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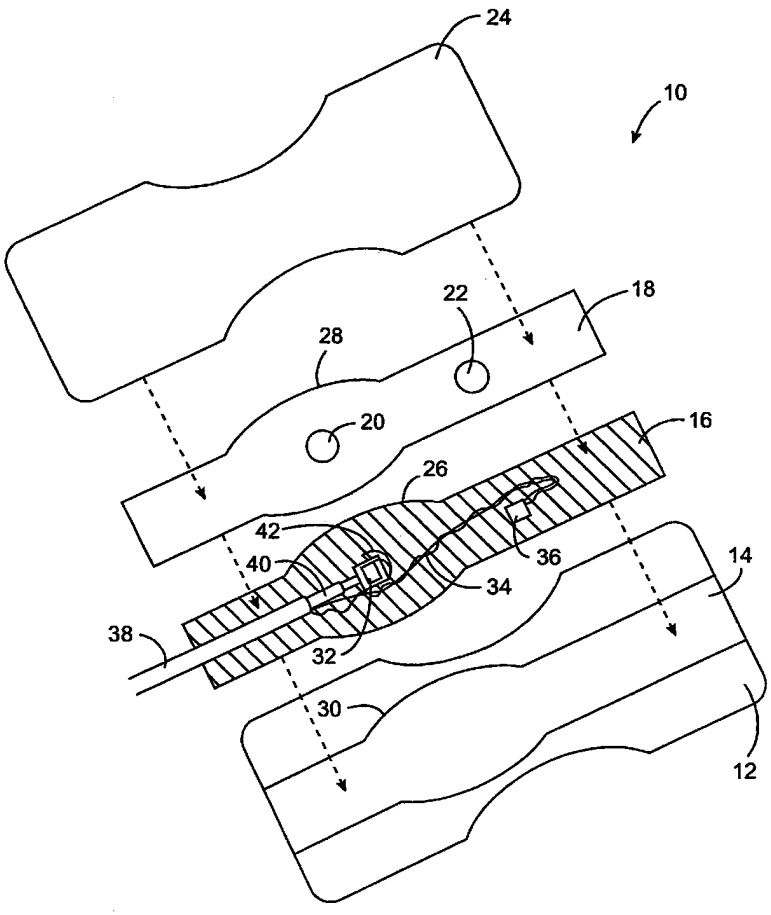
(54) Title: PULSE OXIMETER SENSOR WITH WIDENED METAL STRIP



(57) Abstract: A pulse oximeter sensor having an opaque, metalized layer (16) to shield from ambient light. The metalized layer (16) surrounds the area of the light detector (32). In one embodiment, the sensor has a transparent portion (12), with the opaque, metalized layer (16) covering only the portions around the light detector (32) and other areas, such as a strip extending between the light detector (32) and the emitter (36). In a preferred embodiment, the opaque, metalized layer (16) is a strip which has a widened portion in the area around the light detector (32).

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PULSE OXIMETER SENSOR WITH WIDENED METAL STRIP

BACKGROUND OF THE INVENTION

The present invention relates to pulse oximeter sensors, and in particular to techniques for shielding against ambient light and preventing delamination of flexible, disposable sensors.

A type of pulse oximeter sensor that is commonly used is a flexible, disposable sensor. It typically has multiple layers, with white layers on the outside visible to the user. The white gives the image of cleanliness and sterility, and also is opaque to certain wavelengths of light over the range of the photodetector's sensitivity. An example of a sensor referring to a white opaque layer is set forth in Patent No. 4,865,038.

A number of these sensors include metalized layers which can be either a conductive shield or a shield from ambient light. See, for example, Patent Nos. 4,928,691; 5,246,003; 5,094,240; 5,054,488; and 4,964,408. Patent No. 4,928,691 refers to the use of a red layer to avoid ambient light.

Ambient light can interfere with the operation of a pulse oximeter, especially under the bright lights of surgery or in outdoor, daylight conditions. While the use of a metal layer has been effective to shield from such ambient light, there is also a competing desire to have transparency in order to observe how a sensor is attached. In addition, the introduction of additional layers into the sensor is susceptible to sensor failure by delamination.

Accordingly, it would be desirable to have a sensor which would shield against ambient light, be resistant to delamination and have some transparency.

SUMMARY OF THE INVENTION

The present invention provides a pulse oximeter sensor having an opaque, metalized layer to shield from ambient light. The metalized layer surrounds the area of the light detector. In one embodiment, the sensor has a transparent portion, with the opaque, metalized layer covering only the portions around the light detector and other areas, such as a strip extending between the light detector and the emitter. In a preferred embodiment, the opaque, metalized layer is a strip which has a widened portion in the area around the light detector.

The widened portion of the metalized layer, in conjunction with widened portions that match on adjacent layers, resists delamination stresses.

In another aspect of the invention, the wires connecting to the emitter take an angular path, preferably crossing over from one side of the detector, across a center line between the emitter and detector, to an opposite side of the emitter. This angular path, as opposed to a straight path, disperses stresses caused by the wires, further inhibiting delamination or separation of the layers of the sensor.

In a preferred embodiment, the widened area of the metalized and adjacent layers has a semi-circular profile around the photodetector.

For a further understanding of the nature and advantages of the invention, reference should be made to the following description taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of a sensor according to the present invention showing the different layers.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

Fig. 1 illustrates a sensor 10 according to the invention. The sensor includes a transparent layer 12 which is wider than a white layer 14 mounted on top of it. On top of white layer 14, is mounted a correspondingly-shaped metalized layer 16. On metalized layer 16 is mounted another white layer 18 having holes 20 and 22 allowing light to pass from/to the emitter and detector. The emitter and detector are mounted on metalized layer 16. Adhesives may be used between the layers for mounting.

As can be seen, metalized layer 16 includes a widened region defined by a curved perimeter 26. Similar widened regions 28 and 30 are found on white strips 18 and 14, respectively. This widened area surrounds the photodetector 32. Such a widened area prevents ambient light from reaching the photodetector and disturbing its readings. At the same time, by only widening a portion of the strip, other areas of transparent layer 12 allow viewing of the patient when the sensor is attached. This allows, for example, an examination of how tightly the sensor is secured to the patient by looking through transparent layer 12.

Widened area 26 and corresponding widened areas 28 and 30 also resist delamination. As opposed to a straight line strip, these areas are curved such that when

the sensor is wrapped around a user's finger or other appendage, the stresses are dispersed rather than being focused on a line. Accordingly, it has been found that this design resists delamination and has fewer failures than a straight strip.

Another stress that can result in delamination is the stress induced by the wires 34 which connect to the emitter or light emitting diode (LED) 36. The present invention reduces the stresses by providing an angular path of wires 34 between cable 38 and photo emitter or LEDs 36. In prior devices, the wires were laid out in a straight line, which was found to contribute to delamination. The angular path where the wires start out beside photodetector 32 and cross the center line between the photodetector and emitter, then above emitter 36 reduces the stresses.

In addition, the wires circle around and attach to photo emitter 36 from the backside, as in previous devices. Also, as in previous devices, photodetector 32, which attached to a coaxial cable 40 inside cable 38, is mounted closer to cable 38 so that the coaxial cable extends onto less of the sensor.

Preferably, metalized layer 16 is a layer of aluminized mylar having a thickness of less than 1 mm. The curved area 26 preferably extends for at least three-quarters of an inch, more preferably slightly more than one inch along the length of strip 16. It preferably extends outward from the straight edge of strip 16 by at least one-eighth of an inch, more preferably approximately one-quarter inch.

Fig. 1 also shows a Faraday shield 42 which wraps around photodetector 32. It is shown partially open in Fig. 1. The Faraday shield is preferably a piece of copper which is solid metal, except for a mesh portion directly above photodetector 32. In one embodiment, part of Faraday shield 42 attaches directly to metal layer 16.

As will be understood by those of skill in the art, the present invention may be embodied in other specific forms without departing from the essential characteristics thereof. For example, the widened area could be any shape, not just semi-circular. It could be more of an oval shape, square, trapezoidal, etc. Additionally, the metalized layer need not extend the entire length of the sensor, but could simply be in the area around the photodetector, or around the photodetector and photo emitter. Additionally, wires 34 could take any other angular path between the emitter and detector. Also, the strips themselves could be other shapes, with the transparent strip 12 in particular having other patterns for the portion which is viewable. Parts (layers) may have translucent layered components as well as transparent layered components. Layer 16 could be a metalized translucent layer. Layer 12 can be transparent. Layer 18 can be

reflective white layer. Layer 24 is not used in a preferred embodiment. Layer 24 can be added if delamination is a problem. In one embodiment there are adhesive layers between each of layers 12, 14 16, and 18.

Accordingly, the foregoing description is intended to be illustrative, but not limiting, of the scope of the invention which is set forth in the following claims.

WHAT IS CLAIMED IS:

1. A pulse oximeter sensor comprising:

a flexible, transparent substrate;

an opaque, metalized layer mounted on a first side of said transparent substrate, said metalized layer covering only a portion of said transparent substrate;

a light emitter mounted on a first side of said metalized layer to emit light away from said metalized layer;

a light detector mounted on said first side of said metalized layer;

a non-transparent layer mounted over said light emitter and said detector, said non-transparent layer having holes over said light emitter and detector; and

an adhesive layer disposed on said non-transparent layer and a portion of said transparent layer not covered by said metalized layer and said non-transparent layer.

2. The sensor of claim 1 further comprising a second flexible, non-transparent layer mounted between said transparent layer and said metalized layer.

3. The sensor of claim 1 wherein said metalized layer comprises a strip extending at least from said emitter to said detector, said strip having a wider portion adjacent said detector.

4. The sensor of claim 3 wherein said wider portion of said strip has a curved perimeter.

5. The sensor of claim 4 wherein said curved perimeter extends along at least three quarters of an inch on both sides of said strip adjacent said detector, and extends outward at least an eighth of an inch from said strip at a maximum point of extension.

6. The sensor of claim 3 wherein said non-transparent layer comprises a strip having a wider portion matching said wider portion of said metalized layer.

7. The sensor of claim 1 further comprising a cable extending into said sensor, said detector being mounted closer to said cable than said emitter, and further comprising wires from said cable connecting to said emitter, said wires crossing over a

line between said emitter and said detector in a region between said emitter and said detector.

8. The sensor of claim 1 further comprising a Faraday shield at least partially surrounding said detector, said Faraday shield being connected to said metalized layer.

9. A pulse oximeter sensor comprising:

a flexible, transparent substrate;

an opaque, metalized layer mounted on a first side of said transparent substrate, said metalized layer covering only a portion of said transparent substrate, said metalized layer being a strip extending at least from said emitter to said detector, said strip having a wider portion adjacent said detector, said wider portion of said strip having a curved perimeter;

a light emitter mounted on a first side of said metalized layer to emit light away from said metalized layer;

a light detector mounted on said first side of said metalized layer;

a first non-transparent layer mounted over said light emitter and said detector, said non-transparent layer having holes over said light emitter and detector;

a second flexible, non-transparent layer mounted between said transparent layer and said metalized layer; and

an adhesive layer disposed on said non-transparent layer and a portion of said transparent layer not covered by said metalized layer and said non-transparent layer.

10. The sensor of claim 9 wherein said curved perimeter extends along at least three quarters of an inch on both sides of said strip adjacent said detector, and extends outward at least an eighth of an inch from said strip at a maximum point of extension.

11. The sensor of claim 9 further comprising a cable extending into said sensor, said detector being mounted closer to said cable than said emitter, and further comprising wires from said cable connecting to said emitter, said wires crossing over a line between said emitter and said detector in a region between said emitter and said detector.

12. The sensor of claim 9 further comprising a Faraday shield at least partially surrounding said detector, said Faraday shield being connected to said metalized layer.

13. A pulse oximeter sensor comprising:

a first non-transparent strip having a wider portion, said wider portion having a curved perimeter;

a light emitter mounted on a first side of said first non-transparent strip to emit light away from said first non-transparent strip;

a light detector mounted on said first side of said first non-transparent strip adjacent said wider portion of said first non-transparent strip;

said first non-transparent strip extending at least from said emitter to said detector;

a second non-transparent strip mounted over said light emitter and said detector, said second non-transparent strip having holes over said light emitter and detector, said second non-transparent strip having a wider portion matching the shape of said wider portion of said first non-transparent strip;

an adhesive layer disposed on said second non-transparent strip.

14. The sensor of claim 13 further comprising:

a flexible, transparent substrate mounted on an outside of said first non-transparent strip opposite said emitter and detector, said transparent substrate having a portion extending beyond said first non-transparent strip, and said adhesive layer also being disposed on a said portion of said transparent layer extending beyond said first non-transparent layer.

15. The sensor of claim 13 further comprising a cable extending into said sensor, said detector being mounted closer to said cable than said emitter, and further comprising wires from said cable connecting to said emitter, said wires crossing over a line between said emitter and said detector in a region between said emitter and said detector.

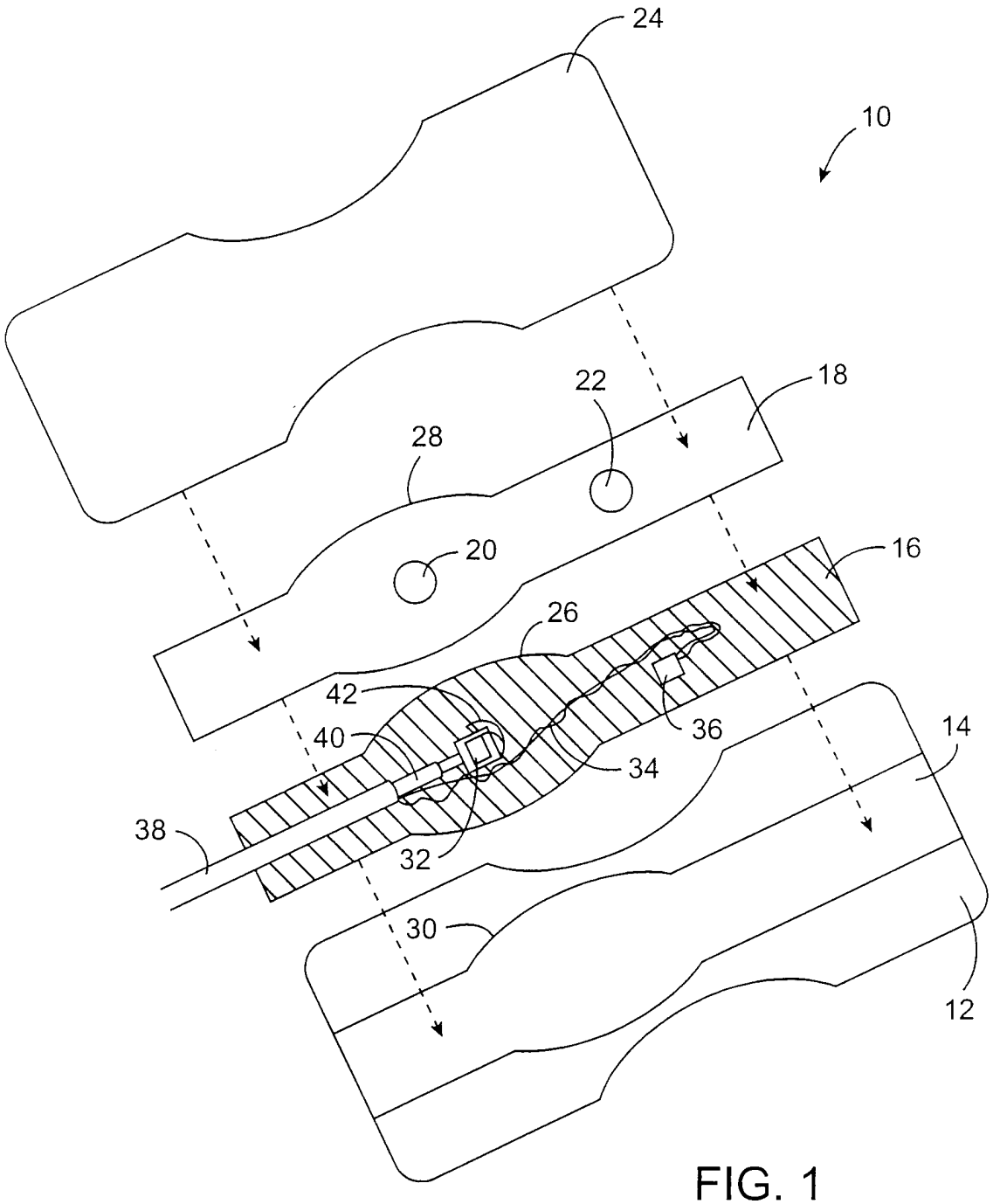

FIG. 1

INTERNATIONAL SEARCH REPORT

In ..ational Application No
PCT/US 00/30219

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B5/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 246 003 A (NELLCOR) 21 September 1993 (1993-09-21) cited in the application column 2, line 31 -column 5, line 50	1-3,7-9, 11,12
Y A	EP 0 538 631 A (BOC) 28 April 1993 (1993-04-28) column 10, line 15 - line 25	1-3,7-9, 11,12 13-15
A	US 5 054 488 A (MUZ) 8 October 1991 (1991-10-08) cited in the application column 3, line 24 -column 5, line 25; figure 1	1,3-6,9, 10,13-15

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2001	12/03/2001

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

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

In. .ational Application No
PCT/US 00/30219

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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专利名称(译)	带有加宽金属条的脉搏血氧仪传感器		
公开(公告)号	EP1231857A1	公开(公告)日	2002-08-21
申请号	EP2000976831	申请日	2000-11-01
[标]申请(专利权)人(译)	马林克罗特公司		
申请(专利权)人(译)	马林克罗特INC.		
当前申请(专利权)人(译)	马林克罗特INC.		
[标]发明人	CHIN RODNEY		
发明人	CHIN, RODNEY		
IPC分类号	A61B5/145 A61B5/00 A61B5/1455		
CPC分类号	A61B5/6826 A61B5/14552 A61B5/6838 A61B2562/182		
优先权	09/447455 1999-11-22 US		
其他公开文献	EP1231857B1		
外部链接	Espacenet		

摘要(译)

一种脉冲血氧计传感器，具有不透明的金属化层（16）以屏蔽环境光。金属化层（16）围绕光检测器（32）的区域。在一个实施例中，传感器具有透明部分（12），不透明的金属化层（16）仅覆盖光检测器（32）周围的部分和其他区域，例如在光检测器（32）之间延伸的条带。和发射器（36）。在优选实施例中，不透明的金属化层（16）是条带，其在光检测器（32）周围的区域中具有加宽部分。