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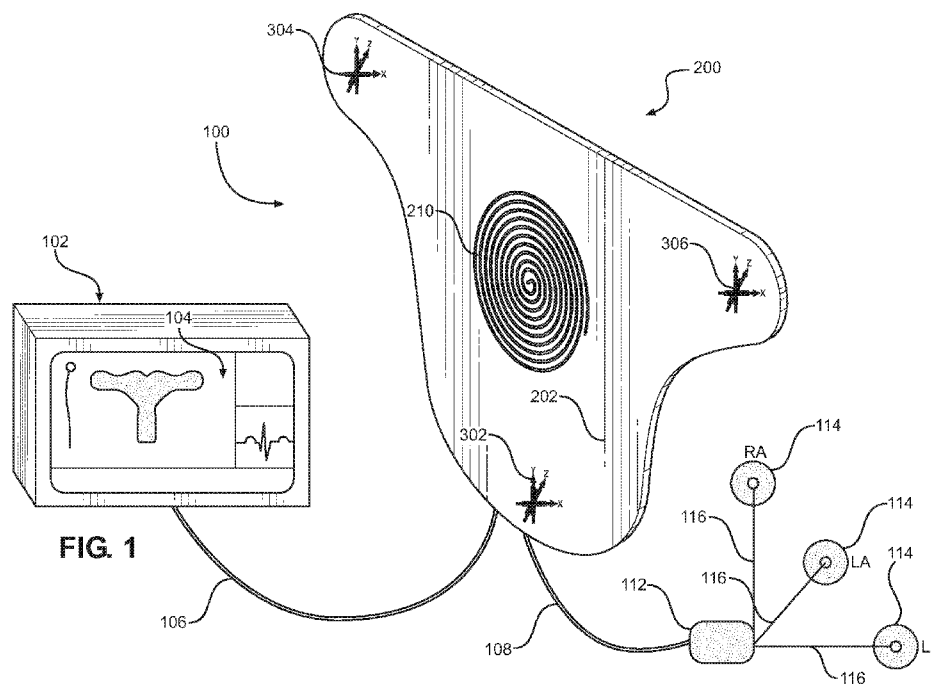
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AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
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TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: WIRELESS MEDICAL DEVICE NAVIGATION SYSTEMS AND METHODS



(57) Abstract: The present disclosure relates to a navigation system for placing a medical device into a patient. The system may include an external unit configured to be disposed on a chest of the patient, the external unit having: a radiating element configured to produce a first radio frequency ("RF") signal; and a plurality of three-axis sensors configured to receive a second RF signal. The system may also include a medical device such as a catheter. The catheter may have: a first antenna configured to receive the first RF signal and produce an alternating current; a rectifier configured to convert the alternating current into a direct current; a frequency generator configured to produce a second RF signal that is received by the plurality of three-axis sensors. The RF signals received by the plurality of three-axis sensors may be used to determine a position of the catheter relative to the external unit.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US18/59727

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:

*** Continued in extra 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 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.:
1-13 and 20

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

International application No.

PCT/US18/59727

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61B 34/20; H02J 50/20; G01C 21/00 (2018.01)

CPC - A61B 34/20; H02J 50/20; G01C 21/00

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)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y -- A	US 2009/0029754 A1 (SLOCUM, A et al) 29 January 2009, abstract, fig. 3, paragraphs [0066]-[0067]	20 ----- 1-13
Y	US 2006/0058695 A1 (CHEN, T) 16 March 2006, paragraphs [0004], [0014]	20
Y -- A	US 2016/0380488 A1 (QUALCOMM INCORPORATED) 29 December 2016, paragraphs [0049], [0069], [0071], [0106]-[0107], [0257]	20 ----- 1-13
A	US 5,377,678 A (DUMOULIN et al) 03 January 1995, entire document	1-13, 20
A	US 2016/0245670 A1 (NOSTIX, LLC) 08 August 2016, entire document	1

☐ 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 December 2018 (18.12.2018)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US18/59727

-Continued from Box No. III Observations where unity of invention is lacking -

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-13 and 20 are directed towards a system and chest plate having plurality of three-axis sensors, each three-axis sensor comprising three receiver coils configured to receive a second RF signal.

Group II: Claims 14-19 are directed towards a catheter configured to be inserted into a patient.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include at least A navigation system for placing a medical device into a patient, the system comprising: an external unit configured to be disposed on a chest of the patient, the external unit comprising: a radiating element configured to produce a first radio frequency ("RF") signal; and a plurality of three-axis sensors, each three-axis sensor comprising three receiver coils configured to receive a second RF signal; a control system connected to the external unit; and the medical device comprising: a first antenna configured to receive the first RF signal and supply power to a second antenna; and the second antenna configured to broadcast a second RF signal such that the receiver coils of the plurality of three-axis sensors receive the second RF signal, wherein the control system is configured to energize the radiating element, and the radiating element produces the first RF signal when the control system energizes the radiating element, and wherein the control system is configured to determine a position of the second antenna relative to the external unit based on the second RF signal received by the receiver coils of the plurality of three-axis sensors; chest plate configured to be disposed on a chest of a patient, the chest plate comprising: wherein the radiating element is disposed in a center portion of the chest plate, and wherein each of the plurality of three-axis sensors is disposed proximate to an outer edge of the chest plate, which are not present in Group II.

The special technical features of Group II include at least a catheter configured to be inserted into a patient, the catheter comprising: a flexible tubular body having a proximal end and a distal end; and a tip attached to the distal end of the flexible tubular body, the tip comprising: a first antenna configured to receive a first radio frequency ("RF") signal and produce an alternating current; a filter configured to filter the alternating current; a rectifier configured to convert the filtered alternating current into a direct current; a frequency generator configured to produce a second RF signal; an amplifier configured to amplify the second RF signal; and a second antenna configured to broadcast the second RF signal, wherein at least the frequency generator, the amplifier, and the second antenna are energized by the direct current., which are not present in Group I.

The common technical features shared by Groups I-II are a first antenna configured to receive a first radio frequency "RF" signal and a second antenna configured to broadcast the second RF signal.

However, these common features are previously disclosed by US 7,643,848 B2 (ROBINETT). ROBINETT discloses a first antenna configured to receive a first radio frequency "RF" signal (a wireless device having a second section with a second antenna (first antenna) for receiving a second TDMA frequency band (first RF signal), claim 1 of ROBINETT) and a second antenna configured to broadcast the second RF signal (the wireless device having a first section coupled to a first antenna (second antenna) for transmitting (broadcast) on a first TDMA frequency band (the second RF signal, claim 1 of ROBINETT).

Since the common technical features are previously disclosed by the ROBINETT reference, these common features are not special and so Groups I-II lack unity.