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(54) Benævnelse: **MOTORSTRUKTUR DER ER I STAND TIL AT DISSIPERE VARME DERI**

(56) Fremdragne publikationer:
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TW-A- 201 036 310
US-A- 4 074 156
US-A1- 2015 130 306

DESCRIPTION

(a) Technical Field of the Invention

[0001] The present invention relates to a motor structure capable of dissipating heat therein and, more particularly, to a motor which can effectively dissipate the heat generated in its housing through multiple paths, so that heat is not easy to accumulate in the motor's housing, and thus the performance and service life of the motor can be increased.

(b) Description of the Prior Art

[0002] In today's industry, motors are one of commonly used devices for providing mechanical power. However, while a motor is running, heat is easy to accumulate in the motor's housing. If the heat is not timely dissipated, the magnetic field provided by the magnets in the motor's housing will decrease, so that the performance of the motor can be gradually reduced. Besides, when the temperature in the motor rises to a certain level, the coils or enamel wires in the motor can be damaged, and this may cause a short circuit, and thus the motor may burn out. For preventing such a problem, a motor is usually provided with a cooling fan. Such a conventional motor cooling design is known, for example, from document TW 20103 6310 A disclosing a servo motor including a fan and defining an air flow space and air channels. Document US 4 074 156 A also discloses conventional air cooling means for a dynamoelectric machine including an external motor cooling fan.

[0003] However, the air current generated by the cooling fan of the motor can merely flow along the outer surface of the motor's housing, but cannot flow into the interior of the motor, and thus the capacity of dissipating the heat generated in the motor is limited. The problem of heat accumulation in the motor's housing has not yet been solved completely.

SUMMARY OF THE INVENTION

[0004] One object of the present invention is to provide a motor, which can effectively dissipate the heat generated in its housing through multiple paths.

[0005] According to one feature of the present invention, the motor generally includes a housing, a cover, an air collecting structure, a rotating shaft, and a cooling fan. The housing has a surrounding wall defining therein an inner space with a front opening and has a rear closure wall opposite to the front opening. The rear closure wall defines a central hole and a plurality of outlet holes. The cover, which closes the front opening of the housing, has a central hub defining a central hole and defines a plurality of inlet holes around the central hub thereof. The air collecting structure, which is adapted to be fixed to the cover, has a central hub

defining a central hole aligned with the central hole of the cover for allowing the rotating shaft to insert therethrough and has an outer ring around the central hub of the air collecting structure and defines a plurality of through holes, located between the outer ring and the central hub of the air collecting structure and aligned with the inlet holes of the cover, whereby a central portion of a whirling, ongoing air current generated by the cooling fan can flow through the space between the outer ring and the central hub of the air collecting structure and then flow through the through holes of the air collecting structure and the inlet holes of the cover to enter the inner space of the housing and finally flow out of the housing via the outlet holes for dissipating the heat generated in the housing.

[0006] According to another feature of the present invention, an air guiding shell is mounted around the housing and the air collecting structure to define an annular air-guiding channel therebetween which communicates the inlet holes of the housing and faces the cooling fan, whereby an outer portion of the air current can quickly pass through the annular air-guiding channel and the inlet holes of the housing to enter the housing to take away the heat generated in the housing, so that maximum power output of the motor can be achieved, and thus the performance and service life of the motor can be increased.

[0007] According to one advantage of the present invention, the motor can be used in a high-temperature environment without being damaged. In a test, the motor was continuously operated in a closed space of 70 degrees C for a long time without burning out.

[0008] Other objects, advantages, and novel features of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 shows an exploded view of a motor according to one embodiment of the present invention.

FIG. 2 shows a 3-dimensional view of the motor.

FIG. 3 shows another 3-diemensional view of the motor, which is viewed from a different angle than FIG 2.

FIG. 4 shows an air collecting structure, which can be fixed to a cover used in the motor.

FIG. 5 shows a side view of the motor.

FIG. 6 shows a sectional view of the motor taken along line A-A in FIG 5, wherein some of the air current, which follows the airflow path (A) to enter the motor's housing for dissipating the heat generated in the motor, and some of the air current, which follows the airflow path (C) to

cool down the motor's housing for dissipating the heat generated in the motor, are manifested.

FIG. 7 shows a sectional view of the motor, wherein some of the air current, which follows the airflow path (B) to enter the motor's housing for dissipating the heat generated in the motor, and some of the air current, which follows the airflow path (C) to cool down the motor's housing for dissipating the heat generated in the motor, are manifested.

FIG. 8 shows a front view of the motor, wherein different portions of the air current, which respectively follow the airflow paths (A) (B) to enter the motor's housing for dissipating the heat generated in the motor, are manifested.

FIG. 9 shows a sectional view of the motor, wherein some of the air current, which follows the airflow path (B) to enter the motor's housing for dissipating the heat generated in the motor, is manifested.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Since the structure and operational principles of a motor have been known widely, a detailed description for the constituent parts thereof is not provided in the following paragraphs.

[0011] Referring first to FIGS. 1 through 3, a motor according to one embodiment of the present invention is shown, which generally includes a cylindrical housing 1, a cover 2, an air collecting structure 9, an air guiding shell 3, a rotating shaft 8, and a cooling fan 4. The housing 1 has a surrounding wall, which defines therein an inner space with a front opening, and has a rear closure wall 11 opposite to the front opening. The rear closure wall 11 defines a central hole, in which a bearing may be mounted, and a plurality of outlet holes 12 around the central hole. The surrounding wall of the housing 1 defines a plurality of inlet holes 10, through which outside air may enter the inner space of the housing 1. Furthermore, a rotor 5, coils 6 and magnets 7, which are necessary elements for a motor, are provided in the housing 1 (see FIGS. 6, 7 and 9). The rotating shaft 8 is mounted across the inner space of the housing 1, wherein the rotating shaft 8 has a first end 80 which is inserted through the central hole of the rear closure wall 11 for connecting with a transmission mechanism (not shown) for providing necessary mechanical power. The rotating shaft 8 has a second end 89 which is inserted out of the front opening of the housing 1 to be fitted with the cooling fan 4, as will be further illustrated below. A magnetically permeable sleeve 19, which can be made of metal, is closely fitted around the outer surface of the surrounding wall of the housing 1, to increase the performance of the motor.

[0012] The cover 2, which is substantially disk-shaped and closes the front opening of the housing 1, has a central hub 20 defining a central hole 21 and defines a plurality of inlet holes 26 around the central hub 20. The cover 2 is engaged with two sheaths 22, 23 provided at the

housing 1, so that the cover 2 is installed to the housing 1 and closes the front opening of the housing 1. Furthermore, two electrical terminal blades 24, 25 provided at the housing 1 are inserted through the two sheaths 22, 23 to facilitate electrical connection for the motor. In this embodiment, the air collecting structure 9 is provided with two U-shaped members 94, 95, capable of engaging with the two sheaths 22, 23 extending out of the cover 2, so that the air collecting structure 9 can be fixed to the cover 2. Also, the air collecting structure 9 has a central hub 90, which can be aligned with the central hub 20 of the cover 2, and an outer ring around the central hub 90 and defines a plurality of through holes 93, located between the outer ring and the central hub 90 and aligned with the outlet holes 26 of the cover 2, wherein the central hub 90 has a conical surface 92, and defines a central hole 91 for allowing the second end 89 of the rotating shaft 8 to insert therethrough. The central hub 90 tapers off from its round base which is formed integrally with other portions of the air collecting structure 9; namely, the diameter of a cross section of the central hub 90 is gradually reduced as compared to the round base of the central hub 90. While the cover 2 is being installed to the housing 1, the second end 89 of the rotating shaft 8 can be inserted through the central hole 21 of the cover 2 and the central hole 91 of the air collecting structure 9, wherein a bearing (not shown) may be provided in the central hub 20 of the cover 2 and fitted with the rotating shaft 8.

[0013] As shown in FIG 1, the cooling fan 4 defines a central hole 40, into which the second end 89 of the rotating shaft 8 extending out of the central hole 21 of the cover 2 and the central hole 91 of the air collecting structure 9 can be fitted, so that the cooling fan 4 is attached to and rotated together with the rotating shaft 8.

[0014] The air guiding shell 3 has a neck portion 31, a head portion 32, which has a dimension greater than the neck portion 31, and a gradually enlarged transitional portion integrally formed between the neck portion 31 and the head portion 32. The neck portion 31 opens out at a first opening 310, and the head portion 32 opens out at a second opening 320, which is opposite to the first opening 310. The air guiding shell 3 is mounted around the housing 1 and the air collecting structure 9, such that the neck portion 31 thereof is closely fitted around the housing 1, and the head portion 32 thereof is located above the inlet holes 10 of the housing 1, thus defining an annular air-guiding channel 33, between the head portion 32 and the housing 1, which communicates with the inlet holes 10 and forms an intercepting surface 34 at an inner surface of the gradually enlarged transitional portion of the air guiding shell 3, wherein the inlet holes 10 are located between the intercepting surface 34 and the second opening 320 of the air guiding shell 3. The annular air-guiding channel 33 faces towards the cooling fan 4. Preferably, the first and second openings 310, 320 of the air guiding shell 3 are circular in shape, and the air guiding shell 3 is a bell-shaped or funnel-shaped body such that the annular air-guiding channel 33 has a cross-sectional dimension which increases gradually from the intercepting surface 34 to the second opening 320 of the air guiding shell 3. The first opening 310 of the air guiding shell 3 has a diameter of (Y), the second opening 320 of the air guiding shell 3 has a diameter of (X), and the gradually enlarged transitional portion of the air guiding shell 3 generally has an internal diameter of (Z) at its intercepting surface 34, wherein the relationship of $X > Y$ and $X > Z$ and $Y < - Z$ is fulfilled. The annular air-guiding channel 33 is

defined between the head portion 32 of the air guiding shell 3 and the housing 1, and the inlet holes 10 are located between the intercepting surface 34 and the second opening 320 of the air guiding shell 3, so that an current generated by the cooling fan 4 can pass through the annular air-guiding channel 33 and the inlet holes 10 to enter the housing 1 to take away the heat generated therein. The intercepting surface 34 of the air guiding shell 3, which is generally at the left side of the inlet holes 10, can intercept or guide the air current entering the annular air-guiding channel 33 to facilitate the air current passing through the inlet holes 10 to enter the housing 1 to dissipate the heat generated therein.

[0015] Of course, the second opening 320 or any cross section of the head portion 32 is not limited to be circular in shape. The head portion 32 of the air guiding shell 3 is configured such that the second opening 320 of the head portion 32 has a dimension greater than any cross section of the head portion 32.

[0016] FIGS. 2 and 3 show one embodiment of the motor being assembled from the housing 1, the cover 2, the air collecting structure 9, the air guiding shell 3, and the cooling fan 4. When the motor is started, the cooling fan 4 can be rotated together with the rotating shaft 8 to generate a whirling, ongoing air current towards the cover 2 and the air collecting structure 9, so that the air at the right side of the cooling fan 4 can be forced to flow into the left side of the cooling fan 4 (see FIG. 5). In particular, the air current can enter the inner space of the housing 1 easily, and the heat generated in the housing 1 can be dissipated effectively through multiple paths (see FIGS 5 through 9). A central portion of the air current generated by the cooling fan 4 can be guided by the outer ring and the conical surface 92 of the air collecting structure 9 to smoothly flow through the space between the outer ring and the conical surface 92 of the air guiding structure 9, and then to pass through the associated holes 26, 93 to enter the inner space of the housing 1, as indicated by the airflow path (A) shown in FIGS. 6 and 8. In addition, an outer portion of the air current, which is outside the area of the outer ring of the air collecting structure 9, can be divided into two sub-portions of air, one of which may follow the airflow path (B) while the other of which may follow the airflow path (C) (see FIG 7). With the assistance of the intercepting surface 34 of the head portion 32, the sub-portion of the air current which follows the airflow path (B) to enter the annular air-guiding channel 33 may flow through the corresponding inlet holes 10 to enter the inner space of the housing 1 more easily, so that heat is not easy to accumulate in the housing 1 (see FIGS. 7, 8 and 9). The sub-portion of the air current which follows the airflow path (C), which does not enter the annular air-guiding channel 33, may flow along the outer surface of the housing 1 or the sleeve 19 (see FIGS. 6 and 7), so that the housing 1 can be effectively cooled down to facilitate dissipation of the heat generated in the housing 1. In this embodiment, the air current which has entered the inner space of the housing 1 can flow out of the housing 1 via the outlet holes 12 (see FIGS. 6 and 7), so that the heat generated in the housing 1 can be taken away with the leaving air current. The multiple airflow paths (A), (B) and (C) allow the heat generated in the housing 1 to dissipate more effectively, so that the motor can be prevented from burning out.

[0017] As a summary, the present invention employs the air collecting structure 9 fixed to the cover 2, and the air guiding shell 3 mounted around the housing 1 and the air collecting

structure 9 to dissipate the heat generated in the housing 1 through multiple paths. The inlet holes 26 of the cover 2 and the through holes 93 of the air collecting structure 9 allow the motor of the present invention to provide an airflow path (A) via which a central portion of the air current generated by the cooling fan 4 enters the inner space of the housing 1 to dissipate the heat generated in the housing 1. Furthermore, the annular air-guiding channel 33 defined between the air guiding shell 3 and the housing 1, and the inlet holes 10 of the housing 1 allow the motor of the present invention to provide another airflow path (B) via which one sub-portion of an outer portion of the air current enters the inner space of the housing 1. Still furthermore, the present invention provides a further airflow path (C) via which another sub-portion of the outer portion of the air current flows along the outer surface of the housing 1 to lower the temperature of the housing 1 and thus to increase the capacity of dissipating the heat generated in the housing 1. Through multiple paths for heat dissipation, heat is not easy to accumulate in the housing 1 of the motor; therefore, maximum power output of the motor can be achieved, and thus the performance and service life of the motor can be increased. Even though the motor is operated in a high-temperature environment, it will not burn out. These features render the motor of the present invention useful and inventive.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- TW201036310A **[0002]**
- US4074156A **[0002]**

Patentkrav

1. Motor der omfatter et hus (1), et dæksel (2), en roterende aksel (8) og en køleventilator (4),

hvilket hus (1) har en omgivende væg, der definerer et indre rum deri med en forreste åbning, og som har en bageste lukkevæg (11) modsat den forreste åbning, hvilken bageste lukkevæg (11) definerer et centralt hul og et antal udløbshuller (12);

hvilket dæksel (2) der i det væsentlige er skiveformet og lukker den forreste åbning af huset (1), har et centralt nav (20) der definerer et centralt hul (21);

hvilken roterende aksel (8) er monteret på tværs af det indre rum i huset (1), og hvilken roterende aksel (8) har en første ende (80), der er indsat gennem det centrale hul i den bageste lukkevæg (11) og har en anden ende (89), der er indsat gennem det centrale hul (21) af dækslet (2);

hvilken køleventilator (4) er fastgjort til den anden ende (89) af den roterende aksel (8), således at køleventilatoren (4) drejes sammen med den roterende aksel (8);

hvilket dæksel (2) definerer et antal indløbshuller (26) omkring dets centrale nav (20);

kendetegnet ved, at

en luftopsamlende struktur (9) som er indrettet til at blive fastgjort til dækslet (2), har et centralt nav (90), der definerer en konisk overflade (92) og et centralt hul (91), som er på linje med det centrale hul (21) af dækslet (2) for at lade den anden ende (89) af den roterende aksel (8) blive indsat derigennem, og har en ydre ring omkring det centrale nav (90) af den luftopsamlende struktur (9) og definerer et antal gennemgående huller (93), der er placeret mellem den ydre ring og det centrale nav (90) af den luftopsamlende struktur (9) og som er på linje med indløbshullerne (26) af dækslet (2),

hvorved en central del af en hvirvlende, løbende luftstrøm der er genereret af køleventilatoren (4), kan strømme gennem rummet mellem den ydre ring og det centrale nav (90) af den luftopsamlende struktur (9) og derefter strømme gennem de gennemgående huller (93) af den luftopsamlende struktur (9) og indløbshullerne (26) af dækslet (2) for at komme ind i det indre rum i huset (1) og til

sidst strømme ud af huset (1) via udløbshuller (12) for at dissipere den varme, der er genereret i huset (1).

2. Motoren ifølge krav 1, hvor en luftledende skal (3) er monteret omkring huset (1) og den luftopsamlende struktur (9), hvilken luftledende skal (3) har en halsdel (31), en hoveddel (32) med en dimension større end halsdelen (31) og en gradvist forstørret overgangsdel der er integralt dannet mellem halsdelen (31) og hoveddelen (32), hvilken halsdel (31) åbner ved en første åbning (310), hvilken hoveddel (32) åbner ved en anden åbning (320), der er modsat den første åbning (310),

hvilken luftledende skal (3) er monteret således, at halsdelen (31) er tæt monteret omkring huset (1) og danner en afskærende overflade (34) ved en indre overflade af den gradvist forstørrede overgangsdel af den luftledende skal (3),

hvilken omgivende væg af huset (1) definerer mindst et indløbshul (10)) der er placeret mellem den afskærende overflade (34) og den anden åbning (320) af den luftledende skal (3),

hvilken hoveddel (32) af den luftledende skal (3) er placeret over det mindst ene indløbshul (10) af huset (1), og således definerer en ringformet luftledende kanal (33) mellem hoveddelen (32) og huset (1), hvilken ringformede luftledende kanal (33) kommunikerer med indløbshullet (10) af huset (1) og vender mod køleventilatoren (4),

hvorved en ydre del af luftstrømmen hurtigt kan passere gennem den ringformede luftledende kanal (33) og indløbshullet (10) af huset (1) for at komme ind i huset (1) for at fjerne den deri genererede varme.

3. Motoren ifølge krav 2, hvor den første og anden åbning (310, 320) af den luftledende skal (3) er cirkulær i form, og den luftledende skal (3) er et klokkeformet legeme, således at den ringformede luftledende kanal (33) har en tværsnitsdimension, der gradvist forøges fra den afskærende overflade (34) til den anden åbning (320) af den luftledende skal (3).

4. Motoren ifølge krav 3, hvor den første åbning (310) af den luftledende skal (3) har en diameter på (Y), den anden åbning (320) af den luftledende skal (3)

har en diameter på (X) og den gradvist forstørrede overgangsdel af den luftledende skal (3) har generelt en indre diameter på (Z) ved dens afskæringsflade (34).

5. Motoren ifølge krav 2, hvor den anden åbning (320) eller et hvilket som helst tværsnit af hoveddelen (32) af den luftledende skal (3) er ikke-cirkulær i form.

6. Motoren ifølge krav 1, hvor dækslet (2) er i indgreb med to hylstre (22, 23), der er tilvejebragt ved huset (1), således at dækslet (2) er installeret på huset (1) og lukker den forreste åbning af huset (1); hvor to elektriske terminale blade (24, 25) der er tilvejebragt ved huset (1), er indsat gennem de to hylstre (22, 23) for at lette elektrisk forbindelse til motoren.

7. Motoren ifølge krav 6, hvor den luftopsamlende struktur (9) er tilvejebragt med to U-formede elementer (94, 95), der er i stand til at gå i indgreb med de to hylstre (22,23), således at den luftopsamlende struktur (9) er fastgjort til dækslet (2).

8. Motoren ifølge krav 1, hvor en muffe (19) der er fremstillet af et magnetisk permeabelt metal er tæt tilpasset omkring den omgivende væg af huset (1).

DRAWINGS

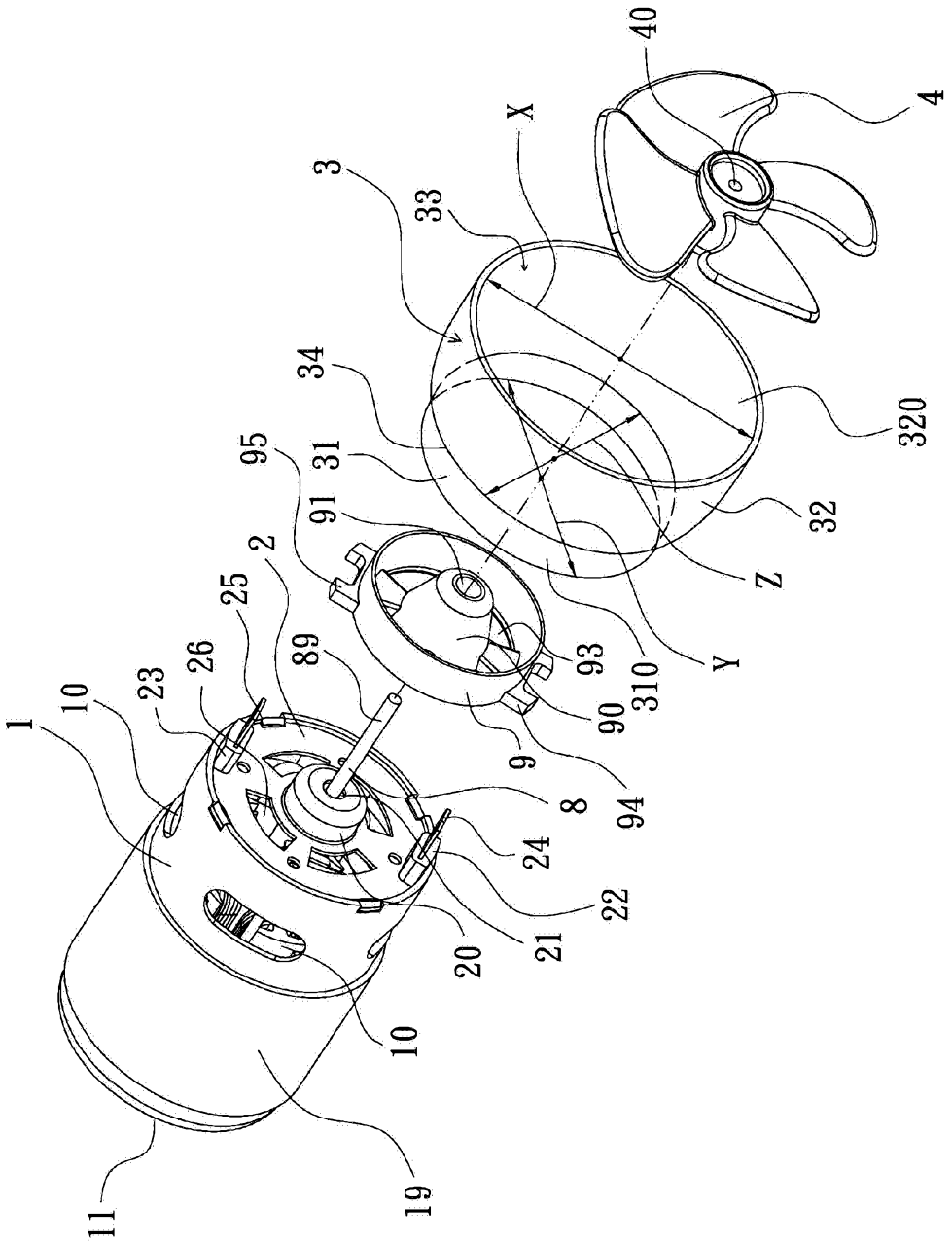


FIG. 1

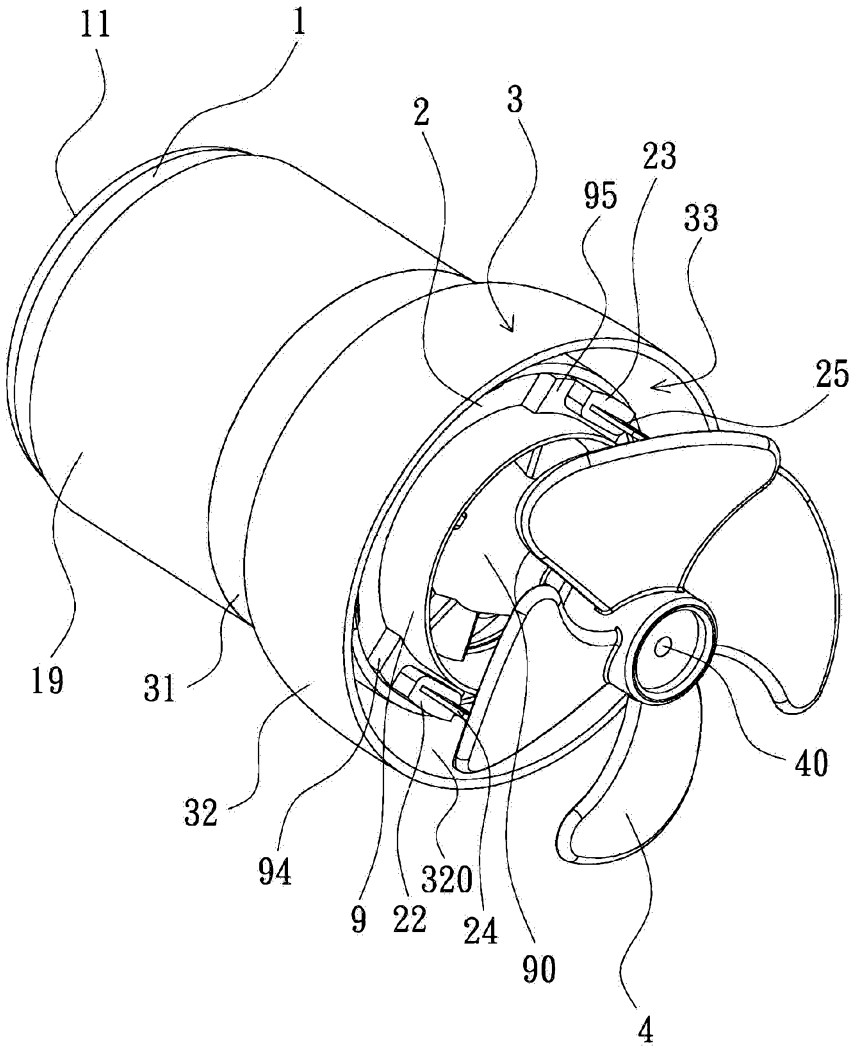


FIG. 2

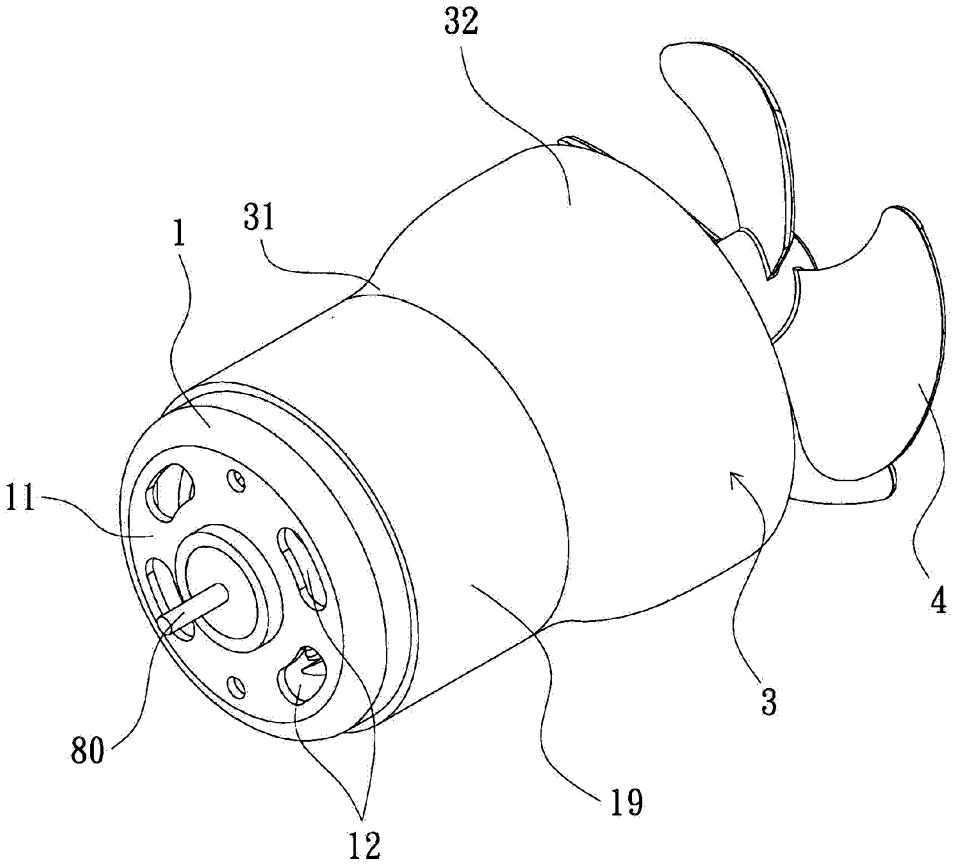


FIG. 3

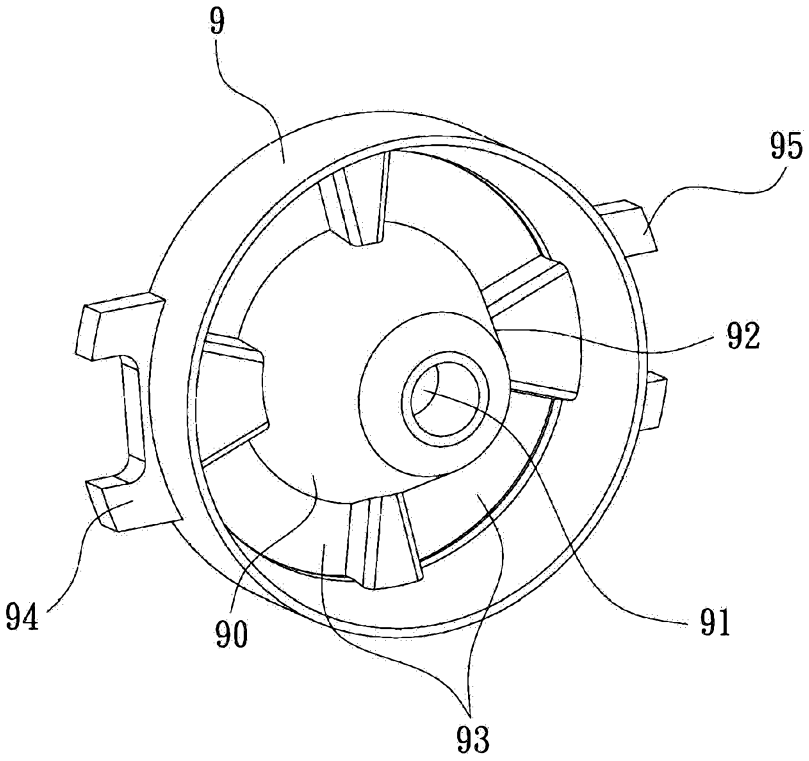


FIG. 4

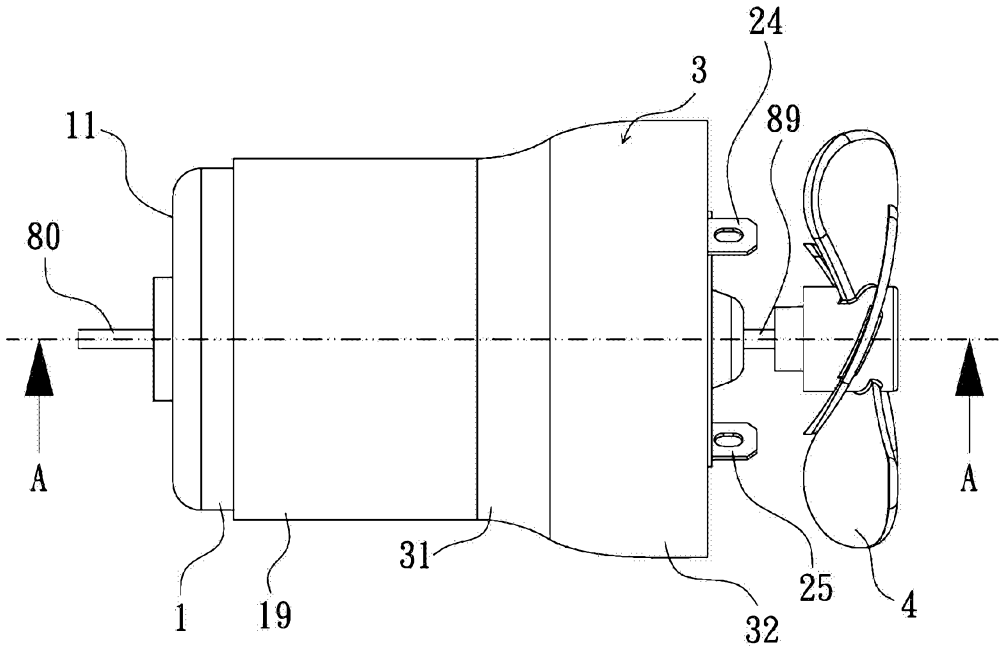
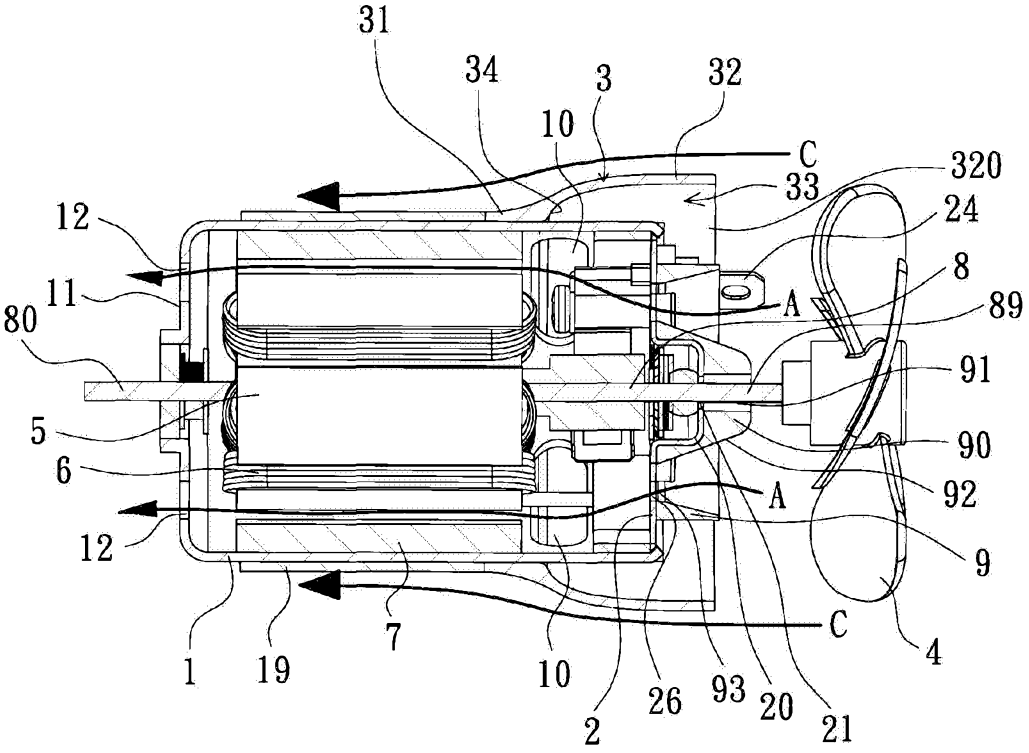


FIG. 5


31
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3
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C
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8
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FIG. 6

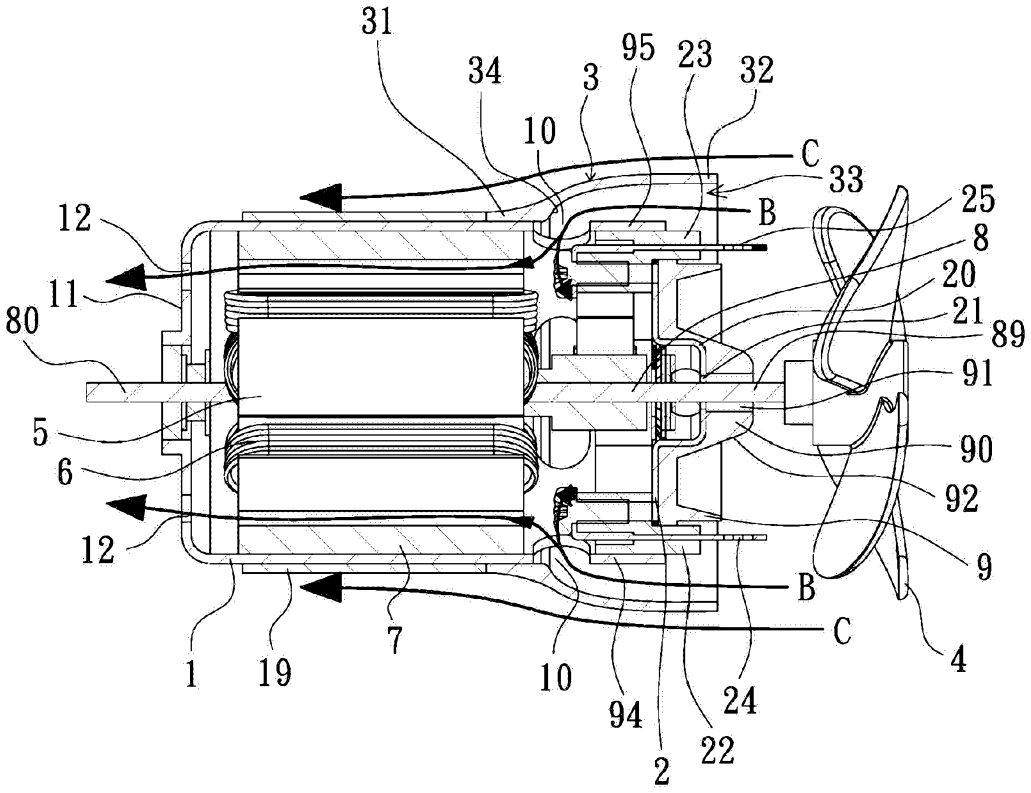
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FIG. 7

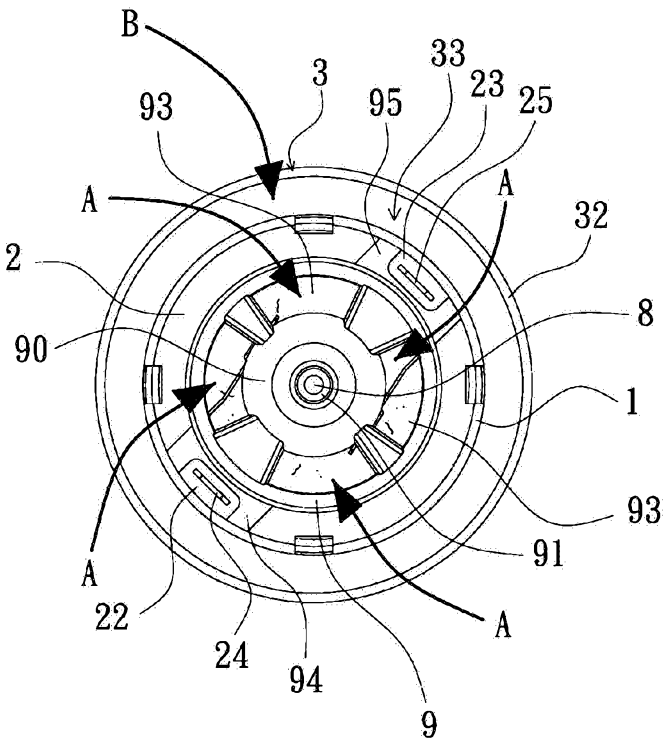

FIG. 8

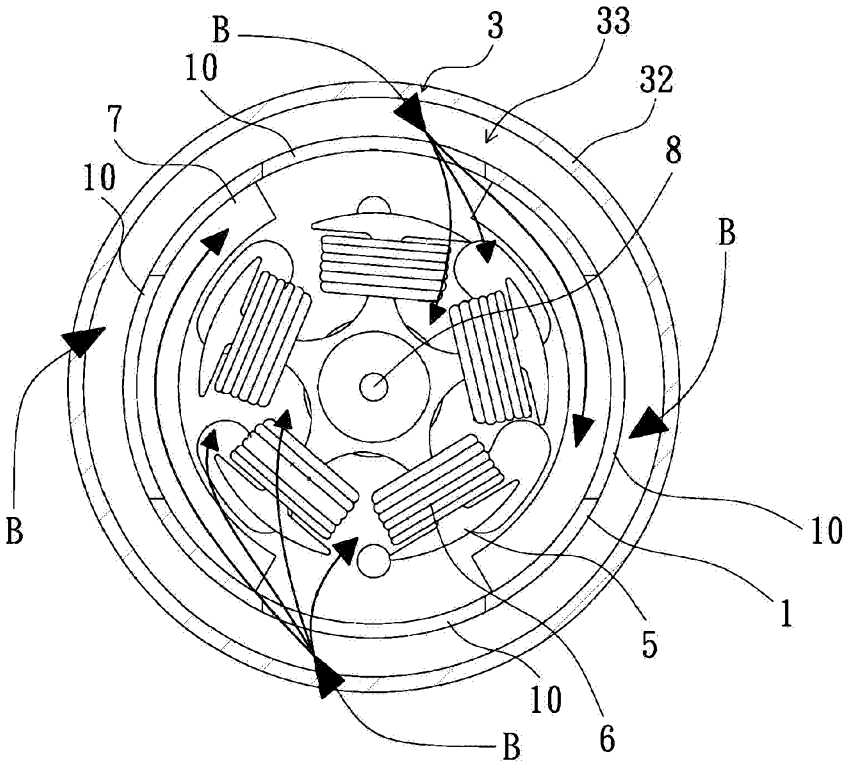

FIG. 9