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Al-Ali

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(54) **ARRHYTHMIA ALARM PROCESSOR**

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Related U.S. Application Data

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(51) **Int. Cl.**
G08B 29/00 (2006.01)

(52) **U.S. Cl.** **340/511**; 340/539.12; 340/573.1; 600/322; 600/323

(58) **Field of Classification Search** 340/511, 340/539.12, 573.1; 600/322, 323
See application file for complete search history.

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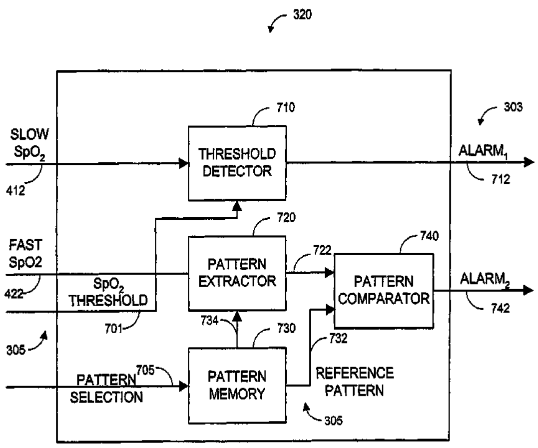
(57) **ABSTRACT**

An arrhythmia alarm processor has a pattern extractor and a predetermined reference pattern. The pattern extractor has an output responsive to short duration, intermittent oxygen desaturations of a patient as determined by a fast blood oxygen saturation processor incorporated within a pulse oximeter. The reference pattern is indicative of a series of oxygen desaturations resulting from an irregular heartbeat. An alarm is triggered when the pattern extractor output matches the predetermined reference pattern.

4 Claims, 9 Drawing Sheets



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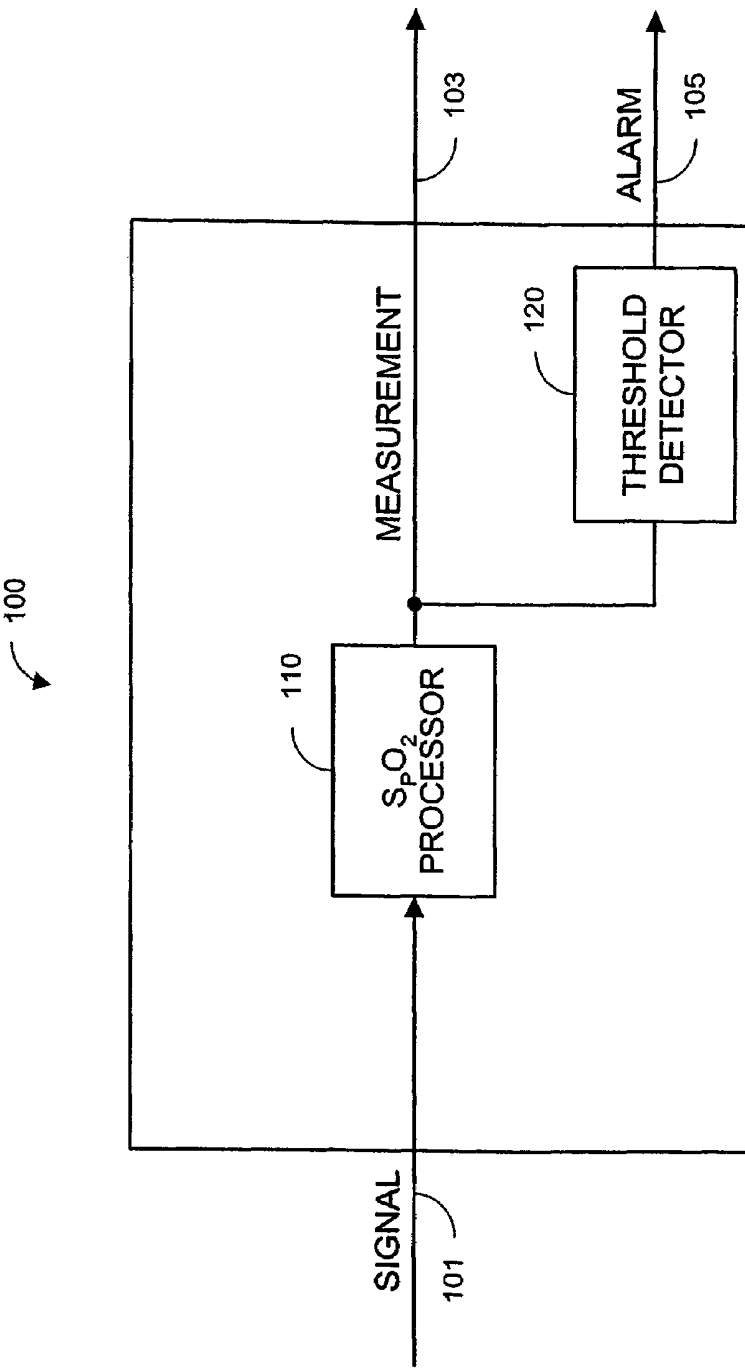

FIG. 1 (Prior Art)

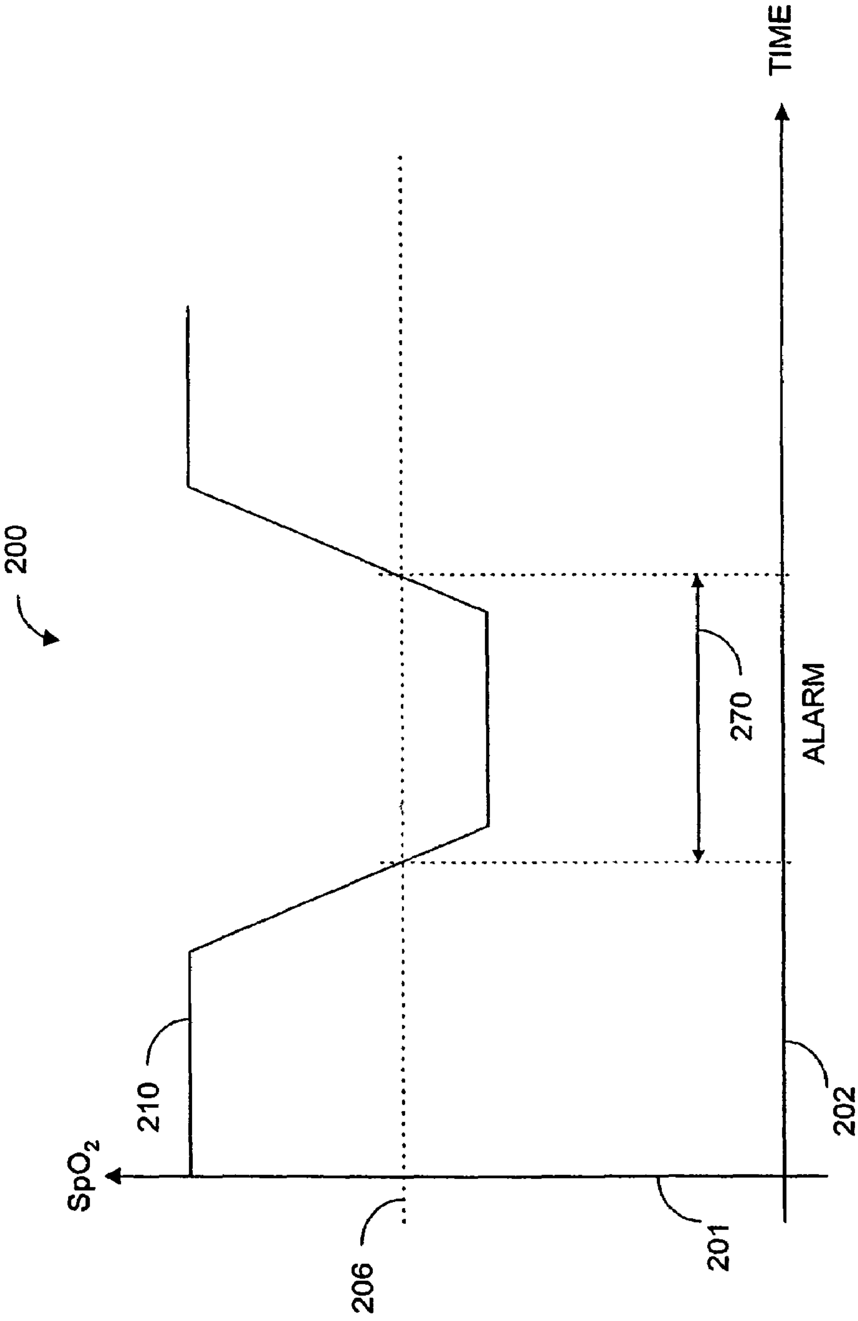

FIG. 2

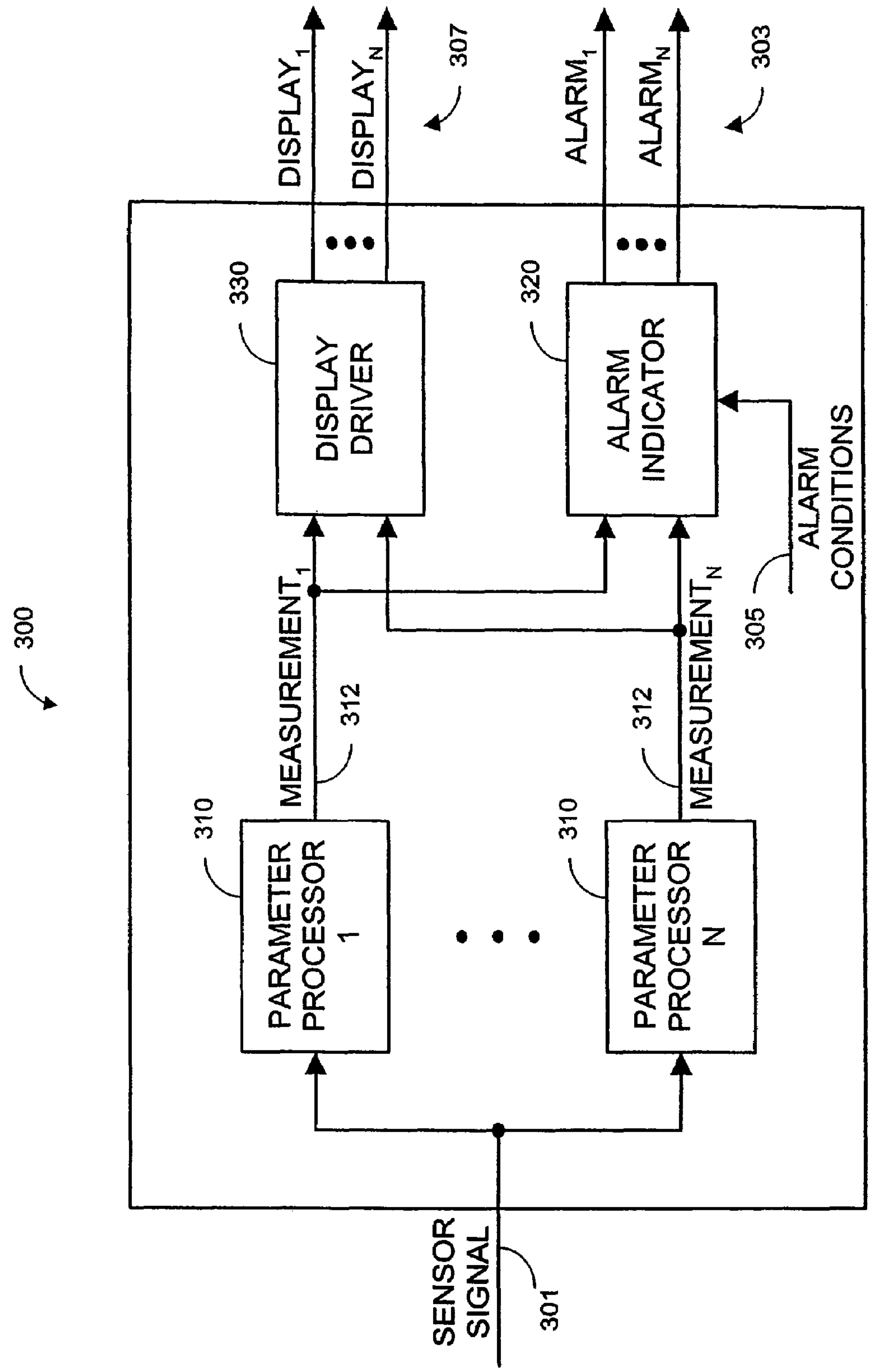
300
PARAMETER PROCESSOR 1
PARAMETER PROCESSOR N
310
310
MEASUREMENT$_1$
MEASUREMENT$_N$
312
312
DISPLAY DRIVER
330
ALARM INDICATOR
320
ALARM CONDITIONS
305
DISPLAY$_1$
DISPLAY$_N$
307
ALARM$_1$
ALARM$_N$
303
SENSOR SIGNAL
301

FIG. 3

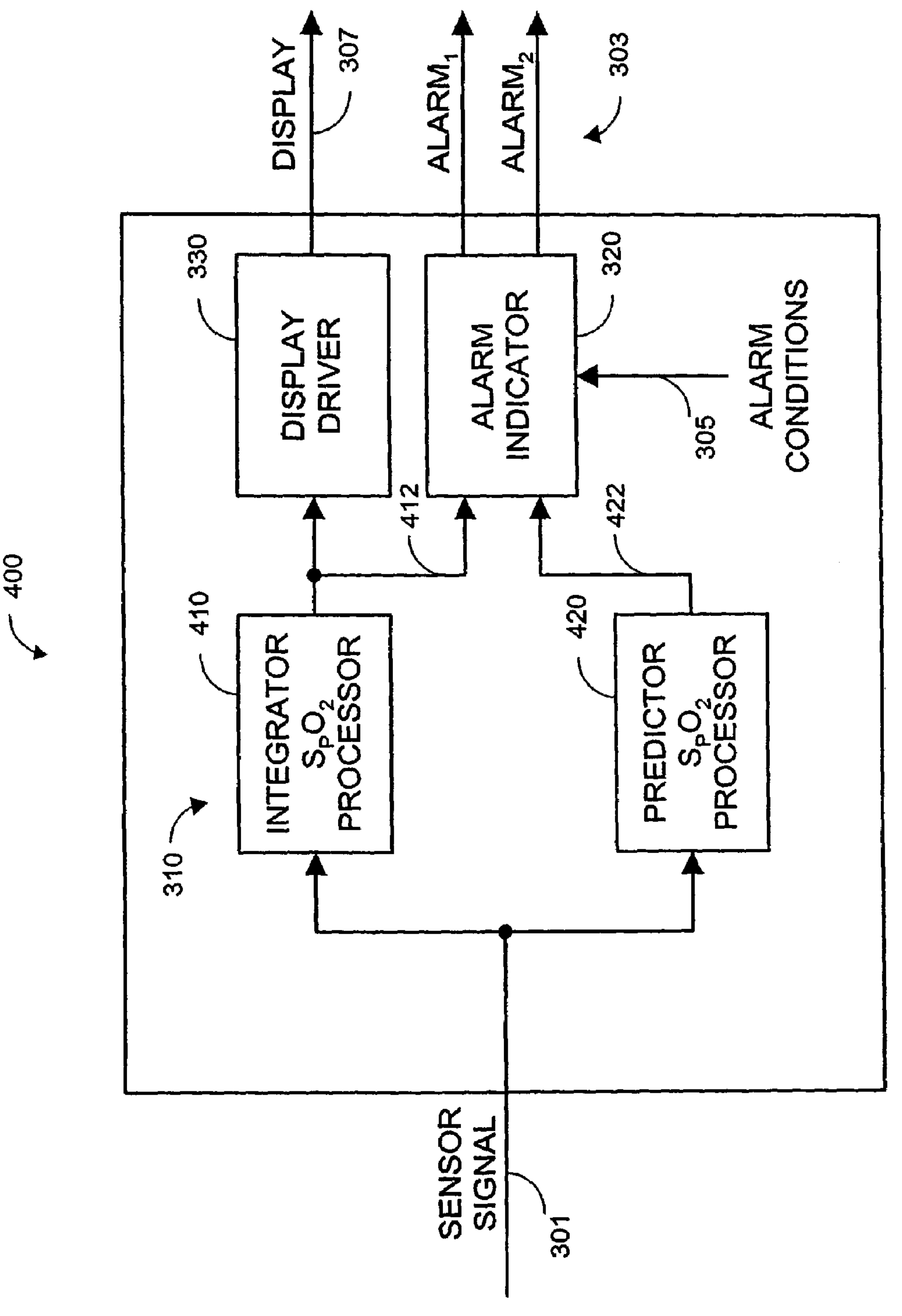
400
310
INTEGRATOR S_pO_2 PROCESSOR
410
PREDICTOR S_pO_2 PROCESSOR
420
DISPLAY DRIVER
330
ALARM INDICATOR
320
412
422
DISPLAY
307
ALARM1
ALARM2
303
ALARM CONDITIONS
305
SENSOR SIGNAL
301

FIG. 4

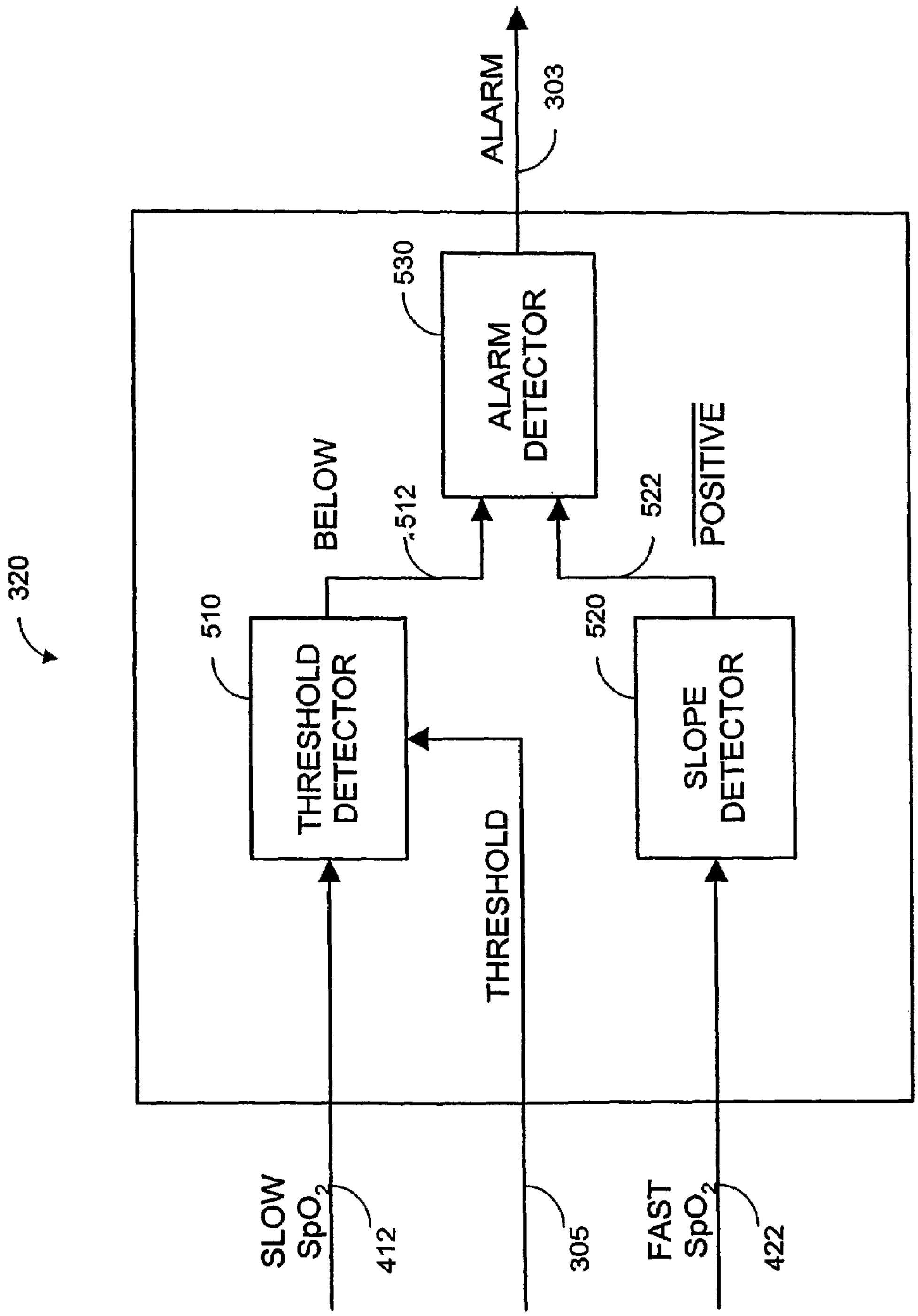
320
ALARM
303
530
ALARM DETECTOR
BELOW
512
522
POSITIVE
510
THRESHOLD DETECTOR
520
SLOPE DETECTOR
THRESHOLD
SLOW SpO2
412
305
FAST SpO2
422

FIG. 5

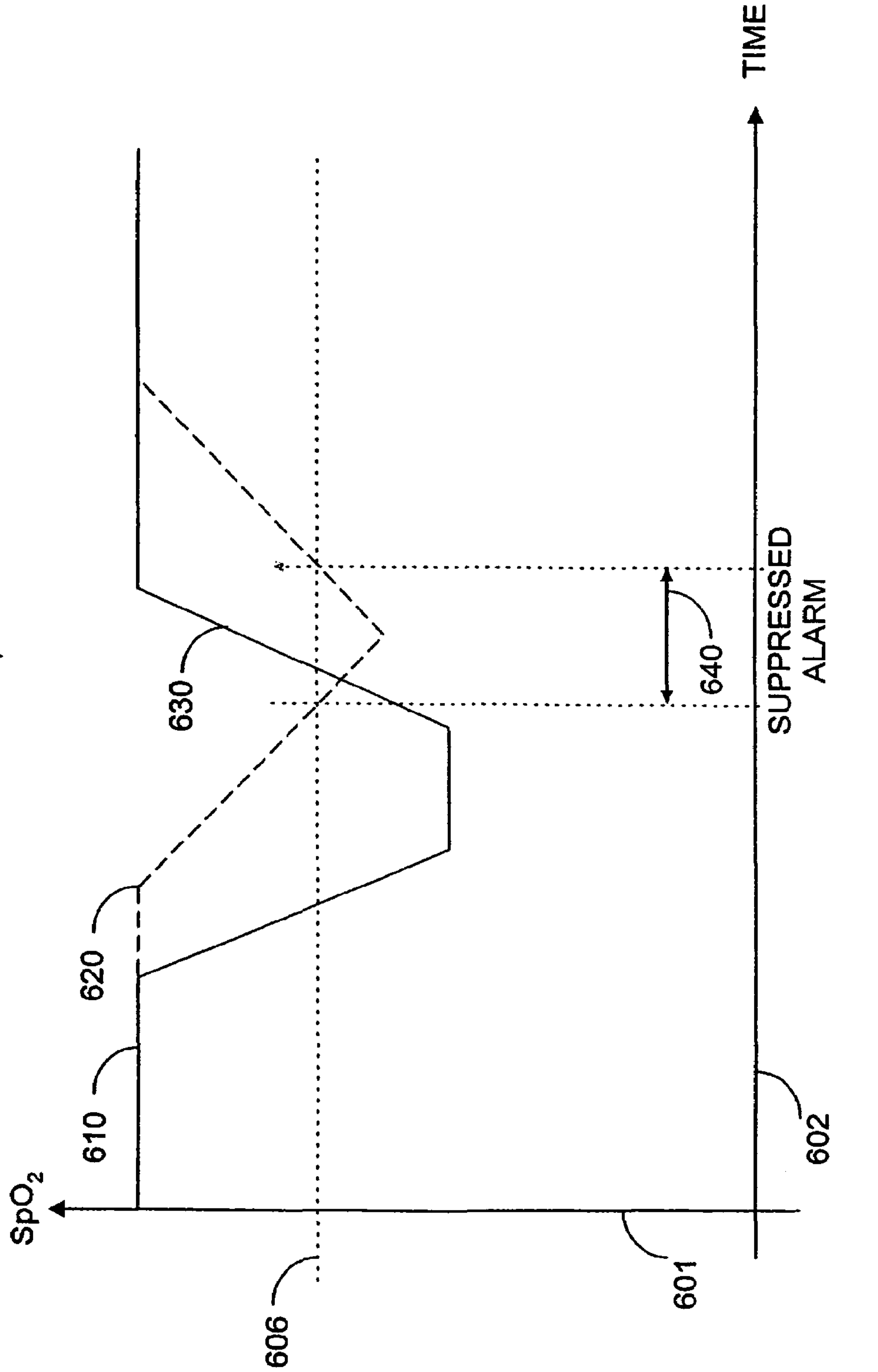

FIG. 6A

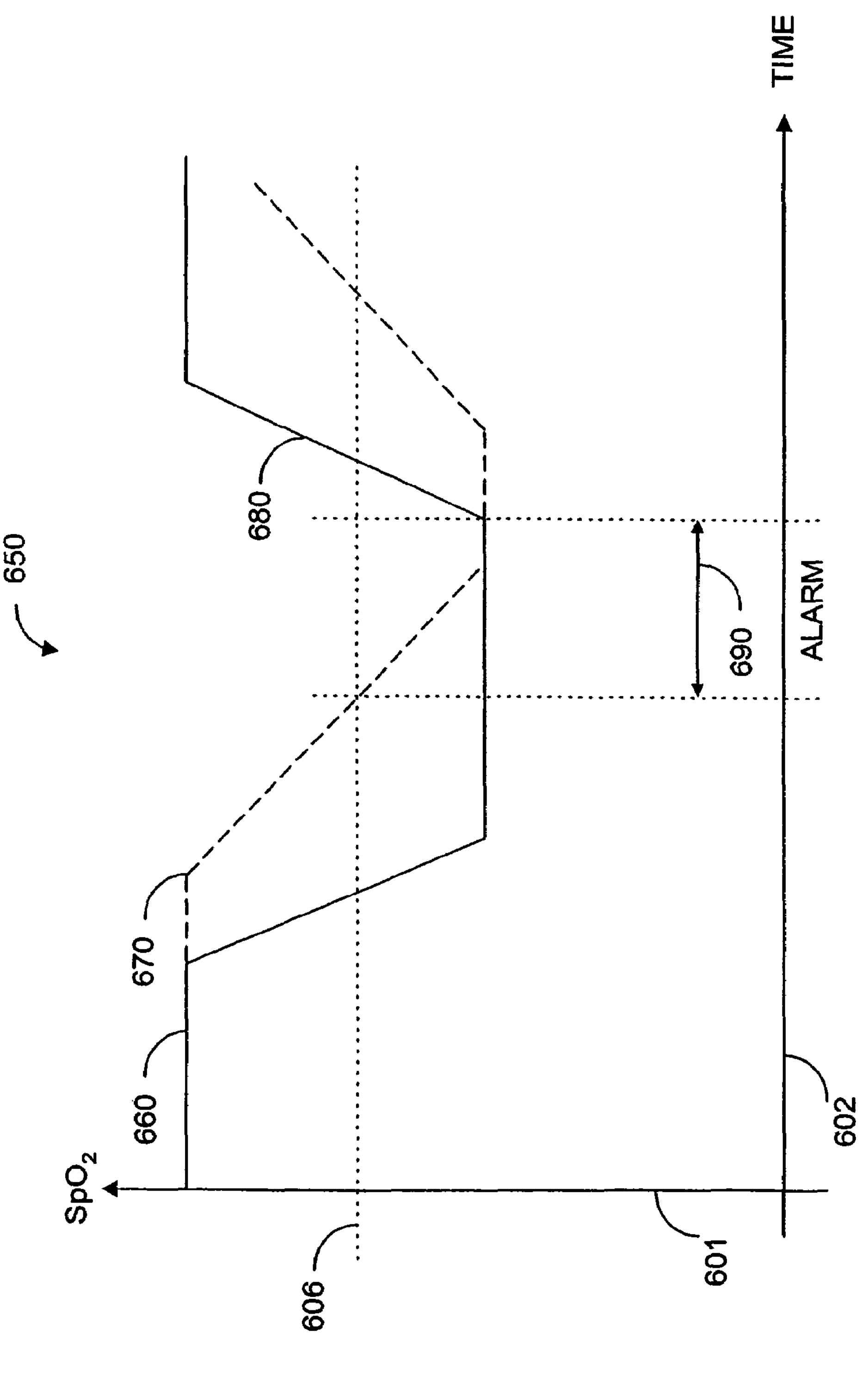

FIG. 6B

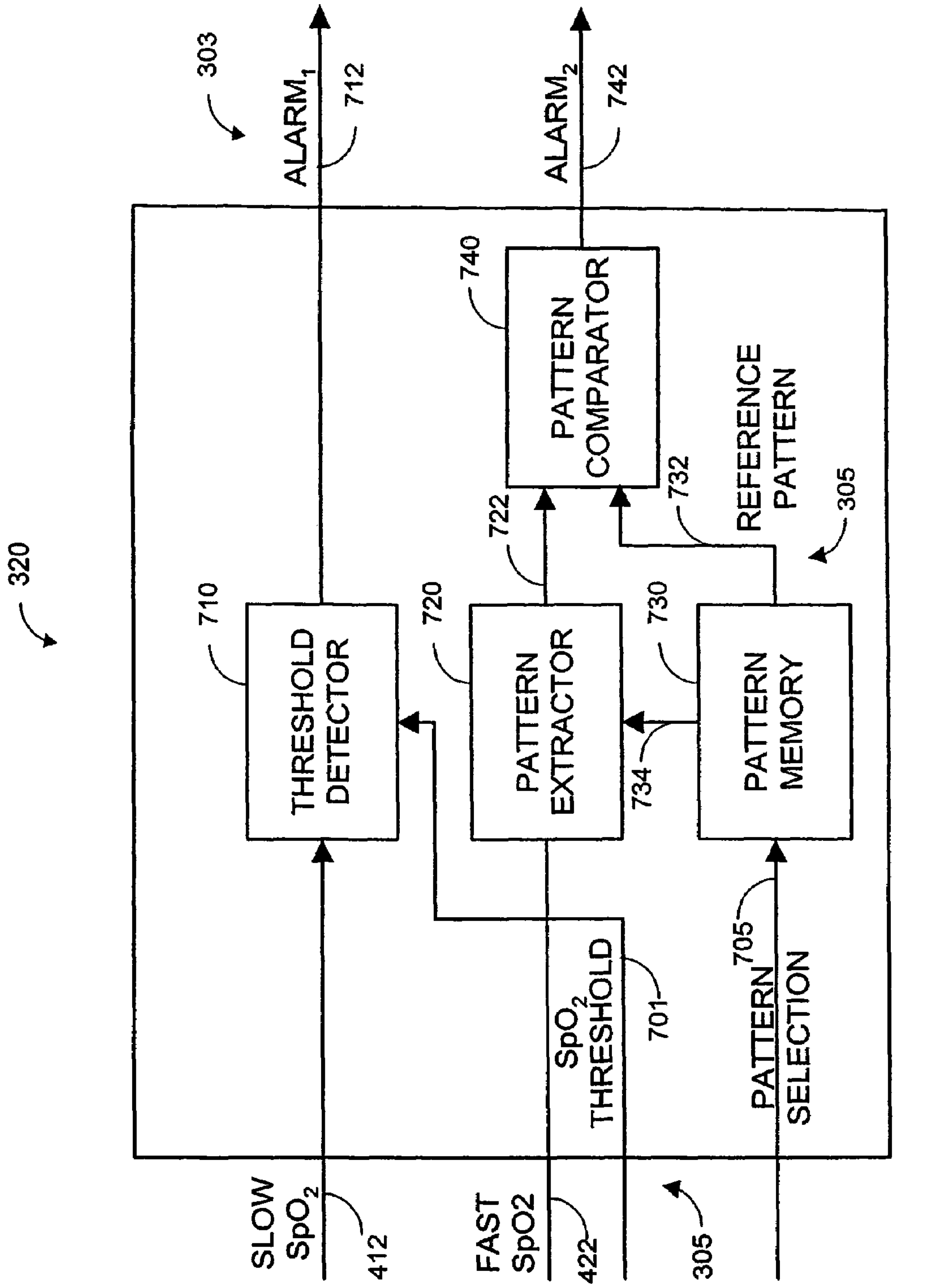
320
303
ALARM$_1$
712
ALARM$_2$
742
740
PATTERN COMPARATOR
REFERENCE PATTERN
732
722
305
710
THRESHOLD DETECTOR
720
PATTERN EXTRACTOR
730
PATTERN MEMORY
734
705
SpO$_2$ THRESHOLD
701
PATTERN SELECTION
SLOW SpO$_2$
412
FAST SpO2
422
305

FIG. 7

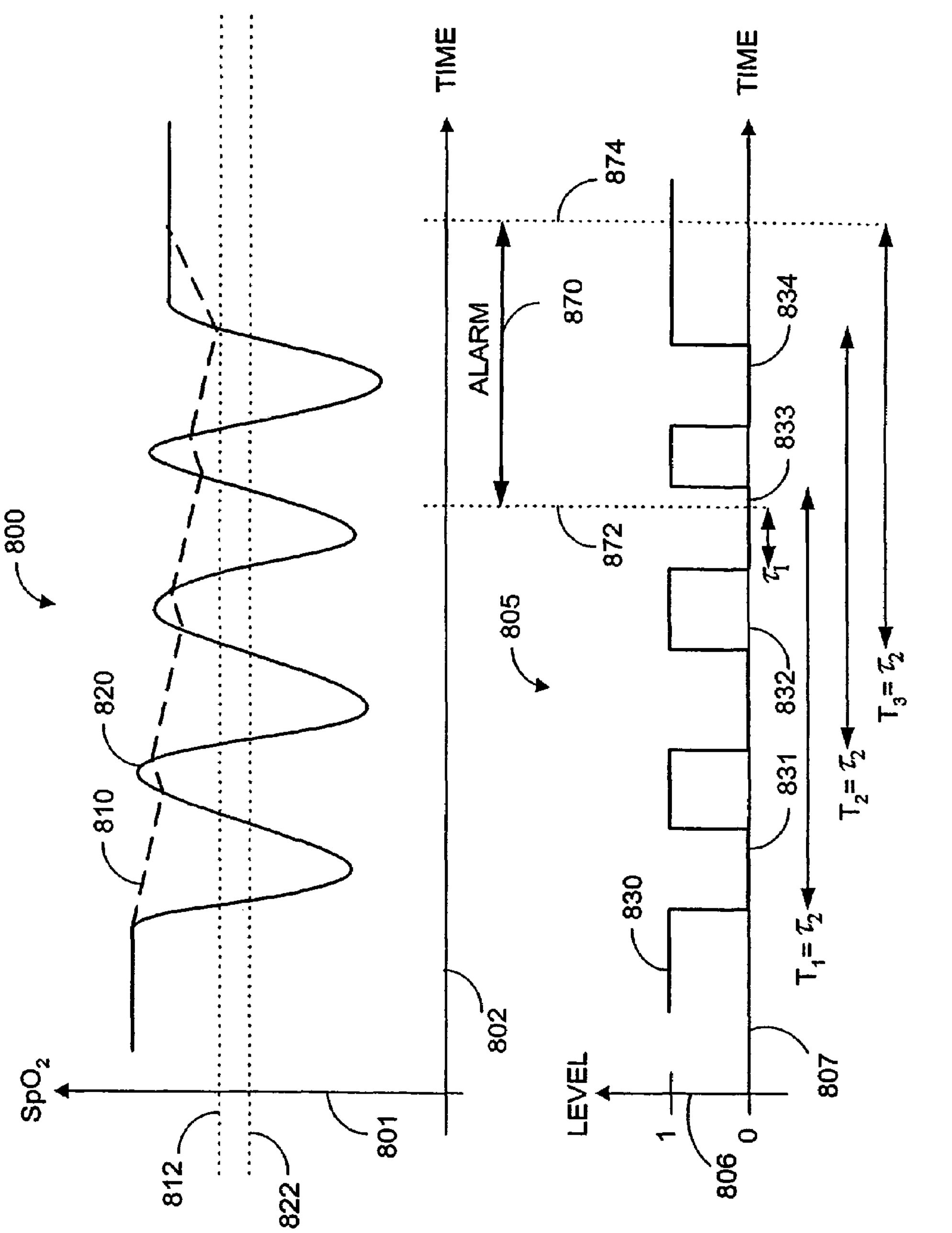
800
SpO_2
TIME
810
820
812
822
801
802
ALARM
870
872
874
805
LEVEL
1
0
806
807
830
831
832
833
834
τ_1
$T_1 = \tau_2$
$T_2 = \tau_2$
$T_3 = \tau_2$
TIME

FIG. 8

ARRHYTHMIA ALARM PROCESSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a CON of 10/975,860 Oct. 28, 2004 U.S. Pat. No. 7,030,749 which is a CON of 10/351,735 Jan. 24, 2003 U.S. Pat. No. 6,822,564 which claims benefit of 60/351,510 Jan. 24, 2002. The present application also incorporates the foregoing utility disclosures herein by reference.

BACKGROUND OF THE INVENTION

Physiological measurement instruments employed in healthcare environments often feature visual and audible alarm mechanisms that alert a caregiver when a patient's vital signs are outside of predetermined limits. One example is a pulse oximeter, which measures the oxygen saturation level of arterial blood, an indicator of oxygen supply. A typical pulse oximeter displays a numerical readout of the patient's oxygen saturation, a numerical readout of pulse rate, and a plethysmograph, which is indicative of a patient's pulse. In addition, a pulse oximeter provides an alarm that warns of a potential desaturation event.

FIG. **1** illustrates a prior art pulse oximeter portion **100** having a signal input **101** and generating an oxygen saturation measurement output **103** and an alarm output **105**. The pulse oximeter portion **100** has an oxygen saturation (SpO_2) processor **110** and an associated threshold detector **120**. The SpO_2 processor **110** derives an oxygen saturation measurement from the signal input **101**. The signal input **101** is typically an amplified, filtered, digitized and demodulated sensor signal. A sensor emits both red and infrared (IR) wavelength light, which is transmitted through a patient's tissue, detected and input to the pulse oximeter. The pulse oximeter calculates a normalized ratio (AC/DC) of the detected red and infrared intensities, and an arterial oxygen saturation value is empirically determined based on a ratio of these normalized ratios, as is well-known in the art. The oxygen saturation measurement output **103** is typically a digital signal that is then communicated to a display.

FIG. **2** illustrates the operation of a conventional threshold detector **120** (FIG. **1**) utilizing a graph **200** of oxygen saturation **201** versus time **202**. The graph **200** displays a particular oxygen saturation measurement **210** corresponding to the measurement output **103** (FIG. **1**) and a predetermined alarm threshold **206**. During an alarm time period **270** when the measured oxygen saturation **210** is below the threshold **206**, an alarm output **105** (FIG. **1**) is generated, which triggers a caregiver alert. Adjusting the threshold **206** to a lower value of oxygen saturation **201** reduces the probability of an alarm, i.e. reduces the probability of a false alarm and increases the probability of a missed event. Likewise, adjusting the threshold **206** to a higher value of oxygen saturation **201** increases the probability of an alarm, i.e. increases the probability of a false alarm and decreases the probability of a missed event.

SUMMARY OF THE INVENTION

One performance measure for a physiological measurement instrument is the probability of a false alarm compared with the probability of a missed event. Missed events, such as an oxygen desaturation when measuring oxygen saturation, may detrimentally effect patient health. False alarms waste caregiver resources and may also result in a true alarm being ignored. It is desirable, therefore, to provide an alarm mechanism to reduce the probability of false alarms without significantly increasing the probability of missed events, and, similarly, to reduce the probability of missed events without significantly increasing the probability of false alarms.

An alarm processor has a signal input responsive to a physiological parameter and a plurality of parameter processors responsive to the signal input so as to provide a plurality of measurements of the parameter having differing characteristics. In addition, the alarm processor has an alarm condition applicable to at least one of the measurements so as to define a limit for the parameter. Further, the alarm processor has an alarm indicator operating on the measurements and the alarm condition so as to provide an alarm output that changes state to indicate that the parameter may have exceeded the limit.

One aspect of an arrhythmia alarm processor is a pattern extractor and a predetermined reference pattern. The pattern extractor has an output responsive to short duration, intermittent oxygen desaturations of a patient as determined by a fast blood oxygen saturation processor incorporated within a pulse oximeter. The reference pattern is indicative of a series of oxygen desaturations resulting from an irregular heartbeat. An alarm is triggered when the pattern extractor output matches the predetermined reference pattern.

In another aspect of an arrhythmia alarm processor, a patient monitor is configured to receive a sensor signal responsive to multiple wavelengths of light emitted into a tissue site. The patient monitor has a blood oxygen saturation processor, a pattern processor and a blood oxygen saturation processor. The blood oxygen saturation processor is capable of providing a predictor measurement of blood oxygen saturation derived from a tissue site in response to a sensor signal and is responsive to short duration, intermittent oxygen desaturations of a patient. The pattern processor is responsive to the predictor measurement of blood oxygen saturation so as to detect a pattern in a series of oxygen desaturations indicative of an irregular heartbeat of a patient. An alarm is responsive to the pattern processor so as to indicate the occurrence of irregular heartbeats.

A further aspect of an arrhythmia alarm processor comprises transmitting light having multiple wavelengths into a patient tissue site and detecting the light after absorption by arterial blood within the tissue site so as to generate a sensor signal. A predictor blood oxygen saturation measurement responsive to the sensor signal and to short duration, intermittent oxygen desaturations of the patient is generated. A pattern in the blood oxygen saturation measurement indicative of an irregular heartbeat event is recognized. An alarm is triggered in response to the recognized pattern.

In yet another aspect of an arrhythmia alarm processor, a patient monitor has a processor means, a pattern recognition means, a reference means and an alarm means. The processor means is for deriving a plurality of oxygen saturation measurements. The pattern recognition means is for extracting a desaturation pattern of short duration, intermittent oxygen desaturations. The reference means is for comparing the extracted desaturation pattern with a stored pattern indicative of irregular heartbeats. The alarm means is for indicating a match between the extracted desaturation pattern and the stored pattern.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a prior art pulse oximeter portion;

FIG. **2** is a graph of oxygen saturation versus time illustrating a conventional threshold detector alarm;

FIG. **3** is a block diagram of an alarm processor utilizing parallel measurements of a physiological parameter;

FIG. **4** is a block diagram of a pulse oximeter processor utilizing dual oxygen saturation measurements;

FIG. **5** is a block diagram of a predictive alarm indicator utilizing a threshold detector with a slow oxygen saturation measurement input and a slope detector with a fast oxygen saturation measurement input;

FIGS. **6**A–B are graphs of oxygen saturation versus time illustrating operation of the alarm indicator according to FIG. **5**;

FIG. **7** is a block diagram of a pattern recognition alarm indicator utilizing a threshold detector with a slow oxygen saturation measurement input and a pattern extractor with a fast oxygen saturation measurement input; and

FIG. **8** is a graph of oxygen saturation versus time illustrating the pattern recognition alarm indicator according to FIG. **7**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **3** illustrates a parallel measurement alarm processor **300**. The alarm processor **300** has a sensor signal input **301** responsive to a physiological parameter and provides one or more alarm outputs **303** to indicate that the physiological parameter may have exceeded particular limits. The alarm processor **300** also has multiple parameter processors **310**, which do not necessarily have the same or similar internal configurations. The multiple parameter processors **310** input the sensor signal **301** and provide parallel measurements **312** of the physiological parameter, each measurement having differing characteristics, such as response time or bandwidth to name a few. The alarm processor **300** further has an alarm indicator **320** that inputs the parallel parameter measurements **312** and generates the alarm outputs **303** based upon alarm conditions **305**. The alarm outputs **303** change state to indicate that the parameter may have exceed one or more limits and to trigger an alarm accordingly. The alarm conditions **305** define particular limits with respect to one or more of the measurements **312**. The alarm conditions **305** may be predefined, such as by user input, or determined by a separate process, such as a measurement of sensor signal quality or data confidence as described in U.S. patent application Ser. No. 09/858,114 entitled "Pulse Oximetry Data Confidence Indicator," assigned to Masimo Corporation, Irvine, Calif. and incorporated by reference herein. The alarm processor **300** may also have a display driver **330** that processes one or more of the parameter measurements **312** and provides one or more display outputs **307**.

FIG. **4** illustrates a pulse oximeter embodiment **400** of the alarm processor **300** (FIG. **3**) described above. A pulse oximeter sensor (not shown) provides a signal input **301** responsive to arterial oxygen saturation, as described with respect to FIG. **1**, above. The alarm processor **400** has dual oxygen saturation processors **310**. An integrator oxygen saturation (SpO_2) processor **410** outputs a slow SpO_2 measurement **412**, i.e. a measurement having a slow response time to changes in the SpO_2 parameter. A predictor SpO_2 processor **420** outputs a fast SpO_2 measurement **422**, i.e. a measurement having a fast response time that tracks changes in the SpO_2 parameter. The slow SpO_2 measurement **412** is input to a display driver **330**, which provides an oxygen saturation display output **307**. For example, the display output **307** may be input to a digital display that provides a numerical readout of oxygen saturation to a caregiver. Both the slow SpO_2 measurement **412** and the fast SpO_2 measurement **422** are input to an alarm indicator **320** that generates at least one alarm output **303** based upon alarm conditions **305**, as described in further detail with respect to FIGS. **5**–**8**, below.

The integrator SpO_2 processor **410**, advantageously, provides a smoothed measurement of oxygen saturation suitable for threshold detection. The predictor SpO_2 processor **420**, advantageously, provides a curve-fitting or a predictive measurement of oxygen saturation that detects trends in oxygen saturation, as described in further detail with respect to FIG. **5** and FIGS. **6**A–B, below. Further, the predictor SpO_2 processor **420** advantageously tracks oxygen saturation details that may signal a critical physiological event, as described in further detail with respect to FIGS. **7**–**8**, below. The integrator SpO_2 processor **410** and predictor SpO_2 processor **420** may be a pulse oximeter as described in U.S. patent application Ser. No. 09/586,845 entitled "Variable Mode Averager," assigned to Masimo Corporation, Irvine, Calif. and incorporated by reference herein.

FIG. **5** illustrates a trend embodiment of an alarm indicator **320**, which has a threshold detector **510**, a slope detector **520** and alarm detector **530**. The threshold detector **510** has a slow SpO_2 measurement **412** and a threshold alarm condition **305** as inputs and a logic output BELOW **512**. The slope detector **520** has a fast SpO_2 measurement **422** input and a logic output POSITIVE/**522**. The alarm detector **530** has BELOW **512** and POSITIVE/**522** logic inputs and generates an alarm output **303**. The threshold detector **510** is a comparator that asserts BELOW **512** while the slow SpO_2 measurement **412** is less in value than the value of the threshold **305**. The slope detector **520** is a differentiator and comparator that asserts POSITIVE/**522** while the slope of the fast SpO_2 measurement **422** is non-positive, i.e. while the derivative of the fast SpO_2 measurement **422** is zero or less than zero. The alarm detector **530** performs a logical AND function, asserting the alarm output **303** and indicating an alarm when BELOW **512** and POSITIVE/**522** are both asserted. In this manner, an alarm output **303** only changes state when the slow SpO_2 measurement **412** is below a threshold **305** and the fast SpO_2 measurement **422** has not begun to increase in value. Advantageously, the trend recognition alarm indicator **320** reduces false alarms by suppressing a threshold-based alarm on the slow SpO_2 measurement **412** when the fast SpO_2 measurement **422** determines that a patient's oxygen saturation is in recovery, as described in further detail with respect to FIGS. **6**A–B, below.

FIGS. **6**A–B illustrate operation of the trend recognition alarm indicator **320** (FIG. **5**). In FIG. **6**A, a graph **600** has an SpO_2 axis **601** and a time axis **602**. Shown along the SpO_2 axis **601** is a constant SpO_2 value **606** corresponding to a threshold **305** (FIG. **5**). The graph **600** shows a first plot of SpO_2 versus time **610** corresponding to a fast SpO_2 measurement **422** (FIG. **5**). The graph **600** also shows a second plot of SpO_2 versus time **620** corresponding to a slow SpO_2 measurement **412** (FIG. **5**). A suppressed alarm interval **640** along the time axis **602** corresponds to an alarm that would be indicated by the threshold detector **510** (FIG. **5**) but is suppressed as occurring during a positive slope portion **630** of a fast SpO_2 measurement **610**. The alarm detector **530** (FIG. **5**) would not assert an alarm output **303** (FIG. **5**) during this interval.

In FIG. **6**B, a graph **650** shows a first plot of SpO_2 versus time **660** corresponding to a fast SpO_2 measurement **422** (FIG. **5**). The graph **650** also shows a second plot of SpO_2

versus time **670** corresponding to a slow SpO_2 measurement **412** (FIG. **5**). An alarm interval **690** along the time axis **602** corresponds to an alarm period triggered by the alarm output **303** (FIG. **5**). This alarm interval **640** occurs while a slow SpO_2 measurement **670** is below the threshold **606** and before a positive slope portion **680** of a fast SpO_2 measurement **660**.

FIG. **7** illustrates a pattern recognition embodiment of an alarm indicator **320**, having a threshold detector **710**, a pattern extractor **720**, a pattern memory **730** and a pattern comparator **740**. Further, the alarm indicator **320** has slow SpO_2 **412** and fast SpO_2 **422** measurement inputs in addition to threshold **701** and reference pattern **732** alarm condition inputs **305**. The threshold detector **710** has a slow SpO_2 measurement **412** and a SpO_2 threshold **701** as inputs and a first alarm output **712**. The threshold detector **710** changes the state of the first alarm output **712** when the value of the slow SpO_2 measurement **412** crosses the SpO_2 threshold **701**. For example, the first alarm output **712** changes state to trigger an alarm when the slow SpO_2 measurement **412** becomes less than the SpO_2 threshold **701**.

As shown in FIG. **7**, the pattern extractor **720** has a fast SpO_2 measurement **422** and a pattern threshold **734** as inputs and an extracted pattern output **722**. The pattern extractor **720** identifies features of the fast SpO_2 measurement **422** that may be used for pattern matching. Features may be, for example, the number of times the fast SpO_2 measurement **422** crosses the pattern threshold **734** within a certain time period, or the duration of each time period that the fast SpO_2 measurement **422** is less than the pattern threshold **734**, to name a few. The pattern memory **730** has a pattern selection input **705** and a reference pattern output **732**. The pattern memory **730** stores values for particular features that are identified by the pattern extractor **720**. The reference pattern output **732** transfers these stored values to the pattern comparator **740**. The pattern memory **730** may be nonvolatile and one or more patterns may be stored at the time of manufacture or downloaded subsequently via a data input (not shown). One of multiple patterns may be determined via the pattern selection input **705**, by a user or by a separate process, for example. The pattern threshold **734** may be generated in response to the pattern selection input **705** or in conjunction with a selected reference pattern **732**.

Also shown in FIG. **7**, the pattern comparator **740** has the extracted pattern **722** and the reference pattern **732** as inputs and generates a second alarm output **742**. That is, the pattern comparator **740** matches extracted measurement features provided by the pattern extractor **720** with selected features retrieved from pattern memory **730**, changing the state of the second alarm output **742** accordingly. For example, the second alarm output **742** changes state to trigger an alarm when features of the fast SpO_2 measurement **422** match the reference pattern output **732**. Advantageously, the pattern recognition alarm indicator **320** reduces missed events by supplementing the threshold-based first alarm output **712** responsive to the slow SpO_2 measurement **412** with a pattern-based second alarm output **742** responsive to detail in the fast SpO_2 measurement **422**. In this manner, if a patient's oxygen saturation is, for example, irregular or intermittent, the second alarm output **742** may trigger a caregiver alert when the first alarm output **712** does not, as described in further detail with respect to FIG. **8**, below.

FIG. **8** illustrates operation of a pattern recognition alarm indicator **320** (FIG. **7**), as described above. A graph **800** has an SpO_2 axis **801** and a time axis **802**. The graph **800** shows a SpO_2 plot versus time **810** corresponding to the slow SpO_2 measurement **412** (FIG. **7**). Shown along the time axis **802** is a constant SpO_2 value **812** corresponding to the SpO_2 threshold **701** (FIG. **7**). Due to the short duration of irregular and intermittent drops in SpO_2, the slow SpO_2 measurement **810** does not fall below the SpO_2 threshold **812**. Thus, the first alarm output **712** (FIG. **7**) does not trigger an alarm in this example.

Also shown in FIG. **8**, the graph **800** shows a SpO_2 plot versus time **820** corresponding to the fast SpO_2 measurement **422** (FIG. **7**). Shown along the time axis **802** is a constant SpO_2 value **822** corresponding to the pattern threshold **734** (FIG. **7**). A corresponding graph **805** has a logic level axis **806** and a time axis **807**. The graph **805** shows a logic level plot versus time **830** corresponding to the extracted pattern output **722** (FIG. **7**). The logic level plot **830** has a "1" level when the fast SpO_2 plot **820** is above the pattern threshold **822** and a "0" level when the fast SpO_2 plot **820** is below the pattern threshold **822**. In this manner, the logic level plot **830** indicates the number and duration of times the fast SpO_2 plot **820** falls below a threshold value **822**.

Further shown in FIG. **8**, an alarm interval **870** along the time axis **802** corresponds to an alarm period indicated by the pattern comparator **740** (FIG. **7**). This alarm interval **870** occurs after a reference pattern **732** (FIG. **7**) is detected as matching an extracted pattern **722** (FIG. **7**) and ends, correspondingly, when there is no longer a match. For example, assume that the reference pattern output **732** (FIG. **7**) has the alarm criteria that at least three below threshold periods of minimum duration T_1 must occur during a maximum period T_2, where the value of T_1 and T_2 are illustrated along the time axis **807**. The below threshold time periods **831**–**834** are each greater in duration than T_2 and a first set of three, below-threshold time periods **831**–**833** occurs within a time period $T_1=T_2$, as illustrated. Thus, the alarm interval beginning **872** is triggered by the second alarm output **742** (FIG. **7**). A second set of three, below-threshold time periods **832**–**834** also occurs within a time period $T_2=T_2$, as illustrated. Thus, the alarm interval **870** continues. There is no third set of three, below-threshold time periods. Thus, after the end of the time interval $T_3=T_2$, the alarm interval end **874** is triggered. This example illustrates how the pattern recognition alarm indicator **320** (FIG. **7**) can trigger an alarm on an event, such as a period of irregular heartbeats, that might be missed by a threshold-based alarm responsive to the slow SpO_2 measurement **412**.

Although some alarm processor embodiments were described above in terms of pulse oximetry and oxygen saturation measurements, one of ordinary skill in the art will recognize that an alarm processor as disclosed herein is also applicable to the measurement and monitoring of other blood constituents, for example blood glucose and total hemoglobin concentration to name a few, and other physiological parameters such as blood pressure, pulse rate, respiration rate, and EKG to name a few.

An arrhythmia alarm processor 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. An arrhythmia alarm processor comprising:

a pattern extractor having an output responsive to short duration, intermittent oxygen desaturations of a patient as determined by a fast blood oxygen saturation processor incorporated within a pulse oximeter;

a predetermined reference pattern indicative of a series of oxygen desaturations resulting from an irregular heartbeat; and

an alarm triggered when the pattern extractor output matches the predetermined reference pattern.

2. A patient monitor configured to receive a sensor signal responsive to multiple wavelengths of light emitted into a tissue site, the patient monitor comprising:

a blood oxygen saturation processor capable of providing a predictor measurement of blood oxygen saturation derived from a tissue site in response to a sensor signal, wherein the blood oxygen saturation processor is responsive to short duration, intermittent oxygen desaturations of a patient;

a pattern processor responsive to the predictor measurement of blood oxygen saturation so as to detect a pattern in a series of oxygen desaturations indicative of an irregular heartbeat of a patient; and

an alarm responsive to the pattern processor so as to indicate the occurrence of irregular heartbeats.

3. An arrhythmia alarm method comprising the steps of:

transmitting light having multiple wavelengths into a patient tissue site;

detecting the light after absorption by arterial blood within the tissue site so as to generate a sensor signal;

generating a predictor blood oxygen saturation measurement responsive to the sensor signal and to short duration, intermittent oxygen desaturations of the patient;

recognizing a pattern in the blood oxygen saturation measurement indicative of an irregular heartbeat event; and

triggering an alarm in response to the recognized pattern.

4. A patient monitor comprising:

a processor means for deriving a plurality of oxygen saturation measurements;

a pattern recognition means for extracting a desaturation pattern of short duration, intermittent oxygen desaturations;

a reference means for comparing the extracted desaturation pattern with a stored pattern indicative of irregular heartbeats; and

an alarm means for indicating a match between the extracted desaturation pattern and the stored pattern.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,190,261 B2
APPLICATION NO. : 11/405815
DATED : March 13, 2007
INVENTOR(S) : Ammar Al-Ali

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page item 56
On Page 2, Column 2, Line 14, please delete “Pishney et al.” and insert -- Kiani et al. --, therefore.

On Page 2, Column 2, Line 61, please delete “Al et al.” and insert -- Ali et al. --, therefore.

Sheet 1 of 9 (FIG. 1), Box No. 110, above PROCESSOR, please delete “S_pO_2” and insert -- SpO_2 --, therefore.

Sheet 4 of 9 (FIG. 4), Box No. 410, above PROCESSOR, please delete “S_pO_2” and insert -- SpO_2 --, therefore.

Sheet 4 of 9 (FIG. 4), Box No. 420, above PROCESSOR, please delete “S_pO_2” and insert -- SpO_2 --, therefore.

Signed and Sealed this

Twenty-fourth Day of June, 2008

JON W. DUDAS
Director of the United States Patent and Trademark Office

专利名称(译)	心律失常报警处理器		
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摘要(译)

心律失常警报处理器具有图案提取器和预定的参考图案。图案提取器具有响应于短持续时间的输出，由脉搏血氧计中包含的快速血氧饱和度处理器确定的患者的间歇性氧饱和度降低。参考图案表示由不规则心跳引起的一系列氧饱和度降低。当模式提取器输出与预定参考模式匹配时，触发警报。