Shun-Chen (Taoyuan, TW), Yang; Chao-Fu (Taoyuan, TW)**

Applicant: **DELTA ELECTRONICS, INC.** (Taoyuan, TW)

Family ID: **65993865**

Assignee: **DELTA ELECTRONICS, INC. (Taoyuan, TW)**

Appl. No.: **18/511850**

Filed: **November 16, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240084810 A1	Mar. 14, 2024

Foreign Application Priority Data

CN	201710943492.1	Oct. 11, 2017

Related U.S. Application Data

division parent-doc US 16022192 20180628 US 11867188 child-doc US 18511850

Publication Classification

Int. Cl.: **F04D25/06** (20060101); **F04D17/06** (20060101); **F04D19/02** (20060101); **F04D25/08** (20060101); **F04D29/42** (20060101); **F04D29/44** (20060101); **G06F1/20** (20060101); **H02K7/14** (20060101); **H05K7/20** (20060101)

U.S. Cl.:

CPC **F04D25/0606** (20130101); **F04D17/06** (20130101); **F04D19/02** (20130101); **F04D25/08** (20130101); **F04D29/4226** (20130101); **F04D29/441** (20130101); **G06F1/20** (20130101); **H02K7/14** (20130101); **H05K7/20172** (20130101); H05K7/20136 (20130101)

Field of Classification Search

CPC: F04D (25/0606); F04D (17/06); F04D (29/4226); F04D (29/441); F04D (19/02); F04D (25/08); F04D (25/064); F04D (25/0646); F04D (29/522); H05K (7/20172); H05K (7/20136); G06F (1/20); H02K (7/14)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
5385447	12/1994	Geister	N/A	N/A
7726939	12/2009	Lee	415/220	F04D 29/544
2009/0142204	12/2008	Yamamoto	N/A	N/A
2011/0156520	12/2010	Mai	N/A	N/A
2011/0255239	12/2010	Franz	N/A	N/A
2014/0356149	12/2013	Chang et al.	N/A	N/A
2016/0178265	12/2015	Lee	N/A	N/A
2018/0266440	12/2017	Shiozawa	N/A	H02K 9/06

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
104121230	12/2013	CN	N/A
104214139	12/2013	CN	N/A
204628094	12/2014	CN	N/A
105715564	12/2015	CN	N/A
2677174	12/2012	EP	F04D 17/06

OTHER PUBLICATIONS

Raw Machine Translation of EP2677174, Lichau Christian, “Fan and electric motor”, Dec. 25, 2013. cited by examiner

Raw Machine Translation of CN204628094 (U), Cai Xujie, Axial fan , Sep. 9, 2015. cited by applicant

Primary Examiner: Omgba; Essama

Assistant Examiner: Pekarskaya; Lilya

Attorney, Agent or Firm: MUNCY, GEISSLER, OLDS & LOWE, P.C.

Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This Non-provisional application is a Divisional Application (DA) of U.S. Ser. No. 16/022,192, filed on Jun. 28, 2018, which claims priority under 35 U.S.C. § 119(a) on Patent Application No(s). 201710943492.1 filed in People's Republic of China on Oct. 11, 2017, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION
Field of Invention
(1) The present disclosure relates to a fan and, in particular, to a fan having a fan frame configured with two turning portions.
Related Art
(2) As the enhancement of the performance of electronic devices, a lot of heat will be generated during the operation of electronic devices. If the generated heat cannot be dissipated rapidly, the temperature of the electronic device will increase, thereby causing the damage of the internal components and decreasing the performance and lifetime of the electronic device. In general, a fan is provided in the electronic device for dissipating the generated heat. Moreover, in some electronic devices requiring high-pressure fans, such as air conditioner or vacuum cleaner, two high-speed fans or two motors are connected in series and provided for achieving the needed heat-dissipating effect and the sufficient air pressure, thereby reaching a higher heat dissipation efficiency. However, although the above methods can increase the heat dissipation efficiency, the generated airflow of the two fans will impact the fan frame and the internal components so as to generate a laud operation noise. Besides, the flow field inside the fan frame will also be interfered, so that the airflow cannot be concentrated, which can decrease the performance of the fans and increase the operation noise.
(3) Therefore, it is an important subject to provide the sufficient air quantity for dissipating heat and increase the heat dissipation efficiency with a single fan motor, thereby lowering the manufacturing cost and decreasing the operation noise.
SUMMARY OF THE INVENTION
(4) To achieve the above, the present disclosure provides a fan including a fan frame and a driving device. The fan frame includes a base, a frame shell and a plurality of static blades. The static blades are arranged on a periphery of the base and connected between the base and the frame shell. The driving device is disposed on the base and includes a stator structure and a rotor structure. The stator structure includes a stator magnetic pole group and a bushing. The stator magnetic pole group is disposed on the base, and at least a part of the bushing is protruded beyond the stator magnetic pole group. The rotor structure is disposed corresponding to the stator structure and includes at least a bearing, a shaft, a rotor shell, a magnetic structure and a plurality of blades. The bearing is disposed in the bushing, and the shaft is disposed through the bearing. The rotor shell is connected with the shaft. The magnetic structure is disposed corresponding to the stator magnetic pole group, and the stator magnetic pole group magnetically drives the magnetic structure to rotate the shaft and the rotor shell. The blades are arranged on a periphery of the rotor shell, and the blades are disposed corresponding to the frame shell. Two ends of the frame shell adjacent to the

blades are configured with a first turning portion and a second turning portion, respectively. The first and second turning portions are disposed between parts of the frame shell with different curvatures.

(5) In one embodiment, a radius from the second turning portion to a center of the shaft is greater than a radius from the first turning portion to the center of the shaft.

(6) In one embodiment, an outer shape of the frame shell includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.

(7) In one embodiment, a diameter of the rotor shell close to the first turning portion is less than a diameter of the rotor shell close to the second turning portion, and an outer shape of the rotor shell is gradually expanded from the first turning portion to the second turning portion.

(8) In one embodiment, a surface of the rotor shell facing the blades includes at least an arc surface, at least a curved surface, at least a slant surface, or any combination thereof.

(9) In one embodiment, the blades are obliquely disposed along a periphery of the rotor shell, and distances from sides of the blades facing the frame shell to an inner wall of the frame shell are equivalent.

(10) In one embodiment, a ratio of a maximum height of the blade to a maximum height of the static blade is 1˜4.

(11) In one embodiment, the frame shell includes a first and a second sub frame shells, the first sub frame shell is engaged with the second frame, the first sub frame shell is located corresponding to the rotor shell and the blades, and the static blades are annularly disposed between the base and the second sub frame shell.

(12) In one embodiment, one end of the frame shell is formed with a radial shrinking structure toward the first turning portion, and the radial shrinking structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.

(13) In one embodiment, one end of the frame shell is formed with a cylindrical structure toward the first turning portion.

(14) In one embodiment, one end of the frame shell is formed with a radial expanding structure from the first turning portion to the second turning portion, and the radial expanding structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.

(15) In one embodiment, the stator magnetic pole group is disposed at an outer periphery of the magnetic structure.

(16) In one embodiment, the base is formed with a radial shrinking structure from one end of the base configured with the static blades, and the radial shrinking structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.

(17) In one embodiment, the stator structure further includes an upper shell disposed corresponding to the base.

(18) In one embodiment, the fan further includes at least a fixing structure embedded between the upper shell and the base, and the fixing structure connects and fixes the upper shell to the base.

(19) In one embodiment, the fixing structure is a screw structure or an engaging structure.

(20) In one embodiment, the upper shell has a positioning portion corresponding to a positioning portion of the base, and the stator magnetic pole group or the magnetic structure is limited between the positioning portions.

(21) In one embodiment, at least a part of the bushing protrudes beyond the upper shell, and one end of the bearing disposed on the bushing is disposed corresponding to the upper shell. Otherwise, another end of the bearing disposed on the bushing protrudes beyond the upper shell.

(22) In one embodiment, the magnetic structure is disposed at an outer periphery of the stator magnetic pole group, and the rotor structure further includes a magnetic shell disposed between an inner wall of the rotor shell and an outer periphery of the magnetic structure.

(23) In one embodiment, the base further includes a first base, a second base and a supporting sleeve. The second base and the supporting sleeve are disposed inside the first base, the second base is disposed between the supporting sleeve and the first base, the stator magnetic pole group is disposed at one end of the supporting sleeve, the bushing is disposed inside the stator magnetic pole group and the supporting sleeve, and a maximum diameter of the rotor shell close to the second turning portion is corresponding to a diameter of the first base.
(24) In one embodiment, one end of the bearing disposed on the bushing is located corresponding to the stator magnetic pole group. Otherwise, another end of the bearing disposed on the bushing is located corresponding to the supporting sleeve.
(25) In one embodiment, the rotor structure further includes another bearing disposed in the bushing, and at least one of the bearing protrudes from the stator magnetic pole group.
(26) In one embodiment, a ratio of a maximum height of the blade to a height of the fan is 0.3˜0.7.
(27) As mentioned above, the fan frame of the fan of this disclosure is configured with a first and a second turning portions for concentrating the airflow and providing the radial pressure. In addition, the outer shape of the rotor shell is gradually expanded, and the blades are obliquely disposed. Thus, the impact frequency between the airflow and the internal components of the fan can be reduced, so that the flow field inside the fan frame becomes steady. Accordingly, the sufficient air pressure and air quantity can be provided, and the operation noise of the fan can be decreased, thereby improving the operation performance of the fan.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The present invention will become more fully understood from the subsequent detailed description and accompanying drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:
(2) FIG. **1**A is a schematic diagram showing a fan according to a first embodiment of the disclosure;
(3) FIG. **1**B is an exploded view of the fan of FIG. **1**A;
(4) FIG. **1**C is a sectional perspective view of the fan of FIG. **1**A;
(5) FIG. **1**D is a sectional front view of the fan of FIG. **1**A;
(6) FIG. **2**A is a schematic diagram showing a fan according to a second embodiment of the disclosure;
(7) FIG. **2**B is an exploded view of the fan of FIG. **2**A;
(8) FIG. **2**C is a sectional perspective view of the fan of FIG. **2**A; and
(9) FIG. **2**D is a sectional front view of the fan of FIG. **2**A.
DETAILED DESCRIPTION OF THE INVENTION
(10) The present invention will be apparent from the following detailed description, which proceeds with reference to the accompanying drawings, wherein the same references relate to the same elements.
(11) The basic structure and features of a fan according to a first embodiment of the disclosure will be described hereinafter with reference to FIGS. **1**A to **1**D. FIG. **1**A is a schematic diagram showing a fan according to a first embodiment of the disclosure, FIG. **1**B is an exploded view of the fan of FIG. **1**A, FIG. **1**C is a sectional perspective view of the fan of FIG. **1**A, and FIG. **1**D is a sectional front view of the fan of FIG. **1**A.
(12) The first embodiment of the present disclosure provides a fan F**1** including a fan frame **1** and a driving device **2**. The fan frame **1** includes a base **11**, a frame shell **12**, and a plurality of static blades **13**. The static blades **13** are arranged on a periphery of the base **11** and connected between the base **11** and the frame shell **12**. The static blades are disposed at the upper end **11**A of the base

11, and the lower end **11**B of the base **11** is formed with a radial shrinking structure. In more detailed, an upper part of the base **11** close to the rotor shell **224** is defined as the upper end **11**A of the base **11**, which is configured with the static blades **13**. As shown in the figures, a lower part of the base **11**, which is configured without the static blades **13**, is defined as the lower end **11**B of the base **11**. The lower end **11**B of the base **11** is gradually shrunk along a direction away from the static blades **13**.

(13) The driving device **2** is disposed on the base **11** and includes a stator structure **21** and a rotor structure **22**. The stator structure **21** includes a stator magnetic pole group **211** and a bushing **212**. The stator magnetic pole group **211** is disposed on the base **11**, and at least a part of the bushing **212** is protruded beyond the stator magnetic pole group **211**. The rotor structure **22** is disposed corresponding to the stator structure **21** and includes at least a bearing **221**, a shaft **223**, a rotor shell **224**, a magnetic structure **225**, and a plurality of blades **226**. The bearing **221** is disposed in the bushing **212**, and the shaft **223** is disposed through the bearing **221**. The rotor shell **224** is connected with the shaft **223**. The magnetic structure **225** is disposed corresponding to the stator magnetic pole group **211**, and the stator magnetic pole group **211** magnetically drives the magnetic structure **225** to rotate the shaft **223** and the rotor shell **224**. The blades **226** are arranged on a periphery of the rotor shell **224**, and the blades **226** are disposed corresponding to the frame shell **12**. The stator magnetic pole group **211** is disposed on, for example but not limited to, the outer periphery of the magnetic structure **225**, so that the driving device **2** becomes an internal rotor structure **22**. In addition, according to the design requirement of the internal flow field of the fan F**1**, the magnetic structure **225** can be disposed on the outer periphery of the stator magnetic pole group **211**, so that the driving device **2** becomes an external rotor structure **22**.

(14) In this embodiment, the rotor structure **22** can further include another bearing **222**, which is disposed in the bushing **212**. In more specific, the bearings **221** and **222** are disposed inside the bushing **212**. At least one bearing **221** is protruded beyond the stator magnetic pole group **211**, and the shaft **223** is disposed through the bearings **221** and **222**. The rotor shell **224** is connected to the shaft **223**.

(15) The detailed designs of the frame shell **12**, the static blades **13** and the rotor structure **22** of this embodiment will be described hereinafter with reference to FIGS. **1**C and **1**D. In this embodiment, two ends of the frame shell **12** adjacent to the blades **226** are configured with a first turning portion T**1** and a second turning portion T**2**, respectively. The first and second turning portions T**1**, T**2** are disposed between parts of the frame shell **12** with different curvatures. A radius from the second turning portion T**2** to a center of the shaft **223** is greater than a radius from the first turning portion T**1** to the center of the shaft **223**. In this embodiment, according to different requirements for flow field, an outer shape of the frame shell **12** includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. The frame shell **12** can be formed by the arc surface or curved surface with different curvatures, or the planar surface or slant surface with different slopes. The frame shell **12** can also include at least a guiding angle or at least a reverse angle.

(16) In more specific, the first turning portion T**1** is around the part of the upper end of the frame shell **12** having the maximum curvature. The first turning portion T**1** is an inflection point for connecting a part of the frame shell **12** above the first turning portion T**1** and a part of the frame shell **12** below the first turning portion T**1**. The upper end of the frame shell **12** is formed with a radial shrinking structure toward the first turning portion T**1**, and the radial shrinking structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. Accordingly, the airflow can enter through the upper end of the frame shell **12** so as to achieve the concentration of the airflow. In addition, according to the design requirement for flow field, the upper end of the frame shell **12** can be formed with a cylindrical structure toward the first turning portion T**1** for achieving the effect of primarily controlling the air quantity.

(17) Similarly, the second turning portion T**2** is around the part of the lower end of the frame shell **12** (below the first turning portion T**1**) having the maximum curvature. The second turning portion T**2** is an inflection point for connecting a part of the frame shell **12** below the first turning portion T**1** and a part of the frame shell **12** below the second turning portion T**2**. The lower end of the frame shell **12** is formed with a radial expanding structure from the first turning portion T**1** to the second turning portion T**2**, and the radial expanding structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. Accordingly, after the airflow is concentrated at the first turning portion T**1** of the frame shell **12**, the airflow can flow from the first turning portion T**1** to the second turning portion T**2**, thereby achieving the effects of airflow concentration and pressure increasing.
(18) Referring to FIGS. **1**B, **1**C and **1**D, in this embodiment, a diameter of the rotor shell **224** close to the first turning portion T**1** is less than a diameter of the rotor shell **224** close to the second turning portion T**2**. An outer shape of the rotor shell **224** is gradually expanded from the first turning portion T**1** to the second turning portion T**2**. In addition, a surface of the rotor shell **224** facing the blades **226** includes at least an arc surface, at least a curved surface, at least a slant surface, or any combination thereof. In more specific, the outer shape of the rotor shell **224** is gradually expanded from top to bottom. Besides, the outline of the rotor shell **224** is composed by a concave arc surface or a concave curved surface so that the rotor shell **224** is formed similar to a cone structure. The blades **226** are obliquely disposed along a periphery of the rotor shell **224**. In more detailed, the blades **226** are obliquely disposed along the outline of the rotor shell **224**, and the distances from the sides of the blades **226** facing the frame shell **12** to an inner wall of the frame shell **12** are equivalent. Thus, the sides of the blades **226** close to the frame shell **12** has a shape corresponding to the shape of the frame shell **12**. Since the shapes of the rotor shell **224** and the blades **226** are corresponding to the shape of the frame shell **12**, the airflow can be effective pressured after entering the frame shell **12**. This configuration can reduce the impact frequency between the airflow and the internal components of the fan F**1**, steady the flow field inside the fan frame **12**, provide the sufficient air pressure and air quantity, and decrease the operation noise of the fan F**1**.
(19) Furthermore, in this embodiment, a ratio of a maximum height of the blade **226** to a maximum height of the static blade **13** is 1˜4, and a ratio of a maximum height of the blade **226** to a height of the fan F**1** is 0.3˜0.7. The base **11** is formed with a radial shrinking structure from the upper end **11**A of the base **11** that is configured with the static blades **13** to the lower end **11**B of the base **11** that is configured without the static blades **13**. The radial shrinking structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. In more specific, the upper end **11**A of the base **11** is close to the rotor shell **224** and is configured with the static blades **13**. The lower end **11**B of the base **11** is not configured with the static blades **13**, and the lower end of the base **11** is formed with a radial shrinking structure toward a direction away from the static blades **13**. Based on the designs of the maximum heights of the blades **226** and the static blades **13** and the radial shrinking structure of the base **11** toward the direction away from the static blades **13**, the internal flow field inside the frame shell **12** can be steadied and the sufficient air pressure and air quantity can be provide when the airflow flows through the frame shell **12**. Accordingly, the flow field inside the frame shell **12** can be perfectly controlled.
(20) In order to increase the convenience for assembling, the frame shell **12** of this embodiment includes a first and a second sub frame shells **121**, **122**. The first sub frame shell **121** is engaged with the second sub frame shell **122**, and the first sub frame shell **121** is located corresponding to the rotor shell **224** and the blades **226**. The static blades **13** are annularly disposed between the base **11** and the second sub frame shell **122**. After assembling the stator structure **21** and the rotor structure **22** in the base **11**, the first and second sub frame shells **121**, **122** can be directly engaged to finish the entire assembling procedure of the fan F**1**.

(21) The stator structure **21** further includes an upper shell **213** disposed corresponding to the base **11**. The fan F**1** further includes at least a fixing structure **3** embedded between the upper shell **213** and the base **11**, and the fixing structure **3** connects and fixes the upper shell **213** to the base **11**. In this embodiment, the fixing structure **3** can be, for example but not limited to, a screw structure or an engaging structure. The screw structure can be a screw and the engaging structure can be a bolt or a latch. In this case, the upper shell **213** has at least a positioning portion **2131**, and the base **11** has a positioning portion **111** corresponding to the positioning portion **2131**. The stator magnetic pole group **211** or the magnetic structure **225** is limited between the positioning portions **111** and **2131**. Accordingly, the stator magnetic pole group **211** or the magnetic structure **225** can be disposed and fixed between the upper shell **213** and the base **11** without additional fixing mechanism.

(22) In addition, as shown in FIGS. **1**C and **1**D, two bearings **221** and **222** are protruded beyond the stator magnetic pole group. At least a part of the bushing **212** protrudes beyond the upper shell **213**. One bearing **222** is disposed in the lower end of the bushing **212** and located corresponding to the upper shell **213**. The bearing **222** disposed in the lower end of the bushing **212** can be located within a range defined by the upper shell **213**. The other bearing **221** is disposed in the upper end of the bushing **212** and protruded beyond the upper shell **213**. This embodiment is not limited to the above aspect with two bearings. In some embodiments, the rotor structure may include a single bearing. For example, the bearing **222** can also be disposed in the other end of the bushing **212** and protruded beyond the upper shell **213**. The bearing can be a ball bearing or an oil bearing. In addition, in the aspect that the rotor structure includes two bearings, the bearing **222** is not needed to be protruded beyond the upper shell **213**.

(23) The basic structure and features of a fan according to a second embodiment of the disclosure will be described hereinafter with reference to FIGS. **2**A to **2**D. FIG. **2**A is a schematic diagram showing a fan according to a second embodiment of the disclosure, FIG. **2**B is an exploded view of the fan of FIG. **2**A, FIG. **2**C is a sectional perspective view of the fan of FIG. **2**A, and FIG. **2**D is a sectional front view of the fan of FIG. **2**A.

(24) The second embodiment of the present disclosure provides a fan F**2** including a fan frame **5** and a driving device **6**. The fan frame **5** includes a base **51**, a frame shell **52**, and a plurality of static blades **53**. The static blades **53** are arranged on a periphery of the base **51** and connected between the base **51** and the frame shell **52**. The driving device **6** is disposed on the base **51** and includes a stator structure **61** and a rotor structure **62**. The stator structure **61** includes a stator magnetic pole group **611** and a bushing **612**. The stator magnetic pole group **611** is disposed on the base **51**, and at least a part of the bushing **612** is protruded beyond the stator magnetic pole group **611**. The rotor structure **62** is disposed corresponding to the stator structure **61** and includes at least a bearing **621**, a shaft **623**, a rotor shell **624**, a magnetic structure **625**, and a plurality of blades **626**. The bearing **621** is disposed in the bushing **612**, and the shaft **623** is disposed through the bearing **621**. The rotor shell **624** is connected with the shaft **623**. The magnetic structure **625** is disposed corresponding to the stator magnetic pole group **611**, and the stator magnetic pole group **621** magnetically drives the magnetic structure **625** to rotate the shaft **623** and the rotor shell **624**. The blades **626** are arranged on a periphery of the rotor shell **624**, and the blades **626** are disposed corresponding to the frame shell **52**. The magnetic structure **625** is disposed on, for example but not limited to, the outer periphery of the stator magnetic pole group **611**, so that the driving device **6** becomes an external rotor structure **62**. In addition, according to the design requirement of the internal flow field of the fan F**2**, the stator magnetic pole group **611** can be disposed on the outer periphery of the magnetic structure **625** so that the driving device **6** becomes an internal rotor structure **62**.

(25) In this embodiment, the rotor structure **62** can further include another bearing **622**, which is disposed in the bushing **612**. In more specific, the bearings **621** and **622** are disposed inside the bushing **612**. At least one bearing **621** is protruded beyond the stator magnetic pole group **611**, and

the shaft **623** is disposed through the bearings **621** and **622**. The rotor shell **624** is connected to the shaft **623**.
(26) In addition, the rotor structure **62** further includes a magnetic shell **627** disposed between an inner wall of the rotor shell **624** and an outer periphery of the magnetic structure **625**. The material of the rotor shell **624** and the blades **626** can be plastic materials formed by ejection molding, or metal material.
(27) In this embodiment, the base **51** further includes a first base **511**, a second base **512**, and a supporting sleeve **513**. The second base **512** and the supporting sleeve **513** are disposed inside the first base **511**. The second base **512** is disposed between the supporting sleeve **513** and the first base **511**. The stator magnetic pole group **611** is disposed at one end of the supporting sleeve **513**. The bushing **612** is disposed inside the stator magnetic pole group **611** and the supporting sleeve **513**. As shown in the figures, the bearing **621** is disposed in the upper end of the bushing **612** and located corresponding to the stator magnetic pole group **611**. The other bearing **622** is disposed in the lower end of the bushing **612** and located corresponding to the supporting sleeve **513**. The bearing **622** is protruded beyond the bottom of the stator magnetic pole group **611**. In addition, a maximum diameter of the rotor shell **624** close to the second turning portion T**4** is corresponding to a diameter of the first base **511**. That is, the maximum diameter of the bottom of the rotor shell **624** is corresponding to the diameter of the top of the first base **511**. This embodiment is not limited to the above aspect with two bearings. In some embodiments, the rotor structure may include a single bearing. For example, the bearing **621** can also be disposed in the lower end of the bushing **612** and located corresponding to the supporting sleeve **513**, so that the bearing **621** is protruded beyond the bottom of the stator magnetic pole group **611**. In addition, the bearing **621** can also be disposed in the other end of the bushing **612** and located corresponding to the supporting sleeve **513**. The bearing can be a ball bearing or an oil bearing. In addition, in the aspect that the rotor structure includes two bearings, the bearing **622** is not needed to be protruded beyond the bottom of the stator magnetic pole group **611**.
(28) The detailed designs of the frame shell **52**, the static blades **53** and the rotor structure **62** of this embodiment will be described hereinafter with reference to FIGS. **2**C and **2**D. In this embodiment, two ends of the frame shell **52** adjacent to the blades **626** are configured with a first and a second turning portions T**3**, T**4**, respectively. The first and second turning portions T**3**, T**4** are disposed between parts of the frame shell **52** with different curvatures. A radius from the second turning portion T**4** to a center of the shaft **623** is greater than a radius from the first turning portion T**3** to the center of the shaft **623**. In this embodiment, according to different requirements for flow field, an outer shape of the frame shell **52** includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. The frame shell **52** can be formed by the arc surface or curved surface with different curvatures, or the planar surface or slant surface with different slopes. The frame shell **52** can also include at least a guiding angle or at least a reverse angle.
(29) In more specific, the first turning portion T**3** is around the part of the upper end of the frame shell **52** having the maximum curvature. The first turning portion T**3** is an inflection point for connecting a part of the frame shell **52** above the first turning portion T**3** and a part of the frame shell **52** below the first turning portion T**3**. The upper end of the frame shell **52** is formed with a radial shrinking structure toward the first turning portion T**3**, and the radial shrinking structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. Accordingly, the airflow can enter through the upper end of the frame shell **52** so as to achieve the concentration of the airflow.
(30) Similarly, the second turning portion T**4** is around the part of the lower end of the frame shell **52** below the first turning portion T**3** having the maximum curvature. The second turning portion T**4** is an inflection point for connecting a part of the frame shell **52** below the first turning portion T**3** and a part of the frame shell **52** below the second turning portion T**4**. The lower end of the

frame shell **52** is formed with a radial expanding structure from the first turning portion T**3** to the second turning portion T**4**, and the radial expanding structure includes at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof. Accordingly, after the airflow is concentrated at the first turning portion T**3** of the frame shell **52**, the airflow can flow from the first turning portion T**3** to the second turning portion T**4**, thereby achieving the effects of airflow concentration and pressure increasing.

(31) Referring to FIGS. **2**B, **2**C and **2**D, in this embodiment, a diameter of the rotor shell **624** close to the first turning portion T**3** is less than a diameter of the rotor shell **624** close to the second turning portion T**4**, and an outer shape of the rotor shell **624** is gradually expanded from the first turning portion T**3** to the second turning portion T**4**. In addition, a surface of the rotor shell **624** facing the blades **626** includes at least an arc surface, at least a curved surface, at least a slant surface, or any combination thereof. In more specific, the outer shape of the rotor shell **624** is gradually expanded from top to bottom. Besides, the outline of the rotor shell **624** is composed by a concave arc surface or a concave curved surface, so that the rotor shell **624** is formed similar to a cone structure. The blades **626** are obliquely disposed along a periphery of the rotor shell **624**. In more detailed, the blades **626** are obliquely disposed along the outline of the rotor shell **624**, and the distances from the sides of the blades **626** facing the frame shell **52** to an inner wall of the frame shell **52** are equivalent. Thus, the sides of the blades **626** close to the frame shell **52** has a shape corresponding to the shape of the frame shell **52**. Since the shapes of the rotor shell **624** and the blades **626** are corresponding to the shape of the frame shell **52**, the airflow can be effective pressured after entering the frame shell **52**. This configuration can reduce the impact frequency between the airflow and the internal components of the fan F**2**, steady the flow field inside the fan frame **52**, provide the sufficient air pressure and air quantity, and decrease the operation noise of the fan F**2**.

(32) Furthermore, in this embodiment, a ratio of a maximum height of the blade **626** to a maximum height of the static blade **53** is 1˜4, and a ratio of a maximum height of the blade **626** to a height of the fan F**2** is 0.3˜0.7. Based on the designs of the maximum heights of the blades **626** and the static blades **53**, the internal flow field inside the frame shell **52** can be steadied and the sufficient air pressure and air quantity can be provide when the airflow flows through the frame shell **52**. Accordingly, the flow field inside the frame shell **52** can be perfectly controlled.

(33) In order to increase the convenience for assembling, the frame shell **52** of this embodiment includes a first and a second sub frame shells **521**, **522**. The first sub frame shell **521** is engaged with the second sub frame shell **522**, and the first sub frame shell **521** is located corresponding to the rotor shell **624** and the blades **626**. The static blades **53** are annularly disposed between the base **51** and the second sub frame shell **522**.

(34) In summary, the fan frame of the fan of this disclosure is configured with two turning portions for concentrating the airflow entering from the upper end of the frame shell and providing the radial pressure. In addition, the outer shapes of the rotor shell and the blades are corresponding to the outer shape of the frame shell, so that the airflow can be effectively pressured after entering from the frame shell. Thus, the impact frequency between the airflow and the internal components of the fan can be reduced, so that the flow field inside the fan frame becomes steady. Accordingly, the sufficient air pressure and air quantity can be provided, and the operation noise of the fan can be decreased, thereby improving the operation performance of the fan.

(35) In addition, the frame shell can be assembled by two sub frame shells. Accordingly, after assembling the stator structure and the rotor structure in the base, the two sub frame shells can be directly engaged to finish the entire assembling procedure of the fan. This design can improve the convenience of assembling.

(36) Although the present invention has been described with reference to specific embodiments, this description is not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments, will be apparent to persons skilled in

the art. It is, therefore, contemplated that the appended claims will cover all modifications that fall within the true scope of the present invention.

Claims

1. A fan comprising: a fan frame comprising a base, a frame shell and a plurality of static blades, wherein the plurality of static blades is arranged on a periphery of the base and connected between the base and the frame shell, the frame shell has an inlet opening, the inlet opening has a bell mouth shape; and a driving device disposed on the base and comprising: a stator structure comprising a stator magnetic pole group and a bushing, wherein the stator magnetic pole group is disposed on the base, and at least a part of the bushing is protruded beyond the stator magnetic pole group; and a rotor structure corresponding to the stator structure and comprising: at least a bearing disposed in the bushing, a shaft disposed through the bearing, a rotor shell connected with the shaft, a magnetic structure disposed at an outer periphery of the stator magnetic pole group, wherein the stator magnetic pole group magnetically drives the magnetic structure to rotate the shaft and the rotor shell, a magnetic shell disposed between an inner wall of the rotor shell and an outer periphery of the magnetic structure, and a plurality of blades arranged on a periphery of the rotor shell, wherein the plurality of blades arranged on the periphery of the rotor shell are disposed corresponding to the frame shell; wherein two ends of the frame shell adjacent to the plurality of blades arranged on the periphery of the rotor shell are configured with a first turning portion and a second turning portion, respectively, and the first turning portion and the second turning portion are disposed between parts of the frame shell with different curvatures, a curvature of the first turning portion is larger than a curvature of the second turning portion, the first turning portion is higher than the second turning portion in an axial direction, the second turning portion of the frame shell is higher than a lowest portion of the periphery of the rotor shell in the axial direction, wherein the base further comprises a first base, a second base and a supporting sleeve, the second base and the supporting sleeve are disposed inside the first base, the second base is disposed between the supporting sleeve and the first base, the stator magnetic pole group is disposed at one end of the supporting sleeve, the bushing is disposed inside the stator magnetic pole group and the supporting sleeve, and a maximum diameter of the rotor shell close to the second turning portion is corresponding to a diameter of the first base.
2. The fan according to claim 1, wherein a radius from the second turning portion to a center of the shaft is greater than a radius from the first turning portion to the center of the shaft.
3. The fan according to claim 1, wherein an outer shape of the frame shell comprises at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.
4. The fan according to claim 1, wherein a diameter of the rotor shell close to the first turning portion is less than a diameter of the rotor shell close to the second turning portion, and an outer shape of the rotor shell is gradually expanded from the first turning portion to the second turning portion.
5. The fan according to claim 4, wherein a surface of the rotor shell facing the plurality of blades arranged on the periphery of the rotor shell comprises at least an arc surface, at least a curved surface, at least a slant surface, or any combination thereof.
6. The fan according to claim 4, wherein the plurality of blades arranged on the periphery of the rotor shell is being obliquely disposed along the periphery of the rotor shell, and distances from sides of the plurality of blades that are arranged on the periphery of the rotor shell facing the frame shell to an inner wall of the frame shell are equivalent.
7. The fan according to claim 1, wherein a ratio of a maximum height of each blade of the plurality of blades arranged on the periphery of the rotor shell to a maximum height of each static blade of the plurality of the static blades is 1˜4.

8. The fan according to claim 1, wherein the frame shell comprises a first sub frame shell and a second sub frame shell, the first sub frame shell is engaged with the second sub frame shell, the first sub frame shell is located corresponding to the rotor shell and the plurality of blades that is arranged on the periphery of the rotor shell, and the plurality of static blades is annularly disposed between the first base and the second sub frame shell.
9. The fan according to claim 1, wherein one end of the frame shell is formed with a radial shrinking structure toward the first turning portion, and the radial shrinking structure of the frame shell comprises at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.
10. The fan according to claim 1, wherein one end of the frame shell is formed with a radial expanding structure from the first turning portion to the second turning portion, and the radial expanding structure of the frame shell comprises at least an arc surface, at least a curved surface, at least a planar surface, at least a slant surface, or any combination thereof.
11. The fan according to claim 1, wherein the stator magnetic pole group is disposed at an outer periphery of the magnetic structure.
12. The fan according to claim 1, wherein a ratio of a maximum height of each blade of the plurality of blades arranged on the periphery of the rotor shell to a height of the fan is 0.3˜0.7.