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(54) Title: AUDIO HEADSET WITH BIO-SIGNAL SENSORS

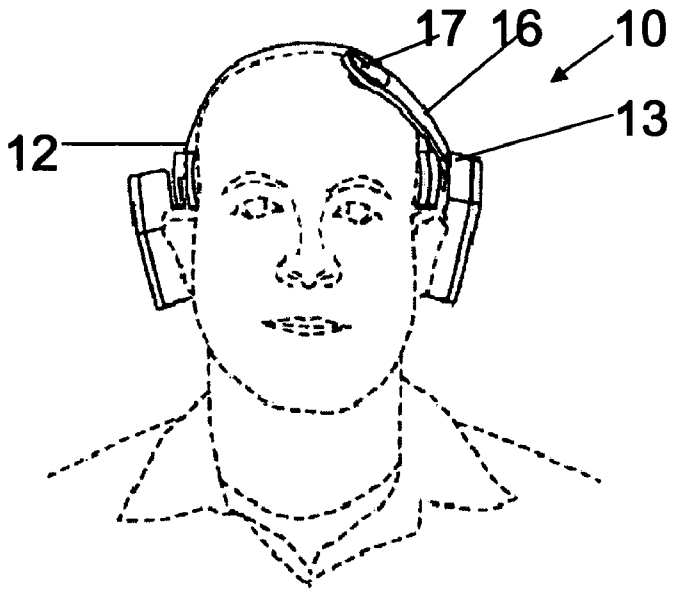

FIG. 1A

(57) Abstract: An audio headset comprising: a first side portion of the audio headset having a first earpiece attached to the first side portion so that the first earpiece can be placed on top of, over, or inside a user's ear when the audio headset is worn by the user, with bio-signal sensors provided. In some embodiments, an audio headset that includes one or more electroencephalography (EEG) sensors positioned inside of the first earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user.

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AUDIO HEADSET WITH BIO-SIGNAL SENSORS

CROSS REFERENCE TO OTHER APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/028,258 (Attorney Docket No. NEURP004+) entitled NEURO-HEADSET DEVICE WITH AUDIO SPEAKERS filed February 13, 2008 which is incorporated herein by reference for all purposes.

BACKGROUND OF THE INVENTION

[0002] Typical headsets have audio speakers that channel sound to the user's ears or are sound cancelling devices. These typical headsets do not include one or more bio-signal sensors (e.g., EEG sensors that allow the brain waves of the user wearing the headset to be measured). Thus, it is desirable to provide an audio headset with one or more bio-signal sensors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Various embodiments of the invention are disclosed in the following detailed description and the accompanying drawings.

[0004] **Figures 1A** through **1C** are diagrams illustrating a neuro-headset being worn by a user in accordance with some embodiments of the present invention.

[0005] **Figure 2** illustrates a neuro-headset with audio speakers and EEG sensors in accordance with some embodiments of the present invention.

[0006] **Figure 3** illustrates a neuro-headset with audio speakers and EEG sensors in accordance with some embodiments of the present invention.

[0007] **Figure 4** illustrates a flexible arm portion of the neuro-headset with audio speakers and EEG sensors in accordance with some embodiments of the present invention.

[0008] **Figure 5** illustrates an implementation of the earpiece of the neuro-headset with audio speakers and the EEG sensor in accordance with some embodiments of the present invention.

[0009] **Figure 6** illustrates an implementation of the earpiece of the neuro-headset with audio speakers and fabric EEG sensors in accordance with some embodiments of the present invention.

DETAILED DESCRIPTION

[0010] The invention can be implemented in numerous ways, including as a process; an apparatus; a system; a composition of matter; a computer program product embodied on a computer readable storage medium; and/or a processor, such as a processor configured to execute instructions stored on and/or provided by a memory coupled to the processor. In this specification, these implementations, or any other form that the invention may take, may be referred to as techniques. In general, the order of the steps of disclosed processes may be altered within the scope of the invention. Unless stated otherwise, a component such as a processor or a memory described as being configured to perform a task may be implemented as a general component that is temporarily configured to perform the task at a given time or a specific component that is manufactured to perform the task. As used herein, the term 'processor' refers to one or more devices, circuits, and/or processing cores configured to process data, such as computer program instructions.

[0011] A detailed description of one or more embodiments of the invention is provided below along with accompanying figures that illustrate the principles of the invention. The invention is described in connection with such embodiments, but the invention is not limited to any embodiment. The scope of the invention is limited only by the claims and the invention encompasses numerous alternatives, modifications and equivalents. Numerous specific details are set forth in the following description in order to provide a thorough understanding of the invention. These details are provided for the purpose of example and the invention may be practiced according to the claims without some or all of these specific details. For the purpose of clarity, technical material that is known in the technical fields related to the invention has not been described in detail so that the invention is not unnecessarily obscured.

[0012] In some embodiments, the device as described herein is particularly applicable to an audio headset with bio-signal sensors (e.g., a neuro-headset with EEG sensors and over the ear headphones or earbud headphones), and it is in this context that the device will be described. It will be appreciated, however, that the device has greater utility, because, for example, the audio headset can be used with other types of sensors (such as other types of bio-signal sensors) inside of the earpieces of the headset (and/or otherwise located in connection with the headset) and/or other types of multimedia capabilities, such as audio/hearing bone conduction, headphone video head mounted display (e.g., video glasses with audio speakers) and/or 3D stereoscopic.

[0013] **Figures 1A** through **1C** are diagrams illustrating a neuro-headset being worn by a user in accordance with some embodiments of the present invention. As shown, a neuro-headset 10 is being worn by a user who is shown in phantom in which a dashed outline is provided to depict the user in the diagrams. For example, the neuro-headset 10 can have first and second side portions 12, 13 that rest near the ears of the user and allow an electroencephalography (EEG) sensor 15 (e.g., as shown in Figures 2 and 3) to sit against the skin of the user behind the ear. The neuro-headset 10 also includes an arm portion 16 with an EEG sensor 17 located near the end of the arm portion 16, which, for example, can be used to position the EEG sensor on the forehead of the user. In some embodiments, two or more EEG sensors are provided in an earpiece of the neuro-headset 10. In some embodiments, EEG sensors are provided in each earpiece of the neuro-headset 10. In some embodiments, other types of bio-signal sensors are provided in one or both earpieces of the headset in place of or in addition to the EEG sensors. In some embodiments, the headset is a mono-headset, in which there is only one earpiece instead of two earpieces. For example, once the neuro-headset 10 is properly positioned on the head of the user, the brainwaves of the user can be measured based on the signals detected by the sensors 15, 17 as described in more detail in U.S. Patent Application Serial No. 11/656,828, filed on January 22, 2007 and entitled "Method and Apparatus for Quantitatively Evaluating Mental States Based on Brain Wave Signal Processing System," which is incorporated herein by reference.

[0014] **Figure 2** and **Figure 3** each illustrate embodiments of neuro-headsets with audio speakers and EEG sensors in accordance with some embodiments of the present invention. As shown, these embodiments of the neuro-headset 10 include both audio speakers and EEG sensors. For example, the neuro-headset 10 can have the first and second side portions 12, 13 and the arm portion 16 with the EEG sensor 17 as described above. The neuro-headset 10 can also have an earpiece/speaker portion 22 at the end of each side portion

12, 13 so that the earpiece portion, for example, fits over the ear of the user when the neuro-headset 10 is being worn by the user. As shown, the neuro-headset 10 includes the EEG sensor 15 within the earpiece portions 22. In some embodiments, EEG sensors are provided in each earpiece of the neuro-headset 10. Also, the EEG sensor 15 can be located at different locations within the earpiece portions 22 as shown in Figure 2 and Figure 3. In some embodiments, the EEG sensor 15 is supported with a flexible material to adapt to different users' head and ear shape and sizes, provide wearing comfort, while providing enough pressure to the ear surface to ensure proper contact. In some embodiments, each sensor includes a spring-loaded mechanism that acts as the flexible support material. In some embodiments, other types of flexible materials, such as a rubber sleeve with metallic spine as shown in Figure 5, are utilized.

[0015] **Figure 4** illustrates a flexible arm portion of the neuro-headset with audio speakers and EEG sensors in accordance with some embodiments of the present invention. As shown, the arm portion 16 (e.g., for each of the embodiments shown in Figures 2 and 3) includes a flexible portion 24 that allows the EEG sensor 17 to be more precisely positioned against the forehead of the user even with different head shapes and sizes of the user. For example, once the headset is properly positioned on the head of the user, it can be worn much like a normal headset with earpieces.

[0016] **Figure 5** illustrates an implementation of the earpiece of the neuro-headset with audio speakers and the EEG sensor in accordance with some embodiments of the present invention. As shown, the earpiece portion 22 (e.g., which can be padded for user comfort) includes the EEG sensor 15, which rests against the skin adjacent the user's ear when the headset is worn by the user, and which is able to sense the user's brainwave signals used for brainwave measurements. In some embodiments, such as the embodiments shown in Figures 2, 3 and 5, the EEG sensor 15 (also referred to as an electrode) is located in the earpiece of the headset so as to allow for contact with the preauricular skin area or helix or antihelix of the user's ear when the headset is worn by the user. In some embodiments, one or more of the EEG sensors are provided on the padded portion of the earpiece portion 22, and/or one or more of the EEG sensors are provided in the inner section of the earpiece portion 22 as shown.

[0017] **Figure 6** illustrates an implementation of the earpiece of the neuro-headset with audio speakers and fabric EEG sensors (also referred to as fabric electrodes) in accordance with some embodiments of the present invention. As shown, the earpiece portion

22 (e.g., which can be padded for user comfort) includes two fabric EEG sensors 14, 15, which rest against the skin adjacent the user's ear when the headset is worn by the user, and which is able to sense the user's brainwave signals used for brainwave measurements.

[0018] In some embodiments, the headset and headset components shown in Figures 2 through 5 allow the EEG sensor(s) to be included discretely inside the ear piece(s) of an audio headset or earphone or headphone, which provides a simple to use, easy to wear, and easy to manufacture headset that is effective in sensing the EEG signals. In some embodiments, the device can be used with any headsets or earphones or headphone with earpiece(s) that enclose, or rest on the skin of wearer's ear(s) wherein one or more bio-signal electrodes are built inside the ear piece(s) to touch the skin of the wearer's ear.

[0019] In some embodiments, the bio-signal sensor(s) (e.g., EEG sensors and/or other types of bio-signal sensors) location and flexible support material allow for a headset and earphone design that can collect, for example, EEG signals effectively, while keeping the overall headset or earphone design essentially the same as the ones without an EEG sensor, which makes the headset or earphone simple to use, easy to wear and easy to manufacture. For example, the location of the EEG sensors in the earpieces of the headset as described herein can provide for effective signal detection in which the signals captured by such EEG sensors of the headset are comparable to the signals captured by a medical grade EEG sensor on, for example, a known BioPac MP150 system.

[0020] Although the foregoing embodiments have been described in some detail for purposes of clarity of understanding, the invention is not limited to the details provided. There are many alternative ways of implementing the invention. The disclosed embodiments are illustrative and not restrictive.

[0021] WHAT IS CLAIMED IS:

CLAIMS

1. An audio headset comprising:

a first side portion of the audio headset having a first earpiece attached to the first side portion so that the first earpiece can be placed on top of, over, or inside a user's ear when the audio headset is worn by the user; and

a first bio-signal sensor positioned inside of the first earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user.

2. The audio headset of claim 1, wherein the audio headset is a mono-headset.

3. The audio headset of claim 1, further comprising:

a second side portion of the audio headset having a second earpiece attached to the second side portion so that the first and second earpieces can be placed on top of, over, or inside a user's ears when the audio headset is worn by the user.

4. The audio headset of claim 1, further comprising:

a second bio-signal sensor positioned inside of the second earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user.

5. The audio headset of claim 1, further comprising:

a second bio-signal sensor positioned inside of the first earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user.

6. The audio headset of claim 1, further comprising:

a second bio-signal sensor positioned inside of the first earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user; and

a third bio-signal sensor positioned inside of the first earpiece that is capable of resting against a skin portion of the ear of the user when the audio headset is worn by the user.

7. The audio headset of claim 1, further comprising:

an arm of the audio headset for holding a second bio-signal sensor that is capable of resting against a skin portion of a forehead of the user when the audio headset is worn by the user.

8. The audio headset of claim 1, further comprising:

a flexible arm of the audio headset holding a second bio-signal sensor that is capable of resting against a skin portion of a forehead of the user when the audio headset is worn by the user.

9. The audio headset of claim 1, wherein the first earpiece further comprises a flexible material inside of the first earpiece that supports the first bio-signal sensor and provides outwards pressure.

10. The audio headset of claim 1, wherein the first earpiece further comprises a flexible material inside of the first earpiece that supports the first bio-signal sensor and provides outwards pressure, and the flexible material further comprises a spring loaded mechanism.

11. The audio headset of claim 1, wherein the first bio-signal sensor includes an electroencephalography (EEG) sensor.

12. The audio headset of claim 1, wherein the first bio-signal sensor includes an electroencephalography (EEG) sensor for detecting brainwave signals.

13. The audio headset of claim 1, wherein the first bio-signal sensor includes a fabric electroencephalography (EEG) sensor for detecting brainwave signals.

14. The audio headset of claim 1, wherein the first bio-signal sensor includes an electroencephalography (EEG) sensor for detecting brainwave signals, and the first bio-signal sensor is located on a padded portion of the first earpiece.

15. The audio headset of claim 1, wherein the first earpiece further comprises an over the ear headphone.

16. The audio headset of claim 1, wherein the first earpiece further comprises an audio bone conduction headphone.

17. The audio headset of claim 1, wherein the first earpiece further comprises an earbud headphone.

18. The audio headset of claim 1, further comprising:

a video head mounted display.

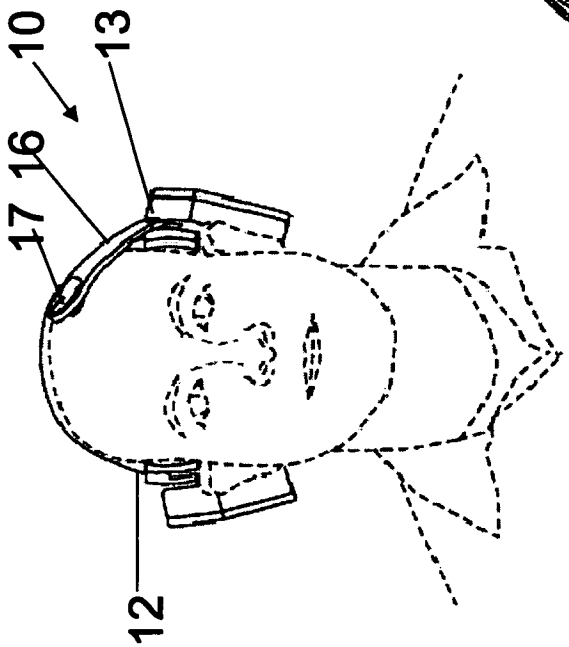

FIG. 1A

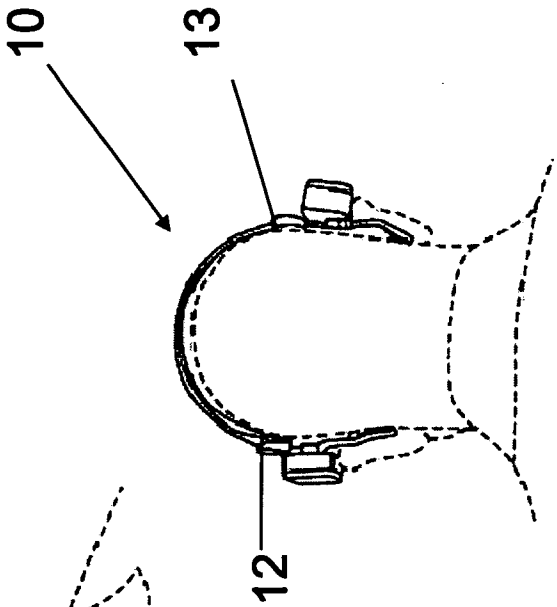

FIG. 1B

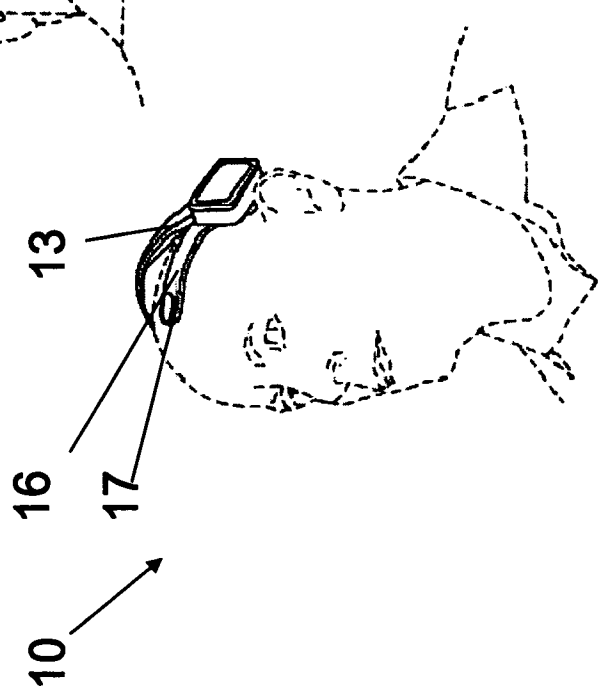

FIG. 1C

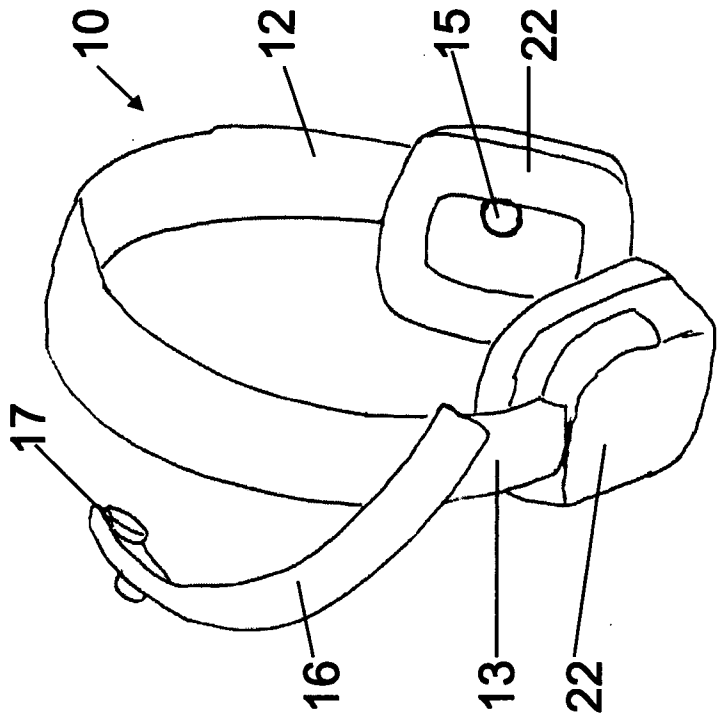

FIGURE 2

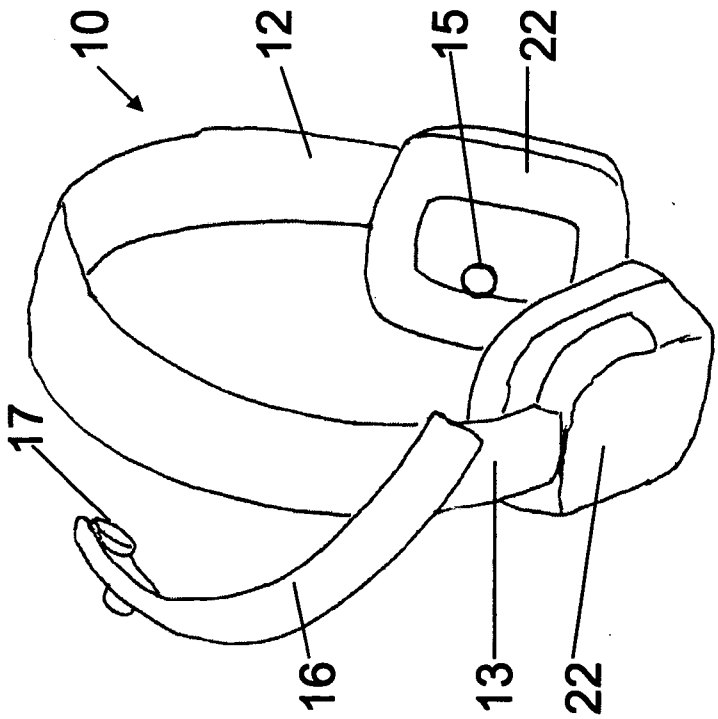

FIGURE 3

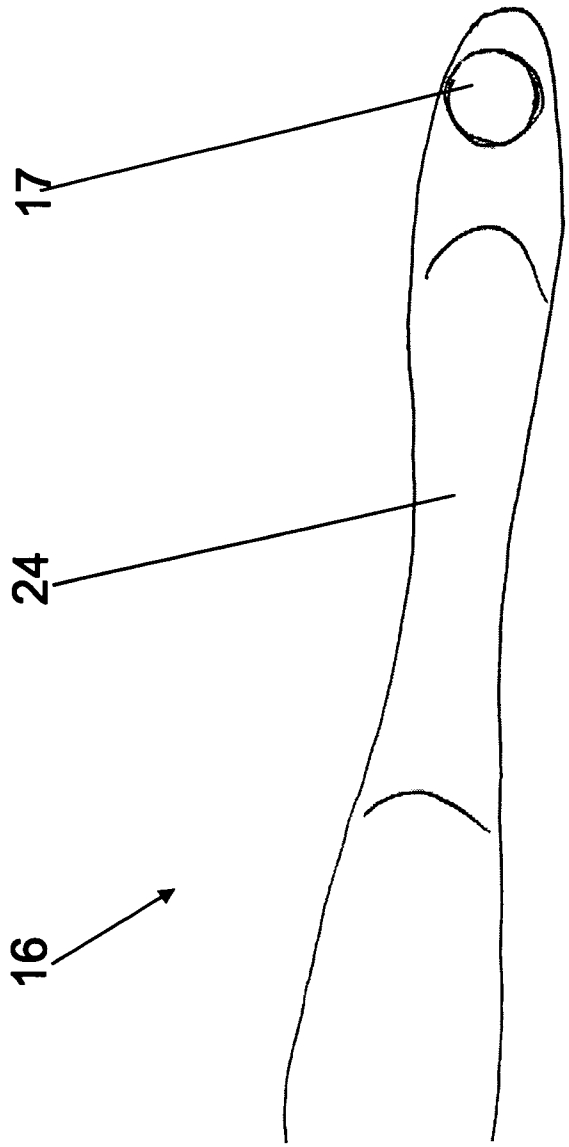

FIGURE 4

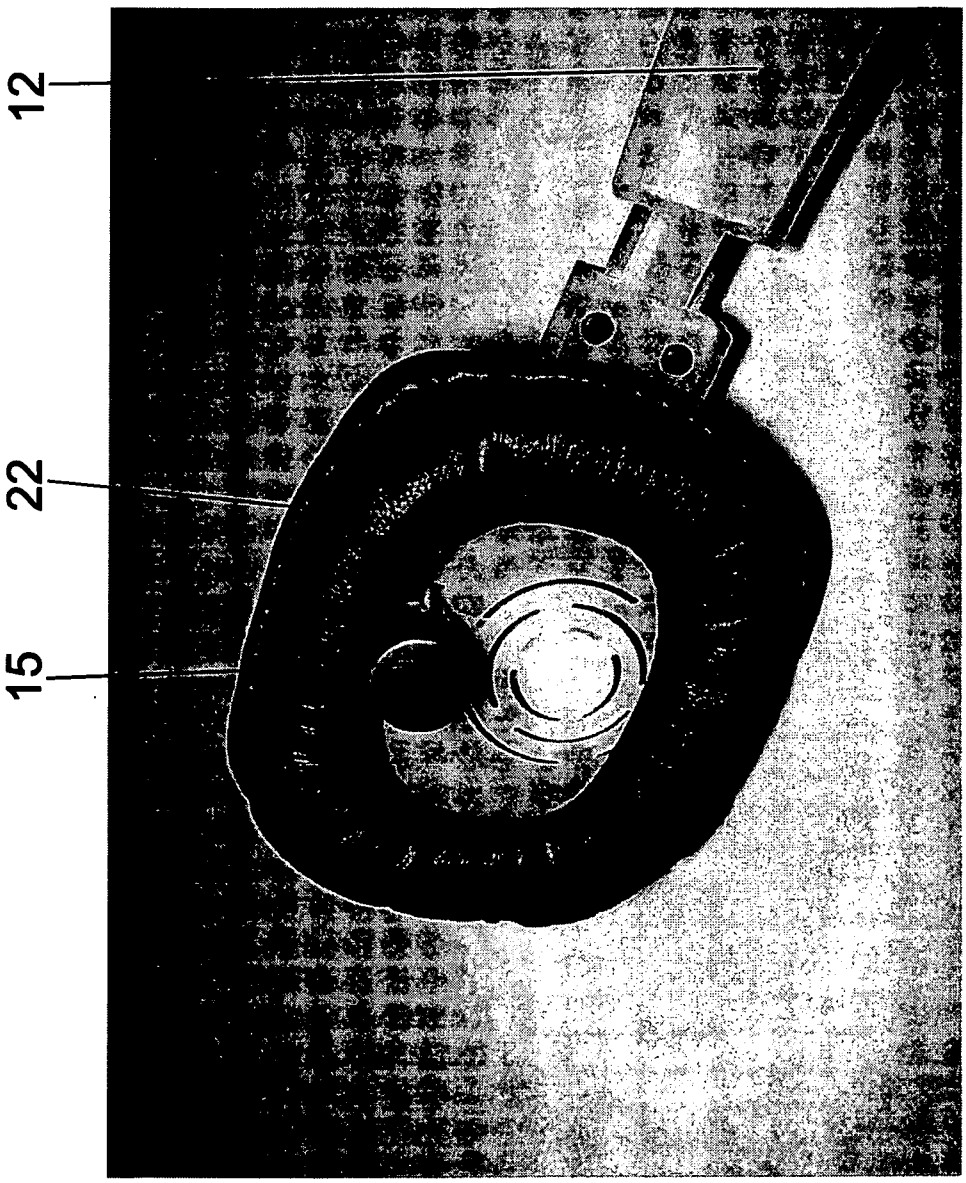

FIGURE 5

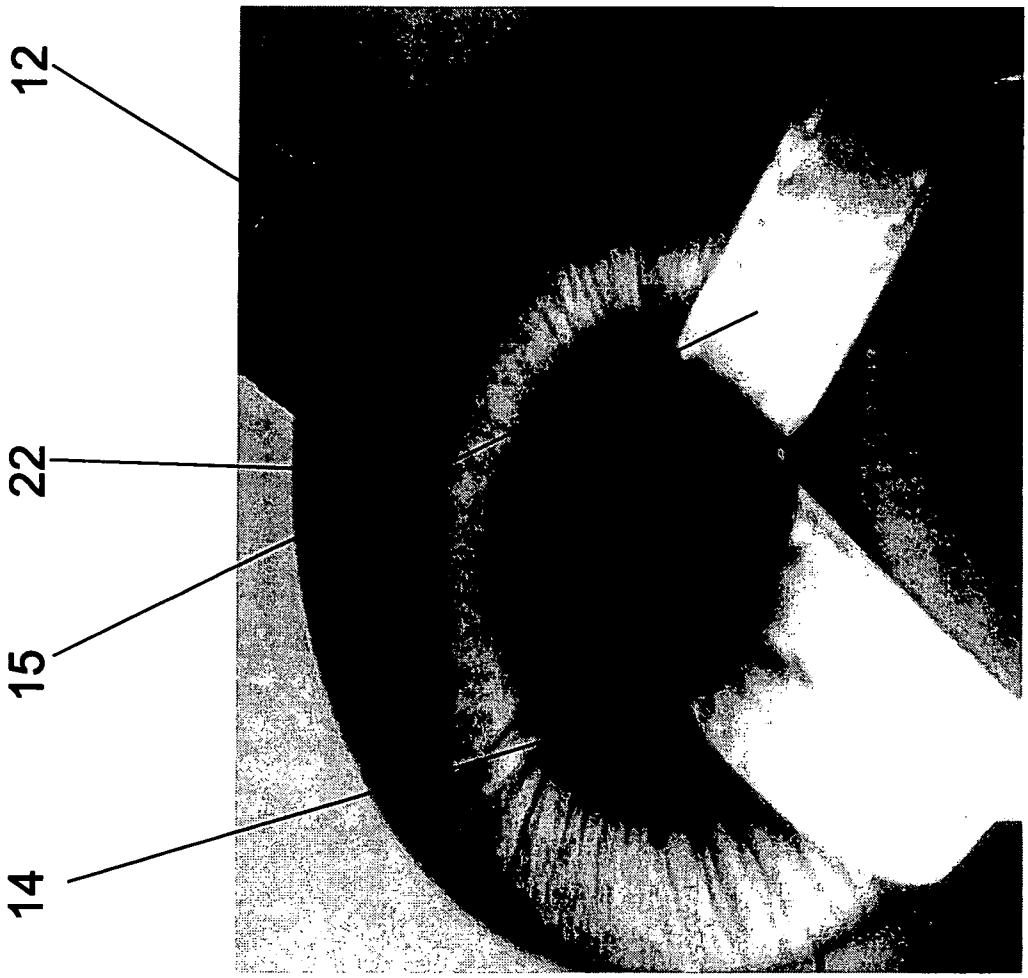

FIGURE 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/000856

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 5/04 (2009.01)
USPC - 600/544
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(8) - A61B 5/04 (2009.01)
USPC - 463/36; 600/383, 544

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 practicable, search terms used)
PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,954,667 A (FINKENZELLER et al) 21 September 1999 (21.09.1999) entire document	1-2, 5, 7, 9-12, 14-17
Y		3-4, 6, 8, 13, 18
Y	US 7,197,350 B2 (KÖPKE) 27 March 2007 (27.03.2007) entire document	3-4
Y	US 6,694,180 B1 (BOESEN) 17 February 2004 (17.02.2004) entire document	6
Y	US 2004/0073129 A1 (CALDWELL et al) 15 April 2004 (15.04.2004) entire document	13
Y	US 7,128,577 B2 (RENAUD) 31 October 2006 (31.10.2006) entire document	18
Y	US 2004/0252103 A1 (BONNAT) 16 December 2004 (16.12.2004) entire document	8

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"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
24 March 2009	14 APR 2009

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774