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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, BR, BW, BY, BZ, CA, CH, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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[Continued on next page]

- (54) **Title:** CARDIAC PACEMAKERS AND SYSTEMS AND METHODS FOR USING THEM

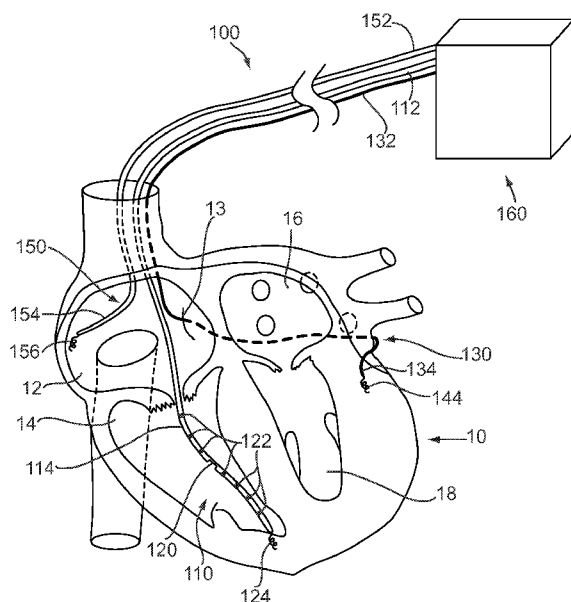


FIG. 2

(57) **Abstract:** Systems and methods are provided for determining the pressure-volume relationship for one or more chambers of a heart. An implantable device includes a catheter including a distal end sized for introduction into a chamber of a heart, a pressure sensor for measuring pressure within the chamber, and a resistance sensor for measuring fluid resistance within the chamber. A processor coupled to the catheter obtains pressure data from the pressure sensor and fluid resistance data from the resistance sensor. The processor approximates fluid volume within the chamber as a function of time and determines one or more pressure-volume loops based upon the pressure data and the fluid volume. In one embodiment, the catheter is a lead including a pacing electrode and a controller including the processor delivers pulses to the pacing electrode based upon the pressure-volume loops to deliver electrical therapy to the heart.



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- *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:**
24 September 2009

A. CLASSIFICATION OF SUBJECT MATTER*A61N 1/36(2006.01)i, A61H 31/00(2006.01)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)

IPC 8: A61N

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

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

eKOMPASS(KIPO Internal) "pacemaker", "heart", "pressure", "electrode", "controller", "pulse", "transmitter", "wireless"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005-0027323 A1 (LAWRENCE J. MULLIGAN et al.) 3 February 2005	17-20, 22
Y	See claims 27-35, paragraph [0033], figures 1-3	1-16, 21
Y	US 6415183 B1 (AVRAM SCHEINER et al.) 2 July 2002 See claim 27, column 3, lines 29-44, figure 1A	1-16, 21
A	US 2005-0215914 A1 (GENE A. BORNZIN et al.) 29 September 2005 See claim 32, paragraph [0036], figures 1-2	1-22
A	US 2003-0229386 A1 (DANIEL C. ROSENMAN et al.) 11 December 2003 See claims 1 and 7, abstract, figure 1	1-22
A	US 2002-0161423 A1 (NICOLAAS M. LOKHOFF et al.) 31 October 2002 See claims 1 and 12, abstract, figures 1-6	1-22



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 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 JULY 2009 (28.07.2009)

Date of mailing of the international search report

29 JULY 2009 (29.07.2009)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2008/088219**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.: 23-37
because they relate to subject matter not required to be searched by this Authority, namely:
Claims 23-37 pertain to methods for treatment of human or animal body by surgery and thus relate to a subject matter which this International Searching Authority is not required to search under Article 17(2)(a)(i) and Rule 39.1(iv) PCT.
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:

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 fee, this Authority did not invite payment of any additional fee.
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.:

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

Information on patent family members

International application No.

PCT/US2008/088219

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005-0027323 A1	03.02.2005	CA 2460227 A1	08.05.2003
		EP 1455896 A2	15.09.2004
		JP 2005-507721 A	24.03.2005
		WO 2003-037428 A2	08.05.2003
		WO 2003-037428 A3	08.05.2003
US 6415183 B1	02.07.2002	AU 2001-19521 A1	07.12.2000
		WO 2001-041868 A1	14.06.2001
US 2005-0215914 A1	29.09.2005	EP 1582233 A2	05.10.2005
		EP 1582233 A3	07.06.2006
		EP 1588738 A1	26.10.2005
		US 7272443 B2	18.09.2007
		US 2005-0216067 A1	29.09.2005
		US 7505814 B2	17.03.2009
US 2003-0229386 A1	11.12.2003	AU 2003-237407 A1	22.12.2003
		WO 2003-103764 A1	18.12.2003
US 2002-0161423 A1	31.10.2002	US 6909920 B2	21.06.2005
		WO 2002-087690 A1	07.11.2002