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(54) **PULSE OXIMETRY SENSOR**

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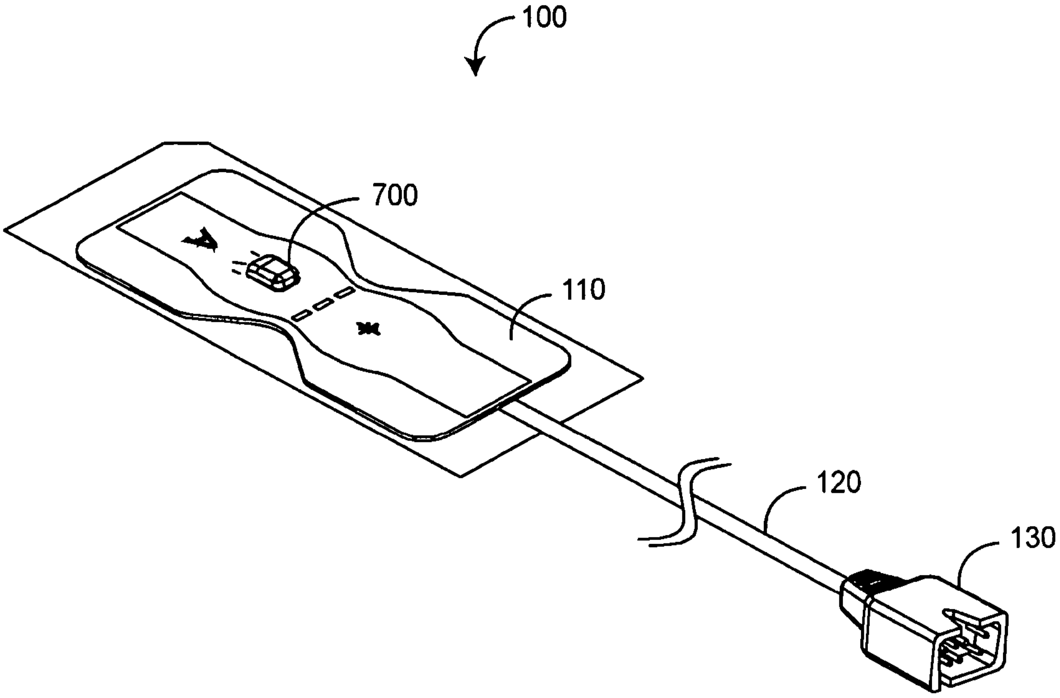
Publication Classification

(51) **Int. Cl.**[7] **A61B 5/00**
(52) **U.S. Cl.** **600/323**

(57) **ABSTRACT**

A pulse oximetry sensor has an emitter adapted to transmit optical radiation of at least two wavelengths into a tissue site and a detector adapted to receive optical radiation from the emitter after tissue site absorption. A tape assembly is adapted to attach the emitter and detector to the tissue site. A flexible housing is disposed around and optically shields the detector.



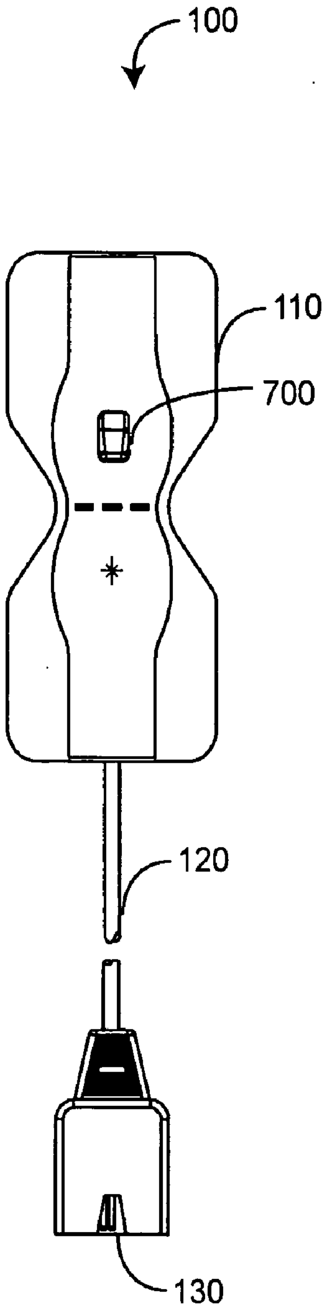


FIG. 1A

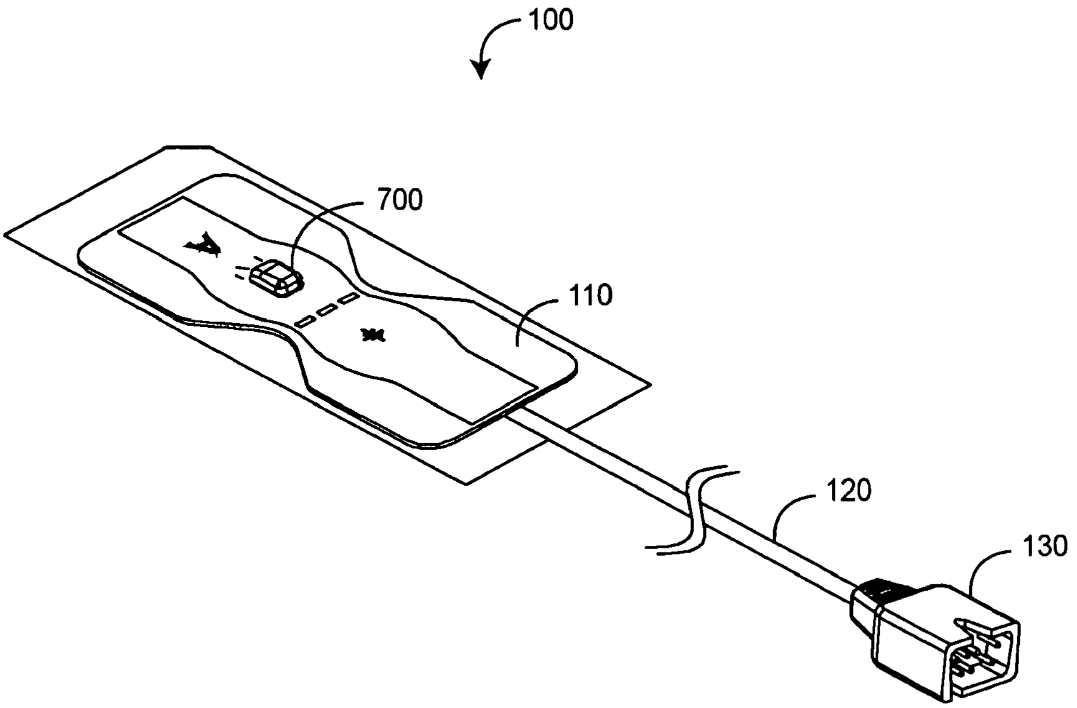


FIG. 1B

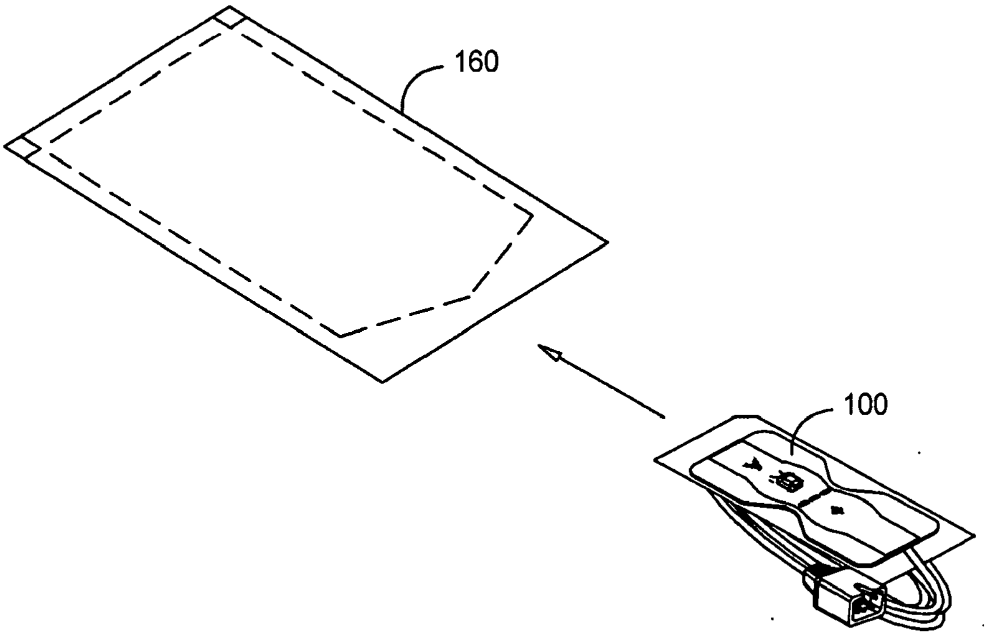


FIG. 1C

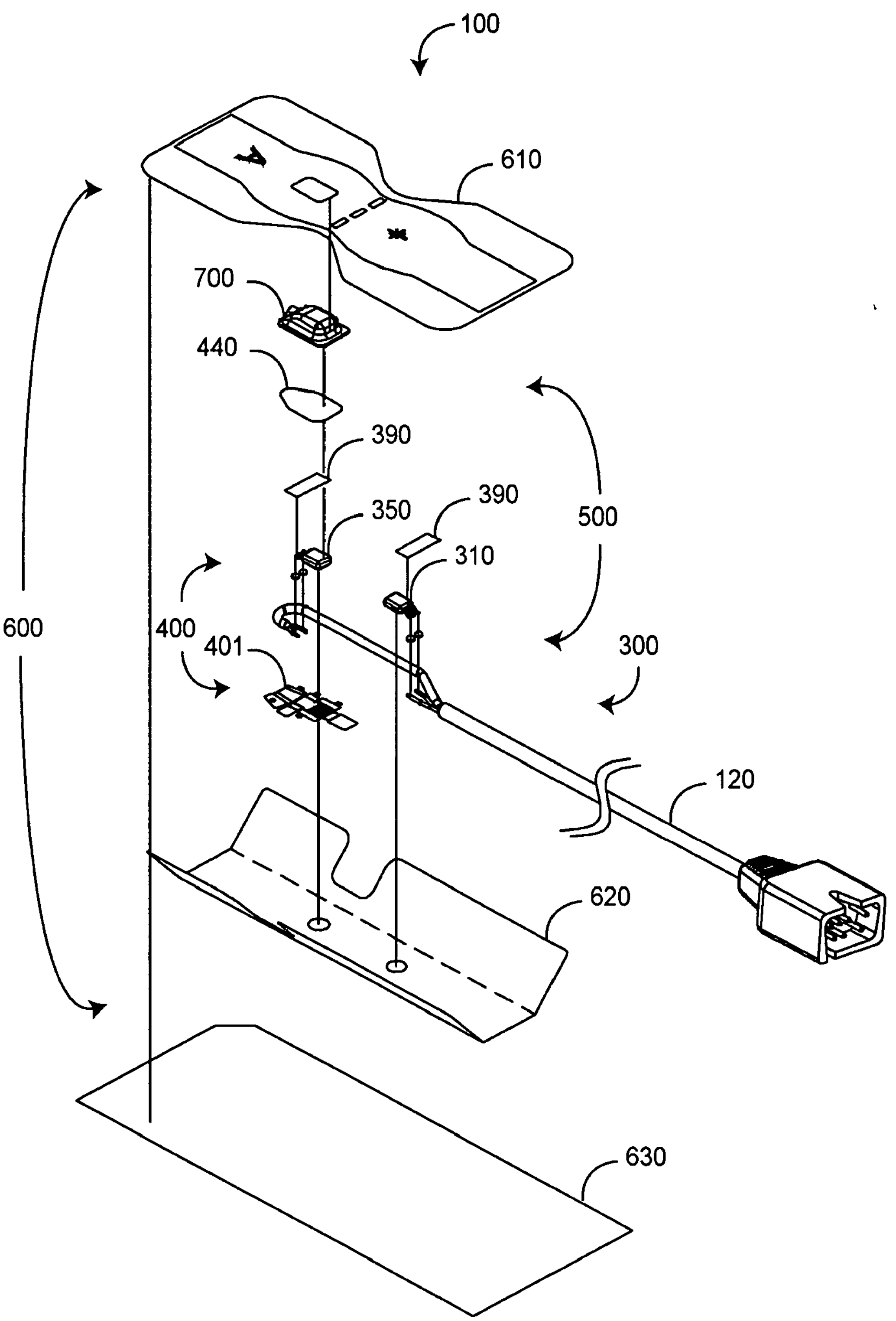


FIG. 2

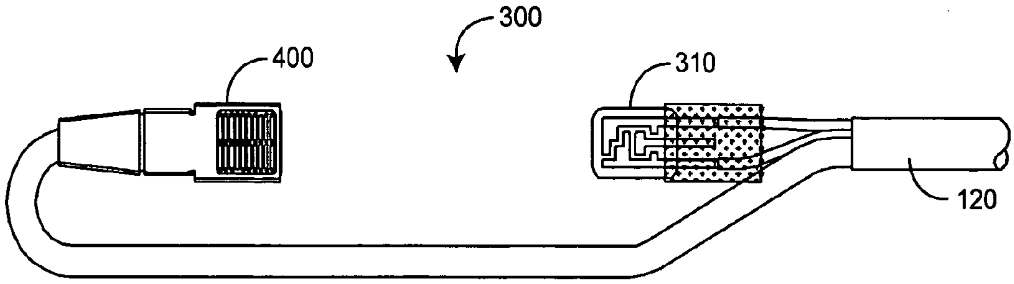


FIG. 3A

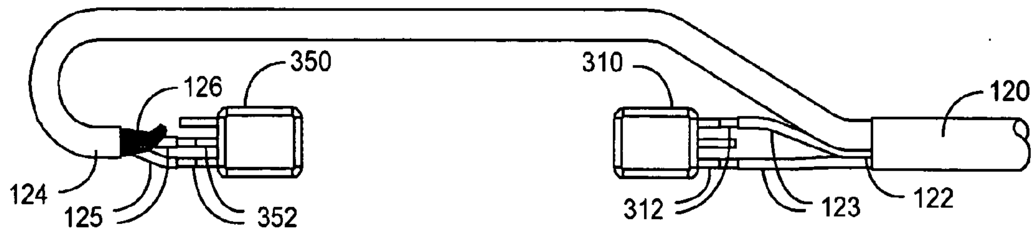


FIG. 3B

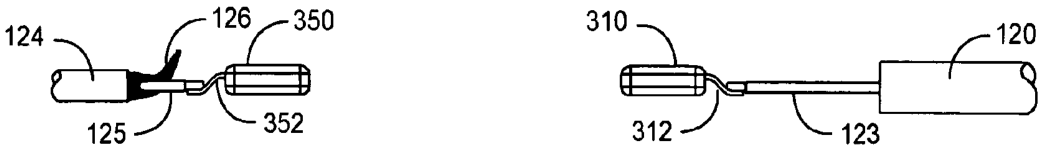


FIG. 3C

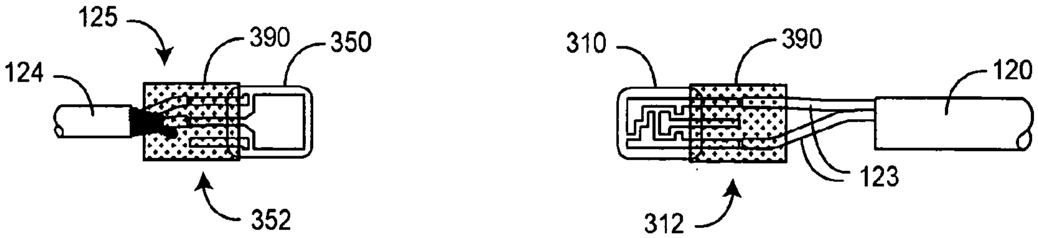


FIG. 3D

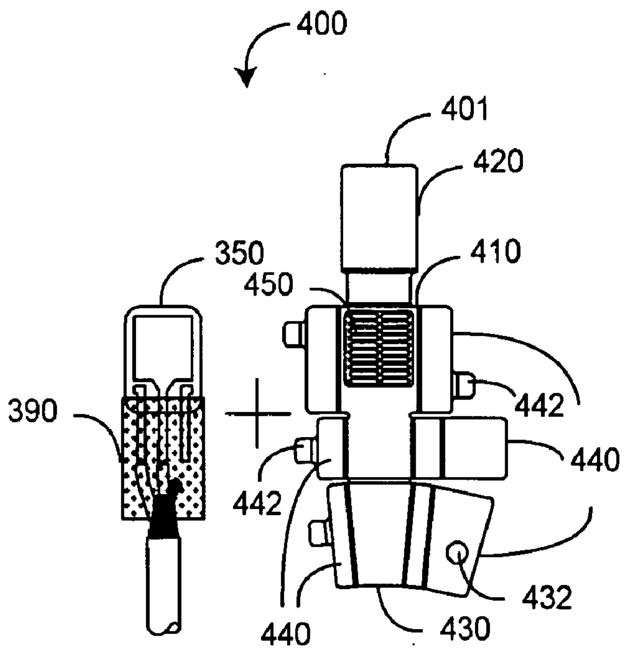

400
401
420
350
410
450
390
442
440
442
432
440
430

FIG. 4A

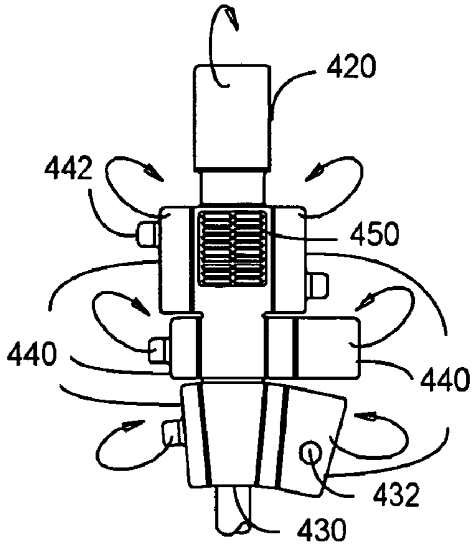

420
442
450
440
440
432
430

FIG. 4B

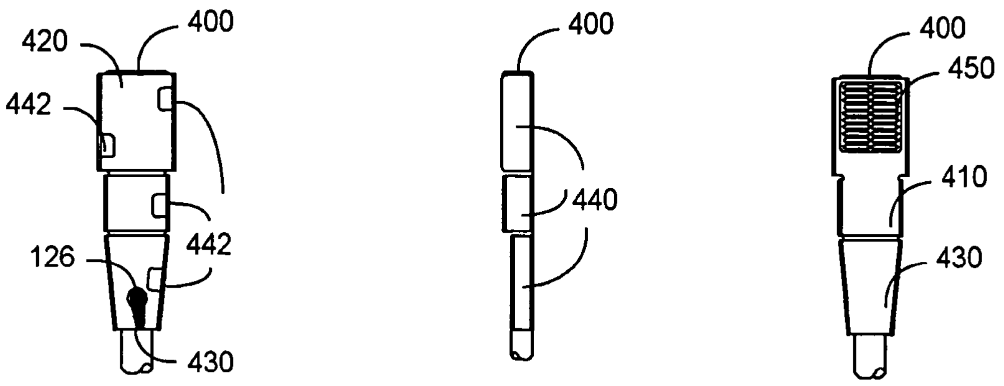


FIG. 4C FIG. 4D FIG. 4E

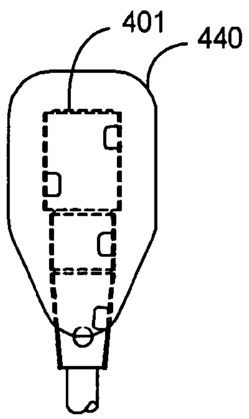


FIG. 4F

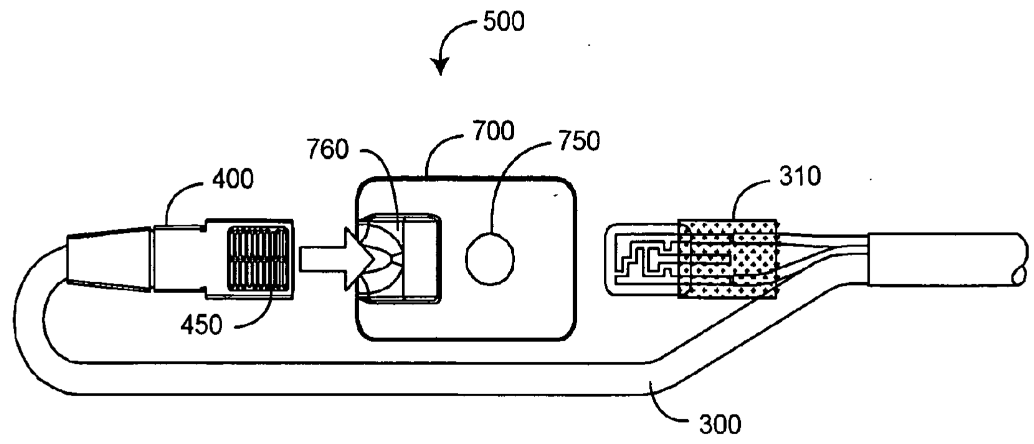


FIG. 5A

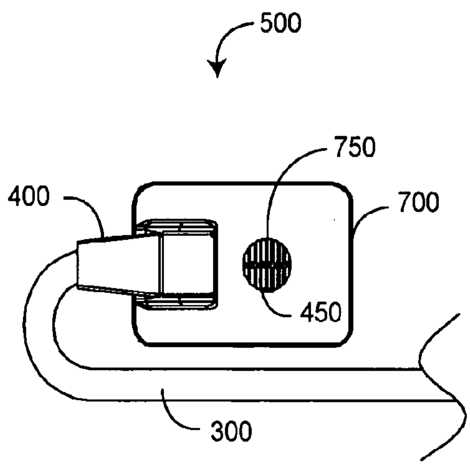


FIG. 5B

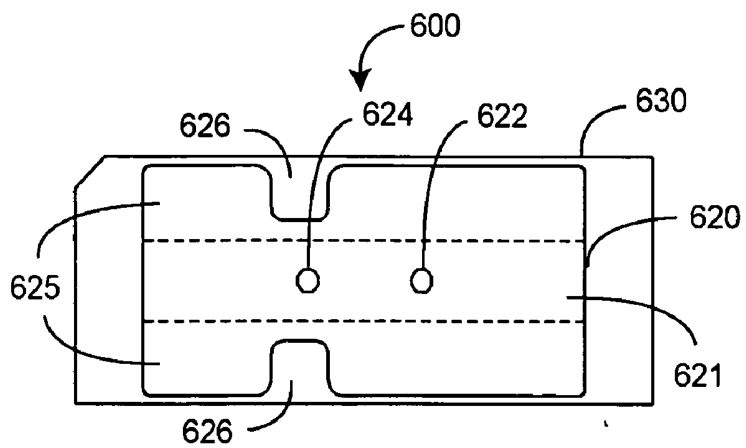


FIG. 6A

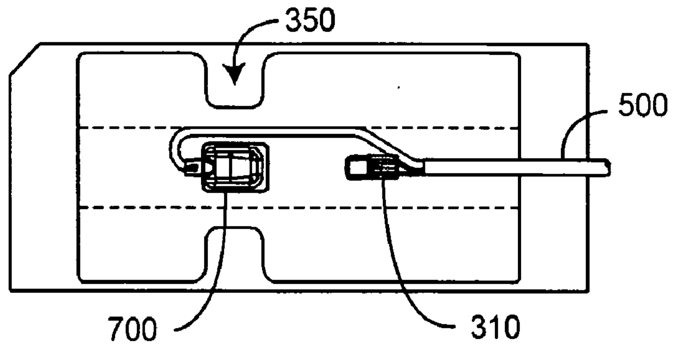


FIG. 6B

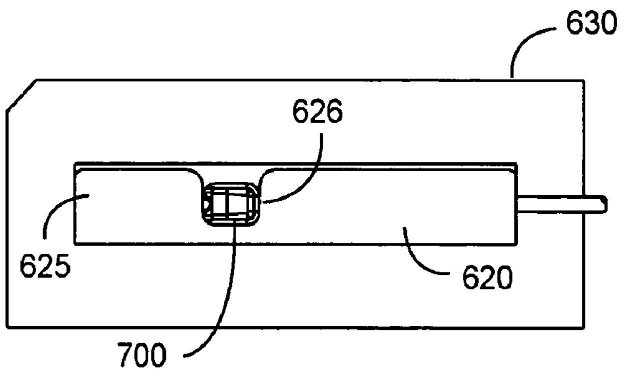


FIG. 6C

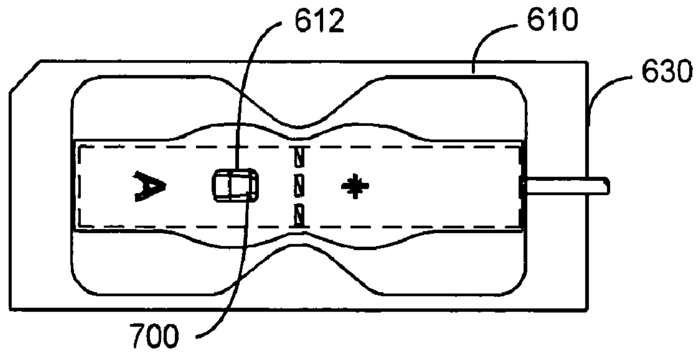


FIG. 6D

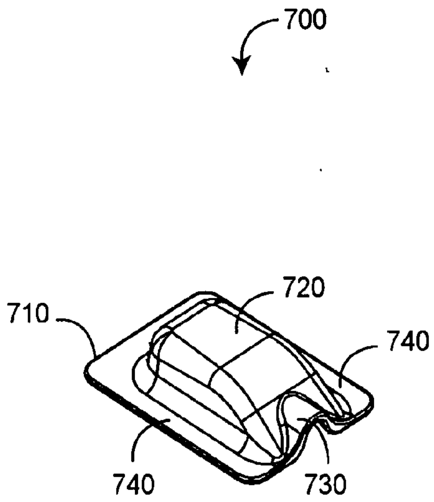


FIG. 7A

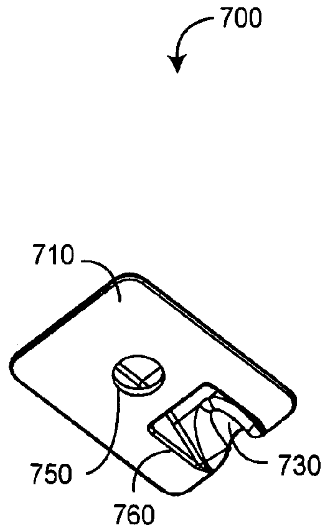


FIG. 7B

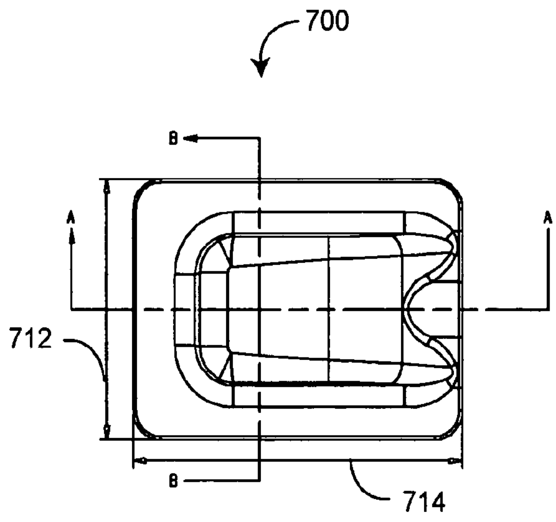


FIG. 7C

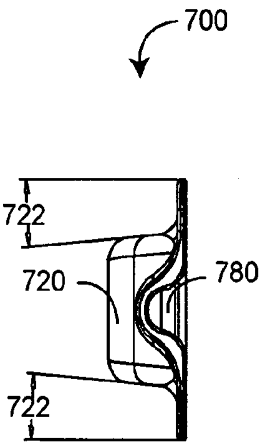


FIG. 7D

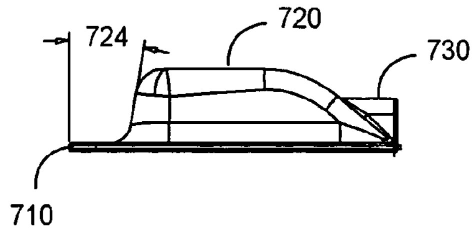


FIG. 7E

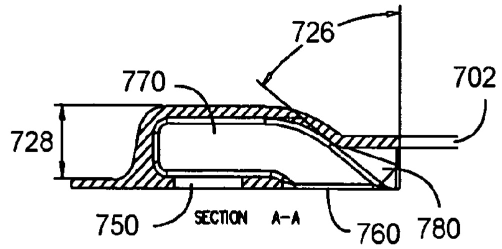


FIG. 7F

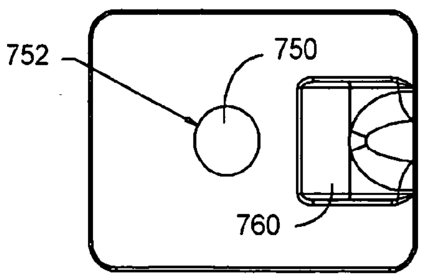


FIG. 7G

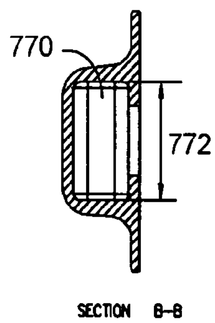


FIG. 7H

PULSE OXIMETRY SENSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application relates to and claims the benefit of prior U.S. Provisional Patent Application No. 60/534,331 entitled Pulse Oximetry Sensor, filed 01/05/2004 and incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0002] Pulse oximetry is a widely accepted noninvasive procedure for measuring the oxygen saturation level of arterial blood, an indicator of a person's oxygen supply. Early detection of low blood oxygen level is critical in the medical field, for example in critical care and surgical applications, because an insufficient supply of oxygen can result in brain damage and death in a matter of minutes. A pulse oximetry system consists of a sensor applied to a patient, a monitor, and a patient cable connecting the sensor and the monitor. The sensor is attached to a tissue site, such as an adult patient's finger. The sensor has an emitter configured with both red and infrared LEDs that, for finger attachment, project light through the fingernail and into the blood vessels and capillaries underneath. A detector is positioned at the finger tip opposite the fingernail so as to detect the LED emitted light as it emerges from the finger tissues. In general, the emitter is adapted to transmit optical radiation of at least two wavelengths into a tissue site, and the detector is adapted to receive optical radiation from the emitter after absorption by pulsatile blood flowing within the tissue site.

SUMMARY OF THE INVENTION

[0003] There are various noise sources for a sensor including electromagnetic interference (EMI), ambient light and piped light. Light that illuminates the detector without propagating through the tissue site, such as ambient light and piped light, is unwanted optical noise that corrupts the desired sensor signal. Ambient light is transmitted to the detector from external light sources, i.e. light sources other than the emitter. Piped light is stray light from the emitter that is transmitted around a tissue site along a light conductive surface, such as a reflective inner surface of face stock material, directly to the detector. A pulse oximetry sensor advantageously provides EMI shielding and optical shielding, including multiple barriers to ambient light and piped light.

[0004] One aspect of a pulse oximetry sensor comprises an emitter adapted to transmit optical radiation of at least two wavelengths into a tissue site and a detector adapted to receive optical radiation from the emitter after tissue site absorption. A tape assembly is adapted to attach the emitter and detector to the tissue site. A flexible housing is disposed around and optically shields the detector.

[0005] Another aspect of a pulse oximetry sensor comprises a detector adapted to receive optical radiation from an emitter after absorption by pulsatile blood flowing within a tissue site. A shielded detector assembly has an EMI shield disposed around the detector. A housing assembly has a flexible housing disposed around the shielded detector assembly. A tape assembly is folded around the housing assembly and is adapted to attach the detector and emitter to the tissue site.

[0006] A further aspect of a pulse oximetry sensor is a method providing an emitter adapted to transmit optical radiation of at least two wavelengths into a tissue site and a detector adapted to receive optical radiation from the emitter after absorption by pulsatile blood flowing within the tissue site. The emitter and detector are incorporated within a cable assembly adapted to provide electrical communications between the emitter and detector and a monitor. The detector is EMI shielded so as to reduce electromagnetic noise, and the EMI shielded detector is optically shielded with an opaque, flexible housing so as to reduce optical noise from ambient and piped light. The cable assembly is disposed within a tape assembly adapted to attach the emitter and detector to a tissue site.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIGS. **1**A-C are assembled top plan, assembled perspective and packaged perspective views, respectively, of a pulse oximetry sensor;

[0008] **FIG. 2** is an exploded perspective view of a pulse oximetry sensor;

[0009] FIGS. **3**A-D are shielded bottom, untaped top, untaped side and taped bottom views, respectively, of a cable assembly;

[0010] FIGS. **4**A-F are unassembled bottom, unfolded bottom, folded top, folded side, folded bottom and light barrier covered top views, respectively, of a shielded detector assembly;

[0011] FIGS. **5**A-B are unassembled and assembled bottom plan views, respectively, of a housing assembly;

[0012] FIGS. **6**A-D are top plan views of a tape assembly;

[0013] FIGS. **7**A-H are top perspective, bottom perspective, top, back, side, side cross sectional, bottom, and back cross sectional views, respectively, of a housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] FIGS. 1A-C illustrate a pulse oximetry sensor **100** having a body **110**, a cable **120** and a connector **130**. The body **110** is configured to wrap around a fingertip and incorporates an emitter **310** (**FIG. 2**) and a detector **350** (**FIG. 2**) that provide physiological measurements responsive to a patient's blood oxygen saturation, as described above. The body **110** also incorporates a flexible housing **700** configured to enclose a shielded detector assembly **400** (**FIG. 2**). Advantageously, the flexible housing **700** optically shields the detector **350** (**FIG. 2**), blocking ambient and piped light. The cable **120** provides electrical communication between the emitter **310** (**FIG. 2**) and detector **350** (**FIG. 2**) and the connector **130**. The connector **130** is adapted to a patient cable, which electrically and mechanically connects the sensor **100** to a monitor (not shown).

[0015] **FIG. 2** further illustrates a pulse oximetry sensor **100** having a cable assembly **300**, a shielded detector assembly **400**, a housing assembly **500**, a tape assembly **600** and a flexible housing **700**. The cable assembly **300** has the cable **120**, the emitter **310**, the shielded detector assembly **400** and insulating tape **390**, as described in detail with respect to FIGS. **3**A-D. The shielded detector assembly **400** has the detector **350**, an electromagnetic interference (EMI) shield **401** and a light barrier **440**, as described in detail with respect to FIGS. 4A-F. The housing assembly **500** has the cable assembly **300** and the flexible housing **700**, as described in detail with respect to FIGS. 5A-B. The tape assembly **600** has a face tape **610**, a trifold wrap **620** and a release liner **630**, as described in detail with respect to FIGS. 6A-D. The flexible housing **700** is described in detail with respect to FIGS. 7A-H.

[0016] FIGS. 3A-D illustrate a cable assembly **300** having an emitter **310**, a shielded detector assembly **400** and a cable **120**. The detector **350** is incorporated within the shielded detector assembly **400**. The cable **120** has an emitter portion **122** and a detector portion **124**. A pair of emitter wires **123** extend from the emitter portion **122** and are soldered to corresponding emitter leads **312**. A pair of detector wires **125** extend from the detector portion **124** and are soldered to corresponding detector leads **352**. A cable shield **126** also extends from the detector portion **124** and is dressed for attachment to the EMI shield **401** (FIGS. 4A-B), as described below. As shown in **FIG. 3D**, insulating tape **390** is wrapped around the emitter wires **123** and emitter leads **312** at the emitter portion **122** and wrapped around the detector wires **125** and detector leads **352** at the detector portion **124**.

[0017] FIGS. 4A-F illustrate a shielded detector assembly **400** having a detector **350**, insulating tape **390** and an EMI shield **401**. The EMI shield **401** has a front portion **410**, a foldable back portion **420** and a cable portion **430**. The front portion **410** is disposed between the back **420** and the cable **430** portions. A conductive grid **450** is disposed on the front portion **410**. Foldable sides **440** extend from the side edges of the front portion **410** and the cable portion **430**. Tabs **442** extend from some of the foldable sides **440**. An aperture **432** is defined in the cable portion **430**.

[0018] As shown in **FIG. 4A**, the detector **350** is placed on the inside of the EMI shield **401** so that the light sensitive areas of the detector **350** are proximate the grid **450**. As shown in **FIG. 4B**, the back portion **420** and the sides **440** are folded back to cover the detector **350**. As shown in FIGS. 4C-E, the tabs **442** secure the sides **440** and the back **420** in a closed position. The EMI shield **401** reduces electromagnetic interference at the detector **350**. The grid **450** allows light from the emitter **410** that is attenuated by tissue to pass through to the detector **350**. The cable shield **126** is placed through the aperture **432** and soldered or otherwise electrically connected to the cable portion **430** of the EMI shield **401**. Any excess cable shield **126** is trimmed. As shown in **FIG. 4F**, a light barrier **440** is placed over the back of the EMI shield **401**. In one embodiment, the light barrier **440** is a metal foil, such as aluminum.

[0019] FIGS. 5A-B illustrate a housing assembly **500** having a cable assembly **300** attached to a flexible housing **700**. The cable assembly **300** has an emitter **310** and the shielded detector assembly **400**, as described above with respect to FIGS. 3A-D and FIGS. 4A-F, respectively. The housing **700** has an aperture **750** and an opening **760**. The shielded detector assembly **400** is inserted into the housing **700** through the opening **760** and secured within a pocket **770** (**FIG. 7F**) so that the grid **450** is aligned with the aperture **750**. The aperture **750** allows emitted light to pass to the detector **350** (**FIG. 2**) via the grid **450**.

[0020] FIGS. 6A-D illustrate a tape assembly **600** having a face tape **610**, a trifold wrap **620** and a release liner **630**. As shown in **FIG. 6A**, the trifold wrap **620** has a center portion **621** disposed between foldable side portions **625**, which are symmetrical about the center portion **621**. The center portion **621** has an emitter aperture **622** and a detector aperture **624**. The emitter aperture **622** passes light from the emitter **310** (**FIG. 6B**) and the detector aperture **624** passes light to the detector **350** (not visible). The side portions **625** have cutouts **626** configured to accommodate the housing **700** when the side portions **625** are folded. The trifold wrap **620** has a pressure sensitive adhesive (PSA) on the component side and a Med **3044** adhesive on the center portion **621** of the patient side. The release liner **630** is removably attached to the patient side of the trifold wrap **620**.

[0021] As shown in **FIG. 6B**, the housing assembly **500** is attached to the center portion **621** on the side opposite the release liner **630** so that the emitter **310** is aligned with the emitter aperture **622** and the housing aperture **750** (**FIG. 5B**) is aligned with the detector aperture **624**. As shown in **FIG. 6C**, the side portions **625** are folded around the housing assembly **500** so that the housing **700** protrudes through the cutouts **626**. As shown in **FIG. 6D**, the face tape **610** is fixedly attached to the trifold wrap **620** and removably attached to the release liner **630**. A face tape aperture **612** also accommodates the protruding housing **700**. In one embodiment, the trifold wrap **620** is polypropylene and the face tape **610** is a laminate of Bioflex RX848P and 3M 1527ENP.

[0022] FIGS. 7A-H illustrate a housing **700** that advantageously functions as both a light barrier and an optical cavity and is flexible and easy to manufacture. In one embodiment, the housing is injection molded as single piece of opaque, gray, medical grade PVC. As shown in FIGS. 7A-H, the housing **700** has a base **710**, a cover **720**, a cable strain relief **730**, and a flange portion **740** of the base **710** disposed around the periphery of the cover **720**. The cover **720** defines a pocket **770**, which receives the detector assembly **400** (FIGS. 4A-F), as described above with respect to FIGS. 5A-B. The base **710** defines a generally centered, generally circular aperture **750** and an opening **760** for the pocket **770**. The flange **740** provides a structure for securing the housing **700** to the trifold wrap **620** (FIGS. 6A-D). The pocket **770** is raised above the base **710**, which advantageously recesses the detector **350** (**FIG. 2**) to reduce ambient and piped light from entering the detector **350** (**FIG. 2**) from the sides. In particular, the aperture **750** provides an optical cavity that allows optical radiation from the emitter **310** (**FIG. 2**) that propagates through the tissue site to reach the detector **350** (**FIG. 2**), while rejecting optical noise sources.

[0023] Further shown in FIGS. 7A-H, the housing **700** has a width **712**, a length **714**, a cover thickness **702**, a side angle **772**, a front angle **724** and a back angle **726**. In one embodiment, the width **712** is about 0.44 inches, the length **714** is about 0.598 inches, the cover thickness **702** is about 0.02 inches, the side angle **722** is about 5°, the front angle **724** is about 10° and the back angle **726** is about 52.5°. Further, the aperture diameter **752** is about 0.117 inches, the pocket width **762** is about 0.2 inches and the cover height **728** is about 0.14 inches.

[0024] A pulse oximetry sensor 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 art will appreciate many variations and modifications.

What is claimed is:

1. A pulse oximetry sensor comprising:

an emitter adapted to transmit optical radiation of at least two wavelengths into a tissue site;

a detector adapted to receive optical radiation from said emitter after tissue site absorption;

a tape assembly adapted to attach said emitter and said detector to said tissue site; and

a flexible housing disposed around and optically shielding said detector.

2. The pulse oximetry sensor according to claim 1 wherein said housing comprises:

a base;

a cover extending from said base; and

a pocket defined by said cover and adapted to receive said detector, said pocket raised above said base.

3. The pulse oximetry sensor according to claim 2 wherein said housing further comprises an aperture defined by said base so as to form an optical cavity that allows light originating from said emitter and absorbed by said tissue site to reach said detector while rejecting optical noise.

4. The pulse oximetry sensor according to claim 3 wherein said housing further comprises an opening defined in said base and configured to allow said detector to insert into said pocket.

5. The pulse oximetry sensor according to claim 4 wherein said housing further comprises a flange disposed around the periphery of said cover.

6. The pulse oximetry sensor according to claim 5 wherein said housing further comprises a flange providing structure to secure said housing to said tape assembly.

7. The pulse oximetry sensor according to claim 6 further comprising a cable assembly adapted to provide electrical communications between a pulse oximetry monitor and said emitter and said detector, a strain relief portion of said housing configured for a cable portion of said cable assembly.

8. The pulse oximetry sensor according to claim 7 wherein said housing is molded from an opaque, gray, medical grade PVC.

9. A pulse oximetry sensor comprising:

a detector adapted to receive optical radiation from an emitter after absorption by pulsatile blood flowing within a tissue site;

a shielded detector assembly having an EMI shield disposed around said detector;

a housing assembly having a flexible housing disposed around said shielded detector assembly; and

a tape assembly folded around said housing assembly and adapted to attach said detector and said emitter to said tissue site.

10. The pulse oximetry sensor according to claim 9 wherein said flexible housing comprises:

a base; and

a pocket raised above said base and retaining said shielded detector assembly,

said base defining an opening for said pocket and a generally circular aperture extending to said pocket.

11. The pulse oximetry sensor according to claim 10 wherein said aperture aligns with a grid portion of said EMI shield.

12. The pulse oximetry sensor according to claim 11 wherein said flexible housing further comprises a flange that secures said flexible housing to said tape assembly.

13. The pulse oximetry sensor according to claim 12 wherein said tape assembly comprises a tri-fold wrap having cutouts configured to accommodate said flexible housing.

14. The pulse oximetry sensor according to claim 13 wherein said tape assembly further comprises a face tape having a face tape aperture configured to accommodate said flexible housing.

15. A pulse oximetry sensor method comprising the steps of:

providing an emitter adapted to transmit optical radiation of at least two wavelengths into a tissue site;

providing a detector adapted to receive optical radiation from said emitter after absorption by pulsatile blood flowing within said tissue site;

incorporating said emitter and said detector within a cable assembly adapted to provide electrical communications between said emitter and said detector and a monitor;

EMI shielding said detector so as to reduce electromagnetic noise;

optically shielding said EMI shielded detector with an opaque, flexible housing so as to reduce optical noise from ambient light and piped light; and

disposing said cable assembly within a tape assembly adapted to attach said emitter and said detector to a tissue site.

16. The pulse oximetry sensor according to claim 15 wherein said optical shielding step comprises the substeps of:

enclosing said EMI shielded detector within said flexible housing so as to reduce ambient light; and

forming an optical cavity within said flexible housing so as to reduce piped light.

17. The pulse oximetry sensor according to claim 16 wherein said enclosing step comprises the substeps of:

defining a pocket within said flexible housing; and

inserting said EMI shielded detector into said pocket through an opening in a base of said flexible housing.

18. The pulse oximetry sensor according to claim 18 wherein said forming step comprises the substeps of:

raising said pocket above said base so as to recess said detector from said base; and defining a generally circular aperture extending through said base to said pocket so as to allow optical radiation from said emitter that propagates through said tissue site to said aperture to reach said detector.

19. The pulse oximetry sensor according to claim 18 wherein said enclosing step comprises the further substep of aligning a light sensitive area of said EMI shielded detector with said aperture.

20. The pulse oximetry sensor according to claim 19 wherein said disposing step comprises the substep of securing a flange portion of said housing to said tape assembly.

* * * * *

patsnap

专利名称(译)	脉搏血氧饱和度传感器		
公开(公告)号	[US20050197550A1](US20050197550A1)	公开(公告)日	2005-09-08
申请号	US11/029009	申请日	2005-01-04
[标]申请(专利权)人(译)	AL ALI AMMAR 戴铂MOHAMEDķ COVERSTON RONALD 毛勒GARRICK 约翰·施密特 舒尔茨CHRIS		
申请(专利权)人(译)	AL-ALI AMMAR 戴铂MOHAMED K. COVERSTON RONALD 毛勒GARRICK 约翰·施密特 舒尔茨CHRIS		
当前申请(专利权)人(译)	摩根大通银行，NATIONAL ASSOCIATION		
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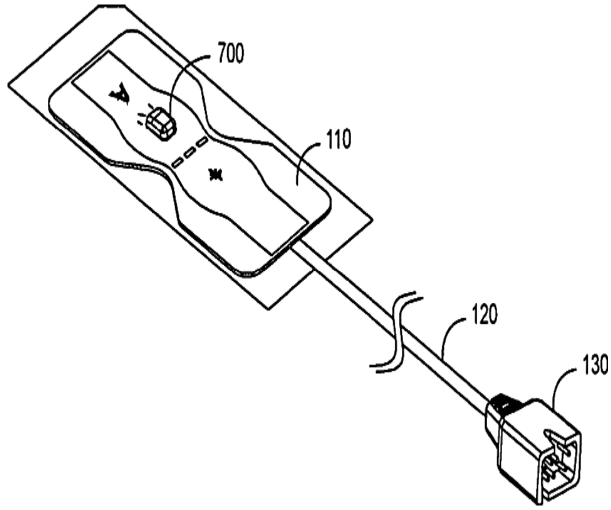
摘要(译)

脉搏血氧饱和度传感器具有适于将至少两个波长的光辐射传输到组织部位的发射器和适于在组织部位吸收之后接收来自发射器的光辐射的检测器。带组件适于将发射器和检测器连接到组织部位。柔性外壳围绕检测器设置并且光学屏蔽检测器。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