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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, IR, IS, JP, KE, KG, 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, 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.

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[Continued on next page]

(54) **Title:** SYSTEMS AND METHODS FOR MAKING TIP ELECTRODES FOR LEADS OF ELECTRICAL STIMULATION SYSTEMS

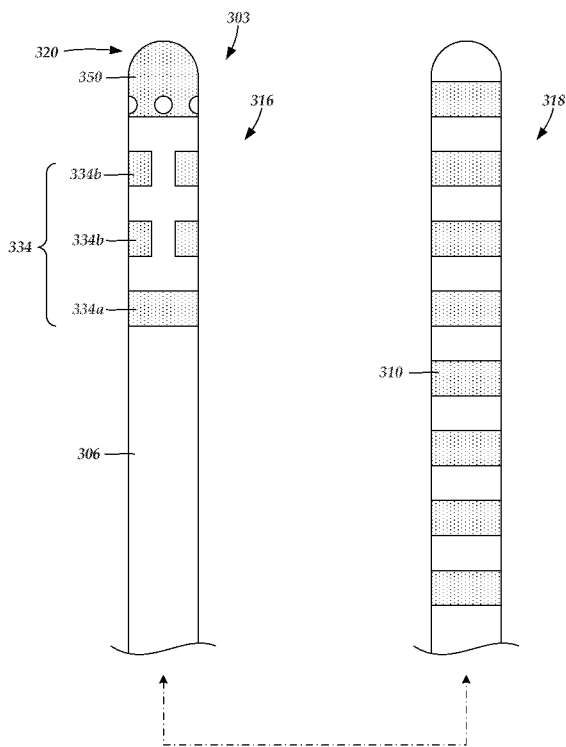


Fig. 3

(57) **Abstract:** An implantable electrical stimulation lead includes a lead body, electrodes disposed along a distal end of the lead body, terminals disposed along the proximal end of the lead body, and conductors coupling the terminals to the electrodes. The electrodes include a tip electrode having an electrode body with an outer stimulating surface. An internal lumen is defined in the electrode body and extends inwardly from an opening in a proximal end of the electrode body. Side apertures are formed between the outer stimulating surface and the internal lumen. A portion of the lead body is disposed within the internal lumen and side apertures through the opening in the proximal end of the electrode body. That portion of the lead body facilitates retention of the tip electrode on a distal tip of the lead body.

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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).

— *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))*

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

INTERNATIONAL SEARCH REPORT

International application No  
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A. CLASSIFICATION OF SUBJECT MATTER  
INV. A61N1/36 A61N1/05  
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 2002/147488 A1 (DOAN PHONG D [US] ET AL) 10 October 2002 (2002-10-10)	1,6-12
Y	paragraphs [0027] - [0048]; figures 2-3, 7	1-5,11
Y	US 2009/319014 A1 (MUECKE DAVID [US] ET AL) 24 December 2009 (2009-12-24)	1,11
Y	paragraphs [0027] - [0030]; figures 5A, 5B, 5C, 5D	1-5,11
Y	US 2010/211144 A1 (JANG GRACE [US] ET AL) 19 August 2010 (2010-08-19)	1-12
A	paragraphs [0054] - [0055]; figures 16-19	
A	US 6 064 905 A (WEBSTER JR WILTON W [US] ET AL) 16 May 2000 (2000-05-16)	1-12
	the whole document	

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  
18 July 2014

Date of mailing of the international search report  
11/11/2014

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2014/035957

## 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.: 13  
because they relate to subject matter not required to be searched by this Authority, namely:  
see FURTHER INFORMATION sheet PCT/ISA/210
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.:  
1-12

### 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.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

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

1. claims: 1-12

An implantable electrical stimulation lead, comprising a lead body, a plurality of terminals, a plurality of conductors, and a plurality of electrodes comprising a tip electrode, the tip electrode comprising an electrode body having an outer stimulating surface, an internal lumen, and a plurality of side apertures formed through the outer stimulating surface and opening into the internal lumen, the side apertures facilitating retention of the tip electrode on the distal tip of the lead body; and

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2. claims: 14-20

An implantable electrical stimulation lead, comprising a lead body, a plurality of terminals, a plurality of conductors, and a plurality of electrodes comprising a tip electrode, the tip electrode comprising an electrode body and an internal lumen defining a plurality of longitudinal grooves formed along the internal lumen, the grooves facilitating retention of the tip electrode on the distal tip of the lead body.

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**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

Continuation of Box II.1

Claims Nos.: 13

Claim 13 relates to subject-matter considered by this Authority to be covered by the provisions of Rule 39.1(iv) / 67.1(iv) PCT - Method for treatment of the human or animal body by surgery. In particular, claim 13 relates to a method of implanting an electrical stimulation lead, comprising the step of advancing the tip electrode of the implantable electrical stimulation lead into proximity with a target stimulation location within a patient.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/035957

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002147488	A1	10-10-2002	NONE
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