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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 March 2019 (21.03.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/053669 A3

(51) International Patent Classification:
H02K 19/12 (2006.01) *H02K 11/04* (2016.01)
H02K 1/18 (2006.01) *H02K 11/042* (2016.01)
H02K 7/09 (2006.01)

(21) International Application Number:
PCT/IB2018/057107

(22) International Filing Date:
17 September 2018 (17.09.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1714896.6 15 September 2017 (15.09.2017) GB

(71) Applicant: **DETROIT ELECTRIC EV TECHNOLOGIES (ZHEJIANG) LIMITED** [CN/CN]; Room 1217-19, Building 3, No. 1366 Hongfeng Rd, Huzhou City, Zhejiang Province (CN).

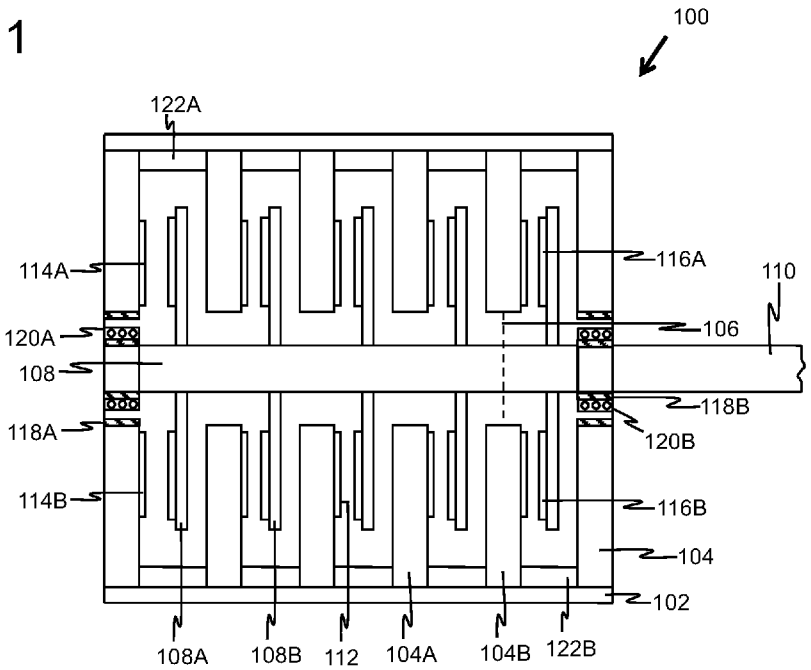
(72) Inventor: **LAM, Albert**; Detroit Electric, Spa Park, 5-6 Harrison Way, Leamington Spa Warwickshire CV31 3HJ (GB).

(74) Agent: **NORRIS, Timothy**; Basck Ltd, 16 Saxon Road, Cambridge Cambridgeshire CB5 8HS (GB).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, 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,

(54) Title: ELECTRICAL MOTOR ARRANGEMENT FOR ELECTRICAL VEHICLES

FIG. 1



(57) Abstract: Disclosed is an electrical motor arrangement for an electrical vehicle. The electrical motor arrangement includes at least one electrical motor. The at least one electrical motor includes a casing, a stator mounted on casing, a rotor including a rotor shaft and magnetic bearings coupled to ends of rotor shaft. The stator includes one or more radial plate-like stator elements extending from the casing, wherein each of the stator elements includes a central hole. The rotor shaft is disposed within the central hole of each of the one or more plate-like stator elements. The rotor includes one or more radial plate-like rotor elements attached to rotor shaft. Moreover, principal planes of one or more radial plate-like stator and rotor elements are arranged mutually to abut with a magnetic separation gap therebetween, and one or more radial plate-like stator and rotor elements are arranged to have electrical winding coil arrangements disposed thereon. Optionally, alternatively, the at least one electrical motor is implemented so that its rotor encircles its stator, wherein the stator is centrally implemented within the at least one electrical motor.

WO 2019/053669 A3

[Continued on next page]

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).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) **Date of publication of the international search report:**
13 June 2019 (13.06.2019)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/057107

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K19/12 H02K1/18 H02K7/09 H02K11/04 H02K11/042
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 2016 204444 A1 (SUZUKI MOTOR CORP [JP]) 22 September 2016 (2016-09-22)	1,2,4-8, 11,13, 15-17
Y	paragraph [0039] - paragraph [0044]; figures 1, 2 paragraph [0051] paragraph [0056] paragraph [0061] - paragraph [0062]; figure 10 paragraph [0072] - paragraph [0076]; figure 11 paragraph [0105]; figure 1 paragraph [0110] ----- -/--	9,10

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
14 February 2019	17/04/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Moyaerts, Laurent

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2018/057107

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 2, 4-11, 13-19, 21-28, 30-33

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/057107

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/359400 A1 (FRAMPTON ISAAC S [US] ET AL) 8 December 2016 (2016-12-08)	1,2,4-7, 11,13, 14, 17-19, 21-24, 27,28, 30,31,33
Y	paragraph [0032] - paragraph [0035]; figure 1 paragraph [0043] paragraph [0048] - paragraph [0052]; figure 6	25,26
X	US 5 177 392 A (SCOTT DENNIS J [US]) 5 January 1993 (1993-01-05) column 4, line 1 - line 18; figure 3 column 4, line 66 - line 68 column 7, line 33 - line 53; figure 7	1,2,4-8, 11,13, 15-17
X	WO 96/04094 A2 (WOODWARD RICHARD C JR [US]) 15 February 1996 (1996-02-15) last two paragraphs; page 3; figures 5, 6 figure 23	1,2,4-8, 11,13, 17-19, 21-24, 27,28, 30,32,33
Y	US 2015/333679 A1 (BOX GARY WILLIAM [US]) 19 November 2015 (2015-11-19) paragraph [0051] - paragraph [0052]; figures 1, 2A, 2B	9,10,25, 26
A,P	DE 10 2017 214766 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]) 26 April 2018 (2018-04-26) paragraph [0037] - paragraph [0045]; figure 9 paragraph [0059] - paragraph [0060]; figure 5	9,10,25, 26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2018/057107

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102016204444 A1	22-09-2016	CN 105990968 A	05-10-2016
		DE 102016204444 A1	22-09-2016
		JP 6464856 B2	06-02-2019
		JP 2016178830 A	06-10-2016
US 2016359400 A1	08-12-2016	CN 106253620 A	21-12-2016
		EP 3113341 A2	04-01-2017
		US 2016359400 A1	08-12-2016
US 5177392 A	05-01-1993	CA 2059227 A1	15-07-1992
		DE 69218470 D1	30-04-1997
		DE 69218470 T2	23-10-1997
		EP 0495582 A2	22-07-1992
		ES 2099202 T3	16-05-1997
		JP H0556612 A	05-03-1993
		KR 920015676 A	27-08-1992
		US 5177392 A	05-01-1993
WO 9604094 A2	15-02-1996	AU 3236495 A	04-03-1996
		US 5777421 A	07-07-1998
		WO 9604094 A2	15-02-1996
US 2015333679 A1	19-11-2015	AU 2015259582 A1	27-10-2016
		CA 2947294 A1	19-11-2015
		CN 106463255 A	22-02-2017
		EP 3123488 A1	01-02-2017
		JP 2017516444 A	15-06-2017
		KR 20170007273 A	18-01-2017
		MX 359091 B	13-09-2018
		US 2015333679 A1	19-11-2015
		WO 2015175316 A1	19-11-2015
DE 102017214766 A1	26-04-2018	DE 102017214766 A1	26-04-2018
		WO 2019038080 A1	28-02-2019

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 4-11, 13-19, 21-28, 30-33

   Electrical motor characterized by the spatial arrangement of rotor and stator elements

1.1. claims: 1, 2, 4, 5, 11, 13, 18, 19, 21, 27, 28, 30

   Electrical motor characterized by general constructional aspects

1.2. claims: 6, 7, 17, 22, 23, 33

   Electrical motor characterized by the type of energization

1.3. claims: 8, 14, 24, 31

   Electrical motor characterized by elements of the magnetic circuit

1.4. claims: 9, 10, 25, 26

   Electrical motor characterized by the field excitation

1.5. claims: 15, 16, 32

   Electrical motor characterized by constructional elements of the rotor elements

---

2. claims: 3, 12, 20, 29

   Electrical motor characterized by a combination of magnetic and mechanical bearings

---