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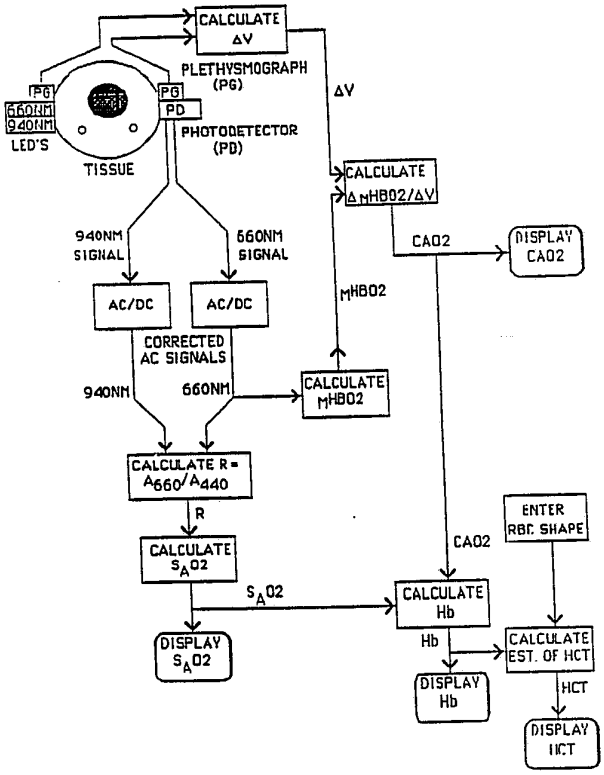
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
23 August 1990 (23.08.90)

(54) Title: METHOD FOR NONINVASIVE INTERMITTENT AND/OR CONTINUOUS HEMOGLOBIN, ARTERIAL OXYGEN CONTENT, AND HEMATOCRIT DETERMINATION

(57) Abstract

Described here are a novel means and device for noninvasively quantifying important blood constituents. Total hemoglobin, arterial oxygen content, hematocrit, and other parameters can all be determined quickly and easily without the need for skin puncture or lengthy laboratory analysis. The invention described here concerns the simultaneous measurement of volume changes and changes in the mass of either oxyhemoglobin, total hemoglobin, or reduced hemoglobin. The data obtained by these measurements is used to quantity the parameters of interest.



SCHEMATIC OF INVENTION INCORPORATED INTO A PULSE OXIMETER

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US 89/04846

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: A 61 B 5/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	A 61 B, G 01 N

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	Proceedings of the IEEE Seventh Annual Conference of the Engineering in Medicine and Biology Society, 27-30 September 1985, volume 1, IEEE, (US), T.M. Donahoe et al.: "A new noninvasive backscattering oximeter", pages 144-147 see the whole article	1,26
A	--	2-4,9,10,12-14,21,22,27-29,34,35,37,44,45
Y	Hewlett-Packard Journal, volume 28, no. 2, October 1976, (Palo Alto, US), E.B. Merrick et al.: "Continuous, non-invasive measurements of arterial blood oxygen levels", pages 2-9 see page 5, sectin: "Design details" - page 8, section: "The baseline" ./.	1,26

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
26th March 1990	03. 07. 90
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	MISS T. TAZELAAR

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	--	2-4,9,21,22, 27-29,34,44,
Y	US, A, 4167331 (NIELSEN) 11 September 1979 see figures 1-4; column 3, line 34 - column 12, line 34	1,26
A	--	2-4,9,10,12, 13,21-24,27-29,34,35,44-47
A	IEEE Transactions on Biomedical Engineering,volume 35, no. 3, March 1988, IEEE, (New York, US), S. Takatani et al.: "A miniature hybrid reflection type optical sensor for measurement of Hemoglobin content and oxygen saturation of whole blood", pages 187-198 see page 187, "Introduction" - page 192, section "B. Data Processing System"	1-4,9,10,22, 23,26-29,34, 35,46
A	--	
A	US, A, 4506626 (SCHURMAN) 26 March 1985 see figures 1-10; column 5, line 24 - column 10, line 35	1-5,8,9,21-24,26-29,33, 34,44,46,47
A	--	
A	GB, A, 2197499 (HAMAMATSU PHOTONICS K.K.) 18 May 1988 see figure 3; page 1, line 111 - page 3, line 83	3-8,28-33
A	--	
A	US, A, 4524777 (KISIOKA et al.) 25 June 1985 see figure 1; column 2, line 67 - column 6, line 5	16,39
A	--	
A	DE, B, 1076323 (FIGAR) 25 February 1960	19,20,42,43

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers....., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-24,26-47

2. Claim 25

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

1-24, 26-47

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 8904846 SA 32938

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 22/06/90
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4167331	11-09-79	DE-A- 2756462 JP-A,B,C53088778	22-06-78 04-08-78
US-A- 4506626	26-03-85	None	
GB-A- 2197499	18-05-88	JP-A- 63053443 US-A- 4920386	07-03-88 24-04-90
US-A- 4524777	25-06-85	JP-A- 59156325	05-09-84
DE-B- 1076323		None	