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KW, 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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(54) Title: SYSTEMS AND METHODS FOR LOCATING AND/OR MAPPING BURIED UTILITIES USING VEHICLE-MOUNTED LOCATING DEVICES

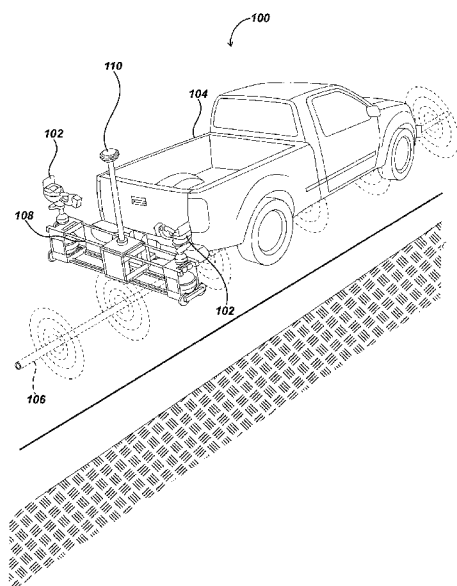


FIG. 1A

(57) Abstract: Systems and methods for locating and/or mapping buried utilities are disclosed. In one embodiment, one or more magnetic field sensing locating devices may be mounted on a vehicle. These locating devices may include one or more antenna nodes to sense magnetic field signals emitted from a buried utility, and a processing unit coupled to the antenna node(s) to receive the sensed magnetic field signals and further coupled to a velocity module to receive vehicle velocity data. The received magnetic field signals may be processed by the processing unit in conjunction with the vehicle velocity data to determine information associated with location of the buried utility.



INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2017/029455

A. CLASSIFICATION OF SUBJECT MATTER  
INV. G01V3/165  
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)  
G01V  
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.
Y	US 5 629 626 A (RUSSELL RICHARD J [US] ET AL) 13 May 1997 (1997-05-13) abstract; figure 4 column 7, line 15 - column 10, line 4 column 12, line 8 - column 13, line 12 column 15, lines 8-16 column 19, lines 19-34	1-26, 39-45
X	US 7 336 078 B1 (MEREWETHER RAY [US] ET AL) 26 February 2008 (2008-02-26)	1,5-10, 13, 16-18,22
Y	abstract; figures 8,12 column 1, lines 16-49 column 5, lines 61-67 column 15, lines 35-60 column 28, lines 11-18 column 31, line 51 - column 32, line 67	1-26, 39-45
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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  3 August 2017	Date of mailing of the international search report  21/11/2017
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  de Jong, Frank
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2017/029455

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014/125509 A1 (STOLARCZYK LARRY G [US] ET AL) 8 May 2014 (2014-05-08)  abstract; figure 3A paragraphs [0054], [0059], [0060], [0076], [0089] -----	2-11,13, 24,25, 40,41,44
Y	US 2013/127470 A1 (OLSSON MARK S [US] ET AL) 23 May 2013 (2013-05-23) abstract; figures 5,6 paragraphs [0096], [0097], [0149] -----	12,21, 26,42
Y	US 2015/123664 A1 (OLSSON MARK S [US] ET AL) 7 May 2015 (2015-05-07) paragraphs [0064], [0095] -----	14,15
Y	US 2006/232259 A1 (OLSSON MARK S [US] ET AL) 19 October 2006 (2006-10-19) paragraphs [0013], [0047] - [0049] -----	19,20

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2017/029455

## 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:

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.:  
1-26, 39-45

### 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: 1-26, 39-45

System and method for providing buried utility information, wherein a suitable sampling rate is derived from velocity information

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2. claims: 27-31

System and method for providing buried utility information, wherein a support frame for the measuring devices is provided transversely to the vehicle's hitch receiver

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3. claims: 32-38

System and method for providing buried utility information, wherein a suitable reference time mechanism is provided

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4. claims: 46-54

System and method for providing buried utility information, wherein measurements made by different surveys or survey vehicles are combined

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2017/029455
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5629626	A	13-05-1997	NONE
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US 7336078	B1	26-02-2008	NONE
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