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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, 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 OF DETERMINING LOCATION USING A MEDICAL DEVICE

(57) **Abstract:** According to at least one aspect, a wearable medical device is provided. The wearable medical device may include a sensing electrode to sense an electrocardiogram signal of a patient, a therapy electrode to provide treatment to the patient, a garment to be worn about a torso of the patient and receive the sensing electrode and the therapy electrode, and a controller operatively coupled to the sensing electrode and the therapy electrode. The controller may be configured to determine a current location of the wearable medical device based on a previous position of the medical device and at least a speed and a direction of movement of the wearable medical device.

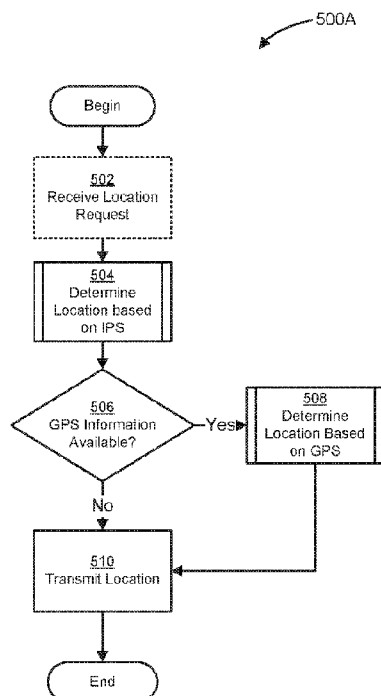


FIG. 5A



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).

Published:**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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

— *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:

3 November 2016

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/23718

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 5/02, 5/11; A61N 1/08, 1/37 (2016.01)

CPC - A61B 5/0004, 5/0006, 5/0402, 5/48, 5/6801, 5/1113, 5/1118, 5/1123; A61N 1/3937; G06F 19/3418

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 5/02, 5/11; A61N 1/08, 1/37 (2016.01)

CPC: A61B 5/0004, 5/0006, 5/0402, 5/48, 5/6801, 5/1113, 5/1118, 5/1123; A61N 1/3937; G06F 19/3418; USPC: 600/595; 607/4, 6, 7

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)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google; Google Scholar; Google Patent; EBSCO.
Search terms: garment*, wear*, torso*, ECG, electrocard*, electro*, sensor*, track*, location*, gait*, stride*, walk*, dementia*, dead*_reckon*, six, test*, evaluat*

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 2013/0324868 A1 (ZOLL MEDICAL CORPORATION) December 05, 2013; abstract; paragraphs [0055]-[0056], [0061]-[0087]; claim 9	1-5, 11, 15-17, 21 ----- 6-10, 12-14, 18-20
Y	US 2013/0218053 A1 (KAISER, WJ, et al.) August 22, 2013; paragraphs [0003], [0024], [0050]-[0051], [0100]	6-9
Y	US 2014/0207371 A1 (ZOLL MEDICAL CORPORATION) July 24, 2014; paragraphs [0025], [0031], [0038], [0045]-[0047]; claim 1	10
Y	US 2013/0045759 A1 (SMITH, C) February 21, 2013; paragraphs [0097]-[0098], [0109], [0114], [0144]-[0145]	12-14, 18-20
A	US 2014/0163334 A1 (ZOLL MEDICAL CORPORATION) June 12, 2014, entire document	1-21

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

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Date of mailing of the international search report

19 SEP 2016

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/23718

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:

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 fees must be paid.

Group I: Claims 1-21 are directed toward a wearable medical device.

Group II: Claims 22-30 are directed toward an ambulatory medical device.

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:

-Continued Within the Next Supplemental Box-

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.:
1-21

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/US16/23718

Continuation of Box No. III - Observations where unity of invention is lacking:

Group I includes a sensing electrode to sense an electrocardiogram signal of a patient; a therapy electrode to provide treatment to the patient; a garment to be worn about a torso of the patient and receive the sensing electrode and the therapy electrode; a motion detector to detect a movement of the medical device; and a controller coupled to the sensing electrode, the therapy electrode, and the motion detector, the controller being configured to track a location of the wearable medical device based on the detected movement of the medical device, which are not present in Group II.

Group II includes a memory to store building map information including a layout of a building; and a controller coupled to the sensing electrode and the memory, the controller being configured to monitor cardiac events of the patient, track a location of the ambulatory medical device within the building, and generate a building map with a location history of the ambulatory medical device based on the building map information and the tracked location of the ambulatory medical device, which are not present in Group I.

The common technical feature of Groups I-II are a medical device comprising a sensing electrode to sense an electrocardiogram signal of a patient; and a controller coupled to the sensing electrode, the controller being configured to track a location of the medical device.

These common features are disclosed by US 2014/0163334 A1 to Zoll Medical Corporation (hereinafter 'Zoll') discloses a medical device (a wearable defibrillator; abstract) comprising a sensing electrode to sense an electrocardiogram signal of a patient (device monitors the patient's ECG with sensing electrodes; abstract); and a controller coupled to the sensing electrode (a monitoring computer coupled to the cardiac sensing electrodes; claim 1), the controller being configured to track a location of the medical device (monitoring computer detects the position of the monitor, belt, and/or patient using accelerometers which are linked to the monitoring device providing the capability of tracking the location of the medical device; paragraphs [0003-0006], [0020], and [0032]).

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