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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/920,570	06/18/2013	Weimin Zhou	ARL 12-44	5749

21364 7590 02/12/2018

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ART UNIT	PAPER NUMBER
2855	

MAIL DATE	DELIVERY MODE
02/12/2018	PAPER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WEIMIN ZHOU, OLUKAYODE OKUSAGA, and JAMES P. CAHILL

Appeal 2017-005086
Application 13/920,570
Technology Center 2800

Before ROMULO H. DELMENDO, DEBRA L. DENNETT, and SHELDON M. McGEE, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

The Appellant[1] appeals under 35 U.S.C. § 134(a) from the Primary Examiner's final decision to reject claims 1–20.[2] We have jurisdiction under 35 U.S.C. § 6(b).

We reverse.

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[1] The Appellant is the Applicant, U.S. Army Research Laboratory. According to the Brief, the real party in interest is the "U.S. Government as represented by the Secretary of the Army" (Appeal Brief filed June 29, 2016, hereinafter "Appeal Br.," 1).

[2] Appeal Br. 7–30; Reply Brief filed February 8, 2017, hereinafter "Reply Br.," 1–20; Final Office Action entered November 12, 2015, hereinafter "Final Act.," 2–30; Examiner's Answer entered December 16, 2016, hereinafter "Ans.," 2–32.

I. BACKGROUND

The subject matter on appeal relates to a system and a method for sensing vibrational and/or acoustical signals from a target area (Specification filed June 18, 2013, hereinafter "Spec.," Abstract and ¶¶ 5, 10). According to the Specification, the invention may be used, e.g., for covert remote activity sensing or in other applications such as subterranean seismic sensing (*id.* ¶¶ 70–71). Figure 1, reproduced below, is illustrative.

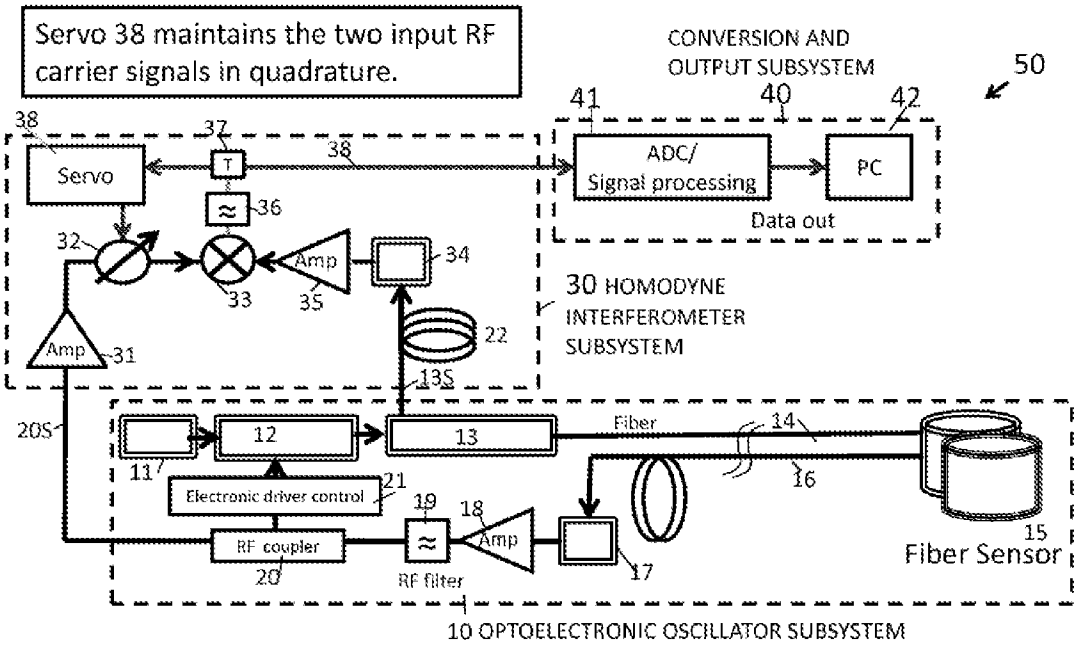

FIG. 1

Figure 1 above depicts an embodiment for an acoustic/seismic sensor system **50** in accordance with the invention, wherein the system includes: an optoelectronic oscillator subsystem **10** comprising, *inter alia*, a laser **11**, an optical modulator **12**, a fiber optical coupler **13**, sensing fiber **14**, a fiber sensor **15** (a target area); a homodyne interferometer subsystem **30** for removing signals other than sideband signals including, e.g., an RF phase

shifter **32** and an RF mixer **33**; and a conversion and output subsystem **50** including an analog-to-digital signal processor **41** (Spec. ¶¶ 38–42).

Representative claim 1 is reproduced from the Claims Appendix to the Appeal Brief (Appeal Br. 31), with key limitations emphasized and some line spacing added, as follows:

> 1. A system for sensing vibrational and/or acoustical signals from a target area comprising:
>
> an optoelectronic oscillator comprising a light generator, a modulator, and at least one optical fiber, ***the optoelectronic oscillator operating to send a modulated carrier signal having a carrier-frequency through the optical fiber into-a target area and receive a return signal comprising sideband signals***;
>
> a circuit for removal of signals other than sideband signals operatively connected to the optoelectronic oscillator for receiving of the optical return signal from the target area and substantially removing the carrier frequency; ***the circuit for removal of the carrier frequency comprising***;
>
> ***a phase shifter***;
>
> ***a mixer operatively connected to the phase shifter***;
>
> ***a control circuit operatively connected to the mixer and the phase shifter*** for controlling the phase shifter and operating to remove the[ ]carrier frequency;
>
> ***a signal processor*** operatively connected to the circuit for removal of the carrier frequency, the signal processor operating to process the sideband signals to detect acoustical and/or vibrational signals from the target area.

II. REJECTIONS ON APPEAL

On appeal, the Examiner maintains two rejections under AIA 35 U.S.C. § 103, as follows:

A. Claims 1–9, 12–15, and 17–20 as unpatentable over Cole et al.[3] (hereinafter "Cole") in view of Bakhtiari et al.[4] (hereinafter "Bakhtiari"); and

B. Claims 10, 11, and 16 as unpatentable over Cole in view of Bakhtiari and Maruyama.[5]

(Ans. 2–32; Final Act. 2–30.)

III. DISCUSSION

The Examiner finds that Cole describes a system for sensing vibrational and/or acoustical signals from a target area including many of the limitations recited in claim 1 (Ans. 2–3). The Examiner finds that Cole's disclosure differs from claim 1's subject matter in that the reference does not describe the "circuit for removal of the carrier frequency" and "signal processor" limitations (*id.* at 3). To resolve these differences, the Examiner relies on Bakhtiari's teachings (*id.* at 3–4). The Examiner concludes from these findings that a person of ordinary skill in the art would have combined certain elements or features disclosed in Bakhtiari with Cole's system in the manner claimed by the inventors (*id.* at 4).

The Appellant contends that, contrary to the Examiner's findings, Cole does not disclose the "optoelectronic oscillator" limitations highlighted

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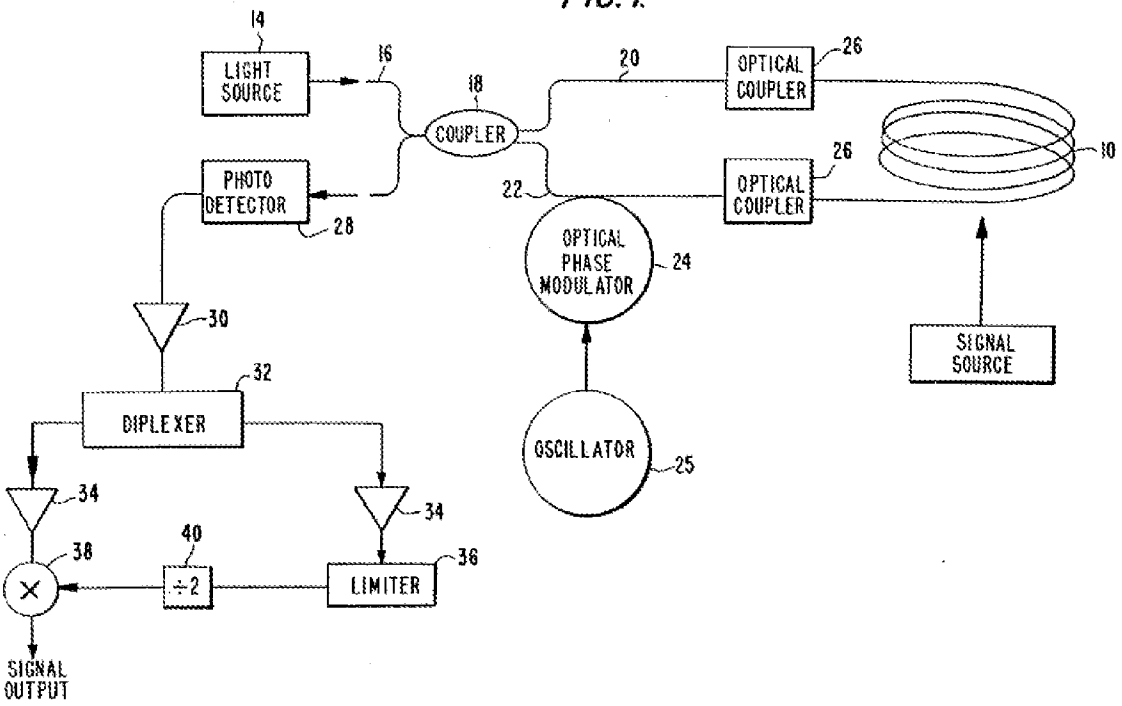
[3] US 5,012,088, issued April 30, 1991.
[4] US 2010/0290063 A1, published November 18, 2010.
[5] US 2001/0032514 A1, published October 25, 2001.

above in reproduced claim 1 (Appeal Br. 7). Specifically, the Appellant argues that "Cole recovers the signal in a different manner using cross propagated ***light*** beams" and that "[i]n Cole, the vibrating signal applied to the sensor are used to phase modulate the counter propagating optical signals" (*id.*). According to the Appellant, Cole does not teach "a return signal comprising sideband signals" and subsequently removing the carrier frequency, as required by the claims (*id.* at 7, 11; Reply Br. 1–2, 13). Furthermore, the Appellant argues that the Examiner failed to articulate a sufficient reason or motivation to combine Bakhtiari and Cole in the manner claimed by the inventors (Appeal Br. 8–17).

We agree with the Appellant that the Examiner's rejection is not well-founded. Our reasons follow.

Cole describes an optical sensor for measuring naturally-occurring phenomena such as vibrations (Abstract). Cole's Figure 1 is reproduced as follows:

FIG. 1.



Cole's Figure 1 above depicts a block diagram for a vibration sensing device (Cole, col. 2, ll. 61–64). As described in Cole, the optical circuit includes a light source **14** from which low coherence light is propagated through an optical fiber **16** into a single mode coupler **18**, which splits the light into two beams applied at the other side of the coupler to optical fibers **20** and **22** (*id.* at col. 3, ll. 17–30). Thus, Cole teaches that "counter rotating beams of light are interjected into the opposite ends of the sensor **10** such that they combine or merge into one beam" (*id.* at col. 3, ll. 48–51). Cole teaches that, on fiber **22**'s side, if a phase modulator **24** operates at a carrier frequency supplied by an oscillator **25**, the vibrating signal applied to sensor **10** can be used to phase modulate the counter propagating optical signals (*id.* at col. 3, ll. 51–54). According to Cole, the counter rotating optical signals are coherently combined by coupler **18** to produce an amplitude modulated intensity signal, which may then be detected by photodetector **28**, which in turn is connected

to amplifier **30** to a demodulator circuit for recovering the signal obtained from sensor **10** (*id.* at col. 3, ll. 58–64).

Contrary to the Examiner's findings (Ans. 2–3), Cole has not been shown to disclose, either explicitly or inherently, an optoelectronic oscillator that sends a modulated carrier signal having a carrier frequency through the optical fiber into a target area and receives a return signal comprising sideband signals, as required by claim 1. Instead, Cole merely teaches that "[i]f the modulator **24** is controlled to operate at a carrier frequency supplied by an oscillator **25**, the vibrating signal applied to the sensor **10** can be used to phase modulate the counter propagating optical signals" (Cole, col. 3, ll. 51–54), as we found above. Again, according to Cole, "[t]he counter rotating optical signals are coherently combined by the coupler **18** to produce an amplitude modulated intensity signal" (*id.* at col. 3, ll. 58–60). These teachings are insufficient to support the Examiner's finding that the disputed "optoelectronic oscillator" limitations are described in Cole.

In addition, we agree with the Appellant (e.g., Appeal Br. 9) that the Examiner's articulated reason for combining Bakhtiari with Cole does not support an obviousness conclusion with some rational underpinning based on facts. According to the Examiner, a person having ordinary skill in the art would have used, e.g., a quadrature mixer that involves a phase shifter as disclosed in Bakhtiari (¶ 31) in place of the elements disclosed in Cole (col. 3, l. 65–col. 4, l. 5) as "art-recognized equivalents for removal of the carrier frequency to determine the vibrational signal from the target area" (Ans. 3–4). Bakhtiari, however, appears to relate to a different type of system—i.e., a millimeter wavelength (MMW) measurement (MMW) system (Abstr.). In particular, Bakhtiari teaches that "[a]nalogous to ***heterodyne*** detection of

interferometric optical signals, mixing of the backscattered electromagnetic signal with a portion of the reference transmitted signal (i.e., a local oscillator) allows recovery of low-frequency modulations induced by the vibrating target" (Bakhtiari ¶ 28) (emphasis added). Thus, according to Bakhtiari, "phase interference of the coherent MMW radiation is used to deduce information about relative small in-plane displacements" (*id.*). Furthermore, as the Appellant points out (Appeal Br. 10), Bakhtiari teaches that phase modulation is induced by the target—not a phase shifter (¶ 28). The Examiner does not direct us to sufficient evidence establishing that Bakhtiari's quadrature mixer and Cole's amplifier **30**, diplexer **32**, amplifiers **34**, limiter **36**, mixer **38**, and divider **40** are in fact art-recognized equivalents. Even if a person of ordinary skill in the art would have combined these references, the Examiner does not direct us to sufficient evidence that the resulting combination would result in the claimed system in which the carrier frequency is removed from the return signal comprising sideband signals resulting from the signal sent to the target area by the optoelectronic oscillator.

For these reasons, we do not sustain the Examiner's rejection as entered against claim 1 and all claims dependent thereon. Additionally, because the two other independent claims—i.e., claims 9 and 12—recite limitations similar to the disputed limitations recited in claim 1, we do not sustain the rejections as to all claims.

IV. SUMMARY

Rejections A and B are not sustained. Therefore, the Examiner's final decision to reject claims 1–20 is reversed.

REVERSED