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(54) **Hearing aid with miniature loudspeaker**

Hörgerät mit Miniaturlautsprecher

Appareil d'aide auditive avec un haut-parleur miniature

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Description

[0001] The present invention relates to improvements in hearing aids, and especially in miniature hearing aids, such as ITE/CIC/ITC hearing aids, which require extremely small components and which need to be adapted to the dimensions of the ear canal of the user.

BACKGROUND OF THE INVENTION

[0002] Hearing aid receivers or loudspeakers have conventionally been mounted in both BTE and ITE hearing aids with the use of resilient suspensions to suppress or attenuate mechanical vibrations of the receivers and prevent that these were transmitted to a microphone of the hearing aid. Due to the requirements of very large acoustical gain between proximately located microphone and receiver components, the utilisation of the resilient suspension has been required to avoid feedback oscillation caused by coupling of mechanical vibrations between the receiver and microphone.

[0003] Conventional or prior art resilient suspensions include elastomeric rubber boots and elastomeric strips or ribbons mounted to partly or fully encircle the receiver housing and optionally were provided with shock absorbing protrusions and several other types of resilient supports. Through careful design of the resilient properties of these prior art resilient suspensions these have been adapted to attenuate or decouple mechanical vibrations of the receiver so as to prevent these from being coupled to the housings of the BTE and ITE hearing aids.

[0004] Furthermore, electrical signals from a hearing aid amplifier to the receiver have conventionally been provided through for example a pair of flexible electrical leads such as multi-core litze wires soldered to respective terminals of the receiver.

[0005] These prior art hearing aid constructions incurred a number of technical problems that are overcome by the present inventions.

[0006] One problem associated with the above-mentioned hearing aid construction techniques is the space requirement inside the hearing aid shell to accommodate the resilient suspension and flexible leads. In small hearing aids such as the ITE type of hearing aids and in particular in ITC and CIC type of hearing aids, the available space for the resilient suspension at a tip of the hearing aid shell is typically very limited since the shell tip must be dimensioned for placement deeply inside the ear canal of the user or patient. Another problem is that even if adequate space for the resilient suspension is available at the tip of the hearing aid shell, the correct placement of the resilient suspension can be very difficult and therefore time consuming for the assembly technician because it must be ensured that the resiliently suspended receiver is allowed substantially unrestricted vibration and is without contact to one of the walls of the hearing aid shell. Finally, the correct placement of the resiliently suspended receiver is subjected to additional difficulties

by the presence of the pair of flexible electrical leads which tends to pull or push the receiver away from the correct position due to the stiffness of the leads and the low weight and resilient suspension of the receiver.

5 **[0007]** These problems are firstly encountered during manufacture of the hearing aid but unfortunately resur-
face if the hearing aid receiver malfunctions or fails in the field and needs replacement in a service and repair shop. This is unfortunately a very common situation because
10 the receiver is placed at a very exposed position deeply inside in the user's ear canal where it is subjected to moisture and cerumen contamination. In this latter repair situation, it may be an even more difficult task for the service technician to ensure correct positioning of the replacement receiver inside its resilient suspension and the shell part(s) because he may lack adequate instructions, measurement equipment or training to complete the task. Furthermore, in prior art of ITE hearing aids the receiver has only been replaceable from a rear portion
15 or so-called faceplate portion of the aid where a substantially plane premanufactured plastic plate has been glued to the upper circumferential portion of the hearing aid shell so as to isolate the interior of the hearing aid from the surrounding environment. Accordingly, to replace the defective receiver, the faceplate portion of the aid had to be reopened with a substantial risk of damaging the cus-
20 tomized ITE shell and/or mechanical or electronic components housed within the shell.

[0008] US 4,109,116 discloses a miniature dual-diaphragm moving armature receiver for hearing aid applications. The dual-diaphragm receiver is formed as a back-to-back mounted assembly of a pair of conventional single diaphragm moving armature receiver to achieve cancellation of mechanical vibrations of the receiver. The dual-diaphragm receiver is mounted inside an earphone and the earphone may be inserted into and acoustically
25 coupled to an earmold that is insertable in the ear canal of a hearing aid user. The disclosed dual-diaphragm moving armature receiver does not comprise a common front chamber or a common back chamber but has separate chambers coupled exclusively to each single diaphragm receiver.

[0009] WO 2004/049756 discloses a single diaphragm moving armature receiver that comprises a motion reversing arrangement or linkage assembly coupled between a diaphragm and the moving armature. If the effective moving masses of the armature assembly and the diaphragm assembly are made identical, some cancellation of mechanical vibrations of the receiver can be
30 achieved.

[0010] US2003/0048920 describes a receiver having two sound outputs for different frequency intervals. These outputs are derived from the front and back chamber, respectively, of the receiver and output from different
35 outputs of a housing.

[0011] Other technologies may be seen in US-A-6,549,634 and 6,891,956, WO2004/103018, and DE 35
40 02 178.

DESCRIPTION OF THE INVENTION

[0012] The invention relates to a number of solutions to those problems. In a first aspect, the invention relates to a hearing aid according to claim 1.

[0013] In this connection, "acoustic path/opening/tunnel/channel" is to be interpreted with the acoustic properties in mind at audible frequencies. The path may be provided by an open channel or via e.g. a membrane, if that is desired. The path may be adapted to provide predetermined acoustic properties - normally in the audible area.

[0014] In this context, a "miniature loudspeaker" or "miniature transducer" will be a loudspeaker/transducer having extend, in the plane of the diaphragm, over an area of less than 4.0x4.0 mm, such as 3.5x3.5 mm, or even more preferably less than 3.0x3.0 mm. Alternatively or additionally, a miniature loudspeaker/transducer comprises a so-called MEMS based transducer element which is a transducer element wholly or at least partly fabricated by application of Micro Mechanical System Technology. The miniature loudspeaker element may comprise a semiconductor material such as Silicon or Gallium Arsenide in combination with conductive and/or isolating materials such as silicon nitride, polycrystalline silicon, silicon oxide and glass. Alternatively, the miniature transducer element may comprise solely conductive materials such as aluminium, copper etc. optionally in combination with isolating material like glass and/or silicon oxide.

[0015] According to the invention, the miniature loudspeaker comprises a pair of diaphragms, the first sides of which are oppositely directed. This set-up normally is called a dual-diaphragm miniature loudspeaker. This opposite direction means that in order for both diaphragms to provide a pressure pulse in the front chamber (to feed toward the sound outlet), the two diaphragms must move in opposite directions. This has the advantage that this oppositely directed movement of the diaphragms reduces or cancels vibration of the miniature loudspeaker and housing during sound generation. This provides a number of advantages both in the manner in which the miniature loudspeaker may be mounted in the housing and how it may be engaged for electrical contact. Thus, normally, the two first sides either face each other or point away from each other.

[0016] According to the invention, the housing and miniature loudspeaker are hard mounted to each other. This hard mounting is a mounting without resilient suspension, such as a mounting of the miniature loudspeaker directly to the housing using glue, welding, soldering or the like.

[0017] The dual-diaphragm miniature loudspeaker is then mounted directly to the hearing aid device shell/housing inside the closed first compartment without using a resilient suspension. According to the invention, the air volume confined inside the acoustic first compartment is interconnected to the back chamber of the dual-dia-

phragm miniature loudspeaker while a common front volume of the miniature loudspeaker is connected to the sound outlet port of the acoustic chamber so as to convey sound to the user's ear canal. This provides the dual-diaphragm miniature loudspeaker with a very large effective back volume or chamber which in turn has several beneficial effects such as increasing the maximum output sound pressure capability, increasing the efficiency and raising the sensitivity of the dual-diaphragm miniature loudspeaker. Furthermore, since the dual-diaphragm miniature loudspeaker is attached directly to the communication device shell and electrically connected through the use of engaging/abutting/biasing (see below) contacts inside the acoustic chamber, a significant size of the internal volume in the acoustic chamber can be obtained inside a shell of a small ITE/ITC/CIC type of hearing aid device.

[0018] In one embodiment, the first compartment and the miniature loudspeaker comprise mating first and second electrically conducting contact means adapted to provide solderless/solderfree, electrical conduction between the contact means of the first compartment and the miniature loudspeaker. Such conduction may be provided by abutting the electrically conducting means, preferably using a physical biasing in order to ensure contact during thermal changes, vibrations etc. Alternatively, a more fixed engagement (using a thread or other mechanically engaging parts) may be used. Preferably, the engagement is detachable in a non-destructive manner.

[0019] In the present embodiment, at least one of the first and second electrically conducting contact means may be adapted to provide a resilient, electrically conducting contact means. In order to provide the above-mentioned biasing, this resilient electrically conducting contact means could comprise an electrically conducting spring, such as a helical, torsion, or leaf spring. Alternatively, the resilient electrically conducting contact means could comprise electrically conducting foam (such as polymeric foam with a surface covering of an electrically conducting material), a web (of an electrically conducting material) or the like.

[0020] Preferably, the electrically conducting contact means are provided on an outer surface thereof opposite to the first area or part.

[0021] Also, it is preferred to have means for releasably fixing the miniature loudspeaker to a housing, the fixing means being operable by engaging the housing and/or the miniature loudspeaker from outside the housing and/or miniature loudspeaker. These fixing means could comprise one or more of a snap lock, a thread, a bayonet coupling, a key way, and snap taps.

[0022] Preferably, the electrically conducting contact means are adapted to provide a resilient electrically conducting contact means. These resilient electrically conducting contact means could comprise an electrically conducting spring (such as a helical, torsion, and/or leaf spring), or an electrically conducting foam, web, or the like.

[0023] Advantageously, the miniature loudspeaker comprises a second predetermined area or part at least substantially parallel to the first area or part, the second area or part comprising the fixing means and/or the electrically conducting contact means.

[0024] Also, advantages are obtained when the miniature loudspeaker has an outer contour, in a plane perpendicular to an axis of the miniature loudspeaker and through the sound outlet thereof, and over a majority of its length from a position farthest from the outlet and toward the inlet/outlet, which outer contour may be circumscribed by a predetermined contour, such as a contour of an opening through which it is to be introduced.

[0025] Also, the housing may be a customized ITE/ITC/CIC housing. These housings must have very small dimensions of the parts positioned in the ear canal of the user. The present invention facilitates the providing of very small communication devices.

[0026] In addition, the housing may comprise a wall part comprising a plurality of through-going electrical conductors separating the first compartment and a second compartment. Thus, the miniature transducer/loudspeaker could be positioned in the first compartment and the second compartment could comprise battery, amplifier, other miniature transducer/loudspeakers etc. Then, also, any electrical contacts and any fixing means could be attached to or integral with this wall part separating the two compartments.

[0027] Finally, the housing could have outer dimensions adapted to the dimensions of an ear canal of a specific person and wherein inner dimensions of the first compartment are adapted to the person's hearing problems. This is due to the fact that miniature transducer/loudspeakers may be made so small that excess space is available when no resilient mounting is required of the miniature transducer/loudspeaker in the housing. This space may be used for acoustically adapting the hearing aid device to the particular person and the particular hearing problems of that user.

[0028] In the following, the invention will be described with reference to the drawings, wherein:

- Fig. 1 illustrates an embodiment of a communication device with a receiver/transducer element therein,
- Fig. 2 illustrates a first embodiment of a receiver/transducer element,
- Fig. 3 illustrates a second embodiment of a receiver/transducer element,
- Fig. 4 illustrates a third embodiment of a receiver/transducer element,
- Fig. 5 illustrates a manner of fixing the receiver/transducer element to the housing,
- Fig. 6 illustrates the use of an external biasing ele-

ment, and

- Fig. 7 illustrates another embodiment using a particular type of transducer.

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[0029] In Figure 1, the overall structure of a preferred embodiment of a personal communication device, here in the form of a hearing aid 10, is seen, having a housing 12 in which is mounted a hearing aid receiver or loudspeaker 20.

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[0030] The present invention is able to reduce the overall dimensions of the system so that it is useful even in CIC, ITE, and ITC hearing aids. Naturally, also larger systems and dimensions may be provided, as may systems comprising multiple microphones/loudspeakers for increasing the volume or directional properties of the sound emission/detection.

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[0031] The housing 12 has an inner space that is divided into first and second inner compartments 14 and 15, respectively. The first inner compartment 14 is delimited by the housing walls 17 and an intermediate wall 16 providing an acoustic sealing between the compartments 14 and 15. The transducer element 20 is mounted in the space 14 so as to close or seal an opening 18 in the housing 12.

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[0032] The transducer element 20 is adapted to receive or generate sound and has a sound inlet/outlet 22 exposed to the surroundings of the hearing aid 10 in the sound inlet/outlet port or opening 18.

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[0033] The inner structure of the hearing aid receiver or transducer element 20 will be described in further detail further below, primarily as a sound generator even though the present structure is also useful as a sound receiver.

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[0034] In addition to the sound outlet 22, the receiver/transducer element 20 comprises one or more acoustical apertures or openings 24, the operation of which will be described further below.

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[0035] The sound generation or reception of the transducer element 20 is controlled or assisted using electronics 30 provided inside the housing 12 and which is electrically connected to the element 20 via electrical conductors 32 contacting solder bumps 34 on the element 20.

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[0036] One embodiment of the inner structure of the element 20 may be seen in Figure 2, wherein the element 20 comprises two diaphragms 42 and 44. The diaphragms have a first side pointing away from each other and a second side facing each other. In normal acoustical transducer terminology, the volume or space between the outlet 22 and the diaphragms 42/44 is denoted a front chamber 48, and the space on the other side of (between) the diaphragm(s) 42/44 is denoted the back chamber 50. The two diaphragms 42/44 may have separate back chambers, as it is described in relation to Figures 3 and 4, or share a single or common back chamber, as it is illustrated in Figure 2.

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[0037] This system may be similar to that described in

US2003/0048920 and may have the advantage that it is automatically vibration damped compared to single diaphragm systems.

[0038] Sound is generated by the diaphragms 42/44 by a driver system illustrated by 46, which drives the diaphragms to generate sound. The driver system may be as that illustrated in the above US application. Other drive systems are well known in the art.

[0039] It should be noted that the direction of the sound may also be reversed so that sound is received by entering the inlet 22, exiting the diaphragms 42/44, which then drive the means 46 which now generates a voltage/current/frequency or the like and transmits it to the means 30 which will process the signal further.

[0040] The common back chamber 50 is sealed by the diaphragms 42/44 and walls 52 and 54 which support the diaphragms 42/44 in known manners.

[0041] In an embodiment not forming part of the invention, the front chamber 48, when the element 20 is provided inside the space 14, is acoustically connected to the space 14 via the opening 46. Thus, the acoustic properties of the front chamber 48, and thereby of the hearing aid 10, may be determined by the dimensions also of the openings 24, the number of and positions thereof, as well as the dimensions of the space 14. In addition, the size of the chamber 48 may now be drastically reduced in that the space 14 is now also brought into use.

[0042] According to the invention, as is illustrated in Figure 3, the openings 24 are provided into the back chamber 50. This affects the acoustic properties of the back chamber 50, the element 20, and therefore of the hearing aid 10.

[0043] In Figure 3, it is also illustrated that the back chamber 50 may be divided between the diaphragms 42/44 and each of the back chambers 50 may be connected to the space 14 via one or more openings 24.

[0044] Figure 4 illustrates yet another embodiment in which the front chamber 48 now extends between the diaphragms 42/44 which now have their first sides facing toward each other and their second sides facing away from each other.

[0045] Again, walls 52/54 separate the front and back chambers 48/50. Also, the hatched line illustrates that the back chamber 50 may be divided in order to provide a separate back chamber for each diaphragm. In this embodiment, the openings 24 connect the back chamber to the space 14.

[0046] In this figure, however, the solder bumps 34 have been replaced with the springs 32 in order to have these resilient means provided on the element 20.

[0047] The mounting of the element 20 in the housing 12 is provided by sliding or translating the element 20 through the opening 18 in such a manner that the element 20, optionally using a sealing element, blocks the opening 18. Preferably, this blocking also facilitates a fixing of the element 20 in the housing 12.

[0048] Preferably, the element 20 has a circumferential shoulder 60 either adapted to the inner dimensions

of the opening 18 or adapted to engage the opening 18 via a sealing member 62, such as an O-ring or the like.

[0049] Alternatively, this shoulder may be adapted to enter a cut-out part 61 (see Figure 5) of the housing. This provides more surfaces and more space for providing the fixing means desired.

[0050] This shoulder may have the means for fixing the element 20 in the space 14. Such means may be snap fixing means, a thread, key way, bayonet socket, or any other manner in which one element may be removably fixed on/with/in another. Preferably, this manner is one with which the element 20 may be brought into engagement with and out of engagement with solely by operating or handling the housing 10 and element 20 from the outside thereof, such as using a translation or a rotation of one element in relation to the other.

[0051] The use of a vibration damped element 20 actually facilitates a hard mounting where no vibration damping is provided between the element 20 and the housing 12. This hard mounting may be provided by suitable adhesive agents such as an epoxy based UV curable adhesive, or by welding.

[0052] The shoulder 60 may be dispensed with, as is seen in Figure 4 illustrating an element 20 without the shoulder 60. The opening 18 or the sealing means 62 would then instead abut or engage the outer surface of the element 20.

[0053] Naturally, the fixing means could be provided also at other positions, such as at the sides of the element 20 or at the bottom thereof close to the wall 16.

[0054] One alternative is seen in Figure 6, wherein an external fixing member 64 is provided which is able to be releasably fixed to the housing 12. This fixing member 64 is adapted to engage or abut the transducer/receiver 20 and force it toward the compartment 14, such as against the springs 32, in order to fix the receiver/transducer 20 in a predetermined position (such as defined by a cavity in the means 64) and in order to ensure the electrical connection between the means 32 and 34, if these are positioned as illustrated in Figure 1.

[0055] This means 64 may also serve other purposes, such as provide a sealing member, such as a membrane, for preventing dirt, dust, wax etc. from entering the opening 22. The member 62 may also simply provide a grating or guard preventing physical contact from the outside to the receiver/transducer 20.

[0056] Naturally, the means 64 may be fixed in any of the above-mentioned manners in order for it to be releasably fixed to the housing 12.

[0057] The sealing means 62 may be provided after positioning of the element 20 in the space 14, so that the circumference of the element 20 need not be fully adapted to the inner circumference of the opening 18. Also, in that situation, the circumference of the element 20 need not be the largest at the position closest to the opening 18, when the element 20 is in position in the space 14. Thus, the solder bumps 34 may be positioned on the side of the element 20 as illustrated in Figures 2 and 3, even

if no shoulder 60 is present.

[0058] However, it is preferred that the largest outer contour circumscribing the outer surface of the transducer element, when projected onto a plane perpendicular to the direction of introduction (see the fat arrow), is positioned at the position also abutting/engaging the opening 18 or the sealing means 62. In that manner, it is ensured that the element 20 is introducible through the opening 18 and that a sufficient sealing is obtainable.

[0059] The solder bumps 34 and the conductors 32 provide an electrical connection using only abutment and no adhesion/welding/soldering/gluing or the like. In that manner, connection is automatically obtained when the element 20 is in the correct position and no additional steps are required.

[0060] Different positions are possible for the solder bumps 34 and the conductors 32. In Figures 1 and 4, these elements are provided at the bottom of the space 14 at the opposite end of the element 20 than the opening 22. In that manner, the element 20 may be biased toward the conductors 32, which may themselves provide a spring action by e.g. forming a torsion spring, leaf spring, a resilient material or the like. This biasing may be provided by the hard mounting or vibration damping mounting or by other means.

[0061] Other positions may be at sides of the element 20, but the biasing effect may be the same.

[0062] Naturally, other manners of providing the pressure contacts or abutting contacts may be used, such as electrically conducting areas of the surface of the element 20 replacing solder bumps. The resilient parts may be provided on the element 20 instead in the housing 12.

[0063] Figure 7 illustrates another embodiment in which a transducer 20 is positioned in a housing 12 to form an assembly for a hearing aid 10.

[0064] The transducer 20 comprises two oppositely positioned membranes 42 and 44 driven by a driver 43 or which feed a detecting means 43 detecting movements of the membranes 42/44.

[0065] Side facing openings 49 are provided between the first (outer) sides of the membranes 42/44, where also small front chambers are defined, and a common, or second, front chamber 48 of the transducer. The sound inlet/output 22 of the transducer 20 being directly connected to the common front chamber 48.

[0066] Naturally, the sound from the diaphragms 42/44 may also be transported via openings radially (seen in the figure), if suitable openings or sound ports are provided in the housing 12. Alternatively, the transducer 20 may extend slightly out of the housing 12 in order for the sound to exit in that direction.

[0067] The transducer 20 has, in addition to the back chambers defined on the "inner" sides of the diaphragms 42/44, a built-in common back chamber 50, which is connected to the second sides (facing each other and the means 43) of the membranes 42/44 via openings 45.

[0068] The housing 12 comprises, as does that of Fig. 1, a first chamber 14 in which the transducer is positioned,

and a second chamber 15, separated from the chamber 14 by a wall 16. As mentioned, electronics (amplifier or the like) and batteries, etc. may be positioned in the second chamber 15 in order to have as large a volume as possible in the first chamber 14.

[0069] In the present embodiment, the transducer 20 is fixed inside the housing 12 by two interlocking hooks 70, one of which is fixed to the wall 16 and one of which is fixed to the transducer 20. Introducing the transducer 20 through the opening in the housing 12 will make the hooks 70 engage and thereby fix the transducer 20 in the housing 12.

[0070] Naturally, other fixing means may be used, and in general, it may be preferred that the fixing means are detachable in order to easily have these disengage in order to be able to remove the transducer 20 from the housing 12.

[0071] In addition or alternatively, the hooks 70 may be used for providing electrical connection to the driving means 43, preferably comprising two coils in the present transducer 20. Alternatively, connection means as described in the other drawings may be used in order to obtain a solder-less or solder-free, electrical connection to the driving means or detecting means of the transducer.

[0072] It should be noted that the set-up of Fig. 7 may be used equally well in all types of communication systems having a part for introduction into the ear of a person. It is not important from where the signal for a driver (to generate sound) or to where a signal (if sound is detected, is transmitted. Thus, this set-up is useful in both hearing aids, where the signal stems from a microphone) as well as in ear monitors, where the signal may be transmitted over a wireless connection from a remote source.

Claims

1. A hearing aid device (10) comprising a device housing (12) comprising:
 - a first compartment (14) comprising a sound outlet port toward the surroundings of the housing,
 - a miniature loudspeaker (20) releasably mounted in the first compartment (14) and comprising a loudspeaker housing having therein:
 - a sound outlet (22) positioned in a first, predetermined area or part of the miniature loudspeaker and acoustically coupled to the sound outlet port,
 - a pair of parallelly positioned diaphragms (42, 44) each having a first side and a second, opposite side, the first sides of the diaphragms or membranes (42, 44) being oppositely positioned, one or two back chamber(s) (50) being defined at the second sides of the diaphragms or membranes (42, 44),

- a first acoustic path/opening/tunnel/channel (48) between the first sides to the sound outlet (22), and
- a second acoustic path/opening/tunnel/channel (24,45) interconnecting the back chamber(s) (50) to an air volume confined in the first compartment (14),

characterised in that:

- the device housing comprises a second compartment (15) acoustically sealed from the first compartment,
 - the miniature loudspeaker further comprises one or more electrically conducting contact means (32, 34) positioned on an outer surface of the loudspeaker housing and adapted to provide solderless/solderfree engagement with mating contact means (32,34) of the device housing (12).
 - the miniature loudspeaker is mounted directly to the device housing.
2. A hearing aid device according to claim 1, wherein the electrically conducting contact means -(32,34) are provided on an outer surface of the loudspeaker opposite to the first area or part.
 3. A hearing aid device according to claim 1 or 2, further comprising means (64,70) for releasably fixing the miniature loudspeaker (20) to the device housing (12), the fixing means being operable by engaging the device housing (12) and/or the miniature loudspeaker (20) from outside the device housing (12) and/or miniature loudspeaker (20).
 4. A hearing aid device according to claim 3, wherein the fixing means (64,70) comprise one or more of a snap lock, a thread, a bayonet coupling, a key way, and snap taps.
 5. A hearing aid device according to any of claims 1-4, wherein the electrically conducting contact means (32,34) are adapted to provide a resilient electrically conducting contact means.
 6. A hearing aid device according to claim 5, wherein the resilient electrically conducting contact means (32,34) comprises an electrically conducting spring.
 7. A hearing aid device according to claim 3, the miniature loudspeaker (20) comprising a second predetermined area or part at least substantially parallel to the first area or part, the second area or part comprising the fixing means (64,70) and/or the electrically conducting contact means (32,34).
 8. A hearing aid device according to any of claims 1-7,

wherein the miniature loudspeaker has an outer contour, in a plane perpendicular to an axis of the miniature loudspeaker (20) and through the sound outlet (22) -thereof, and over a majority of its length from a position farthest from the outlet (22) and toward the outlet (22), which outer contour may be circumscribed by a predetermined contour.

9. A hearing aid device according to any of claims 1-8, wherein the miniature loudspeaker (20) is a moving armature transducer or a moving coil transducer.
10. A hearing aid device according to any of claims 1-9, the miniature loudspeaker (20) further comprising one or more of:
 - a mounting ring for providing a sealing (62) between the outlet (22) and the miniature loudspeaker (20), the ring having predetermined dimensions,
 - an element (64,70) adapted to engage the device housing (12) at the outlet (22) and to bias the miniature loudspeaker inwardly into the first chamber, and
 - a wax guard sealing (64) provided between the outlet and the surroundings.

Patentansprüche

1. Hörgerätvorrichtung (10) mit einem Gerätegehäuse (12), das
 - eine erste Kammer (14) mit einer Schallauslassöffnung in Richtung der Umgebung des Gehäuses und
 - einen Miniaturlautsprecher (20) aufweist, der lösbar in der ersten Kammer (14) angebracht ist und über ein Lautsprechergehäuse verfügt, und
 das
 - einen Schallauslass (22), der in einem ersten vorbestimmten Bereich oder Teil des Miniaturlautsprechers angeordnet und akustisch mit der Schallauslassöffnung gekoppelt ist,
 - ein Paar parallel angeordnete Diaphragmen (42, 44), die jeweils eine erste Seite und eine zweite gegenüberliegende Seite aufweisen, wobei die ersten Seiten der Diaphragmen oder Membranen (42, 44) gegenüberliegend angeordnet sind, wobei eine oder zwei hintere Kammer(n) (50) an den zweiten Seiten der Diaphragmen oder Membranen (42, 44) ausgebildet ist/sind,
 - eine(n) erste(n) akustische(n) Weg/Öffnung/Tunnel/Kanal (48) zwischen den ersten Seiten zu dem Schallauslass (22) und

- eine(n) zweite(n) akustische(n) Weg/Öffnung/Tunnel/Kanal (24, 45) aufweist, der/die die hintere(n) Kammer(n) (50) mit einem in der ersten Kammer (14) eingeschlossenen Luftvolumen verbindet,

dadurch gekennzeichnet, dass

- das Gerätegehäuse eine zweite Kammer (15) aufweist, die von der ersten Kammer akustisch abgedichtet ist,
 - der Miniaturlautsprecher weiterhin über ein oder mehrere elektrisch leitende(s) Kontaktmittel (32, 34) verfügt, das/die auf einer äußeren Oberfläche des Lautsprechergehäuses angeordnet und dazu eingerichtet ist/sind, einen nichtverlöteten/lötfreien Eingriff mit passenden Kontaktmitteln (32, 34) des Gerätegehäuses (12) zu bilden, und dass
 - der Miniaturlautsprecher direkt an dem Gerätegehäuse angebracht ist.
2. Hörgerätvorrichtung nach Anspruch 1, bei der die elektrisch leitenden Kontaktmittel (32, 34) auf einer äußeren Oberfläche des Lautsprechers gegenüber dem ersten Bereich oder Teil angeordnet sind.
 3. Hörgerätvorrichtung nach Anspruch 1 oder 2, die weiterhin Mittel (64, 70) zum lösbaren Befestigen des Miniaturlautsprechers (20) an dem Gerätegehäuse (12) aufweist, wobei die Befestigungsmittel einsetzbar sind, indem sie mit dem Gerätegehäuse (12) und/oder dem Miniaturlautsprecher (20) von außerhalb des Gerätegehäuses (12) und/oder des Miniaturlautsprechers (20) in Eingriff gebracht werden.
 4. Hörgerätvorrichtung nach Anspruch 3, bei der die Befestigungsmittel (64, 70) eines oder mehrere von einer Schnappverbindung, einem Gewinde, einer Bajonettverbindung, einer Keilnut und Rastzungen aufweisen.
 5. Hörgerätvorrichtung nach einem der Ansprüche 1-4, bei der die elektrisch leitenden Kontaktmittel (32, 34) dazu eingerichtet sind, ein nachgiebiges elektrisch leitendes Kontaktmittel bereitzustellen.
 6. Hörgerätvorrichtung nach Anspruch 5, bei der das nachgiebige elektrisch leitende Kontaktmittel (32, 34) eine elektrisch leitende Feder aufweist.
 7. Hörgerätvorrichtung nach Anspruch 3, bei der der Miniaturlautsprecher (20) einen zweiten vorbestimmten Bereich oder Teil aufweist, der wenigstens im Wesentlichen parallel zu dem ersten Bereich oder Teil ist, wobei der zweite Bereich oder Teil die Befestigungsmittel (64, 70) und/oder die elektrisch leitenden Kontaktmittel (32, 34) aufweist.

8. Hörgerätvorrichtung nach einem der Ansprüche 1-7, bei der der Miniaturlautsprecher eine äußere Umrandung in einer zu einer Achse des Miniaturlautsprechers (20) rechtwinkligen Ebene und durch den Schallauslass (22) desselben sowie über einen Großteil seiner Länge von einer am weitesten von dem Auslass (22) entfernten Position und in Richtung des Auslasses (22) aufweist, wobei die äußere Umrandung durch eine vorbestimmte Umrandung begrenzt sein kann.
9. Hörgerätvorrichtung nach einem der Ansprüche 1-8, bei der der Miniaturlautsprecher (20) ein elektromagnetischer Schallwandler oder ein elektrodynamischer Schallwandler ist.
10. Hörgerätvorrichtung nach einem der Ansprüche 1-9, bei der der Miniaturlautsprecher (20) eines oder mehrere von
 - einem Einbauring zum Bereitstellen einer Abdichtung (62) zwischen dem Auslass (22) und dem Miniaturlautsprecher (20), wobei der Ring vorbestimmte Ausmaße aufweist,
 - einem Element (64, 70), das dazu eingerichtet ist, mit dem Gerätegehäuse (12) an dem Auslass (22) in Eingriff zu kommen und den Miniaturlautsprecher nach innen in die erste Kammer vorzuspannen, und
 - einer zwischen dem Auslass und der Umgebung angeordnete Wachsschutzabdichtung (64) aufweist.

Revendications

1. Un appareil d'aide auditive (10) comprenant un logement de dispositif (12) comprenant:
 - un premier compartiment (14) comprenant un orifice de sortie du son en direction de l'entourage du logement,
 - un haut-parleur miniature (20) monté de manière amovible dans le premier compartiment (14) et comprenant un logement de haut-parleur miniature contenant :
 - une sortie sonore (22) disposée dans une première partie zone ou partie prédéterminée du haut-parleur miniature et acoustiquement couplée à l'orifice de sortie du son,
 - une paire de diaphragmes disposés parallèlement (42,44), chacun ayant un premier côté et un second côté opposé, les premiers côtés des diaphragmes ou membranes (42,44) étant disposés de manière opposée, une ou deux chambre(s) arrière(s) étant définie(s) sur les seconds côtés des diaphragmes ou membranes (42,44),
 - un premier chemin/ouverture/tunnel acousti-

- que (48) entre les premiers côtés et la deuxième sortie (22) et
- un deuxième chemin/ouverture/tunnel acoustique (24,45) interconnectant la ou les chambre(s) arrière(s) (50) à un volume d'air confiné dans le premier compartiment (14),
- caractérisé en ce que**
- le logement de dispositif comprend un deuxième compartiment (15) isolé acoustiquement du premier compartiment,
 - le haut-parleur miniature comprend en outre un ou plusieurs moyen(s) de contact électriquement conducteurs (32,34) disposé(s) sur une surface extérieure du logement de haut-parleur et adapté(s) pour fournir une fixation sans soudure avec des moyens de contact en correspondance (32,34) du logement de dispositif (12) et
- en ce que**
- le haut-parleur miniature est monté directement sur le logement de dispositif.
2. Un appareil d'aide auditive selon la revendication 1, dans lequel les moyens de contact électriquement conducteurs (32,34) sont disposés sur une surface extérieure du haut-parleur opposée à la première zone ou partie.
 3. Un appareil d'aide auditive selon la revendication 1 ou 2, comprenant en outre des moyens (64,70) pour fixer de façon amovible le haut-parleur miniature (20) sur le logement de dispositif (12), les moyens de fixation étant utilisables en engageant le logement de dispositif (12) et/ou le haut-parleur miniature (20) depuis l'extérieur du logement de dispositif (12) et/ou du haut-parleur miniature (20).
 4. Un appareil d'aide auditive selon la revendication 3, dans lequel les moyens de fixation (64,70) comprennent un ou plusieurs fermoirs, filetages, couplages à baïonnette, moyens à clé et bandes d'accrochage.
 5. Un appareil d'aide auditive selon l'une quelconque des revendications 1 à 4, dans lequel les moyens de contact électriquement conducteurs (32,34) sont adaptés pour fournir un moyen élastique de contact électriquement conducteur.
 6. Un appareil d'aide auditive selon la revendication 5, dans lequel le moyen élastique de contact électriquement conducteur (32,34) comprend un ressort électriquement conducteur.
 7. Un appareil d'aide auditive selon la revendication 3, le haut-parleur miniature (20) comprenant une seconde zone ou partie prédéterminée au moins sensiblement parallèle à la première zone ou partie, la seconde zone ou partie comprenant les moyens de fixation (64,70) et/ou les moyens de contact électriquement conducteurs (32,34).
 8. Un appareil d'aide auditive selon l'une quelconque des revendications 1 à 7, dans lequel le haut-parleur miniature a un contour extérieur, dans un plan perpendiculaire à un axe du haut-parleur miniature (20) et à travers la sortie de son (22) de ce dernier, et sur la majorité de sa longueur depuis l'emplacement le plus éloigné de la sortie (22) et vers la sortie (22), lequel contour extérieur peut être entouré par un contour prédéterminé.
 9. Un appareil d'aide auditive selon l'une quelconque des revendications 1 à 8, dans lequel le haut-parleur miniature (20) est un transducteur à armature mobile ou un transducteur à bobine mobile.
 10. Un appareil d'aide auditive selon l'une quelconque des revendications 1 à 9, le haut-parleur miniature (20) comprenant en outre un ou plusieurs des éléments suivantes :
 - un anneau de montage pour fournir une étanchéité (62) entre la sortie (22) et le haut-parleur miniature (20), l'anneau ayant des dimensions prédéterminées,
 - un élément (64,70) adapté pour fixer le logement de dispositif (12) sur la sortie (22) et pour forcer le haut-parleur miniature vers l'intérieur de la première chambre, et
 - une étanchéité de maintien à la cire (64) prévue entre la sortie et l'entourage.

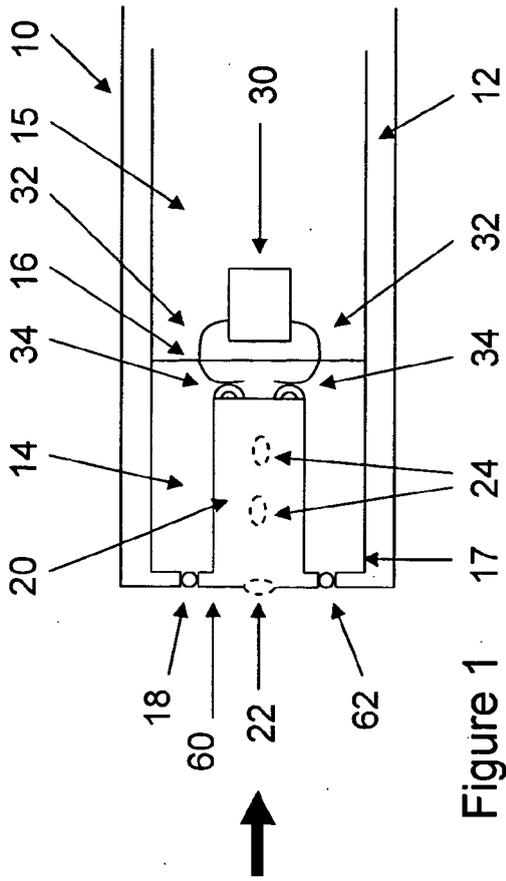


Figure 1

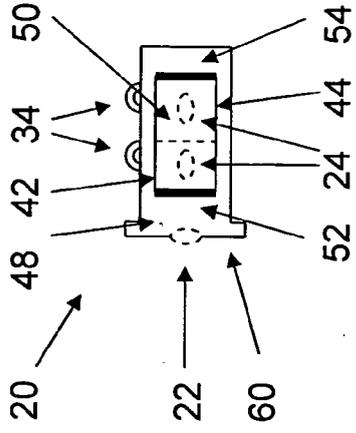


Figure 3

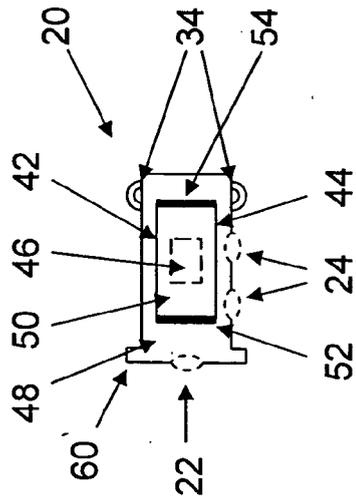


Figure 2

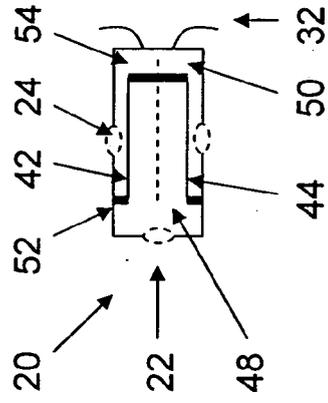


Figure 4

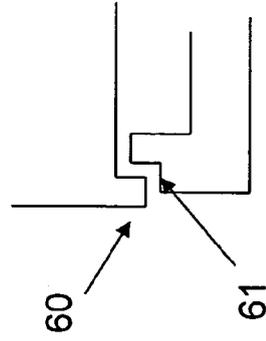


Figure 5

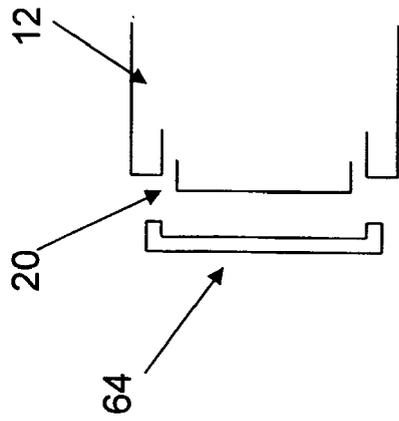


Figure 6

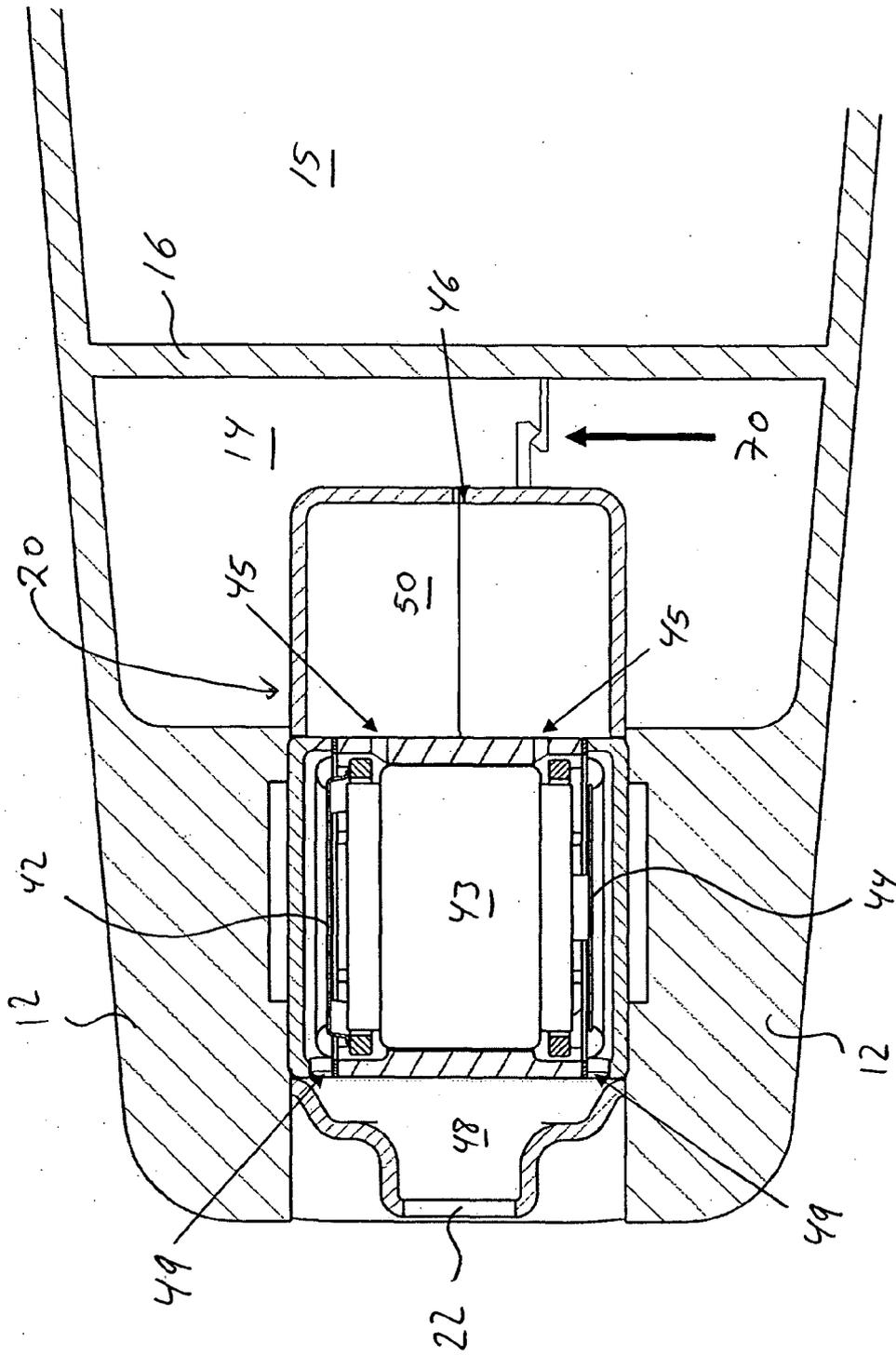


Figure 7

REFERENCES CITED IN THE DESCRIPTION

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