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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 nextpage]

(54) **Title:** MULTIPOLARIZED VECTOR SENSOR ARRAY ANTENNA SYSTEM FOR SEARCH AND RESCUE APPLICATIONS

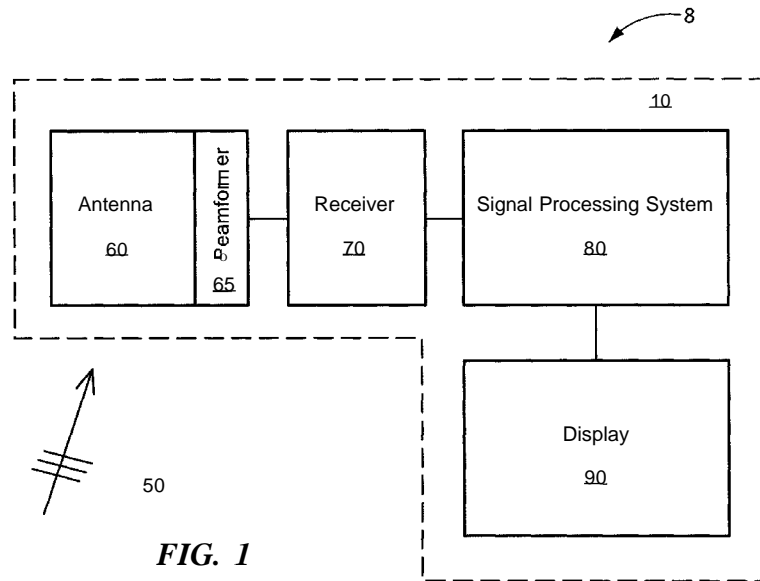


FIG. 1

(57) **Abstract:** The present disclosure is directed towards direction finding (DF) systems that can detect and locate a radio frequency (RF) signal (e.g. an emergency beacon) in two dimensions (i.e., azimuth and elevation). In one embodiment, a DF system comprises an array of multipolarized loop antennas coupled to a beamformer which provides monopole, dipole, and loop antenna element modal signals. The DF system may also comprise a multi-channel digital receiver system coupled to the beamformer. The multi-channel digital receiver system is configured to receive modal signals provided thereto from the beamformer which can be used for accurate two-dimensional geolocation of RF signals including, but not limited to, location of RF emergency beacon sources.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01Q 21/00, H01Q 13/00 (2016.01)

CPC - H01Q 13/04, H01Q 21/062, H01Q 13/10

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) - H01Q 21/00, H01Q 13/00 (2016.01)
CPC - H01Q1 3/04, H01Q21/062, H01Q13/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - H01Q 21/00, H01Q 13/00 (2016.01); CPC - H01Q13/04, H01Q21/062, H01Q13/10; USPC - 343/792.5, 343/769

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

Electronic Database Searched: PatBase, Google Scholar/Patents

Search Terms Used; Direction finding, antenna, array, loop, ground plane, beamformer, receiver, location, geolocation, polarized, monopole, dipole, common, phase, center, bands, quarter wavelength, coupler, hybrid magic tee/T, sum, difference, avalanche, calibrate

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 6,295,035 B1 (Holzheimer) 25 September 2001 (25.09.2001), entire document, especially FIG. 1-3, col. 5, ln. 8-20; col. 8, ln. 26-30; col. 8, ln. 55 to col. 9, ln. 15 | 1, 3, 7, 9-12,15-17 ----- 2, 4-6, 8, 13, 14, 18-20 |
| Y --- A | US 2014/0176373 A1 (Crouch et al.) 26 June 2014 (26.06.2014), para. [001 1], [0053], FIG. 3 | 1, 3, 7, 9-12,15-17 ----- 2, 4-6, 8, 13, 14, 18-20 |
| Y --- A | US 2008/0231517 A1 (Zheng) 25 September 2008 (25.09.2008), para. [0029]-[0030], [0033] | 1, 3, 7, 9-12 ----- 2, 4-6, 8, 13, 14 |
| Y | US 7,505,009 B2 (Parsche et al.) 17 March 2009 (17.03.2009), col. 4, ln. 26-38 | 7 |
| Y | US 2013/0278416 A1 (Button et al.) 24 October 2013 (24.10.2013), para. [0003], [0038] | 10, 11 |
| A | US 5,274,384 A (Hussain et al.) 28 December 1993 (28.12.1993), FIG. 5, col. 14, ln. 56 to col. 15, ln. 41 | 2, 6 |
| A | US 2010/0277363 A1 (Kainulainen et al.) 04 November 2010 (04.11.2010), para. [0080], [0081] | 13, 14 |
| A | US 2010/0124263 A1 (Martin et al.) 20 May 2010 (20.05.2010), para. [0054], [0058], [0070], FIG. 8-10 | 18-20 |

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

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| "P" document published prior to the international filing date but later than the priority date claimed | |

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| Date of the actual completion of the international search | Date of mailing of the international search report |
| 01 September 2016 (01.09.2016) | 3 0 SEP 2016 |

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| 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. 571-273-8300 | Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774 |
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INTERNATIONAL SEARCH REPORT

International application No.

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| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
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| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | US 6,987,489 B2 (Melconian et al.) 17 January 2006 (17.01.2006), entire document | 1-20 |
| A | US 6,535,180 B1 (Gregorwich et al.) 18 March 2003 (18.03.2003), entire document | 1-20 |
| A | US 7,978,139 B2 (Robinson et al.) 12 July 2011 (12.07.2011), entire document | 1-20 |