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(54) **Title:** METHOD FOR MANUFACTURING A HEARING DEVICE AS WELL AS A HEARING DEVICE

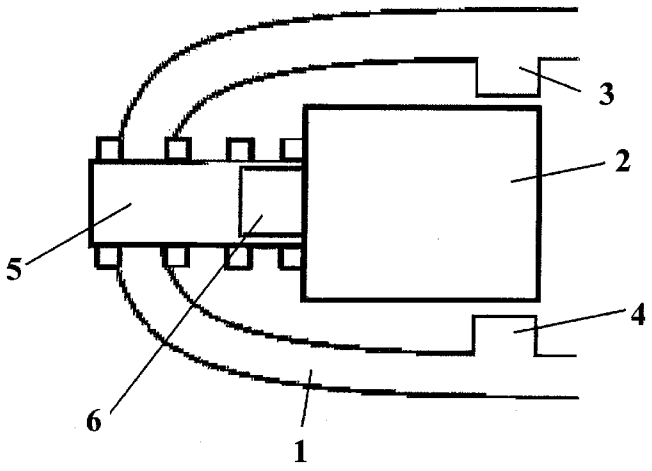

Fig. 1

(57) **Abstract:** A method for manufacturing a hearing device at least comprising one acoustic transducer (2) in a housing (1), the method comprising the steps of selecting the at least one acoustic transducer (2) to be inserted into the housing (1), determining a vibration pattern of the at least one acoustic transducer (2), introducing the at least one acoustic transducer (2) into the housing (1), and positioning the at least one acoustic transducer (2) in dependence on the vibration pattern. Furthermore, a hearing device is specified.

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Method for manufacturing a hearing device as well as a hearing device

The present invention is related to a method for manufacturing a hearing device according to the pre-amble of claim 1 as well as to a hearing device.

In US-6 879 697, a method is disclosed for manufacturing of a hearing aid housing comprising a face plate and a shell that is individually matched to the shape of the auditory canal of a user. Although special care has been taken when suspending the receiver in the shell, there is still significant transmission of mechanical vibrations generated by the receiver, which vibrations are transmitted to the shell of the hearing aid. It has been found that the microphone mounted on the face plate picks up these vibrations resulting in feedback, in particular when a rather high gain is applied in the hearing aid.

It is therefore one object of the present invention to provide a method for manufacturing a hearing device that does not incorporate the above-mentioned disadvantages.

This and other objects are accomplished by the measures specified in the characterizing part of claim 1. Further embodiments of the present invention as well as a hearing device are specified in further claims.

The present invention is firstly directed to a method for manufacturing a hearing device at least comprising one acoustic transducer in a housing. The method according to the present invention comprises the steps of:

- selecting the at least one acoustic transducer to be inserted into the housing,
- determining a vibration pattern of the at least one acoustic transducer,
- introducing the at least one acoustic transducer into the housing,
- positioning the at least one acoustic transducer within the housing in dependence on the vibration pattern.

The present invention has the advantage that the transmission of vibrations are dramatically reduced, if the connecting points between the acoustic transducer and the housing are limited to low vibrating areas.

In an embodiment of the method according to the present invention, the step of positioning the at least one acoustic transducer is performed by fixing the at least one acoustic transducer at positions, at which the vibration pattern is minimal.

Thereby, optimal results are obtained if the connecting points are arranged at the minimum vibration areas.

In a further embodiment of the present invention, the method further comprises the step of providing supporting

elements inside the housing for fixing the at least one acoustic transducer at positions, at which the vibration pattern is minimal.

Supporting elements can be placed in the design step of the shell taking into account the vibration pattern.

In a further embodiment of the present invention, the method further comprises the step of limiting contacts of the supporting elements to low vibrating areas of the at least one acoustic transducer.

In a still further embodiment of the present invention, the method further comprises the step of providing a transducer pocket in the housing for holding the at least one acoustic transducer.

Providing a transducer pocket is in particular advantageous when a standard acoustic transducer is inserted in the housing because the transducer pocket can be fixed at arbitrary positions to the housing while the transducer pocket is already adapted to the individual vibration pattern. Therefore, the insertion or positioning of the acoustic transducer can be performed very quickly.

In a still further embodiment of the present invention, the pocket is designed for holding standardized acoustic transducers.

In a still further embodiment of the present invention, the supporting elements are made of rubber or silicon.

This material can be stretched and is able to damp residual vibrations still present at the suspension position.

Furthermore, in a more specific embodiment, the at least one acoustic transducer can be applied to a microphone or a receiver. In addition, it is also feasible to apply the above-mentioned steps to both components, namely to the microphone as well as to the receiver.

Finally, further embodiments of the present invention are characterized in that the housing is a shell that is matched to an auditory canal of a hearing device user.

Secondly, the present invention is directed to a hearing device that comprises at least one acoustic transducer contained in a housing, wherein contact points are provided between the housing and the acoustic transducer for holding the acoustic transducer in its position. According to the present invention, the contact points are arranged at minimum vibration areas of the acoustic transducer, the minimum vibration areas having been determined via a vibration pattern of the acoustic transducer.

In an embodiment of the hearing device according to the present invention, the supporting elements are arranged at the contact points, the supporting elements being a part of the housing.

In further embodiments of the hearing device according to the present invention, a transducer pocket is provided to hold the acoustic transducer in its position in the housing.

In still further embodiments of the hearing device according to the present invention, the supporting elements are made of silicon or rubber.

Furthermore, in more specific embodiments of the hearing device according to the present invention, the at least one acoustic transducer is one or a combination of both of the following components:

- microphone;
- receiver.

Finally, in still more specific embodiments of the hearing device according to the present invention, an outer surface of the housing is matched to an auditory canal of a user.

The present invention is further explained in more detail by referring to drawings illustrating exemplified embodiments of the present invention.

Fig. 1 schematically shows a cross-section of a part of a first embodiment of an inventive hearing device comprising a receiver,

Fig. 2 schematically shows a cross-section of another part of an embodiment of an inventive hearing device comprising supporting elements for a microphone, and

Fig. 3 schematically shows a cross-section of the same part of an inventive hearing device, but with other supporting elements for the microphone.

The present invention is directed to a method for manufacturing a hearing device. A part of the hearing device, namely the tip pointing to the inner ear while the hearing device is inserted into a user's ear, is depicted in Fig. 1, which shows a shell 1 matched to the auditory canal of the hearing device user. Within the shell 1, an acoustic transducer 2, such as a receiver, is contained having a nipple 6 that is operatively connected to an outlet 5 extending through the shell 1. Furthermore, supporting elements 3 and 4 in the form of protrusions are provided in the shell 1 in order to prevent the acoustic transducer 2 from moving within the shell 1. According to the present invention, the positioning of the supporting elements 3 and 4 are chosen in such a manner that a transmission of vibrations from the shell 1 to the acoustic transducer 2 - and vice versa - is minimal. Therefore, a vibration pattern of the acoustic transducer 2 is determined. Once the vibration pattern of the acoustic transducer 2 is determined, the acoustic transducer 2 is positioned in the shell 1 in such a manner that mechanical connections between the shell 1 and the acoustic transducer

2 are limited to areas, in which no or only little vibration is expected. By positioning the acoustic transducer 2 at positions, at which the vibration pattern is minimal, the advantage is obtained that vibrations are not transmitted, or the transmission of vibration is at least reduced, resulting in an improved feedback behavior of the hearing device. In fact, it has been shown that a 15 dB improvement of vibrations has been obtained compared to known hearing devices, i.e. vibrations could have been considerably reduced so that higher gain are now possible without provoking feedback in the hearing device.

In an embodiment of the present invention, the inner cavity of the shell 1 is modified in order to provide a transducer pocket, in which the acoustic transducer 2 is supported and suspended at specific location. The present invention proposes a limited connection between the shell 1 and the acoustic transducer 2 based on the vibration pattern. The connections are reduced to the outlet 5 and to some contact points (supporting elements 3, 4; protrusions) positioned at the low vibrating area of the acoustic transducer 2.

In a further embodiment of the present invention, the supporting elements 3 and 4, or suspension points, are made of rubber or silicone to reduce the vibration transmission. The present invention comprises an intelligent placement of the transducer pocket for a minimal vibration transmission (according to the vibration pattern of the receiver) and for an easy insertion of the acoustic transducer in the shell 1 (insertion path verification).

Fig. 2 schematically shows a cross-section of another embodiment of an inventive hearing device. A transducer is again being referred to by reference sign 2 indicating a microphone, for example, arranged to pick-up sound entering via an opening 10 in the shell 1. The transducer 2 is again supported by supporting elements 7, 8 and 9. As for the embodiment according to Fig. 1, the positioning of the supporting elements 7, 8, 9 depicted in Fig. 2 are also chosen in such a manner that a transmission of vibrations from the shell 1 to the acoustic transducer 2 - and vice versa - is minimal. Therefore, a vibration pattern of the acoustic transducer 2 - here the microphone - is determined. Once the vibration pattern of the acoustic transducer 2 is known, the acoustic transducer 2 is positioned in the shell 1 in such a manner that mechanical connections between the shell 1 and the acoustic transducer 2 are limited to areas, in which no or only little vibration is expected.

Fig. 3 shows the same section as in Fig. 2, but with a supporting element 7 which is different to the one shown in Fig. 2. In the embodiment of Fig. 3, the supporting element 7 encloses the transducer 2 at an end section which is positioned opposite to the opening 10 in the shell 1. Therewith, a so called transducer pocket is provided which prevents the transducer 2 from moving within the shell 1.

While the embodiment of Fig. 1 shows a receiver as transducer 2 being supported according to the present

invention, and while the embodiment of Figs. 2 and 3 show a microphone as transducer 2, a further embodiment of the present invention is directed to a combination of the two embodiments described in connection with Figs. 1 to 3. In fact, an overall improvement results by supporting all transducers that are present within a hearing device housing. Therewith, all transducers 2 being susceptible to acoustic inferences contribute to the improved feedback behavior resulting in a particularly advantageous hearing device.

Furthermore, and apart from the embodiments described so fare, the present invention is not limited to be applied to an ITE-(in-the-ear) or ITC-(in-the-canal) hearing device but can also very well be applied to a so called BTE-(behind-the-ear) hearing device. In fact, the present invention can very well be applied to any type of hearing device housing.

Claims:

1. A method for manufacturing a hearing device at least comprising one acoustic transducer (2) in a housing (1), the method comprising the steps of:

- selecting the at least one acoustic transducer (2) to be inserted into the housing (1),

characterized by

- determining a vibration pattern of the at least one acoustic transducer (2),
- introducing the at least one acoustic transducer (2) into the housing (1),
- positioning the at least one acoustic transducer (2) within the housing (1) in dependence on the vibration pattern.

2. The method according to claim 1, characterized in that the step of positioning the at least one acoustic transducer (2) is performed by fixing the at least one acoustic transducer (2) at positions, at which the vibration pattern is minimal.

3. The method according to claim 1 or 2, characterized by providing supporting elements (3, 4) inside the housing (1) for fixing the at least one acoustic transducer (2) at positions, at which the vibration pattern has a minimum.

4. The method according to claim 3, characterized by limiting contacts of the supporting elements (3, 4) to low

vibrating areas of the at least one acoustic transducer (2).

5. The method according to one of the claims 1 to 4, characterized by providing a transducer pocket in the housing (1) for holding the at least one acoustic transducer (2).

6. The method according to claim 5, characterized in that the transducer pocket being designed for holding standardized acoustic transducers (2).

7. The method according to one of the claims 3 to 6, characterized in that the supporting elements (3, 4) are made of rubber or silicon.

8. The method according to one of the claims 1 to 7, characterized in that the at least one acoustic transducer (2) is one or a combination of both of the following components:

- microphone;
- receiver.

9. The method of one of the claims 1 to 8, characterized in that the housing (1) is a shell that is matched to an auditory canal of a user.

10. A hearing device comprising at least one acoustic transducer (2) contained in a housing (1), wherein contact points are provided between the housing (1) and the

acoustic transducer (2) for holding the acoustic transducer (2) in its position, characterized in that the contact points are arranged at minimum vibration areas of the acoustic transducer (2), the minimum vibration areas having been determined via a vibration pattern of the acoustic transducer (2).

11. The hearing device of claim 10, characterized in that the supporting elements (3, 4) are arranged at the contact points, the supporting elements (3, 4) being a part of the housing (1).

12. The hearing device of claim 10 or 11, characterized in that a transducer pocket is provided to hold the acoustic transducer (2) in its position in the housing (1).

13. The hearing device of one of the claims 10 to 12, characterized in that the supporting elements (3, 4) are made of silicon or rubber.

14. The hearing device of one of the claims 10 to 13, characterized in that the at least one acoustic transducer (2) is one or a combination of both of the following components:

- microphone;
- receiver.

15. The hearing device of one of the claims 10 to 14, characterized in that an outer surface of the housing (1) is matched to an auditory canal of a user.

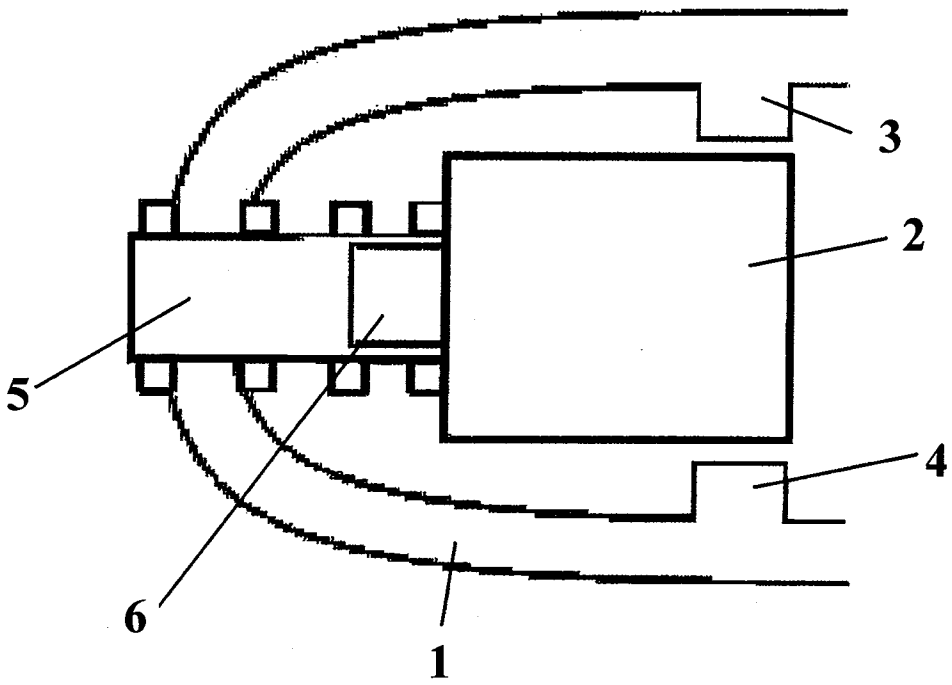

Fig. 1

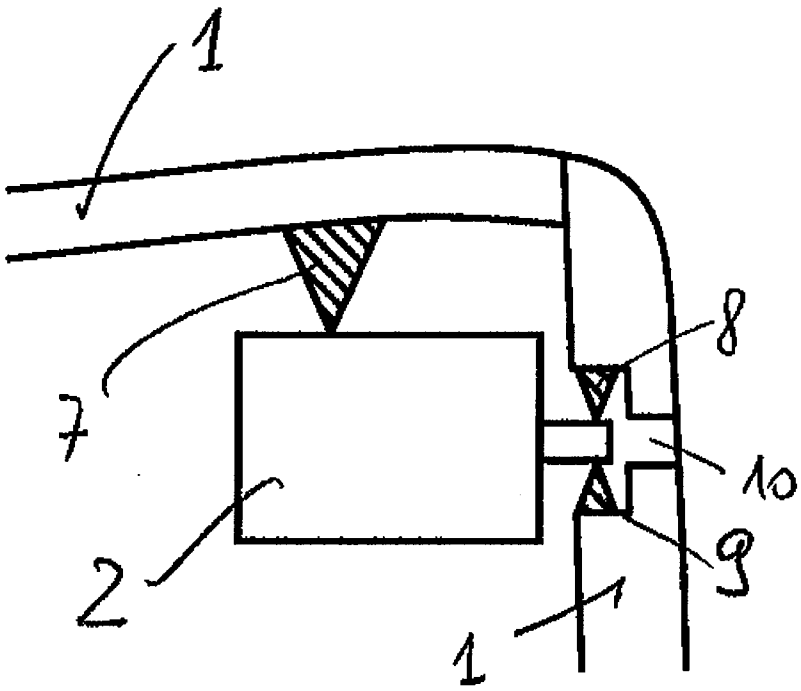

Fig. 2

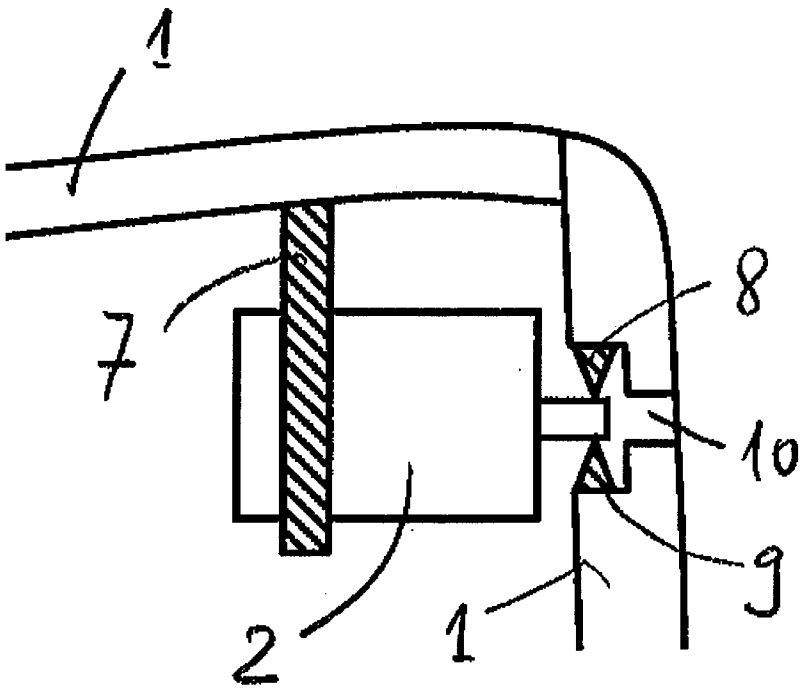

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/050574

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/00

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 440 982 A (KAANDERS JOHANNES M G M [NL] ET AL) 3 April 1984 (1984-04-03) figure 1 column 1, line 63 - column 2, line 9 column 3, line 20 - line 29	1-15
X	US 2002/146141 A1 (GESCHIERE ONNO [NL] ET AL) 10 October 2002 (2002-10-10) figures 1-4,10 paragraph [0029] paragraph [0032] - paragraph [0034] paragraphs [0046], [0047]	1-3,5-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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