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(54) **Receiver module for a hearing device, hearing device and hearing device earpiece**

(57) The present invention refers to a receiver module (21 T) of a hearing device (10). The receiver module is adapted for insertion into a canal element (22) of the hearing device which further comprises a circuit module (11). The canal element is to be arranged in a user's ear canal and defines a closed portion of the user's ear canal between the canal element and the user's eardrum. The receiver module comprises a sensor (50) arranged at a distal end (25) of the receiver module for sensing acoustical conditions (sound signals) in the closed portion of the user's ear canal and generating corresponding detection signals which are subject to a predetermined processing by said circuit module, a connector (12) for communicating said detection signals to said circuit module, and fastening elements (24, 27) for removably fixing said receiver module in said canal element.

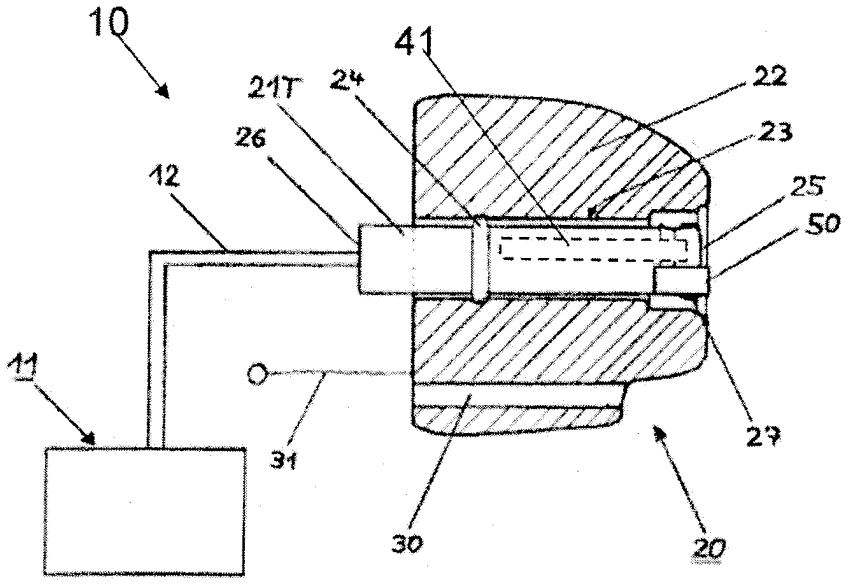

Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention refers to a receiver module for a hearing device, to a hearing device, such as a behind-the-ear (BTE) hearing aid, or a receiver-in-the-ear (RITE) being equipped with the receiver module and to an earpiece of a hearing device comprising the receiver module.

BACKGROUND OF THE INVENTION

[0002] A conventional hearing device or hearing aid which is, for example, disclosed in document US 2005/0244026, comprises a flexible earpiece to be inserted into the outer part of the ear canal of a user for wearing the hearing aid, and the flexible earpiece is connected to a BTE device through a connecting tubular element. The flexible earpiece may comprise a receiver, i.e. a hearing aid speaker, which is mounted on the earpiece so as to inject sound into the user's ear canal (receiver-in-the-ear (RITE) hearing aid) as well as a vent. In case the BTE element of the hearing aid comprises the receiver, the sound is injected into the tubular connector communicating the sound to the earpiece arranged in the user's ear canal.

[0003] Furthermore, document US 5 606 621 discloses a hybrid BTE and a CIC (completely-in-the-canal) hearing aid, wherein the earpiece is implemented as a CIC element and placed into the user's ear canal in such a manner so as to touch the bony region of the ear canal. By inserting the CIC element deep into the bony region of the ear canal occlusion effect may be avoided while a high gain still can be maintained since sound communicated through the tissue into the ear canal (instead of from ear opening) may freely escape the ear canal.

[0004] Moreover, reference US 2004/0010181 discloses a further hybrid BTE/CIC hearing aid which comprises a connector for communicating the process sound signals from BTE element to a speaker in the CIC part. The connector is detachably connected to either the BTE or CIC part and is designed to be inserted into the ear canal so deep as to touch the bony part of the ear canal. The connector therefore must be sufficiently rigid to allow the connector to be used to insert and remove the CIC element from the ear canal of the user.

[0005] A hearing aid having the receiver being arranged in the ear (RITE hearing aid) is known for good sound quality since a receiver tube for carrying the sound from a receiver behind the ear and into the ear canal is not necessary. In the RITE hearing aid,only an electric wiring is used for communicating electrical signals representing the sound signals which are picked up by the microphone to the receiver module, which isinserted into the ear canal of the user.

[0006] According to a further development, a RITE hearing aid has only one microphone for picking up sound signals surrounding the user and this microphone is located at the receiver module, that is, the microphone is arranged in the user's ear canal.In this way the microphone will point outwards from the ear canal in order to pick up the sound signals from the outside. The advantage is to preserve natural directional cues due to the microphone position at the natural sound entrance of the ear canal. Only one microphone is used and therefore the usual subtractive directionality provided from two omni-directional microphones is not to be used, and this has advantages such as reduced microphone noise. Instead, spatial cues will help people having mild hearing loss in getting better speech understanding.

[0007] To obtain an optimized sound processing with the RITE hearing device, an adaptation to the acoustical conditions of the user's ear canal is required. This will facilitate the achievement of an acoustical impression for the user, wearing the hearing device, which is as natural as possible while compensating the user's hearing loss.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a receiver module of a hearing device, a corresponding hearing device equipped with such a receiver module as well as an earpiece of a hearing device comprising the receiver module which ensures a proper setting of the hearing device according to acoustical conditions which are specific to the users ear canal.

[0009] According to the present invention, this object is accomplished by a receiver module for a hearing device, by a hearing device using the receiver module and an earpiece of a hearing device using the receiver module as set out in the appended claims.

[0010] The present invention concerns a receiver module of a hearing device. The receiver module is adapted for insertion into a canal element. The assembly of receiver module and canal element is placeable in a user's ear canal. The hearing device further comprises a circuit module which is electrically connected to the receiver module by a connector. When the canal element is placed in a user's ear canal, a closed portion of the user's ear canal is defined between the ear drum and a distal part of the canal element.

[0011] The receiver module comprises a distal end exposed to the closed portion of the user's ear canal and a sensor is arranged at the receiver module and the sensor is adapted for sensing acoustical conditions, such as sound pressure in the closed portion of the user's ear canal and for generating corresponding electrical signals. Further, the connector for communicating the electrical signals to the circuit module is established, such that the processing of the signals may be performed in the circuit module. Fastening elements adapted for removably fixing the receiver module in the canal element are also provided.

[0012] Hence, the specific receiver module facilitates a proper setting and calibration of the hearing device,

since on the one hand the sensor is provided at the receiver module and adapted to be exposed to the user's ear canal and on the other hand a mechanical structure of the receiver module is provided which allows an easy replacement of an ordinary receiver module for regular daily use with the specific receiver module for measuring and calibration. The easy replacement of the two receiver modules: the one for regular daily use, and the one for calibration purposes, is possible as they have basically the same size and almost the same acoustical and mechanical properties. This leads to a time-saving testing and setting (calibration) process of the hearing device. and the user can be sure that the setting of the hearing device is made the best way based on the real (natural) sound situation in the ear canal.

[0013] The fastening elements of the receiver module may be adapted for engagement with a snapping element of the canal element. The snapping element allows the placement of the receiver modules in a secure manner in the canal element, and further the snapping element leaves the hearing care professional in no doubt that the receiver module and the canal element are correctly positioned in relation to each other.

[0014] The fastening elements of the receiver module may further be adapted for engagement with a canal element comprising compliant parts of a flexible dome. Such a compliant part may comprise hollow pipe part arranged centrally of dome elements made of flexible material. The fastening elements may be shaped as circumferential beads on the receiver module placed close to the distal and the proximal end thereof, such that the pipe element is to fit in between the beads.

[0015] Furthermore, the detection signals obtained by the sensor may include measurement signals to be used for calibration or testing of the hearing device. The sensor may be adapted to detect the sound pressure level in the closed portion of the user's ear reflecting the acoustical conditions while the receiver provides a measurements signal such as a tone sweep or similar. Also the measurements signals may be obtained during exposure to sounds externally of the ear canal.

[0016] The receiver module may be adapted for longitudinally extending in an axial opening of the canal element. An axial length of the receiver module may be larger than an axial length of the opening in the canal element, and the receiver module may further comprise a proximal end at which the connector is arranged.

[0017] The fastening elements may be arranged at a distal end of the receiver module which is to be exposed to the closed portion of the user's ear canal during use and the snapping element may be at least partly arranged in the opening of the canal element for engagement with the fastening elements of the receiver module. An advantage of having the snapping elements provided in the opening is that a visual inspection becomes possible, such that the hearing care professional or the user of the hearing aid may se if the receiver module is correctly placed. Also the snapping element may be provided as a separate element which is insertable into the opening to cause interlocking between the canal element and the receiver module.

[0018] In an embodiment the sensor is adapted to detect the sound pressure level in the closed portion of the user's ear reflecting said acoustical conditions whereby a sound canal from the sensor to the place of detection is provided. In this manner the sensor may be located at any point at the receiver module between its distal and its proximal end. Also the sound canal may extend as a tube past the distal portion of the canal element and into the ear canal of the user in case the sound pressure at some point off set from the distal portion of the canal element is required.

[0019] According to an aspect, the present invention refers to a hearing device which comprises an earpiece including a canal element to be arranged in a user's ear canal whereby a closed portion of the user's ear canal is defined, and a receiver module adapted for insertion in the canal element, the receiver module including a distal end exposed to the closed portion of the user's ear canal and a sensor arranged at the receiver module and being adapted for sensing acoustical conditions in the closed portion of the user's ear canal and generating corresponding electrical signals, a circuit module arranged outside the user's ear canal adapted for performing processing of the detected signals, and a connector adapted for at least communicating the detected signals of the sensor to the circuit module, wherein the receiver module further includes fastening elements adapted for removably fixing the receiver module to the canal element.

[0020] Furthermore, the sensor may be adapted to detect a sound pressure level in the closed portion of the user's ear, and the circuit module may be adapted for performing a calibration of the hearing device on the basis of at least the sound pressure level detected in the closed portion of the user's ear.

[0021] The fastening elements may be arranged at the distal end of the receiver module exposed to the closed portion of the user's ear canal, and the snapping element may at least partly be arranged in the opening of the canal element for engagement with the fastening element of the receiver module. The snapping means may be an integral part of the canal element, or the snapping means may be separately mounted in the canal element at the distal end of the receiver module.

[0022] According to a third aspect, the present invention refers to a hearing device earpiece for connecting to a circuit module to constitute a hearing device, the earpiece comprising the above receiver module.

[0023] The advantages obtained by the second and third aspects of the present invention are the same as those of the first aspect.

[0024] The foregoing and other objects, features and advantages of the present invention will become more apparent from the following detailed description in conjunction with the appended drawings referring to embod-

iments and developments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The drawings according to the present invention show in

Fig. 1 an overall and partly cross-sectional view of a hearing device according to an embodiment of the present invention,

Fig: 2 an overall and partly cross-sectional view of a hearing device including a modified receiver module,

Fig. 3 an overall and partly cross-sectional view of a canal element with and every day receiver module along with a frontal view of same,

Fig. 4 an overall and partly cross-sectional view of a canal element with a measuring receiver module along with a frontal view of same.

Fig 5 ???

DETAILED DESCRIPTION OF EMBODIMENTS

[0026] The present invention is described in the following in conjunction with the schematic diagrams of Fig. 1 and Fig. 2.

[0027] As is shown in Fig. 1, the hearing device 10 comprises a circuit module 11 which is provided in the form of a BTE unit and which includes circuitry for data processing based on the sound signals picked up by a microphone. The processing may include running predetermined programs to provide in a controlled manner an amplification of the sound signals for compensation of the user's hearing loss. From the circuitry an output electrical signal will then be provided which is served at the receiver in the user's ear, where the electrical signal is converted into sound signals for the user to hear. The circuit module 11 may comprise a microcomputer or a microprocessor.

[0028] The circuit module 11 is located outside the user's ear canal and may be arranged behind the ear of the user (BTE hearing aid) and may include a battery as power source.

[0029] The electrical signals resulting from the sign processing in circuit module 11 are communicated, via a connector 12, to an earpiece 20 and in particular to an output module or receiver module 21 forming part of the earpiece 20. The earpiece 20 in conjunction with the receiver module 21 is adapted for insertion into an ear canal of a user. The receiver module 21 of the earpiece 20 is adapted for converting the processed electrical signals back into acoustic signals or sound pressure, thereby allowing the user wearing the hearing aid to hear. The receiver module 21 comprises to this end a speaker or an output transducer also termed "a receiver" 41. The earpiece 20 is arranged in the user's ear canal so that the acoustic signals or sound pressure resulting fro the reproduced electrical signals are radiated into the user's ear canal towards the user's eardrum.

[0030] The earpiece 20 further comprises a main body in the form of a canal element 22 which is to be inserted into the outer part of the ear canal of the user of the hearing device 10. The canal element 22 of the earpiece 20 is preferably molded to fit the ear canal of the user, or as described below comprise a flexible domed structure adaptable to the user's ear canal. The canal element 22 in fig. 1 and fig. 2 comprises an opening 23, such as a bore running completely through the canal element 22, and the receiver module 21 is for normal operation of the hearing device 10 inserted into the opening 23 of the canal element 22. The receiver module 21 may advantageously comprise a fastening element or fixing element 24 which may be provided in the form of an O-ring for obtaining a tight fit of the receiver module 21 in the opening 23 of the canal element 22. The O-ring of this embodiment also serves to ensure sound tight fit between the canal element and the receiver module.

[0031] Moreover, the receiver module 21 is preferably partly and basically of a cylindrical shape, and the opening 23 in the canal element 22 may correspondingly have a circular cross-sectional area.

[0032] The basical cylindrical shape of the receiver module 21 and the opening 23 of the canal element 22 having a circular cross-sectional area allows the receiver module 21 to be rotatably moved in the opening 23 of the canal element 22 when accommodated therein. If this is not required, or considered undesirable, non-circular cross sectional area may be chosen.

[0033] The receiver module 21 comprises a distal surface or distal end 25 which faces towards the inner portion of the user's ear canal and the user's eardrum, when the earpiece 20 is inserted into the ear canal, as well as a proximal surface or proximal end 26 which faces towards the outside portion of the user's ear canal. The connector 12 basically including an electric wiring is mounted or connected to the receiving module 21 at or close to the proximal surface 26.

[0034] Moreover, the receiver module 21 comprises a circumferential ridge section 27 which is arranged near the distal end 25 and which is adapted to snap into engagement with a snapping element 28, thereby maintaining the receiving module 21 in the canal element 22 of the earpiece 20 in an axially fixed position within the opening 23 of the canal element 22. When the receiver module 21 ,in an axial direction thereof, is inserted in the canal element 22 into opening 23 thereof and the snapping element 28 is mounted to the receiver module 21 close to the distal surface 25, this fixes the position of the receiver module 21 with respect to the opening 23. At the ridge section 27 the receiver module 21 departs from the preferred cylindrical shape thereof.

[0035] The snapping element 28 may be an integral part of the canal element 22 of the earpiece 20 or may

be provided as an independent part inserted into the opening 23 of the canal element 22 to the distal surface 25 of the receiver module 21. In case the snapping element 28 is formed as an independent part (relative to the canal element 22) it may comprise a flange 29 which is adapted for axially locking the snapping element 28 against further axial movement while fixing and locking the receiver module 21 in the opening 23 of the canal element 22 at a predetermined position thereof.

[0036] The receiver module 21 is inserted into the opening 23 of the canal element 22 from the side of the canal element 22 facing the outer portion of the user's ear canal, and the snapping element 28, when it is considered that the snapping element 28 is provided as an independent part, is inserted from the other side of the canal element 22 facing the user's eardrum to come into engagement with the ridge section 27 of the receiver module 21, thereby fixing the receiver module 21 at the predetermined position in the opening 23 of the canal element 22. However, when the snapping element 28 is provided as an integral part of the canal element 22, the receiver module 21 is inserted from the side of the canal element 22 facing the outer portion of the user's ear canal and is moved in the opening 23 of the canal element 22 until the receiver module 21 snaps into the snapping element of the canal element 22 being arranged at the side of the canal element 22 pointing to the user's eardrum and a closed portion of the user's ear canal. The snapping element 28, the ridge portion 27 as well as the fixing element 24 constitute fastening elements of the receiver module 21 in this embodiment.

[0037] For protecting the opening 23 of the canal element 22 and specifically for protecting the receiver module 21 and receiver 41 therein, a wax filter (not shown in the Figures) may be provided to prevent the receiver 41 from being deteriorated by the user's earwax.

[0038] As is shown in Fig. 1 and Fig. 2, the cross-sectional representation of the canal element 22 of the earpiece 20 includes in the lower portion thereof a venting channel 30 (ventilation channel, vent) for allowing a balance of pressure between the inner portion of the user's ear canal between the earpiece 20 inserted in the ear canal and the user's eardrum, and the outer portion of the user's ear canal opening to the outside. Hence, the venting channel 30 is provided for reducing the occlusion effect which is caused when any hearing device or hearing aid or any part thereof is inserted into the user's ear canal and defines the above-mentioned sealed or closed portion of the user's ear canal between the hearing device and/or the respective part thereof and the user's eardrum.

[0039] Regarding the dimensions of the venting channel 30 provided in the canal elements 22 of the earpiece 20, the diameter and the length of the venting channel are determined in accordance with the required gain for compensating for a particular hearing loss of the user. By providing a shortened axial length of the venting channel 30 a smaller diameter may be used achieving a required balance between suppression of occlusion and provision of a sufficient gain for optimizing the normal operation of the hearing device 10.

[0040] The earpiece 20 may also comprise a pullout string 31 for enabling the user to pull the earpiece 20 out of the ear canal after use of the hearing device 10. When inserting the earpiece 20 into the ear canal of the user, the user may hold on the part of the receiver module 21 extending out of the canal element 22 (opening 23 thereof) and gently insert the earpiece 20 into the ear canal.

[0041] In addition to the mechanical arrangement of the means and functions described above in conjunction with Fig. 1 there is shown in Fig. 1 the arrangement of a sensor 40 which is located preferably at a position at the receiver module 21 close to the receiver module's proximal surface 26. The sensor 40 which may preferably be arranged on the receiver module 21 points to the outside through the open portion of the user's ear canal to pick up sound signals, noise and any acoustical information which occurs around the user wearing the hearing device 10, and the acoustic signals are converted into electrical signals by sensor 40 and are communicated to the circuit module 11 via the connector 12 which is structured to allow a bidirectional data communication between the circuit module 11 and the components arranged in the earpiece 20. The sensor 40 is preferably provided in the form of a microphone or a directional microphone.

[0042] Regarding Fig. 1, the sensor signals (electrical signals, detection signals) of sensor 40 communicated to the circuit module 11 are processed according to a predetermined manner based on an initial setting of the hearing device 10 and are amplified according to a gain depending upon the structure of the hearing device 10 and the user's hearing loss. This represents the normal or regular function of the hearing device 10, and the receiver module 21 including the sensor 40 and being supported by the canal element 22 constitutes the receiver module of the hearing device for regular or daily use.

[0043] Specifically, when the user of the hearing device visits his dispenser, the hearing device 10 is applied to his ears, and in particular the circuit module 11 preferably provided in the form of a BTE unit is arranged behind the ear, whereas the earpiece 20 is inserted into the user's ears. Depending upon the sound signals and sound information surrounding the user (surrounding sound pressure) the hearing device 10 is set or calibrated for proper operation thereof. This setting is based on the acoustical signals (sound, noise) or predetermined acoustical signals surrounding the user.

[0044] However, in connection with the setting of the hearing device, getting additional information about the individual ear (ear canal) of the user and storing this as a part of the hearing aid setting or calibration is considered to be very useful in relation to more accurate acoustic output and optimized performance of the hearing device according to the present invention. If it were to be combined with an estimate of the physical size of the ear (the user's ear canal), it would be possible to obtain an

improved estimate of the sound pressure level at the eardrum of the user of the hearing device.

[0045] Referring to the arrangement shown in Fig. 2, the earpiece 20 shown in Fig. 2 is basically structured in the same manner as according to Fig. 1 so that additional explanations of the various components of the hearing device 10 are not repeated. In contrast to the structure of the earpiece 20 of Fig. 1, a (specific, modified) receiver module 21 T is provided with a sensor 50 instead of sensor 40 of Fig. 1, the sensor 50 being specifically arranged close to the distal surface or distal end 25 of the receiver module 21. As is shown in Fig. 2, similar to the structure of Fig. 1 in conjunction with the snapping element 28 (not shown in Fig. 2), the ridge portion 27 as well as the fixing element 24 constitute fastening elements of the receiver module 21T for fixing the receiver module 21 T to the opening 23 of the canal element 22.

[0046] The sensor 50 which is preferably provided in the form of a microphone, is directed to the closed or sealed portion of the user's ear canal and is therefore directed towards the user's eardrum. The sensor 50 therefore senses the acoustical conditions (acoustical signals, sound pressure) prevailing in the closed portion of the ear canal of the user. The picked-up acoustical signals are converted into corresponding electrical signals (detection signals) which are communicated to the circuit module 11 via the connector 12 for further data evaluation. The connector 12 is structured to allow a bidirectional data communication between the circuit module 11 and the components arranged in the earpiece 20.

[0047] The arrangement of the receiver module 21 T in conjunction with the sensor 50 constitutes a specific receiver module which is suitable for testing purposes when the user visits his dispenser. For providing the setting of the hearing device 10, and specifically the circuitry arranged in the circuit module 11, the receiver module 21 as shown in Fig. 1 (including sensor 40) which is arranged and structured for daily use and for performing the regular function of the hearing device 10 is replaced by the receiver module 21 T according to the arrangement shown in Fig. 2, wherein the sensor 50 is provided for sensing in the opposite direction (closed portion of user's ear canal) in contrast to the structure shown in Fig. 1A staff member at the dispenser can easily remove the receiver module 21 according to Fig. 1 and replace this regular receiver module 21 with the specific receiver module 21 T for testing purposes according to the arrangement of Fig. 2.

[0048] The hearing device 10 for the user with the specific receiver module 21 T being inserted into the canal element 22 of the earpiece 20 may be adapted for connection to any suitable test equipment available at the dispenser for predetermined data evaluation, and the circuit module 11 may be adapted for performing a calibration of the hearing device 10 on the basis of at least the sound pressure level (detected by sensor 50) in the closed portion of the user's ear canal.

[0049] After having made corresponding and sufficient measurement and checking of the prevailing acoustic conditions in the user's ear canal in conjunction with the hearing device 10 and specifically the earpiece 20 thereof provided with the receiver module 21T, receiver module 21T for testing purposes is removed and replaced by the regular receiver module 21 as shown in Fig. 1, and the regular or normal operation of the hearing device for daily use thereof can again be started.

[0050] At the dispenser an extra receiver module 21T having the arrangement shown in Fig. 2 is kept where the sensor 50 points into the residual cavity or closed portion of the user's ear canal behind the earpiece 20 of the hearing device 10. Thus, for providing the measurements and testing of the specific acoustical conditions in this closed portion of the user's ear canal the regular receiver module 21 (Fig. 1) is temporarily replaced by the specific receiver module 21 T as shown in Fig. 2, and testing of the closed portion of the user's ear canal is possible, resulting in the provision of measurements and testing in a natural environment, that is, taking the necessary measurements with the earpiece 20 of the hearing device being placed basically at the correct and regular position and the same canal element 22 as in the daily use.

[0051] An easy temporary replacement of the normal receiver module 21 (Fig. 1) with the specific extra receiver module 21T (Fig. 2) is possible due to the fact that both receiver modules 21 and 21T basically have the same outer shape so that a facilitated insertion of the respective receiver module 21 and 21T into the opening 23 of the canal element 22 of the earpiece 20 is ensured. A rotation of the receiver modules 21 and 21T in the opening 23 is possible.

[0052] The testing of the operation of the hearing device and the acoustical conditions prevailing in the enclosed portion of the user's ear canal at the position at which the earpiece 20 of the hearing device is positioned and used during normal wearing of the hearing device reduces measurement effort and time and therefore in general reduces work which may be cumbersome for the user of the hearing device 10. The easy exchange of the receiver modules 21 and 21T basically based on the same size and almost the same acoustical and mechanical properties provides a time-saving testing and setting (calibration) process of a particular hearing device, and the user can be sure that the setting of the hearing device is made the best way based on the real (natural) situation.

[0053] When at the dispenser for adapting the hearing device to the user's condition the regular (standard) receiver module 21 (Fig. 1) for the daily use is removed and instead the extra or special receiver module 21T is equipped to the hearing device 10 and specifically to the earpiece 20 thereof, reliable testing and measurements can be performed easily without inserting into the user's ear canal any other measuring devices which are able to sense the acoustical conditions in the user's ear canal, but not under real or natural conditions.

[0054] The specific receiver module 21T (Fig. 2), thus,

basically includes the means as the regular receiver module 21 (such as a speaker or transducer for reproducing the electrical signals supplied via the connector) as well as a sensor for sensing acoustical conditions, but the sensor 50 at or on this specific receiver module 21 T directed to the inner portion (sealed or closed portion) of the user's ear canal serves for obtaining measurement in view of ear impedance data of the individual ear of the user or for doing other types of real ear measurement.

[0055] Hence, the extra receiver module 21 T as shown in Fig. 2 having the sensor 50 provided at a position of the receiver module 21T close to its distal end 25 forms a real ear measurement receiver module for dispenser use, that is, such an extra or specific receiver module 21T is kept at the dispenser for any testing purposes and calibration processes to be performed in conjunction with the hearing device 10 in question.

[0056] In case any element or unit of the hearing device 10 needs maintenance or should be replaced for repair purposes, an easy new measurement of the prevailing acoustic conditions in the user's ear canal under the natural situation can be repeated, since the acoustic properties of the user's ear canal and a long-time use of the hearing aid may lead to varied or still changing conditions.

[0057] The easy replacement of one of the receiver modules 21 or 21 T with the respective other receiver module is facilitated due to the fact that any such receiver module can easily be inserted into the opening 23 of the canal element 22 of the earpiece 20, since the respective receiver module 21 or 21 T is fixed at its optimal position in the canal element 22 by means of the snapping element 28. When both the snapping element 28 and the respective receiver module 21 or 21 T are at their predetermined position the receiver module is in engagement with the snapping element 28, and both components are fixed.

[0058] The sensor 40 of the regular receiver module 21 and the sensor 50 of the specific receiver module 21 T are provided at a position and in such a manner that the outer shape of the respective receiver module 21 or 21T is not affected in view of the possibility to obtain an easy insertion into the opening 23 and to have the engagement with the snapping element 28.

[0059] In both versions of the receiver module 21 or 21A the connector 12 includes a corresponding wiring for connecting the sensors 40 and 50 with the circuit module 11 for data evaluation and processing of the picked-up sound signals of the sound signals, noise and acoustical information surrounding the user.

[0060] The data evaluation provided in the circuit module 11 may make use of an active noise cancellation or not, depending upon the technology and the user's preferences.

[0061] When a hearing aid of the RITE style is used, wherein the sensor for picking up surrounding sound signals is arranged at the receiver module inserted into the ear canal, the sensor pointing (for the regular and daily use of the hearing device) to the outside of the user's ear canal, such a style of the hearing device is cosmetically attractive since it reduces the size of the casing or shell to be arranged behind the ear of the user.

[0062] The arrangement of the hearing device according to the present invention and as discussed above is also highly attractive in view of its technology, since cumbersome measurements with any other technical devices or sensors to be inserted in the user's ear canal are not necessary, as such measurements would not result in completely reliable setting or calibration data since a situation is missing which corresponds to the situation when the user is wearing the hearing device, and specifically when the earpiece 20 with the regular receiver module 21 (for daily use, Fig. 1) is inserted in the user's ear canal. This normal and regular situation is obtained according to the present invention when the extra specific receiver module 21T (Fig. 2) is used having the sensor 50 arranged to pick up sound information and, thus, measurement data from behind the earpiece 20 from the closed or sealed portion of the user's ear canal with the canal element (mould, micro mould) which is provided for regular daily use.

[0063] In fig. 3 a further embodiment is shown, wherein the canal element 122 comprises a flexible moulded part having a central tube element 123 and one or more domes 130 extending away from the tube element 123. The domes are made with a flexibility which allows them to adjust to the size of the ear canal of the user, when inserted into the ear canal. In the central tube element 123 a circuit module 121 is insertable. The circuit module 121 comprise a receiver 141 shown schematically in dashed line in figs. 3 and 4 as well as a microphone 140, 150. As seen in fig. 3 the circuit module 121 for daily use has the microphone 140 arranged to receive sounds from the direction pointing away from the ear, whereas the circuit module 121T used during measurements has a microphone 150 arranged for receiving sounds from within the ear canal. The circuit modules for daily use and for measurements are both provided with circumferential beads 160, 161 between which the tube element 123 is to be arranged during use. Due to the flexible nature of the tube element and domes, placement and replacement of the circuit module in the tube element is easily performed, and the beads will allow the hearing care professional to easily see when the two pieces are correctly assembled. Alternative ways of securing correct assembly of the two parts may be envisaged, such as indents on one or both parts.

[0064] In the view of the dome and circuit module assembly shown from the ear side in fig. 3 and fig. 4, vent holes 131 are shown. The size, placement and number of holes may vary according to the hearing loss of the person to use the hearing aid.

[0065] The receiver module 121T shown in fig. 4 is used in the same way as the receiver module 121 T of fig. 2. The module 121 T is inserted in the canal element 122 in lieu of the usual every day receiver module 121, and through the connector 120 the receiver module 121T

is connected to the circuit module 111 as earlier explained. Following this the assembly of receiver module 121T and canal element 130 is placed in the users ear, and test signals are provided from the circuit module resulting in test sounds being served into the ear by the receiver. The microphone 150 may then be used to measure various aspects of the resulting sound in the ear canal of the user. The measured sound signal is served back at the circuit module 11. During the measurement session the circuit module may be connected by wire or wirelessly to a further signal processing unit such as a table top computer or the like having a display coupled thereto. This allows the hearing care professional to monitor and/or control the process of measuring. Once the measurements are over, the receiver module 121T is removed from the canal element 122, and the every day receiver module 121 is inserted in stead, and now, based on the measurement results a fine tuning of the hearing aid, which takes into account the conditions of the ear canal which are specific to the user may be performed. Following this the hearing aid is ready to carry. This mode of operation is also to be employed for the hearing aid and receiver module disclosed and described with reference to figs. 1 and 2.In fig. 5 an enlarged view of a further embodiment of the dome and receiver module 121T is shown. In this embodiment the microphone 150 is placed at a location close to the proximal end 26 of the receiver module 121T. However, a tube 151 (indicated in dashed lines) is further provided which may guide sound from the area at the distal end 25 to the microphone 150. As shown in solid line the tube 151 may extend forwardly of the distal end 25 and towards the tympanic membrane if this is desired. Preferably this tube part extending further into the ear is flexible, such that no injury is allowed thereby if the hearing aid professional pushes the dome too far into the ear canal of the user. As may be learned from this example, the actual placement of the microphone 150 may vary, however it is important that both the receiver and the microphone 150 have access to the region between the earpiece 20 and the tympanic membrane when the earpiece is placed inside the ear canal.

[0066] In the arrangements shown in Figs. 1 and 2 the respective sensors 40 and 50 are located at a predetermined position on or at the respective receiver modules 21 or 21T. The present invention is, of course, not limited to the arrangement shown in Figs. 1 - 5, and any other suitable arrangement of the sensors 40 and 50, respectively, in conjunction with the corresponding receiver modules 21 or 21 T is possible without affecting the function of the components of the hearing device 10 according to the present invention and without giving up the advantages obtained.

[0067] It is further to be noted that the Figures described above and showing examples of embodiments of the present invention do not necessarily represent real proportions but only provide a schematic view which is helpful for the explanation and understanding of the subject matter of the present invention described above on the basis of embodiments and modifications thereof. Moreover, the present invention has been illustrated and described in detail by means of the foregoing description in conjunction with the drawings, and such illustrations and descriptions are to be considered illustrative or exemplary and not restrictive.

[0068] The subject matter of the present invention is not limited to embodiments and developments as described above, and even reference number shown in the drawings and referred to in the description and claims do not limit the scope of the present invention. It is considered that all technical means and equivalent elements or components are included in the present invention and are considered to form part of the scope of the present invention as defined by the appended claims.

Claims

1. Receiver module adapted for insertion into a canal element (22,122) of a hearing device (10) which comprises a circuit module (11) as well as said canal element to be arranged in a user's ear canal and defining a closed portion of the user's ear canal, said receiver module (21T, 121T) comprising:

   a distal end (25) exposed to said closed portion of the user's ear canal,
   a receiver (41,141) arranged to radiate sound into the user's ear canal,
   a sensor (50, 150) arranged at the receiver module for sensing acoustical signals in the closed portion of the user's ear canal and generating corresponding detection signals,
   a connector adapted for communicating said detection signals to said circuit module for processing by said circuit module, and
   fastening elements (24, 27,160,161) adapted for removably fixing said receiver module in said canal element at a predetermined location therein.

2. Receiver module according to claim 1, wherein said fastening elements of said receiver module are adapted for engagement with a snapping element (28) of said canal element.

3. Receiver module according to claim 1, wherein said fastening elements (160,161) of said receiver module are adapted for engagement with a canal element comprising compliant parts of a flexible dome.

4. Receiver module according to claim 1 or claim 3, wherein said detection signals obtained by said sensor (50, 150) include measurement signals to be used for calibration or testing of said hearing device.

5. Receiver module according to claim 1, wherein said

receiver module (21 T) is adapted for longitudinally extending in an axial opening (23) of said canal element.

6. Receiver module according to claim 5, wherein an axial length of said receiver module is larger than an axial length of said opening in said canal element, and said receiver module (21T) further comprises a proximal end (26) at which said connector is arranged.

7. Receiver module according to claim 2, wherein said fastening elements are arranged at a distal end (25) of said receiver module (21T) exposed to said closed portion of the user's ear canal, and said snapping element is at least partly arranged in said opening of said canal element for engagement with the fastening elements of the receiver module.

8. Receiver module according to claim 1, wherein said sensor (50) is adapted to detect the sound pressure level in the closed portion of the user's ear reflecting said acoustical conditions whereby a sound canal from the sensor to the place of detection is provided.

9. Hearing device, comprising
an earpiece (20) including a canal element (22,122) to be arranged in a user's ear canal whereby a closed portion of said user's ear canal is defined, and a receiver module (21T,121T) adapted for insertion in said canal element, said receiver module including a distal end (25) exposed to said closed portion of the user's ear canal and a sensor (50,150) arranged at said receiver module and being adapted for sensing acoustical conditions in said closed portion of said user's ear canal and generating corresponding electrical signals,
a circuit module (11) arranged outside the user's ear canal and being adapted for performing processing of the detected signals, and
a connector (12,120) being adapted for at least communicating said detected signals of said sensor to said circuit module, wherein
said receiver module further includes fastening elements adapted for removably fixing said receiver module to said canal element.

10. Hearing device according to claim 9, wherein said fastening elements of said receiver module are adapted for engagement with a snapping element (28) of said canal element.

11. Hearing device according to claim 9, wherein said fastening elements of said receiver module are adapted for engagement with compliant parts of said canal element

12. Hearing device according to claim 9, wherein said sensor (50,150) is adapted to detect a sound pressure level in the closed portion of a user's ear, and said circuit module is adapted for performing a calibration of said hearing device on the basis of at least the sound pressure level detected in the closed portion of the user's ear.

13. Receiver module according to claim 9, wherein said receiver module is adapted for longitudinally extending in an axial opening (23) of said canal element.

14. Hearing device according to claim 13, wherein an axial length of said receiver module (21 T) is longer than an axial length of said opening (23) in said canal element, and said receiver module further comprises a proximal end at which said connector is arranged.

15. Hearing device according to claim 10, wherein said fastening elements (24, 27) are arranged at the distal end (25) of said receiver module exposed to said closed portion of a user's ear canal, and said snapping element (28) is at least partly arranged in said opening of said canal element for engagement with the fastening element of the receiver module (21 T).

16. Hearing device according to claim 10 or 15, wherein said snapping element (28) is an integral part of the canal element.

17. Hearing device according to claim 10 or 15, wherein said snapping element (25) is separately mounted in the canal element at the distal end (25) of the receiver module (21 T).

18. Hearing device earpiece adapted for connecting to a circuit module to constitute a hearing device, the earpiece comprising the receiver module (21T) according to any one of claims 1 to 8.

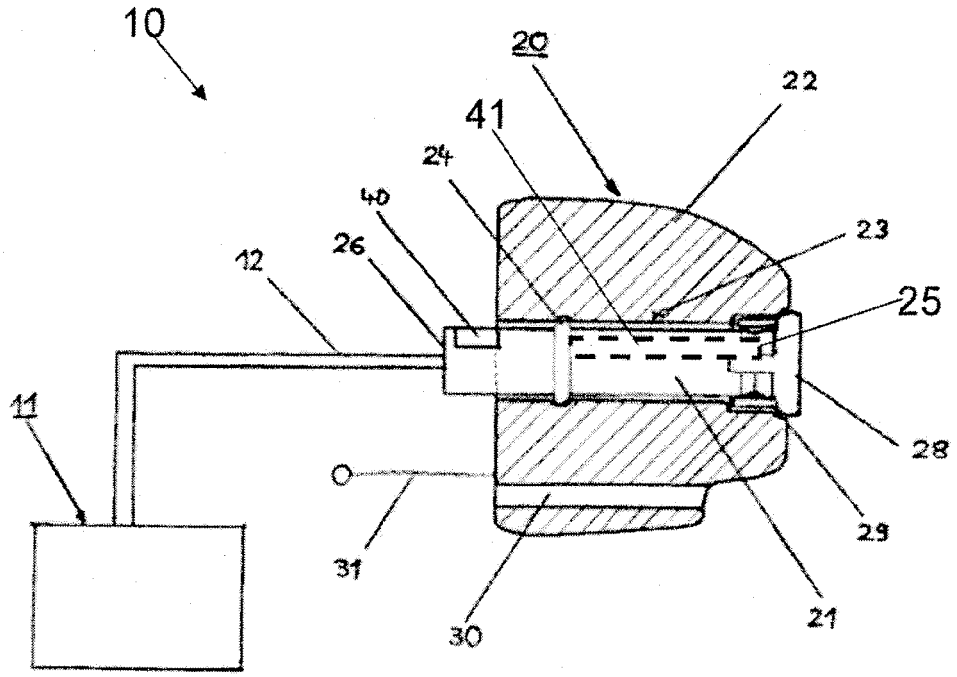

Fig. 1

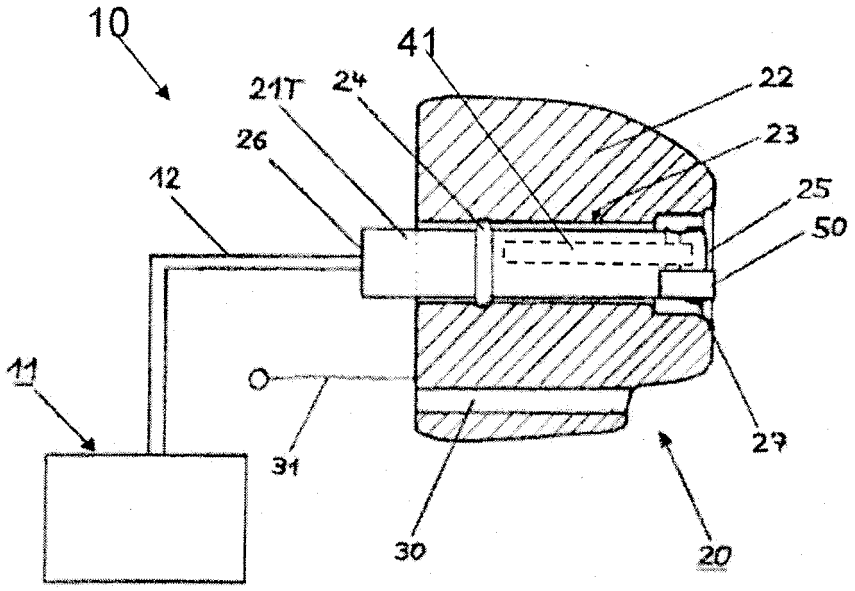

Fig. 2

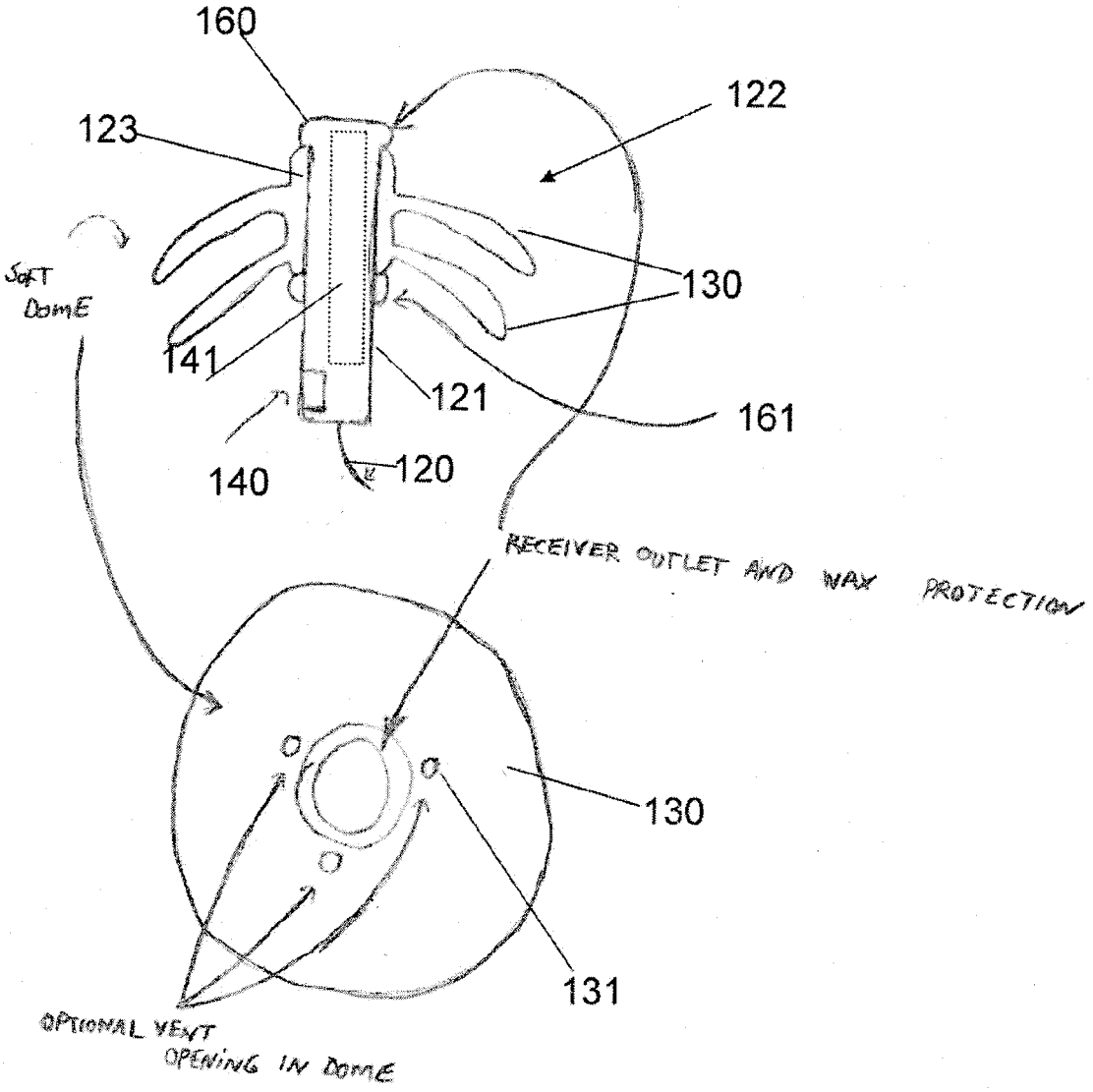
160
123
122
130
SOFT DOME
141
121
161
140
120
RECEIVER OUTLET AND WAX PROTECTION
130
131
OPTIONAL VENT OPENING IN DOME

Fig. 3

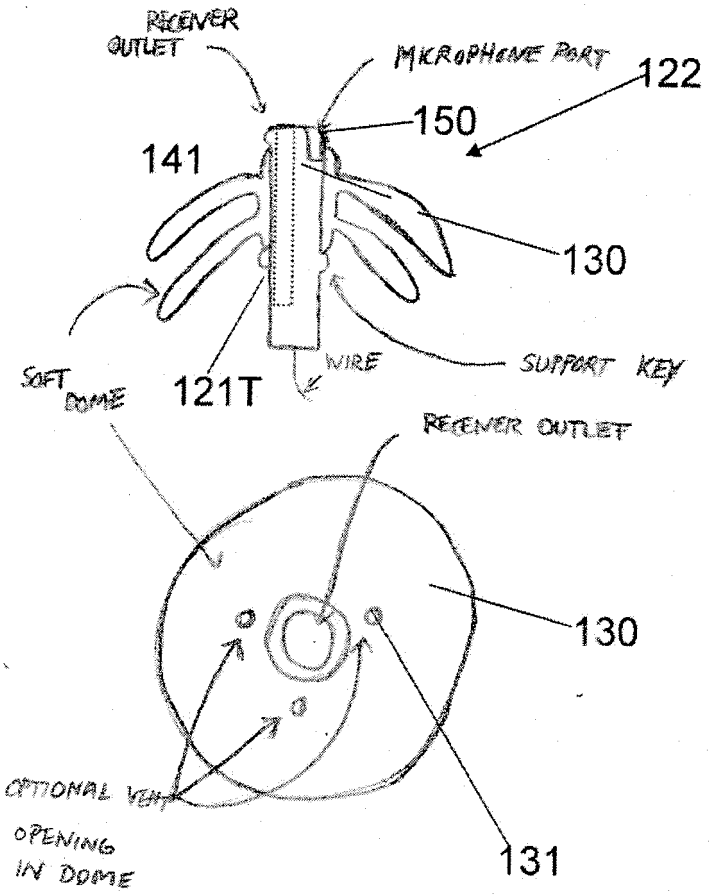
RECEIVER OUTLET
MICROPHONE PORT
122
150
141
130
SOFT DOME
121T
WIRE
SUPPORT KEY
RECEIVER OUTLET
130
OPTIONAL VENT OPENING IN DOME
131

Fig. 4

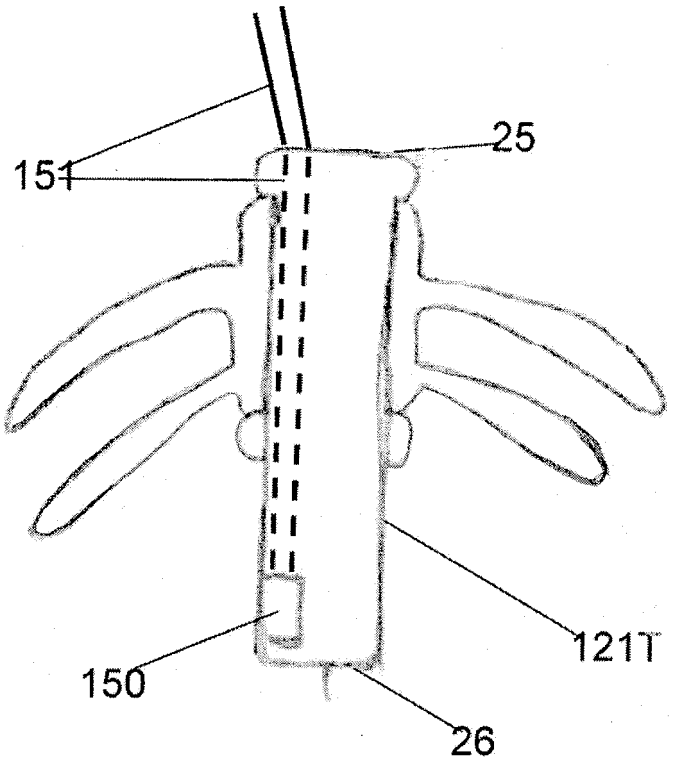

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 1666

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 July 2008	Heiner, Christoph

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