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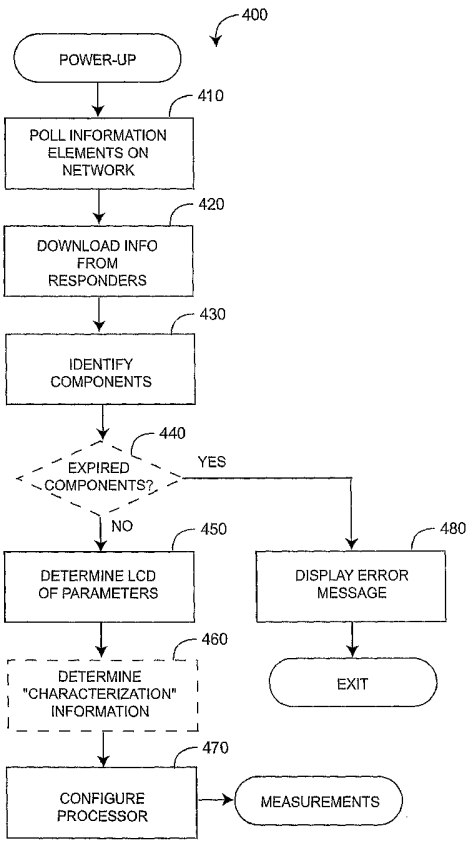
[Continued on next page]

(54) Title: CONFIGURABLE PHYSIOLOGICAL MEASUREMENT SYSTEM



(57) Abstract: A physiological measurement system has a sensor, a processor, a communications link and information elements. The sensor is configured to transmit light having a plurality of wavelengths into a tissue site and to generate a sensor signal responsive to the transmitted light after tissue attenuation. The processor is configured to operate on the sensor signal so as to derive at least one physiological parameter. The communications link is adapted to provide communications between the sensor and the processor. The information elements are distributed across at least one of the sensor, the processor and the communications link and provide operational information corresponding to at least one of the sensor, the processor and the communications link.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CONFIGURABLE PHYSIOLOGICAL MEASUREMENT SYSTEM

PRIORITY CLAIM TO RELATED PROVISIONAL APPLICATIONS

[0001] The present application claims priority benefit under 35 U.S.C. § 119(e) to U.S. Provisional Patent Application Serial No. 60/657,596, filed March 1, 2005, entitled "*Multiple Wavelength Sensor,*" No. 60/657,281, filed March 1, 2005, entitled "*Physiological Parameter Confidence Measure,*" No. 60/657,268, filed March 1, 2005, entitled "*Configurable Physiological Measurement System,*" and No. 60/657,759, filed March 1, 2005, entitled "*Noninvasive Multi-Parameter Patient Monitor.*" The present application incorporates the foregoing disclosures herein by reference.

INCORPORATION BY REFERENCE OF COPENDING RELATED APPLICATIONS

[0002] The present application is related to the following copending U.S. utility applications:

	App. Sr. No.	Filing Date	Title	Atty Dock.
1	11/###,###	March 1, 2006	Multiple Wavelength Sensor Emitters	MLR.002A
2	11/###,###	March 1, 2006	Multiple Wavelength Sensor Equalization	MLR.003A
3	11/###,###	March 1, 2006	Multiple Wavelength Sensor Substrate	MLR.004A
4	11/###,###	March 1, 2006	Multiple Wavelength Sensor Interconnect	MLR.005A
5	11/###,###	March 1, 2006	Multiple Wavelength Sensor Attachment	MLR.006A
6	11/###,###	March 1, 2006	Multiple Wavelength Sensor Drivers	MLR.009A
7	11/###,###	March 1, 2006	Physiological Parameter Confidence Measure	MLR.010A
8	11/###,###	March 1, 2006	Configurable Physiological Measurement System	MLR.011A
9	11/###,###	March 1, 2006	Noninvasive Multi-Parameter Patient Monitor	MLR.012A
10	11/###,###	March 1, 2006	Noninvasive Multi-Parameter Patient Monitor	MLR.013A
11	11/###,###	March 1, 2006	Noninvasive Multi-Parameter Patient Monitor	MLR.014A

The present application incorporates the foregoing disclosures herein by reference.

BACKGROUND OF THE INVENTION

[0003] Spectroscopy is a common technique for measuring the concentration of organic and some inorganic constituents of a solution. The theoretical basis of this technique is the Beer-Lambert law, which states that the concentration c_i of an absorbent in solution can be determined by the intensity of light transmitted through the solution, knowing the pathlength d_λ, the intensity of the incident light $I_{0,\lambda}$, and the extinction coefficient $\varepsilon_{i,\lambda}$ at a particular wavelength λ. In generalized form, the Beer-Lambert law is expressed as:

$$I_\lambda = I_{0,\lambda} e^{-d_\lambda \cdot \mu_{a,\lambda}} \quad (1)$$

$$\mu_{a,\lambda} = \sum_{i=1}^{n} \varepsilon_{i,\lambda} \cdot c_i \quad (2)$$

where $\mu_{a,\lambda}$ is the bulk absorption coefficient and represents the probability of absorption per unit length. The minimum number of discrete wavelengths that are required to solve EQS. **1-2** are the number of significant absorbers that are present in the solution.

[0004] A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure oxygen saturation (SpO_2) and pulse rate. In general, the sensor has light emitting diodes (LEDs) that transmit optical radiation of red and infrared wavelengths into a tissue site and a detector that responds to the intensity of the optical radiation after absorption (e.g., by transmission or transreflectance) by pulsatile arterial blood flowing within the tissue site. Based on this response, a processor determines measurements for SpO_2, pulse rate, and can output representative plethysmographic waveforms. Thus, "pulse oximetry" as used herein encompasses its broad ordinary meaning known to one of skill in the art, which includes at least those noninvasive procedures for measuring parameters of circulating blood through spectroscopy. Moreover, "plethysmograph" as used herein (commonly referred to as "photoplethysmograph"), encompasses its broad ordinary meaning known to one of skill in the art, which includes at least data representative of a change in the absorption of particular wavelengths of light as a function of the changes in body

tissue resulting from pulsing blood. Pulse oximeters capable of reading through motion induced noise are available from Masimo Corporation ("Masimo") of Irvine, California. Moreover, portable and other oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,157,850, 6,002,952 5,769,785, and 5,758,644, which are owned by Masimo and are incorporated by reference herein. Such reading through motion oximeters have gained rapid acceptance in a wide variety of medical applications, including surgical wards, intensive care and neonatal units, general wards, home care, physical training, and virtually all types of monitoring scenarios.

SUMMARY OF THE INVENTION

[0005] A physiological measurement system has a sensor that transmits optical radiation at a multiplicity of wavelengths other than or including the red and infrared wavelengths utilized in pulse oximeters. The system also has a processor that determines the relative concentrations of blood constituents other than or in addition to HbO_2 and Hb, such as carboxyhemoglobin (HbCO), methemoglobin (MetHb), fractional oxygen saturation, total hemaglobin (Hbt) and blood glucose to name a few. Further, such a system may be combined with other physiological parameters such as noninvasive blood pressure (NIBP). There is a need to easily configure such a physiological measurement system from compatible components capable of measuring various physiological parameters.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a general block diagram of a configurable physiological measurement system;

[0007] FIG. **2** is a detailed block diagram of a configurable physiological measurement system embodiment;

[0008] FIG. **3** is a detailed block diagram of networked information elements in a configurable physiological measurement system;

[0009] FIG. **4** is a flowchart of a physiological measurement system configuration process; and

[0010] FIGS. **5A-B** are block diagrams illustrating forward and backward sensor compatibility with various processors.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] In this application, reference is made to many blood parameters. Some references that have common shorthand designations are referenced through such shorthand designations. For example, as used herein, HbCO designates carboxyhemoglobin, HbMet designates methemoglobin, and Hbt designates total hemoglobin. Other shorthand designations such as COHb, MetHb, and tHb are also common in the art for these same constituents. These constituents are generally reported in terms of a percentage, often referred to as saturation, relative concentration or fractional saturation. Total hemoglobin is generally reported as a concentration in g/dL. The use of the particular shorthand designators presented in this application does not restrict the term to any particular manner in which the designated constituent is reported.

[0012] FIG. **1** illustrates a configurable physiological measurement system **100** having a processor **110**, a sensor **120** and a communications link **130**. In one embodiment, the sensor **120** has two or more light emitters that transmit optical radiation of two or more wavelengths into a tissue site and at least one detector that generates a signal responsive to the optical radiation after attenuation by the tissue site. Multiple wavelength sensors are described in U.S. Pat. App. No. 10/719,928, entitled *Blood Parameter Measurement System*, assigned to Masimo Corporation, Irvine, CA and incorporated by reference herein.

[0013] The processor **110** generates drive signals so as to activate the sensor emitters and inputs and processes the corresponding detector signal so as determine the relative concentrations of two or more blood constituents. The communications link **130** provides communications between the processor **110** and sensor **120** including transmitting the drive signals from the processor **110** to the sensor **120** and the detector signals from the sensor **120** to the processor **110**. In one embodiment, the communications link **130** is a cable and corresponding sensor and processor connectors that provide a wired connection between the processor **110** and connector **120**. In another embodiment, the communications link **130** provides a wireless connection between the processor

110 and connector **120**. The wireless connection may utilize Bluetooth®, IEEE 802.11 or similar wireless technologies.

[0014] As shown in FIG. **1**, the configurable physiological measurement system **100** also has information elements **112**, **122**, **132** distributed across the processor **110**, the sensor **120** and the communications link **130**, which provide system configuration information, as described below. The information elements **112**, **122**, **132** may be memory devices, such as described below, or other active or passive electrical components. The information provided by the information elements **112**, **122**, **132** may be digital data stored in memory or component values determined by DC, AC or combinations of DC and AC voltages or currents. The information element **112**, **122**, **132** information may be determined by the processor **110** or by a reader or other device in communication with the information elements **112**, **122**, **132** and the processor **110**.

[0015] FIG. **2** illustrates configurable physiological measurement system embodiments having processor **210**, sensor **220** and cable **230** components. In one embodiment, the processor **210** has a processor printed circuit board "board" **212** and an optional daughter board **214**, which plugs into and expands the functionality of the processor board **212**. For example, the daughter board **214** may be a noninvasive blood pressure (NIBP) controller that communicates with a blood pressure sensor and the processor board **212** so as to measure blood pressure parameters.

[0016] Also shown in FIG. **2**, in one embodiment the sensor **220** is a "resposable" sensor comprising a reusable portion **222** and a disposable portion **224**. In a particular embodiment, the reusable portion has at least one of a reusable emitter portion and a reusable detector portion, and the disposable portion **224** has at least one of a disposable emitter portion, a disposable detector portion and a disposable tape for attaching the reusable sensor **222** to a tissue site. A resposable sensor is described in U.S. Pat. No. 6,725,075 entitled *Resposable Pulse Oximetry Sensor*, assigned to Masimo Corporation and incorporated by reference herein.

[0017] Further shown in FIG. **2**, in one embodiment the cable **230** is a patient cable **232** or a sensor cable **234** or a combination of a patient cable **232** and a sensor cable **234**. A sensor cable **234** is fixedly attached at one end to a sensor

and has a connector at the other end for attaching to a monitor or a patient cable. A patient cable **234** has connectors at both ends for interconnecting a sensor or sensor cable to a monitor.

[0018] FIG. **3** illustrates an information element (IE) network **300** that advantageously enables a physiological measurement system **200** (FIG. **2**) to be composed of various components **214-234** (FIG. **2**) having, perhaps, differing parameter measurement capabilities, as described above. The IE network **300** also allows various components to "plug and play," i.e. interoperate without hardware or software modification, as described with respect to FIG. **4**, below. Further, the IE network **300** provides for forward and backward compatibility between sensors and processors, as described with respect to FIGS. **5A-B**, below.

[0019] As shown in FIG. **3**, the IE network **300** has information elements **314-334**, a network controller **301** and a communications path **305**. In one embodiment, the network controller **301** resides on or is otherwise incorporated within a processor board **212** (FIG. **2**). The information elements **314-334** correspond to the physiological measurement system components **210-230** (FIG. **2**). In one embodiment, there may be zero, one, two or more information elements **314-334** on or within each physiological measurement system component **214-224** (FIG. **2**). For example, the information elements **314-324** may include a DB element **314** mounted on a daughter board **214** (FIG. **2**), a RS element **322** mounted within a reusable sensor portion **222** (FIG. **2**), a DS element **324** mounted within a disposable sensor portion **224** (FIG. **2**), a PC element **332** mounted within a patient cable **232** (FIG. **2**) or connector thereof, and a SC element **334** mounted within a sensor cable **234** (FIG. **2**) or connector thereof.

[0020] Also shown in FIG. **3**, in one embodiment the information elements **314-334** are EPROMs or EEPROMs or a combination of EPROMs or EEPROMs within a particular component **210-230** (FIG. **2**). In an advantageous embodiment, the communications path **305** is a single shared wire. This reduces the burden on the components **210-230** (FIG. **2**) and associated connectors, which may have a relatively large number of conductors just for drive signals and detector signals when a multiplicity of sensor emitters are utilized for multiple

parameter measurements. An information element **314-324** may be, for example, a Dallas Semiconductor DS2506 EPROM available from Maxim Integrated Products, Inc., Sunnyvale, CA, or equivalent.

[0021] FIG. **4** illustrates a configuration process **400** for a physiological measurement system **200** (FIG. **2**). This process is executed by the network controller **301** (FIG. **3**) or the processor **210** (FIG. **2**) or both with respect to information elements **314-334** (FIG. **3**) that exist on the network **305** (FIG. **3**). After system power-up, any information elements on the network are polled **410** so they identify themselves. Information is then downloaded from the responding information elements **420**. In one embodiment, download information can be some or all of *Identification* (*ID*), *Life*, *Parameters*, *Characterization* and *Features* information. *ID* identifies a component on the network, either the type of component generally, such as a sensor or cable, or a particular part number, model and serial number, to name a few. As another example, *ID* for a disposable sensor portion **224** (FIG. **2**) may be an attachment location on a patient and ID for a reusable sensor portion **222** (FIG. **2**) may be a patient type.

[0022] *Life*, for example, may be a predetermined counter written into an EEPROM to indicate the number of uses or the length of use of a particular component. Then, *Life* is counted down, say each time power is applied, until a zero value is reached, indicating component expiration.

[0023] *Parameters* specifies the measurements the component is capable of supporting, which may include, for example, one or more of SpO_2, HbCO, MetHb, fractional SpO_2, Hbt, NIBP and blood glucose to name just a few. With respect to a sensor, *Parameters* depend on the number of emitters, emitter wavelength and emitter configuration, for example. For a cable, *Parameters* depend on the number of conductors and connector pinouts, for example. *Parameters* may also simply reflect a license to use a component, such as disposable tape, with respect to a particular system configuration.

[0024] *Features* set the mode for the processor or other system elements. As one example, *Features* specify the mode or modes of one or more algorithms, such as averaging.

[0025] *Characterization* allows the processor to "plug and play" with a particular component. For example, if the component is a sensor,

Characterization may include information necessary to drive the emitters, such as the LED wavelengths and drive pattern. *Characterization* may also include calibration data for the parameters measured. As another example, *Characterization* for a sensor component **220** (FIG. **2**) may indicate sensitivity to a probe-off condition depending on the sensor type. Probe-off detection is described in U.S. Pat. No. 6,654,624 entitled *Pulse Oximeter Probe-Off Detector* and U.S. Pat. No. 6,771,994 entitled *Pulse Oximeter Probe-Off Detection System*, both assigned to Masimo Corporation and incorporated by reference herein.

[0026] As shown in FIG. **4**, components are identified **430** from downloaded *ID* information. If any of the information elements provide *Life* information, a check is made to determine if the corresponding component is expired **440**. If so, an error message is displayed **480**. The message may be a warning to replace the component or it may indicate that the system is nonfunctional. Next, the least common denominator (LCD) of the parameters is determined **450** from the *Parameters* information. This is described in further detail with respect to FIGS. **5A-B**. *Characterization* is determined **460**, if necessary for a particular component, such as a daughterboard or sensor. Finally, the processor is configured **470** and the system is ready to begin parameter measurements.

[0027] FIGS. **5A-B** illustrate embodiments of a configurable physiological measurement system **100** demonstrating both forward sensor compatibility (FIG. **5A**), and backward sensor compatibility (FIG. **5B**). Further, the parameter measurement capability of each system **100** is determined by the least common denominator (LCD) of the parameter capabilities of a processor **210** and a sensor **220**.

[0028] As shown in FIG. **5A**, configurable physiological measurement systems **200** comprise a family of processors (P0, P1, P2) **210** including those capable of computing SpO_2 **510-530**, HbCO **520-530** and MetHb **530**. The systems **200** also comprise a family of sensors **220** (S0, S1, S2) including those capable of detecting SpO_2 **550-570**, HbCO **560-570** and MetHb **570**. Here, the lower numbered processors and sensors represent less capability, e.g. older generation processors and sensors or current generation, but less costly processors and sensors. Illustrated is forward sensor compatibility, i.e. less

capable sensors are capable of running on more capable processors. For example, an SpO_2 only sensor **550** is capable of working with a multiple parameter (SpO_2, HbCO, MetHb) processor **530**. Also illustrated is LCD functionality. A system **200** having a P2 processor **530** and a S0 sensor **550** is functional but only capable of measuring SpO_2.

[0029] FIG. **5B** illustrates backward sensor compatibility, i.e. more capable sensors are capable of running on less capable processors. For example, a multiple parameter (SpO_2, HbCO, MetHb) sensor **570** is capable of working with an SpO_2 only processor **510**. Also, a system **200** having a P0 processor **510** and a S2 sensor **570** is functional, but only capable of measuring SpO_2.

[0030] Forward and backward sensor compatibility is described above with respect to configurable physiological measurement systems **200** having various processor **210** capabilities and sensor **220** capabilities. The configurable physiological measurement systems **200** can have any or all of the processor **210**, sensor **220** and cable **230** components described with respect to FIG. **2**, above. As such forward and backward compatibility is equally applicable to combinations of processor **210** and cable **230** or combinations of sensor **220** and cable **230**, including the components of such described with respect to FIG. **2**, where the capability of such combinations is determined by LCD functionality, as described above.

[0031] A configurable physiological measurement system has been disclosed in detail in connection with various embodiments. These embodiments are disclosed by way of examples only and are not to limit the scope of the claims that follow. One of ordinary skill in the art will appreciate many variations and modifications.

WHAT IS CLAIMED IS:

1. A physiological measurement system comprising:

a sensor configured to transmit light having a plurality of wavelengths into a tissue site and to generate a sensor signal responsive to the transmitted light after tissue attenuation;

a processor configured to operate on the sensor signal so as to derive at least one physiological parameter;

a communications link adapted to provide communications between the sensor and the processor; and

a plurality of information elements distributed across at least one of the sensor, the processor and the communications link,

wherein the information elements provide operational information corresponding to at least one of the sensor, the processor and the communications link.

2. The physiological measurement system according to claim 1 further comprising a network controller capable of reading the information elements and providing the information to the processor.

3. The physiological measurement system according to claim 2 wherein the operational information is the least common denominator of the parameter measurement capability of the sensor, the processor and communications link.

4. The physiological measurement system according to claim 3 wherein the sensor comprises a reusable portion and a disposable portion, each having at least one of the information elements.

5. The physiological measurement system according to claim 4 wherein the processor comprises a processor board and a daughter board, each having at least one of the information elements.

6. The physiological measurement system according to claim 5 wherein the communications link is a cable having a patient cable portion and a sensor cable portion, each portion having at least one of the information elements.

7. The physiological measurement system according to claim 4 further comprising:

attachment data provided by a first information element associated with the disposable portion describing where the sensor is attached; and

patient data provided by a second information element associated with the reusable portion describing patient type.

8. The physiological measurement system according to claim 3 further comprising:

at least one sensor information element associated with the sensor;

sensor type data readable from the sensor information element,

wherein the processor utilizes the sensor type data to determine a sensitivity to a probe-off condition where the sensor is not properly positioned with respect to the tissue site.

9. In a physiological measurement system, a sensor configured to transmit light having a plurality of wavelengths into a tissue site and to generate a sensor signal responsive to the transmitted light after tissue attenuation, a processor configured to operate on the sensor signal so as to derive at least one physiological parameter and a communications link adapted to provide communications between the sensor and the processor, the sensor comprising:

a disposable portion of the sensor having a first information element; and

a reusable portion of the sensor having a second information element,

wherein the disposable portion is capable of removable attachment to the reusable portion, and

wherein the first information element and the second information are readable by the processor so as to determine the operational capability of the sensor.

10. The sensor according to claim 9 further comprising parameter information associated with at least one of the first information element and the second information element indicating physiological parameter measurements supported by at least one of the disposable portion, the reusable portion and the combination of the disposable portion and the reusable portion.

11. The sensor according to claim 10 wherein the parameter information comprises information relating to characteristics of light emitters incorporated on at least one of the disposable portion and the reusable portion.

12. The sensor according to claim 9 further comprising:

attachment information associated with the first information element describing where on a patient the sensor is attached; and

patient information associated with the second information element describing a patient type.

13. The sensor according to claim 9 further comprising sensor life information associated with the first information element that is updated according to a sensor usage measure.

14. The sensor according to claim 9 further comprising characterization information associated with at least one of the first information element and the second information element indicating at least one of light emitter wavelengths, light emitter drive requirements and calibration data.

15. A physiological measurement method for a system having a sensor configured to transmit light having a plurality of wavelengths into a tissue site, a processor configured to operate on a sensor signal responsive to the transmitted light after tissue attenuation and a communications link configured to provide communications between the sensor and the processor comprising the steps of:

reading a plurality of information elements distributed among at least one of the sensor, the processor and the communications link;

determining a physiological parameter that the system is capable of measuring; and

configuring the processor to measure the physiological parameter.

16. The physiological measurement method according to claim 15 comprising the further step of identifying components of the system based upon data read from the information elements.

17. The physiological measurement method according to claim 16 wherein the determining a physiological parameter step comprises the substep of finding a least common denominator of parameter measurement capabilities of the identified system components.

18. The physiological measurement method according to claim 17 comprising the further step of characterizing at least one of the system components based upon data read from the information elements.

19. The physiological measurement method according to claim 18 comprising the further step of determining if any of the system components are expired.

20. The physiological measurement method according to claim 19 wherein the reading step comprises the substeps of:

polling memory devices connected to a network; and

downloading information from responding memory devices.

21. A physiological measurement system having sensor, communication and processor components configured to derive at least one physiological parameter based upon light having a plurality of wavelengths transmitted into a tissue site and detected after tissue attenuation, the physiological measurement system comprising an information element network means for allowing various configurations of the components to interoperate without modification.

22. The physiological measurement system according to claim 21 wherein the information element network means comprises a network controller means for reading data from individual information elements of the network.

23. The physiological measurement system according to claim 22 wherein the network controller means comprises a parameter means for determining the parameter measurement capability of the combined system components.

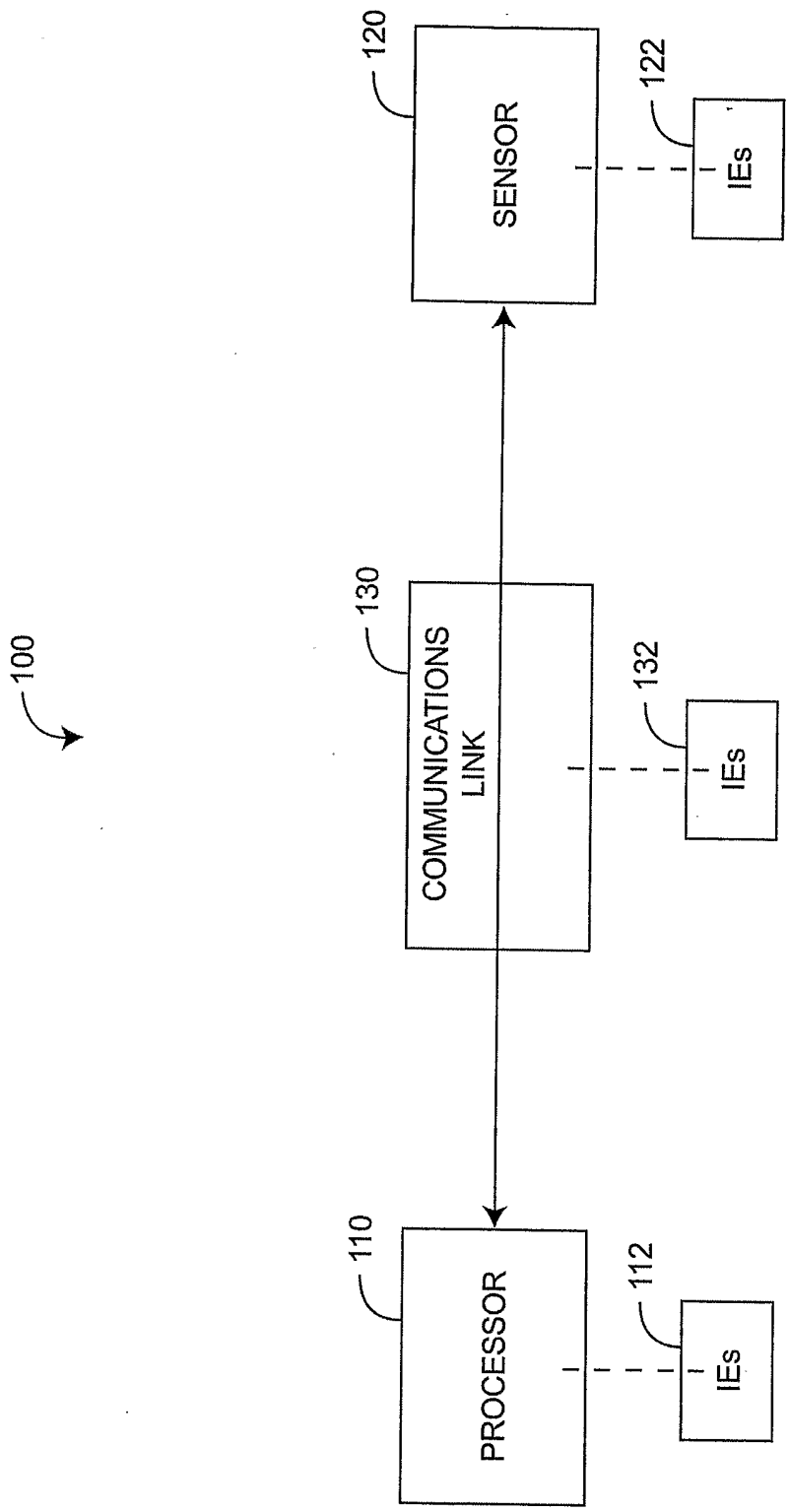
100
120
SENSOR
122
IEs
130
COMMUNICATIONS LINK
132
IEs
110
PROCESSOR
112
IEs

FIG. 1

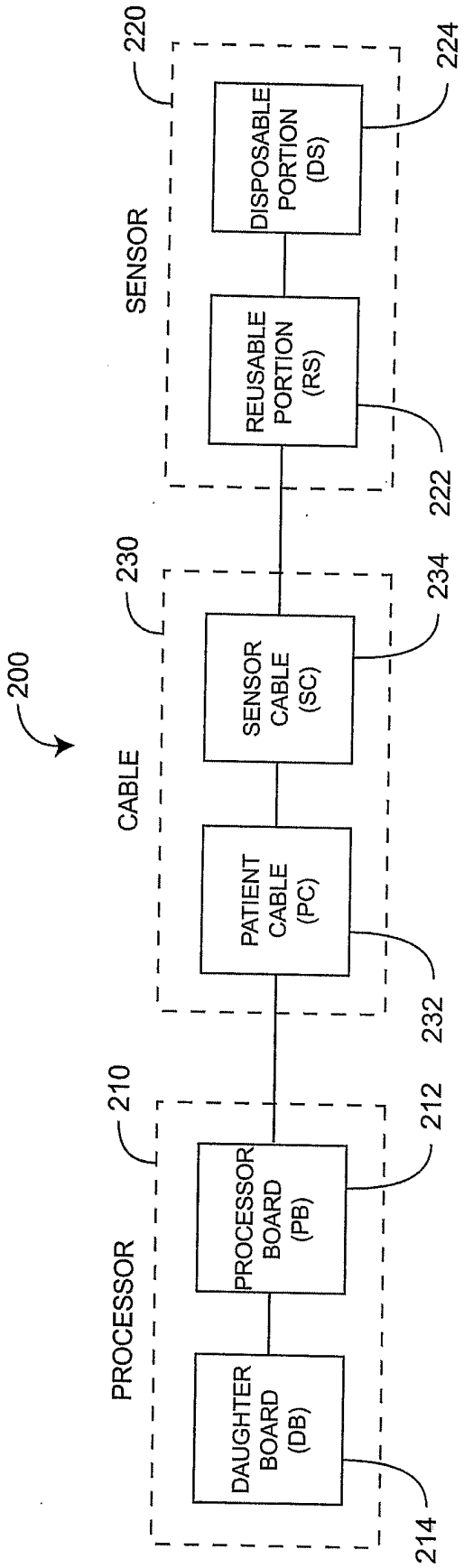
200
PROCESSOR
210
DAUGHTER BOARD (DB)
214
PROCESSOR BOARD (PB)
212
CABLE
230
PATIENT CABLE (PC)
232
SENSOR CABLE (SC)
234
SENSOR
220
REUSABLE PORTION (RS)
222
DISPOSABLE PORTION (DS)
224

FIG. 2

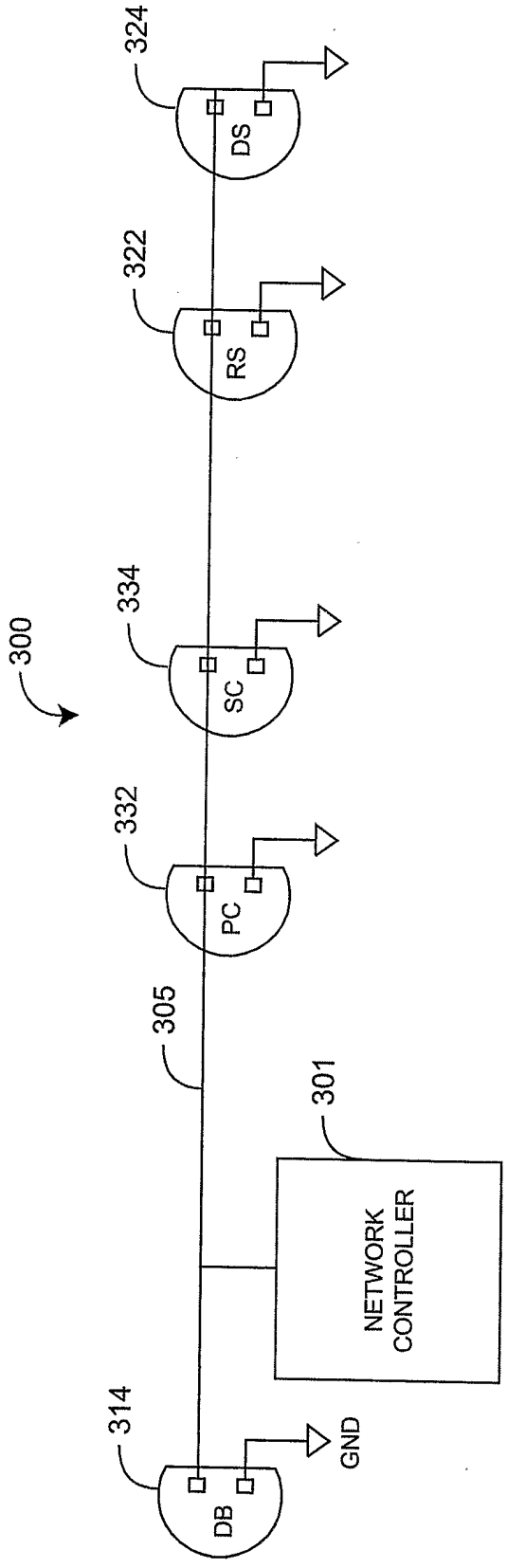
300
DB
314
GND
305
NETWORK CONTROLLER
301
PC
332
SC
334
RS
322
DS
324

FIG. 3

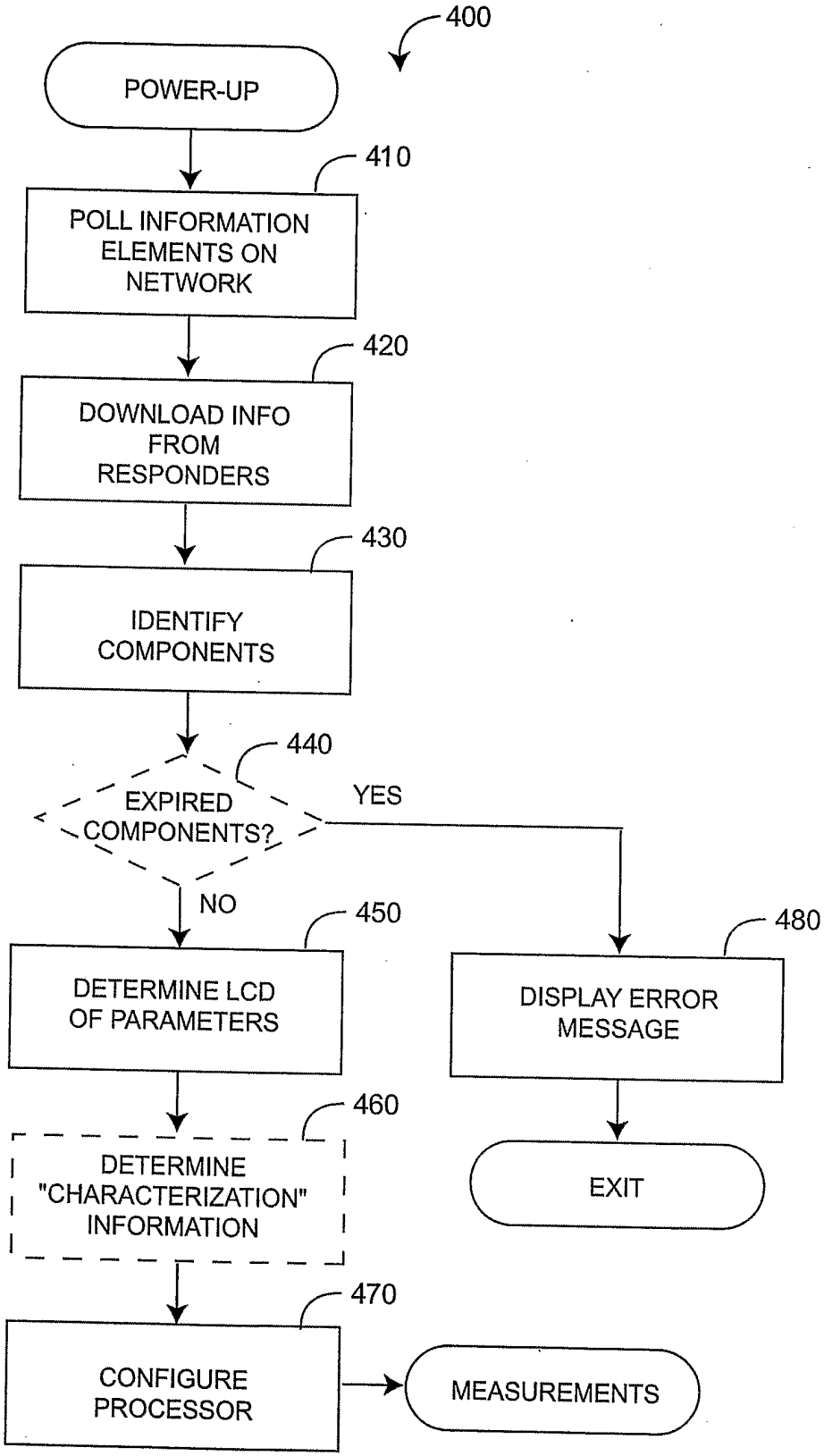
400
POWER-UP
410
POLL INFORMATION ELEMENTS ON NETWORK
420
DOWNLOAD INFO FROM RESPONDERS
430
IDENTIFY COMPONENTS
440
EXPIRED COMPONENTS?
YES
NO
450
DETERMINE LCD OF PARAMETERS
460
DETERMINE "CHARACTERIZATION" INFORMATION
470
CONFIGURE PROCESSOR
MEASUREMENTS
480
DISPLAY ERROR MESSAGE
EXIT

FIG. 4

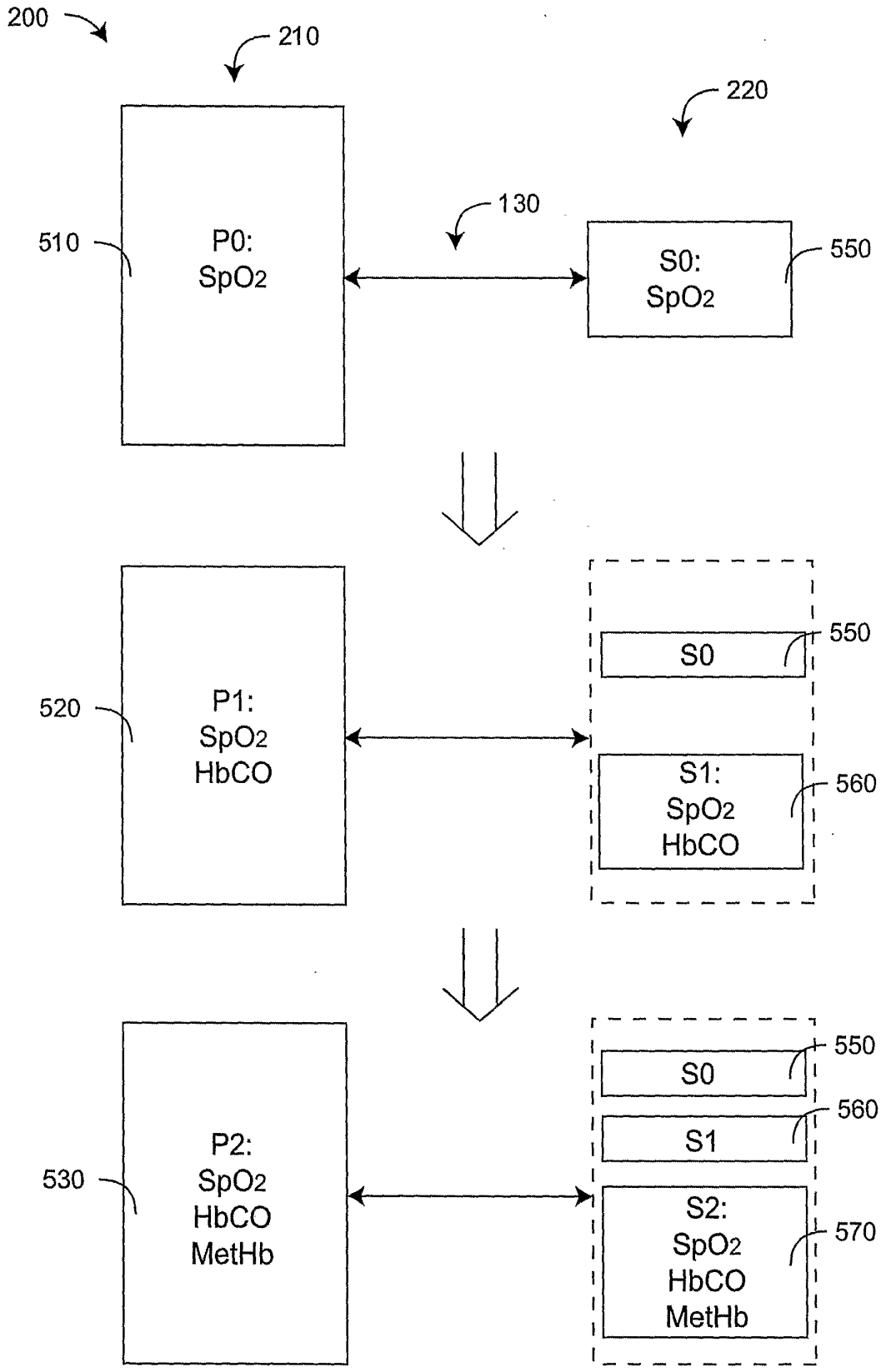
200
210
220
130
510
P0:
SpO2
S0:
SpO2
550
520
P1:
SpO2
HbCO
S0
550
S1:
SpO2
HbCO
560
530
P2:
SpO2
HbCO
MetHb
S0
550
S1
560
S2:
SpO2
HbCO
MetHb
570

FIG. 5A

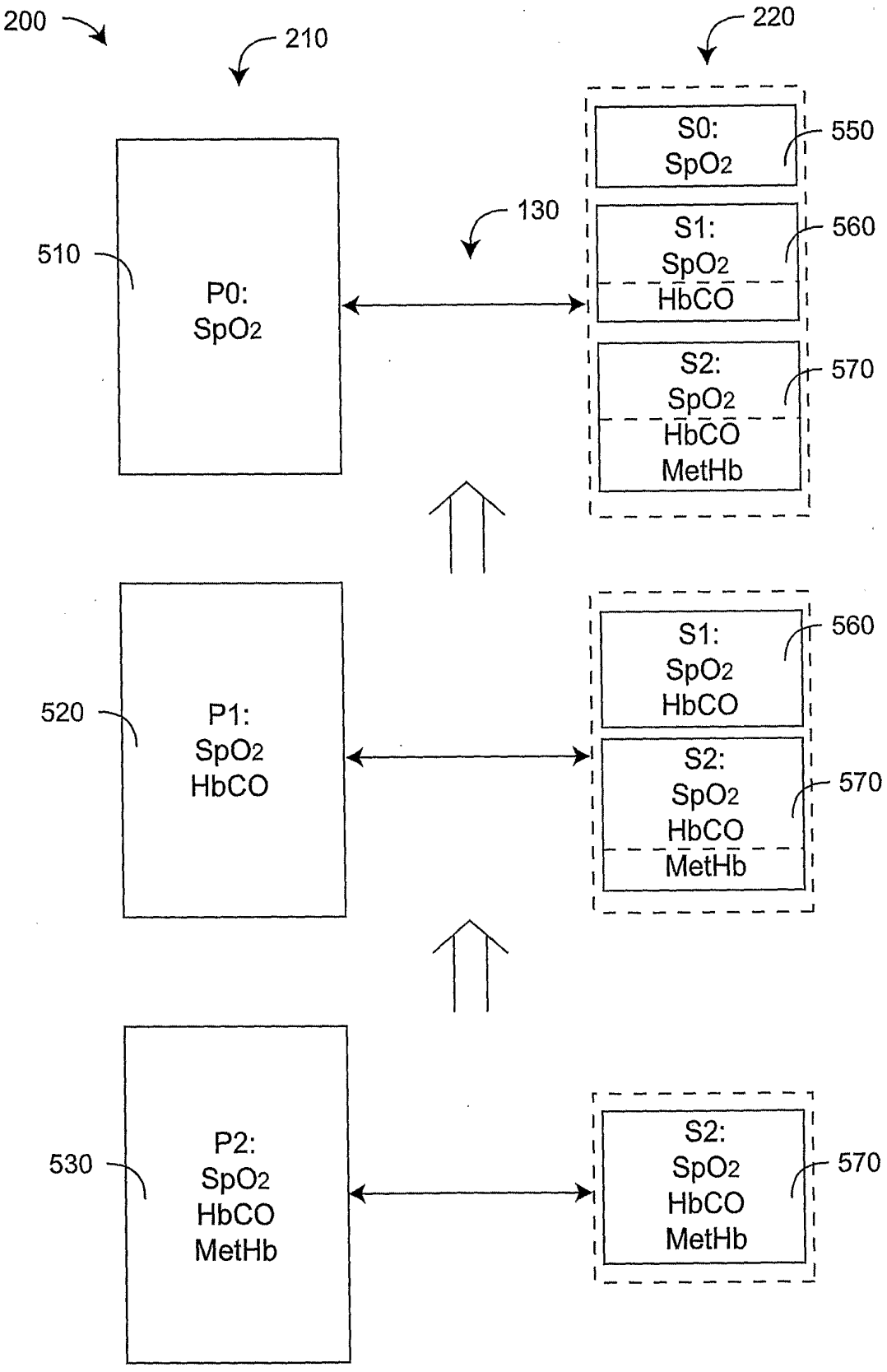
200
210
220
130
510
P0:
SpO2
S0:
SpO2
550
S1:
SpO2
HbCO
560
S2:
SpO2
HbCO
MetHb
570
520
P1:
SpO2
HbCO
S1:
SpO2
HbCO
560
S2:
SpO2
HbCO
MetHb
570
530
P2:
SpO2
HbCO
MetHb
S2:
SpO2
HbCO
MetHb
570

FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/007506

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2004/147823 A1 (KIANI MASSI E ET AL) 29 July 2004 (2004-07-29) paragraph [0006] - paragraph [0025] paragraph [0075] figure 14	1-3, 15-23 8
X A	US 5 827 182 A (RALEY ET AL) 27 October 1998 (1998-10-27) column 2, line 28 - column 3, line 63 column 5, line 61 - column 6, line 24	1 9,15,21
Y	US 6 708 049 B1 (BERSON THOMAS A ET AL) 16 March 2004 (2004-03-16) column 3, line 38 - line 42	8

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 July 2006	17/07/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Abraham, V

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/007506

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/007506

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US 2004267103 A1	30-12-2004	NONE	