(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 December 2024 (12.12.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/250198 A1

(51) International Patent Classification:
H02K 11/01 (2016.01)

(21) International Application Number:
PCT/CN2023/098934

(22) International Filing Date:
07 June 2023 (07.06.2023)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT,

(54) Title: SHIELDING STRUCTURE AND ELECTRONIC DEVICE

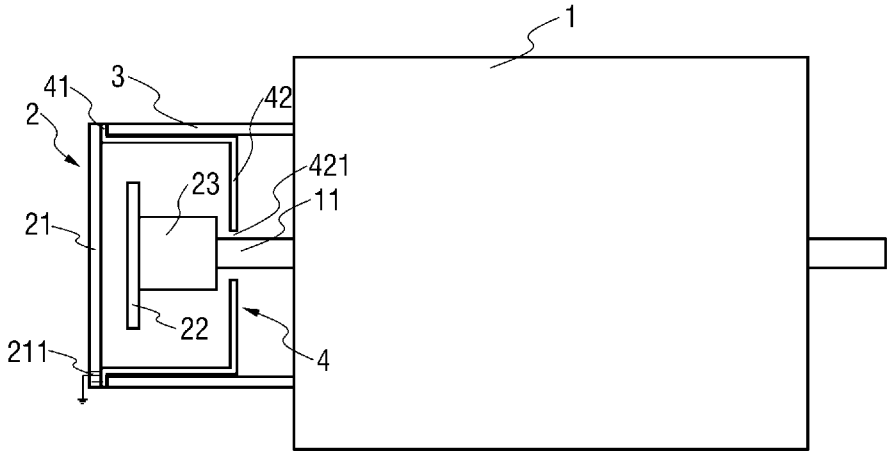

Figure 1

(57) Abstract: A shielding structure (4) includes a mounting end face (41), used to be fixed between an encoder support (3) and a stator disk (21) of an encoder (2), wherein the encoder support (3) is used to fix the stator disk (21) on a motor (1); and a shielding cover (42), fixedly connected with the mounting end face (41) and comprising a cavity for accommodating other parts of the encoder (2) except the stator disk (21), wherein the other parts of the encoder (2) except the stator disk (21) is mounted on a motor shaft (11). The shielding structure (4) can isolate the electromagnetic interference.

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LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

SHIELDING STRUCTURE AND ELECTRONIC DEVICE

FIELD

[0001] The present application relates to mechanical technologies, and more particularly, to a shielding structure and an electronic device for isolating electromagnetic interference.

BACKGROUND

[0002] In an electronic device equipped with a motor, an encoder is usually used to measure information such as the rotation angle of the motor. However, an inductive or capacitive encoder is particularly sensitive to electromagnetic interference, especially the magnetic field generated by the motor, such as the electromagnetic field produced by cutting the magnetic line during interaction between a motor rotor and a motor stator, the magnet inside the motor, or the magnetic field generated by the brake, all of which will reduce the performance (e.g. resolution, accuracy, speed ripple) of the encoder. The encoder as a part of the motor closed control loop, the instability of encoder performance will lead to the deterioration of motor performance.

[0003] Therefore, those skilled in the art are committed to finding solutions for reducing the electromagnetic interference.

SUMMARY

[0004] According to embodiments of the present application, a shielding structure and an electronic device for isolating electromagnetic interference are provided to reduce the electromagnetic interference.

[0005] The shielding structure provided by embodiments of the present application includes: a mounting end face, used to be fixed between an encoder support and a stator disk of an encoder, wherein the encoder support is used to fix the stator disk on a motor; and a shielding cover, fixedly connected with the mounting end face and comprising a cavity for accommodating other parts of the encoder except the stator disk, wherein the other parts of the encoder except the stator disk is mounted on a motor shaft.

[0006] In an example, other parts of the encoder except the stator disk include a rotor disk of the encoder, and a shaft sleeve of the rotor disk.

[0007] In an example, the shielding cover is barrel shaped, whose barrel mouth is connected to the mounting end face, and barrel bottom comprises a through hole which matches the motor shaft; the mounting end face comprises a through hole matching the barrel mouth.

[0008] In an example, the shielding structure is integrally-formed.

[0009] In an example, material of the shielding structure is non-magnet metal material.

[0010] The electronic device provided by embodiments of the present application includes: a motor; an encoder, comprising a stator disk, and other parts of the encoder except the stator disk are mounted on a motor shaft of the motor; an encoder support, used to fix the stator disk on the motor; and a shielding structure, including: a mounting end face, used to be fixed between an encoder support and a stator disk of an encoder; and a shielding cover, fixedly connected with the mounting end face and comprising a cavity for accommodating other parts of the encoder except the stator disk.

[0011] In an example, other parts of the encoder except the stator disk include a rotor disk of the encoder, and a shaft sleeve of the rotor disk.

[0012] In an example, the shielding cover is barrel shaped, whose barrel mouth is connected with the mounting end face, and barrel bottom comprises a through hole which matches the motor shaft; the mounting end face includes a through hole matching the barrel mouth.

[0013] In an example, the shielding structure is integrally-formed.

[0014] In an example, the stator disk comprises a stator PCB, and the stator PCB comprises a window opening at the contact part of the mounting end face and the stator PCB, the shielding structure is grounded through the window opening.

[0015] It can be seen from the above technical solutions in embodiments of the application, since a shielding structure is provided for the encoder to isolate the electromagnetic interference from the motor, the electromagnetic interference is reduced and the encoder performance is stable, especially, the performance of capacitive and inductive encoders is stable and increased. In addition, compared with the conditional solution of non-magnetic motor shaft material, the overall motor cost is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a better understanding of the present application, reference should be made to the Detailed Description below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

[0017] Figure 1 is a schematic diagram illustrating an electronic device according to an embodiment of the present application.

[0018] Figure 2 is a schematic diagram illustrating a shielding structure in the electronic device according to an embodiment of the present application.

[0019] Figure 3 is a schematic diagram illustrating electromagnetic interference simulation result of an electronic device without a shielding structure.

[0020] Figure 4 is a schematic diagram illustrating electromagnetic interference simulation result of an electronic device with a shielding structure.

[0021] The reference numerals are as follows:

Reference numeral	Object
1	motor
11	motor shaft
2	encoder
21	stator disk
22	rotor disk
23	shaft sleeve
3	encoder support
4	shielding structure
41	mounting end face
42	shielding cover
421	first through-hole

DETAILED DESCRIPTION

[0022] In order to avoid that the performance of the capacitive encoder is affected by the electromagnetic interference, in some applications, the material of the motor shaft is changed to non-magnetic material. However, due to the relatively large size of the motor shaft, non-magnetic materials will increase the material cost; meanwhile, the non-magnetic motor shaft can only isolate direct conducted interference and cannot isolate spatial interference.

[0023] It is found that the electromagnetic interference to the encoder is mainly from the motor. Therefore, it is very important to isolate the electromagnetic interference of the motor to the encoder to improve the performance of the encoder. In embodiments of the present application, it is considered to provide an electromagnetic interference shielding structure.

[0024] At first, the shielding structure cannot pass between the rotor disk and the stator disk of the encoder, because the shielding material may affect the medium of gap between the rotor disk and the stator disk, which may affect or even cause the encoder fail.

[0025] Secondly, the shielding material may be non-magnet material, such as copper material, on the one hand, the non-magnet material can isolate the magnet field interference of the motor, on the other hand, the metal material can form an electric circuit, namely the shielding structure can form a Faraday cage when connected to the ground, thus effectively isolated from the electric field and electromagnet wave interference may be achieved, and electrostatic shielding may be formed.

[0026] Reference will now be made in detail to examples, which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present application. Also, the figures are illustrations of an example, in which assemblies shown in the figures are not necessarily essential for implementing the present application. In other instances, well-known assemblies, components, and circuits have not been described in detail so as not to unnecessarily obscure aspects of the examples.

[0027] Figure 1 is a schematic diagram illustrating an electronic device according to an embodiment of the present application. Figure 2 is a schematic diagram illustrating a shielding structure in the electronic device according to an embodiment of the present application.

[0028] As shown in figures 1 and 2, the electronic device includes a motor 1, an encoder 2, an encoder support 3 and a shielding structure 4.

[0029] The encoder includes a stator disk 21, a rotor disk 22 and a shaft sleeve 23 of the rotor disk 22.

[0030] The encoder support 3 is used to fix the stator disk 21 on the motor 1. Other parts of the encoder 2 except the stator disk 21 are mounted on a motor shaft 11 of the motor 1, namely in the embodiment, the rotor disk 22 and the shaft sleeve 23 are mounted on a motor shaft 11 of the motor 1.

[0031] The shielding structure 4 includes a mounting end face 41 and a shielding cover 42.

[0032] The mounting end face 41 is used to be fixed mounted on edge of the stator disk 21 of the encoder 2. In an example, as shown in figure 1, the mounting end face 41 may be used to be fixed between the encoder support 3 and the stator disk 21 of the encoder 2.

[0033] The shielding cover 42 is fixedly connected with the mounting end face 41 and has a cavity for accommodating the rotor disk 22 and the shaft sleeve 23.

[0034] In an example, as shown in figure 1, the shielding cover 22 may be barrel shaped, whose barrel mouth is connected to the mounting end face 21, and barrel bottom has a first through-hole 421 which matches the motor shaft 11. Correspondingly, the mounting end face 21 has a second through-hole matching the barrel mouth of the shielding cover 22.

[0035] In an example, the shielding structure 4 may be integrally-formed.

[0036] In an example, the stator disk 21 may include a stator PCB, and the stator PCB may has a window opening at the contact part of the mounting end face 41 and the stator PCB, through the window opening, the shielding structure 4 may be grounded.

[0037] In an example, the material of the shielding structure 4 is non-magnet metal material.

[0038] Figure 3 is a schematic diagram illustrating electromagnetic interference simulation result of an electronic device without a shielding structure. Figure 4 is a schematic diagram illustrating electromagnetic interference simulation result of an electronic device

with a shielding structure. During the simulation process, an exciting transient current is imposed to the motor shaft as a simulation of the motor electromagnet interference (in fact, there are still some interference from space, namely the actual interference is bigger than the simulation value) , the induction voltage of the stator disk of the electronic device without a shielding structure is 0.9596, and the induction voltage of the stator disk of the electronic device with a shielding structure is 0.8471. By comprising the induction voltage of the stator disk of the electronic device with a shielding structure to that of the electronic device without a shielding structure, it can be seen that the interference on the stator disk of the electronic device with a shielding structure is lower more 10% than that of the electronic device without a shielding structure, thus the shielding scheme is effective.

[0039] It can be seen from the above technical solutions in embodiments of the application, since a shielding structure is provided for the encoder to isolate the electromagnetic interference from the motor, the electromagnetic interference is reduced and the encoder performance is stable, especially, the performance of capacitive and inductive encoders is stable and increased. In addition, compared with the conditional solution of non-magnetic motor shaft material, the overall motor cost is reduced.

[0040] It should be understood that, as configured herein, unless the context clearly supports exceptions, the singular forms "a" ("a", "an", "the") are intended to include the plural forms. It should also be understood that, "and / or" configured herein is intended to include any and all possible combinations of one or more of the associated listed items.

[0041] The foregoing description, for purpose of explanation, has been described with reference to specific examples. However, the illustrative discussions above are not intended to be exhaustive or to limit the present application to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The examples were chosen and described in order to best explain the principles of the present application and its practical applications, to thereby enable others skilled in the art to best utilize the present application and various examples with various modifications as are suited to the particular use contemplated.

CLAIMS

WHAT IS CLAIMED IS:

1. A shielding structure, characterized in that, comprising:

a mounting end face, used to be fixed mounted on edge of a stator disk of an encoder; and

a shielding cover, fixedly connected with the mounting end face and comprising a cavity for accommodating other parts of the encoder except the stator disk, wherein the other parts of the encoder except the stator disk is mounted on a motor shaft.

2. The shielding structure according to claim 1, characterized in that, the mounting end face is used to be fixed between an encoder support and the stator disk, wherein the encoder support is used to fix the stator disk on a motor.

3. The shielding structure according to claim 1, characterized in that, the other parts of the encoder except the stator disk comprise a rotor disk of the encoder, and a shaft sleeve of the rotor disk.

4. The shielding structure according to claim 1, characterized in that, the shielding cover is barrel shaped, whose barrel mouth is connected with the mounting end face, and barrel bottom comprises a through hole which matches the motor shaft;

the mounting end face comprises a through hole matching the barrel mouth.

5. The shielding structure according to claim 1, characterized in that, the shielding structure is integrally-formed.

6. The shielding structure according to any one of claims 1 to 5, characterized in that, material of the shielding structure is non-magnet metal material.

7. An electronic device, characterized in that, comprising:

a motor;

an encoder, comprising a stator disk, and other parts of the encoder except the stator disk are mounted on a motor shaft of the motor;

an encoder support, used to fix the stator disk on the motor; and

a shielding structure, comprising:

a mounting end face, used to be fixed on edge of a stator disk of an encoder; and

a shielding cover, fixedly connected with the mounting end face and comprising a cavity for accommodating other parts of the encoder except the stator disk.

8. The electronic device according to claim 7, characterized in that, the mounting end face is used to be fixed between an encoder support and the stator disk, wherein the encoder support is used to fix the stator disk on a motor.

9. The electronic device according to claim 7, characterized in that, the other parts of the encoder except the stator disk comprise a rotor disk of the encoder, and a shaft sleeve of the rotor disk.

10. The electronic device according to claim 7, characterized in that, the shielding cover is barrel shaped, whose barrel mouth is connected with the mounting end face, and barrel bottom comprises a through hole which matches the motor shaft;

the mounting end face comprises a through hole matching the barrel mouth.

11. The electronic device according to claim 10, characterized in that, the shielding structure is integrally-formed.

12. The electronic device according to any one of claims 7 to 11, characterized in that, the stator disk comprises a stator PCB, and the stator PCB comprises a window opening at the contact part of the mounting end face and the stator PCB, through the window opening, the shielding structure is grounded.

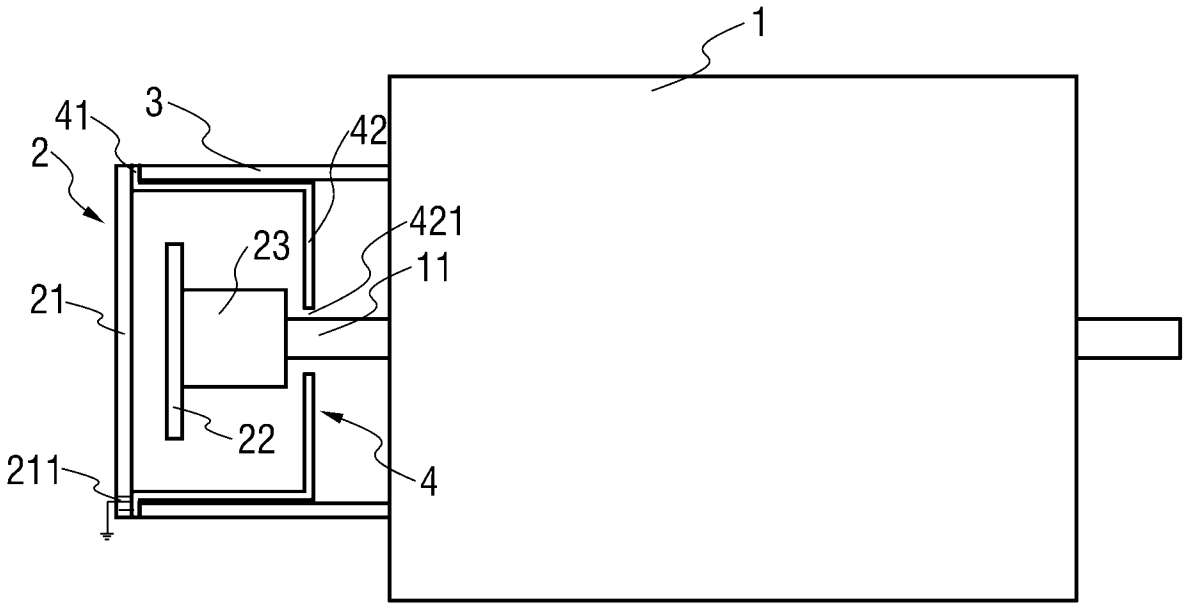

Figure 1

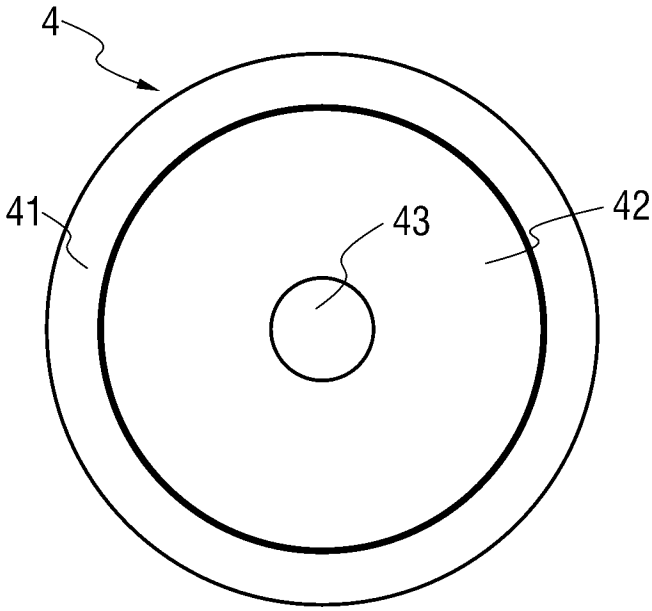

Figure 2

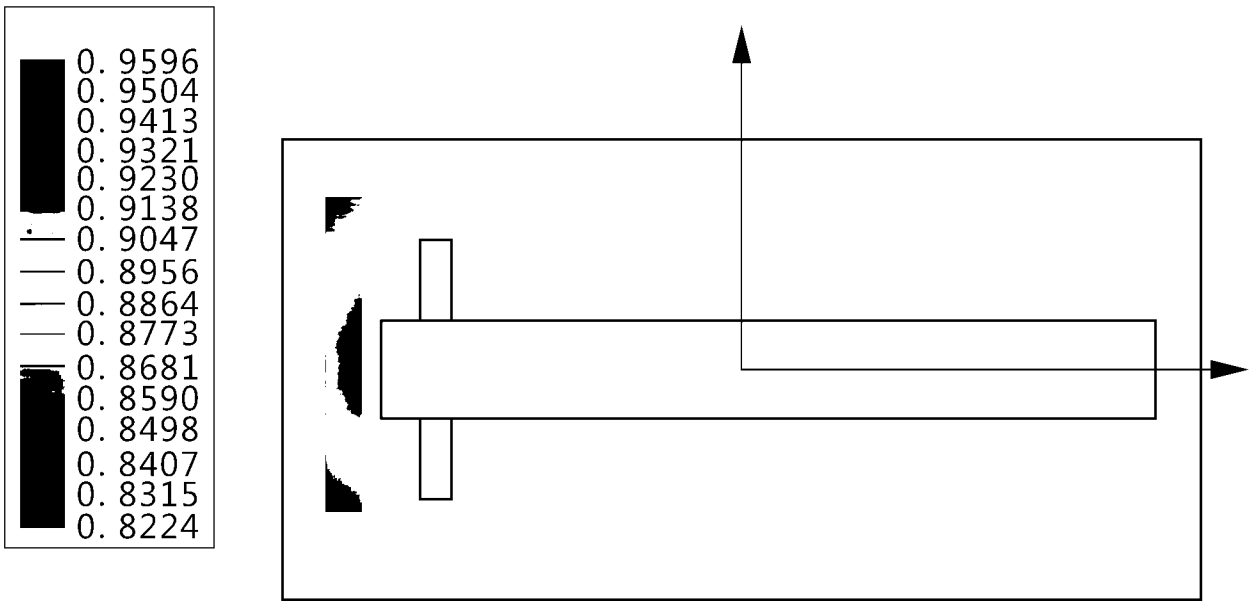

Figure 3

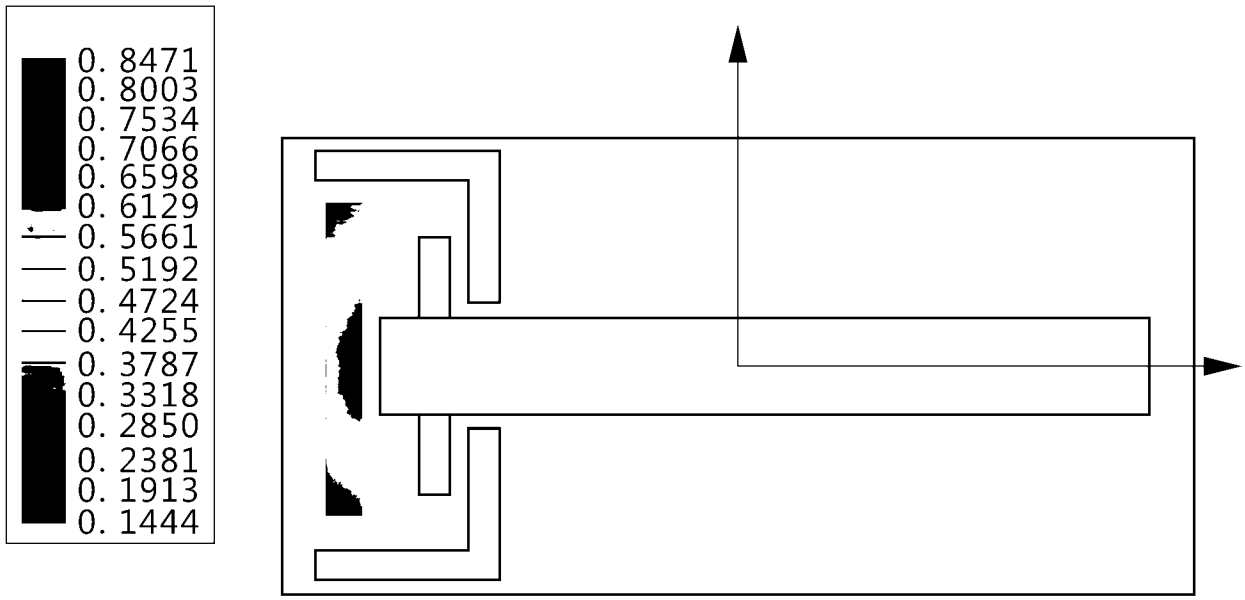
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Figure 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/098934

A. CLASSIFICATION OF SUBJECT MATTER

H02K 11/01(2016.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT, ENTXTC, DWPI, CNKI, IEEE: encoder, motor, eletromagnetic, interference, isolat+, shield+, support, housing, casing, cover, ground+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 114207383 A (SMC CORPORATION) 18 March 2022 (2022-03-18) description, paragraphs [0005]-[0075], and figures 1-6	1-11
Y	CN 114207383 A (SMC CORPORATION) 18 March 2022 (2022-03-18) description, paragraphs [0005]-[0075], and figures 1-6	12
Y	CN 109120108 A (NIDEC SANKYO CORPORATION) 01 January 2019 (2019-01-01) description, paragraphs [0005]-[0092], and figures 1-10	12
A	CN 214480147 U (SHENZHEN LZ POWER TECHNOLOGY CO., LTD.) 22 October 2021 (2021-10-22) the whole document	1-12
A	CN 218526198 U (CHANGCHUN HUITONG PHOTOELECTRIC TECHNOLOGY CO., LTD) 24 February 2023 (2023-02-24) the whole document	1-12
A	US 2017146365 A1 (BAUMER HUEBNER GMBH) 25 May 2017 (2017-05-25) the whole document	1-12

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 December 2023	**25 December 2023**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/098934

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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