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**United States Patent** [19]  
**Scharf**

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- [54] **GREEN LIGHT PULSE OXIMETER**
- [75] Inventor: **John Edward Scharf**, Oldsmar, Fla.
- [73] Assignee: **University of South Florida**, Tampa, Fla.
- [21] Appl. No.: **749,898**
- [22] Filed: **Nov. 18, 1996**
- [51] Int. Cl.<sup>6</sup> ..... **A61B 5/00**
- [52] U.S. Cl. .... **600/323**
- [58] Field of Search ..... 600/310, 322, 600/323, 324, 326, 330, 476; 356/41

[56] **References Cited**

**U.S. PATENT DOCUMENTS**

- 3,802,776 4/1974 Tchang .
- 3,815,583 6/1974 Scheidt .
- 4,109,643 8/1978 Bond et al. .

(List continued on next page.)

**FOREIGN PATENT DOCUMENTS**

- 63-311937 12/1988 Japan .
- 1377605 2/1986 U.S.S.R. .
- 92/07505 1/1990 WIPO .

**OTHER PUBLICATIONS**

“Optimization of Portable Pulse Oximetry Through Fourier Analysis,” John E. Scharf et al., IEEE, Jun. 1993, pp. 233–235, first available on Apr. 2, 1993, at the IEEE, 12th Southern Biomedical Conference at Tulane University, New Orleans, LA, held Apr. 2–4, 1993.  
 “Pulse Oximetry Through Spectral Analysis,” John E. Scharf et al., 1993 IEEE, Jun. 1993, pp. 227–229, first available on Apr. 2, 1993, at the IEEE, 12th Southern Biomedical Conference at Tulane University, New Orleans, LA, held Apr. 2–4, 1993.

“Direct Digital Capture of Pulse Oximetry Waveforms,” John E. Scharf et al., 1993 IEEE, Jun. 1993, pp. 230–232, first available on Apr. 2, 1993, at the IEEE, 12th Southern Biomedical Conference at Tulane University, New Orleans, LA, held Apr. 2–4, 1993.

Light-To-Frequency Converter—TSL220, Texas Instruments Inc., D3619, Aug. 1990, Rev. Jun. 1991.

Programmable Light-To-Frequency Converter—TSL230, Texas Instruments Inc., SOES007A, Dec. 1992, Rev. Dec. 1993.

CMOS—8-Bit Buffered Multiplying DAC—AD7524, Digital-to-Analog Converters, Rev. A, pp. 2–399, 402–403.

Burr-Brown ACF2101 Advertisement and Product Data Sheet (PDS-1079, Mar. 1991).

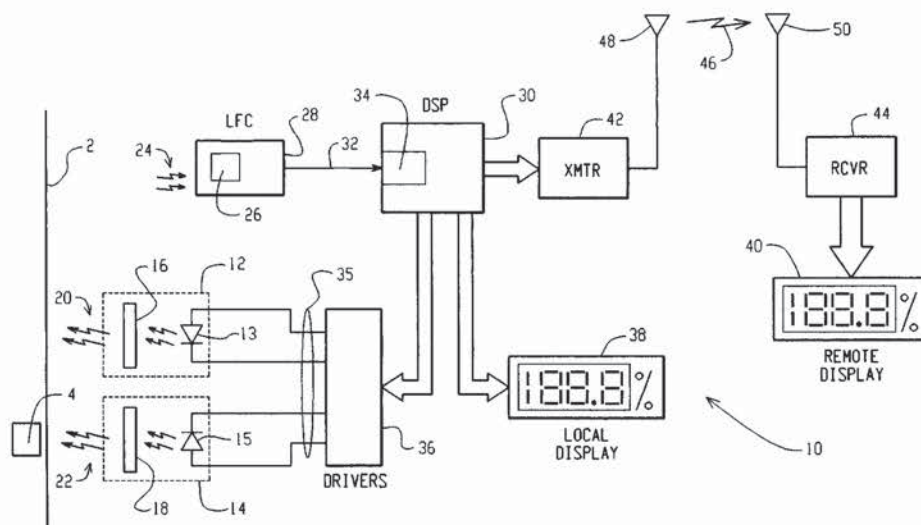
“In Vivo Reflectance of Blood and Tissue as a Function of Light Wavelength”, Cui, et al., IEEE Transactions on Biomedical Engineering, vol. 37, No. 6, pp. 632–639, Jun. 1990.

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[57] **ABSTRACT**

A reflectance pulse oximeter that determines oxygen saturation of hemoglobin using two sources of electromagnetic radiation in the green optical region, which provides the maximum reflectance pulsation spectrum. The use of green light allows placement of an oximetry probe at central body sites (e.g., wrist, thigh, abdomen, forehead, scalp, and back). Preferably, the two green light sources alternately emit light at 560 nm and 577 nm, respectively, which gives the biggest difference in hemoglobin extinction coefficients between deoxyhemoglobin, RHB, and oxyhemoglobin, HbO<sub>2</sub>.

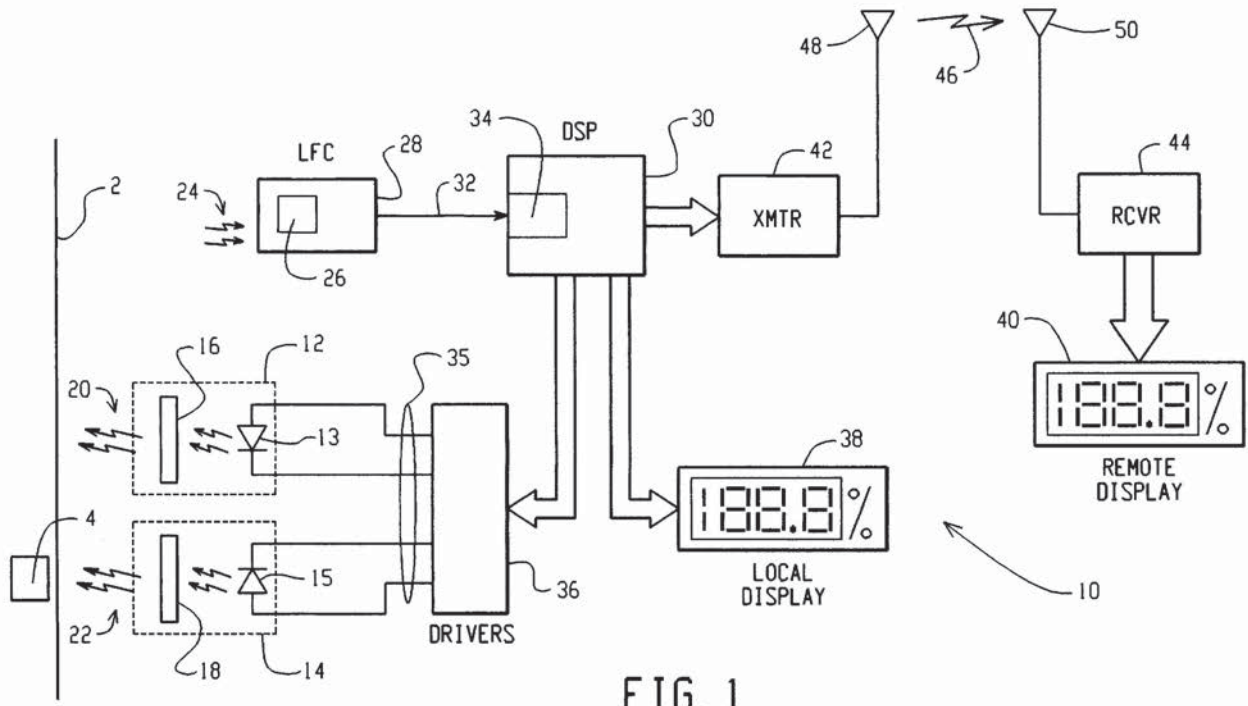
**41 Claims, 7 Drawing Sheets**



APL\_MAS\_ITC\_00023168  
RX-0335.0001

## U.S. PATENT DOCUMENTS

4,167,331	9/1979	Nielsen .	4,934,372	6/1990	Corenman et al. .
4,266,554	5/1981	Hamaguri .	4,997,769	3/1991	Lundsgaard .
4,267,844	5/1981	Yamanishi .	5,040,539	8/1991	Schmitt et al. .
4,357,105	11/1982	Loretz .	5,047,208	9/1991	Schweitzer et al. .
4,407,290	10/1983	Wilber .	5,078,136	1/1992	Stone et al. .
4,447,150	5/1984	Heinemann .	5,111,817	5/1992	Clark et al. .
4,498,020	2/1985	Gloima et al. .	5,113,861	5/1992	Rother .
4,586,513	5/1986	Hamaguri .	5,149,503	9/1992	Kohno et al. .
4,694,833	9/1987	Hamaguri .	5,167,230	12/1992	Chance .
4,800,495	1/1989	Smith .	5,190,038	3/1993	Polson .
4,807,630	2/1989	Malinouskas .	5,299,570	4/1994	Hatschek .
4,807,631	2/1989	Hersh et al. .	5,308,919	5/1994	Minnich .
4,824,242	4/1989	Frick et al. .	5,365,924	11/1994	Erdman .
4,869,254	9/1989	Stone et al. .	5,512,940	4/1996	Takasugi et al. .... 348/71
4,883,353	11/1989	Hausman et al. .	5,524,617	6/1996	Mannheimer .
4,911,167	3/1990	Corenman et al. .	5,575,284	11/1996	Athan et al. .



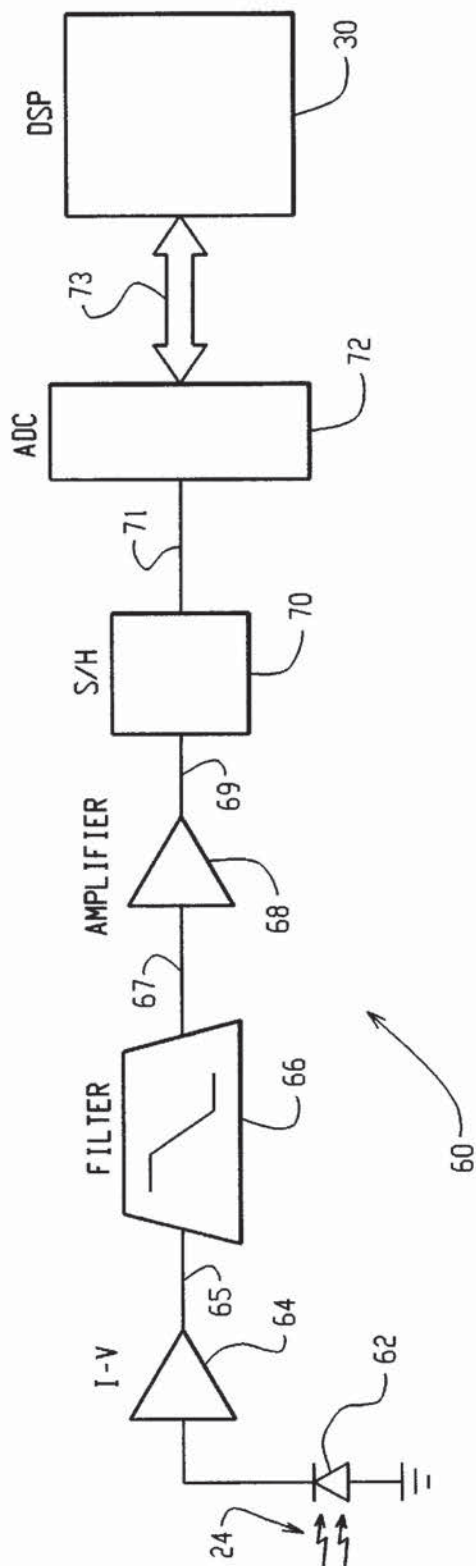


FIG. 2

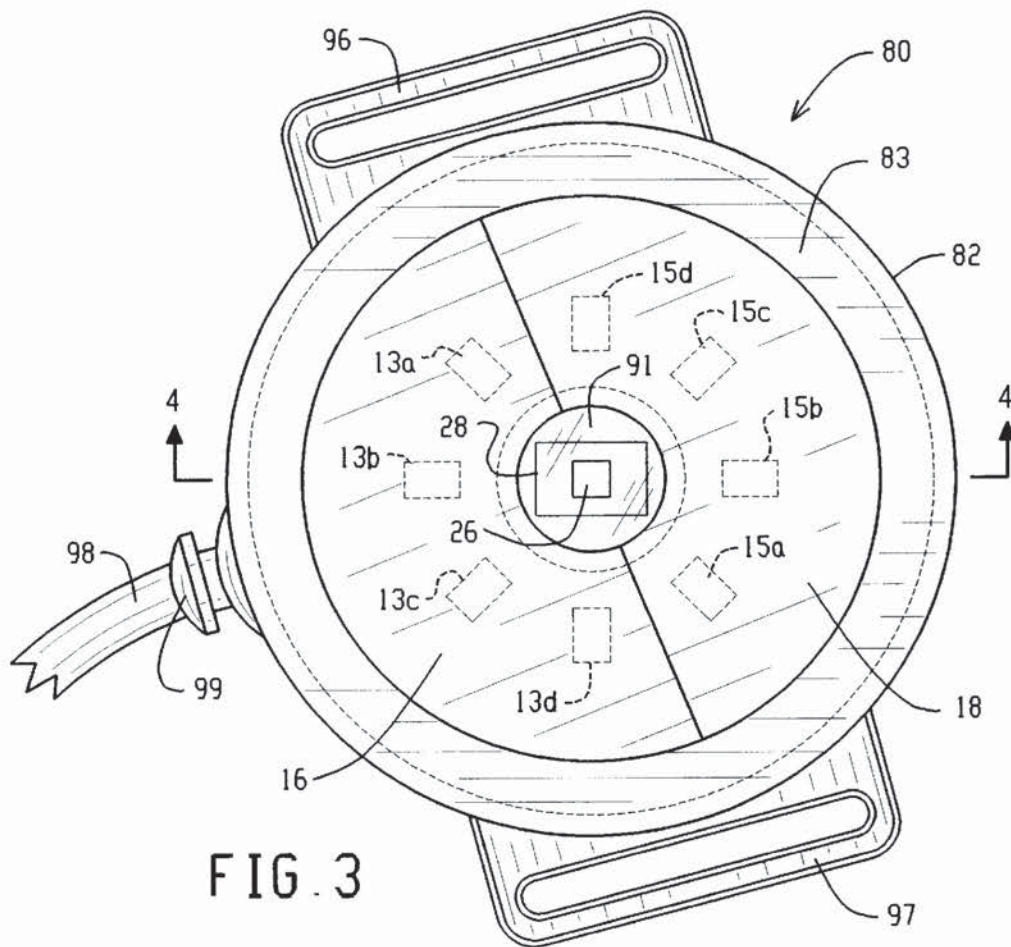


FIG. 3

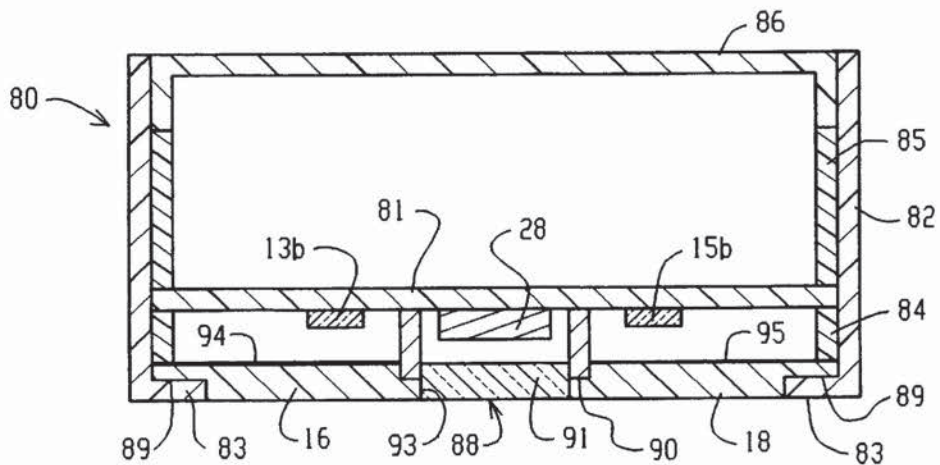


FIG. 4

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