



US006898451B2

(12) **United States Patent**
Wuori

(10) **Patent No.:** **US 6,898,451 B2**
(45) **Date of Patent:** **May 24, 2005**

(54) **NON-INVASIVE BLOOD ANALYTE MEASURING SYSTEM AND METHOD UTILIZING OPTICAL ABSORPTION**

(75) Inventor: **Edward R. Wuori**, Mounds View, MN (US)

(73) Assignee: **Minformed, L.L.C.**, Mounds View, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/104,782**

(22) Filed: **Mar. 21, 2002**

(65) **Prior Publication Data**

US 2003/0050541 A1 Mar. 13, 2003

Related U.S. Application Data

(60) Provisional application No. 60/277,758, filed on Mar. 21, 2001.

(51) **Int. Cl.⁷** **A61B 5/00**

(52) **U.S. Cl.** **600/322; 600/310**

(58) **Field of Search** 600/309-310, 600/322-326, 316, 476, 473

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,596,057 A	*	7/1971	Arntz	219/354
3,983,751 A	*	10/1976	Cipriano	73/295
4,271,358 A	*	6/1981	Schwarz	250/338.1
4,651,001 A		3/1987	Harada et al.	
5,069,214 A	*	12/1991	Samaras et al.	600/323
5,197,470 A	*	3/1993	Helfer et al.	600/342
5,348,003 A	*	9/1994	Caro	600/310
5,355,880 A	*	10/1994	Thomas et al.	600/326
5,361,758 A		11/1994	Hall et al.	
5,660,181 A	*	8/1997	Ho et al.	600/408
5,755,226 A	*	5/1998	Carim et al.	600/323
5,784,507 A	*	7/1998	Holm-Kennedy et al.	385/31
5,817,007 A		10/1998	Fodgaard et al.	
5,900,632 A		5/1999	Sterling et al.	

6,039,697 A	*	3/2000	Wilke et al.	600/310
6,119,031 A	*	9/2000	Crowley	600/310
6,175,750 B1	*	1/2001	Cook et al.	600/310
6,198,949 B1	*	3/2001	Braig et al.	600/310
6,215,403 B1	*	4/2001	Chan et al.	600/323
6,341,257 B1	*	1/2002	Haaland	702/27
6,361,501 B1	*	3/2002	Amano et al.	600/500
6,452,179 B1	*	9/2002	Coates et al.	250/339.09
6,542,762 B1	*	4/2003	Alam et al.	600/310
2001/0034477 A1	*	10/2001	Mansfield et al.	600/316

FOREIGN PATENT DOCUMENTS

JP 62-250320 * 10/1987 374/121

OTHER PUBLICATIONS

Tatsyi Tigawa, Patient Monitoring, Wiley Encyclopedia of Electrical and Electronics Engineering Online, 1999.*
Webster's II New Riverside University Dictionary, Riverside Publishing Company,, 1994, p. 761.*

* cited by examiner

Primary Examiner—Max F. Hindenburg

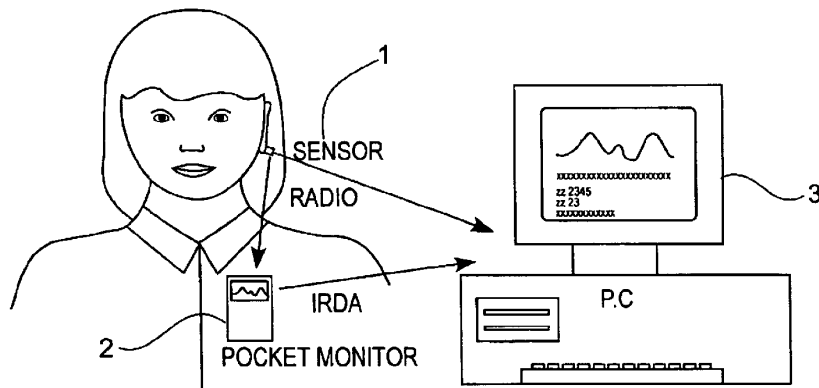
Assistant Examiner—Matthew Kremer

(74) *Attorney, Agent, or Firm*—Fredrikson & Byron, P.A.

(57) **ABSTRACT**

A device and method for measuring the concentration of analytes in the blood of a portion of tissue. The device includes a sensor module, a monitor, and a processor (separate from or integral with the sensor module). The sensor module includes a radiation source for emitting radiation to the tissue; a collimator and narrow band filter for processing the radiation after it has transmitted through or been reflected by the tissue; and one or more sensors for sensing the transmitted or reflected radiation. The one or more sensors send a signal to the processor which algorithmically converts the radiation using linear regression or orthogonal functions to determine the concentration of one or more blood analytes. The device self-calibrates to eliminate error caused by variables such as skin character. The sensor module is integrated to reduce size and weight such that it is inobtrusive, and the monitor is compact for transport

31 Claims, 11 Drawing Sheets



Apple Inc.
APL1054

Fig. 1

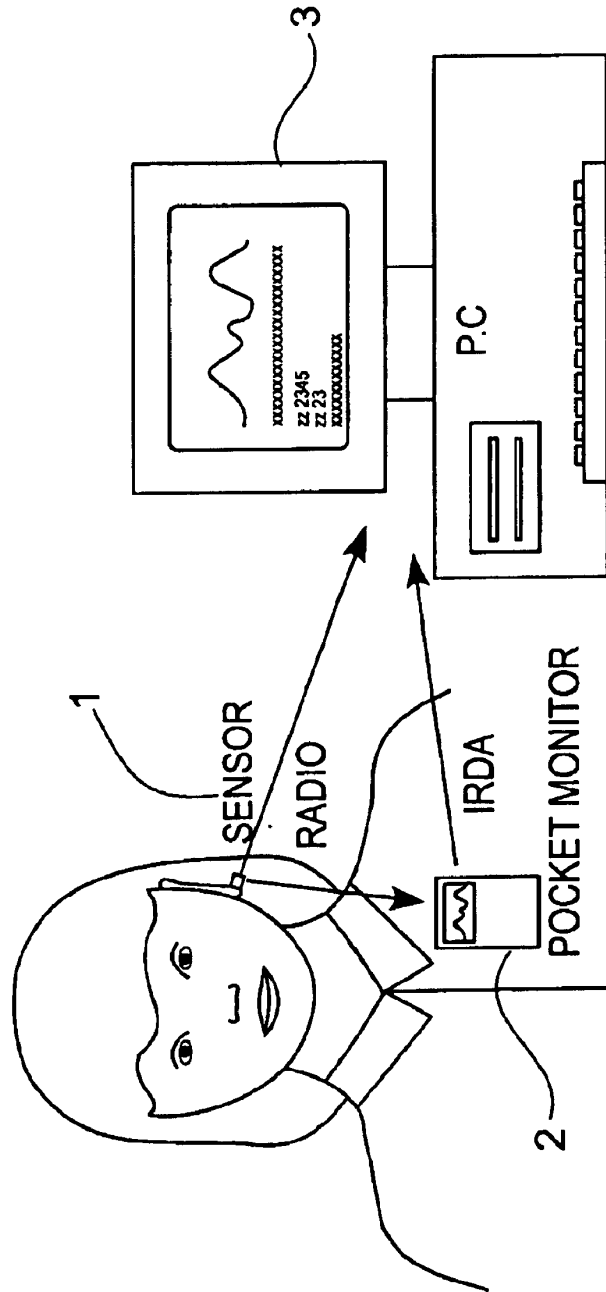


Fig. 2

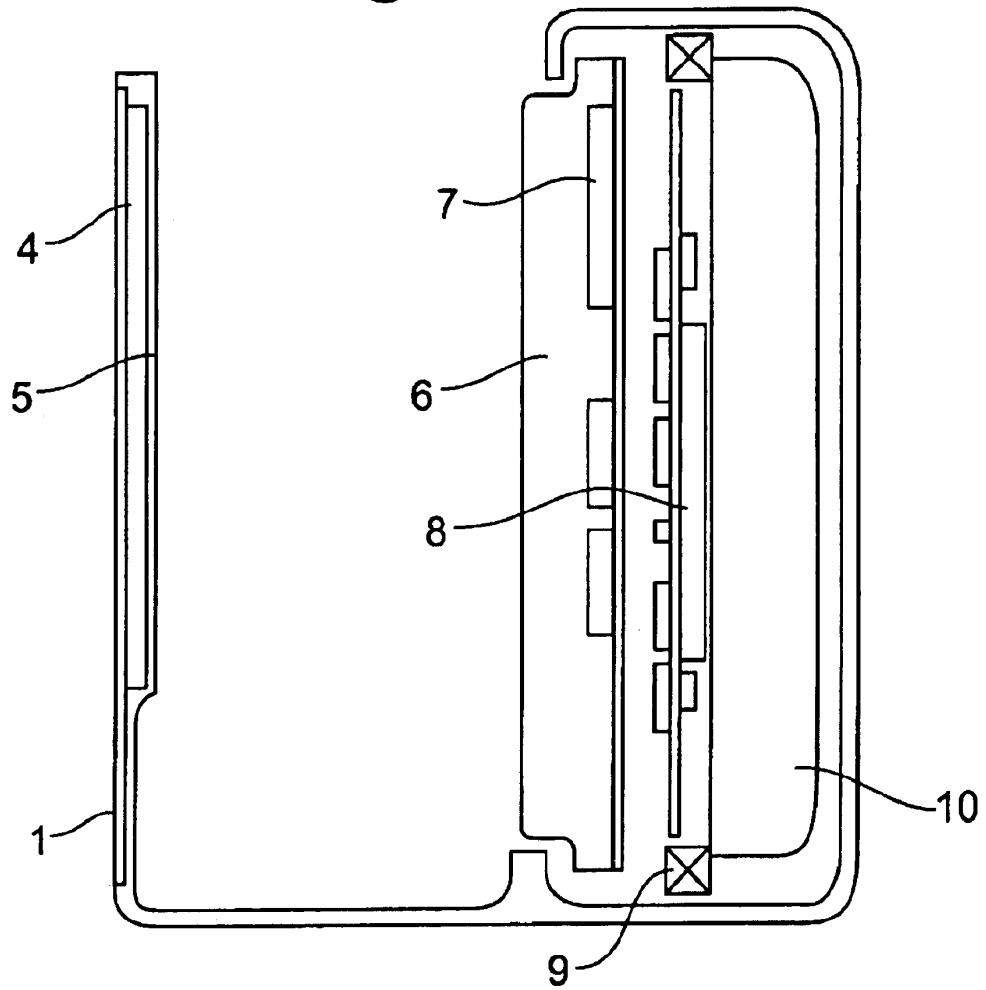


Fig. 3

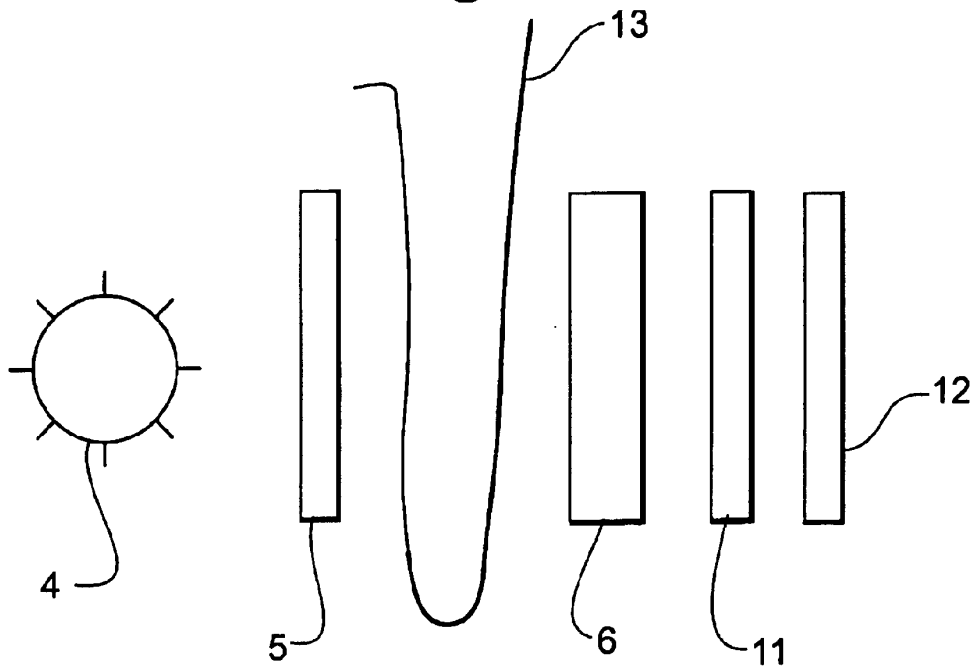
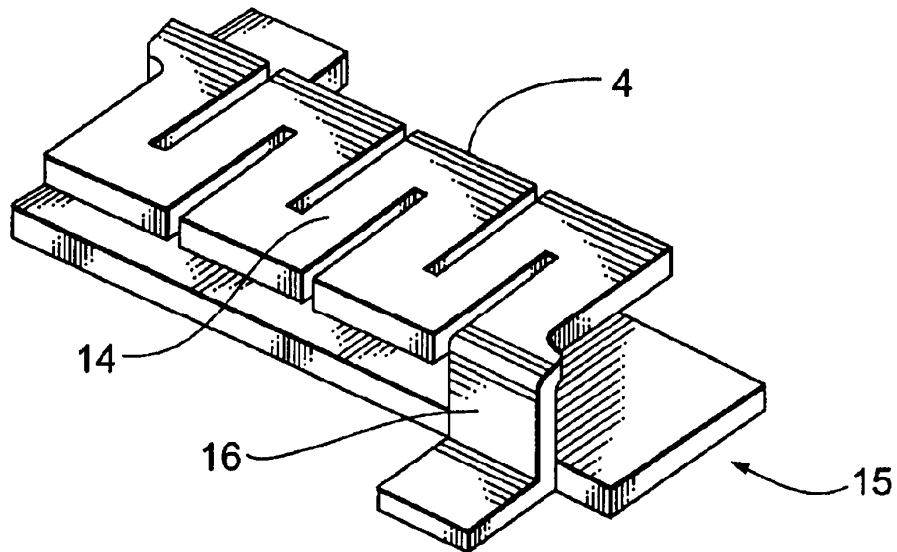


Fig. 4



Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.