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(54) Title: METHOD FOR LOCATING A HEARING DEVICE AND DEVICES THAT ARE OPERABLE ACCORDING TO SAID METHOD

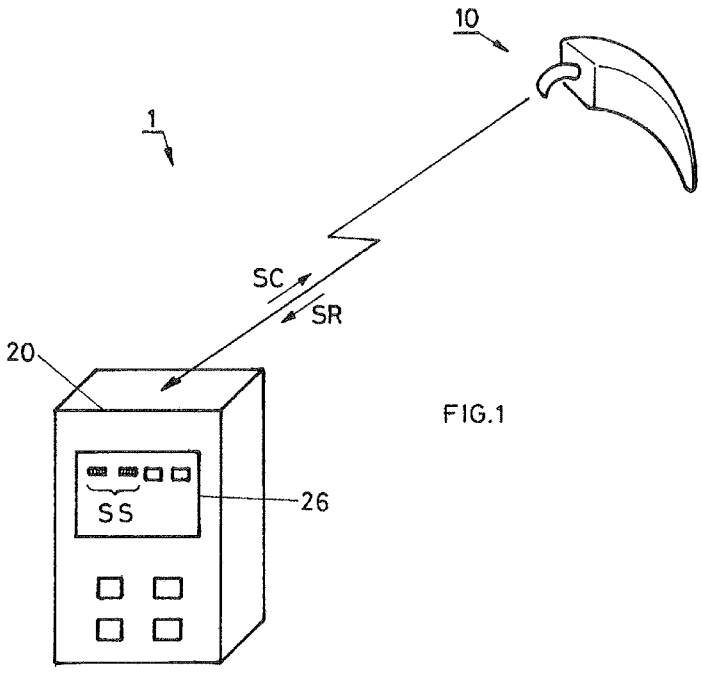

FIG.1

(57) Abstract: The present invention is related to a method for locating a hearing device (10) by means of a remote control (20) and to devices that are operable according to said method. The remote control (20) comprises an output user interface (26) and a receiving unit, which is wirelessly connected to the hearing device (10). The method comprises the steps of: emitting a call signal (SC) by the remote control (20) upon activation; receiving an input signal (SR) by the receiving unit (22), the input signal (SR) being transmitted from the hearing device (10) as a response to the call signal (SC); measuring a signal strength (SS) of the received input signal (SR); forwarding information to the output user interface (26), the information corresponding to the measured signal strength (SS); presenting an indication to the user of the remote control (20), the indication being presented by the output user interface (26) and being indicative of the measured signal strength (SS).

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METHOD FOR LOCATING A HEARING DEVICE AND DEVICES THAT ARE OPERABLE ACCORDING TO SAID METHOD

TECHNICAL FIELD OF THE INVENTION

The present invention is related to a method for locating a hearing device by means of a remote control and to devices, in particular a remote control and a hearing system, that are operable according to said method.

BACKGROUND OF THE INVENTION

It may happen to a user of a hearing aid that he misplaces his hearing aid. In order to help him to find the misplaced hearing aid, different methods have been proposed.

For example, US 5'721'783 discloses a method for locating a misplaced earpiece of a hearing aid by means of a remote processing unit. The remote processing unit serves as an external processor for the earpiece, comprises a display and is carried by the user, separately from the earpiece, e.g. in his pocket. For locating the earpiece, the user manually activates the remote processing unit and the display indicates to the user in case that a communication connection has been established between the earpiece and the remote processing unit. Therefore, the user is able to locate the earpiece by observing the display while moving around searching for the misplaced earpiece.

SUMMARY OF THE INVENTION

The present invention has the objective to propose an improved method for locating a hearing device and to propose improved devices that are operable according to said method.

This objective is reached by a method comprising the features specified in claim 1 and by devices according to the respective claims. Further embodiments of the method as well as of the devices are specified in respective dependent claims.

Under the term "hearing device" a device is understood, which is worn in or adjacent to the user's ear with the object to improve the user's acoustical perception. Such an improvement may also relate to a communication using audio or communication devices to provide sound signals to persons with normal hearing capability such as a hearing assistance which improves perception under difficult acoustical circumstances, particularly in a noisy environment. The improvement may also be barring acoustic signals from being perceived in the sense of hearing protection for the user. If the hearing device is tailored so as to improve the perception of a hearing impaired user towards hearing perception of a user with normal hearing ability, then the hearing device is regarded as a hearingaid, alternatively called hearing instrument or hearing prostheses. With respect to the application area, a

hearing device may be applied behind the ear, in the ear or completely in the ear canal.

In particular, the invention proposes a method for locating a hearing device by means of a remote control. The remote control comprises an output user interface and a receiving unit, which is wirelessly connected to the hearing device. The method comprises the steps of:

- emitting a call signal by the remote control upon activation;
- receiving an input signal by the receiving unit, the input signal being transmitted from the hearing device as a response to the call signal;
- measuring a signal strength of the received input signal;
- forwarding a receiving information to the output user interface, the receiving information corresponding to the measured signal strength;
- presenting an indication to the user of the remote control, the indication being presented by the output user interface and being indicative of the measured signal strength.

Such a method enables the user to determine the direction of increasing signal strength, which, in turn, allows the user to efficiently proceed towards the location of the misplaced hearing device.

The method according to the invention takes advantage of the characteristics of the radio technology and in particular of the spatial distribution of the signal

strength of wirelessly transmitted signals, the so called field gradients. This enables the user to determine the direction of the radiating source, i.e. the hearing device, by identifying the path that shows the most increasing signal strength. By moving along this path the user is directed towards the misplaced hearing device, or at least to its proximity. Therefore, the method and the devices according to the invention are target orientated and enable an efficient and comfortable locating of the hearing device.

Further, by providing information about the received signal strength, the invention proves to be surprisingly effective by giving precise indications of the current situation of the radio transmission. This enables a comfortable and convenient locating of the hearing device, even in situations with difficult radio transmission, e.g. with obstructions, moving senders and/or receivers as well as distance attenuations.

In addition, a loss of the hearing device can have a large economical impact, because a hearing device can cost several thousands of Euros. Therefore the loss may cause stress and discomfort to the user. This can be reduced or even the avoided by an efficient and target orientated locating of the misplaced hearing device.

In particular, the method according to the invention is advantageous for:

- young children and babies, not being aware that they have lost the hearing device and/or not being able to describe when and/or where they lost the hearing device;

- seniors, suffering from Dement or Alzheimer, or disabled persons may not be able to remember where the hearing device has been left;

- care givers, being in need to efficiently find the hearing device without knowing where to search.

The process of the locating the hearing device is initiated by the remote control upon an activation, in particular upon an automatically generated command or upon a manual user interaction such as pushing a button or selecting a menu item. Thus, the hearing device only transmits signals as response to the call signal received from the remote control and there is no need for the hearing device to transmit signals on its own motion, for example by spontaneous transmissions. This way, high power consumption for signal transmission, i.e. radiation power, only occurs during the actual responding to a call signal, whereas a constant listening to call signals is less power demanding. Therefore, with this type of initiation, the energy of the power supply of the hearing device is saved.

The indication of the measured signal strength can be presented continuously or only on request of the user, for example after a manual activation, namely by issuing a

search command on the remote control, for example by pressing a button and/or by selecting an activation command from a menu on a graphical user interface.

Usually the change of the measured signal strength relates to a movement of the user resp. the remote control carried by the user. In particular, the user can determine the direction of the most increasing signal strength, by moving the remote control with an approximately constant speed in different directions and by observing the speed of the increase of the measured signal strength. Consequently, the direction with the most rapid increasing signal strength is most likely directing to the misplaced hearing device.

In a first embodiment of the method according to the invention, the output user interface is provided by an optical display, in particular a LCD display, and/or an audio signal generator. Such a display or audio signal generator allows for the presentation of detailed information and therefore provides an efficient and comfortable indication of the measured signal strength. The optical display is particularly advantageous for a user of a hearing device such as a person with a reduced hearing capability, for example a person with a severe to profound hearing impairment.

In a further embodiment of the method according to the invention, the indication generates an audio signal such as

a beep, a tune, a series of tunes or speech and/or depicts a figure or a bar indicator, wherein, in particular, the number of displayed bars depends on the measured signal strength. This provides for a clear and intuitive visual representation of the measured signal strength. This is advantageous for the care givers and/or for the user of a hearing device himself.

In one example, the frequency and/or the series of tunes and/or the modulation of the generated audio signal corresponds to the measured signal strength. For example, the frequency of a generated beep may correspond, in particular proportionally, to the measured signal strength. This way, an increasing frequency of the beep indicates a decreasing distance between the receiving unit and the hearing device.

In another example, the number of the displayed bars increases, in particular proportionally, to an increase of the measured signal strength. Thus, the increasing number of bars indicates a decreasing distance between the receiving unit and the hearing device.

Further, the bar indicator may serve as RSSI (Receiving Strength Signal Indicator), which can be used as a zoom. This gives the possibility to localize the hearing device more precisely. In addition, the bar indication presents the measured signal strength in a stepwise manner, which

provides clear indications, particularly useful for persons with limited eye sight.

In a further embodiment of the method according to the invention, the indication represents a change, in particular an increase, calculated over a predetermined period of time. In an example, the predetermined period of time is in a range of 0.5 to 5 seconds, in particular in a range of 1 to 2 seconds. By subtracting the value measured at the beginning of the period from the measured value measured at end of the period, the change of the measured signal strength can be calculated and indicated to the user. This way, the user can conveniently observe a change without remembering a previous measurement.

In particular, the change is indicated by presenting the sign of the change, e.g. a plus or a green light for an increase and a minus or a red light for a decrease. Further, a single indication, e.g. indicating an increase only, is also possible.

In a further embodiment of the method according to the invention, the indication presents an average value calculated over a predetermined period of time. This helps to compensate for short-term fluctuations of the measured signal strength and therefore provides a particularly precise and clear indication to the user. In an example,

the predetermined period of time is in a range of 0.5 to 5 seconds, in particular in a range of 1 to 2 seconds.

In a further embodiment of the method according to the invention, the hearing device is a hearingaid or a hearing protection device. For these devices, an efficient way for locating is particularly important, because a loss of the hearingaid may result in not being able to perceive an alarm or a loss of the hearing protection device may result in a harmful overexposure to sound.

In a further embodiment of the method according to the invention, the method comprises the step of establishing a communication by emitting with the remote control a call signal and by identifying the input signal as a response to the call signal. In an example, the command for emitting a call signal is initiated by the user of the remote control via a user interface, e.g. by activating a switch or button, or by selecting a command from a menu on a display of the remote control. The command usually starts a search procedure within the remote control, which, in turn, initiates the emitting of the call signal.

In a further embodiment of the method according to the invention, the method comprises the step of requesting a status register readback from the hearing device to the remote control. This enables the remote control to determine the distance to the hearing device, in particular

by capturing the content of the status register, the remote control is able to indicate to the user that the hearing device is in close proximity.

In a further embodiment of the method according to the invention, the method comprises the step of determining from the received input signal an identification parameter of the hearing device, in particular a frequency, a channel number, a code or a number. In an example, the signal strength is measured and/or the information corresponding to the measured signal strength is forwarded only in the case the identification parameter corresponds to a predetermined parameter, for example a unique identification number of the hearing device. This allows for selectively measuring the specific hearing device and therefore reduces or avoids interferences from other radio sources such as further hearing devices or mobile phones.

The invention further proposes a remote control, a hearing system and a hearing device that are operable according to the aforementioned method and their embodiments.

In particular, the invention proposes a remote control comprising :

- a means for emitting a call signal upon activation,
- a receiving unit being wirelessly connectable to a hearing device for receiving an input signal, and

- an output user interface for presenting an indication to the user of the remote control.

Thereby the remote control further comprises:

- a means for measuring a signal strength of the received input signal, and
- a means for forwarding a receiving information to the output user interface, the receiving information corresponding to the measured signal strength,

and wherein the indication is indicative of the measured signal strength. Such a remote control enables the user to determine the direction of increasing signal strength, which in turn allows the user to efficiently proceed towards the location of the misplaced hearing device.

In a further embodiment of the remote control according to the invention, the output user interface is an optical display, in particular a LCD display.

In a further embodiment of the remote control according to the invention, the remote control comprises a measurement unit for measuring the signal strength of the received input signal, the measurement unit being operationally connected to the output user interface for forwarding the receiving information.

In a further embodiment of the remote control according to the invention, the remote control comprises a signal processing unit for evaluating the results of the measuring

step and for providing the receiving information. This way possessing intensive operations such as calculation an average value can be carried out in a dedicated unit such as a microprocessor or an integrated circuit.

In a further embodiment according to the invention, the remote control comprises a memory unit that is configured to store a predetermined identification parameter such as an identification number of the hearing device to be searched. The memory unit is operationally connected to the measurement unit for providing the stored identification parameter to the measurement unit for identifying the hearing device. This provides an efficient identification of the hearing devices. In particular, the memory is non-volatile to prevent a loss of the stored identification parameter in the case of a power supply disruption.

In particular, the invention further proposes a hearing system comprising a remote control according to any one of previous remote control embodiments and at least one hearing device that is wirelessly connectable to the remote control. Such a system provides a good interaction between the involved devices in order to achieve an efficient localization of the hearing device.

Further, the hearing system may comprise several components such as a plurality of hearing devices and one or more remote control, which may be located at different places, and which, when in use, may all be operationally connected.

In general, the components of the hearing system are intended to be worn or carried by the user. For example, the hearing devices can each be worn in the left and the right ear of the user. In another example, the at least one hearing device of the hearing system is a hearingaid or a hearing protection device.

In particular, the invention involves a hearing device that comprises a processing unit being operationally connected to an input transducer for receiving an electrical signal that corresponds to an acoustical input signal. The processing unit is operable to provide an intermediate signal by processing the electrical signal. The hearing device further comprises an output transducer that is operationally connected to the processing unit for receiving the intermediate signal. The output transducer is operable to provide an output signal to the user of said hearing device, wherein the output signal corresponds to the intermediate signal. Thereby the hearing device comprises a means for sending a response signal, in particular an identification of the hearing device, upon receiving of a call signal from a remote control.

The input and output transducers convert an acoustical input signal to an electrical signal or vice versa and can be implemented by a great variety of devices. Typically, the transducers are sound transducers such as microphones or loudspeakers, which may be based on electromagnetic, electrodynamic, electrostatic, piezoelectric or

piezoresistive principles. The input transducer can also embraces remote devices such as remote microphones, stationary or mobile telephones, which receive and converted an acoustical input signal remotely and transmit the converted signal to the processing unit of the hearing device via a wire or wireless connection. Further, the output transducer may also convert the intermediate signal into a mechanical signal such as mechanical vibrations. The mechanical signal may then be applied directly to the hearing bone of the user. It may also be possible to convert the electrical signal into a further electrical signal that is applied directly to the acoustic organ of the user, e.g. by using a cochlear implant.

The processing unit of the hearing device is typically implemented by a digital component such as a digital filter or a DSP (Digital Signal Processor) . However, analog components may also be used. The processing unit may be a programmable unit, for example a microprocessor or a FPGA, but it could also be implemented by using fixed wired circuits, for example discrete electronic components or ASICs (application specific integrated circuit) .

It is expressly pointed out that any combination of the above-mentioned embodiments, or combinations of combinations, is subject to a further combination. Only those combinations are excluded that would result in a contradiction .

BRIEF DESCRIPTION OF THE DRAWINGS

Below, the present invention is described in more detail by means of exemplary embodiments and the included drawings. It is shown in:

Fig. 1 a simplified overview illustrating an embodiment of a hearing system according to the invention with a remote control 20 and a wirelessly connected hearing device 10;

Fig. 2 a simplified block diagram illustrating an embodiment of a remote control 20 according to Fig. 1; and

Fig. 3 a simplified block diagram illustrating an embodiment of a hearing device 10 according to Fig. 1.

BRIEF DESCRIPTION OF THE INVENTION

The described embodiments are meant as illustrating examples and shall not confine the invention.

Fig. 1 shows a simplified overview illustrating an embodiment of a hearing system 1 according to the invention. The hearing system 1 comprises a remote control 20 and a hearing device 10, which may be misplaced at some

invisible location. However, the hearing device 10 is connected to the remote control 20 via a bidirectional wireless connection. The remote control 20 comprises a display 26, which serves as an output user interface for presenting an indication to the user of the remote control 20.

The wireless connection enables the remote control 20 to transmit a call signal SC to the hearing device 10. In the other direction, a response signal SR can be transmitted from the hearing device 10 to the remote control 20.

In order to locate the hearing device 10 the user of the remote control may press a button on the remote control 20. According to this user command the remote control 20 emits a call signal SC to its environment. The hearing device 10 receives the call signal SC and thereupon sends a response signal SR to the remote control 20, such that the response signal SR relates to the call signal SC.

As shown and explained in more detail in the simplified block diagram of Fig. 2 the remote control 20 measures the signal strength of the received input signal SR and forwards a receive information to the display 26. Thereby the forwarded receive information corresponds to the measured signal strength SS.

On the display 26 of the remote control 20, an indication 0I is presented to the user of the remote control 20. The indication 01 corresponds to the receive information and

consequently the indication 0I is indicative of the measured signal strength SS. In this specific embodiment, the measured signal strength SS is depicted by a bar indicator with two different colours, e.g. white and black. In the shown example, the number of the dark bars indicates that the measured signal strength SS is approximately 50% of the full measurement range. However, the indication may also be depicted in many different ways such as by pointer instruments or pie charts.

Fig. 2 shows a simplified block diagram illustrating an embodiment of a remote control 20 according to Fig. 1. The remote control 20 comprises a receiving unit 22, a measurement unit 24, the display 26 and a processing unit 25. The measurement unit 24 is operationally connected to the receiving unit 22, wherein the term "operationally connected" is understood in the meaning that the connection may include one or more interconnected devices. Further, the display 26 is operationally connected to the processing unit 25 and the processing unit 25 is operationally connected to the measurement unit 24.

In use, namely during locating of a misplaced hearing device 10, the receiving unit 22 receives the input signal SR, that has been transmitted from the hearing device 10. From the receiving unit 22 the input signal is forwarded to the measurement unit 24. The measurement unit 24 measures the signal strength SS of the received input signal SR and forwards the results of the measuring step to the processing unit 25. The processing unit 25 evaluates the

results of the measuring step by calculating an average value of the measured signal strength SS. Further, the processing unit 25 provides an information that corresponds to the average measured signal strength SS, the so called receiving information and forwards this receiving information to the display 26. The display 26 presents receiving information, as described in Fig. 1, by depicting the measured signal strength SS with a bar indicator.

As indicated by the dashed line, the receiving unit 22, the measurement unit 24 and the processing unit 25 may be integrated into a single unit. In general, the constituents of this embodiment are at least in part merely functional units, which of course can be arranged in various ways, e.g., two or more of them can be united in one physical unit, or one or more of them can be distributed over two or more physical units. Further, many of these functions may be implemented in form of software, e.g. as a program that is executable on a processor such as a signal processor or a microprocessor.

Fig. 3 shows a simplified block diagram that illustrates an embodiment of a hearing device 10 according to the invention. The hearing device 10 comprises a microphone 12 that serves as input transducer, a signal processing unit 14, a loudspeaker 16 that serves as output transducer and a wireless transmitter unit 18. The signal processing unit 14 is operationally connected on its input side to the microphone 12 for receiving an electrical signal and on its

output side to the loudspeaker 16 for providing an electrical output signal that serves as intermediate signal. Further, the signal processing unit 14 is operationally connected via a bidirectional connection to the wireless transmitter unit 18 in order to exchange information between the processing unit 14 and wireless transmitter unit 18.

In operation, namely during normal use of the hearing device 10, the microphone 12 provides an electrical signal that corresponds to an acoustical input signal. The signal processing unit 14 receives this electrical signal and processes it according to the set of gains to provide the intermediate signal. The loudspeaker 16 receives the electrical output signal and provides a sound signal to the user of the hearing device 10, wherein this sound signal is an output signal that corresponds to the intermediate signal .

For exchanging information with the remote control 20 (Fig. 2), a communication signal that has been received via the wireless transmitter unit 18 is forwarded to the signal processing unit 14 and information from the signal processing unit 14 is transmitted via the wireless transmitter unit 18 to the remote control, in particular to the receiver unit 22 (Fig. 2).

As indicated by the dashed line, the hearing device 10 may be implemented as a compact device that comprises all the above mentioned components. However, the hearing device 10

may also comprise separated components such as separated building elements that are operationally connected together, for example a remote processing unit, a remote microphone or a remote loudspeaker. Further, the wireless transmitter unit 18 may be integrated into the signal processing unit 14 as indicated by the dash-dotted line.

CLAIMS

1. A method for locating a hearing device (10) by means of a remote control (20) comprising an output user interface (26) and a receiving unit (22), which is wirelessly connected to the hearing device (10), the method comprises the steps of:

- emitting a call signal (SC) by the remote control (20) upon activation;

- receiving an input signal (SR) by the receiving unit (22), the input signal (SR) being transmitted from the hearing device (10) as a response to the call signal (SC);

- measuring a signal strength (SS) of the received input signal (SR);

- forwarding a receiving information to the output user interface (26), the receiving information corresponding to the measured signal strength (SS);

- presenting an indication (01) to the user of the remote control (20), the indication (01) being presented by the output user interface (26) and being indicative of the measured signal strength (SS).

2. The method according to claim 1, wherein the output user interface (26) is provided by an optical display, in particular a LCD display, and/or an audio signal generator .

3. The method according to claim 1 or 2, wherein the indication (01) generates an audio signal such as a beep, a tune, a series of tunes or speech and/or depicts a figure or a bar indicator, wherein, in particular, the number of displayed bars depends on the measured signal strength.

4. The method according to any one of the claims 1 to 3, wherein the indication (01) represents a change, in particular an increase, calculated over a predetermined period of time.

5. The method according to any one of the claims 1 to 4, wherein the indication (01) represents an average calculated over a predetermined period of time.

6. The method according to any one of the claims 1 to 5, wherein the hearing device (10) is a hearingaid or a hearing protection device.

7. The method according to any one of the claims 1 to 6, further comprising the step of establishing a communication by emitting with the remote control (20) a call signal (SC) and by identifying the input signal (SR) as a response to the call signal (SC) .

8. The method according to any one of the claims 1 to 7, further comprising the step of requesting a status register readback from the hearing device (10) to the remote control (20) .

9. The method according to any one of the claims 1 to 8, wherein the method further comprises the step of determining from the received input signal (SR) an identification parameter of the hearing device (10), in particular a frequency, a channel number, a code or a number .

10. A remote control (20) comprising:

- a means for emitting a call signal (SC) upon activation,

- a receiving unit (22) being wirelessly connectable to a hearing device (10) for receiving an input signal (SR) that is transmitted from the hearing device (10) as a response to the call signal (SC) ,and

- an output user interface (26) for presenting an indication (01) to the user of the remote control (20) ,

characterized by comprising:

-a means for measuring a signal strength (SS) of the received input signal (SR), and

- a means for forwarding a receiving information to the output user interface (26), the receiving information corresponding to the measured signal strength (SS),

wherein the indication (01) is indicative of the measured signal strength (SS).

11. The remote control (20) according to claim 10, wherein the output user interface (26) is an optical display (26), in particular a LCD display, and/or a sound generator.

12. The remote control (20) according to claim 10 or 11, further comprising a measurement unit (24) for measuring the signal strength (SS) of the received input signal (SR), the measurement unit (24) being operationally connected to the output user interface (26) for forwarding the receiving information.

13. The remote control (20) according to claim 10 or 12, wherein the measurement unit (24) comprises a signal processing unit for evaluating the results of the measuring step and for providing the receiving information.

14. A hearing system (1) comprising a remote control (20) according to any one of the claims 10 to 13 and at least one hearing device (10) that is wirelessly connectable to the remote control (20) .

15. The hearing system (1) according to claim 14, wherein the hearing device (10) is a hearingaid or a hearing protection device.

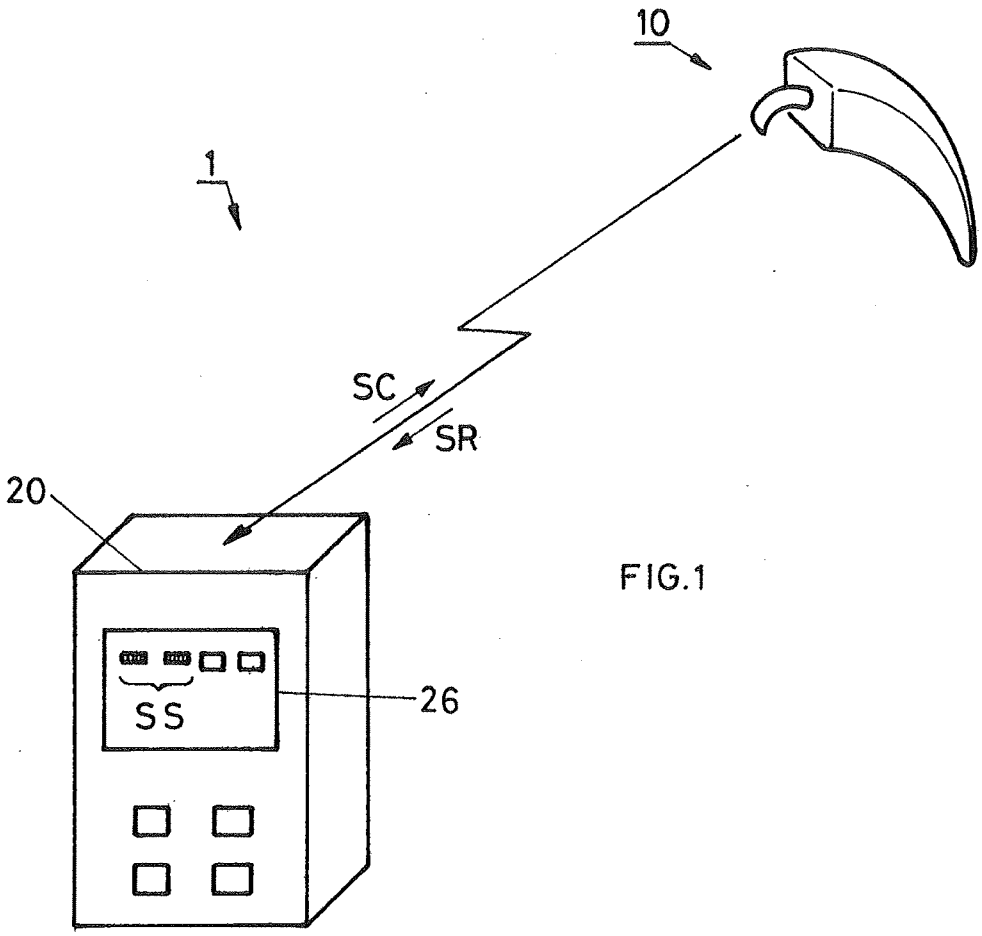

FIG.1

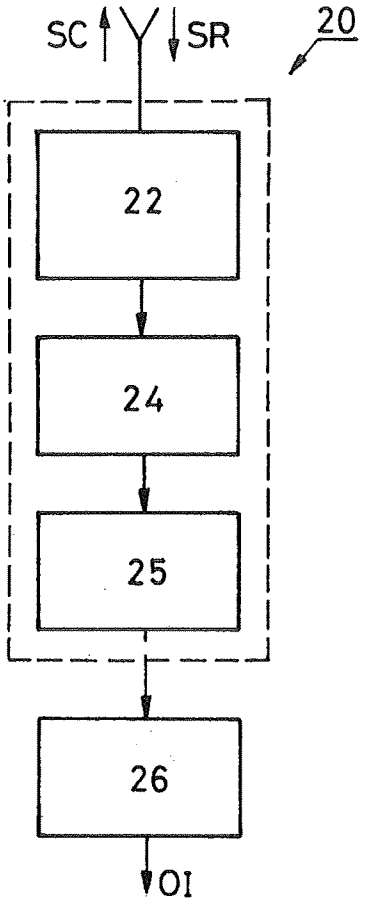

FIG.2

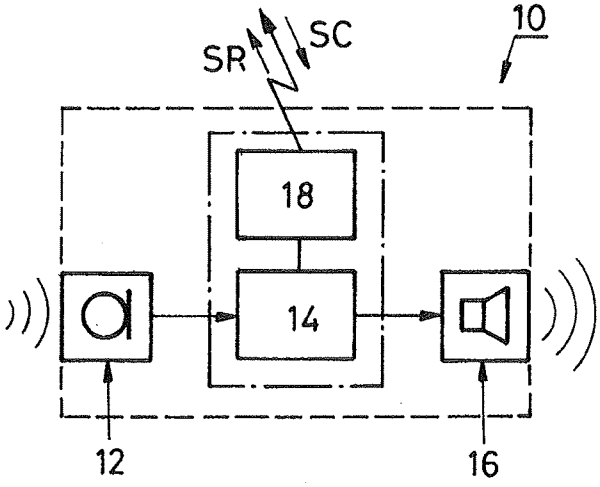

FIG.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/059737

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/55
ADD.

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)
H04R H04B G08B

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)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 084 517 A (RABANNE MICHAEL C [US] ET AL) 4 July 2000 (2000-07-04) column 2, line 28 - column 5, line 6; figures 1,6-10 column 8, line 25 - column 11, line 31	1-15
A	EP 2 150 076 A2 (SIEMENS MEDICAL INSTR PTE LTD [SG]) 3 February 2010 (2010-02-03) the whole document	1-15
X	US 2009/058670 Al (SWEENEY JEFFREY M [US] ET AL) 5 March 2009 (2009-03-05) the whole document	1-15
A	WO 02/073562 Al (VISER TECHNOLOGIES LLC [US]) 19 September 2002 (2002-09-19) the whole document	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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31 October 2012	15/11/2012

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/059737

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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