



(12) **United States Patent**
Wilcken et al.

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(54) **LENSET/DETECTOR ARRAY ASSEMBLY FOR HIGH DATA RATE OPTICAL COMMUNICATIONS**

6,049,593 A 4/2000 Acampora
6,285,481 B1 9/2001 Palmer
6,307,521 B1 10/2001 Schindler et al.
6,567,200 B1* 5/2003 Pammer et al. 398/202

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(Continued)

FOREIGN PATENT DOCUMENTS

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WO WO 02/32020 4/2002

OTHER PUBLICATIONS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

Tao, et al. "Wideband fully differential CMOS transimpedance preamplifier," *Electronics Letters* 39(21): Oct. 16, 2003; 2 pages.

(Continued)

(21) Appl. No.: **10/961,173**

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Assistant Examiner—Stephen Yam

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(74) *Attorney, Agent, or Firm*—Timothy K. Klintworth; Wildman, Harrold, Allen & Dixon, LLP

(65) **Prior Publication Data**

(57) **ABSTRACT**

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H03F 3/08 (2006.01)

(52) **U.S. Cl.** **250/214 A**; 250/208.2;
398/202; 330/308

(58) **Field of Classification Search** 250/214 A;
398/202; 330/308

See application file for complete search history.

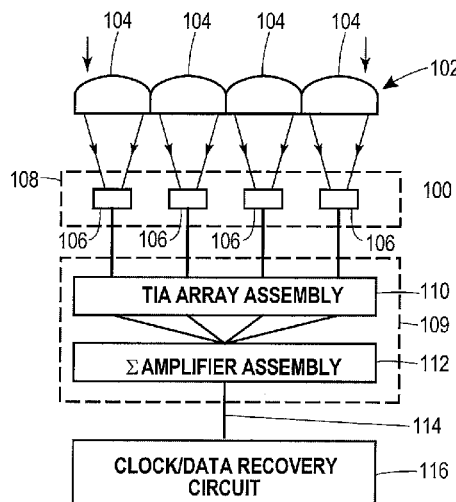
An assembly is provided that may be used in high data rate optical communications, such as free-space communication systems. The assembly may include a main optical receiver element and a lenslet array or other optical element disposed near the focal plane that collects an optical signal and focuses that signal as a series of optical signal portions onto a photodetector array, formed of a series of InGaAs photodiodes, for example. The electrical signals from the photodetectors may be amplified using high bandwidth transimpedance amplifiers connected to a summing amplifier or circuit that produces a summed electrical signal. Alternatively, the electrical signals may be summed initially and then amplified via a transimpedance amplifier. The assembly may be used in remote optical communication systems, including free-space laser communication environments, to convert optical signals up to or above 1 Gbit/s or higher data rates into electrical signals at 1 Gbit/s or higher data rates.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,282,527 A 8/1981 Winderman et al.
4,477,814 A 10/1984 Brumbaugh et al.
5,034,997 A 7/1991 Iwasaki
5,214,438 A 5/1993 Brusgard et al.
5,327,149 A 7/1994 Kuffer
5,343,033 A* 8/1994 Cain 250/208.2
5,479,595 A 12/1995 Israelsson
5,760,942 A* 6/1998 Bryant 398/208

25 Claims, 4 Drawing Sheets



U.S. PATENT DOCUMENTS

6,618,125	B2 *	9/2003	Stann	356/5.09
6,834,165	B2 *	12/2004	Feng	398/202
6,983,110	B2 *	1/2006	Buckman et al.	398/212
2001/0026390	A1 *	10/2001	Braun	359/189
2002/0109076	A1 *	8/2002	Tochio et al.	250/214 SW
2005/0047801	A1 *	3/2005	Schrodinger	398/202
2005/0218299	A1 *	10/2005	Olsen et al.	250/214 A

OTHER PUBLICATIONS

Oh, et al. "A 2.5Gb/s CMOS Transimpedance Amplifier Using Novel Active Inductor Load," 27th European Solid-State Circuits Conference, Villach, Austria, Sep. 18-20, 2001.

Ambundo, et al. "Fully Integrated Current-Mode Subaperture Centroid Circuits and Phase Reconstructor," 10th NASA Symp. VLSI Design, Albuquerque, NM Mar. 2002.

Ribak, et al. "A fast modal wave-front sensor," Optics Express 9(3):152-157 (2001).

"New Paint Compounds Provide Early Detection of Corrosion to Aircraft"; AFSOR: Research Highlights Jul./Aug. 1999.

Ballard, et al., "MTI Focal Plane Assembly Design and Performance" SPIE—Imaging Spectrometry V, Denver, CO (US), Jun. 17, 1999.

* cited by examiner

FIG. 1

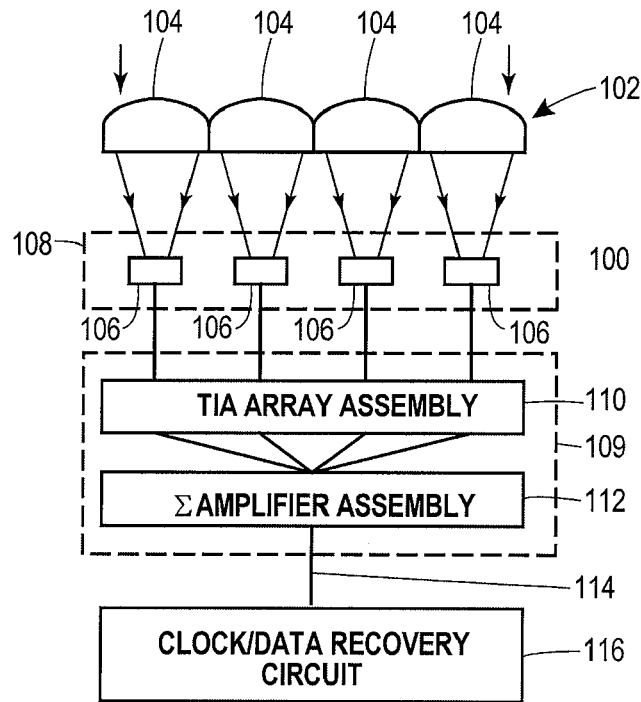


FIG. 2

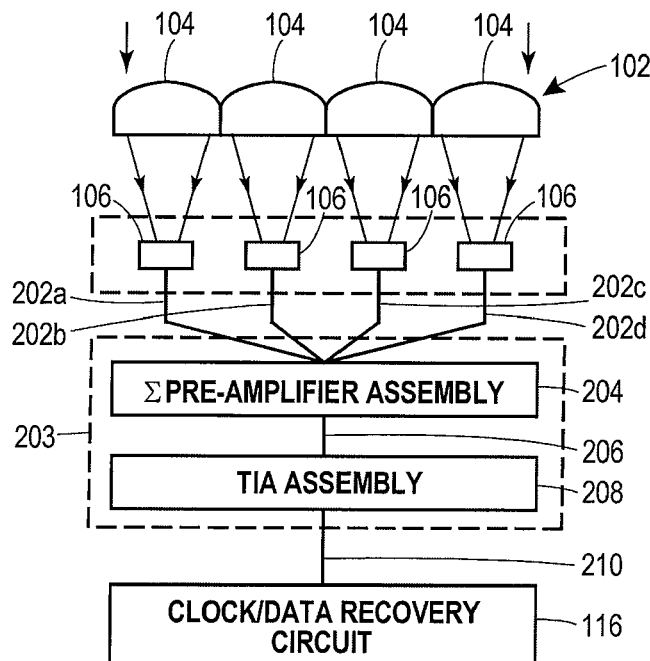


FIG. 3

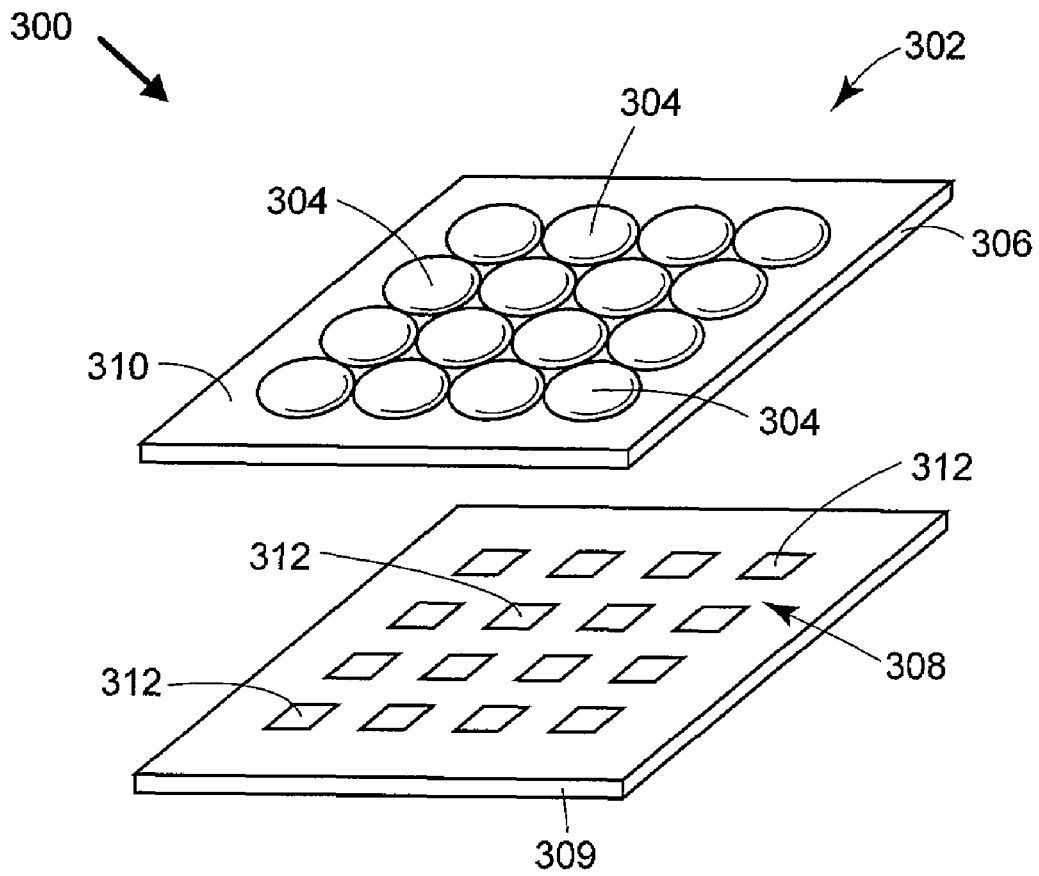


FIG. 4

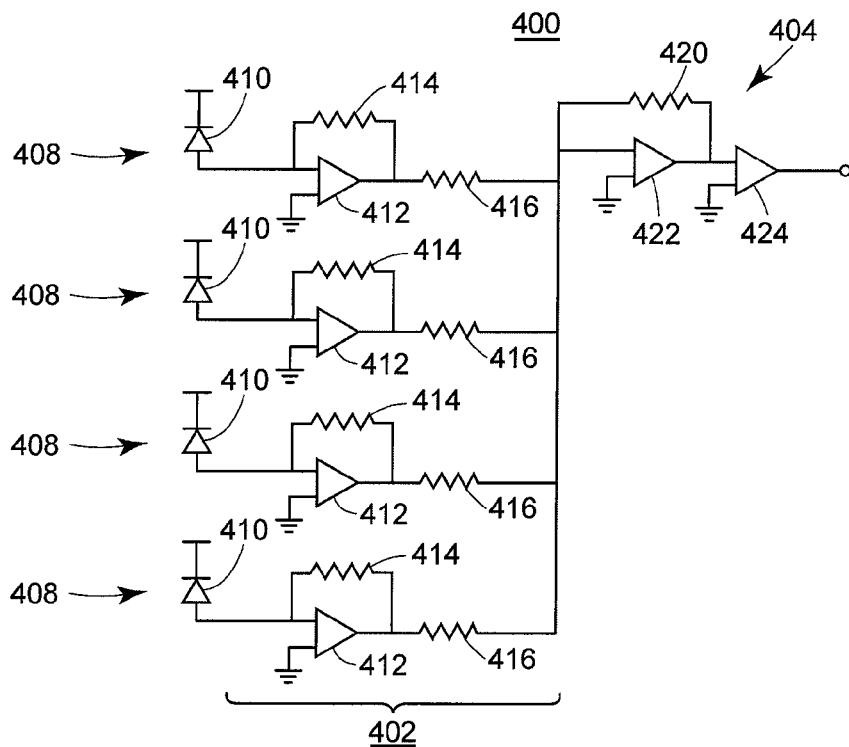


FIG. 5

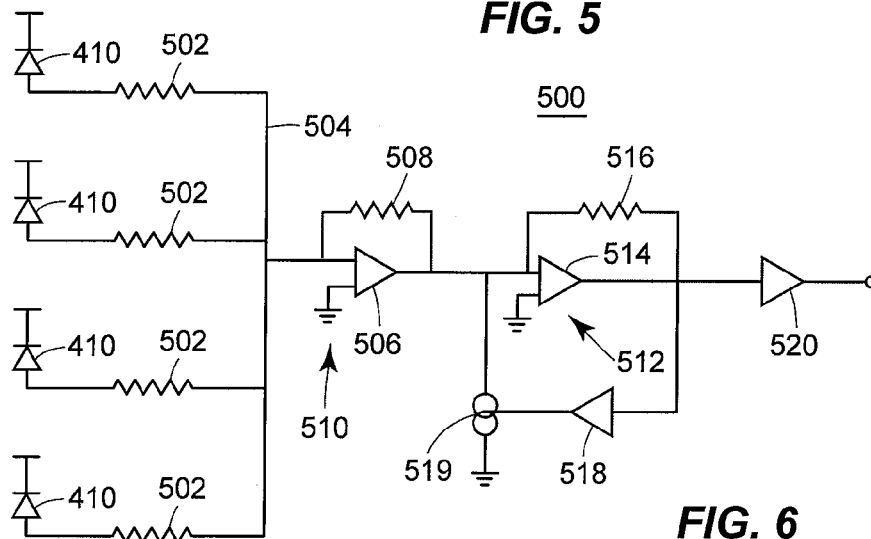
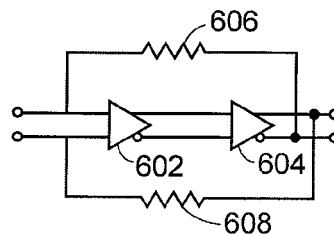


FIG. 6



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