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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 May 2011 (05.05.2011)

PCT

(10) International Publication Number
WO 2011/053941 A4

(51) International Patent Classification:
*G01S 13/536* (2006.01) *G01S 7/02* (2006.01)

(21) International Application Number:
PCT/US2010/055019

(22) International Filing Date:
1 November 2010 (01.11.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/590,116 2 November 2009 (02.11.2009) US
12/590,117 2 November 2009 (02.11.2009) US
12/590,145 2 November 2009 (02.11.2009) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 12/590,145 (CON)
Filed on 2 November 2009 (02.11.2009)

(71) Applicant *(for all designated States except US)*: **INVENTION PLANET, LLC** [US/US]; 3535 Industrial Drive, Suite A4, Santa Rosa, California 95403 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **STEWART, Christopher, E.** [US/US]; 912 Furlong Road, Sebastopol, California 95472 (US). **MOULTON, Grant, E.** [US/US]; 2348 Marsh Court, Santa Rosa, California 95403 (US). **GOODY, Steven, H.** [US/US]; 3926 Fawnglen Place, Santa Rosa, California 95403 (US).

(74) Agents: **CASH, Brian** et al.; 5670 Wilshire Boulevard, Suite 2100, Los Angeles, California 90036 (US).

(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, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, 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.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, 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, ML, MR, NE, SN, TD, TG).

**Published**:

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

— *with amended claims (Art. 19(1))*

(88) Date of publication of the international search report:
18 August 2011

**Date of publication of the amended claims**: 6 October 2011

**(54) Title**: DETECTOR SYSTEM

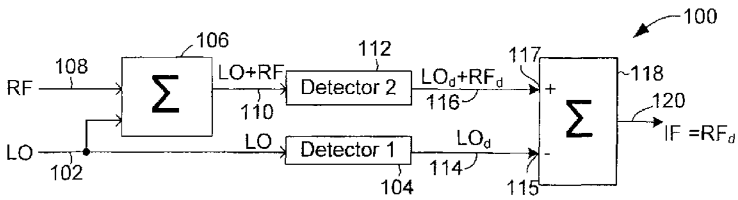


FIG. 1

**(57) Abstract**: A detector system has a first detector configured to detect a first high-frequency signal having amplitude-modulated ("AM") noise to produce a first detected signal having at least a first detected AM noise signal component and a demodulated signal component and a second detector configured to detect a second high-frequency signal having the AM noise to produce a second detected signal having at least a second detected AM noise signal component. An algebraic combining network combines the first detected signal and the second detected signal to cancel the first detected AM noise signal component with the second detected AM noise signal component to produce an output signal including the demodulated signal component.

WO 2011/053941 A4

## AMENDED CLAIMS
## received by the International Bureau on 12 August 2011 (12.08.2011)

1. A detector system comprising:

a first detector configured to detect a first high-frequency signal having amplitude-modulated ("AM") noise to produce a first detected signal having at least a first detected AM noise signal component and a demodulated signal component;

a second detector configured to detect a second high-frequency signal having the AM noise to produce a second detected signal having at least a second detected AM noise signal component; and

an algebraic combining network combining the first detected signal and the second detected signal to cancel the first detected AM noise signal component with the second detected AM noise signal component to produce an output signal including the demodulated signal component.

2. The detector system of claim 1 wherein the first high-frequency signal includes a local high-frequency signal and a received high-frequency signal, the demodulated signal component being at a difference frequency between the local high-frequency signal and the received high-frequency signal.

3. The detector system of claim 2 wherein the second high-frequency signal is the local high-frequency signal.

4. The detector system of claim 2 wherein the second high-frequency signal includes the local high-frequency signal and the received high-frequency signal, the second detected signal further including a second demodulated signal component at the difference frequency.

5. The detector system of claim 4 wherein the output signal of the algebraic combining network further includes the second demodulated signal component added to the demodulated signal component.

6. The detector system of claim 2 wherein the received high-frequency signal is a reflected signal of the local high-frequency signal.

7. The detector system of claim 1 further comprising a high-frequency algebraic combining network combining the local high-frequency signal and the received high-frequency signal and providing the local high-frequency signal and the received high-frequency signal to the first detector.

8. The detector system of claim 1 wherein the algebraic combining network has an inverting input and a non-inverting input, the first detected signal being provided to the non-inverting input and the second detected signal being provided to the inverting input.

9. The detector system of claim 1 wherein the first high-frequency signal includes a local high-frequency signal and a received high-frequency signal, the output signal being at a difference frequency.

10. The detector system of claim 1 further including a high-frequency algebraic combining network configured to receive a local high-frequency signal and a received high-frequency signal and to provide the local high-frequency signal and the received high-frequency signal to the first detector, and to provide the local high-frequency signal and an inverse of the received high-frequency signal to the second detector, the second detector producing the second detected signal having the second detected AM noise signal component and an inverse demodulated signal component.

11. The detector system of claim 10 wherein the algebraic combining network has an inverting input and a non-inverting input, the first detected signal being provided to the non-inverting input and the second detected signal being provided to the inverting input to produce an inverse AM noise signal component and a second demodulated signal component, the output signal being a sum of the demodulated signal component and the second demodulated signal component, the inverse AM noise signal component canceling the AM noise signal component.

12. The detector system of claim 1 wherein the first detector comprises a first single-diode detector and the second detector comprises a second single-diode detector.

13. The detector system of claim 1 wherein the first detector comprises a first dual-diode detector and the second detector comprises a second dual-diode detector.

14. The detector system of claim 1 wherein the first detector comprises a first diode voltage multiplier and the second detector comprises a second diode voltage multiplier.

15. The detector system of claim 10 wherein the high-frequency algebraic combining network comprises

a first received signal path through the high-frequency algebraic combining network,

a second received signal path through the high-frequency algebraic combining network,

a first LO signal path through the high-frequency algebraic combining network,

a second LO signal path through the high-frequency algebraic combining network,

a first high-frequency combiner combining a received signal in the first received signal path and an LO signal in the first LO signal path and providing a first combined signal to the first detector, and

a second high-frequency combiner combining the received signal in the second RF signal path and the LO signal in the second LO signal path and providing a second combined signal to the second detector.

16. The detector system of claim 15 wherein the first combined signal is the LO signal plus the received signal and the second combined signal is the LO signal minus the received signal.

17. The detector system of claim 1 further comprising a second algebraic combining network disposed between the first detector and the algebraic combining network having a first positive output connected to a first non-inverting input of the algebraic combining network, and a first negative output connected to a first inverting input of the algebraic combining network.

18. The detector system of claim 17 wherein the second detected signal further includes a second demodulated signal component, further comprising a third algebraic combining network disposed between the second detector and the algebraic combining network having a second positive output connected to a second inverting input of the algebraic combining network, and a second negative output connected to a second non-inverting input of the algebraic combining network.

19. The detector system of claim 18 further comprising an adjustable gain stage disposed between the algebraic combining network and one of the second algebraic combining network and the third algebraic combining network.

20. The detector system of claim 19 wherein the second detected AM noise signal component is equal to the first detected AM noise signal times a gain factor, the adjustable gain stage dividing the second detected AM noise signal component by the gain factor.

21. A field disturbance sensing system comprising:

an antenna;

an oscillator producing a high-frequency signal;

a first detector circuit;

a second detector circuit;

a combining network configured to couple the high-frequency signal to the antenna, and to couple the high-frequency signal and a reflected high-frequency signal to the first detector and to the second detector;

an algebraic summing network summing a first detected signal having first detected high-frequency signal and a first detected reflected signal from the first detector circuit and a second detected signal having second detected high- frequency signal and a second detected reflected signal from the second detector circuit to produce a detected output signal wherein the first detected reflected signal is added to the second detected reflected signal and the first detected high- frequency signal is subtracted from the second detected high-frequency signal; and

a controller configured to convert the detected output signal to a speed between the antenna and a target.

22. The field disturbance sensing system of claim 21 further comprising an electronic display screen configured to display the speed to a user.

23. The field disturbance sensing system of claim 1 further comprising

a housing incorporating the field disturbance sensing system, and the electronic display screen so as to provide a hand-held field disturbance system, wherein the hand-held field disturbance sensing system is a hand-held continuous wave radar system.

24. The field disturbance sensing system of claim 21 wherein the oscillator is a dielectric stabilized oscillator.

25. The field disturbance sensing system of claim 21 wherein the antenna is a patch antenna defined on a first side of a printed circuit board and the oscillator is defined on a second side of the printed circuit board.

26. The field disturbance sensing system of claim 25 wherein the printed circuit board has a polytetrafluoroethylene-based substrate with metal-foil traces on the first side and on the second side.

27. The field disturbance sensing system of claim 25 wherein the printed circuit board has an epoxy-fiberglass composite substrate with metal traces on the first side and on the second side.

28. The field disturbance sensing system of claim 25 wherein the first detector circuit and the second detector circuit are defined on the first side of the printed circuit board.

29. The field disturbance sensing system of claim 28 wherein the combining network includes a first ring coupler and a second ring coupler defined on the first side of the printed circuit board, the first ring coupler having an LO input port connected to the oscillator, an antenna port connected to the antenna, an RF port connected to the second ring coupler at an RF input port, and an LO port connected to the second ring coupler at a second LO input port.

30. The field disturbance sensing system of claim 29 wherein the LO input port is separated from the LO port by a quarter wavelength distance around the first ring coupler in a first direction, and is separated from the antenna port by a second quarter wavelength distance around the first ring coupler in a second direction, and is separated from the RF port by a half wavelength distance around the first ring coupler.

31. The field disturbance sensing system of claim 30 where the RF input port is separated from the second LO input port a first distance around the second ring coupler in a third direction and a second distance around the second ring coupler in a fourth direction, the difference between the first distance and the second distance being an integer multiple of a half wavelength distance, the second ring coupler further comprising a first detector port a third distance from the second LO input port in the third direction and a second detector port the third distance from the second LO input port in the fourth direction.

32. The field disturbance sensing system of claim 31 wherein the third distance is an odd integer multiple of a quarter wavelength distance.

33. The field disturbance sensing system of claim 1 further comprising a second antenna coupled to the combining network, wherein the antenna transmits the high-frequency signal at the target and the second antenna receives the reflected high-frequency signal from the target.

34. The field disturbance sensing system of claim 33 further comprising an amplifier between the second antenna and the combining network.

35. The field disturbance sensing system of claim 21 wherein the antenna transmits the high-frequency signal at the target and the antenna receives the reflected high-frequency signal from the target.

36. The field disturbance sensing system of claim 21 further comprising:

an amplitude modulation ("AM") noise source configured to selectively produce AM noise on the high-frequency signal; and

a noise calibration circuit configured to achieve a minimum AM noise on the detected output signal when the selected AM noise is produced on the high- frequency signal.

37. A method of down-converting comprising:

coupling a first high-frequency signal to a first detector and to a second detector;

receiving a received signal at an antenna;

providing the received signal to at least the first detector;

detecting the high-frequency signal and the received signal to produce a first detected signal including a first detected high-frequency signal and a demodulated signal;

concurrently detecting the high-frequency signal to produce a second detected high-frequency signal; and subtracting the second detected signal from the first detected signal so as to cancel amplitude-modulated noise on a detected signal output, the detected signal output including the demodulated signal.

38. The method of claim 37 wherein the step of coupling the first high-frequency signal to the first detector and to the second detector further comprises concurrently coupling the first high-frequency signal to the antenna, the received signal being a reflected signal of the first high-frequency signal from a target.

39. The method of claim 38 further comprising calculating a speed between the antenna and the target according to the demodulated signal component.

40. The method of claim 37 wherein the step of providing the received signal to the first detector further includes providing the received signal to the second detector, and wherein the step of concurrently detecting the high-frequency signal to produce a second detected signal further includes concurrently converting the received signal provided to the second detector to a second demodulated signal, a second detected signal including the second detected high-frequency signal and the second demodulated signal, and further comprising

adding the second demodulated signal to the demodulated signal.

41. The method of claim 40 wherein the received signal is provided to the first detector at a first phase and is provided to the second detector at a second phase, the second phase being shifted one hundred and eighty degrees from the first phase.

42. The method of claim 41 wherein the high-frequency signal is provided to the first detector at a phase and to the second detector at the phase.

43. The method of claim 40 wherein the step of subtracting the second detected high- frequency signal from the first detected high-frequency signal and the step of adding the second demodulated signal to the demodulated signal includes amplifying a differential signal of the first detected signal and the second detected signal so as to

cancel amplitude modulation ("AM") noise of the high-frequency signal at the detected signal output.

44. The method of claim 40 wherein the first detector and the second detector form a differential detector, and the first detected signal and the second detected signal are coupled to a differential amplifier.

45. The method of claim 45 wherein the high-frequency signal is transmitted from an antenna and the received signal is a reflected signal received by the antenna.

46. The method of claim 45 wherein the high-frequency signal is coupled to the antenna from a high-frequency source through a transmission structure having a high-frequency signal output port and a reflected signal output port separated from the high-frequency signal port by a selected transmission length so as to cancel the high-frequency signal at the reflected signal output port.

47. The method of claim 40 further comprising
adjusting a gain setting of a second detected signal path so as to reduce amplitude-modulated ("AM") noise at the detected signal output.

48. The method of claim 47 further comprising, before transmitting the high-frequency signal from the antenna to the target:
shielding the antenna;
determining the gain setting for minimum AM noise;
saving the gain setting; and
applying the gain setting to the second detected signal path.

49. The method of claim 40 further comprising
amplitude modulating the high-frequency signal;
determining a gain setting for minimum detected AM signal;
saving the gain setting; and

applying the gain setting to the second detected signal path so as to reduce amplitude-modulated ("AM") noise at the detected signal output.