



(12) **United States Patent**
Mendelson

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(54) **PULSE OXIMETER AND METHOD OF OPERATION**
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(73) Assignee: **Cybro Medical, Ltd.**, Haifa (IL)
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4,740,080 A	4/1988	Donohue et al.	356/326
4,773,422 A	9/1988	Isaacson et al.	
4,796,636 A	1/1989	Branstetter et al.	
4,802,486 A	2/1989	Goodman et al.	
4,819,649 A	4/1989	Rogers et al.	
4,819,752 A	4/1989	Zelin	
4,854,699 A	8/1989	Edgar, Jr.	356/41
4,859,057 A	8/1989	Taylor et al.	356/41
4,867,557 A	9/1989	Takatani et al.	356/41
4,892,101 A	1/1990	Cheung et al.	
4,928,692 A	5/1990	Goodman et al.	
4,934,372 A	6/1990	Corenman et al.	
4,960,126 A	10/1990	Conlon	
5,190,038 A	3/1993	Polson et al.	
5,224,478 A	7/1993	Sakai et al.	
5,348,004 A	9/1994	Hollub	
5,349,519 A	9/1994	Kaestle	364/413.09

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

WO	WO9403102	2/1994
WO	WO0154573	8/2001
WO	WO0184107	11/2001

OTHER PUBLICATIONS

"Reflecance Pulse Oximetry at the Forehead of Newborns: The Influence of Varying Pressure on the Probe"; A. Carin M. Dassel, MD, et al.; Dept of Obstetrics and Gynecology, Univ. Hospital Groningen, Groningen; Journal of Clinical Monitoring 12: pp. 421-428, 1996.

(List continued on next page.)

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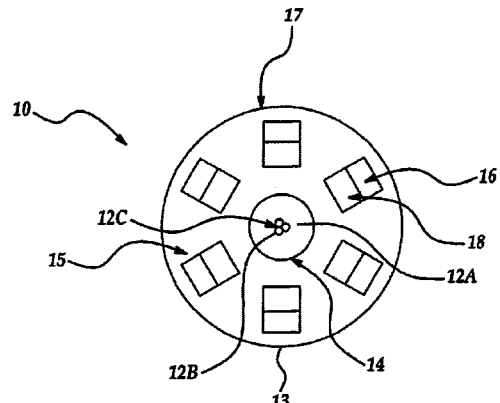
(57) **ABSTRACT**

A sensor for use in an optical measurement device and a method for non-invasive measurement of a blood parameter. The sensor includes sensor housing, a source of radiation coupled to the housing, and a detector assembly coupled to the housing. The source of radiation is adapted to emit radiation at predetermined frequencies. The detector assembly is adapted to detect reflected radiation at least one predetermined frequency and to generate respective signals. The signals are used to determine the parameter of the blood.

5 Claims, 6 Drawing Sheets

Related U.S. Application Data
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(30) **Foreign Application Priority Data**
Oct. 5, 2000 (IL) 138884
(51) **Int. Cl.**⁷ **A61B 5/00**
(52) **U.S. Cl.** **600/330; 600/322; 600/336**
(58) **Field of Search** 600/310, 322, 600/323, 330, 336

(56) **References Cited**
U.S. PATENT DOCUMENTS
3,638,640 A 2/1972 Shaw
3,799,672 A 3/1974 Vurek 356/41
3,847,483 A 11/1974 Shaw 356/41
3,998,550 A 12/1976 Konishi et al. 356/39
4,086,915 A 5/1978 Kofsky et al.
4,167,331 A 9/1979 Nielsen 356/39
4,266,554 A 5/1981 Hamaguri
4,357,105 A 11/1982 Loretz 356/40
4,407,290 A 10/1983 Wilber
4,446,871 A 5/1984 Imura
4,714,341 A 12/1987 Hamaguri et al. 356/41



U.S. PATENT DOCUMENTS

5,355,880	A	10/1994	Thomas et al.	
5,398,680	A	3/1995	Polson et al.	
5,413,100	A	5/1995	Barthelemy et al.	
5,421,329	A	6/1995	Casciani et al.	
5,482,036	A	1/1996	Diab et al.	
5,490,505	A	2/1996	Diab et al.	
5,490,506	A	2/1996	Takatani et al.	
5,494,032	A	* 2/1996	Robinson et al.	600/323
5,517,988	A	5/1996	Gerhard	
5,533,507	A	7/1996	Potratz	
5,632,272	A	5/1997	Diab et al.	
5,645,060	A	7/1997	Yorkey	
5,685,299	A	11/1997	Diab et al.	
5,758,644	A	6/1998	Diab et al.	
5,769,785	A	6/1998	Diab et al.	600/364
5,782,237	A	7/1998	Casciani et al.	
5,823,950	A	10/1998	Diab et al.	600/310
5,842,981	A	12/1998	Larsen et al.	600/323
5,853,364	A	12/1998	Baker, Jr. et al.	600/500
5,919,134	A	7/1999	Diab	600/323
5,995,856	A	11/1999	Mannheimer et al.	600/322
6,011,986	A	1/2000	Diab et al.	600/323
6,031,603	A	2/2000	Fine et al.	356/41
6,036,642	A	3/2000	Diab et al.	600/364
6,067,462	A	5/2000	Diab et al.	600/310
6,081,735	A	6/2000	Diab et al.	600/310
6,083,172	A	7/2000	Baker, Jr. et al.	600/500

OTHER PUBLICATIONS

“*Reflectance Pulse Oximetry—Principles and Obstetric Application in the Zurich System*”; Voker Konig, Renate Huch, and Albert Huch; Perinatal Physiology Research Dept., Dept. of Obstetrics, Computing 14: pp. 403–412, 1998.

“*Effect of location of the sensor on reflectance pulse oximetry*”; A.C. M. Dassel, Research Fellow et al. British Journal of Obstetrics and Gynecology; Aug. 1997, vol. 104, pp. 910–916.

“*Design and Evaluation of a New Reflectance Pulse Oximeter Sensor*”; Y. Mendelson, PhD, et al.; Worcester Polytechnic Institute, Biomedical Engineering Program, Worcester, MA 01609; Association for the Advancement of Medical Instrumentation, vol. 22, No. 4, 1988; pp. 167–173.

“*Skin Reflectance Pulse Oximetry: In Vivo Measurements from the Forearm and Calf*”; Y. Mednelson, PhD and M.J. McGinn, MSc; Dept. of Biomedical Engineering, Worcester Polytechnic Institute, Worcester, MA 01609; Journal of Clinical Monitoring, vol. 7, No. 1, 1991; pp. 7–12.

“*Experimental and Clinical Evaluation of a Noninvasive Reflectance Pulse Oximeter Sensor*”; Setsuo Takatani, PhD, et al.; Dept. of Surgery, Baylor College of Medicine, One Baylor Plaza, Houston, TX 77030; Journal of Clinical Monitoring, vol. 8, No. 4, Oct. 1992; pp. 257–266.

“*Wavelength Selection for Low-Saturation Pulse Oximetry*”; Paul D. Mannheimer, et al.; IEEE Transactions on Biomedical Engineering, vol. 44, No. 3, Mar. 1997; pp. 148–158.

“*Noninvasive Pulse Oximetry Utilizing Skin Reflectance Photoplethysmography*”; Yitzhak Mendelson and Burt D. Ochs; IEEE Transactions on Biomedical Engineering, vol. 35, No. 10, Oct. 1988; pp. 798–805.

“*Physio-optical considerations in the design of fetal pulse oximetry sensors*”; P.D. Mannheimer, M.E. Fein and J.R. Casciani; European Journal of Obstetrics & Gynecology and Reproductive Biology 72 Suppl. 1 (1997) S9–S19.

“*Fetal pulse oximetry: influence of tissue blood content and hemoglobin concentration in a new in-vitro model*”; Thomas Edrich, Gerhard Rall, Reinhold Knitza; European Journal of Obstetrics & Gynecology and Reproductive Biology 72 Suppl. 1 (1997) S29–S34.

* cited by examiner

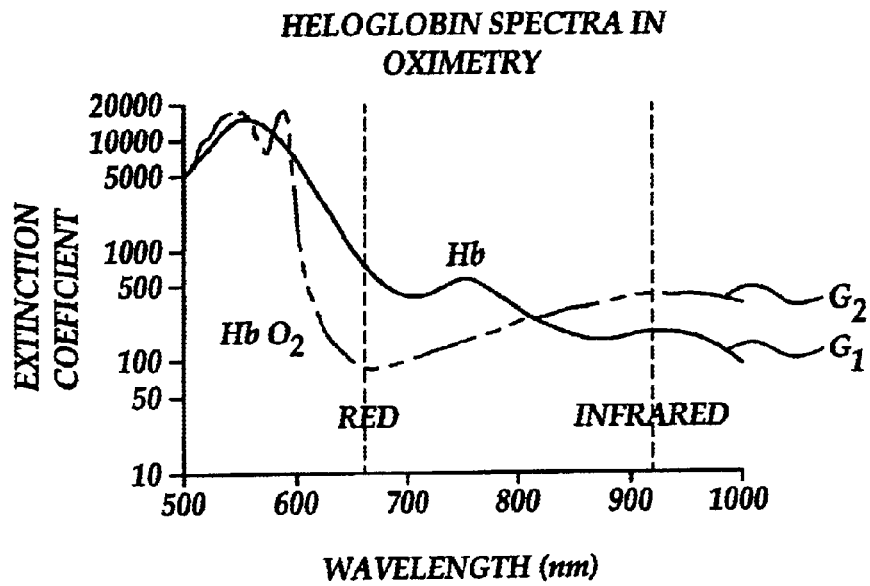


Figure 1

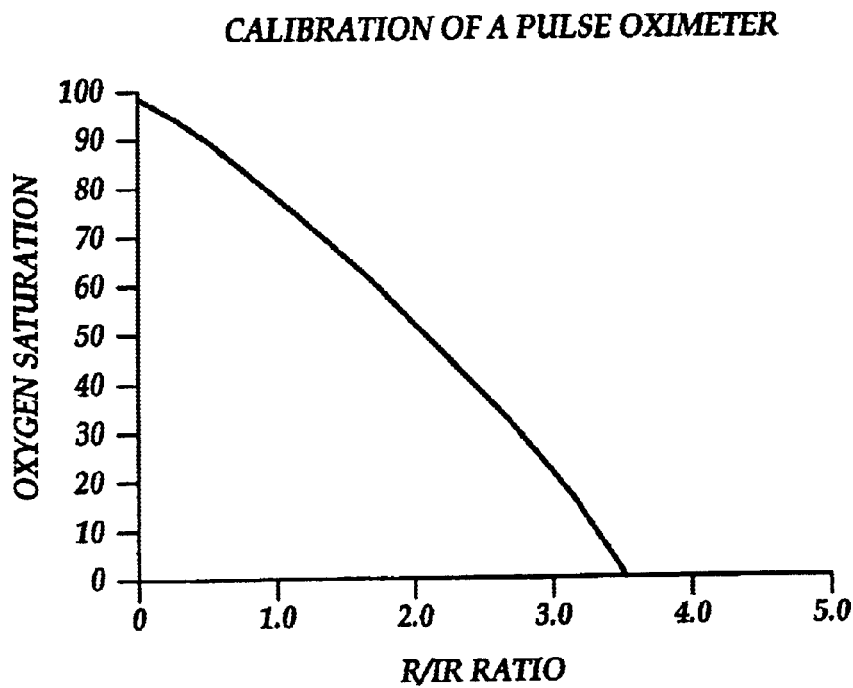


Figure 2

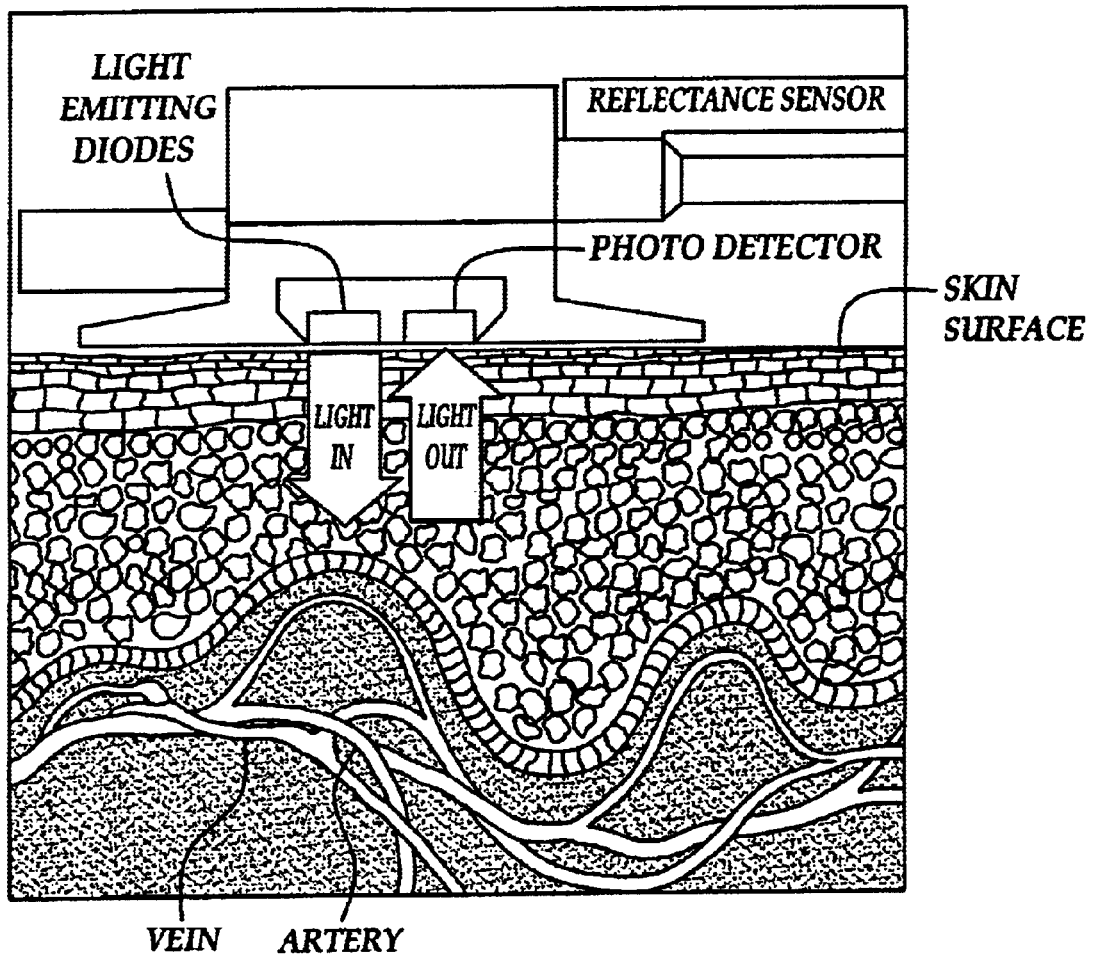


Figure 3

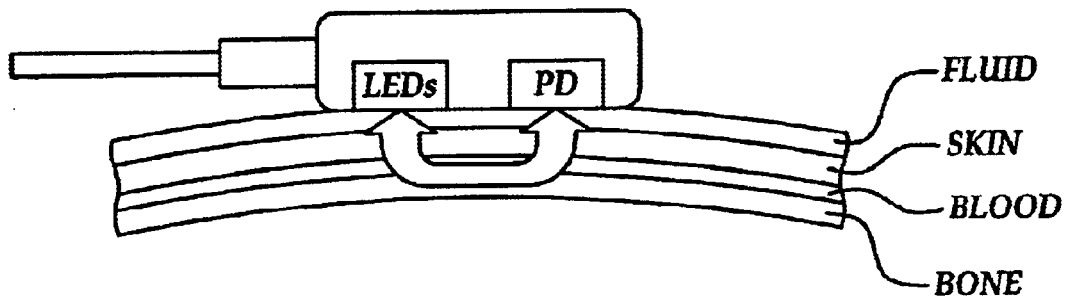


Figure 4

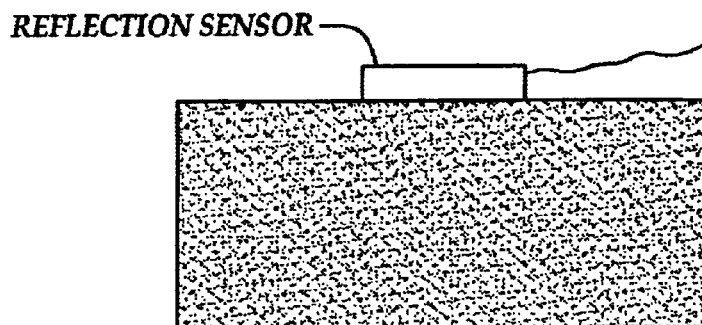


Figure 5A

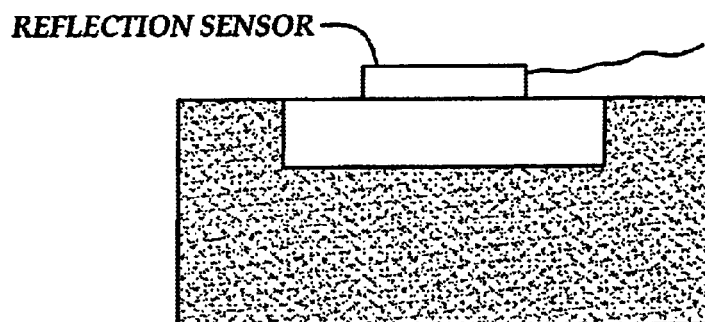


Figure 5B

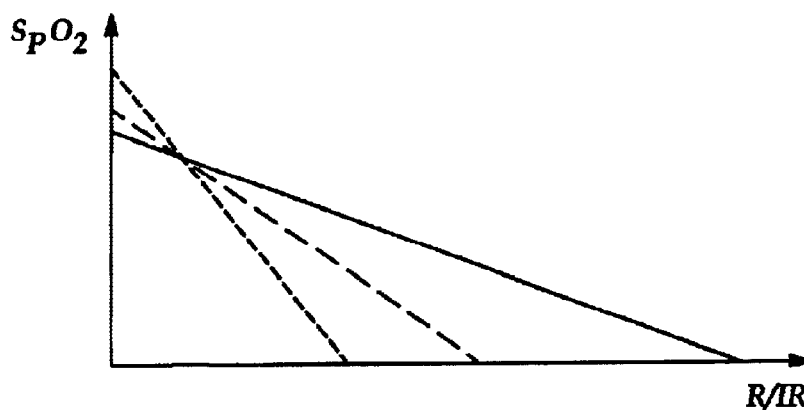


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