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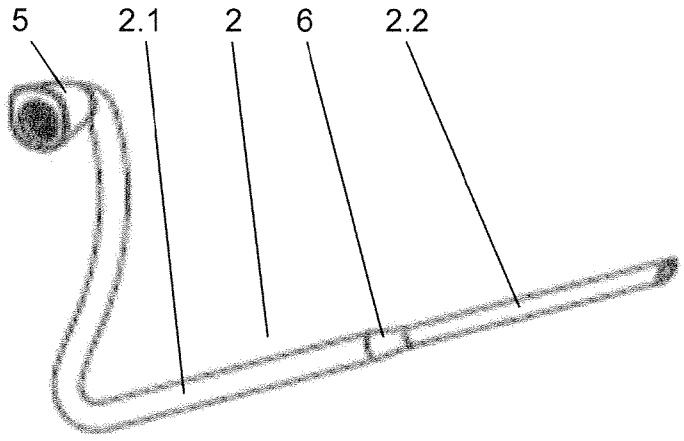

Fig. 3

(57) Abstract: The present invention provides a slim sound tube (2) for connecting a sound output port of a behind-the-ear component with a sound input port of an ear mould, wherein said sound tube (2) has a preformed shape and comprises a first end section (2.1) and a second end section (2.2), said first end section (2.1) having an inner diameter in the range of 1.2 mm to 1.6 mm, preferably in the range of 1.3 mm to 1.5 mm, more preferably of approximately 1.4 mm, and an outer diameter in the range of 1.7 mm to 2 mm, and said second end section (2.2) having an outer diameter which is less than the outer diameter of said first end section (2.1). Furthermore, the present invention pertains to a more inconspicuous hearing device with such a slim sound tube (2), to a kit of parts for assembling such a hearing device according to the individual needs of a user as well as a method for affixing such a slim sound tube (2) to an ear mould of such a hearing device.

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SOUND TUBE FOR A HEARING DEVICE AND A HEARING DEVICE WITH SUCH A SOUND TUBE

TECHNICAL FIELD

The present invention relates to the field of hearing devices, more specifically to sound tubes for behind-the-ear (BTE) type hearing devices as well as to BTE hearing devices with such sound tubes for providing high gain in order to achieve a high output sound pressure level (SPL) within an ear canal of a user of the hearing device. Furthermore, the present invention pertains to a kit of parts for assembling such a hearing device according to the individual needs of a user as well as a method for affixing such a sound tube to an ear mould of such a hearing device.

BACKGROUND OF THE INVENTION

In the context of the present invention the term "hearing device" refers to hearing aids (alternatively called hearing instruments or hearing prostheses) used to compensate hearing impairments of hard of hearing persons as well as audio and communication devices used to provide sound signals to persons with normal hearing capability, e.g. in order to improve hearing in harsh acoustic surroundings. Moreover, it also encompasses ear-level

hearing protection devices, which safeguard a user from damaging his sense of hearing when subjected to severe acoustic shock events such as for instance gunfire or when exposure to excessive noise or sound levels for prolonged periods of time. Combinations of the mentioned devices such as for example hearing protection devices including a communication capability are also regarded as hearing devices in connection with the present invention.

Known hearing devices for providing a high output sound pressure level (SPL) into the ear canal of a user, such as for instance hearing aids classified as power, high power, or super power hearing devices for improving the hearing capability of users with a severe or profound hearing loss, are typically provided as behind-the-ear (BTE) type hearing devices. Such hearing devices comprise a BTE component shaped to fit behind an ear of a user and an ear mould shaped to fit at least partly into an ear canal of the user. The BTE component houses a receiver, i.e. a miniature loudspeaker, as well as electronic circuitry for amplifying the audio signal output by the receiver. The sound produced by the receiver is delivered to the ear mould via a flexible sound tube, which is connected to a rigid ear hook at one end and to an outer opening of the ear mould at the other end. The ear hook is attached to the BTE component and provides a sound passage from the receiver output into the sound tube. The ear hook usually features a flange over which the sound tube is pushed and thus secured. Very commonly a #13 standard sound tube with

an outer diameter of about 3 mm is employed. The described configuration is rather bulky and clearly visible when being worn. Many users find this to be aesthetically unattractive as well as annoying in terms of wearing comfort. Moreover, there is a high probability of sound leakage due to the many interfaces present in this arrangement, i.e. between (i) receiver spout and hook, (ii) hook and sound tube, and (iii) sound tube and ear mould, which results in a loss of the sound pressure level delivered into the ear canal and potentially leads to acoustic feedback, perceivable as a high pitched whistling noise.

Methods and means for attaching a sound tube to an ear mould of a hearing device are disclosed in EP 1 848 244 A2 and in EP 1 906 703 A1.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a less conspicuous power hearing device providing increased wearing comfort compared with presently known power hearing devices.

At least this object is achieved by providing a slim sound tube according to claim 1 for use with a power hearing device.

At least this object is achieved by the hearing device according to claim 4.

It is a further aim of the present invention to provide the proposed hearing device in such a way that it can be assembled according to the individual needs of a user.

At least this further aim is achieved by employing a kit of parts according to claim 11.

Moreover, it is yet a further goal of the present invention to provide a method for affixing a sound tube to an ear mould of a hearing device.

At least this further goal is achieved by the method according to claim 13.

Preferred embodiments are given in the dependent claims.

The present invention provides a sound tube for connecting a sound output port of a behind-the-ear component with a sound input port of an ear mould, wherein said sound tube has a preformed shape and comprises a first end section and a second end section, said first end section having an inner diameter in the range of 1.2 mm to 1.6 mm, preferably

in the range of 1.3 mm to 1.5 mm, more preferably of approximately 1.4 mm, and an outer diameter in the range of 1.7 mm to 2 mm, and said second end section having an outer diameter which is less than the outer diameter of said first end section.

In an embodiment the proposed sound tube has an outer diameter of approximately 1.9 mm, which is compatible with the inner diameter of a #13 standard sound tube.

As a consequence it is feasible to fit the proposed slim sound tube into a #13 standard sound tube. In this way it is possible to retrofit an existing ear mould fitted with a #13 standard sound tube with a slim sound tube by cutting off the existing #13 standard sound tube at the opening of the ear mould and then adhering, e.g. gluing the slim sound tube into the remaining piece of #13 standard tubing within the opening of the ear mould.

In a further embodiment the proposed sound tube is made of material which is pre-formable to a desired shape and which has a hardness in the range of 65 to 85 Shore D, preferably of approximately 72 Shore D. This makes the sound tube sufficiently rigid and stiff enough to withstand crippling or buckling when torque is applied as may be the case when the hearing device is being arranged at the ear. Furthermore, the sound tube can thus be shaped according to the individual needs of the user.

In a further embodiment the proposed sound tube is made of material selected from a group consisting of fluorinated ethylene propylene (FEP), nylon, polyether block amide (PEBA), silicone, polyurethane (PU), polytetrafluoroethylene (PTFE) or ethylvinylacetate (EVA). Such materials provide the desired rigidity and preformability.

The present invention further provides a hearing device with a sound tube according to the present invention and further comprising:

- a behind-the-ear component shaped to fit behind an ear of a user, wherein said behind-the-ear component features a sound output port and includes a receiver which is operationally connected to said sound output port; and
- an ear mould shaped to fit at least partly into an ear canal of the user, wherein said ear mould features a sound input port and a sound outlet;

wherein the sound tube connects said sound output port of said behind-the-ear component with said sound input port of said ear mould.

Such a hearing device with a slim sound tube is substantially smaller and thus less bulky that known solutions employing a hook along with a standard sound tube

having an outer diameters of about 3.0 mm. Hence a hearing device according to the present invention is less conspicuous and therefore aesthetically more pleasing. At the same time a hearing device according to the present invention is more comfortable to wear since the absence of an ear hook and the reduced thickness of the sound tube allows a less constraining arrangement of the hearing device at the ear which is less vulnerable to generating pressure points.

In a further embodiment of the proposed hearing device said behind-the-ear component includes a sound amplification means such that the hearing device is capable of providing an "HF average OSPL90" in the range of 139 dB SPL to 144 dB SPL and/or an "HF average full on gain" in the range of 75 dB to 85 dB, where the "HF average OSPL90" is defined as the high frequency (HF) average of the SSPL90, i.e. the average of the saturation sound pressure level (SSPL) produced by the hearing device with a 90 dB (SPL) input signal and the hearing device gain control in the full on position at 1000, 1600 and 2500 Hz, and the "HF average full on gain" is defined as the average of the full on gain values at 1000, 1600 and 2500 Hz. The proposed hearing device is therefore capable of providing a high gain and to deliver a high output sound pressure level (SPL) into the ear canal of a user. Hence, the proposed hearing device does not suffer a loss of output sound pressure level nor does it sacrifice bandwidth compared to known high power hearing devices.

In a further embodiment of the proposed hearing device a sound passage between said sound input port of said ear mould and said sound outlet of said ear mould has a diameter which increases from said sound input port towards said sound outlet, wherein this increase is gradual or stepwise. By flaring the inner diameter of the sound passage in this way the amount of high frequency gain is increased by up to 6 dB.

In a further embodiment of the proposed hearing device said sound passage in said ear mould is horn-shaped, preferably in the form of a Libby horn. This helps to provide a boost of the sound output in the frequency region around 4 kHz.

In a further embodiment of the proposed hearing device said sound passage in said ear mould has a length of at least 10 mm. This ensures the desired improvement of the high frequency response.

In a further embodiment of the proposed hearing device said the cross sectional area of said sound outlet of said ear mould is larger than the cross sectional area of the aperture of said sound tube, preferably twice as large as the cross sectional area of the aperture of said sound tube. With such a ratio of the output aperture to the input aperture a desirable augmentation in output sound pressure level for higher audio frequencies is attainable.

In a further embodiment of the proposed hearing device said second end section of said sound tube is arranged within and adhered, e.g. glued to said sound input port of said ear mould. In this way a firm connection is achieved between the sound tube and the ear mould.

In a further embodiment of the proposed hearing device said ear mould is selected from a group consisting of a custom ear mould and a universal ear tip. In this way the hearing device can be very individually tailored towards the needs of a specific user or be provided to a broad range of users using a more generic "one-size-fits-many" solution.

In a further embodiment of the proposed hearing device said ear mould seals the ear canal when it is inserted into the ear canal of the user. In this way the low frequency sound cannot escape the ear canal and feedback howling or squeaking/whistling can be prevented.

In a further embodiment of the proposed hearing device said ear mould comprises a vent. This increases the wearing comfort since ventilation of the inner part of the ear canal, which is sealed off from the exterior by the ear mould, as well as pressure equalisation with the exterior is provided in this way.

In a further embodiment of the proposed hearing device said behind-the-ear component includes a feedback reduction means. In this way feedback noises generated from leaking acoustic energy can be mitigated.

In a further embodiment of the proposed hearing device said behind-the-ear component further comprises a microphone for such applications as hearing aids, also referred to as hearing instruments or hearing prostheses.

In a further embodiment of the proposed hearing device said behind-the-ear component further comprises a wireless receiver unit for such applications as communication devices such as for instance a head set or earphone.

In a further aspect of the present invention a kit of parts is provided for assembling a hearing device, said kit of parts comprising a plurality of sound tubes according to the invention, wherein said sound tubes have different lengths, and/or are shaped to fit either behind a left or a right ear of the different users, and/or have different inner diameters, preferably in the range of 1.2 mm to 1.6 mm, more preferably in the range of 1.3 mm to 1.5 mm.

In a further embodiment the kit of parts further comprises at least one of the following:

- a behind-the-ear component shaped to fit behind an ear of different users, wherein said behind-the-ear component features a sound output port and includes a receiver which is operationally connected to said sound output port;
- a plurality of ear moulds shaped to fit at least partly into an ear canal of the different users, wherein said ear moulds each include a sound input port and a sound outlet, and wherein said ear moulds are selected from a group consisting of custom ear moulds and universal ear tips.

In a further embodiment of the kit of parts at least part of said plurality of ear moulds comprises a horn-shaped sound passage between said sound input port of said ear moulds and said sound outlet of said ear moulds, wherein said part of said plurality of ear moulds differ in the shape and dimensions of said sound passage.

In this way the hearing device according to the present invention can be optimally tailored to the individual needs of a user.

In another aspect of the present invention a method is provided for affixing a slim sound tube having a first end section and a second end section, wherein the outer diameter of said second end section is smaller than the outer diameter of said first end section, and wherein said

outer diameter of said second end section is preferably less than 2 mm, to an ear mould having a sound input port, comprising the steps of:

- applying an adhesive to said sound input port of said ear mould and/or to at least part of said second end section of said slim sound tube; and
- inserting said slim sound tube into said sound input port of said ear mould.

In an embodiment of the proposed method, wherein the ear mould is initially fitted with a #13 standard sound tube having an inner diameter of at least 1.9 mm being attached to said input sound port of said ear mould, comprising the further step of:

- cutting off said fitted #13 standard sound tube at said sound input port of said ear mould;

wherein instead of applying an adhesive to said sound input port of said ear mould:

- applying an adhesive to an inner portion of said #13 standard sound tube at said sound input port of said ear mould; and

wherein instead of inserting said slim sound tube into said sound input port of said ear mould:

- inserting said slim sound tube into said inner portion of said #13 standard sound tube at said sound input port of said ear mould.

In this way old, conventional hearing devices with an existing ear mould fitted with a #13 standard sound tube can be retrofitted or upgraded with a slim sound tube according to the present invention so as to obtain a less conspicuous power hearing device providing increased wearing comfort.

Overall, the present invention provides a power hearing device with greater user acceptance due to its improved cosmetic appearance and superior wearing comfort whilst providing the same level of acoustic performance as presently available more bulky solutions, thus leading to greater user acceptance.

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

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of facilitating the understanding of the present invention, exemplary embodiments thereof are illustrated in the accompanying drawings which are to be considered in connection with the following description. Thus, the present invention may be more readily

appreciated. What is shown in the figures is the following:

Fig. 1 depicts a hearing device according to the present invention with a custom ear mould;

Fig. 2 depicts a hearing device according to the present invention with a universal ear tip; and

Fig. 3 depicts an embodiment of a slim sound tube according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Prior art hearing devices comprise a behind-the-ear (BTE) component containing a receiver, an ear hook which is solidly attached to the BTE component, a standard sound tube and an ear mould. The BTE component together with the ear hook is shaped to be arranged behind the top of the pinna of a user, whereby the curvature of this unit is such that it rests and is held in place by the pinna of the user. The sound tube is pushed over a flange at the end of the ear hook such that it is securely connected with the ear hook. The ear mould is attached to the other end of the sound tube. The length of the sound tube is configured according to the size of the ear of the user such that it connects the BTE component resting behind the pinna with

the ear mould which is inserted at least partly into the ear canal without causing too much pressure on the ear of the user whilst providing a sufficient tension of the hearing device against the pinna to hold the hearing device stably in position.

Typically the following types of standard #13 sound tube are utilised (tubing inner/outer diameter sizes in mm):

- #13 Standard (1.9/2.95) - generally used
- #13 Medium (1.9/3.0) - more often used
- #13 Thick (1.9/3.3) - most often used
- #13 Extra Thick (1.9/3.6) - used with hearing devices for severe to profound hearing losses

Such a known hearing device is bulky and clearly visible when being worn.

Fig. 1 shows an exemplary hearing device according to the present invention. It comprises a BTE component 1, a nozzle 5 solidly attached to the BTE component 1, a slim sound tube 2 and an ear mould 3. The ear hook has been replaced by the nozzle 5 which has smaller dimensions compared to an ear hook. Such a nozzle 5 is disclosed in EP 1 443 802 A2 by the present applicant. Moreover a thinner sound tube 2 is employed than those used with known power hearing devices. It has an inner diameter in the range of 1.2 mm to 1.6 mm, preferably in the range of 1.3

mm to 1.5 mm, more preferably approximately 1.4 mm. Since a reduction of the sound tube diameter leads to an increase of acoustic impedance which has to be driven by the receiver in the BTE component 1, which results in a reduction in the amount of acoustic power that can be transferred through the thinner sound tube 2. This effect can be mitigated by utilising a horn-type structure (not shown in the Figs.) at the output of the sound tube 2, e.g. within the ear mould 3. Such a structure can provide a gradual or stepwise increase of diameter of the sound passage within the ear mould 3. This can for instance be in the form of a Libby horn.

The sound tube 2 can be affixed to the ear mould 3 by adhering, e.g. gluing it into the sound input port of the ear mould 3. For this an adhesive such as glue is applied to the sound input port of the ear mould 3 and/or to at least part of sound tube 2, and subsequently the sound tube 2 is inserted into the sound input port of the ear mould 3. In order to simplify the insertion of the sound tube 2 into the input port of the ear mould 3 the sound tube 2 features a tapering 6, e.g. its second end section 2.2, which is to be attached to the input port of the ear mould 3, has a smaller outer diameter than its first end section 2.1, which is to be connected to the nozzle 5. Excess length of the second end section 2.2 of the sound tube 2 is cut off.

An existing ear mould 3 fitted with a #13 standard sound tube can for instance be replaced by a slim sound tube 2

according to the present invention by cutting off the existing standard sound tube at the opening of the ear mould 3 and inserting a slim sound tube 2 having an outer diameter which is compatible with the inner diameter of the #13 standard sound tube, e.g. 1.9 mm, and affixing it at the opening of the #13 standard sound tube by means of adhering, e.g. gluing. In this way a simple and cheap way is provided for retrofitting or upgrading existing ear moulds 3 fitted with a standard tube.

Different kinds of ear moulds can be employed as depicted in Figs. 1 & 2. Fig. 1 shows a custom ear mould 3 specifically designed to meet the individual needs of a certain user, whereas Fig. 2 illustrates a universal ear tip 3', which fits into the ear canal of a multitude of users.

Fig. 3 illustrates a slim sound tube 2 according to the present invention which exhibits tapering 6 of the outer diameter such that the first end section 2.1 of the sound tube 2 connected to the nozzle 5 has a larger diameter than the second end section 2.2 of the sound tube 2 connected to the input sound port of the ear mould. This makes it easier to insert the second end section 2.2 of the sound tube 2 into the opening of the ear mould whilst retaining the necessary rigidity of the sound tube 2 along its first end section 2.1.

Slim sound tubes 2 of different lengths can be provided to the hearing device dispenser so that varying ear sizes of the users can be accommodated. The slim sound tubes 2 are preformed to have a shape that is adapted for arrangement at the left and right ears of the users.

The acoustic performance of a power hearing device according to the present invention is not compromised compared with that of prior art solutions, despite the fact that a thinner sound tube is being utilised.

Furthermore, a hearing device according to the present invention is far less conspicuous and cosmetically more attractive that prior art power hearing devices.

CLAIMS

1. A sound tube (2) for connecting a sound output port of a behind-the-ear component (1) with a sound input port of an ear mould (3, 3'), characterized in that said sound tube (2) has a preformed shape and comprises a first end section (2.1) and a second end section (2.2), said first end section (2.1) having an inner diameter in the range of 1.2 mm to 1.6 mm, preferably in the range of 1.3 mm to 1.5 mm, more preferably of approximately 1.4 mm, and an outer diameter in the range of 1.7 mm to 2 mm, and said second end section (2.2) having an outer diameter which is less than the outer diameter of said first end section (2.1).

2. The sound tube (2) of claim 1, wherein said sound tube (2) is made of material which is pre-formable to a desired shape and which has a hardness in the range of 65 to 85 Shore D, preferably of approximately 72 Shore D.

3. The sound tube (2) of claim 2, wherein said material is selected from a group consisting of fluorinated ethylene propylene (FEP), nylon, polyether block amide (PEBA), silicone, polyurethane (PU), polytetrafluoroethylene (PTFE) or ethylvinylacetate (EVA).

4. A hearing device with a sound tube according to one of the preceding claims and further comprising:

- a behind-the-ear component (1) shaped to fit behind an ear of a user, wherein said behind-the-ear component (1) features a sound output port and includes a receiver which is operationally connected to said sound output port; and
- an ear mould (3, 3') shaped to fit at least partly into an ear canal of the user, wherein said ear mould (3, 3') features a sound input port and a sound outlet (4);

wherein the sound tube (2) connects said sound output port of said behind-the-ear component (1) with said sound input port of said ear mould (3, 3').

5. The hearing device of claim 4, wherein said behind-the-ear component (1) includes a sound amplification means such that the hearing device is capable of providing an HF average OSPL90 in the range of 139 dB SPL to 144 dB SPL and/or an HF average full on gain in the range of 75 dB to 85 dB.

6. The hearing device of claim 4 or 5, wherein a sound passage between said sound input port of said ear mould (3, 3') and said sound outlet (4) of said ear mould (3, 3') has a diameter which increases from said sound input port towards said sound outlet (4), wherein this increase is gradual or stepwise.

7. The hearing device of claim 6, wherein said sound passage in said ear mould (3, 3′) is horn-shaped, preferably in the form of a Libby horn.

8. The hearing device of one of the claims 4 to 7, wherein the cross sectional area of said sound outlet (4) of said ear mould (3, 3′) is larger than the cross sectional area of the aperture of said sound tube (2), preferably twice as large.

9. The hearing device of one of the claims 4 to 8, wherein said second end section (2.2) of said sound tube (2) is arranged within and adhered to said sound input port of said ear mould (3, 3′).

10. The hearing device of one of the claims 4 to 9, wherein said ear mould (3, 3′) is selected from a group consisting of a custom ear mould (3) and a universal ear tip (3′).

11. A kit of parts for assembling a hearing device, said kit of parts comprising a plurality of sound tubes (2) according to one of the claims 1 to 3, wherein said sound tubes (2) have different lengths, and/or are shaped to fit either behind a left or a right ear of the different users, and/or have different inner diameters, preferably in the range of 1.2 mm to 1.6 mm, more preferably in the range of 1.3 mm to 1.5 mm.

12. The kit of parts according to claim 11, further comprising at least one of the following:

- a behind-the-ear component (1) shaped to fit behind an ear of different users, wherein said behind-the-ear component (1) features a sound output port and includes a receiver which is operationally connected to said sound output port;

- a plurality of ear moulds (3, 3') shaped to fit at least partly into an ear canal of the different users, wherein said ear moulds (3, 3') each include a sound input port and a sound outlet (4), and wherein said ear moulds (3, 3') are selected from a group consisting of custom ear moulds (3) and universal ear tips (3').

13. A method for affixing a slim sound tube (2) having a first end section (2.1) and a second end section (2.2), wherein the outer diameter of said second end section (2.2) is smaller than the outer diameter of said first end section (2.1), and wherein said outer diameter of said second end section (2.2) is preferably less than 2 mm, to an ear mould (3, 3') having a sound input port, comprising the steps of:

- applying an adhesive to said sound input port of said ear mould (3, 3') and/or to at least part of said second end section (2.2) of said slim sound tube (2); and

- inserting said slim sound tube (2) into said sound input port of said ear mould (3, 3').

14. The method of claim 13, wherein the ear mould (3, 3') is initially fitted with a #13 standard sound tube having an inner diameter of at least 1.9 mm being attached to said input sound port of said ear mould (3, 3'), comprising the further step of:

- cutting off said fitted #13 standard sound tube at said sound input port of said ear mould (3, 3');

wherein instead of applying an adhesive to said sound input port of said ear mould (3, 3'):

- applying an adhesive to an inner portion of said #13 standard sound tube at said sound input port of said ear mould (3, 3'); and

wherein instead of inserting said slim sound tube (2) into said sound input port of said ear mould (3, 3'):

- inserting said slim sound tube (2) into said inner portion of said #13 standard sound tube at said sound input port of said ear mould (3, 3').

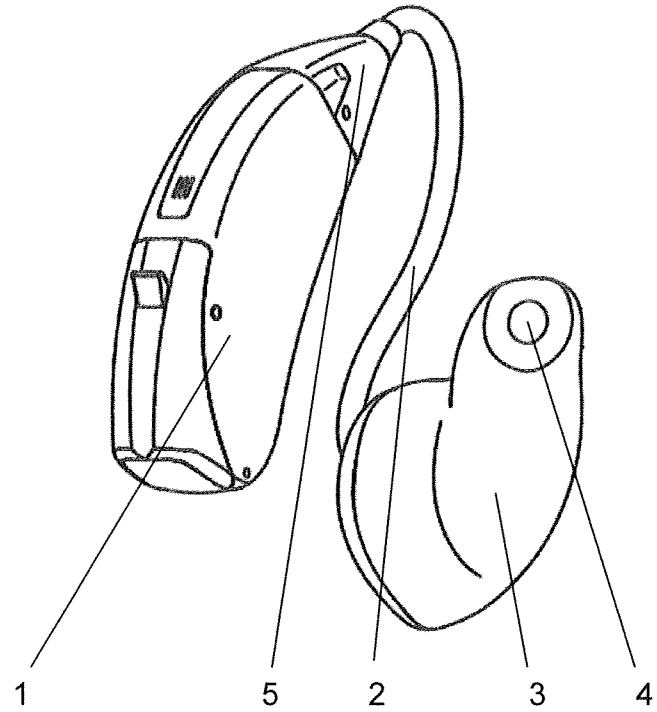

Fig. 1

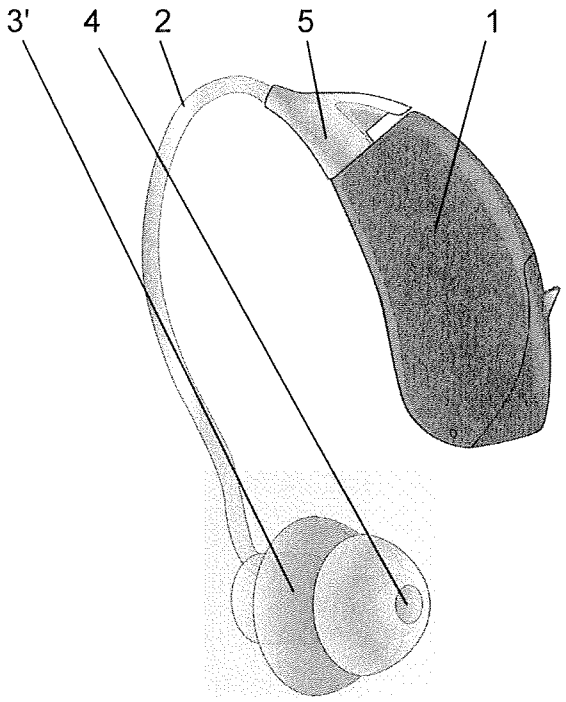

Fig. 2

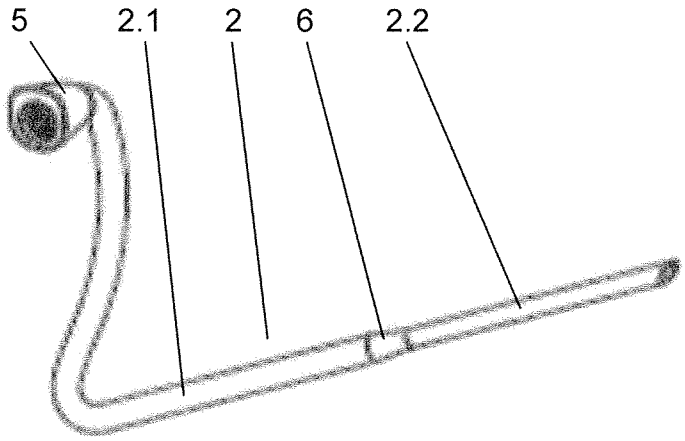

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/054939

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/00
ADD. H04R1/10

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

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
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.
Y	WO 2009/100559 A2 (PHONAK AG [CH]; STIRNEMANN ALFRED [CH]) 20 August 2009 (2009-08-20) page 1, line 1 - page 6, line 11 page 7, line 3 - page 10, line 17	1-14
Y	US 2007/253586 A1 (FICKWEILER WEMER [DE] ET AL) 1 November 2007 (2007-11-01) paragraph [0002] - paragraph [0017] paragraph [0021] - paragraph [0027]	1-14
Y	US 2008/089542 A1 (BRUMBACK MARK A [US] ET AL) 17 April 2008 (2008-04-17) paragraph [0001] - paragraph [0001] paragraph [0030]	1-14

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

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2011	30/05/2011

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 031 219 A (WARD GARY L [US] ET AL) 9 July 1991 (1991-07-09) column 1, line 5 - column 3, line 57 column 4, line 12 - column 6, line 38 -----	1-14

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Information on patent family members

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