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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 January 2007 (11.01.2007)

PCT

(10) International Publication Number
WO 2007/005963 A3

(51) International Patent Classification:
A61B 18/18 (2006.01)

(21) International Application Number:
PCT/US2006/026189

(22) International Filing Date: 5 July 2006 (05.07.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/696,697 5 July 2005 (05.07.2005) US

(71) Applicants and
(72) Inventors: **LANGBERG, Edwin** [US/US]; 56 Bridge Road, Lumberton, NJ 08048 (US). **LANGBERG, Jonathan**; 871 Springdale Rd NE, Atlanta, GA 30306 (US).

(74) Agent: **O'BANION, John, P.**; O'BANION & RITCHEY LLP, 400 Capitol Mall, Suite 1550, Sacramento, CA 95814 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

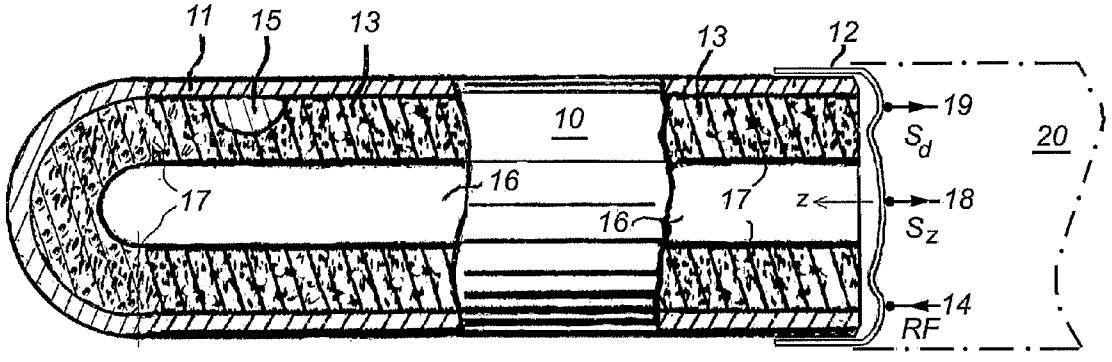
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
4 October 2007

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ELECTRODES USING TWO-PHASE HEAT TRANSFER AND MULTI-VARIATE ALGORITHMS FOR IMPROVED TEMPERATURE MONITORING AND CONTROL



(57) Abstract: A tissue hyperthermia system and method improves temperature monitoring and control along an energy emitter such as an RF electrode. A two-phase heat transfer system includes a material within an enclosed vessel that is thermally coupled to the electrode. Energizing the electrode to an operating condition emits energy into tissue and heats at least to a threshold temperature wherein the material undergoes a phase transformation within the vessel between a liquid phase and a vapor phase. The phase change assists in cooling, monitoring, and control of emitter temperature. Algorithms estimate maximum temperature either at the emitter or in tissue adjacent the emitter based on monitored parameters at the vessel. Multivariate algorithms use simultaneous power and temperature readings to estimate actual regional temperature, including electrode or tissue hot-spot temperature. A multivariate algorithm is based in particular upon time-dependent aspects of a pulsed RF operating mode. The multi-variate algorithms benefit temperature monitoring and control either together with the two-phase heat transfer system or with other more conventional devices.

WO 2007/005963 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US06/26189

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 18/18 (2007.01)
USPC - 606/41, 42, 45, 47, 27, 28, 29, 31
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) A61B 18/18 (2007.01)
USPC - 606/41, 42, 45, 47, 27, 28, 29, 31

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)
MicroPatent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 5,647,871 A (LEVINE et al) 15 July 1997 (15.07.1997) entire document	1, 9, 35-47, 48-57, 66-67, 101-116, 121-122 --- 10, 12-18, 75, 79-84, 99, 117, 123-124
Y	US 5,688,266 A (EDWARDS et al) 18 November 1997 (18.11.1997) entire document	10, 12-18, 75, 79-84, 99, 117
Y	US 5,871,443 A (EDWARDS et al) 16 February 1999 (16.02.1999) entire document	123-124

☐ Further documents are listed in the continuation of Box C. ☐

* 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
05 April 2007	08 AUG 2007
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US06/26189

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:
Group I, claims 1, 9-10, 12-18, 35-57, 66-67, 75, 79-84, 99, 101-117, 121-124, drawn to a system comprising a first energy emitter containing a two phase transfer system.
Group II, claims 2, 6, 58-65, 68, 72, 118-121, drawn to a temperature monitoring system.
Group III, claims 3, 7, 69, 73, 76, drawn to a temperature controlled actuator.
Group IV, claims 4, 8, 11, 19-34, 70, 74, 77, 91-98, drawn to a computer readable medium.
Group V, claims 5, 71, 78, 85-90, 100, drawn to a system comprising a second energy emitter containing an enclosed vessel.

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 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, 9-10 ,12-18 ,35-57 ,66-67 ,75, 79-84, 99, 101-117, 121-124

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.