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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 August 2013 (22.08.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/122634 A3

(51) International Patent Classification:
A61N 1/378 (2006.01)

(21) International Application Number:
PCT/US2012/063778

(22) International Filing Date:
7 November 2012 (07.11.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/397,881 16 February 2012 (16.02.2012) US

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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, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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, 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, 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, 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))*

Published:

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

(88) Date of publication of the international search report:
27 February 2014

(54) Title: A SELF-TUNING EXTERNAL DEVICE FOR WIRELESSLY RECHARGING IMPLANTABLE MEDICAL DEVICES

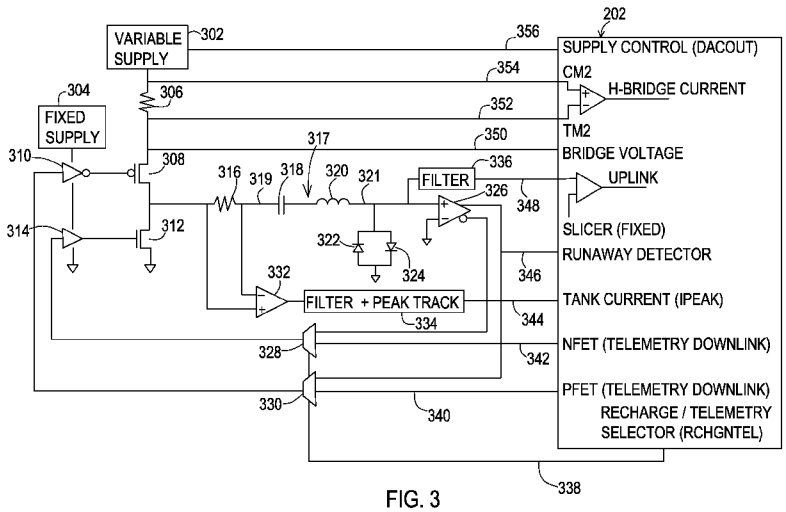

FIG. 3

(57) Abstract: External devices include circuitry that self-tunes so that current is being driven through a coil at a resonant frequency of the tank circuit including the coil. The self-tuning nature of the driver circuitry enables adaptation within a cycle to changes in the resonant frequency such as those due to changing loads on the coil. The self-tuning circuitry monitors the direction of current flow in the tank circuit so that during a non-driven phase of a two-phase cycle, the circuitry detects current naturally changing directions and activates the driver circuitry to drive current into the tank circuit in phase with the natural direction of current flow. Unity power factor is approximated while driving the coil.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/063778

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61N1/378
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)
A61N

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	US 2006/192628 A1 (SCHULMAN JOSEPH H [US] ET AL) 31 August 2006 (2006-08-31) abstract; figures 15, 17 paragraphs [0003], [0004], [0005], [0072]	1-29
A	US 2006/247737 A1 (OLSON DAVID P [US] ET AL) 2 November 2006 (2006-11-02) the whole document	1-29
A	WO 03/096361 A1 (SPLASHPOWER LTD [GB]; CHENG LILY KA LAI [GB]; HAY JAMES WESTWOOD [GB];) 20 November 2003 (2003-11-20) the whole document	1-29

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☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 November 2013	10/12/2013

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/063778

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006192628 A1	31-08-2006	EP 1703638 A1	20-09-2006
		US 2006192628 A1	31-08-2006
US 2006247737 A1	02-11-2006	EP 1904153 A1	02-04-2008
		EP 2243509 A1	27-10-2010
		US 2006247737 A1	02-11-2006
		US 2010268305 A1	21-10-2010
		US 2011301669 A1	08-12-2011
		US 2013211479 A1	15-08-2013
		WO 2006118631 A1	09-11-2006
WO 03096361 A1	20-11-2003	AU 2003233895 A1	11-11-2003
		AU 2003240999 A1	11-11-2003
		AU 2008255158 A1	08-01-2009
		AU 2010210006 A1	02-09-2010
		CN 1653669 A	10-08-2005
		EP 1506554 A1	16-02-2005
		EP 1506605 A2	16-02-2005
		JP 4403285 B2	27-01-2010
		JP 2005525705 A	25-08-2005
		KR 20050016879 A	21-02-2005
		WO 03096361 A1	20-11-2003
		WO 03096512 A2	20-11-2003