



US00RE47244E

(19) **United States**  
(12) **Reissued Patent**  
**Kiani et al.**

(10) **Patent Number: US RE47,244 E**  
(45) **Date of Reissued Patent: Feb. 19, 2019**

(54) **ALARM SUSPEND SYSTEM**

(56) **References Cited**

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U.S. PATENT DOCUMENTS

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4,639,718 A \* 1/1987 Gasper ..... G05D 21/02  
210/739  
4,653,498 A 3/1987 New et al.  
(Continued)

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FOREIGN PATENT DOCUMENTS

WO WO 2005/087097 9/2005  
WO WO 2010/014743 2/2010

(21) Appl. No.: **15/583,935**

(22) Filed: **May 1, 2017**

OTHER PUBLICATIONS

US 9,579,050, 02/2017, Al-Ali (withdrawn)  
(Continued)

**Related U.S. Patent Documents**

Reissue of:

(64) Patent No.: **9,153,121**  
Issued: **Oct. 6, 2015**  
Appl. No.: **14/469,426**  
Filed: **Aug. 26, 2014**

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U.S. Applications:

(63) Continuation of application No. 14/036,496, filed on Sep. 25, 2013, now Pat. No. 8,847,740, which is a  
(Continued)

(57) **ABSTRACT**

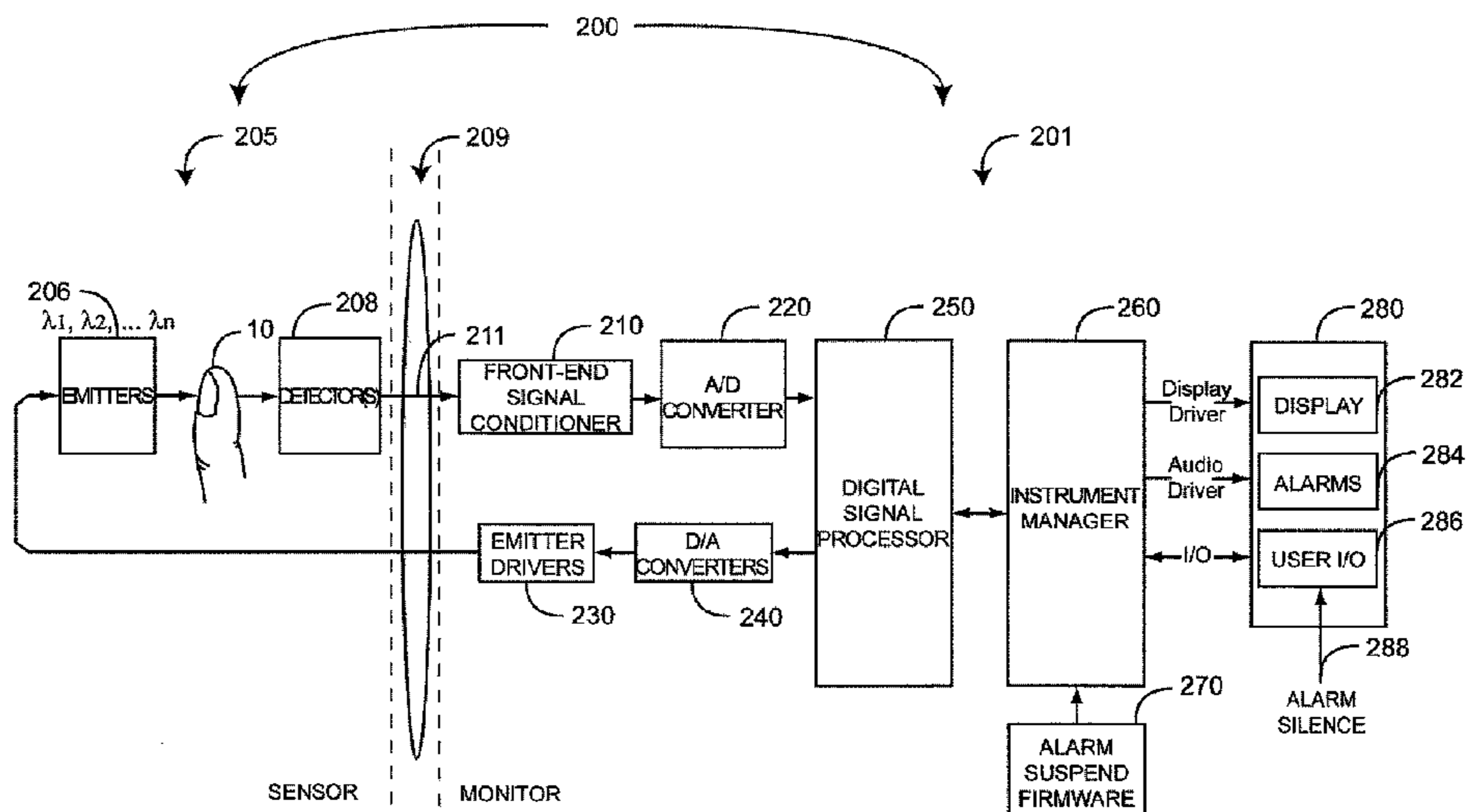
An alarm suspend system utilizes an alarm trigger responsive to physiological parameters and corresponding limits on those parameters. The parameters are associated with both fast and slow treatment times corresponding to length of time it takes for a person to respond to medical treatment for out-of-limit parameter measurements. Audible and visual alarms respond to the alarm trigger. An alarm silence button is pressed to silence the audible alarm for a predetermined suspend time. The audible alarm is activated after the suspend time has lapsed. Longer suspend times are associated with slow treatment parameters and shorter suspend times are associated with fast treatment parameters.

(51) **Int. Cl.**  
**G08B 5/22** (2006.01)  
**G08B 25/00** (2006.01)  
(Continued)

(52) **U.S. Cl.**  
CPC ..... **A61B 5/1455** (2013.01); **A61B 5/6826** (2013.01); **A61B 5/6838** (2013.01);  
(Continued)

(58) **Field of Classification Search**  
CPC ... A61B 5/1455; A61B 5/6826; A61B 5/6838;  
A61B 5/746; A61B 256/0276; G08B 25/001; G08B 5/22  
(Continued)

**26 Claims, 5 Drawing Sheets**



**Related U.S. Application Data**

continuation of application No. 13/476,725, filed on May 21, 2012, now Pat. No. 8,547,209, which is a continuation of application No. 12/510,982, filed on Jul. 28, 2009, now Pat. No. 8,203,438.

(60) Provisional application No. 61/084,615, filed on Jul. 29, 2008.

(51) **Int. Cl.**  
*A61B 5/00* (2006.01)  
*A61B 5/1455* (2006.01)  
*G08B 25/01* (2006.01)

(52) **U.S. Cl.**  
 CPC ..... *A61B 5/746* (2013.01); *G08B 25/01* (2013.01); *A61B 2560/0276* (2013.01); *G08B 5/22* (2013.01)

(58) **Field of Classification Search**  
 USPC .. 340/511, 517, 573.1, 539.12, 286.07, 527; 600/310, 316, 322-324, 336, 344, 507, 600/301, 320  
 See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,960,128 A 10/1990 Gordon et al.  
 4,964,408 A 10/1990 Hink et al.  
 5,041,187 A 8/1991 Hink et al.  
 5,069,213 A 12/1991 Polczynski  
 5,111,817 A 5/1992 Clark et al.  
 5,163,438 A 11/1992 Gordon et al.  
 5,226,417 A 7/1993 Swedlow et al.  
 5,253,645 A 10/1993 Friedman et al.  
 5,253,646 A 10/1993 Delpy et al.  
 5,319,355 A 6/1994 Russek  
 5,319,363 A \* 6/1994 Welch ..... H04Q 9/00  
 340/12.3

5,337,744 A 8/1994 Branigan  
 5,341,805 A 8/1994 Stavridi et al.  
 D353,195 S 12/1994 Savage et al.  
 D353,196 S 12/1994 Savage et al.  
 5,377,676 A 1/1995 Vari et al.  
 D359,546 S 6/1995 Savage et al.  
 5,431,170 A 7/1995 Mathews  
 D361,840 S 8/1995 Savage et al.  
 D362,063 S 9/1995 Savage et al.  
 5,452,717 A 9/1995 Branigan et al.  
 D363,120 S 10/1995 Savage et al.  
 5,456,252 A 10/1995 Vari et al.  
 5,479,934 A 1/1996 Imran  
 5,482,036 A 1/1996 Diab et al.  
 5,490,505 A 2/1996 Diab et al.  
 5,494,043 A 2/1996 O'Sullivan et al.  
 5,533,511 A 7/1996 Kaspari et al.  
 5,534,851 A 7/1996 Russek  
 5,561,275 A 10/1996 Savage et al.  
 5,562,002 A 10/1996 Lalin  
 5,590,649 A 1/1997 Caro et al.  
 5,602,924 A 2/1997 Durand et al.  
 5,632,272 A 5/1997 Diab et al.  
 5,638,816 A 6/1997 Kiani-Azarbayjany et al.  
 5,638,818 A 6/1997 Diab et al.  
 5,645,440 A 7/1997 Tobler et al.  
 5,685,299 A 11/1997 Diab et al.  
 D393,830 S 4/1998 Tobler et al.  
 5,743,262 A 4/1998 Lepper, Jr. et al.  
 5,758,644 A 6/1998 Diab et al.  
 5,760,910 A 6/1998 Lepper, Jr. et al.  
 5,769,785 A 6/1998 Diab et al.  
 5,782,757 A 7/1998 Diab et al.  
 5,785,659 A 7/1998 Caro et al.  
 5,791,347 A 8/1998 Flaherty et al.

5,810,734 A 9/1998 Caro et al.  
 5,823,950 A 10/1998 Diab et al.  
 5,830,131 A 11/1998 Caro et al.  
 5,833,618 A 11/1998 Caro et al.  
 5,860,919 A 1/1999 Kiani-Azarbayjany et al.  
 5,876,348 A 3/1999 Sugo et al.  
 5,890,929 A 4/1999 Mills et al.  
 5,904,654 A 5/1999 Wohltmann et al.  
 5,919,134 A 7/1999 Diab  
 5,934,925 A 8/1999 Tobler et al.  
 5,940,182 A 8/1999 Lepper, Jr. et al.  
 5,995,855 A 11/1999 Kiani et al.  
 5,997,343 A 12/1999 Mills et al.  
 6,002,952 A 12/1999 Diab et al.  
 6,005,658 A 12/1999 Kaluza et al.  
 6,011,986 A 1/2000 Diab et al.  
 6,027,452 A 2/2000 Flaherty et al.  
 6,036,642 A 3/2000 Diab et al.  
 6,045,509 A 4/2000 Caro et al.  
 6,050,951 A 4/2000 Friedman et al.  
 6,067,462 A 5/2000 Diab et al.  
 6,081,735 A 6/2000 Diab et al.  
 6,088,607 A 7/2000 Diab et al.  
 6,110,522 A 8/2000 Lepper, Jr. et al.  
 6,124,597 A 9/2000 Shehada  
 6,128,521 A 10/2000 Marro et al.  
 6,129,675 A 10/2000 Jay  
 6,144,868 A 11/2000 Parker  
 6,151,516 A 11/2000 Kiani-Azarbayjany et al.  
 6,152,754 A 11/2000 Gerhardt et al.  
 6,157,850 A 12/2000 Diab et al.  
 6,165,005 A 12/2000 Mills et al.  
 6,184,521 B1 2/2001 Coffin, IV et al.  
 6,190,325 B1 2/2001 Narimatsu  
 6,206,830 B1 3/2001 Diab et al.  
 6,229,856 B1 5/2001 Diab et al.  
 6,232,609 B1 5/2001 Snyder et al.  
 6,236,872 B1 5/2001 Diab et al.  
 6,241,683 B1 6/2001 Macklem et al.  
 6,253,097 B1 6/2001 Aronow et al.  
 6,256,523 B1 7/2001 Diab et al.  
 6,263,222 B1 7/2001 Diab et al.  
 6,278,522 B1 8/2001 Lepper, Jr. et al.  
 6,280,213 B1 8/2001 Tobler et al.  
 6,285,896 B1 9/2001 Tobler et al.  
 6,301,493 B1 10/2001 Marro et al.  
 6,317,627 B1 11/2001 Ennen et al.  
 6,321,100 B1 11/2001 Parker  
 6,325,761 B1 12/2001 Jay  
 6,334,065 B1 12/2001 Al-Ali et al.  
 6,343,224 B1 1/2002 Parker  
 6,349,228 B1 2/2002 Kiani et al.  
 6,360,114 B1 3/2002 Diab et al.  
 6,368,283 B1 4/2002 Xu et al.  
 6,371,921 B1 4/2002 Caro et al.  
 6,377,829 B1 4/2002 Al-Ali  
 6,388,240 B2 5/2002 Schulz et al.  
 6,397,091 B2 5/2002 Diab et al.  
 6,430,437 B1 8/2002 Marro  
 6,430,525 B1 8/2002 Weber et al.  
 6,463,311 B1 10/2002 Diab  
 6,470,199 B1 10/2002 Kopotic et al.  
 6,501,975 B2 12/2002 Diab et al.  
 6,505,059 B1 1/2003 Kollias et al.  
 6,515,273 B2 2/2003 Al-Ali  
 6,519,487 B1 2/2003 Parker  
 6,525,386 B1 2/2003 Mills et al.  
 6,526,300 B1 2/2003 Kiani et al.  
 6,541,756 B2 4/2003 Schulz et al.  
 6,542,764 B1 4/2003 Al-Ali et al.  
 6,553,242 B1 4/2003 Sarussi  
 6,580,086 B1 6/2003 Schulz et al.  
 6,584,336 B1 6/2003 Ali et al.  
 6,595,316 B2 7/2003 Cybulski et al.  
 6,597,932 B2 7/2003 Tian et al.  
 6,597,933 B2 7/2003 Kiani et al.  
 6,606,511 B1 8/2003 Ali et al.  
 6,632,181 B2 10/2003 Flaherty et al.  
 6,639,668 B1 10/2003 Trepagnier

(56)

References Cited

U.S. PATENT DOCUMENTS

6,640,116 B2	10/2003	Diab	RE39,672 E	6/2007	Shehada et al.
6,643,530 B2	11/2003	Diab et al.	7,239,905 B2	7/2007	Kiani-Azarbayjany et al.
6,645,155 B2	11/2003	Inukai et al.	7,245,953 B1	7/2007	Parker
6,650,917 B2	11/2003	Diab et al.	7,254,429 B2	8/2007	Schurman et al.
6,654,624 B2	11/2003	Diab et al.	7,254,431 B2	8/2007	Al-Ali
6,658,276 B2 *	12/2003	Kianl et al. .... 600/322	7,254,433 B2	8/2007	Diab et al.
6,661,161 B1	12/2003	Lanzo et al.	7,254,434 B2	8/2007	Schulz et al.
6,671,531 B2	12/2003	Al-Ali et al.	7,272,425 B2	9/2007	Al-Ali
6,678,543 B2	1/2004	Diab et al.	7,274,955 B2	9/2007	Kiani et al.
6,684,090 B2	1/2004	Ali et al.	D554,263 S	10/2007	Al-Ali
6,684,091 B2	1/2004	Parker	7,280,858 B2	10/2007	Al-Ali et al.
6,697,656 B1	2/2004	Al-Ali	7,289,835 B2	10/2007	Mansfield et al.
6,697,657 B1	2/2004	Shehada et al.	7,292,883 B2	11/2007	De Felice et al.
6,697,658 B2	2/2004	Al-Ali	7,295,866 B2	11/2007	Al-Ali
RE38,476 E	3/2004	Diab et al.	7,328,053 B1	2/2008	Diab et al.
6,699,194 B1	3/2004	Diab et al.	7,332,784 B2	2/2008	Mills et al.
6,714,804 B2	3/2004	Al-Ali et al.	7,340,287 B2	3/2008	Mason et al.
RE38,492 E	4/2004	Diab et al.	7,341,559 B2	3/2008	Schulz et al.
6,721,582 B2	4/2004	Trepagnier et al.	7,343,186 B2	3/2008	Lamego et al.
6,721,585 B1	4/2004	Parker	D566,282 S	4/2008	Al-Ali et al.
6,725,075 B2	4/2004	Al-Ali	7,355,512 B1	4/2008	Al-Ali
6,728,560 B2	4/2004	Kollias et al.	7,356,365 B2	4/2008	Schurman
6,735,459 B2	5/2004	Parker	7,371,981 B2	5/2008	Abdul-Hafiz
6,745,060 B2	6/2004	Diab et al.	7,373,193 B2	5/2008	Al-Ali et al.
6,754,516 B2	6/2004	Mannheimer	7,373,194 B2	5/2008	Weber et al.
6,760,607 B2	7/2004	Al-Ali	7,376,453 B1	5/2008	Diab et al.
6,770,028 B1	8/2004	Ali et al.	7,377,794 B2	5/2008	Al-Ali et al.
6,771,994 B2	8/2004	Kiani et al.	7,377,899 B2	5/2008	Weber et al.
6,792,300 B1	9/2004	Diab et al.	7,383,070 B2	6/2008	Diab et al.
6,813,511 B2	11/2004	Diab et al.	7,415,297 B2	8/2008	Al-Ali et al.
6,816,741 B2	11/2004	Diab	7,428,432 B2	9/2008	Ali et al.
6,822,564 B2	11/2004	Al-Ali	7,438,683 B2	10/2008	Al-Ali et al.
6,826,419 B2	11/2004	Diab et al.	7,440,787 B2	10/2008	Diab
6,830,711 B2	12/2004	Mills et al.	7,454,240 B2	11/2008	Diab et al.
6,850,787 B2	2/2005	Weber et al.	7,467,002 B2	12/2008	Weber et al.
6,850,788 B2	2/2005	Al-Ali	7,469,157 B2	12/2008	Diab et al.
6,852,083 B2	2/2005	Caro et al.	7,471,969 B2	12/2008	Diab et al.
6,861,639 B2	3/2005	Al-Ali	7,471,971 B2	12/2008	Diab et al.
6,898,452 B2	5/2005	Al-Ali et al.	7,483,729 B2	1/2009	Al-Ali et al.
6,920,345 B2	7/2005	Al-Ali et al.	7,483,730 B2	1/2009	Diab et al.
6,931,268 B1	8/2005	Kiani-Azarbayjany et al.	7,489,958 B2	2/2009	Diab et al.
6,934,570 B2	8/2005	Kiani et al.	7,496,391 B2	2/2009	Diab et al.
6,939,305 B2	9/2005	Flaherty et al.	7,496,393 B2	2/2009	Diab et al.
6,943,348 B1	9/2005	Coffin IV	D587,657 S	3/2009	Al-Ali et al.
6,950,687 B2	9/2005	Al-Ali	7,499,741 B2	3/2009	Diab et al.
6,961,598 B2	11/2005	Diab	7,499,835 B2	3/2009	Weber et al.
6,970,792 B1	11/2005	Diab	7,500,950 B2	3/2009	Al-Ali et al.
6,979,812 B2	12/2005	Al-Ali	7,509,154 B2	3/2009	Diab et al.
6,985,764 B2	1/2006	Mason et al.	7,509,494 B2	3/2009	Al-Ali
6,993,371 B2	1/2006	Kiani et al.	7,510,849 B2	3/2009	Schurman et al.
6,996,427 B2	2/2006	Ali et al.	7,526,328 B2	4/2009	Diab et al.
6,999,904 B2	2/2006	Weber et al.	7,530,942 B1	5/2009	Diab
7,003,338 B2	2/2006	Weber et al.	7,530,949 B2	5/2009	Al Ali et al.
7,003,339 B2	2/2006	Diab et al.	7,530,955 B2	5/2009	Diab et al.
7,015,451 B2	3/2006	Dalke et al.	7,563,110 B2	7/2009	Al-Ali et al.
7,024,233 B2	4/2006	Ali et al.	7,596,398 B2	9/2009	Al-Ali et al.
7,027,849 B2	4/2006	Al-Ali	7,618,375 B2	11/2009	Flaherty
7,030,749 B2	4/2006	Al-Ali	D606,659 S	12/2009	Kiani et al.
7,039,449 B2	5/2006	Al-Ali	7,647,083 B2	1/2010	Al-Ali et al.
7,041,060 B2	5/2006	Flaherty et al.	D609,193 S	2/2010	Al-Ali et al.
7,044,918 B2	5/2006	Diab	D614,305 S	4/2010	Al-Ali et al.
7,067,893 B2	6/2006	Mills et al.	RE41,317 E	5/2010	Parker
7,096,052 B2	8/2006	Mason et al.	7,729,733 B2	6/2010	Al-Ali et al.
7,096,054 B2	8/2006	Abdul-Hafiz et al.	7,734,320 B2	6/2010	Al-Ali
7,123,950 B2	10/2006	Mannheimer	7,761,127 B2	7/2010	Al-Ali et al.
7,132,641 B2	11/2006	Schulz et al.	7,761,128 B2	7/2010	Al-Ali et al.
7,142,901 B2	11/2006	Kiani et al.	7,764,982 B2	7/2010	Dalke et al.
7,149,561 B2	12/2006	Diab	D621,516 S	8/2010	Kiani et al.
7,186,966 B2	3/2007	Al-Ali	7,791,155 B2	9/2010	Diab
7,190,261 B2	3/2007	Al-Ali	7,801,581 B2	9/2010	Diab
7,215,984 B2	5/2007	Diab	7,822,452 B2	10/2010	Schurman et al.
7,215,986 B2	5/2007	Diab	RE41,912 E	11/2010	Parker
7,221,971 B2	5/2007	Diab	7,844,313 B2	11/2010	Kiani et al.
7,225,006 B2	5/2007	Al-Ali et al.	7,844,314 B2	11/2010	Al-Ali
7,225,007 B2	5/2007	Al-Ali	7,844,315 B2	11/2010	Al-Ali
			7,865,222 B2	1/2011	Weber et al.
			7,873,497 B2	1/2011	Weber et al.
			7,880,606 B2	2/2011	Al-Ali
			7,880,626 B2	2/2011	Al-Ali et al.

(56)

## References Cited

## U.S. PATENT DOCUMENTS

7,891,355 B2	2/2011	Al-Ali et al.	8,385,995 B2	2/2013	Al-Ali et al.
7,894,868 B2	2/2011	Al-Ali et al.	8,385,996 B2	2/2013	Smith et al.
7,899,507 B2	3/2011	Al-Ali et al.	8,388,353 B2	3/2013	Kiani et al.
7,899,518 B2	3/2011	Trepagnier et al.	8,399,822 B2	3/2013	Al-Ali
7,904,132 B2	3/2011	Weber et al.	8,401,602 B2	3/2013	Kiani
7,909,772 B2	3/2011	Popov et al.	8,401,607 B2	3/2013	Mannheimer
7,910,875 B2	3/2011	Al-Ali	8,405,608 B2	3/2013	Al-Ali et al.
7,919,713 B2	4/2011	Al-Ali et al.	8,414,499 B2	4/2013	Al-Ali et al.
7,937,128 B2	5/2011	Al-Ali	8,418,524 B2	4/2013	Al-Ali
7,937,129 B2	5/2011	Mason et al.	8,423,106 B2	4/2013	Lamego et al.
7,937,130 B2	5/2011	Diab et al.	8,428,967 B2	4/2013	Olsen et al.
7,941,199 B2	5/2011	Kiani	8,430,817 B1	4/2013	Al-Ali et al.
7,951,086 B2	5/2011	Flaherty et al.	8,437,825 B2	5/2013	Dalvi et al.
7,957,780 B2	6/2011	Lamego et al.	8,455,290 B2	6/2013	Siskavich
7,962,188 B2	6/2011	Kiani et al.	8,457,703 B2	6/2013	Al-Ali
7,962,190 B1	6/2011	Diab et al.	8,457,707 B2	6/2013	Kiani
7,976,472 B2	7/2011	Kiani	8,463,349 B2	6/2013	Diab et al.
7,988,637 B2	8/2011	Diab	8,466,286 B2	6/2013	Bellott et al.
7,990,382 B2	8/2011	Kiani	8,471,713 B2	6/2013	Poeze et al.
7,991,446 B2	8/2011	Ali et al.	8,473,020 B2	6/2013	Kiani et al.
8,000,761 B2	8/2011	Al-Ali	8,483,787 B2	7/2013	Al-Ali et al.
8,008,088 B2	8/2011	Bellott et al.	8,489,364 B2	7/2013	Weber et al.
RE42,753 E	9/2011	Kiani-Azarbayjany et al.	8,498,684 B2	7/2013	Weber et al.
8,019,400 B2	9/2011	Diab et al.	8,504,128 B2	8/2013	Blank et al.
8,028,701 B2	10/2011	Al-Ali et al.	8,509,867 B2	8/2013	Workman et al.
8,029,765 B2	10/2011	Bellott et al.	8,515,509 B2	8/2013	Bruinsma et al.
8,036,727 B2	10/2011	Schurman et al.	8,523,781 B2	9/2013	Al-Ali
8,036,728 B2	10/2011	Diab et al.	8,529,301 B2	9/2013	Al-Ali et al.
8,046,040 B2	10/2011	Ali et al.	8,532,727 B2	9/2013	Ali et al.
8,046,041 B2	10/2011	Diab et al.	8,532,728 B2	9/2013	Diab et al.
8,046,042 B2	10/2011	Diab et al.	D692,145 S	10/2013	Al-Ali et al.
8,048,040 B2	11/2011	Kiani	8,547,209 B2 *	10/2013	Kiani et al. .... 340/286.07
8,050,728 B2	11/2011	Al-Ali et al.	8,548,548 B2	10/2013	Al-Ali
RE43,169 E	2/2012	Parker	8,548,549 B2	10/2013	Schurman et al.
8,118,620 B2	2/2012	Al-Ali et al.	8,548,550 B2	10/2013	Al-Ali et al.
8,126,528 B2	2/2012	Diab et al.	8,554,297 B2	10/2013	Moon et al.
8,123,572 B2	3/2012	Diab et al.	8,560,032 B2	10/2013	Al-Ali et al.
8,128,572 B2	3/2012	Diab et al.	8,560,034 B1	10/2013	Diab et al.
8,130,105 B2	3/2012	Al-Ali et al.	8,570,167 B2	10/2013	Al-Ali
8,145,287 B2	3/2012	Diab et al.	8,570,503 B2	10/2013	Vo et al.
8,150,487 B2	4/2012	Diab et al.	8,571,617 B2	10/2013	Reichgott et al.
8,175,672 B2	5/2012	Parker	8,571,618 B1	10/2013	Lamego et al.
8,180,420 B2	5/2012	Diab et al.	8,571,619 B2	10/2013	Al-Ali et al.
8,182,443 B1	5/2012	Kiani	8,577,431 B2	11/2013	Lamego et al.
8,185,180 B2	5/2012	Diab et al.	8,581,732 B2	11/2013	Al-Ali et al.
8,190,223 B2	5/2012	Al-Ali et al.	8,584,345 B2	11/2013	Al-Ali et al.
8,190,227 B2	5/2012	Diab et al.	8,588,880 B2	11/2013	Abdul-Hafiz et al.
8,203,438 B2 *	6/2012	Kiani et al. .... 340/286.07	8,600,467 B2	12/2013	Al-Ali et al.
8,203,704 B2	6/2012	Merritt et al.	8,606,342 B2	12/2013	Diab
8,204,566 B2	6/2012	Schurman et al.	8,626,255 B2	1/2014	Al-Ali et al.
8,219,172 B2	7/2012	Schurman et al.	8,630,691 B2	1/2014	Lamego et al.
8,224,411 B2	7/2012	Al-Ali et al.	8,634,889 B2	1/2014	Al-Ali et al.
8,228,181 B2	7/2012	Al-Ali	8,641,631 B2	2/2014	Sierra et al.
8,229,533 B2	7/2012	Diab et al.	8,652,060 B2	2/2014	Al-Ali
8,233,955 B2	7/2012	Al-Ali et al.	8,663,107 B2	3/2014	Kiani
8,244,325 B2	8/2012	Al-Ali et al.	8,666,468 B1	3/2014	Al-Ali
8,255,026 B1	8/2012	Al-Ali	8,667,967 B2	3/2014	Al-Ali et al.
8,255,027 B2	8/2012	Al-Ali et al.	8,670,811 B2	3/2014	O'Reilly
8,255,028 B2	8/2012	Al-Ali et al.	8,670,814 B2	3/2014	Diab et al.
8,260,577 B2	9/2012	Weber et al.	8,676,286 B2	3/2014	Weber et al.
8,265,723 B1	9/2012	McHale et al.	8,682,407 B2	3/2014	Al-Ali
8,274,360 B2	9/2012	Sampath et al.	RE44,823 E	4/2014	Parker
8,301,217 B2	10/2012	Al-Ali et al.	RE44,875 E	4/2014	Kiani et al.
8,306,596 B2	11/2012	Schurman et al.	8,690,799 B2	4/2014	Telfort et al.
8,310,336 B2	11/2012	Muhsin et al.	8,700,112 B2	4/2014	Kiani
8,315,683 B2	11/2012	Al-Ali et al.	8,702,627 B2	4/2014	Telfort et al.
RE43,860 E	12/2012	Parker	8,706,179 B2	4/2014	Parker
8,337,403 B2	12/2012	Al-Ali et al.	8,712,494 B1	4/2014	MacNeish, III et al.
8,346,330 B2	1/2013	Lamego	8,715,206 B2	5/2014	Telfort et al.
8,353,842 B2	1/2013	Al-Ali et al.	8,718,735 B2	5/2014	Lamego et al.
8,355,766 B2	1/2013	MacNeish, III et al.	8,718,737 B2	5/2014	Diab et al.
8,359,080 B2	1/2013	Diab et al.	8,718,738 B2	5/2014	Blank et al.
8,364,223 B2	1/2013	Al-Ali et al.	8,720,249 B2	5/2014	Al-Ali
8,364,226 B2	1/2013	Diab et al.	8,721,541 B2	5/2014	Al-Ali et al.
8,374,665 B2	2/2013	Lamego	8,721,542 B2	5/2014	Al-Ali et al.
			8,723,677 B1	5/2014	Kiani
			8,740,792 B1	6/2014	Kiani et al.
			8,754,776 B2	6/2014	Poeze et al.
			8,755,535 B2	6/2014	Telfort et al.

(56)

References Cited

U.S. PATENT DOCUMENTS

8,755,856 B2	6/2014	Diab et al.	9,153,121 B2	10/2015	Kiani et al.
8,755,872 B1	6/2014	Marinow	9,161,696 B2	10/2015	Al-Ali et al.
8,761,850 B2	6/2014	Lamego	9,161,713 B2	10/2015	Al-Ali et al.
8,764,671 B2	7/2014	Kiani	9,167,995 B2	10/2015	Lamego et al.
8,768,423 B2	7/2014	Shakespeare et al.	9,176,141 B2	11/2015	Al-Ali et al.
8,771,204 B2	7/2014	Telfort et al.	9,186,102 B2	11/2015	Bruinsma et al.
8,777,634 B2	7/2014	Kiani et al.	9,192,312 B2	11/2015	Al-Ali
8,781,543 B2	7/2014	Diab et al.	9,195,385 B2	11/2015	Al-Ali et al.
8,781,544 B2	7/2014	Al-Ali et al.	9,211,072 B2	12/2015	Kiani
8,781,549 B2	7/2014	Al-Ali et al.	9,211,095 B1	12/2015	Al-Ali
8,788,003 B2	7/2014	Schurman et al.	9,218,454 B2	12/2015	Kiani et al.
8,790,268 B2	7/2014	Al-Ali	9,226,696 B2	1/2016	Kiani
8,801,613 B2	8/2014	Al-Ali et al.	9,241,662 B2	1/2016	Al-Ali et al.
8,821,397 B2	9/2014	Al-Ali et al.	9,245,668 B1	1/2016	Vo et al.
8,821,415 B2	9/2014	Al-Ali et al.	9,259,185 B2	2/2016	Abdul-Hafiz et al.
8,830,449 B1	9/2014	Lamego et al.	9,267,572 B2	2/2016	Barker et al.
8,831,700 B2	9/2014	Schurman et al.	9,277,880 B2	3/2016	Poeze et al.
8,838,196 B2	9/2014	Mannheimer	9,289,167 B2	3/2016	Diab et al.
8,840,549 B2	9/2014	Al-Ali et al.	9,295,421 B2	3/2016	Kiani et al.
8,847,740 B2 *	9/2014	Kiani et al. .... 340/286.07	9,307,928 B1	4/2016	Al-Ali et al.
8,849,365 B2	9/2014	Smith et al.	9,323,894 B2	4/2016	Kiani
8,852,094 B2	10/2014	Al-Ali et al.	D755,392 S	5/2016	Hwang et al.
8,852,115 B2	10/2014	Muir	9,326,712 B1	5/2016	Kiani
8,852,994 B2	10/2014	Wojtczuk et al.	9,333,316 B2	5/2016	Kiani
8,868,147 B2	10/2014	Stippick et al.	9,339,220 B2	5/2016	Lamego et al.
8,868,150 B2	10/2014	Al-Ali et al.	9,341,565 B2	5/2016	Lamego et al.
8,870,792 B2	10/2014	Al-Ali et al.	9,351,673 B2	5/2016	Diab et al.
8,886,271 B2	11/2014	Kiani et al.	9,351,675 B2	5/2016	Al-Ali et al.
8,888,539 B2	11/2014	Al-Ali et al.	9,364,181 B2	6/2016	Kiani et al.
8,888,708 B2	11/2014	Diab et al.	9,368,671 B2	6/2016	Wojtczuk et al.
8,892,180 B2	11/2014	Weber et al.	9,370,325 B2	6/2016	Al-Ali et al.
8,897,847 B2	11/2014	Al-Ali	9,370,326 B2	6/2016	McHale et al.
8,909,310 B2	12/2014	Lamego et al.	9,370,335 B2	6/2016	Al-Ali et al.
8,911,377 B2	12/2014	Al-Ali	9,375,185 B2	6/2016	Ali et al.
8,912,909 B2	12/2014	Al-Ali et al.	9,386,953 B2	7/2016	Al-Ali
8,920,317 B2	12/2014	Al-Ali et al.	9,386,961 B2	7/2016	Al-Ali et al.
8,921,699 B2	12/2014	Al-Ali et al.	9,392,945 B2	7/2016	Al-Ali et al.
8,922,382 B2	12/2014	Al-Ali et al.	9,397,448 B2	7/2016	Al-Ali et al.
8,929,964 B2	1/2015	Al-Ali et al.	9,408,542 B1	8/2016	Kinast et al.
8,942,777 B2	1/2015	Diab et al.	9,436,645 B2	9/2016	Al-Ali et al.
8,948,834 B2	2/2015	Diab et al.	9,445,759 B1	9/2016	Lamego et al.
8,948,835 B2	2/2015	Diab	9,466,919 B2	10/2016	Kiani et al.
8,956,294 B2	2/2015	McCombie et al.	9,474,474 B2	10/2016	Lamego et al.
8,965,471 B2	2/2015	Lamego	9,192,329 B2	11/2016	Al-Ali
8,983,564 B2	3/2015	Al-Ali	9,192,351 B1	11/2016	Telfort et al.
8,989,831 B2	3/2015	Al-Ali et al.	9,480,422 B2	11/2016	Al-Ali
8,996,085 B2	3/2015	Kiani et al.	9,480,435 B2	11/2016	Olsen
8,998,809 B2	4/2015	Kiani	9,492,110 B2	11/2016	Al-Ali et al.
9,028,407 B1 *	5/2015	Bennett-Guerrero .....	9,510,779 B2	12/2016	Poeze et al.
		A61B 5/1121	9,517,024 B2	12/2016	Kiani et al.
		600/301	9,532,722 B2	1/2017	Lamego et al.
9,028,429 B2	5/2015	Telfort et al.	9,538,949 B2	1/2017	Al-Ali et al.
9,037,207 B2	5/2015	Al-Ali et al.	9,538,980 B2	1/2017	Telfort et al.
9,060,721 B2	6/2015	Reichgott et al.	9,549,696 B2	1/2017	Lamego et al.
9,066,666 B2	6/2015	Kiani	9,554,737 B2	1/2017	Schurman et al.
9,066,680 B1	6/2015	Al-Ali et al.	9,560,996 B2	2/2017	Kiani
9,072,474 B2	7/2015	Al-Ali et al.	9,560,998 B2	2/2017	Al-Ali et al.
9,078,560 B2	7/2015	Schurman et al.	9,566,019 B2	2/2017	Al-Ali et al.
9,084,569 B2	7/2015	Weber et al.	9,579,039 B2	2/2017	Jansen et al.
9,095,316 B2	8/2015	Welch et al.	9,591,975 B2	3/2017	Dalvi et al.
9,106,038 B2	8/2015	Telfort et al.	9,622,693 B2	4/2017	Diab
9,107,625 B2	8/2015	Telfort et al.	2002/0161291 A1	10/2002	Kiani et al.
9,107,626 B2	8/2015	Al-Ali et al.	2003/0137423 A1	7/2003	Al-Ali
9,113,831 B2	8/2015	Al-Ali	2003/0191358 A1	10/2003	MacKin et al.
9,113,832 B2	8/2015	Al-Ali	2004/0162499 A1	8/2004	Nagai et al.
9,119,595 B2	9/2015	Lamego	2005/0027182 A1 *	2/2005	Siddiqui ..... A61B 5/14532
9,131,881 B2	9/2015	Diab et al.	2005/0177096 A1 *	8/2005	Bollish ..... A61B 5/02055
9,131,882 B2	9/2015	Al-Ali et al.	2005/0240091 A1	10/2005	Lynn
9,131,883 B2	9/2015	Al-Ali	2006/0220881 A1 *	10/2006	Al-Ali ..... A61B 5/14552
9,131,917 B2	9/2015	Telfort et al.	2007/0040692 A1 *	2/2007	Smith et al. .... 340/573.1
9,138,180 B1	9/2015	Coverston et al.	2007/0282478 A1	12/2007	Al-Ali et al.
9,138,182 B2	9/2015	Al-Ali et al.	2008/0103375 A1	5/2008	Kiani ..... A61B 5/0002
9,138,192 B2	9/2015	Weber et al.	2008/0244425 A1	10/2008	Kikin-Gil et al.
9,142,117 B2	9/2015	Muhsin et al.	2008/0255438 A1 *	10/2008	Saidara ..... A61B 5/14532
9,153,112 B1	10/2015	Kiani et al.			600/365

(56)

## References Cited

## U.S. PATENT DOCUMENTS

2008/0281168	A1*	11/2008	Gibson .....	A61B 5/0205 600/301	2014/0275808	A1	9/2014	Poeze et al.
2009/0040874	A1*	2/2009	Rooney .....	A61J 7/0472 368/10	2014/0275835	A1	9/2014	Lamego et al.
2009/0247848	A1	10/2009	Baker		2014/0275871	A1	9/2014	Lamego et al.
2009/0247849	A1	10/2009	McCutcheon et al.		2014/0275872	A1	9/2014	Merritt et al.
2009/0247984	A1	10/2009	Lamego et al.		2014/0276115	A1	9/2014	Dalvi et al.
2009/0275813	A1	11/2009	Davis		2014/0288400	A1	9/2014	Diab et al.
2009/0275844	A1	11/2009	Al-Ali		2014/0309507	A1	10/2014	Baker, Jr.
2010/0004518	A1	1/2010	Vo et al.		2014/0316217	A1	10/2014	Purdon et al.
2010/0030040	A1	2/2010	Poeze et al.		2014/0316218	A1	10/2014	Purdon et al.
2010/0113904	A1	5/2010	Batchelder et al.		2014/0316228	A1	10/2014	Blank et al.
2010/0331656	A1	12/2010	Mensingher et al.		2014/0323825	A1	10/2014	Al-Ali et al.
2011/0082711	A1	4/2011	Poeze et al.		2014/0323897	A1	10/2014	Brown et al.
2011/0105854	A1	5/2011	Kiani et al.		2014/0323898	A1	10/2014	Purdon et al.
2011/0125060	A1	5/2011	Telfort et al.		2014/0330092	A1	11/2014	Al-Ali et al.
2011/0208015	A1	8/2011	Welch et al.		2014/0330098	A1	11/2014	Merritt et al.
2011/0213212	A1	9/2011	Al-Ali		2014/0330099	A1	11/2014	Al-Ali et al.
2011/0230733	A1	9/2011	Al-Ali		2014/0336481	A1	11/2014	Shakespeare et al.
2011/0237969	A1	9/2011	Eckerbom et al.		2014/0357966	A1	12/2014	Al-Ali et al.
2011/0288383	A1	11/2011	Diab		2015/0005600	A1	1/2015	Blank et al.
2012/0041316	A1	2/2012	Al-Ali et al.		2015/0011907	A1	1/2015	Purdon et al.
2012/0046557	A1	2/2012	Kiani		2015/0012231	A1	1/2015	Poeze et al.
2012/0059267	A1	3/2012	Lamego et al.		2015/0025406	A1	1/2015	Al-Ali
2012/0088984	A1	4/2012	Al-Ali et al.		2015/0032029	A1	1/2015	Al-Ali et al.
2012/0105233	A1	5/2012	Bobey et al.		2015/0038859	A1	2/2015	Dalvi et al.
2012/0165629	A1	6/2012	Merritt et al.		2015/0045637	A1	2/2015	Dalvi
2012/0209082	A1	8/2012	Al-Ali		2015/0051462	A1	2/2015	Olsen
2012/0209084	A1	8/2012	Olsen et al.		2015/0080754	A1	3/2015	Purdon et al.
2012/0232366	A1*	9/2012	Kiani .....	A61B 5/1455 600/324	2015/0087936	A1	3/2015	Al-Ali et al.
2012/0283524	A1	11/2012	Kiani et al.		2015/0094546	A1	4/2015	Al-Ali
2012/0296178	A1	11/2012	Lamego et al.		2015/0097701	A1	4/2015	Al-Ali et al.
2012/0303085	A1	11/2012	Vitense et al.		2015/0099950	A1	4/2015	Al-Ali et al.
2012/0319816	A1	12/2012	Al-Ali		2015/0099951	A1	4/2015	Al-Ali et al.
2013/0023775	A1	1/2013	Lamego et al.		2015/0099955	A1	4/2015	Al-Ali et al.
2013/0041591	A1	2/2013	Lamego		2015/0101844	A1	4/2015	Al-Ali et al.
2013/0046204	A1	2/2013	Lamego et al.		2015/0106121	A1	4/2015	Muhsin et al.
2013/0060147	A1	3/2013	Welch et al.		2015/0112151	A1	4/2015	Muhsin et al.
2013/0096405	A1	4/2013	Garfio		2015/0116076	A1	4/2015	Al-Ali et al.
2013/0096936	A1	4/2013	Sampath et al.		2015/0126830	A1	5/2015	Schurman et al.
2013/0243021	A1	9/2013	Siskavich		2015/0133755	A1	5/2015	Smith et al.
2013/0253334	A1	9/2013	Al-Ali et al.		2015/0141781	A1	5/2015	Weber et al.
2013/0267804	A1	10/2013	Al-Ali		2015/0165312	A1	6/2015	Kiani
2013/0274572	A1	10/2013	Al-Ali et al.		2015/0196237	A1	7/2015	Lamego
2013/0296672	A1	11/2013	O'Neil et al.		2015/0216459	A1	8/2015	Al-Ali et al.
2013/0296713	A1	11/2013	Al-Ali et al.		2015/0230755	A1	8/2015	Al-Ali et al.
2013/0324808	A1	12/2013	Al-Ali et al.		2015/0238722	A1	8/2015	Al-Ali
2013/0331660	A1	12/2013	Al-Ali et al.		2015/0245773	A1	9/2015	Lamego et al.
2013/0331670	A1	12/2013	Kiani		2015/0245794	A1	9/2015	Al-Ali
2014/0012100	A1	1/2014	Al-Ali et al.		2015/0257689	A1	9/2015	Al-Ali et al.
2014/0034353	A1	2/2014	Al-Ali et al.		2015/0272514	A1	10/2015	Kiani et al.
2014/0051953	A1	2/2014	Lamego et al.		2015/0351697	A1	12/2015	Weber et al.
2014/0066783	A1	3/2014	Kiani et al.		2015/0351704	A1	12/2015	Kiani et al.
2014/0077956	A1	3/2014	Sampath et al.		2015/0359429	A1	12/2015	Al-Ali et al.
2014/0081100	A1	3/2014	Muhsin et al.		2015/0366472	A1	12/2015	Kiani
2014/0081175	A1	3/2014	Telfort		2015/0366507	A1	12/2015	Blank
2014/0100434	A1	4/2014	Diab et al.		2015/0374298	A1	12/2015	Al-Ali et al.
2014/0114199	A1	4/2014	Lamego et al.		2015/0380875	A1	12/2015	Coverston et al.
2014/0120564	A1	5/2014	Workman et al.		2016/0000362	A1	1/2016	Diab et al.
2014/0121482	A1	5/2014	Merritt et al.		2016/0007930	A1	1/2016	Weber et al.
2014/0127137	A1	5/2014	Bellott et al.		2017/0007134	A1	1/2016	Al-Ali et al.
2014/0129702	A1	5/2014	Lamego et al.		2016/0029932	A1	2/2016	Al-Ali
2014/0135588	A1	5/2014	Al-Ali et al.		2016/0045118	A1	2/2016	Kiani
2014/0142401	A1	5/2014	Al-Ali et al.		2016/0051205	A1	2/2016	Al-Ali et al.
2014/0163344	A1	6/2014	Al-Ali		2016/0058338	A1	3/2016	Schurman et al.
2014/0163402	A1	6/2014	Lamego et al.		2016/0058347	A1	3/2016	Reichgott et al.
2014/0166076	A1	6/2014	Kiani et al.		2016/0066823	A1	3/2016	Kind et al.
2014/0171763	A1	6/2014	Diab		2016/0066824	A1	3/2016	Al-Ali et al.
2014/0180038	A1	6/2014	Kiani		2016/0066879	A1	3/2016	Telfort et al.
2014/0180154	A1	6/2014	Sierra et al.		2016/0072429	A1	3/2016	Kiani et al.
2014/0180160	A1	6/2014	Brown et al.		2016/0081552	A1	3/2016	Wojtczuk et al.
2014/0187973	A1	7/2014	Brown et al.		2016/0095543	A1	4/2016	Telfort et al.
2014/0213864	A1	7/2014	Abdul-Hafiz et al.		2016/0095548	A1	4/2016	Al-Ali et al.
2014/0266790	A1	9/2014	Al-Ali et al.		2016/0103598	A1	4/2016	Al-Ali et al.
					2016/0113527	A1	4/2016	Al-Ali et al.
					2016/0143548	A1	5/2016	Al-Ali
					2016/0166182	A1	6/2016	Al-Ali et al.
					2016/0166183	A1	6/2016	Poeze et al.
					2016/0166188	A1	6/2016	Bruinsma et al.
					2016/0166210	A1	6/2016	Al-Ali
					2016/0192869	A1	7/2016	Kiani et al.

(56)

**References Cited**

## U.S. PATENT DOCUMENTS

2016/0196388	A1	7/2016	Lamego
2016/0197436	A1	7/2016	Barker et al.
2016/0213281	A1	7/2016	Eckerbom et al.
2016/0228043	A1	8/2016	O'Neil et al.
2016/0233632	A1	8/2016	Scruggs et al.
2016/0234944	A1	8/2016	Schmidt et al.
2016/0270735	A1	9/2016	Diab et al.
2016/0283665	A1	9/2016	Sampath et al.
2016/0287090	A1	10/2016	Al-Ali et al.
2016/0287786	A1	10/2016	Kiani
2016/0296169	A1	10/2016	McHale et al.
2016/0310052	A1	10/2016	Al-Ali et al.
2016/0314260	A1	10/2016	Kiani
2016/0324486	A1	11/2016	Al-Ali et al.
2016/0324488	A1	11/2016	Olsen
2016/0327984	A1	11/2016	Al-Ali et al.
2016/0328528	A1	11/2016	Al-Ali et al.
2016/0331332	A1	11/2016	Al-Ali
2016/0367173	A1	12/2016	Dalvi et al.
2017/0007190	A1	1/2017	Al-Ali et al.
2017/0007198	A1	1/2017	Al-Ali et al.
2017/0014084	A1	1/2017	Al-Ali et al.
2017/0021099	A1	1/2017	Al-Ali et al.
2017/0027456	A1	2/2017	Kinast et al.
2017/0042488	A1	2/2017	Muhsin
2017/0055847	A1	3/2017	Kiani et al.
2017/0055851	A1	3/2017	Al-Ali
2017/0055882	A1	3/2017	Al-Ali et al.
2017/0055887	A1	3/2017	Al-Ali
2017/0055896	A1	3/2017	Al-Ali et al.
2017/0079594	A1	3/2017	Telfort et al.
2017/0086723	A1	3/2017	Al-Ali et al.

## OTHER PUBLICATIONS

Rheineck-Leyssius, MD, et al., "Advanced Pulse Oximeter Signal Processing Technology Compared to Simple Averaging. I. Effect on Frequency of Alarms in the Operating Room", *Journal of Clinical Anesthesia*, The Netherlands, May 1999, vol. 11, pp. 192-195.

Cust, Ae, et al., "Alarm settings for the Marquette 8000 pulse oximeter to prevent hyperoxic and hypoxic episodes", *Journal Paediatric Child Health*, 1999, vol. 35, pp. 159-162.

Lawless, Stephen T., "Crying wolf: False alarms in a pediatric intensive care unit", *Critical Care Medicine*, 1994, vol. 22, No. 6, pp. 981-985.

Informal Expert Report of Dr. Stephen Barker, Lead Case No. 16-05968-LT11, executed Feb. 10, 2017.

Impact of Clinical Alarms on Patient Safety, ACCE Healthcare Technology Foundation, 2006, 20 pages.

Taenzer, M.D., Andreas, "Impact of Pulse Oximetry Surveillance on Rescue Events and Intensive Care Unit Transfers", *The American Society of Anesthesiologists, Inc.*, Feb. 2010, vol. 112, No. 2, pp. 282-287.

Stefanescu, MD MSc, Beatrice, "Improved Filtering of Pulse Oximeter Monitoring Alarms in the Neonatal ICU: Bedside Significance", *Respiratory Care*, Jan. 2016, vol. 61, No. 1, pp. 85-89.

Rheineck-Leyssius, A.T., et al., "Influence of pulse oximeter lower alarm limit on the incidence of hypoxaemia in the recovery room", *British Journal of Anaesthesia*, 1997, vol. 79, pp. 460-464.

Rheineck-Leyssius, MD, Aart, et al., "Influence of Pulse Oximeter Settings on the Frequency of Alarms, and Detection of Hypoxemia", *Journal of Clinical Monitoring and Computing*, 1998, vol. 14, pp. 151-156.

Pan, MD., Peter, "Intraoperative Pulse Oximetry: Frequency and Distribution of Discrepant Data", *Journal of Clinical Monitoring and Computing*, Nov./Dec. 1994, vol. 6, pp. 491-495.

Graham, Kelly, et al., Monitor Alarm Fatigue: Standardizing Use of Physiological Monitors and Decreasing Nuisance Alarms, *American Journal of Critical Care*, Jan. 2010, vol. 19, No. 1, pp. 27-37.

Barker, PhD, MD, Steven, "'Motion-Resistant' Pulse Oximetry: A Comparison of New and Old Models" Department of Anesthesiology, 2002, vol. 95, pp. 967-972.

National Patient Safety Goals Effective Jan. 1, 2015, Hospital Accreditation Program, The Joint Commission, Jan. 2015, pp. 1-17.

Brostowicz, Heather, et al. Oxygen saturation monitoring in the Neonatal Intensive Care Unit (NICU): Evaluation of a new alarm management, *Journal of Neonatal-Perinatal Medicine* 3, 2010, pp. 135-139.

Kowalczyk, Liz, "Patient alarms often unheard, unheeded" *The Boston Globe*, Feb. 13, 2011, in 5 pages.

Taenzer, Andreas, et al., "Postoperative Monitoring—The Dartmouth Experience", *The Official Journal of the Anesthesia Patient Safety Foundation*, Spring-Summer 2012, vol. 27, No. 1, pp. 1-28.

Tobin, Martin, "Principles and Practice of Intensive Care Monitoring", 1998, in 30 pages.

Severinghaus, M.D., John, et al., Pulse Oximeter Failure Thresholds in Hypotension and Vasoconstriction, *Anesthesiology*, Sep. 1990, vol. 73, No. 3, pp. 532-537.

Pologe, Jonas A., "Pulse Oximetry: Technical Aspects of Machine Design", *International Anesthesiology Clinics, Advances in Oxygen Monitoring*, Fall, 1987, vol. 25, No. 3, pp. 137-153.

Tremper, Ph.D., Kevin et al., "Pulse Oximetry", *Medical Intelligence Article, Anesthesiology*, Jan. 1989, vol. 70, No. 1, pp. 98-108.

Bosque, PhD, Elena, "Symbiosis of nurse and machine through fuzzy logic: Improved specificity of a neonatal pulse oximeter alarm", Dec. 1995, vol. 18, Issue 2, pp. 67-75.

Paine, MPH, Christine, et al., "Systematic review of physiologic monitor alarm characteristics and pragmatic interventions to reduce alarm frequency" *J Hosp Med.*, Feb. 2017, vol. 11, No. 2, pp. 136-144.

Top 10 Technology Hazards for 2012, Guidance Article, Nov. 2011, www.ecri.org, pp. 358-373.

Top 10 Technology Hazards for 2013, Health Devices, ECRI Institute, Nov. 2012, reprinted from vol. 41, Issue 11, in 25 pages.

Top 10 Health Technology Hazards for 2014, Health Devices, ECRI Institute, Nov. 2013, www.ecri.org/2014hazards, 1 page.

Masimo Advanced Alarm Performance: An Evidence-Based Approach to Reduce False Alarms and Nuisance Alarms, 2010, in 8 pages.

International Search Report for PCT/US2009/052146, dated Dec. 15, 2009.

International Preliminary Report on Patentability and Written Opinion for PCT/US2009/052146 dated Feb. 10, 2011.

\* cited by examiner

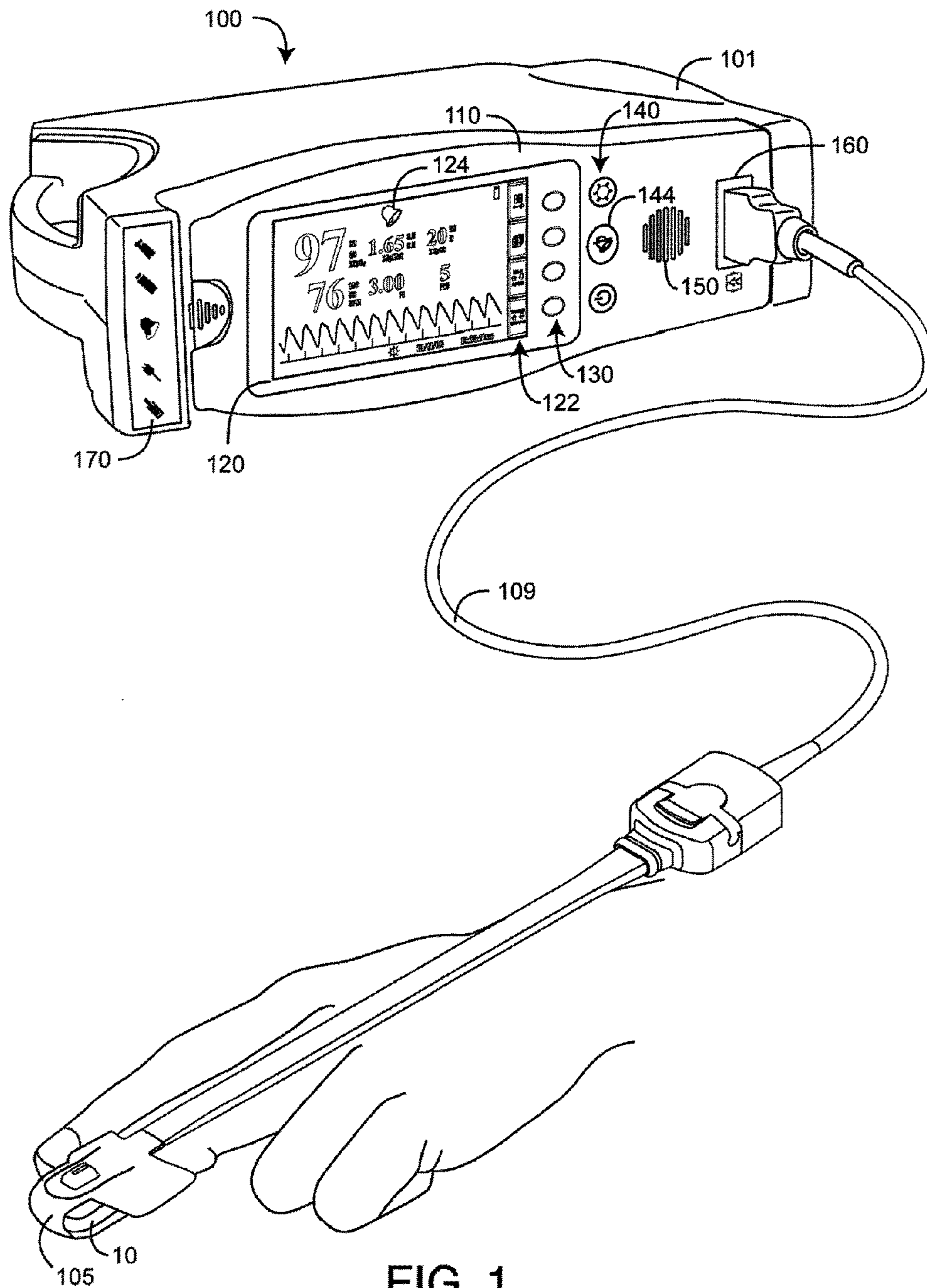


FIG. 1



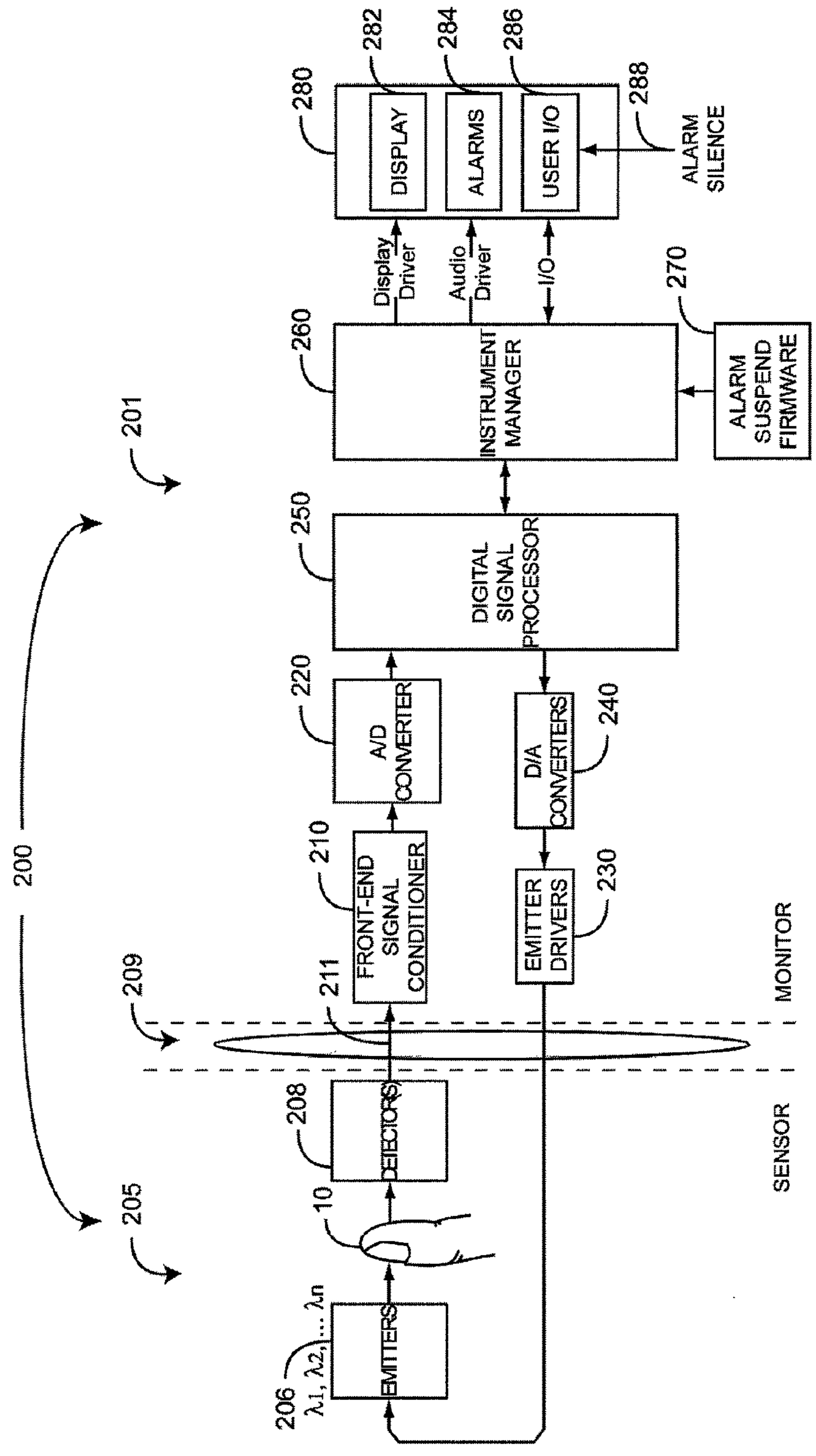


FIG. 2

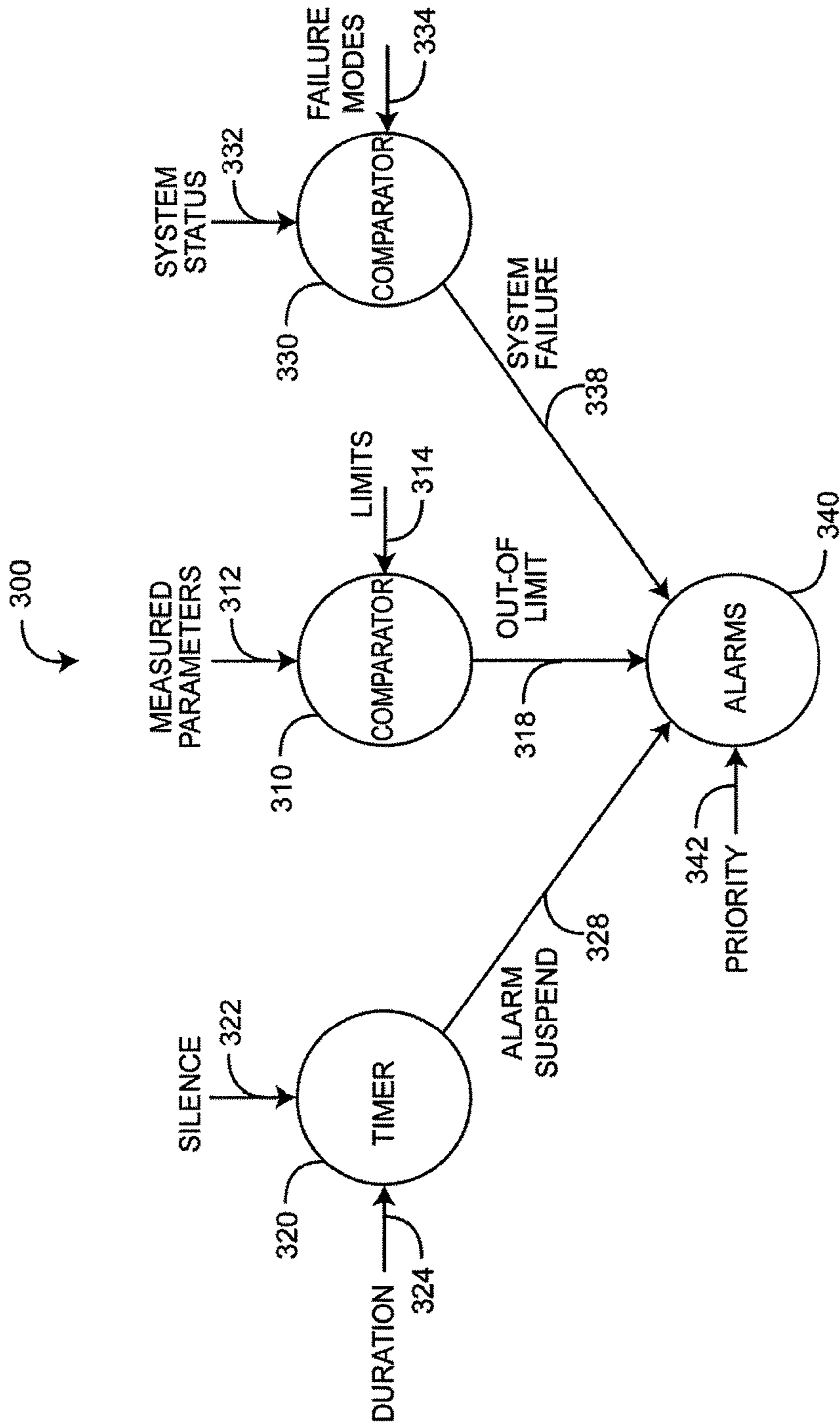


FIG. 3

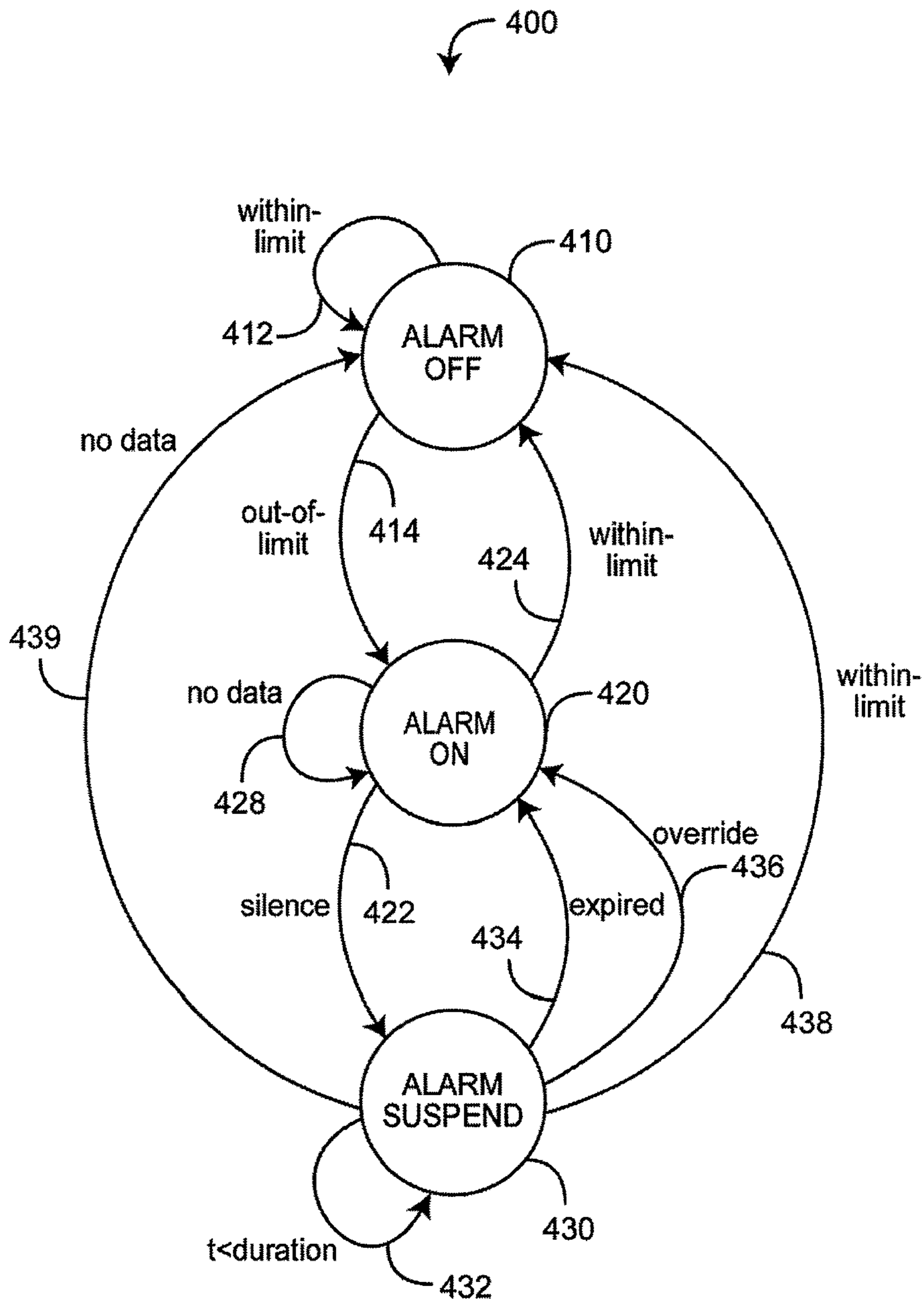


FIG. 4

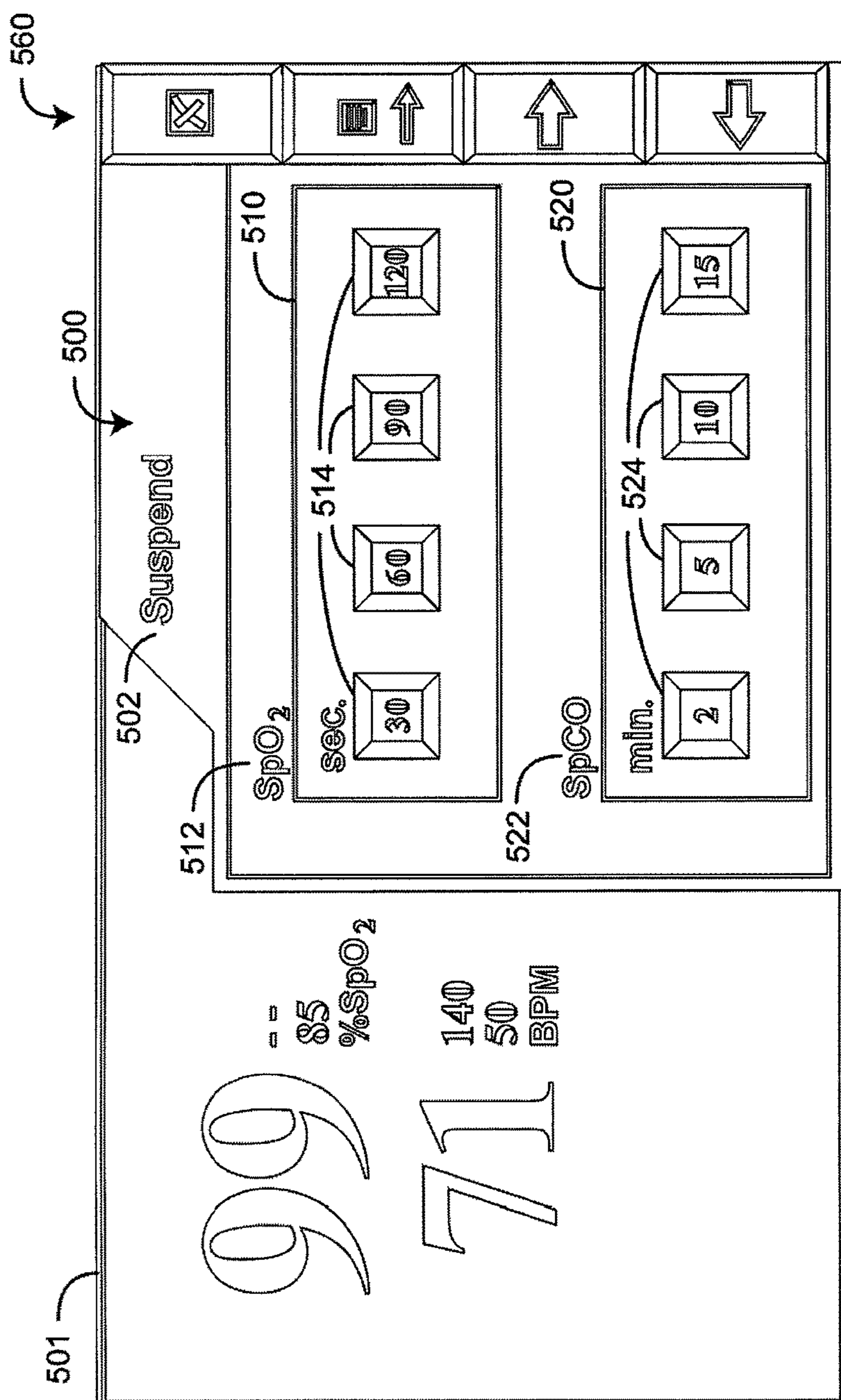


FIG. 5

## ALARM SUSPEND SYSTEM

**Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.**

## CROSS-REFERENCE TO RELATED APPLICATIONS

This [application] is an application for reissue of U.S. Pat. No. 9,153,121, issued on Oct. 6, 2015 and titled "Alarm Suspend System," which is a continuation of U.S. patent application Ser. No. 14/036,496, filed Sep. 25, 2013 and titled "Alarm Suspend System," which is a continuation of U.S. patent application Ser. No. 13/476,725, filed May 21, 2012 and titled "Alarm Suspend System," which is a continuation of U.S. patent application Ser. No. 12/510,982 filed Jul. 28, 2009 and titled "Alarm Suspend System," which claims priority benefit under 35 U.S.C. §119(e) to U.S. Provisional Patent Application Ser. No. 61/084,615, filed Jul. 29, 2008, titled "Alarm Management System[.];" more than one reissue application has been filed for the reissue of U.S. Pat. No. 9,153,121, including U.S. patent application Ser. No. 15/583,935 (the present application), U.S. patent application Ser. No. 15/583,922, and U.S. patent application Ser. No. 15/583,948. All of the above-referenced applications are hereby incorporated by reference herein in their entireties.

## BACKGROUND

Pulse oximetry for measuring constituents of circulating blood has achieved 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. A pulse oximeter generally includes a two-wavelength optical sensor applied to a patient, a monitor for processing sensor signals and displaying results and a patient cable electrically interconnecting the sensor and the monitor. The monitor typically provides a numerical readout of physiological parameters such as oxygen saturation (SpO<sub>2</sub>) and pulse rate (PR). Advanced physiological monitors utilize multiple wavelength sensors and enhanced measurement capabilities to provide readouts of additional parameters, such as carboxy-hemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt).

Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785 and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. ("Masimo") and are incorporated by reference herein.

Physiological monitors and corresponding multiple wavelength optical sensors are described in at least U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006 and titled Multiple Wavelength Sensor Emitters and U.S. patent application Ser. No. 11/366,208, filed Mar. 1, 2006 and titled Noninvasive Multi-Parameter Patient Monitor, both assigned to Masimo Laboratories, Irvine, Calif. (Masimo Labs) and both incorporated by reference herein.

Further, physiological monitoring systems that include low noise optical sensors and pulse oximetry monitors, such as any of LNOP® adhesive or reusable sensors, SofTouch™ sensors, Hi-Fi Trauma™ or Blue™ sensors; and any of Radical®, SatShare™, Rad-9™, Rad-5™, Rad-5v™ or PPO+™ Masimo SET® pulse oximeters, are all available from Masimo. Physiological monitoring systems including multiple wavelength sensors and corresponding noninvasive blood parameter monitors, such as Rainbow™ adhesive and reusable sensors and RAD-57™ and Radical-7™ monitors for measuring SpO<sub>2</sub>, pulse rate (PR), perfusion index (PI), pleth variability index (PVI), signal quality, HbCO and HbMet among other parameters are also available from Masimo.

## SUMMARY OF THE INVENTION

Monitor alarms are triggered by out-of-limit parameters and system failures, the latter including monitor or sensor failures or improper sensor placement, to name a few. Alarms can be visual, audible or both. Alarms can also have different levels of priority, which are reflected in the type of visual and audible alarms. In an embodiment, parameters exceeding limits such as low SpO<sub>2</sub>, high HbCO, high HbMet and low and high BPM trigger high priority alarms. System failures due to sensor off, no sensor or defective sensor also trigger high priority alarms. Parameters exceeding limits such as high SpO<sub>2</sub>, low and high PI, low and high PVI, for example, trigger medium priority alarms. Parameters exceeding limits such as low HbCO and low HbMet along with a system low battery indication are examples of low priority alarms.

An audible alarm may be temporarily suspended by pressing an alarm silence button so as to prevent unnecessary disturbance to the patient and distraction of the caregiver. During alarm suspension, visual alarms remain active. If an alarm condition persists after a predetermined alarm suspend period, the audible alarm resumes. The alarm suspend period is typically long enough to give a caregiver sufficient time to intervene with appropriate patient treatment yet short enough to ensure that patient health is not endangered if intervention is ineffective. For conventional pulse oximetry, an alarm suspend may be, for example, a maximum of 120 seconds.

Alarm suspension on advanced blood parameter monitors is problematic. With conventional pulse oximetry, treatment for abnormal parameter measurements can be quickly applied and a patient response is typically fast. For example, a treatment for low oxygen saturation is the application of an oxygen mask or an increase in oxygen flow. By contrast, the duration of treatment for parameters measured by advanced monitors is highly dependent on the alarm-triggering parameter. For example, the treatment for high methemoglobin is the injection of methylene blue, and the patient response to such an injection is slow. When patient treatment time exceeds the maximum alarm suspend period, an audible alarm will constantly reactivate. Thus, a single alarm suspend duration for all parameters is inadequate to cope with the many different types of parameters measured by advanced monitors.

One aspect of an alarm suspend system for silencing the alarms is an alarm trigger responsive to any of various parameters and predetermined limits corresponding to the parameters, where the parameters are partitioned according to treatment time, i.e. the relative length of time it takes for a person to respond to medical treatment for a parameter measurement outside of the predetermined limits. An

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audible alarm is responsive to the alarm trigger. An alarm silence button is actuated so as to suspend the audible alarm. A timer tracks the duration of the suspended alarm and is initiated by actuation of an alarm silence button. The timer retriggers the audible alarm after the timed duration has lapsed/expired. In an embodiment, a long duration suspend time is associated with slow treatment parameters and a short duration suspend time is associated with fast treatment parameters. Fast treatment parameters may include, for example, parameters relating to normal blood hemoglobin constituents and slow treatment parameters may include parameters relating to abnormal blood hemoglobin constituents.

In various embodiments, a short duration suspend time is less than or equal to about two minutes and a long duration suspended time is greater than about two minutes. A default duration associated with the fast treatment parameters is about two minutes and a default duration associated with the slow treatment parameters is about fifteen minutes. The alarm suspend system may also have an alarm suspend override responsive to a predetermined unit change in the parameter triggering a suspended alarm. The override results in reactivation of the suspended alarm. A physiological monitor having an alarm suspend system may also have a pop-up window that appears on the monitor display in response to actuation of the silence button, where the pop-up window presents a choice of alarm suspend durations.

Another aspect of an alarm suspend system is a partition of measured parameters into at least a first group and a second group. An audible alarm is triggered if at least one parameter is outside of predetermined limits. The audible alarm is suspended in response to a silence request. A first duration is associated with the first group and a second duration is associated with the second group. The audible alarm is reactivated after at least one of the first duration and the second duration. The first duration may be set so as to generally correspond to a first range of treatment times for the first group of parameters. Likewise, the second duration may be set so as to generally correspond to a second range of treatment times for the second group of parameters, where the first range of treatment times and the second range of treatment times are non-overlapping.

In various embodiments, suspended audible alarms are overridden if the triggering parameter has greater than a predetermined unit change before the suspended alarm expires according to either the first duration or the second duration. The first and second groups are defined in relation to normal hemoglobin measurements abnormal hemoglobin measurements, respectively. The first duration is set to be less than or equal to two minutes and the second duration is set to be greater than two minutes, with default durations of about two minutes corresponding to the first group and about fifteen minutes corresponding to the second group. In an embodiment, a pop-up window for a monitor display is constructed and the first duration and the second duration are selected from a range of durations presented within the pop-up window.

A further aspect of an alarm suspend system deactivates an audible alarm for one of a short duration and a long duration according to the alarm-triggering parameter. A first group of parameters is associated with the short duration and a second group of parameters is associated with the long duration. The first group and the second group are partitioned according to a fast treatment time and a short treatment time associated with the parameters. An override reactivates the audible alarm if the trigger parameter changes more than a predetermine amount during the cor-

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responding duration. In various embodiments, the first group comprises parameters related to the measurement of normal hemoglobin and the second group comprises parameters related to the measurement of abnormal hemoglobin. The long duration is greater than about 120 seconds and the short duration is less than or equal to about 120 seconds. A pop-up window for the display allows selection of the long duration and the short duration in response to the silence button.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a physiological measurement system utilizing an alarm suspend system;

FIG. 2 is a detailed block diagram of a physiological measurement system utilizing an alarm suspend system;

FIG. 3 is a flow diagram of an alarm suspend system embodiment;

FIG. 4 is a state diagram of an alarm suspend system embodiment; and

FIG. 5 is an illustration of an alarm suspend pop-up window.

#### DETAILED DESCRIPTION

FIG. 1 illustrates a physiological measurement system **100** that utilizes an alarm suspend system. The physiological measurement system **100** has a noninvasive sensor **105** attached to a tissue site **10**, a physiological monitor **101**, and an interface cable **109** interconnecting the monitor **101** and the sensor **105**. The physiological measurement system **100** may incorporate pulse oximetry in addition to advanced features, such as a multiple wavelength sensor and advanced processes for determining physiological parameters other than or in addition to those of pulse oximetry, such as carboxyhemoglobin, methemoglobin and total hemoglobin, as a few examples.

The monitor **101** has a front panel **110** providing a display **120**, touch keys **130**, controls **140**, a speaker **150**, a sensor port **160** and status indicators **170**. The display **120** shows parameter readouts, limits and waveforms among other items. The display **120** also has touch key icons **122** that indicate touch key **130** functions. The speaker **150** provides an audible alarm in response to physiological measurements that violate preset conditions, such as an out-of-limit parameter, as well as system failures, such as a low battery condition. The controls **140** include an alarm silence button **144** that is pressed to temporarily suspend out-of-limit parameter alarms and system alarms, such as low battery. The display **120** provides visual alarms, which include a bell-shaped alarm status indicator **124** that illuminates during an alarm condition and parameter readouts **210** and limits **220** that flash when parameters are out-of-limit. Status indicators **170** also provide visual alarms. When there are multiple alarm conditions, the parameter displays **202** indicate parameters with the highest alarm priority. Touch keys **130** and corresponding icons **122** include an alarm menu access button for setting alarm conditions, such as high or low alarm limits for SpO<sub>2</sub>, HbCO, HbMet, PR and PI. The alarm silence button **144** is pressed to temporarily suspend audible alarms. Advantageously, an alarm suspend system provides a parameter-dependent variation in the alarm suspend duration, as described below, utilizing a common silence button or other suspend initiator.

FIG. 2 illustrates a physiological measurement system **200** including a physiological monitor **201**, a sensor **205** and an interface cable **209**. The sensor **205** is attached to a tissue site, such as a finger **10**, and includes a plurality of emitters

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206 irradiating the tissue site 10 with multiple wavelengths of light. The sensor 205 also includes one or more detectors 208 capable of detecting the light after attenuation by the tissue site 10. The sensor 205 transmits optical radiation at wavelengths other than or including the red and infrared wavelengths utilized in pulse oximeters. The monitor 201 inputs a corresponding sensor signal 211 and determines the relative concentrations of blood constituents other than or in addition to the “normal” blood hemoglobin constituents HbO<sub>2</sub> and Hb, including “abnormal” blood hemoglobin constituents HbCO, HbMet and blood related parameters such as fractional oxygen saturation, total hemoglobin and blood glucose to name a few.

As shown in FIG. 2, the monitor 201 has a front-end signal conditioner 210, an A/D converter 220, emitter drivers 230, D/A converters 240 and a digital signal processor (“DSP”) 250. In general, the emitter drivers 230 convert digital control signals, via the D/A converters 240, into analog drive signals capable of driving the sensor emitters 206. The front-end signal conditioner 210 converts, via the A/D converter 220, composite analog intensity signal(s) from light sensitive detector(s) 208 into digital data input to the DSP 250. The emitter drivers 230 and front-end signal conditioner 210 communicate with the sensor 205 via the interface cable 209.

Also shown in FIG. 2, the monitor 201 has an instrument manager 260 and a user interface 280. The user interface 280 includes one or more displays 282, alarms 284 and user input/output (I/O) 286. The instrument manager 260 communicates with the DSP 250 to receive parameter data and to present that data on the display 282. The instrument manager 260 may also store and display historical or trending data related to one or more of the measured parameters or combinations of the measured parameters. The instrument manager 260 also controls audible and visual alarms and indicators 284. The instrument manager 260 responds to user-actuated keys and communicates with external devices via various I/O ports 286. Further, the instrument manager 260 executes alarm suspend firmware 270 so as to respond to an alarm silence button press 288, as described in detail with respect to FIGS. 3-4.

FIG. 3 generally illustrates an alarm suspend system 300. Alarm triggers include system failures 338 and out-of-limit parameters 318. Triggered alarms 340 may be audible, visual or both, and may vary according to priority 342. Audible alarms may be generated by a monitor front-panel-mounted speaker 150 (FIG. 1) and may vary in loudness, pitch and sound pattern. Visual alarms may include parameter labels, parameter numerics, symbols and status lights, which can flash and vary in color.

As shown in FIG. 3, measured parameters 312 are compared 310 to default or user-specified limits 314. An out-of-limit condition 318 triggers an alarm 340. An alarm suspend 328 is user-initiated by a silence request 322. This may be a press of a silence button 144 (FIG. 1) on a monitor front panel 110 (FIG. 1). In an embodiment, the alarm suspend 328 silences audible alarms and modifies the display of visual alarms. The alarm suspend 328 is based on a timer 320, which ends the alarm suspend 328 after a predetermined duration 324. The duration 324 may be a function of the out-of-limit parameter 312. In an advantageous embodiment, the duration 324 relates to, or is a function of, the treatment time for the alarm-triggering parameter so as to avoid nuisance alarms while maintaining alarm integrity.

FIG. 4 illustrates an alarm suspend embodiment 400 that operates independently for each measured parameter that

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can trigger an alarm. An alarm is initially off 410. The alarm remains off as long as the parameter is within its set limits 412. If a parameter is measured outside of its set limits 414, an alarm is triggered 420. The alarm may be audible, visual or both audible and visual. A user can request to silence the alarm by pressing an alarm silence button 144 (FIG. 1), for example. The silence request 422 suspends the alarm 430 which turns off audible alarms but, in an embodiment, does not deactivate visual alarms. The audible alarm remains suspended 430 for a predetermined duration 432. When the suspend duration has passed, the alarm suspend expires 434 and audible alarms are once again activated 420. The alarm remains on 428 until the triggering parameter is within limits 424 or a user once again requests silence 422. The alarm suspend 430 deactivates if the measured parameter becomes within limits 438, such as when the patient condition improves, or if no physiological data is detected 439, such as no sensor, sensor off, no cable or malfunctioning sensor situations, to name a few. Also, if the measured parameter changes during the alarm suspend 430 by a sufficient out-of-limit amount, an override 436 reactivates the audible alarms 420.

In an alarm suspend system embodiment, parameters are classified according to the typical time it takes for medical treatment to transition an out-of-limit measurement to a within-limit measurement. Suspend durations 324 (FIG. 3) are set accordingly. For example, in a two-tier embodiment, relatively slow treatment parameters, such as HbMet, HbCO, Hbt and PVI, are assigned relatively long suspend durations. Similarly, relatively fast treatment parameters, such as SpO<sub>2</sub> and PR, are assigned relatively short suspend durations. In an embodiment, the alarm suspend duration is adjustable for each individual parameter, including 2, 5, 10, 15, 20, 25 and 30 minutes for slow treatment parameters, with a default of 15 minutes; and 30, 60, 90 and 120 seconds for fast treatment parameters, with a default of 120 seconds. These alarm features are only active when alarm limits have been set. Other alarm features apply to both slow treatment and fast treatment parameters. For example, an alarm delay of 0, 5, 10 or 15 seconds applies to all enabled parameters.

In an embodiment, an override 436 occurs if slow treatment parameters such as HbCO, HbMet or PVI increase or Hbt decreases by a certain unit change during the alarm suspend duration. The unit change is adjustable for each parameter, such as from 1-15 in increments of 1. TABLE 1 shows a default embodiment of override unit changes for these parameters.

TABLE 1

Override Unit Changes for Selected Parameters		
Parameter	Unit Change	Direction
HbCO	5	Increase
HbMet	2	Increase
Hbt	2	Decrease
PVI	OFF	Increase

FIG. 5 illustrates an alarm suspend window 500 that provides a “pop-up” display so that a monitor user may manually enter an alarm suspend duration. The alarm suspend window 500 appears as a portion of a monitor display 501, such as the front panel display 120 (FIG. 1) described above. The pop-up window 500 responds to a suspend request, such as a silence button 144 (FIG. 1) press. The alarm suspend window 500 has a window identifier 502 and one or more parameter subsections 510, 520. Each param-

eter subsection 510, 520 has a parameter identifier 512, 522 and corresponding suspend duration options 514, 524. In an embodiment, specific suspend times are selected via monitor touch keys 130 (FIG. 1) as guided by corresponding touch key icons 560. Selected suspend times are highlighted or otherwise identified and entered, also via a touch key 130 (FIG. 1). In an alternative embodiment, the monitor display is a touch screen and alarm suspend times are directly entered by a finger press on a specific duration “virtual button” 514, 524. Once one or more suspend durations are entered, the pop-up window 500 disappears from the display 501. The alarm suspend window 500 advantageously allows a user to quickly choose an appropriate alarm suspend duration for the situation at hand, rather than relying on a predetermined or default duration.

An alarm suspend system is described above with respect to alarms triggered by measured parameters and limits associated with those measured parameters. Limits may correspond to levels of a measured parameter, such as a percentage oxygen saturation to name but one example. Limits may also correspond to trends of a measured parameter, such as a rate-of-change of oxygen saturation, for example. Limits may also correspond to patterns in a measured parameter or a comparison of one measured parameter with another measured parameter, as further examples.

An alarm suspend system is described above with respect to a two-tier grouping of parameters, such as slow treatment and fast treatment parameters and alarm suspend durations associated with those groups. Groupings of parameters with respect to alarm suspend durations may be multi-tier, such as slow, medium and fast treatment parameters, to name but one example.

An alarm suspend 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 *noninvasive* physiological sensor [including: a plurality of light emitting diodes] configured to [transmit wavelengths of light onto a tissue site of a patient; and at least one detector configured to measure an indication of the wavelengths of light after attenuation by tissue of the patient and] *be positioned on a patient and output a signal responsive [of the attenuated light] to a physiological condition of the patient;* and
  - one or more processors in communication with the *non-invasive* physiological sensor, the one or more processors configured to *electronically:*
    - process the signal;*
    - responsive to processing the signal, determine a measurement of a physiological parameter based at least in part upon the signal;*
    - determine that the measurement of the physiological parameter satisfies an alarm activation threshold;*
    - [receive, from a user, an indication of] *initiate a parameter-specific alarm delay or suspension period of time corresponding to the physiological parameter, the parameter-specific alarm delay or suspension period of time being [selected from] one of a plurality of parameter-specific alarm delay or suspension periods of time, the parameter-specific alarm delay or suspension period of time being different from at least one other parameter-specific alarm delay or suspension period of time corresponding to at least one other physiological parameter for which*

*the one or more processors are configured to determine at least one measurement; [activate an alarm in response to determining that an alarm activation threshold has been satisfied by the physiological parameter measurement; receive an alarm suspension indication;]* and

[in response to receiving the alarm suspension indication, suspend the alarm for] *activate an alarm for the physiological parameter in response to expiration of an amount of delay or suspension associated with the [indicated] parameter-specific alarm delay or suspension period of time.*

2. The physiological measurement system of claim 1, wherein the one or more processors are further configured to:

provide a user interface to the user including at least a plurality of user-selectable elements, each of the [selectable] *plurality of user-selectable* elements corresponding to one of the plurality of parameter-specific alarm *delay or suspension* periods of time.

3. The physiological measurement system of claim 2, wherein providing the user interface further includes: constructing a pop-up window for a display; and displaying the plurality of user-selectable elements in the pop-up window.

4. The physiological measurement system of claim 3, wherein the plurality of user-selectable elements are configured to allow a user to select a specific one of the plurality of parameter-specific alarm *delay or suspension* periods of time.

5. The physiological measurement system of claim 4, wherein [the] *a* selected parameter-specific alarm *delay or suspension* period of time is selected by selection of one of the plurality of user-selectable elements.

6. The physiological measurement system of claim 1, wherein the one or more processors are further configured to:

associate [the] *a* selected parameter-specific *alarm delay or suspension* period of time [is] with the physiological parameter.

7. The physiological measurement system of claim 6, wherein the selected parameter-specific *alarm delay or suspension* period of time is stored in a memory device in communication with the one or more processors.

8. The physiological measurement system of claim 1, wherein the one or more processors are further configured to:

*responsive to processing the signal, determine a measurement of a second physiological parameter [measurement] based at least in part upon the signal; determine that the measurement of the second physiological parameter satisfies a second alarm activation threshold;*

[receive, from the user, a second indication of] *initiate a second parameter-specific alarm delay or suspension period of time corresponding to the second physiological parameter, the second parameter-specific alarm delay or suspension period of time being [selected from] one of a second plurality of parameter-specific alarm delay or suspension periods of time; [activate a second alarm in response to determining a second alarm activation threshold has been satisfied by the second physiological parameter measurement;]* and [in response to receiving the alarm suspension indication, suspend the second alarm for] *activate a second alarm for the second physiological parameter in response to expiration of an amount of delay or suspension asso-*



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*ciated with the [indicated] second parameter-specific alarm delay or suspension period of time.*

9. The physiological measurement system of claim 8, wherein the one or more processors are further configured to:

provide a user interface to the user including at least a first plurality of user-selectable elements and a second plurality of user-selectable elements, wherein each of the first plurality of user-selectable elements corresponds to one of the plurality of parameter-specific alarm delay or suspension periods of time, and each of the second plurality of user-selectable element corresponds to one of the second plurality of parameter-specific alarm delay or suspension periods of time.

10. The physiological measurement system of claim 9, wherein the one or more processors are further configured to:

construct a pop-up window for a display; and display both the first and second plurality of user-selectable elements in the pop-up window.

11. The physiological measurement system of claim 10, wherein [the] *a* selected parameter-specific alarm delay or suspension period of time is selected by selection of one of the first plurality of user-selectable elements, and [the] *a* selected second parameter-specific alarm delay or suspension period of time is selected by selection of one of the second plurality of user-selectable elements.

12. The physiological measurement system of claim 11, wherein the at least one of the first plurality of parameter-specific alarm delay or suspension periods of time is different from any of the second plurality of parameter-specific alarm delay or suspension periods of time.

13. [An] *A method of electronically delaying or suspending an alarm while an electronically calculated measurement of a physiological parameter satisfies an alarm activation threshold, the measurement of the physiological parameter responsive to a signal from a noninvasive sensor positioned at a monitored patient, the method comprising:*

*electronically processing a signal from a noninvasive sensor;*

[measuring] *responsive to processing the signal, electronically determining a first measurement of a first physiological parameter and a second measurement of a second physiological parameter using a patient monitoring device, the patient monitoring device including a processor and a memory device [configured to store];*

*electronically storing, using the patient monitoring device, a first parameter-specific alarm delay or suspension period of time corresponding to the first physiological parameter and a second parameter-specific alarm delay or suspension period of time corresponding to the second physiological parameter, the first parameter-specific alarm delay or suspension period of time being different from the second parameter-specific alarm delay or suspension period of time;*

*electronically determining, using the patient monitoring device, that the first measurement of the first physiological parameter satisfies a first alarm activation threshold;*

[receiving, from a user, an indication of a] *electronically initiating, using the patient monitoring device, the first parameter-specific alarm delay or suspension period of time [corresponding to the physiological parameter, the parameter-specific alarm suspension period of time being selected from a plurality of parameter-specific alarm suspension periods of time, the parameter-specific alarm suspension period of time being different*

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from at least one other parameter-specific alarm suspension period of time corresponding to at least one other physiological parameter; activating an alarm in response to determining an alarm activation threshold has been satisfied by the physiological parameter measurement; receiving an alarm suspension indication]; and

[in response to receiving the alarm suspension indication, suspending the alarm for] *electronically activating, using the patient monitoring device, a first alarm for the first physiological parameter in response to expiration of a first amount of delay or suspension associated with the [indicated] first parameter-specific alarm delay or suspension period of time.*

14. The method of claim 13, wherein the *first* alarm includes an audible component and a visual component, and wherein [suspending] *activating the first alarm in response to expiration of the first amount of delay or suspension comprises [suspending] activating the audible component [and not suspending the visual component].*

15. The method of claim 13 further comprising: providing a user interface to the user including at least a plurality of user-selectable elements, each of the [selectable] *plurality of user-selectable* elements corresponding to one of [the] *a* plurality of parameter-specific alarm delay or suspension periods of time, wherein the *plurality of parameter-specific alarm delay or suspension periods of time comprise the first parameter-specific alarm delay or suspension period of time.*

16. The method of claim 15 further comprising: constructing a pop-up window for a display; and displaying the plurality of user-selectable elements in the pop-up window.

17. The method of claim 16, wherein [the] *a* selected parameter-specific alarm delay or suspension period of time is selected by selection of one of the plurality of user-selectable elements.

18. A physiological measurement system comprising: a physiological sensor means for outputting a signal responsive to a [noninvasive measurement of attenuated light transmitted through a tissue site] *physiological condition* of a patient; a *memory configured to store a first alarm activation threshold;* and

[a processing means] *one or more processors* in communication with the physiological sensor means and configured to:

*process the signal;*

*responsive to processing the signal, determine a first measurement of [a] the first measured physiological parameter based at least in part upon the signal;*

[receive, from a user, an indication of] *initiate a first parameter-specific alarm delay or suspension period of time corresponding to the first measured physiological parameter, [the parameter-specific alarm suspension period of time being selected from a plurality of parameter-specific alarm suspension periods of time.] the first parameter-specific alarm delay or suspension period of time being different from [at least one other] a second parameter-specific alarm delay or suspension period of time corresponding to [at least one other] a second measured physiological parameter for which the one or more processors are configured to determine a second measurement;*

*delay or suspend activation of an alarm for the first measured physiological parameter for the first*

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*parameter-specific alarm delay or suspension period of time while the first alarm activation threshold is satisfied by the measurement of the first measured physiological parameter; and*

*subsequent to delaying or suspending activation of the alarm for the first parameter-specific alarm delay or suspension period of time, activate [an] the alarm in response to determining [an] the first alarm activation threshold [has been] is satisfied by the first measurement of the first measured physiological parameter [measurement; receive an alarm suspension indication; and in response to receiving the alarm suspension indication, suspend the alarm for the indicated parameter-specific alarm suspension period of time].*

19. The physiological measurement system of claim 18, wherein the [processing means is] *one or more processors are further configured to:*

*responsive to processing the signal, determine [a] the second [physiological parameter] measurement based at least in part upon the signal;*

*[receive, from the user, a second indication of a] initiate the second parameter-specific alarm delay or suspension period of time [corresponding to the second physiological parameter, the second parameter-specific alarm suspension period of time being selected from a second plurality of parameter-specific alarm suspension periods of time];*

*delay or suspend activation of a second alarm for the second measured physiological parameter for the second parameter-specific alarm delay or suspension period of time while a second alarm activation threshold is satisfied by the second measurement; and*

*subsequent to delaying or suspending activation of the second alarm for the second parameter-specific alarm delay or suspension period of time, activate [a] the second alarm [in response] responsive to determining [a] that the second alarm activation threshold [has been] is satisfied by the second [physiological parameter] measurement[; and*

*in response to receiving the alarm suspension indication, suspend the second alarm for the indicated second parameter-specific alarm suspension period of time].*

20. The physiological measurement system of claim 19, wherein the [processing means is] *one or more processors are further configured to:*

*provide a user interface to the user including at least a first plurality of user-selectable elements and a second plurality of user-selectable elements, wherein each of the first plurality of user-selectable elements corresponds to one of [the] a first plurality of parameter-specific alarm delay or suspension periods of time, and each of the second plurality of user-selectable element corre-*

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*sponds to one of [the] a second plurality of parameter-specific alarm delay or suspension periods of time, wherein the first plurality of parameter-specific alarm delay or suspension periods of time comprise the first parameter-specific alarm delay or suspension period of time, and the second plurality of parameter-specific alarm delay or suspension periods of time comprise the second parameter-specific alarm delay or suspension period of time.*

21. The physiological measurement system of claim 20, wherein [the] *a selected first parameter-specific alarm delay or suspension period of time is selected by selection of one of the first plurality of user-selectable elements, and [the] a selected second parameter-specific alarm delay or suspension period of time is selected by selection of one of the second plurality of user-selectable elements.*

22. The physiological measurement system of claim 21, wherein at least one of the first plurality of parameter-specific alarm delay or suspension periods of time is different from any of the second plurality of parameter-specific alarm delay or suspension periods of time.

23. *The physiological measurement system of claim 1, wherein the alarm comprises an audible alarm.*

24. *The physiological measurement system of claim 1, wherein the one or more processors are further configured to:*

*determine that the measurement of the physiological parameter satisfies a second alarm activation threshold different from the alarm activation threshold; and*

*in response to determining that the measurement of the physiological parameter satisfies the second alarm activation threshold, activate the alarm for the physiological parameter prior to expiration of the amount of delay or suspension associated with the first parameter-specific alarm delay or suspension period of time.*

25. *The physiological measurement system of claim 1, wherein the one or more processors are further configured to:*

*determine that a measurement of a second physiological parameter satisfies a second alarm activation threshold; and*

*in response to determining the measurement of the second physiological parameter satisfies the second alarm activation threshold, activate an alarm for the second physiological parameter prior to expiration of the amount of delay or suspension associated with the first parameter-specific alarm delay or suspension period of time.*

26. *The physiological measurement system of claim 1, wherein the physiological parameter comprises an oxygen saturation, and the at least one other physiological parameter comprises a pulse rate.*

\* \* \* \* \*

**(12) INTER PARTES REVIEW CERTIFICATE (3535th)**

**United States Patent  
Kiani et al.**

**(10) Number: US RE47,244 K1  
(45) Certificate Issued: Apr. 1, 2024**

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**(54) ALARM SUSPEND SYSTEM**

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**(73) Assignee: MASIMO CORPORATION**

**Trial Number:**

IPR2020-00967 filed May 21, 2020

**Inter Partes Review Certificate for:**

Patent No.: **RE47,244**  
Issued: **Feb. 19, 2019**  
Appl. No.: **15/583,935**  
Filed: **May 1, 2017**

The results of IPR2020-00967 are reflected in this inter partes review certificate under 35 U.S.C. 318(b).

**INTER PARTES REVIEW CERTIFICATE**  
**U.S. Patent RE47,244 K1**  
**Trial No. IPR2020-00967**  
**Certificate Issued Apr. 1, 2024**

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AS A RESULT OF THE INTER PARTES  
REVIEW PROCEEDING, IT HAS BEEN  
DETERMINED THAT:

Claims 1-26 are cancelled.

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