



(51) International Patent Classification:

*H02K 5/15* (2006.01) *H02K 9/19* (2006.01)  
*H02K 5/20* (2006.01)

(21) International Application Number:

PCT/EP2016/057112

(22) International Filing Date:

31 March 2016 (31.03.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

201520194441.X 1 April 2015 (01.04.2015) CN

(71) Applicant: **CONTINENTAL AUTOMOTIVE GMBH**  
[DE/DE]; Vahrenwalder Straße 9, 30165 Hannover (DE).

(72) Inventors: **LI, Jin-Kang**; 402-63, Lane 811, East Boshan  
Road, Shanghai, 200136 (CN). **GENG, Limin**; 2#1701,  
Lane 1505 Meijiabang Road., Shanghai, 201220 (CN).

(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, CZ, DE, DK, DM,  
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,  
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,  
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,  
MK, MN, 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, SM, ST, SV, SY, TH, TJ, TM, TN,  
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, RW, 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, LU,  
LV, MC, 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))

(54) Title: STATOR HOUSING AND DEVICE FOR ACCOMMODATING STATOR

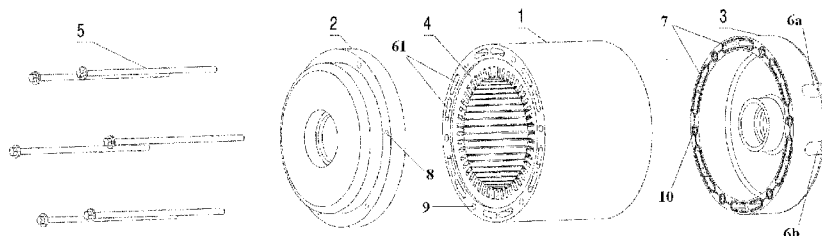


Fig. 1

(57) Abstract: The present application relates to a stator housing, wherein at least one straight-through cooling medium channel is provided in the stator housing. The present application further relates to a device for accommodating a stator. Since the straight-through cooling medium channel in the stator housing provided by the present application is simple in structure, the extrusion technology which is mature and low in cost and defective rate can be used to manufacture the stator housing, such that the total manufacturing cost of an electric motor is reduced and the defective rate is decreased.



Description

**Stator housing and device for accommodating stator**

5 **Technical Field**

The present application relates to the technical field of machinery, in particular to a stator housing and a device for accommodating a stator.

10 **Background Art**

In the prior art, during the operation of an electric motor, a cooling medium (e.g. cooling water) is generally used to cool the electric motor so as to prevent the temperature of the electric motor from being too high. A cooling medium flow channel for an electric motor is generally provided around a stator of the electric motor. However, there is no solution in the prior art for providing a cooling medium flow channel in an electric motor which has a good cooling effect, convenient assembly and low costs.

20

**Summary of the Application**

In order to solve the above problem, the present application provides a stator housing, in which at least one straight-through cooling medium channel is provided.

25 Optionally, the straight-through cooling medium channel in said stator housing extends parallel to an axis of said stator housing and penetrates said stator housing in the axial direction. Further, the present application provides a device for accommodating a stator, which device comprises the above-mentioned stator housing which is used to encircle the stator in the circumferential direction and end covers which enclose said stator in the axial direction; through grooves are provided in said end covers; and after said stator housing and said end covers are assembled together, said straight-through cooling medium

30

channel and said through grooves are in mutual fluid communication so as to form a complete cooling medium flow channel. Optionally, at least one of said through grooves is provided on the end face of said end cover adjacent to the stator housing, and the cross-sectional shape and size of said through grooves are designed such that each through groove can be in fluid communication with two straight-through cooling medium channels in said stator housing.

Optionally, said through groove is a fully open groove provided on said end face of said end cover.

Optionally, said through groove is a semi-open groove provided on said end face of said end cover, the cross-sectional shape of said semi-open through groove is a U shape, and said semi-open through groove comprises two concave parts which are respectively in communication with two straight-through cooling medium channels in said stator housing, and an internal channel which is provided inside said end cover and is in communication with said two concave parts.

Optionally, said electric motor further comprises a cooling medium flow channel inlet and a cooling medium flow channel outlet.

Optionally, said cooling medium flow channel inlet and the cooling medium flow channel outlet are provided on said end covers.

Optionally, said cooling medium flow channel inlet and the cooling medium flow channel outlet are provided on said stator housing.

Optionally, said stator housing and said end covers are fastened together by at least one fastener.

In comparison with the prior art, the stator housing and the device for accommodating a stator provided by the present application at least have the advantages as follows: since the straight-through cooling medium channel in the stator housing provided by the present application is simple in structure, the

extrusion technology which is mature and low in cost and defective rate can be used to manufacture a stator housing, such that the total manufacturing cost of an electric motor is reduced and the defective rate is decreased. Moreover, the cooling medium flow channel for cooling the stator provided by the present application is provided not only in the stator housing, but also in the end covers, so as to increase the acting area of the cooling medium and facilitate in quickly and evenly cooling the stator. In addition, the stator housing and end covers of the present application may be fastened together simply via the fasteners, without any requirement of a complicated assembly process.

### **Description of the Drawings**

Figs.1 and 2 show exploded views of an electric motor in a particular embodiment according to the present application; Fig. 3 shows a front view of an electric motor assembled with a stator in a particular embodiment according to the present application, viewed from the left side of Fig. 1; Fig. 4 shows a sectional view in a cross section A-A in Fig. 3; Fig. 5 shows a sectional view in a cross section B-B in Fig. 3; Fig. 6 shows a sectional view in a cross section C-C in Fig. 4; Fig. 7 shows a perspective view of a cooling medium flow channel of an electric motor in a particular embodiment according to the present application; Fig. 8 shows a sectional view in a cross section D-D in Fig. 4; and Fig. 9 shows a perspective view of a second end cover of an electric motor in a particular embodiment according to the present application.

### **Particular Embodiments**

The stator housing and the device for accommodating a stator according to the embodiment of the present application are described below with reference to the accompanying drawings. In

the following description, many specific details are set forth in order to give those skilled in the art more comprehensive understanding of the present application. However, it would be apparent to a person skilled in the art that the present application may be achieved without some of these specific details. In addition, it should be understood that the present application is not limited to the specific embodiments presented herein. Instead, it is envisaged herein that any combination of the following features and elements can be used to implement the present application, regardless of whether or not they are involved in different embodiments. Therefore, the following aspects, features, embodiments and advantages are merely illustrative and should not be regarded as elements or definitions of the claims, unless explicitly stated in the claims.

Figs. 1 and 2 show exploded views of an electric motor in a particular embodiment according to the present application. Figs. 3-6 show sectional views of an electric motor in a particular embodiment according to the present application. Fig. 7 shows a perspective view of a cooling medium flow channel of an electric motor in a particular embodiment according to the present application. Fig. 8 shows a sectional view in a cross section D-D in Fig. 4. Fig. 9 shows a perspective view of a second end cover of an electric motor in a particular embodiment according to the present application. It can be seen from Fig. 1 to Fig. 9 that the electric motor of the present application comprises a stator 4, a stator housing 1 encircling the stator in the circumferential direction, and a first end cover 2 and a second end cover 3 enclosing the stator 4 in the axial direction. As shown in Figs. 1-7, the stator housing 1 is provided with a straight-through cooling medium channel, a first end cover 2 and a second end cover 3 are respectively provided with through grooves 62, 63, and after the stator housing 1, the first end cover 2 and the second end cover 3 are assembled together, the straight-through cooling medium channel in the stator housing 1

and the through grooves 62, 63 in the first end cover 2 and the second end cover 3 are in mutual fluid communication so as to form a complete cooling medium flow channel 6 as shown in Fig. 7.

As shown in Figs. 1-9, the stator housing 1 is provided with a

straight-through cooling medium channel 61 which extends parallel to an axis of the stator 4, and the straight-through cooling medium channel 61 in the stator housing penetrates the stator housing 1 in the axial direction, so as to form a plurality of channels which run from an axial end part of the stator housing

1 all the way through to the other axial end part of the stator housing 1. A person skilled in the art could configure the number, the cross-sectional shape (e.g. an oval cross section) and the size of the straight-through cooling medium channel 61, and these variations do not depart from the scope of protection of the

present application. Since the straight-through cooling medium channel 61 in the stator housing provided by the present application is simple in structure, the extrusion technology which is mature and low in cost and defective rate can be used to manufacture a stator housing, such that the total manufacturing cost of an electric motor is reduced and the defective rate is decreased.

As shown in Figs. 1-9, a plurality of through grooves 62 extending in the circumferential direction of the first end cover 2 are provided on the end face of the first end cover 2 adjacent to the

stator housing 1, and the shape and size of the through grooves 62 is designed such that each through groove 62 can be in fluid communication with two straight-through cooling medium channels 61 in the stator housing 1, respectively. In particular, the

through groove 62 is a fully open groove provided on an end face of the first end cover 2, the cross section of each fully open through groove 62 can completely cover the cross sections of the two straight-through cooling medium channels 61 in the stator housing 1. The fully open through groove 62 has the advantages of a simple structure and low manufacturing costs.

As shown in Figs. 1-9, a plurality of through grooves 63 extending in the circumferential direction of the second end cover 3 are provided on the end face of the second end cover 3 adjacent to the stator housing 1, and the shape and the size of the through grooves 63 are designed such that each through groove 63 can be in fluid communication with two straight-through cooling medium channels 61 in the stator housing 1, respectively. In particular, the through groove 63 is a semi-open groove, the cross-sectional shape of the semi-open through groove 63 is a U shape, and the semi-open through groove 63 comprises two concave parts 631 which are respectively in communication with two straight-through cooling medium channels 61 of the stator housing 1, and an internal channel 632 which is provided inside the second end cover 3 and is in communication with the two concave parts 631. The cross-sectional shape of the concave part 631 matches the cross-sectional shape of the straight-through cooling medium channel 61 in the stator housing 1. The semi-open through groove 63 has the advantages of enabling the end face of the second end cover 3 adjacent to the stator housing 1 to be as smooth as possible, and facilitating in arranging other components on the end face of the second end cover 3.

After the stator housing 1, the first end cover 2 and the second end cover 3 are assembled together, the fully open through groove 62 on the first end cover 2 is in fluid communication with two straight-through cooling medium channels 61 in the stator housing 1, and the semi-open through groove 63 in the second end cover 3 is in fluid communication with two straight-through cooling medium channels 61 in the stator housing 1 so as to form a complete cooling medium flow channel 6 as shown in Fig. 7. During the operation of an electric motor, a cooling medium (e.g. cooling water) flowing in the cooling medium flow channel 6 cools the electric motor so as to control the temperature of the electric motor. The cooling medium flow channel of the present application is provided not only in the stator housing 1, but also in the first

end cover 2 and the second end cover 3, so as to increase the acting area of the cooling medium and facilitate in quickly and evenly cooling the electric motor.

In the above-mentioned particular embodiments of the present application, the cooling medium flow channels in the first end cover 2 and the second end cover 3 are provided as a fully open through groove 62 and a semi-open through groove 63, i.e. in two completely different forms. However, a person skilled in the art should understand that the cooling medium flow channels in the first end cover 2 and the second end cover 3 may also be arranged as through grooves in the same form, for example, they may be both provided as fully open through grooves 62 of the first end cover 2, or they may also be both provided as semi-open through grooves 63 of the second end cover 3. These variations do not depart from the scope of protection of the present application.

As shown in Figs. 1-9, the electric motor of the present application further comprises a cooling medium flow channel inlet 6a and a cooling medium flow channel outlet 6b, and a cooling medium flows into a cooling medium flow channel 6 from the cooling medium flow channel inlet 6a, through the whole course of the cooling medium flow channel 6 in the direction as indicated by the arrow in Fig. 7, out of the cooling medium flow channel 6 from the cooling medium flow channel outlet 6b.

The cooling medium flow channel inlet 6a and the cooling medium flow channel outlet 6b are provided on the second end cover 3, as shown in Figs. 1-9. However, the cooling medium flow channel inlet 6a and the cooling medium flow channel outlet 6b may also be provided on the first end cover 2. Alternatively, one of the cooling medium flow channel inlet 6a and the cooling medium flow channel outlet 6b may be provided on the first end cover 2, and the other may be provided on the second end cover 3. Alternatively, the cooling medium flow channel inlet 6a and the cooling medium flow channel outlet 6b may be provided on the stator housing 1. Alternatively, one of the cooling medium flow channel

inlet 6a and the cooling medium flow channel outlet 6b may be provided on an end cover, and the other may be provided on the stator housing. These variations do not depart from the scope of protection of the present application.

5 As shown in Figs. 1-9, the stator housing 1, the first end cover 2 and the second end cover 3 may be fastened together by a plurality of fasteners 5. The fastener 5 may be an assembly of bolts and nuts, and holes matching the fastener 5 are provided on the stator housing 1, the first end cover 2 and the second end  
10 cover 3. A set of fasteners 5 may be used to fasten together the stator housing 1, the first end cover 2 and the second end cover 3 in a certain direction, for example, the direction as shown in Figs. 1-7; a plurality of fasteners 5 may be inserted into a through hole 8 on the first end cover 2 and passed through the  
15 first end cover 2, then inserted into a through hole 9 on the stator housing 1 and passed through the stator housing, then inserted into the second end cover 3 via a hole 10 on the second end cover 3; and finally the stator housing 1, the first end cover 2 and the second end cover 3 are fastened together via a nut at  
20 the end part of the fastener 5. Alternatively, the structure of the first end cover 2 and the second end cover 3 as shown in Figs. 1-7 may be modified slightly, such that two sets of fasteners 5 are used to fasten together the stator housing 1, the first end cover 2 and the second end cover 3 in two different directions.  
25 These variations do not depart from the scope of protection of the present application.

In the stator housing and the device for accommodating a stator provided by the present application, since the straight-through cooling medium channel in the stator housing provided by the  
30 present application is simple in structure, the extrusion technology which is mature and low in cost and defective rate can be used to manufacture a stator housing, such that the total manufacturing cost of an electric motor is reduced and the defective rate is decreased. Moreover, the cooling medium flow

channel for cooling the stator provided by the present application is provided not only in the stator housing, but also in the first end cover and the second end cover, so as to increase the acting area of the cooling medium and facilitate in quickly and evenly cooling the stator of the electric motor. In addition, the stator housing and end covers of the present application may be fastened together simply via the fasteners, without any requirement of a complicated assembly process.

While the present application has been disclosed above by means of the preferred embodiments, the present application is not limited thereto. A variety of changes and modifications made by a person skilled in the art, without departing from the spirit and scope of the present application, should be included in the scope of protection of the present application, and thus the scope of protection of the present application should be defined by the claims.

## Patent claims

1. A stator housing (1), characterized in that at least one straight-through cooling medium channel is provided in said stator housing (1).

2. The stator housing as claimed in claim 1, characterized in that the straight-through cooling medium channel in said stator housing (1) extends parallel to an axis of said stator housing and penetrates said stator housing (1) in the axial direction.

3. A device for accommodating a stator (4), characterized in that said device comprises the stator housing (1) as claimed in claim 1 or 2 which is used to encircle the stator (4) in the circumferential direction and end covers (2, 3) which enclose said stator (4) in the axial direction, through grooves are provided in said end covers, and after said stator housing (1) and said end covers are assembled together, said straight-through cooling medium channel and said through grooves are in mutual fluid communication so as to form a complete cooling medium flow channel.

4. The device as claimed in claim 3, characterized in that at least one of said through grooves is provided on an end face of said end cover adjacent to the stator housing (1), and the cross-sectional shape and size of said through grooves are designed such that each through groove can be in fluid communication with two straight-through cooling medium channels in said stator housing.

5. The device as claimed in claim 4, characterized in that said through groove is a fully open groove provided on said end face of said end cover.

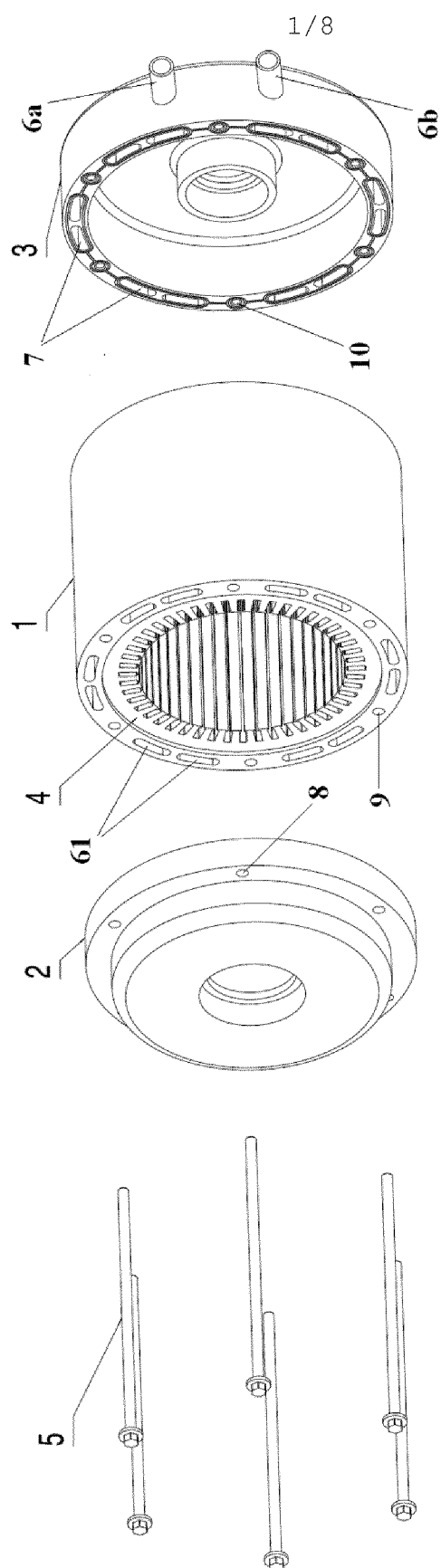
6. The device as claimed in claim 3, characterized in that said through groove is a semi-open groove provided on said end face of said end cover, the cross-sectional shape of said semi-open through groove is a U shape, and said semi-open through groove comprises two concave parts which are respectively in communication with two straight-through cooling medium channels in said stator housing (1), and an internal channel which is provided inside said end cover and is in communication with said two concave parts.

7. The device as claimed in claim 3, characterized in that said electric motor further comprises a cooling medium flow channel inlet (6a) and a cooling medium flow channel outlet (6b).

8. The device as claimed in claim 7, characterized in that said cooling medium flow channel inlet (6a) and the cooling medium flow channel outlet (6b) are provided on said end cover.

9. The device as claimed in claim 7, characterized in that said cooling medium flow channel inlet (6a) and the cooling medium flow channel outlet (6b) are provided on said stator housing (1).

10. The device as claimed in claim 3, characterized in that said stator housing (1) and said end cover are fastened together by at least one fastener (5).



**Fig. 1**

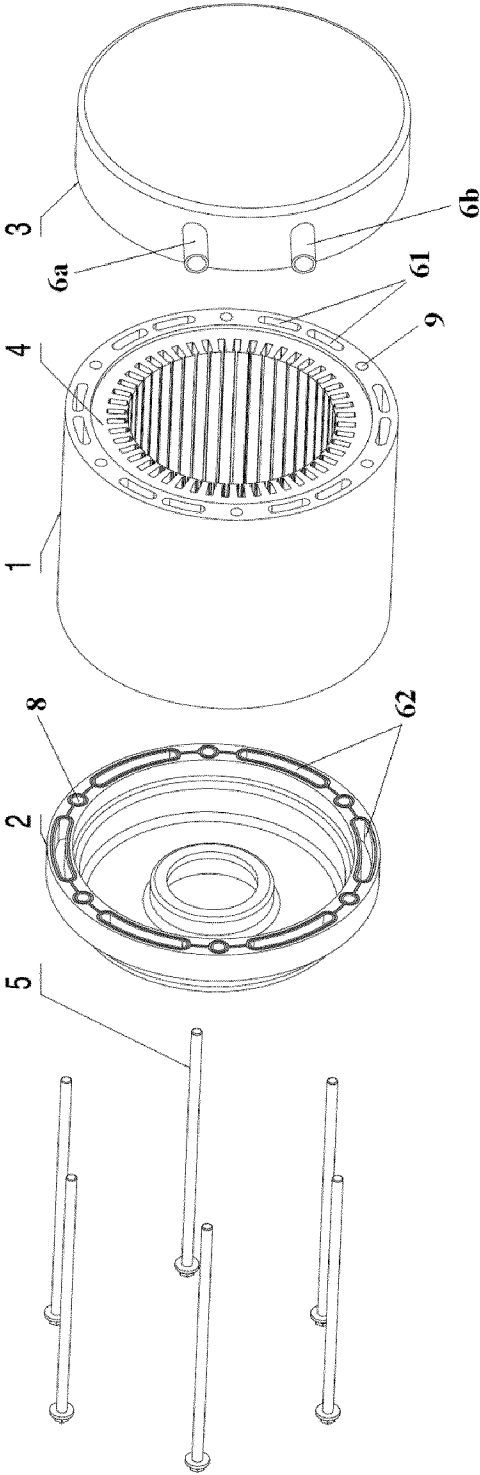


Fig. 2

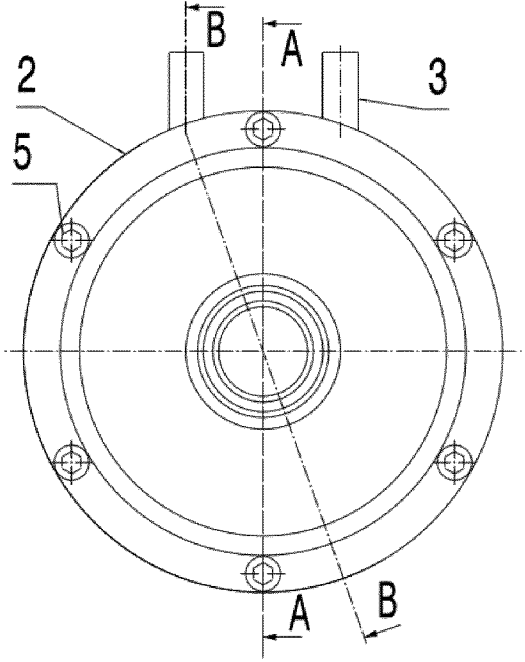


Fig. 3

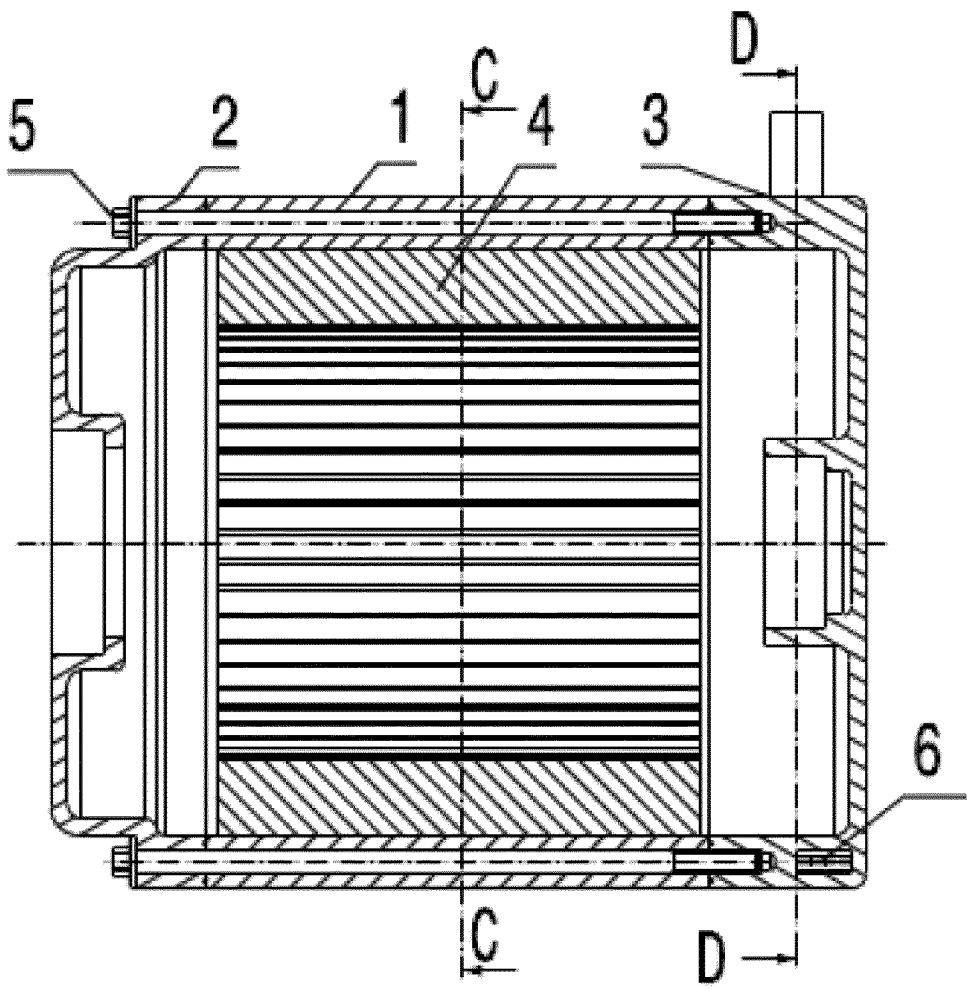


Fig. 4

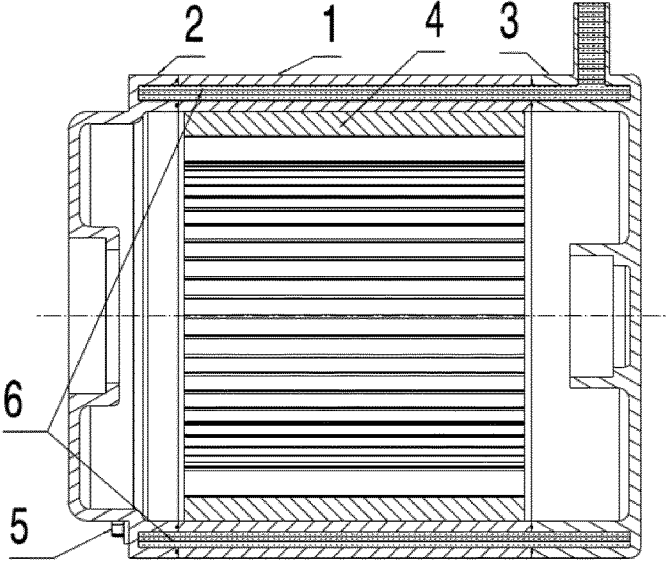


Fig. 5

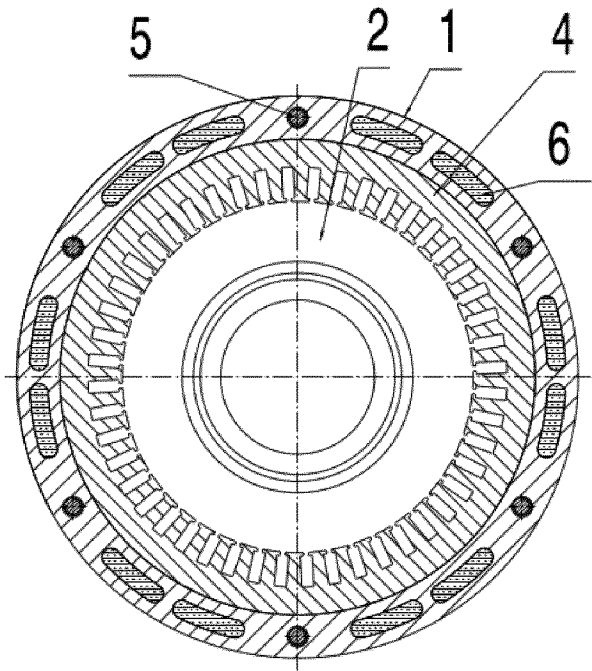


Fig. 6

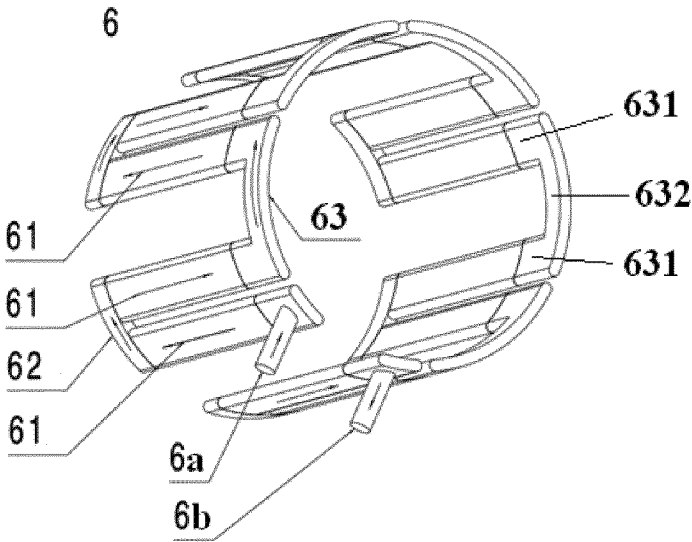


Fig. 7

8/8

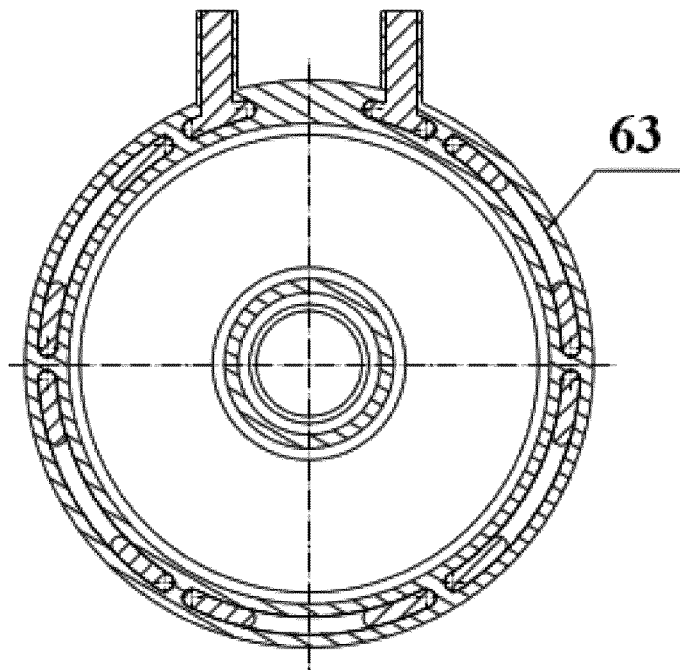


Fig. 8

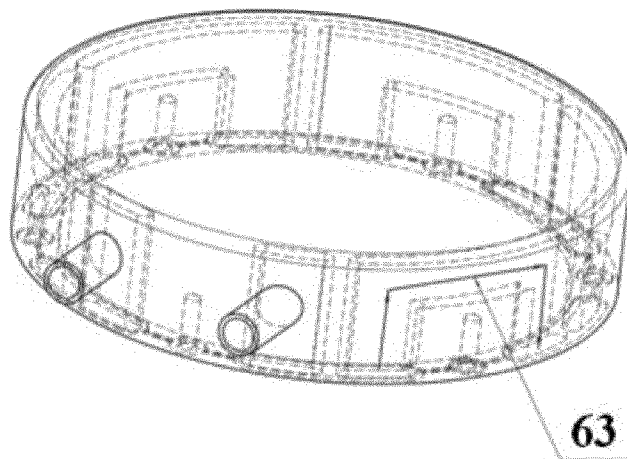


Fig. 9

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2016/057112

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H02K5/15 H02K5/20 H02K9/19  
ADD.

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)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                         | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | DE 10 2009 031467 A1 (SEW EURODRIVE GMBH & CO [DE]) 27 January 2011 (2011-01-27)                                                                           | 1-8,10                |
| Y         | paragraph [0018] - paragraph [0032];<br>figures 1-5                                                                                                        | 9                     |
| Y         | -----<br>WO 2007/102740 A1 (RAPP HYDEMA AS [NO];<br>BOLSOEY BEN [NO])<br>13 September 2007 (2007-09-13)<br>page 4, line 7 - line 10; figure 1              | 9                     |
| X         | -----<br>DE 10 2007 035271 A1 (CONTINENTAL<br>AUTOMOTIVE GMBH [DE])<br>29 January 2009 (2009-01-29)<br>paragraph [0021] - paragraph [0029];<br>figures 1-3 | 1-4,6-8,<br>10        |
|           | -----<br>-/-                                                                                                                                               |                       |



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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

28 June 2016

Date of mailing of the international search report

08/07/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Sedlmeyer, Rafael

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2016/057112

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                      |                       |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                   | Relevant to claim No. |
| X                                                    | WO 2009/038957 A1 (ARVINMERITOR TECHNOLOGY LLC [US]; KRAMER DENNIS A [US]; RITCHIE ADAM []) 26 March 2009 (2009-03-26)<br>page 4, line 11 - page 6, line 3; figures 3,4<br><br>----- | 1-4,6-8,10            |
| X                                                    | WO 2007/033875 A2 (SIEMENS AG [DE]; MUELLER JOERG [DE]; THEN THOMAS [DE]) 29 March 2007 (2007-03-29)<br>page 6, line 16 - page 7, line 38; figures 1-3,6<br><br>-----                | 1-7,9,10              |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/057112

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| DE 102009031467 A1                        | 27-01-2011          | NONE                       |                     |
| -----                                     |                     |                            |                     |
| WO 2007102740 A1                          | 13-09-2007          | EP 1994630 A1              | 26-11-2008          |
|                                           |                     | NO 324136 B1               | 03-09-2007          |
|                                           |                     | WO 2007102740 A1           | 13-09-2007          |
| -----                                     |                     |                            |                     |
| DE 102007035271 A1                        | 29-01-2009          | DE 102007035271 A1         | 29-01-2009          |
|                                           |                     | WO 2009015946 A1           | 05-02-2009          |
| -----                                     |                     |                            |                     |
| WO 2009038957 A1                          | 26-03-2009          | US 2009079278 A1           | 26-03-2009          |
|                                           |                     | WO 2009038957 A1           | 26-03-2009          |
| -----                                     |                     |                            |                     |
| WO 2007033875 A2                          | 29-03-2007          | CN 101268599 A             | 17-09-2008          |
|                                           |                     | DE 102005044832 A1         | 22-03-2007          |
|                                           |                     | JP 2009509484 A            | 05-03-2009          |
|                                           |                     | US 2008252157 A1           | 16-10-2008          |
|                                           |                     | WO 2007033875 A2           | 29-03-2007          |
| -----                                     |                     |                            |                     |