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(54) Title: HEART-SOUNDS BASED ADAPTIVE CARDIAC RESYNCHRONIZATION THERAPY TIMING PARAMETER OPTIMIZATION SYSTEM

(57) Abstract: A medical device and associated method for controlling a cardiac pacing therapy sense a first cardiac signal including events corresponding to cardiac electrical events and a second cardiac signal including events corresponding to cardiac hemodynamic events. A processor is enabled to measure a cardiac conduction time interval using the first cardiac signal and control a signal generator to deliver a pacing therapy. A pacing control parameter is adjusted to a plurality of settings during the pacing therapy delivery. A hemodynamic parameter value is measured from the second cardiac signal during application of each of the control parameter settings. The processor identifies an optimal setting from the plurality of settings and solves for a patient-specific equation defining the pacing control parameter as a function of the cardiac conduction time interval.

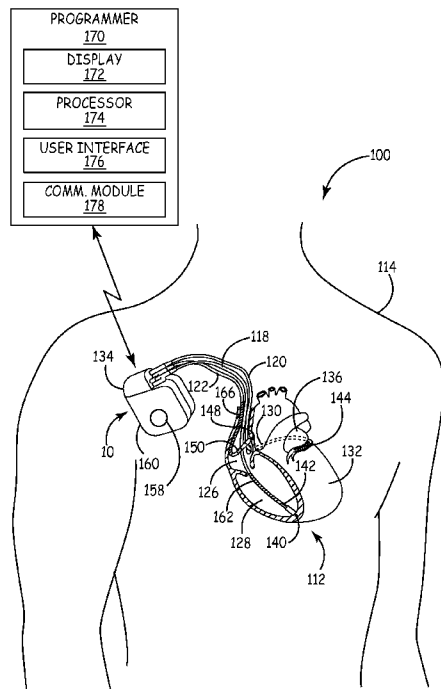


FIG. 1

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).

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A. CLASSIFICATION OF SUBJECT MATTER
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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 2010/145405 A1 (MIN XIAOYL [US] ET AL) 10 June 2010 (2010-06-10) paragraphs [0051], [0055], [0056], [0065], [0078], [0079], [0101], [0103], [0104], [0157], [0158], [0159], [0201], [0202]; claim 1; figures 1,2	1-15
X	US 2010/121401 A1 (MIN XIAOYI [US] ET AL) 13 May 2010 (2010-05-13) paragraph [0019] - paragraph [0137]	1-15
X,P	WO 2012/058521 A1 (MEDTRONIC INC [US]; RAJAN VINAYAKRISHNAN [NL]; STEGEMANN BERTHOLD [DE]) 3 May 2012 (2012-05-03) paragraph [0020] - paragraph [0133]	1-15
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/129764 A1 (BURNES JOHN E [US]) 7 June 2007 (2007-06-07) paragraph [0017] - paragraph [0053] -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 2010145405	A1	10-06-2010		NONE	

US 2010121401	A1	13-05-2010		NONE	

WO 2012058521	A1	03-05-2012	EP	2632540 A1	04-09-2013
			US	2012109247 A1	03-05-2012
			WO	2012058521 A1	03-05-2012

US 2007129764	A1	07-06-2007	US	2007129764 A1	07-06-2007
			WO	2007067883 A2	14-06-2007
