(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 773 183 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
03.12.2014 Bulletin 2014/49

(21) Application number: **05758928.5**

(22) Date of filing: **06.07.2005**

(51) Int Cl.:
A61B 5/145 *(2006.01)* ***A61B 5/1455*** *(2006.01)*
A61B 5/00 *(2006.01)*

(86) International application number:
PCT/IL2005/000720

(87) International publication number:
WO 2006/006153 (19.01.2006 Gazette 2006/03)

(54) **DEVICE AND METHOD FOR NON-INVASIVE OPTICAL MEASUREMENTS**

VORRICHTUNG UND VERFAHREN FÜR NICHTINVASIVE OPTISCHE MESSUNGEN

DISPOSITIF ET PROCEDE DE MESURE OPTIQUE NON EFFRACTIVE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(30) Priority: **08.07.2004 US 885885**

(43) Date of publication of application:
18.04.2007 Bulletin 2007/16

(73) Proprietor: **Orsense Ltd.**
76705 Rehovot (IL)

(72) Inventors:
- **FINAROV, Alexander**
  76555 Rehovot (IL)
- **FINE, Ilya**
  76540 Rehovot (IL)

(74) Representative: **Modiano, Micaela Nadia et al**
Modiano Josif Pisanty & Staub Ltd
Thierschstrasse 11
80538 München (DE)

(56) References cited:
WO-A-01/96872
WO-A-2004/105596
WO-A-2004/112574
US-A- 4 685 464
US-A- 5 782 757
US-A- 6 115 621
US-A1- 2002 077 535
US-A1- 2003 036 690
US-A1- 2004 054 290

EP 1 773 183 B1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] This invention relates to a device and method for non-invasive optical measurements on a human body, which is particularly useful for measuring blood-related parameters.

BACKGROUND OF THE INVENTION

[0002] Non-invasive (*in vivo*) methods for measuring various blood-related parameters have become very popular due to the fact that these measurements, in distinction to invasive ones, do not involve the physical withdrawal of a blood sample from the patient's body. Optical monitoring techniques of the kind specified utilize the detection of light transmitted or reflected from the location on the patient's body under measurement, and are based on spectrophotometric measurements enabling the indication of the presence of various blood constituents based on known spectral behaviors of these constituents. These methods being applied in real medicine rather than in analytical chemistry create the basis for non-invasive blood tests, which present, no doubt, one of today's most exciting challenges. To make blood tests low-cost, safe and painless means to make them non-invasive.

[0003] The two main challenges, that any non-invasive optical method has to deal with, are as follows: (1) the low signal-to-noise ratio, and, (2) the large variability of individual parameters influencing the signal of concrete patients.

[0004] Most of these techniques utilize a measurement optical device or probe, designed in a manner to be attached to the patient's finger, which includes an optical assembly for irradiating the finger with light and detecting its light response. The conventional devices of the kind specified, such as a pulse oximeter, which is the generally accepted standard of everyday clinical practice, provide for measuring enhanced optical pulsatile signals caused by the changes in the volume of a blood flowing through a fleshy medium (e.g., finger).

[0005] It is known that for blood parameters other than oxygen saturation, e.g., glucose concentration, significant difficulties have been accoutered, because their absorption spectral behavior in red and near infrared regions is not as remarkable as for the oxygenized hemoglobin. Hence, the main limitations on the way of expanding the non-invasive techniques to the measurements different from pulse oximetry are associated with the limited selectivity of the absorption based method.

[0006] A different technique is disclosed in U.S. Patent No. 6,400,972, WO 01/45553 and WO 01/96872, all assigned to the assignee of the present application. This is an occlusion-release based technique, according to which an over-systolic pressure is applied to the blood perfused fleshy medium with a normal blood flow so as to create a state of temporary blood flow cessation at the measurement location. The measurement with different wavelengths of incident radiation and/or different polarization states of detected light are carried out at timely separated sessions taken during a time period including a cessation time when the state of the blood flow cessation is maintained. This technique utilizes the condition of the "artificial blood kinetics" rather than the natural blood kinetics taking place when the state of blood cessation is not achieved. As a result of the cessation of the blood flow, a condition of the artificial kinetics is achieved with the optical characteristics of the blood associated with the light response being different from those at the natural blood kinetics. Indeed, it is known that the scattering properties of blood depend on the size and shape of scatterers (aggregates). Thus, time changes of the light response at the condition of artificial kinetics depend on the changes in the shape and average size of the scattering centers in the medium, i.e., red blood cells (RBC) aggregation (Rouleaux effect). It was found that owing to the effect of the artificial kinetics, the optical characteristics of blood changes dramatically, such that they differ from those of the fleshy medium with a normal blood flow by about 25 to 60%, and sometimes even more. Hence, the accuracy (i.e., signal-to-noise ratio) of the technique based on the artificial kinetics as well as selectivity of the optical measurements can be substantially better when compared with those based on measurements of the blood parameters at natural kinetics.

SUMMARY OF THE INVENTION

[0007] There is a need in the art to facilitate non-invasive optical measurements of blood parameters by providing a novel device and method capable of stabilizing the optical response of an illuminated region in a patient's body.

[0008] The present invention provides for detecting the optical response formed by both light reflected from the illuminated body portion and light transmitted therethrough. It should be understood that the terms *"reflected light"* and *"transmitted light"* used herein signify light components detected at, respectively, the same side of the body portion at which the illumination is applied and the opposite side, and actually both light portions include light scattered from the illuminated region.

[0009] The present invention utilizes redirecting reflections of light on its way towards the region of interest (i.e., blood vessel) back to the region of interest. This is implemented using a diffuser accommodated in the optical path of light reflected from the body portion under measurements. Due to the provision of a diffuser, illuminating light that is reflected from the skin and bones is "collected" and directed back to the region of interest. The use of a diffuser stabilizes both the reflected and transmitted responses of the illuminated region, and causes a stable increase of the reflected signal.

[0010] Thus, according to one aspect of the invention, there is provided an optical measurement device for use

in non-invasive measurements on a patient's body, the device comprising:

- an illumination assembly configured and operable to generate illuminating light of a predetermined wavelength range;
- a detection assembly comprising a first detector unit for detecting a first light signal transmitted through an illuminated body portion and generating first measured data indicative of the detected transmitted light, and a second detector unit for detecting a second light signal reflected from the illuminated body portion and generating second measured data indicative of the detected reflected light; and
- a light directing assembly comprising a light diffuser for scattering back light incident thereto, to thereby direct the illuminating light or the light coming from the body portion back towards the body portion, thereby increasing amount of light reaching a region of interest inside the body portion and thus maximizing homogeneity of the first and second detected light signals.

[0011] Preferably, the light diffuser extends along at least a part of the body portion at the illuminated side thereof. The diffuser may be formed with an optical window for allowing passage of light from the illumination assembly towards the body portion; and/or with an optical window for allowing light passage from the body portion to the second detector unit.

[0012] The diffuser may for example be, but not limited to, of dimensions of about 20x24mm, and may be made of a material such as PVC, Polyurethan.

[0013] The device is configured for operating in the occlusion-release mode. To this end, the device includes a pressurizing assembly operable for applying an oversystolic pressure to the patient's body so as to create a condition of artificial blood kinetics in the region of interest and maintain this condition for a certain time period. The pressurizing assembly may be configured and operable for applying a secondary controllably varying under- or over-systolic pressure to the body within the region of interest, so as to alter said condition of artificial blood kinetics over a predetermined time interval within said certain time period, to thereby modulate the amount of blood under measurements.

[0014] Preferably, the device is configured as finger holder. This may be a clip member for enclosing the body portion between its upper and lower arms, one of the upper and lower arms carrying the illumination assembly, the diffuser and the second detector unit, and the other arm carrying the first detector unit. Alternatively, this may be a ring-like device. For example, such a ring may be designed as two U-shaped semi-ring portions, one carrying the illumination assembly, the diffuser and the second detector unit, and the other carrying the first detector unit. If the occlusion-mode operation is considered, the pressurizing assembly is associated with one of the U-shaped portions being in the form of an air cushion on the inner side of said portion, in which case the air cushion is made of a light diffusing material, thereby presenting said diffuser.

[0015] According to another aspect of the invention, there is provided a method for use in non-invasive optical measurements on a patient's body utilizing illumination of a region of interest inside the body portion and detection of light response of the region of interest, the method comprising:

- collecting light coming from the body portion and directing at least a part of the collected light back to the body portion;
- detecting a first light signal transmitted through the body portion and generating first measured data indicative of the detected transmitted light, and detecting a second light signal reflected from the body portion and generating second measured data indicative of the detected reflected light;

the method providing for increasing amount of light reaching the region of interest inside the body portion, and for maximizing homogeneity of the first and second detected light signals.

[0016] The invention is defined in the claims. Other embodiments are presented for illustrative purposes only.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of nonlimiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a measurement device of the present invention utilizing a diffuser;
Fig. 2 illustrates a measurement device according to a specific example of the invention;
Figs. 3A and 3B illustrate the result of typical optical measurements without a diffuser; and
Figs. 4A and 4B illustrate the results of measurements utilizing the device of the present invention with a diffuser.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Referring to **Fig. 1,** there is schematically illustrated an optical measurement device **10** of the present invention for use in non-invasive measurements on a patient's body, e.g., patient's finger **F.** The device **10** includes an illumination assembly **12;** a detection assembly **14;** and a light directing assembly **16.** A control unit **20** is provided for operating the illumination and detection assemblies and for receiving and processing measured data coming from the detection assembly.

[0019] The illumination assembly **12** is accommodated

so as to direct illuminating light towards the finger **F.** The illumination assembly **12** may utilize one or more light emitting elements, e.g., LED(s). Preferably, a matrix of LEDs is used. In this specific example of measuring blood parameters, the illumination assembly **12** is designed for generating light of different wavelengths (at least two different wavelengths), which can be implemented by using different light emitting elements or a single broadband illuminator.

[0020] The light detection assembly **14** includes a first detector unit **14A** accommodated substantially opposite the illumination assembly 12 for detecting a first light signal transmitted through the finger **F** and generating first measured data $\mathbf{MD_1}$ indicative thereof, and includes a second detector unit **14B** accommodated adjacent to the illumination assembly **12** for detecting a second light signal reflected from the inside of the finger and generating second measured data $\mathbf{MD_2}$ indicative thereof. Each of the detector units **14A** and **14B** includes one or more frequency selective detector (e.g., a matrix of detectors), such as spectrophotometer and/or photodiode typically equipped with frequency selective filter and amplifying means, which are not specifically shown.

[0021] It should be understood that generally, the light emitting element(s) as well as a detectors may be accommodated aside the finger in which case light is directed towards and away from the respective locations on the finger via fibers.

[0022] The light directing assembly **16** includes a diffuser **18** accommodated proximate the finger portion under measurements at the illuminating side, so as to collect light reflections from the finger and reflect them back towards the inside of the finger, thereby increasing the amount of light reaching the blood vessel in the finger. As shown in the present example, the diffuser **18** extends along the finger portion and is formed with an optical window **19** so as to allow passage of illuminating light towards the finger. The reflection-mode detector **14B** may be accommodated adjacent to the diffuser slightly aside thereof to detect reflected light propagating along axes that do not intersect with the diffuser, or alternatively, may be vertically aligned with the diffuser in which case the diffuser **18** is formed with an additional optical window **19** allowing passage of light therethrough towards the detector **14B.**

[0023] The diffuser is made of a semi-transparent material, capable to diffuse visible and near-infrared light. The attenuation coefficient and spatial distribution of diffused light has to be a very weak function of wavelength in the operating spectral region. The diffuser has a certain minimal size so as to ensure that the majority of the body surface (e.g., surface of the patient's finger provides efficient return of reflected light to the examined media (e.g., about 48mm^2, e.g., dimensions of about 20x24mm).

[0024] The diffuser thus "collects" light that is typically reflected from the skin and bone while propagating towards the blood vessel and reflects this light back to the blood vessel to thereby increase the amount of light reaching the blood vessel. As a result, both the intensity of light transmitted through the blood vessel and received at the first detector unit **14A** (transmission-mode detector) and the intensity of light reflected from the blood vessel and received at the second detector unit **14B** (reflection-mode detector) are increased, and the homogeneity of the first and second light signals is thus maximized.

[0025] The device **10** may be designed as a finger holder in the form of a clip member attachable to a patient's finger so as to enclose a finger portion between upper and lower arms **11A** and **11B** of the clip member (similar to the conventionally used pulse oximeter). One of the upper and lower arms - lower arm **11B** in the present example, carries the illumination assembly **12,** the diffuser **18** and the reflection-mode detector unit **14B,** and the other arm **11A** carries the transmission-mode detector unit **14A.** The diffuser **18** extends along at least a part of the inner surface of the lower arm **11B** of the clip member.

[0026] The measurement device **10** is configured for operating with the so-called "occlusion-release mode". To this end, the device **10** includes a pressurizing assembly **22** having an occluder arrangement (occlusion cuff) **24** associated with a drive mechanism **25** operable by the control unit **20** for applying an over-systolic pressure to the patient's finger **F** to create a state of blood flow cessation in the vicinity of a measurement location **ML** (where optical measurements are applied). The pressurizing **assembly 22** may also be operable to apply a secondary controllably varying under- or over-systolic pressure to the measurement location **ML,** which in the present example of Fig. 1 is implemented using another cuff **26** associated with a drive mechanism **27.** Thus, the primary over-systolic pressure is applied to a finger location $\mathbf{L_1}$ upstream of the measurement location **ML** with respect to the blood flow direction, and the variable secondary pressure is periodically applied to a location $\mathbf{L_2}$ in the closest vicinity of the measurement location while in the state of temporarily blood flow cessation, thus implementing the so-called "multiple-occlusion" mode.

[0027] The principles of the occlusion-release based measurements are disclosed in the above-indicated US Patents and the multiple-occlusion mode is described in a co-pending US patent application Ser. No. 10/452,932, all assigned to the assignee of the present application, and do not form part of the present invention.

[0028] Moreover, the principles of the present invention consisting of using a diffuser and detecting both light transmitted through and reflected from the region of interest, can advantageously be used in measurements based on detecting a pulsatile signal of a light response of the medium (such as in the conventional pulse oximeter), and in the occlusion-based measurements where a non-pulsatile signal is detected. This will be described further below with reference to Figs. 3A-3B and 4A-4B.

[0029] It should be noted that when using the simultaneous transmission- and reflection-mode measure-

ments, the parameter of interest (e.g., glucose concentration in blood) may be calculated independently from transmission and reflection signals. When a difference between the two readings exceeds a certain predetermined value, the measurement results are defined as an outlier.

[0030] **Fig. 2** illustrates a specific but not limiting example of a measurement device **100** of the present invention. In the present example, the device **100** is designed like a ring, formed by two portions **111A** and **111B** each of a substantially U-shaped cross-section arranged with respect to each other for enclosing and holding therebetween a portion of the patient's finger (not shown here). The U-shape parts **111A** and **111B** are made of a rigid or semi-rigid material, such as metal or plastic. In the cross-section, these U-shape parts can, for example, be of semi-circle or semi-oval forms. The parts **111A** and **111B** can partially overlap over a predetermined distance.

[0031] The measurement device (probe) **100** comprises an illumination assembly (not shown) mounted on a holding frame **112** associated with the semi-ring **111B;** a light detection assembly including a transmission-mode detector unit (not shown) mounted on a holding frame **114A** associated with the semi-ring **111A** so as to be substantially opposite the illumination assembly, and a reflection-mode detector unit (not shown) mounted on the semi-ring **111B;** and a diffuser **118** located on the inner surface of the semi-ring **111B.** Similar to the previously described example, the illumination assembly can include a plurality of light sources (e.g., LEDs) associated with a suitable drive mechanism (not shown) operated by a control unit, or a single broad band illuminator. The light source (or multiple light sources) radiates the measurement location of the finger through an aperture (optical window) **119** in the diffuser **118.** In the present example, another aperture **121** is provided in the diffuser **118** to allow passage of light from the illuminated region to the reflection-mode detector. It should, however, be understood that the provision of this aperture is optional since the reflection-mode deflector may be accommodated adjacent to the diffuser slightly aside thereof to detect reflected light propagating along axes that do not intersect with the diffuser.

[0032] It should also be noted that, although in the present examples of Figs. 1 and 2, the diffuser is shown as constructional part of the illumination/detection arrangement of the measurement device (e.g., finger holder), the diffuser may be a separate element. For example, the diffuser may be configured to be put onto a finger, so as to be located between the finger and the illumination/detection arrangement of the measurement device. The diffuser may be in the form of a thin elastic cover for wrapping at least a part of the body portion (e.g., finger), and configured to enable optical measurements therethrough. For example, the diffuser may be formed with an optical windows, which when the device is put in operation is aligned with the optical path of illuminating light, and possibly also including an additional optical window aligned with the reflection mode detector.

[0033] Turning back to **Fig. 2,** the device **100** further includes a pressurizing assembly that includes an air cushion **124** associated with a drive mechanism (not shown) and operable to apply pressure to the finger portion enclosed between the parts **111A** and **111B.** In the present example, the cushion **124** is made of a light diffusing material thus presenting the diffuser **118.**

[0034] By moving the upper and lower parts **111A** and **111B** of the probe towards each other, a position of a finger therebetween is fixed. Then, a locking device **126** further fixes the parts **111A** and **111B** to thereby apply a certain preliminary pressure to start the measurement procedure. The locking device may be implemented by any suitable known means (e.g., including a teeth arrangement and a spring assembly) and is aimed at preventing the opening of the ring-like probe. Then, the cushion **124,** which in the present example is associated with the lower semi-ring **111B,** is operated to press the finger to the upper semi-ring **111A** to thereby apply an over-systolic pressure (e.g., 220-250mmHg) and create a blood flow cessation in the finger. Then, during the measurements while in the blood flow cessation state, a variable over-systolic secondary pressure is supplied through the cushion **124.** Thus, according to this embodiment of the invention, the primary over-systolic pressure as well as the secondary pressure is applied to the same location on the finger via the same pressurizing assembly (cushion **124).**

[0035] Due to the provision of the diffuser **(18** in Fig. 1 and **118** in Fig. 2), light that while propagating from the illumination assembly towards the blood vessel in the finger is typically reflected from the skin and bone, is collected and reflected back to the blood vessel. As a result, both the intensity of light transmitted through the blood vessel and received by the transmission mode detector and the intensity of light reflected from the blood vessel and received by the reflection mode detector are increased. This maximizes the homogeneity of the detected light signals.

[0036] Reference is made to **Figs. 3A-3B and 4A-4B** showing experimental results: **Figs. 3A and 3B** illustrate the results of measurements with no diffuser and **Figs. 4A and 4B** illustrate the same with the diffuser-based device of the present invention. Each of these figures shows the time variation of a detected light response of a measurement location inside a patient's finger.

[0037] In the example of **Fig. 3A**, the finger is illuminated with 720nm light, and light reflected from the finger is measured. As shown, a graph $\mathbf{G_1}$ has a pulsatile-signal part $\mathbf{L_1}$ measured during a 100sec time period prior to the application of an over-systolic pressure, and a non-pulsatile part $\mathbf{L'_1}$ continuously measured after the application of such pressure. Both the pulsatile and non-pulsatile reflected signals decrease during the measurements. In the example of **Fig. 3B,** the finger is illuminated with 720nm light, and time variations of light reflected

from the finger G_1 and that of light transmitted through the finger G_2 are measured. Measured reflected signal G_1 has an initial pulsatile signal part L_1 and a further non-pulsatile signal part L'_1 resulting from the occlusion; and measured transmitted signal has initial pulsatile signal part L_2 and a further non-pulsatile signal part L'_2. As shown, the reflection occlusion-signal L'_1 decreases, and transmission occlusion-signal increases with time.

[0038] **Figs. 4A and 4B** show the measurements with the diffuser for, respectively, reflection mode, and both reflection and transmission modes. As shown, when using the diffuser, all the signal parts increase during the measurements.

[0039] Those skilled in the art will readily appreciate that various modifications and changes can be applied to the embodiments of the invention as hereinbefore exemplified without departing from its scope defined in and by the appended claims.

Claims

1. An optical measurement device (10, 100) for use in non-invasive measurements on a patient's body, the device comprising:

- an illumination assembly (12) configured and operable to generate illuminating light of a predetermined wavelength range;
- a light detection assembly (14) for detecting light response of an illuminated body portion and generating measured data indicative of the detected light; and
- a light directing assembly;

wherein

said light detection assembly (14) is configured for concurrently performing reflection-mode and transmission-mode measurements, and comprises a first transmission-mode detector unit (14A) configured for detecting a first light signal transmitted through the illuminated body portion and generating first measured data indicative of the detected transmitted light, and a second reflection-mode detector unit (14B) configured for detecting a second light signal reflected from the illuminated body portion and generating second measured data indicative of the detected light;

the device being **characterized in that**:

said light directing assembly comprises a light diffuser (18, 118) configured for scattering back light incident thereto, said light diffuser (18, 118) being located in an optical path of the second light signal, thereby increasing amount of light reaching a region of interest inside the body portion and thus maximizing homogeneity of the first and second detected light signals and

- a pressurizing assembly (22) operable for applying an over-systolic pressure to the patient's body so as to create a condition of artificial blood kinetics in the region of interest and maintain this condition for a certain time period, thereby enabling the device operation with an occlusion-release mode

.

2. The device of Claim 1, wherein the light diffuser (18, 118) has at least one optical window (19, 119) for allowing light passage therethrough.

3. The device of Claim 1 or 2, wherein the light diffuser (18, 118) is located adjacent to the illumination assembly (12) and oriented such that, when the device is applied to the patient's body, the light diffuser (18, 118) extends along at least a part of the body portion at the illuminating side thereof.

4. The device of Claim 3, wherein the diffuser (18, 118) is formed with an optical window (19, 119) for allowing passage of light from the illumination assembly (12) towards the body portion

5. The device of Claim 4, wherein the diffuser (18, 118) has an additional optical window (121) for allowing passage of light, reflected from the body portion, to the second detector unit (14B).

6. The device of any one of preceding Claims, wherein the diffuser (18, 118) is made of a semi-transparent material, capable of diffusing visible and near-infrared light spectra.

7. The device of any one of preceding Claims, wherein a minimal size for the diffuser (18, 118) is such as to ensure that majority of the body surface provides efficient return of reflected light to the region of interest in the body.

8. The device of any one of preceding Claims, wherein the detector unit includes a matrix of light detectors.

9. The device of any one of preceding Claims, wherein the diffuser (18, 118) is mounted on a support arrangement supporting at least one of the illumination and detection assemblies.

10. The device of any one of preceding Claims, wherein the diffuser (18, 118) is an elastic cover configured to wrap at least a part of the body potion under measurements.

11. The device of any one of Claims 1 to 9, wherein the diffuser (18, 118) is a disposable elastic cover configured to wrap at least a part of the body potion

under measurements.

12. The device of any one of the preceding Claims, wherein said pressurizing assembly (22) is configured and operable to apply a secondary controllably varying pressure to the body within the region of interest, so as to alter said condition of artificial blood kinetics over a predetermined time interval within said certain time period, thereby to modulate scattering properties of blood.

13. The device of any one of preceding Claims, wherein the illumination assembly (12) comprises at least one light emitting element.

14. The device of any one of preceding Claims, wherein the illumination assembly (12) comprises a matrix of light emitting elements generating light of different wavelengths.

15. The device of any one of preceding Claims, configured as a clip member for enclosing the body portion between its upper and lower arms, one of the upper and lower arms carrying the illumination assembly (12), the diffuser (18, 118) and the second detector unit (14B), and the other arm carrying the first detector unit (14A).

16. The device of Claim 15, wherein the diffuser (18, 118) extends along at least a part of an inner surface of the respective arm of the clip member

17. The device of Claim 16, wherein the diffuser (18, 118) is located between the illumination assembly (12) and the body portion, and is formed with an optical window (19, 119) for allowing passage of light from the illumination assembly (12) to the body portion.

18. The device of Claim 17, wherein the diffuser (18, 118) is located between the body portion and the second detector unit (14B), and is formed with an optical window (19, 119) allowing light passage therethrough from the body portion to the second detector unit (14B),

19. The device of Claim 17, wherein the diffuser (18, 118) is located between the body portion and the second detector unit (14B), and is formed with an additional optical window (121) allowing light passage therethrough from the body portion to the second detector unit (14B),

20. The device of any one of Claims 1 to 17, comprising a clip member for enclosing the body portion between its upper and lower arms, one of the upper and lower arms carrying the illumination assembly (12) and the second detector unit (14B), and the other arm carrying the first detector unit (14A), the diffuser (18, 118) being an elastic cover configured to wrap at least a part of the body potion under measurements, such that when the device is put in operation, the diffuser (18, 118) is located between the body portion and each of said arms of the clip member.

21. The device of Claim 20, configured for measuring in a patient's finger, said clip member being configured for enclosing the finger between its upper and lower arms.

22. The device of any one of Claims 1 to 14, configured for measuring in a patient's finger.

23. The device of Claim 22, having a ring-like housing for enclosing a portion of the finger therein, said housing carrying at least the illumination and detection assemblies.

24. The device of Claim 23, wherein said ring-like housing is formed by two substantially U-shaped portions (111A, 111B) configured for enclosing and holding a portion of the patient's finger therebetween.

25. The device of Claim 24, wherein one of the U-shaped portions (111B) carries the illumination assembly (12), the diffuser (18, 118) and the second detector unit (14B), and the other of said portions (111A) carries the first detector unit(14A).

26. The device of Claim 24, wherein one of the U-shaped portions carries the illumination assembly (12) and the second detector unit (14B), and the other of said portion carries the first detector unit (14A).

27. The device of any one of Claims 23 to 26, wherein the diffuser (18, 118) is an elastic cover configured to wrap at least a part of the patient's finger.

28. The device of any one of Claims 23 to 26, wherein the diffuser (18, 118) is a disposable elastic cover configured to wrap at least a part of the patient's finger.

29. The device of Claim 24, wherein the pressurizing assembly (22) is associated with one of the U-shaped portions,

30. The device of Claims 12 and 24, wherein said pressurizing assembly (22) is associated with one of the U-shaped portions.

31. The device of Claim 23, wherein the pressurizing assembly (22) comprises an air cushion (124) extending along at least a part of an inner surface of the housing.

32. The device of Claim 31, wherein at least a part of said cushion (124) is made of a light diffusing material, thereby presenting said diffuser (18, 118).

33. A method for use in non-invasive optical measurements on a patient's body utilizing illumination of a region of interest inside the body portion and detection of a light response of the region of interest to said illumination, the method comprising:

- providing a diffuser (18, 118) in an optical path of light coming from the body portion in response to said illumination and diffusing at least a part of said light back to the body portion;
- applying an over-systolic pressure to the patient's body so as to create a condition of artificial blood kinetics in the region of interest and maintain this condition for a certain time period, thereby enabling occlusion-release mode measurements;
- detecting light response of the region of interest to said illumination during the occlusion-release mode measurements, said detection of the light response comprising concurrently detecting a first diffused light signal transmitted through the region of interest and a second diffused light signal reflected from the region of interest; and
- generating first measured data indicative of the detected transmitted light and second measured data indicative of the detected reflected light.

34. The method of Claim 33, wherein the diffuse (18, 118) is made of a semi-transparent material, capable of diffusing visible and near-infrared light spectra.

35. The method of Claim 33 or 34, comprising selecting a minimal size for the diffuser (18, 118) such as to ensure that majority of the body surface provides efficient return of reflected light to the region of interest in the body.

Patentansprüche

1. Eine optische Messvorrichtung (10, 100) zur Verwendung in nicht invasiven Messungen am Körper eines Patienten, wobei die Vorrichtung Folgendes umfasst:

- einen Beleuchtungsaufbau (12), ausgebildet und funktionsfähig, um Beleuchtungslicht mit einem vordefinierten Wellenlängenbereich zu erzeugen;
- einen Lichterfassungsaufbau (14) zur Erfassung einer Lichtreaktion eines beleuchteten Körperabschnitts und Erzeugung von Messdaten, die das erfasste Licht anzeigen; und
- einen Licht-Richtaufbau;

wobei der Lichterfassungsaufbau (14) ausgebildet ist, um Reflexionsmodus- und Transmissionsmodus-Messungen gleichzeitig durchzuführen, und eine erste Transmissionsmodus-Detektoreinheit (14A) umfasst, die ausgebildet ist, um ein erstes Lichtsignal zu erfassen, das durch den beleuchteten Körperabschnitt geleitet wird, und erste Messdaten zu erzeugen, die das erfasste durchgelassene Licht anzeigen, und eine zweite Reflexionsmodus-Detektoreinheit (14B), die ausgebildet ist, um ein zweites Lichtsignal zu erfassen, das vom beleuchteten Körperabschnitt reflektiert wird, und zweite Messdaten zu erzeugen, die das erfasste Licht anzeigen;
die Vorrichtung **dadurch gekennzeichnet ist, dass**:

der Licht-Richtaufbau einen Lichtdiffusor (18, 118) umfasst, der ausgebildet ist, um Licht, das in ihn einfällt, zu streuen, wobei der Lichtdiffusor (18, 118) sich in einem optischen Pfad des zweiten Lichtsignals befindet, wodurch die Lichtmenge erhöht wird, die einen Bereich von Interesse innerhalb des Körperabschnitts erreicht, und so die Homogenität der ersten und zweiten erfassten Lichtsignale maximiert wird, und

- einen Druckaufbau (22), funktionsfähig, um einen übersystolischen Druck auf den Körper des Patienten auszuüben, um so einen Zustand künstlicher Blutkinetik im Bereich von Interesse zu erzeugen und diesen Zustand über einen bestimmten Zeitraum aufrechtzuerhalten, wodurch der Betrieb des Geräts mit einem Okklusions-Freigabe-Modell ermöglicht wird.

2. Die Vorrichtung gemäß Anspruch 1, worin der Lichtdiffusor (18, 118) mindestens ein optisches Fenster (19, 119) hat, um das Durchdringen von Licht dort hindurch zu ermöglichen.

3. Die Vorrichtung gemäß Anspruch 1 oder 2, worin der Lichtdiffusor (18, 118) neben dem Beleuchtungsaufbau (12) positioniert und so ausgerichtet ist, dass der Lichtdiffusor (18, 118), wenn die Vorrichtung an den Körper des Patienten angelegt wird, sich entlang zumindest einem Teil des Körperabschnitts auf der Beleuchtungsseite davon erstreckt.

4. Die Vorrichtung gemäß Anspruch 3, worin der Diffusor (18, 118) mit einem optischen Fenster (19, 119) versehen ist, um den Durchgang von Licht vom Beleuchtungsaufbau (12) zum Körperabschnitt hin zu ermöglichen.

5. Die Vorrichtung gemäß Anspruch 4, worin der Diffusor (18, 118) ein zusätzliches optisches Fenster

(121) hat, um den Durchgang von Licht, das vom Körperabschnitt reflektiert wird, zur zweiten Detektoreinheit (14B) zu ermöglichen.

6. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Diffusor (18, 118) aus einem halbdurchlässigen Material besteht, das in der Lage ist, sichtbare Lichtspektren und Lichtspektren im nahen Infrarotbereich zu zerstreuen.

7. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin eine minimale Größe für den Diffusor (18, 118) derart ist, dass sichergestellt wird, dass der größte Teil der Körperoberfläche für eine effiziente Rückkehr von reflektiertem Licht zu dem Bereich von Interesse im Körper sorgt.

8. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin die Detektoreinheit eine Matrix von Lichtdetektoren einschließt.

9. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Diffusor (18, 118) auf einer Traganordnung montiert ist, die mindestens einen der Beleuchtungs- und Erfassungsaufbauten trägt.

10. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Diffusor (18, 118) eine elastische Abdeckung ist, die ausgebildet ist, um zumindest einen Teil des Körperabschnitts unter Messungen einzuwickeln.

11. Die Vorrichtung gemäß einem beliebigen der Ansprüche 1 bis 9, worin der Diffusor (18, 118) eine elastische Wegwerf-Abdeckung ist, die ausgebildet ist, um zumindest einen Teil des Körperabschnitts unter Messungen einzuwickeln.

12. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Druckaufbau (22) ausgebildet und funktionsfähig ist, um einen sekundären steuerbar variierenden Druck auf den Körper innerhalb des Bereichs von Interesse auszuüben und so den Zustand künstlicher Blutkinetik über ein vordefiniertes Zeitintervall innerhalb des bestimmten Zeitraums zu verändern, wodurch die Streuungseigenschaften von Blut moduliert werden.

13. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Beleuchtungsaufbau (12) mindestens ein Licht emittierendes Element umfasst.

14. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, worin der Beleuchtungsaufbau (12) eine Matrix Licht emittierender Elemente umfasst, die Licht mit verschiedenen Wellenlängen erzeugen.

15. Die Vorrichtung gemäß einem beliebigen der obigen Ansprüche, ausgebildet als Klammerglied zum Einschließen des Körperabschnitts zwischen seinen oberen und unteren Armen, wobei einer der oberen und unteren Arme den Beleuchtungsaufbau (12), den Diffusor (18, 118) und die zweite Detektoreinheit (14B) trägt und der andere Arm die erste Detektoreinheit (14A) trägt.

16. Die Vorrichtung gemäß Anspruch 15, worin der Diffusor (18, 118) sich entlang zumindest einem Teil einer inneren Oberfläche des entsprechenden Arms des Klammerglieds erstreckt.

17. Die Vorrichtung gemäß Anspruch 16, worin der Diffusor (18, 118) sich zwischen dem Beleuchtungsaufbau (12) und dem Körperabschnitt befindet und mit einem optischen Fenster (19, 119) ausgestattet ist, um den Durchgang von Licht vom Beleuchtungsaufbau (12) zum Körperabschnitt zu ermöglichen.

18. Die Vorrichtung gemäß Anspruch 17, worin der Diffusor (18, 118) sich zwischen dem Körperabschnitt und der zweiten Detektoreinheit (14B) befindet und mit einem optischen Fenster (19, 119) ausgestattet ist, das den Durchgang von Licht dadurch vom Körperabschnitt zur zweiten Detektoreinheit (14B) ermöglicht.

19. Die Vorrichtung gemäß Anspruch 17, worin der Diffusor (18, 118) sich zwischen dem Körperabschnitt und der zweiten Detektoreinheit (14B) befindet und mit einem zusätzlichen optischen Fenster (121) ausgestattet ist, das den Durchgang von Licht dadurch vom Körperabschnitt zur zweiten Detektoreinheit (14B) ermöglicht.

20. Die Vorrichtung gemäß einem beliebigen der Ansprüche 1 bis 17, die ein Klammerglied zum Einschließen des Körperabschnitts zwischen seinen oberen und unteren Armen umfasst, wobei einer der oberen und unteren Arme den Beleuchtungsaufbau (12) und die zweite Detektoreinheit (14B) trägt und der andere Arm die erste Detektoreinheit (14A) trägt, worin der Diffusor (18, 118) eine elastische Abdeckung ist, die ausgebildet ist, um zumindest einen Teil des Körperabschnitts unter Messungen einzuwickeln, so dass, wenn die Vorrichtung in Betrieb genommen wird, der Diffusor (18, 118) sich zwischen dem Körperabschnitt und jedem der Arme des Klammerglieds befindet.

21. Die Vorrichtung gemäß Anspruch 20, ausgebildet zur Messung im Finger eines Patienten, wobei das Klammerglied ausgebildet ist, um den Finger zwischen seinen oberen und unteren Armen einzuschließen.

22. Die Vorrichtung gemäß einem beliebigen der An-

sprüche 1 bis 14, ausgebildet zur Messung im Finger eines Patienten.

23. Die Vorrichtung gemäß Anspruch 22, die ein ringartiges Gehäuse hat, um einen Abschnitt des Fingers darin einzuschließen, wobei das Gehäuse mindestens die Beleuchtungs- und Erfassungsaufbauten trägt.

24. Die Vorrichtung gemäß Anspruch 23, wobei das ringartige Gehäuse von zwei im Wesentlichen U-förmigen Abschnitten (111A, 111B) gebildet wird, die ausgebildet sind, um einen Teil des Fingers des Patienten dazwischen einzuschließen und zu halten.

25. Die Vorrichtung gemäß Anspruch 24, wobei einer der U-förmigen Abschnitte (111B) den Beleuchtungsaufbau (12), den Diffusor (18, 118) und die zweite Detektoreinheit (14B) trägt und der andere der Abschnitte (111A) die erste Detektoreinheit (14A) trägt.

26. Die Vorrichtung gemäß Anspruch 24, wobei einer der U-förmigen Abschnitte den Beleuchtungsaufbau (12) und die zweite Detektoreinheit (14B) trägt und der andere der Abschnitte die erste Detektoreinheit (14A) trägt.

27. Die Vorrichtung gemäß einem beliebigen der Ansprüche 23 bis 26, wobei der Diffusor (18, 118) eine elastische Abdeckung ist, die ausgebildet ist, um mindestens einen Teil des Fingers des Patienten einzuwickeln.

28. Die Vorrichtung gemäß einem beliebigen der Ansprüche 23 bis 26, wobei der Diffusor (18, 118) eine elastische Wegwerf-Abdeckung ist, die ausgebildet ist, um mindestens einen Teil des Fingers des Patienten einzuwickeln.

29. Die Vorrichtung gemäß Anspruch 24, wobei der Druckaufbau (22) mit einem der U-förmigen Abschnitte verbunden ist.

30. Die Vorrichtung gemäß den Ansprüchen 12 und 24, wobei der Druckaufbau (22) mit einem der U-förmigen Abschnitte verbunden ist.

31. Die Vorrichtung gemäß Anspruch 23, wobei der Druckaufbau (22) ein Luftkissen (124) umfasst, das sich entlang zumindest einem Teil einer inneren Oberfläche des Gehäuses erstreckt.

32. Die Vorrichtung gemäß Anspruch 31, wobei mindestens ein Teil des Kissens (124) aus einem Licht zerstreuenden Material besteht, dadurch den Diffusor (18, 118) präsentierend.

33. Ein Verfahren zur Nutzung in nicht invasiven optischen Messungen am Körper eines Patienten mit Hilfe von Beleuchtung eines Bereichs von Interesse innerhalb des Körperabschnitts und Erfassung einer Lichtreaktion des Bereichs von Interesse auf die Beleuchtung, wobei das Verfahren Folgendes umfasst:

- Bereitstellung eines Diffusors (18, 118) in einem optischen Lichtpfad, der als Reaktion auf die Beleuchtung von dem Körperabschnitt kommt und mindestens einen Teil des Lichts zurück zum Körperabschnitt streut;
- Anlegen eines übersystolischen Drucks auf den Körper des Patienten, um einen Zustand künstlicher Blutkinetik im Bereich von Interesse zu erzeugen und diesen Zustand über einen bestimmten Zeitraum aufrechtzuerhalten, wodurch Messungen im Okklusions-Freisetzungs-Modus ermöglicht werden;
- Erfassung der Lichtreaktion des Bereichs von Interesse auf die Beleuchtung während der Messungen im Okklusions-Freisetzungs-Modus, wobei die Erfassung der Lichtreaktion die gleichzeitige Erfassung eines ersten gestreuten Lichtsignals, das durch den Bereich von Interesse geleitet wird, und eines zweiten gestreuten Lichtsignals, das von dem Bereich von Interesse reflektiert wird, umfasst; und
- Erzeugung erster Messdaten, die für das erfasste durchgeleitete Licht kennzeichnend sind, und zweiter Messdaten, die für das erfasste reflektierte Licht kennzeichnend sind.

34. Das Verfahren gemäß Anspruch 33, worin der Diffusor (18, 118) aus einem halbdurchlässigen Material besteht, fähig, sichtbare Lichtspektren und Lichtspektren im nahen Infrarotbereich zu zerstreuen.

35. Das Verfahren gemäß Anspruch 33 oder 34, das die Auswahl einer Mindestgröße für den Diffusor (18, 118) umfasst, um sicherzustellen, dass der größte Teil der Körperoberfläche für eine effiziente Rückkehr von reflektiertem Licht zu dem Bereich von Interesse im Körper sorgt.

Revendications

1. Dispositif de mesure optique (10, 100) pour l'utilisation dans des mesures non-invasives sur le corps d'un patient, le dispositif comprenant :

- un ensemble d'éclairage (12) configuré et fonctionnant pour générer une lumière éclairante d'une plage de longueurs d'onde prédéterminée ;
- un ensemble de détection de lumière (14) pour détecter une réponse lumineuse d'une partie de

corps illuminée et générer des données mesurées indicatives de la lumière détectée ; et
- un ensemble de direction de lumière ;
dans lequel ledit ensemble de détection de lumière (14) est configuré pour réaliser simultanément des mesures en mode réflexion et en mode transmission, et comprend une première unité de détection en mode transmission (14A) configurée pour détecter un premier signal lumineux transmis à travers la partie de corps éclairée et générant une première donnée mesurée indicative de la lumière transmise détectée, et une deuxième unité de détection en mode réflexion (14B) configurée pour détecter un deuxième signal lumineux réfléchi depuis la partie de corps éclairée et générant une deuxième donnée mesurée indicative de la lumière détectée ; le dispositif étant **caractérisé en ce que** :

ledit ensemble de direction de lumière comprend un diffuseur de lumière (18, 118) configuré pour rétro-diffusion de lumière incidente à celui-ci, ledit diffuseur de lumière (18, 118) étant situé dans un passage optique du deuxième signal lumineux, augmentant ainsi la quantité de lumière atteignant une région d'intérêt à l'intérieur de la partie de corps et ainsi maximisant l'homogénéité des premier et deuxième signaux lumineux détectés, et

- un ensemble de pressurisation (22) fonctionnel pour appliquer une pression sur-systolique au corps du patient de façon à créer une condition de cinétique de sang artificiel cinétique dans la région d'intérêt et maintenir cette condition pendant une certaine période de temps, permettant ainsi le fonctionnement du dispositif dans un mode de occlusion - libération.

2. Dispositif selon la Revendication 1, dans lequel le diffuseur de lumière (18, 118) présente au moins une fenêtre optique (19, 119) pour permettre le passage de la lumière à travers.

3. Dispositif selon la Revendication 1 ou 2, dans lequel le diffuseur de lumière (18, 118) est situé adjacent à l'ensemble d'éclairage (12) et orienté de telle sorte que, lorsque le dispositif est appliqué au corps du patient, le diffuseur de lumière (18, 118) s'étend le long de, au moins, une partie de la portion de corps au niveau du coté d'éclairage de celui-ci.

4. Dispositif selon la Revendication 3, dans lequel le diffuseur (18, 118) est formé avec une fenêtre optique (19, 119) pour permettre le passage de lumière de l'ensemble d'éclairage (12) vers la portion de corps.

5. Dispositif selon la Revendication 4, dans lequel le diffuseur (18, 118) présente une fenêtre optique supplémentaire (121) pour permettre le passage de lumière, réfléchie depuis la portion de corps, à la deuxième unité de détection (14B).

6. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel le diffuseur (18, 118) est réalisé dans un matériau semi-transparent, capable de diffuser des spectres de lumière visible et proche infrarouge.

7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel une taille minimale pour le diffuseur (18, 118) est telle à assurer que la majorité de la surface de corps fournit un retour efficace de lumière réfléchie à la région d'intérêt dans le corps.

8. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel l'unité de détection inclut une matrice de détecteurs de lumière.

9. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel le diffuseur (18, 118) est monté sur un support d'agencement supportant au moins l'une des ensembles d'éclairage et de détection.

10. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel le diffuseur (18, 118) est une couverture élastique configurée pour envelopper au moins une partie de la portion de corps objet des mesures.

11. Dispositif selon l'une quelconque des Revendications 1 à 9, dans lequel le diffuseur (18, 118) est une couverture élastique jetable configurée pour envelopper au moins une partie de la portion de corps objet des mesures.

12. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel ledit ensemble de pressurisation (22) est configuré et fonctionnel pour appliquer une pression variable de façon contrôlable secondaire au corps dans la région d'intérêt, de sorte à modifier ladite condition de sang artificiel cinétique pendant un intervalle de temps prédéterminé à l'intérieur de ladite certaine période de temps, pour moduler ainsi les propriétés de dispersion du sang.

13. Dispositif selon l'une quelconque des Revendications précédentes, dans lequel l'ensemble d'éclairage (12) comprend au moins un élément d'émission de lumière.

14. Dispositif selon l'une quelconque des Revendica-

tions précédentes, dans lequel l'ensemble d'éclairage (12) comprend une matrice d'éléments d'émission de lumière qui génère lumière de longueurs d'onde différentes.

15. Dispositif selon l'une quelconque des Revendications précédentes, configuré comme un élément de pince pour enserrer la partie de corps entre ses bras supérieurs et inférieurs, l'un des bras supérieurs et inférieurs portant l'ensemble d'éclairage (12), le diffuseur (18, 118) et la deuxième unité de détection (14B), et l'autre bras portant la première unité de détection (14A).

16. Dispositif selon la Revendication 15, dans lequel le diffuseur (18, 118) s'étend le long d'au moins une partie d'une surface interne du bras respectif de l'élément de pince.

17. Dispositif selon la Revendication 16, dans lequel le diffuseur (18, 118) est situé entre l'ensemble d'éclairage (12) et la partie de corps, et est formé avec une fenêtre optique (19, 119) pour permettre le passage de lumière depuis l'ensemble d'éclairage (12) à la partie de corps.

18. Dispositif selon la Revendication 17, dans lequel le diffuseur (18, 118) est situé entre la partie de corps et la deuxième unité de détection (14B), et est formé avec une fenêtre optique (19, 119) permettant le passage de lumière à travers celle-ci depuis la partie de corps à la deuxième unité de détection (14B).

19. Dispositif selon la Revendication 17, dans lequel le diffuseur (18, 118) est situé entre la partie de corps et la deuxième unité de détection (14B), et est formé avec une fenêtre optique additionnelle (121) permettant le passage de lumière à travers celle-ci depuis la partie de corps à la deuxième unité de détection (14B).

20. Dispositif selon l'une quelconque des Revendications 1 à 17, comprenant un élément de pince pour enserrer la partie de corps entre ses bras supérieurs et inférieurs, l'un des bras supérieurs et inférieurs portant l'ensemble d'éclairage (12) et la deuxième unité de détection (14B), et l'autre bras portant la première unité de détection (14A), le diffuseur étant une couverture élastique configurée pour envelopper au moins une partie de la portion de corps objet de mesures, de sorte que lorsque le dispositif est mis en fonctionnement, le diffuseur (18, 118) est situé entre la portion de corps et chacun desdits bras de l'élément de pince.

21. Dispositif selon la Revendication 20, configuré pour mesurer dans le doigt d'un patient, ledit élément de pince étant configuré pour enserrer le doigt entre ses bras supérieurs et inférieurs.

22. Dispositif selon l'une quelconque des revendications 1 à 14, configuré pour mesurer dans le doigt d'un patient.

23. Dispositif selon la Revendication 22, présentant un boîtier en forme de bague pour y enserrer une partie du doigt, ledit boîtier portant au moins les ensembles d'éclairage et de détection.

24. Dispositif selon la Revendication 23, dans lequel ledit boîtier en forme de bague est formé par deux portions essentiellement en forme de U (111A, 111B) configurées pour enserrer et maintenir une partie du doigt du patient entre elles.

25. Dispositif selon la Revendication 24, dans lequel l'une des portions en forme de U (111B) porte l'ensemble d'éclairage (12), le diffuseur (18, 118) et la deuxième unité de détection (14B), et l'autre desdites portions (111A) porte la première unité de détection (14A).

26. Dispositif selon la Revendication 24, dans lequel l'une des portions en forme de U porte l'ensemble d'éclairage (12) et la deuxième unité de détection (14B), et l'autre desdites portions porte la première unité de détection (14A).

27. Dispositif selon l'une quelconque des Revendications 23 à 26, dans lequel le diffuseur (18, 118) est une couverture élastique configurée pour envelopper au moins une partie du doigt du patient.

28. Dispositif selon l'une quelconque des Revendications 23 à 26, dans lequel le diffuseur (18, 118) est une couverture élastique jetable configurée pour envelopper au moins une partie du doigt du patient.

29. Dispositif selon la Revendication 24, dans lequel l'ensemble de pressurisation (22) est associé à l'une des portions en forme de U.

30. Dispositif selon les Revendications 12 et 24, dans lequel l'ensemble de pressurisation (22) est associé à l'une des portions en forme de U.

31. Dispositif selon la Revendication 23, dans lequel l'ensemble de pressurisation (22) comprend un coussin d'air (124) s'étendant le long d'au moins une partie d'une surface interne du boîtier.

32. Dispositif selon la Revendication 31, dans lequel au moins une partie dudit coussin (124) est réalisé dans un matériau diffusant la lumière, présentant ainsi ledit diffuseur (18, 118).

33. Méthode à utiliser dans des mesures optiques non invasives sur le corps d'un patient utilisant l'éclairage d'une région d'intérêt à l'intérieur de la portion de corps et la détection d'une réponse à la lumière de la région d'intérêt au dit éclairage, la méthode comprenant:

- fournir un diffuseur (18, 118) dans un passage optique de lumière venant de la portion de corps en réponse audit éclairage et diffusant au moins une partie de ladite lumière en retour vers la portion de corps;
- appliquer une pression sur-systolique au corps du patient de façon à créer une condition de cinétique de sang artificiel cinétique dans la région d'intérêt et maintenir cette condition pendant une certaine période de temps, permettant ainsi des mesures en mode occlusion - libération;
- détecter une réponse lumineuse de la région d'intérêt au dit éclairage durant les mesures en mode occlusion-libération, ladite détection de la réponse lumineuse comprenant la détection concomitante d'un premier signal lumineux diffusé transmis à travers la région d'intérêt et un deuxième signal lumineux diffusé réfléchi depuis la région d'intérêt ; et
- générer une première donnée mesurée indicative de la lumière transmise détectée et une deuxième donnée mesurée indicative de la lumière détectée réfléchie.

34. Méthode selon la Revendication 33, dans laquelle le diffuseur (18, 118) est réalisé dans un matériau semi-transparent, capable de diffuser des spectres de lumière visible et proche infrarouge.

35. Méthode selon les revendications 33 ou 34, comprenant la sélection d'une taille minimale pour le diffuseur (18, 118) de façon à assurer que la majorité de la surface de corps fournit un retour efficace de lumière réfléchie à la région d'intérêt dans le corps.

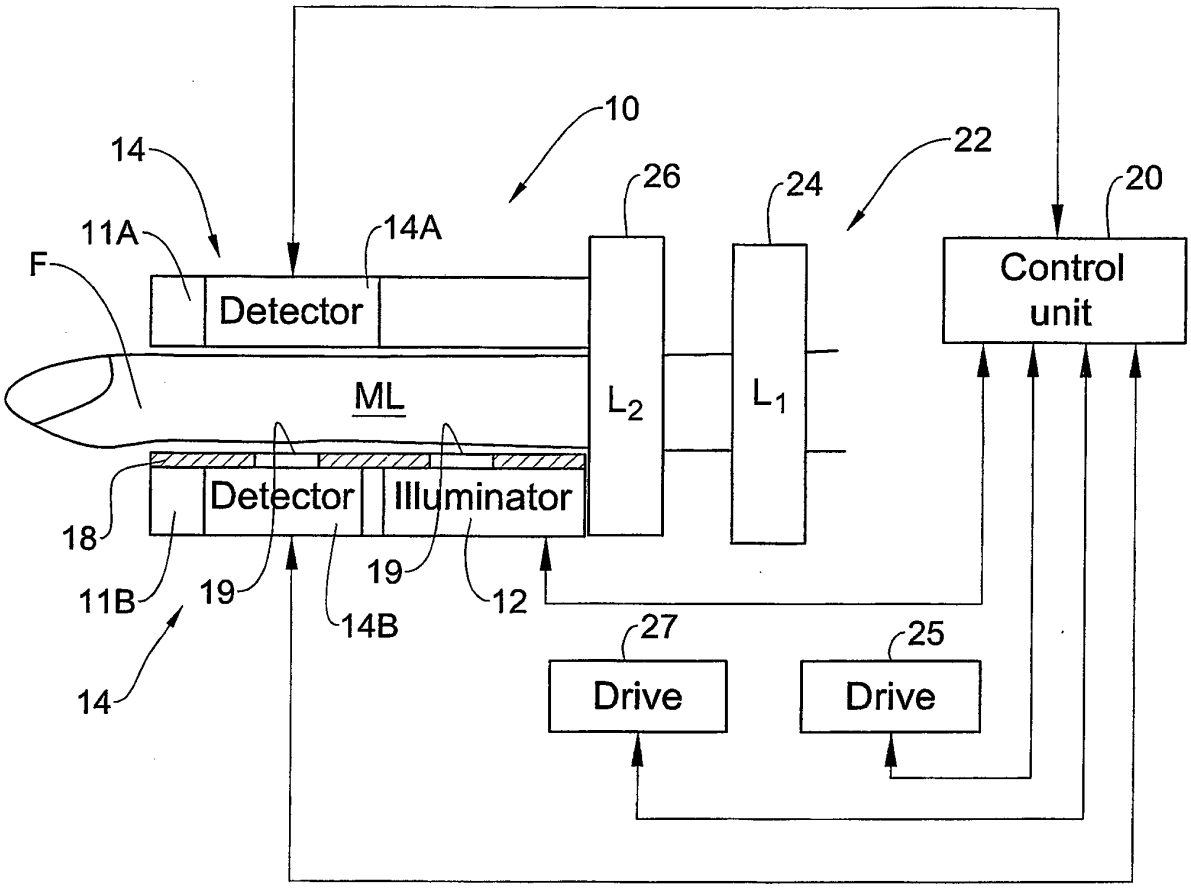
10
14
22
26
24
20
11A
14A
F
Detector
Control unit
ML
L_2
L_1
Detector
Illuminator
18
19
19
11B
14B
12
14
27
25
Drive
Drive

FIG. 1

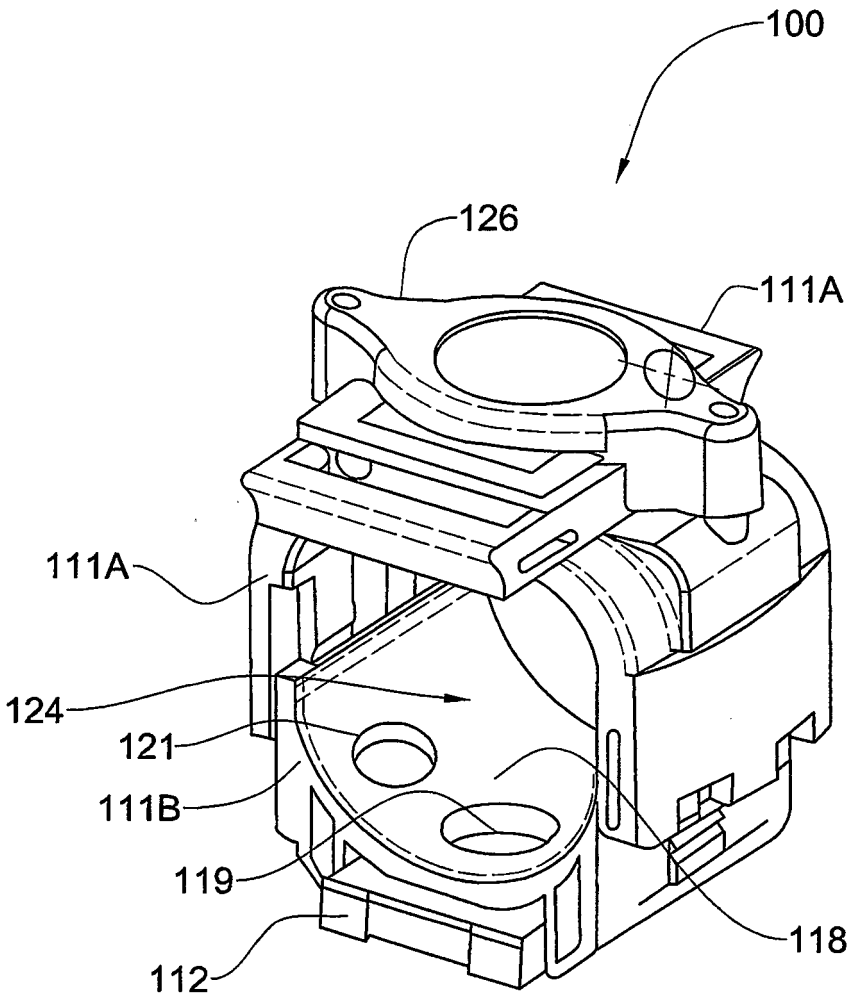

FIG. 2

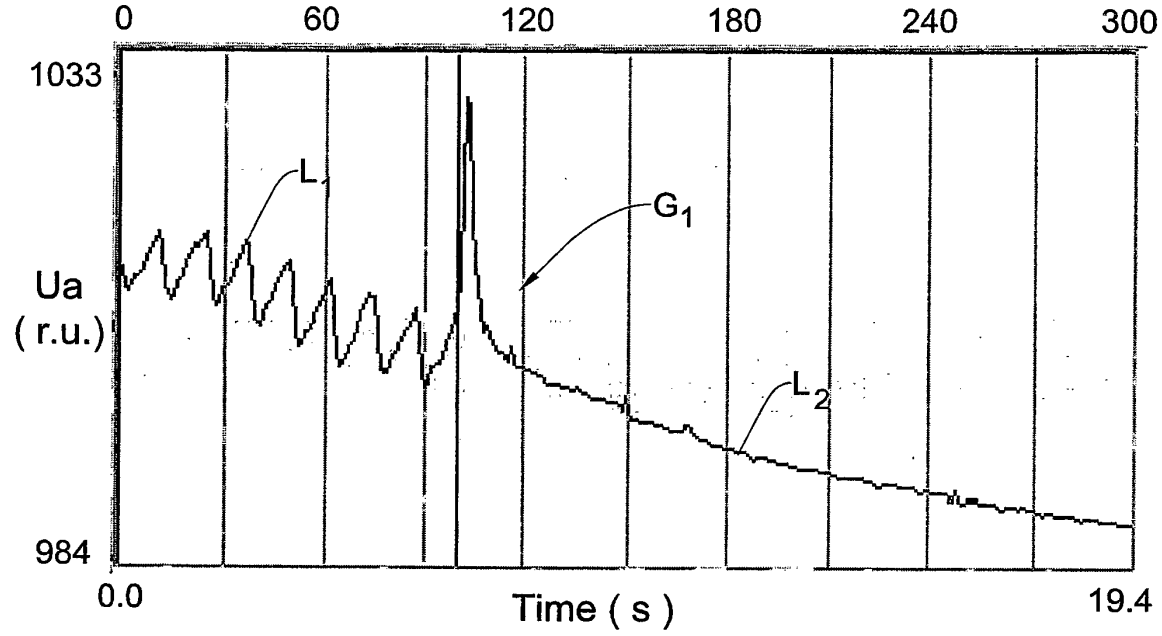
0
60
120
180
240
300
1033
Ua
(r.u.)
984
0.0
Time (s)
19.4
L1
G1
L2

FIG. 3A

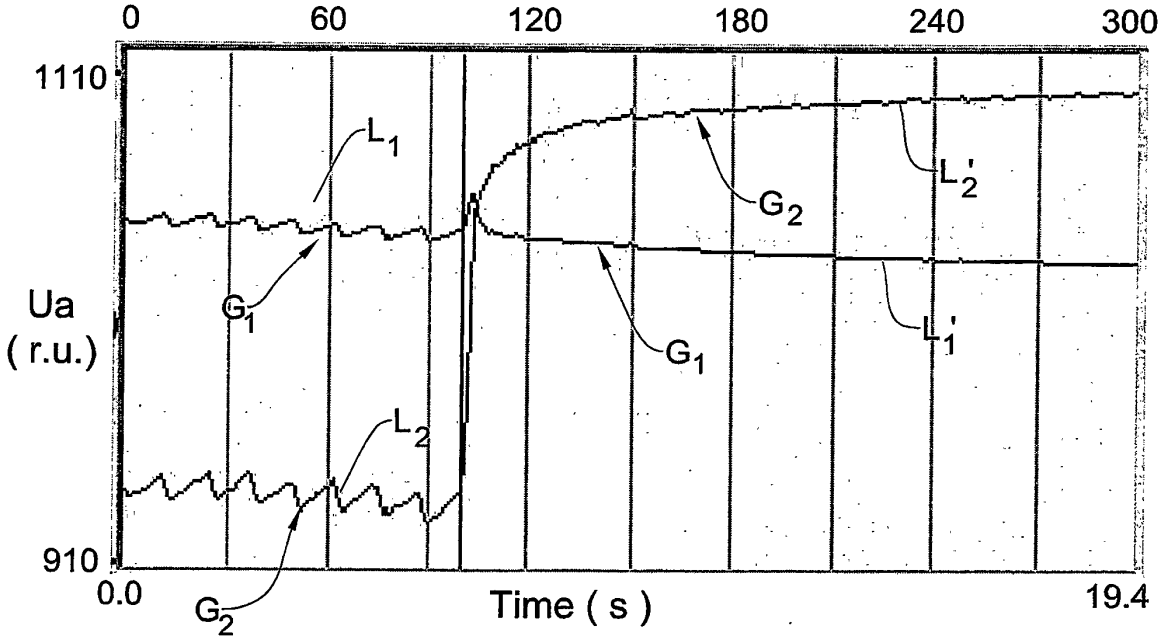
0
60
120
180
240
300
1110
Ua
(r.u.)
910
0.0
Time (s)
19.4
L1
G1
L2
G2
G1
G2
L'2
L'1

FIG. 3B

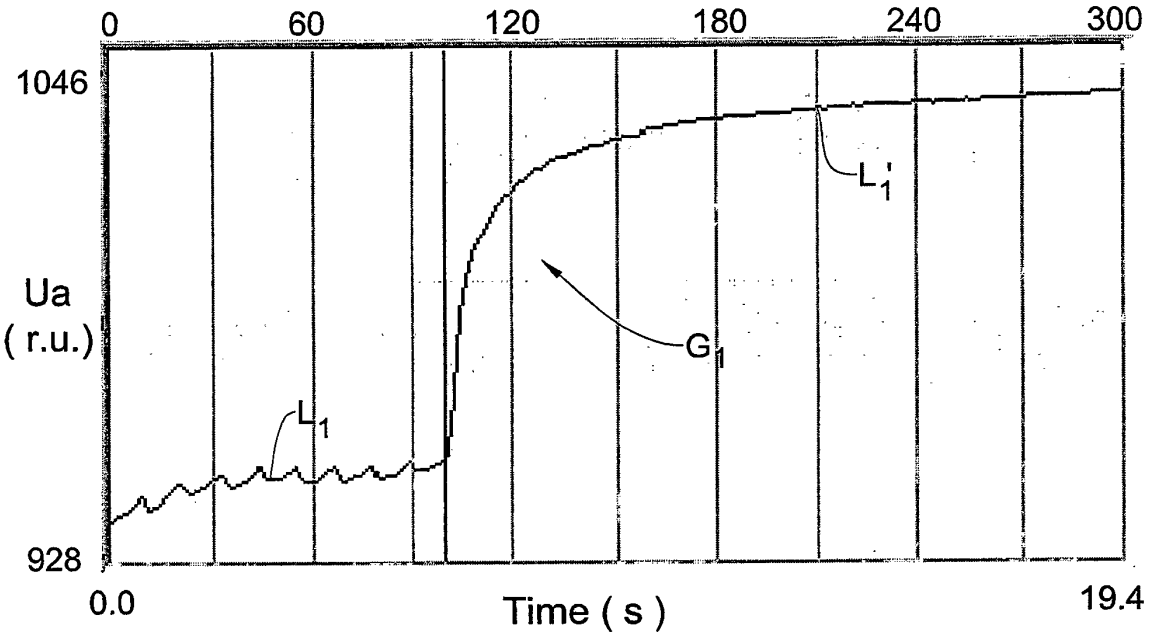
0
60
120
180
240
300
1046
Ua
(r.u.)
928
0.0
Time (s)
19.4
L1
G1
L'1

FIG. 4A

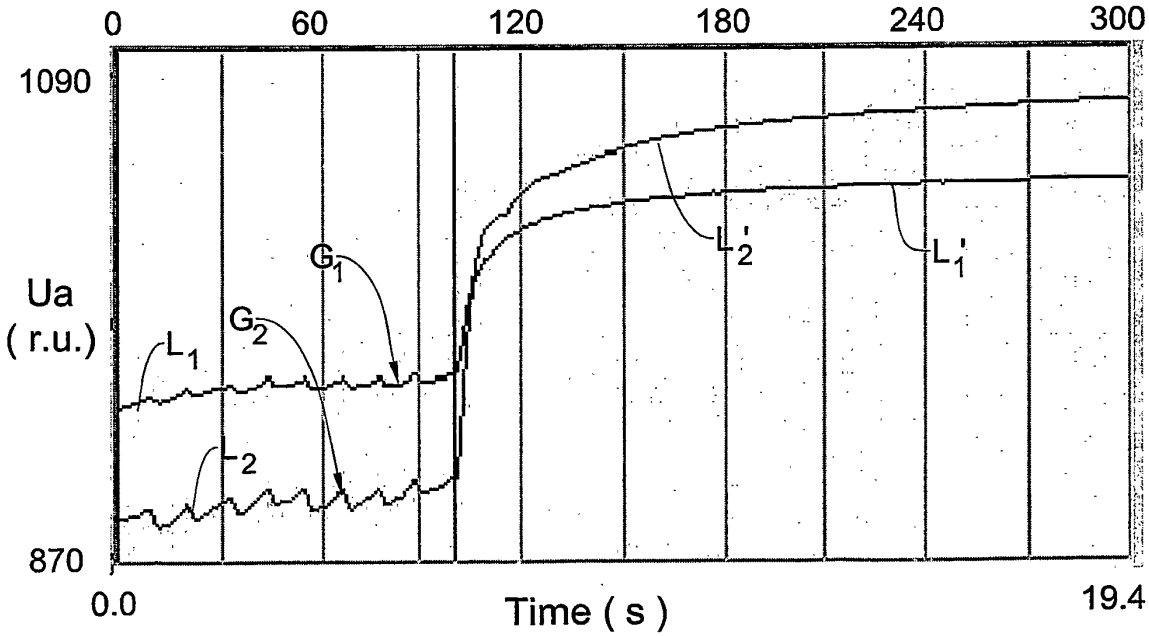
0
60
120
180
240
300
1090
Ua
(r.u.)
870
0.0
Time (s)
19.4
L1
G1
G2
L2
L'2
L'1

FIG. 4B

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 6400972 B **[0006]**
- WO 0145553 A **[0006]**
- WO 0196872 A **[0006]**
- US 452932 A **[0027]**

专利名称(译)	用于非侵入式光学测量的装置和方法		
公开(公告)号	EP1773183B1	公开(公告)日	2014-12-03
申请号	EP2005758928	申请日	2005-07-06
申请(专利权)人(译)	ORSENSE LTD.		
当前申请(专利权)人(译)	ORSENSE LTD.		
[标]发明人	FINAROV ALEXANDER FINE ILYA		
发明人	FINAROV, ALEXANDER FINE, ILYA		
IPC分类号	A61B5/145 A61B5/1455 A61B5/00		
CPC分类号	A61B5/1455 A61B5/0053 A61B5/14532 A61B5/14552 A61B5/6826 A61B5/6838		
优先权	10/885885 2004-07-08 US		
其他公开文献	EP1773183A1		
外部链接	Espacenet		

摘要(译)

提出了一种光学测量装置（10）和方法，用于对患者身体进行非侵入性测量。该装置包括照明组件（12），其配置并可操作以产生预定波长范围的照明光;检测组件（14）;和一个导光组件。检测组件（14）包括第一检测器（14a）单元和第二检测器单元（14b），第一检测器（14a）单元用于检测通过发光体部分传输的第一光信号并产生指示检测到的透射光的第一测量数据，第二检测器单元（14b）用于检测第二检测器从被照亮的身体部分反射的光信号。导光组件包括光漫射器（18），用于散射入射到其上的光，从而将来自主体部分的照明光或光导向身体部分。该技术提供了增加到达身体部分内的感兴趣区域的光量并且使第一和第二检测到的光信号的均匀性最大化。

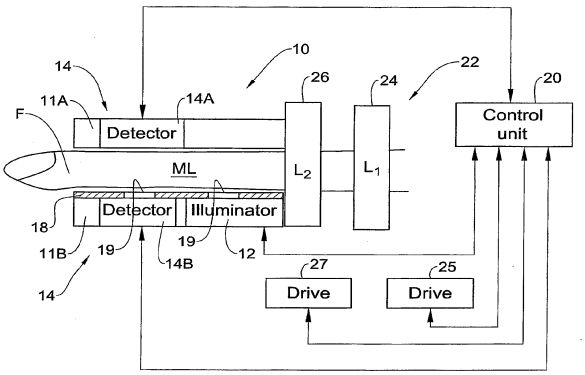

FIG. 1