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(54) **ITE HEARING DEVICE WITH MICROPHONE PROTECTOR ELEMENT**

(57) There is provided an ITE hearing device comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn at least in part in the ear canal of the user, and a microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound (20) to reach the microphone. The ITE hearing device further comprises a microphone protector element (14) configured to be inserted into an outer aperture of the sound port so as to cover the sound port for inhibiting ingress of cerumen (26) towards the microphone. The sound port comprises a trough (28) for collecting residual cerumen having passed through the microphone protector element, with the microphone being laterally off-set with regard to the trough. The microphone protector element comprises an outer end portion (34) for covering the outer aperture of the sound port, an inner end portion (36) extending towards the bottom (38) of the trough so as to guide the residual cerumen into the trough, and a lateral opening (40) allowing sound to propagate towards the microphone.

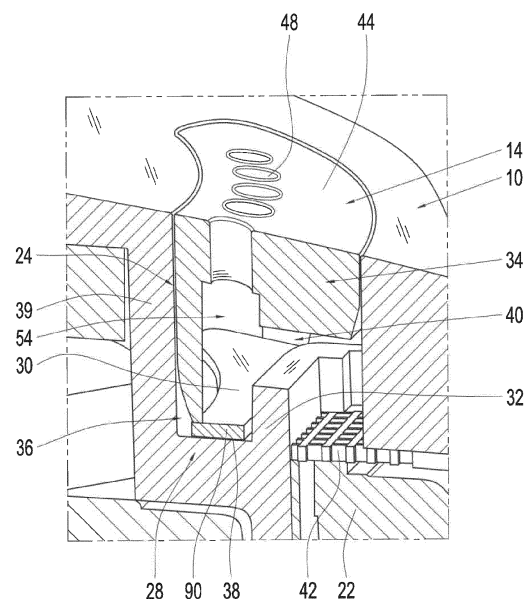


Fig. 5

Description

[0001] The invention relates to an ITE ("in the ear") hearing device comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion oriented towards the exterior of the user's ear when the housing is worn least in part in the ear canal of the user, and a microphone accommodated in the housing, the outer portion of the housing comprising a sound port for allowing ambient sound to reach the microphone.

[0002] Microphones of hearing devices to be worn at least in part in the ear have to be protected from cerumen and other contaminants so as to preserve their functionality. To this end, a microphone protector element may be provided which is removably inserted into an outwardly oriented outer aperture of the sound port so as to cover the sound port for preventing ingress of cerumen towards the microphone. Such microphone protector elements may comprise, for example, a plurality of small holes, see, e.g., EP 1 439 733 B1, a membrane, see, e.g., WO 2008/154954 A1, or a plurality of small holes and a membrane, see, e.g., US 2009/014978 A1. Alternatively, the outer aperture of the sound port may be oriented laterally so that it is actually covered in the outward direction, thereby preventing ingress of cerumen towards the microphone from the outward direction, see, e.g., DE 197 06 306 C1, US 202/0135127 A1 and EP 3 123 743 B1.

[0003] It is an object of the invention to provide for an ITE hearing device with a removable microphone protector element which can be easily cleaned from cerumen.

[0004] It is a further object of the invention to provide for an ITE hearing device with an easily and conveniently insertable microphone protector element.

[0005] It is a further object of the invention to provide for an ITE hearing device with an easily and conveniently removable microphone protector element.

[0006] According to the invention, these objects are achieved by an ITE hearing device as defined in claims 1 and 9, respectively, a microphone protector element as defined in claim 10, an assembly with a tool as defined in claim 11, and a method as defined in claims 13, 14 and 15, respectively.

[0007] ITE hearing device herein refers to a device supporting hearing activity in general which is to be worn at least in part in the ear canal of a user. The hearing device may be used to improve the hearing capability or communication capability of a user, for instance by compensating a hearing loss of a hearing-impaired user, in which case the hearing device is commonly referred to as a hearing instrument such as a hearing aid, or hearing prosthesis. A hearing device may also be used to output sound based on an audio signal which may be communicated by a wire or wirelessly to the hearing device. A hearing device may also be used to reproduce a sound in a user's ear canal received by a microphone. The reproduced sound may be amplified to account for a hearing loss, such as in a hearing instrument, or may be output without accounting for a hearing loss, for instance to pro-

vide for a faithful reproduction of detected ambient sound and/or to add sound features of an augmented reality in the reproduced ambient sound, such as in a hearable. A hearing device may also provide for a situational enhancement of an acoustic scene, e.g. beamforming and/or active noise cancelling (ANC), with or without amplification of the reproduced sound. Different types of ITE hearing devices configured to be worn at least in part in the ear canal of a user include earbuds, hearables, and hearing instruments such as in-the-ear (ITE) hearing aids.

[0008] The invention is beneficial in that, by providing the sound port element with a trough for collecting cerumen, efficient protection of the microphone from cerumen can be achieved.

[0009] The invention is further beneficial in that, by providing the microphone protector element with a trough for collecting cerumen or by providing the microphone protector element with an inner end portion extending towards the bottom of the trough of the sound port so as to guide residual cerumen into the trough, collected cerumen can be easily removed from the ITE hearing device when removing the microphone protector element. In particular, the inner end portion may be provided with a bottom plate which helps collecting and removing the cerumen. Where there is no bottom plate, surfaces of the inner end portion extending towards the bottom of the trough may serve as a guiding surface for the cerumen to flow into the trough.

[0010] The invention is still further beneficial in that, by providing an assembly comprising a tool and a microphone protector element which is fixed at the front end of the tool via a connection with at least one predetermined breaking point, the microphone protector element can be easily and conveniently inserted into the sound port.

[0011] The invention is also beneficial in that, by providing the microphone protector element with a plurality of holes and inserting a pin-like tip of a tool into one of the holes, the microphone protector element can be easily and conveniently removed from the sound port.

[0012] The invention is also beneficial in that, by providing the microphone protector element with a plurality of holes and by providing a punching tool comprising a plurality of pins, each of which conforms with one of the holes of the microphone protector element, the microphone protector element can be easily cleaned from cerumen.

[0013] According to one example, the outer surface of the outer end portion of the microphone protector element may be flush with the outer surface of the outer portion of the housing.

[0014] According to one example, the outer end portion of the microphone protector element may have a plate-like shape; in particular, the outer end portion of the microphone protector element may have a shape of a flat elongate plate. For example, the outer end portion of the microphone protector element may have a banana-like

curvature. The thickness of the outer end portion of the microphone protector element may be from 0.3 to 1.5 mm.

[0015] According to one example, the outer end portion of the microphone protector element may comprise a plurality of holes, such as 3 to 12 holes, for allowing ambient sound to pass through the outer end portion. In particular, the holes may be located above the trough. For example, the holes may have a diameter between 0.2 and 0.9 mm. For example, the holes may be arranged one after the other along a curved line.

[0016] According to another example, the outer end portion of the microphone protector element may comprise a grid or a fur for allowing ambient sound to pass through the outer end portion of the microphone protector element. In particular, the grid or fur may form only a part of the outer surface of the outer end portion of the microphone protector element.

[0017] According to one example, the outer end portion of the microphone protector element may comprise a cavity in a region above the trough so that the thickness of the outer end portion of the microphone protector element is reduced in this region.

[0018] In some implementations, the inner end portion of the microphone protector element may comprise a plate-like element which conforms with the bottom of the trough. According to one example, the plate-like element of the inner end portion of the microphone protector element may be an integral part of the microphone protector element. According to another example, the plate-like element of the inner end portion of the microphone protector element may be a separate part fixed to an intermediate section of the inner end portion of the microphone protector element. For example, the outer end portion and the plate-like element of the inner end portion of the microphone protector element may be connected via at least two column-like connector portions. In particular, the outer end portion and the plate-like element of the inner end portion of the microphone protector element may be connected via a first connector portion provided at one lateral end of the microphone protector element and via a second connector portion provided at an opposite lateral end of the microphone protector element, wherein the lateral opening extends between the first and second connector portion.

[0019] According to one example, the microphone protector element may be detachably held within the sound port by elastic forces; in particular, the microphone protector element may be made of an elastic material having an elasticity of at least 0.5 %. For example, the microphone protector element may be made of at least one of metals, plastics, elastomers and ceramics.

[0020] According to one example, a microphone grid may be provided laterally off-set relative to the trough below the lateral opening of the microphone protector element to protect the microphone from residual cerumen having passed through the microphone protector element.

[0021] In some implementations, the ITE hearing device may further comprise a second one of the microphone protector element inserted in an outer aperture of a second sound port.

[0022] In some implementations, the housing may comprise a shell, wherein the outer end portion of the housing comprises a faceplate fixed at the shell for closing the shell at the side oriented towards the exterior of the user's ear, wherein the sound port is provided in the faceplate. In some implementations, the ITE hearing device is an ITE hearing aid comprising such a shell and faceplate with the sound port in the faceplate.

[0023] In some implementations of the tool of claim 11, the microphone protector element may be made of an elastic material and may comprise a plurality of holes for allowing ambient sound to pass through the microphone protector element towards the microphone(22), wherein a second end of the tool opposite to the first end may comprise a pin-like tip (72) for being inserted into one of the holes so that the microphone protector element when having been detachably inserted into the outer aperture of the sound port is removable from the sound port by withdrawing the tool with the microphone protector element held by elastic forces on the pin-like tip.

[0024] In some implementations of the method of claim 13, the microphone protector element may be provided at the insertion tool via injection molding. For example, the microphone protector element may have an elongate shape with two opposite lateral end portions, wherein the connection to the insertion tool may be formed by two bar-like elements, each extending from another one of the two lateral end portions of the microphone protector element to the insertion tool. In particular, the bar-like elements may be curved.

[0025] In some implementations of the method of claim 14, the hole into which the pin-like tip of the insertion tool is inserted may have a diameter from 0.2 mm to 0.9 mm.

[0026] Preferred embodiments of the invention are defined in the dependent claims.

[0027] Hereinafter, examples of the invention will be illustrated by reference to the attached drawings, wherein:

Fig. 1 is an elevated view of a faceplate of a hearing device according to the invention embodied as an ITE hearing aid with a sound port covered by a microphone protector element according to a first example;

Fig. 2 is a perspective view of the faceplate of Fig. 1, wherein the microphone protector element is shown in a position during insertion or removal;

Fig. 3 is a perspective, partially cut-away view of the faceplate Fig. 1;

Fig. 4A is a perspective view of the faceplate of Fig. 1 wherein the microphone protector element is shown when being inserted into the sound port by an insertion tool;

- Fig. 4B is a view like Fig. 4A when insertion has been completed;
- Fig. 5 is a view like Fig. 3, wherein a second example of a microphone protector element is shown;
- Fig. 6 is a perspective view of the microphone protector element of Fig. 5 prior to insertion with an insertion tool;
- Fig. 7 is a view like Fig. 3, wherein a third example of a microphone protector element is shown;
- Fig. 8 is a perspective view of the microphone protector element of Fig. 7 prior to insertion with an insertion tool;
- Figs. 9A-C are perspective views illustration removal of the microphone protection element according to the first example;
- Fig. 10 is a perspective view of the faceplate of Fig. 1 with a punching tool for cleaning the holes of the microphone protector element; and
- Figs. 11A-C elevated views of variants of the microphone protector element.

[0028] Fig. 1 is an elevated view of a first example of a faceplate 10 of a hearing device embodied as an ITE hearing aid with two symmetrically arranged sound ports 12, each covered by a microphone protector element 14 which is removably inserted into the respective sound port 12 (for illustrative purposes the left-hand microphone protector element 14 is omitted in Fig. 1). The faceplate 10 further comprises a pushbutton 16 for manual operation of the hearing aid by the user and a central circular element 18 with a central pin, which serve as electrical contact surfaces. Fig. 2 is a perspective view of the faceplate 10 of Fig. 1, wherein the microphone protector elements 14 are shown, for illustrative purposes, in a position during insertion into or removal from the respective sound port 12. The faceplate 10 is part of the outer (i.e., outwardly oriented portion) of the housing of the ITE hearing aid and is fixed at a shell of the housing for closing the shell at the side oriented towards the exterior of the user's ear canal when the ITE hearing aid is worn in the ear canal.

[0029] Fig. 3 is a perspective, partially cut-away view of the faceplate 10 of Figs. 1 and 2, which shows one of the microphone protector elements 14, when inserted into the sound port 12, in more detail.

[0030] The sound port 12 is provided for allowing ambient sound 20 to reach a microphone 22 located within the housing of the hearing aid. The microphone protector element 14 is inserted into an outer aperture 24 of the sound port 12 so as to cover the sound port for inhibiting ingress of cerumen 26 towards the microphone 20. The sound port 12 comprises a trough 28 for collecting residual cerumen 26 having passed through the microphone protector element 14 in a collection space 30, with the microphone 20 being laterally off-set with regard to the trough 28 and being separated from the collection space 30 of the trough by a lateral wall 32 (hereinafter, "laterally" or "lateral" indicates a direction which is transverse/per-

pendicular of a direction in which sound enters the sound port 12 through the microphone protector element 14; in case that the outer portion of the housing is formed by a faceplate such lateral direction is essentially parallel to a general plane of the faceplate 10, i.e. roughly transverse to a direction essentially perpendicular to a general plane of the face plate).

[0031] The microphone protector element 14 comprises an outer end portion 34 for covering the outer aperture 24 of the sound port 12 and an inner end portion 36 extending towards the bottom 38 of the trough 28 into the collection space 30, wherein the microphone protector element 14 forms a lateral opening 40 between the outer end portion 34 and the inner end portion 36 for allowing sound to propagate towards the microphone 22. The sound port 12, in particular its backwall 39 opposite to the lateral opening 40, cooperates with the microphone protector element 14, in particular its lateral opening 40, to direct sound towards the microphone 22. In the example shown in Fig. 3 the lateral wall 32 of the trough 28 covers part of the lateral opening 40.

[0032] A microphone grid 42 is provided laterally off-set relative to the trough 28 below the lateral opening 40 of the microphone protector element and the lateral wall 32 of the trough 28 to protect the microphone 22 from residual cerumen having passed through the microphone protector element 14.

[0033] In the example of Fig. 3 the outer surface 44 of the outer end portion 34 of the microphone protector element 14 is flush with the outer surface 46 of the faceplate 10. Such flush arrangement prevents the user's "blind" finger from confusing the microphone protector element 14 with the pushbutton 16, so that operation of the pushbutton is facilitated and inadvertent pollution of the microphone protector element 14 by the user's finger is reduced.

[0034] The microphone protector element 14 may have a dark color so as to conceal pollution / contamination of the microphone protector element 14.

[0035] As shown in Fig. 3, the outer end portion 34 of the microphone protector element 14 may have a plate-like flat shape, with a thickness of for example, from 0.15 mm to 0.8 mm. In particular, the outer end portion 34 of the microphone protector element 14 may have a shape of a flat elongate plate, such as a reniform shape. For example, the outer end portion 34 of the microphone protector element 14 may have a banana-like curvature, as shown in Figs. 1 and 2.

[0036] In the example of Figs. 1 to 3 the outer end portion 34 of the microphone protector element 14 comprises a plurality of holes 48 for allowing ambient sound to pass through the outer end portion 34, with the holes 48 being arranged one after the other along a curved line. The holes 48 may have a diameter between 0.2 mm and 0.9 mm. While in the example five of the holes 48 are shown, there may be a larger or a smaller number of holes 48, such as from 3 to 12.

[0037] Further, the holes 48 are located above the

trough 28, so that residual cerumen passing through one of the holes 48 is collected within the collection space of the trough 28. In particular, by arranging the holes 48 above the trough 28, the microphone 22, which is laterally off-set with regard to the trough, is also laterally off-set with regard to the holes 48, so that a labyrinth-type structure is created wherein the lateral wall 32 of the trough 28 prevents the direct ingress of cerumen towards the microphone 22. Further, the lateral off-set of the microphone 22 relative to the holes is beneficial in that thereby the microphone is protected from damages by thin objects which may pass through the holes 48, such as needles or bristles.

[0038] Moreover, the provision of a cerumen collection trough 28 which is lateral off-set with regard to the microphone 22 allows for less frequent replacement of the microphone protector element 14, thereby enhancing user comfort. In particular, the longer sound path formed by the labyrinth-type structure through the lateral opening extends the usage time of the microphone 22, and its protection is extended.

[0039] While in the example of Figs. 1 to 3 the microphone protector element 14 is provided with a plurality of holes 48 for allowing ambient sound to pass through the microphone protector element 14, the holes 48 could be replaced by other structures, such as a grid 50 or a fur 52 (artificial or natural), which allow ambient sound to pass through the outer end portion 34 of the microphone protector element 14, as schematically illustrated in Figs. 11A-C. The grid 50 or fur 52 may cover substantially the entire the outer surface of the outer end portion of the microphone protector element (Fig. 11A, C) or only part of it (Fig. 11B). It is to be understood that the grid 50 or fur 52 covers a sound opening (not shown in Figs. 11A-C) extending through the outer end portion 34 of the microphone protector element 14.

[0040] Figs. 4A and B illustrate an example of how to insert the microphone protector element 14 into the sound port 12, wherein there is provided an assembly comprising an insertion tool 60 carrying at its front end 62 the microphone protector element 14 which is fixed at the front end 62 of the insertion tool 60 via a connection 64 with at least one predetermined breaking point. The microphone protector element 14 is inserted into the outer aperture of the sound port 12 by moving the insertion tool 60 accordingly until the outer end portion 34 of the microphone protector element 14 is flush with the outer surface 46 of the faceplate 10 (Fig. 4A). Then the insertion tool 60 is tilted relative to the inserted microphone protector element 14 so as to detach the insertion tool 60 from the microphone protector element 14 by breaking the connection 64 at the at least one predetermined breaking point. Finally, the insertion tool 60 is removed (Fig. 4B). The insertion tool 60 may have a shape similar to a pencil or rod.

[0041] For example, the microphone protector element 14 may be provided at the insertion tool 60 via injection molding; in particular, the insertion tool 60 and the mi-

crophone protector element 14 may be integrally formed as one piece by an injection molding process.

[0042] In the example shown in Figs. 4A,B the microphone protector element 14 has an elongate shape with two opposite lateral end portions 14A, 14B, wherein the connection 64 to the insertion tool 60 is formed by two bar-like elements 64A, 64B, each extending from another one of the two lateral end portions of the microphone protector element to the insertion tool 60. The bar-like elements 64A, 64B may be curved, as shown in Fig. 4A.

[0043] While in Fig. 4A the insertion tool 60 carries only one of the two microphone protector elements 14, both microphone protector elements 14 may be provided, at the correct mutual distance given by the distance of the two sound ports 12, at the insertion tool 60, so as to allow for simultaneous insertion into two sound ports 12.

[0044] Providing the microphone protector element(s) 14 at the tip of an insertion tool 60 facilitates handling of the microphone protector elements 14 during insertion into the sound port 12; in particular, the need for using a microscope may be eliminated thereby.

[0045] After insertion the microphone protector element 14 is detachably held within the sound port 12 by elastic forces. For example, the microphone protector element 14 may be made of an elastic material having an elasticity of at least 0.5 %; in particular, the microphone protector element 14 may be made of at least one of metals, plastics, elastomers and ceramics. According to one example, the walls of the sound port 12 and/or the microphone protector element 14 may be provided with press ribs. Alternatively, the dimensions of the sound port 12 and/or the microphone protector element 14 are selected for providing press fit of the microphone protector element 14 within the sound port 12.

[0046] An example of how the microphone protector element 14 may be removed, for replacement, from the sound port 12 is illustrated in Figs. 9A-C, wherein a pin-like tip 72 of a removal tool 70 is inserted into one of the holes 48 (Fig. 9B) and then the microphone protector element 14 is removed from the sound port 12 by withdrawing the removal tool 70 with the microphone protector element 14 held by elastic forces on the pin-like tip 72 (Fig. 9C). The hole 48 into which the pin-like tip 72 of the removal tool 70 is inserted may have the same diameter as the other holes 48, or its diameter may deviate from that of the other holes; for example, the hole 48 may have a diameter from 0.2 mm to 0.9 mm. The removal tool 70 may have a shape similar to a pencil or rod. By inserting a pin-like tip 72 of a removal tool 70 is inserted into one of the holes 48 the microphone protector element 14 can be removed in very simply and convenient way.

[0047] According to one example, the insertion tool 60 and the removal tool 70 may be combined into a single combined tool wherein one of the two opposite end portions is formed by the insertion tool 60 carrying at its end the microphone protector element 14 and the other end portion is formed by the removal tool 70 having at its end the pin-like tip 72. Thus, after having detachably inserted

the microphone protector element 14 into the sound port 12 (and accordingly having broken the connection 64), i.e., after having used the combined tool as an insertion tool, the combined tool can be used as a removal tool by inserting the pin-like tip 72 into one of the holes 48 for removing again the microphone protector element 14 when necessary.

[0048] An example of how the microphone protector element 14 may be cleaned, while remaining inserted within the sound port 12, is schematically illustrated in Fig. 10, wherein a punching tool 80 is provided which comprises a plurality of pins 82, each of which conforms with one of the holes 48 of the microphone protector element 14. The pins 82 of the punching tool 80 are inserted into the holes 48 of the microphone protector element 14 so as to free the holes 48 from cerumen, with the displaced cerumen being collected by the trough 48. Finally, the pins 82 of the punching tool 80 are withdrawn from the holes 48 of the microphone protector element 14.

[0049] The punching tool 80 provides for a convenient and efficient way of cleaning the microphone protector element 14 without a need to remove the microphone protector element 14 from the sound port 12.

[0050] In the example of Figs. 1 to 3 the inner end portion 36 of microphone protector element 14 is fully open towards bottom 38 of the trough 28, with a column-like element 35A, 35B provided at each of the lateral end portions 14A, 14B extending into the trough 28 towards the bottom 38 of the trough 28 so as to guide residual cerumen into the trough 28, wherein surfaces of the column-like elements 35A,B may serve as a guiding surface for the cerumen to flow into the trough 28. In alternative implementations the inner end portion 36 of the microphone protector element 14 may comprise a plate-like element 90 extending along the bottom 38 of the trough 28 so as to collect residual cerumen in the trough 28. In particular, the plate-like element 90 may conform with the bottom 38 of the trough. Thereby the microphone protector element 14, when being removed from the sound port 12, provides for removal of most or all of the residual cerumen collected within the trough 28, thereby facilitating cleaning of the sound port 12.

[0051] According to one example, the plate-like element 90 of the inner end portion 36 of the microphone protector element may be a separate part, such as a plate, fixed to an intermediate section of the inner end portion 36 of the microphone protector element 14 formed by the column-like elements 35A,B, as illustrated in Figs. 5 and 6, wherein Fig. 6, similar to Fig. 4A, shows an assembly comprising an insertion tool 60 carrying at its front end 62 the microphone protector element 14 which is fixed at the front end 62 of the insertion tool 60 via a connection 64 with at least one predetermined breaking point, and wherein Fig. 5, like Fig. 3, shows the microphone protector element 14 after having been inserted into the sound port 12.

[0052] According to an alternative example, the plate-like element 90 of the inner end portion 36 of the micro-

phone protector element 14 may be an integral part of the microphone protector element 14, as illustrated in Figs 7 and 8, wherein Fig. 8, similar to Fig. 4A, shows an assembly comprising an insertion tool 60 carrying at its front end 62 the microphone protector element 14 which is fixed at the front end 62 of the insertion tool 60 via a connection 64 with at least one predetermined breaking point, and wherein Fig. 7, like Fig. 3, shows the microphone protector element 14 after having been inserted into the sound port 12.,

[0053] In both examples, the outer end portion 34 and the plate-like element 90 of the microphone protector element 14 may be connected via at least two column-like connector portions 35A, 35B, preferably each one provided at one of the lateral end portions 14A, 14B, respectively.

[0054] Thereby the outer end portion 34 and plate-like element 90 of the inner end portion 36 of the microphone protector element 14 are connected via a first connector portion 35A provided at one lateral end 14A of the microphone protector element 14 and via a second connector portion 35B provided at the opposite lateral end 14B of the microphone protector element 14, so that a lateral opening 40 of the microphone protector element 14 oriented towards the microphone 22 extends between the first and second connector portion 35A, 35B.

[0055] According to Figs. 5 and 7 the outer end portion 34 of the microphone protector element 14 comprises a cavity 54 in a region above the trough 28 so that the thickness of the outer end portion 34 of the microphone protector element 14 is reduced in this region.

[0056] While in the examples described so far the trough 28 is implemented as part of the sound port 12, in alternative implementations the trough could be implemented by the inner end portion of the microphone protector element, as a modification of the examples of Figs. 5 to 8, i.e., the inner end portion 36 could be formed as a trough.

[0057] While in all examples described so far the sound ports with the microphone protection elements have been provided in faceplate, in alternative implementations the sound ports with the microphone protection elements could be provided in the shell (in case the shell has a portion which is oriented towards the exterior of the user's ear when the shell is worn in the ear canal or, more generally, the sound ports with the microphone protection elements could be provided in an outer portion of the housing oriented towards the exterior of the user's ear when the shell is worn in the ear canal.

Claims

1. An ITE hearing device, comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn at least in part in the ear canal of the user, and a

microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound (20) to reach the microphone,

- wherein the ITE hearing device further comprises a microphone protector element (14) configured to be inserted into an outer aperture of the sound port so as to cover the sound port for inhibiting ingress of cerumen (26) towards the microphone, 5
 - wherein the sound port comprises a trough (28) for collecting residual cerumen having passed through the microphone protector element, with the microphone being laterally off-set with regard to the trough, 10
 - wherein the microphone protector element comprises an outer end portion (34) for covering the outer aperture of the sound port and 15
 - an inner end portion (36) extending towards the bottom (38) of the trough so as to guide the residual cerumen into the trough, and wherein 20
 - the microphone protector element (14) comprises a lateral opening (40) allowing sound to propagate towards the microphone. 25
2. The ITE hearing device of claim 1, wherein the outer surface (44) of the outer end portion (34) of the microphone protector element (14) is flush with the outer surface (46) of the outer portion (10) of the housing. 30
 3. The ITE hearing device of one of the preceding claims, wherein the outer end portion (34) of the microphone protector element (14) comprises a plurality of holes (48) for allowing ambient sound (20) to pass through the outer end portion. 35
 4. The ITE hearing device of claim 3, wherein the holes (48) are located above the trough (28), wherein the outer end portion (34) of the microphone protector element (14) comprises 3 to 12 of the holes (48) for allowing ambient sound to pass through the outer portion wherein the holes (48) have a diameter between 0.2 and 0.9 mm, and/or wherein the holes (48) are arranged one after the other along a curved line. 40 45
 5. The ITE hearing device of one of the preceding claims, wherein the inner end portion (36) of the microphone protector element (14) comprises a plate-like element (90) which conforms with the bottom (38) of the trough (28). 50
 6. The ITE hearing device of claim 5, wherein the plate-like element (90) of the inner end portion (36) of the microphone protector element (14) is an integral part of the microphone protector element, or wherein the plate-like element (90) of the inner end portion (36) 55

of the microphone protector element (14) is a separate part fixed to an intermediate section (35A,B) of the inner end portion (36) of the microphone protector element.

7. The ITE hearing device of one of claims 5 and 6, wherein the outer end portion (34) and the plate-like element (90) of the inner end portion (36) of the microphone protector element (14) are connected via at least two column-like connector portions (35A, B).
 8. The ITE hearing device of claim 7, wherein the outer end portion (34) and the plate-like element (90) of the inner end portion (36) of the microphone protector element (14) are connected via a first connector portion (35A) provided at one lateral end (14A) of the microphone protector element and via a second connector portion (35B) provided at an opposite lateral end (14B) of the microphone protector element, and wherein the lateral opening (40) extends between the first and second connector portion.
 9. An ITE hearing device, comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn least in part in the ear canal of the user, and a microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound to reach the microphone, 60
- wherein the ITE hearing device further comprises a microphone protector element (14) configured to be inserted into an outer aperture of the sound port so as to cover the sound port for inhibit ingress of cerumen (26) towards the microphone, 65
- wherein the microphone protector element comprises an outer end portion (34) for covering the outer aperture of the sound port and an inner end portion forming a trough (28) for collecting residual cerumen having passed through the microphone protector device, with the microphone being laterally off-set with regard to the trough, and wherein the microphone protector element forms a lateral opening (40) between the outer end portion and the inner end portion allowing sound to propagate towards the microphone. 70
10. A microphone protector element configured to be inserted into an outer aperture of a sound port (12) of an outer portion (10) of a housing of an ITE hearing device so as to cover the sound port for inhibiting ingress of cerumen (26) towards a microphone (22) accommodated in the housing, wherein the microphone protector element (14) comprises an outer end portion (34) for covering the outer aperture of 75

the sound port, an inner end portion (36) for extending towards the bottom (38) of a trough (28) of the sound port for collecting residual cerumen having passed through the microphone protector element, the inner end portion configured to guide the residual cerumen into the trough, and a lateral opening (40) allowing ambient sound to propagate towards the microphone.

11. An assembly comprising a tool (60) and a microphone protector element (14) carried at a first end (62) of the tool, wherein the microphone protector element is configured to be inserted into an outer aperture of a sound port (12) of an outer portion (10) of a housing of an ITE hearing device so as to cover the sound port for inhibiting ingress of cerumen (26) towards a microphone (22) accommodated in the housing, wherein the microphone protector element is fixed at the first end of the insertion tool via a connection (64A,B) having at least one predetermined breaking point when the tool is tilt relative to the microphone protector element after having been inserted into the outer aperture of the sound port, so as to the detach the tool from the microphone protector element by breaking the connection at the at least one predetermined breaking point.
12. The assembly of claim 11, wherein the microphone protector element (14) is made of an elastic material and comprises a plurality of holes (48) for allowing ambient sound to pass through the microphone protector element towards the microphone (22), and wherein a second end of the tool opposite to the first end comprises a pin-like tip (72) for being inserted into one of the holes so that the microphone protector element when having been detachably inserted into the outer aperture of the sound port is removable from the sound port by withdrawing the tool with the microphone protector element held be elastic forces on the pin-like tip.
13. A method for assembling an ITE hearing device comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn least in part in the ear canal of the user, and a microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound (20) to reach the microphone, the method comprising:

providing an assembly comprising an insertion tool (60) carrying at its front end a microphone protector element (14) configured to be inserted into an outer aperture of the sound port so as to cover the sound port for inhibiting ingress of cerumen (26) towards the microphone, wherein

the microphone protector element is fixed at the front end (62) of the insertion tool via a connection (64A,B) with at least one predetermined breaking point;

inserting, by moving the tool with the microphone protector element, the microphone protector element into the outer aperture of the sound port;

tilting the tool relative to the inserted microphone protector element so as to the detach the tool from the microphone protector element by breaking the connection at the at least one predetermined breaking point; and
removing the tool.

14. A method for maintaining an ITE hearing device comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn least in part in the ear canal of the user, and a microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound (20) to reach the microphone, wherein a microphone protector element (14) made of an elastic material and comprising a plurality of holes (48) has been detachably inserted into an outer aperture of the sound port so as to cover the sound port for preventing ingress of cerumen (26) towards the microphone; the method comprising:

inserting a pin-like tip (72) of a removal tool (70) into one of the holes; and

removing microphone protector element from the sound port by withdrawing the insertion tool with the microphone protector element held be elastic forces on the pin-like tip.

15. A method for maintaining an ITE hearing device comprising a housing to be worn at least in part in the ear canal of a user and including an outer portion (10) oriented towards the exterior of the user's ear when the housing is worn least in part in the ear canal of the user, and a microphone (22) accommodated in the housing, the outer portion of the housing comprising a sound port (12) for allowing ambient sound (20) to reach the microphone, wherein a microphone protector element (14) comprising a plurality of holes (48) has been detachably inserted into an outer aperture of the sound port so as to cover the sound port for inhibiting ingress of cerumen (26) towards the microphone, wherein the sound port comprises a trough (28) for collecting residual cerumen having passed through the microphone protector element, with the microphone being laterally off-set with regard to the trough, the method comprising:

providing a punching tool (80) comprising a plu-

ality of pins (82), each of which conforms with one of the holes (48) of the microphone protector element (14);

inserting the pins of the punching tool into the holes of the microphone protector element so as to free the holes from cerumen, with the cerumen being collected by the trough; and withdrawing the pins of the punching tool from the holes of the microphone protector element.

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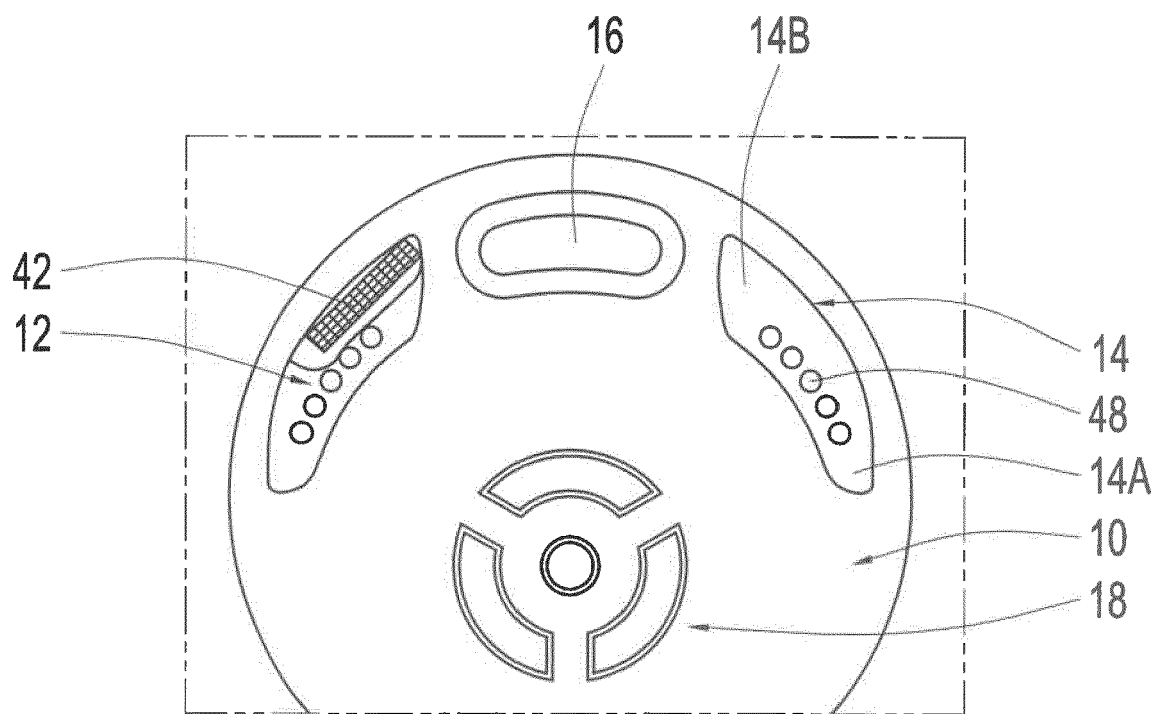


Fig. 1

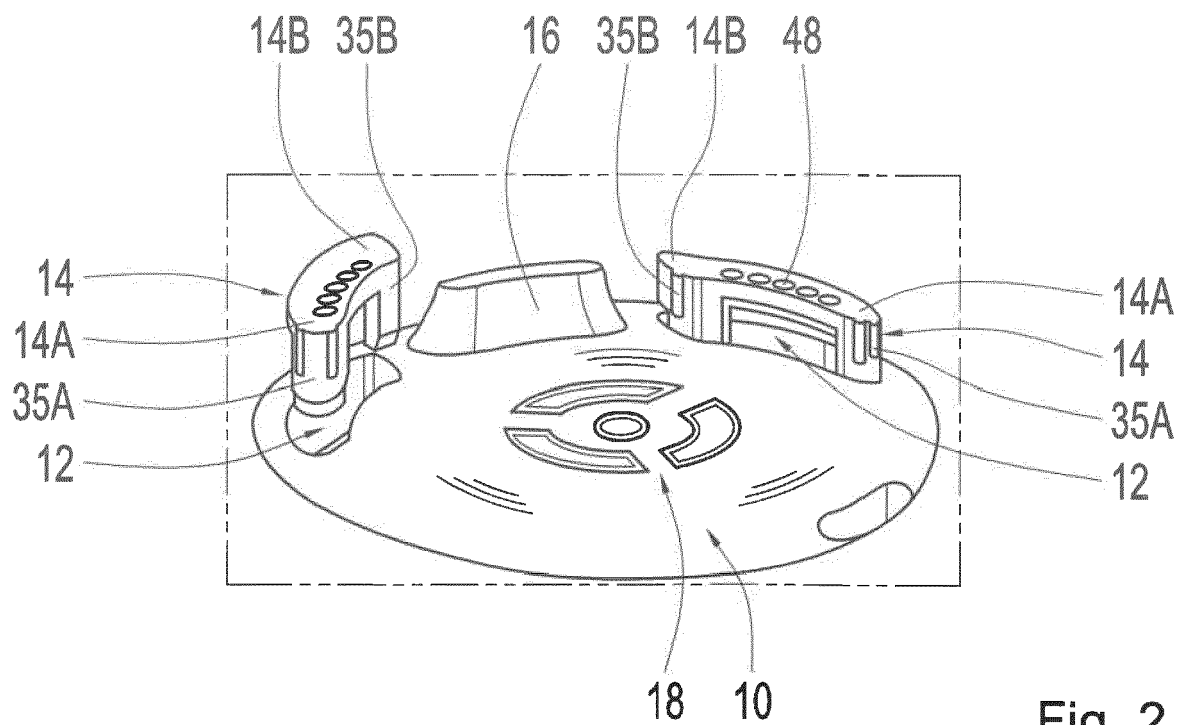


Fig. 2

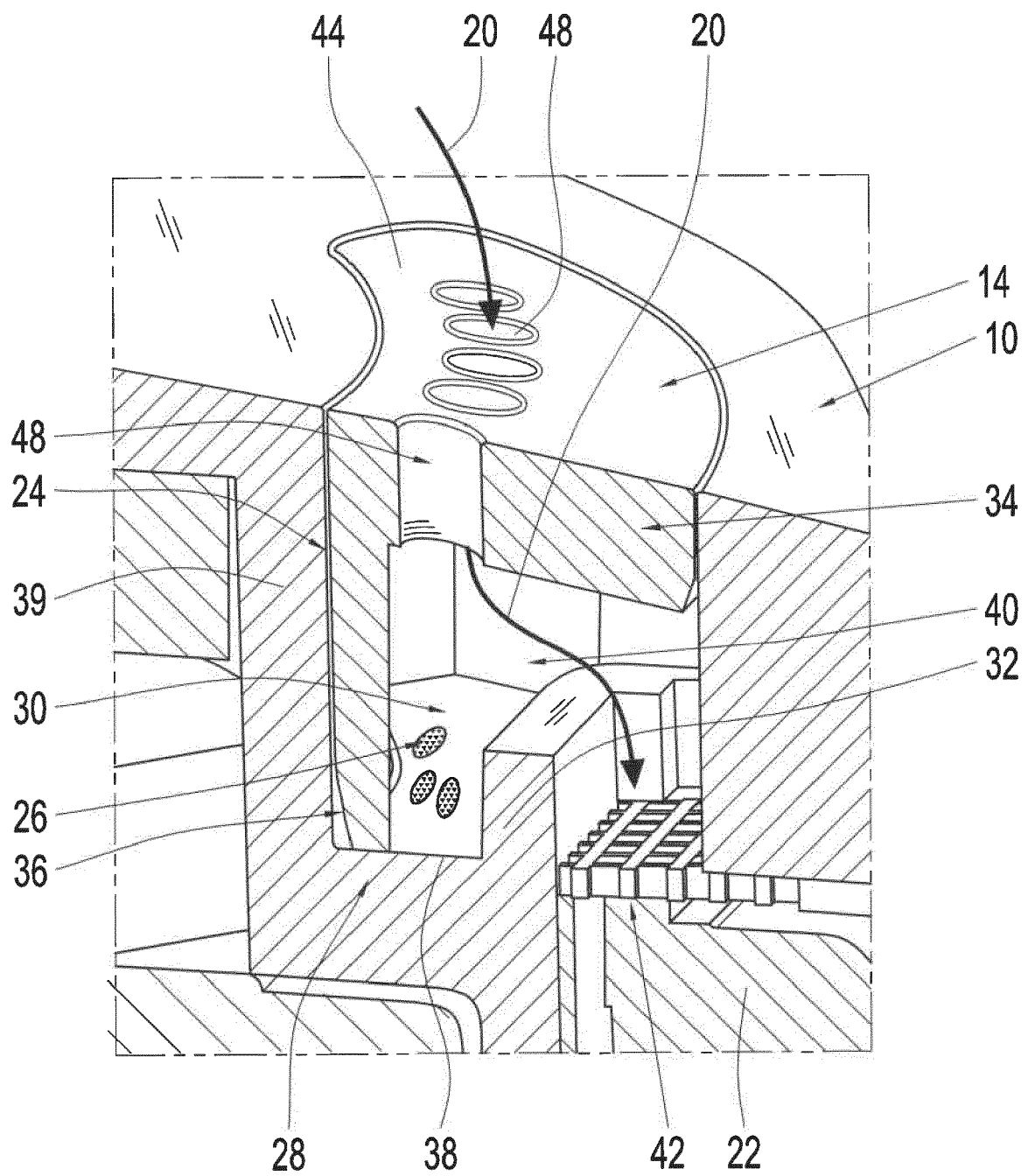


Fig. 3

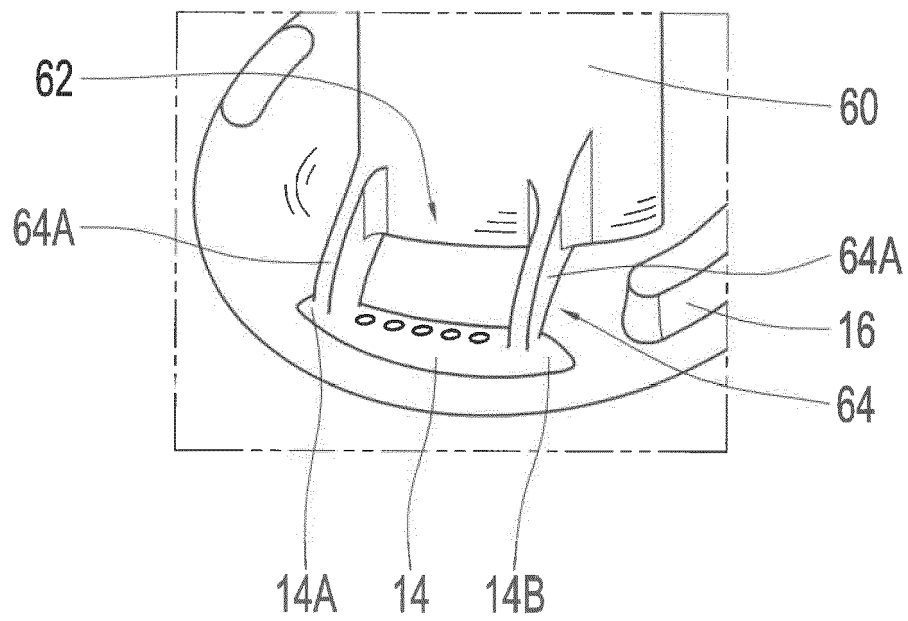


Fig. 4A

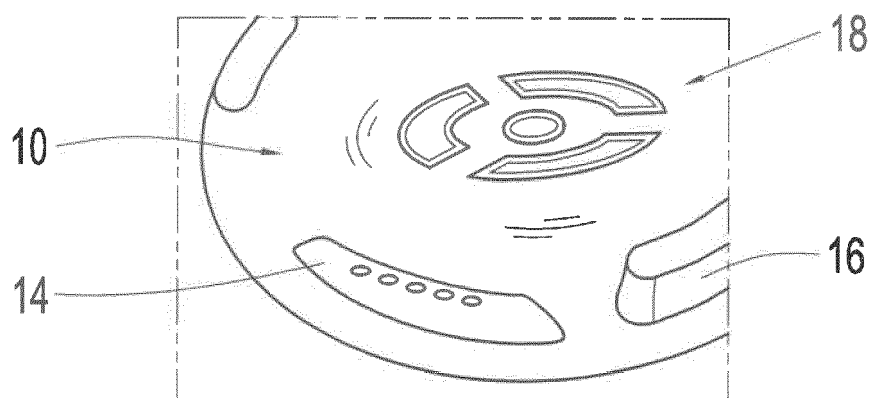


Fig. 4B

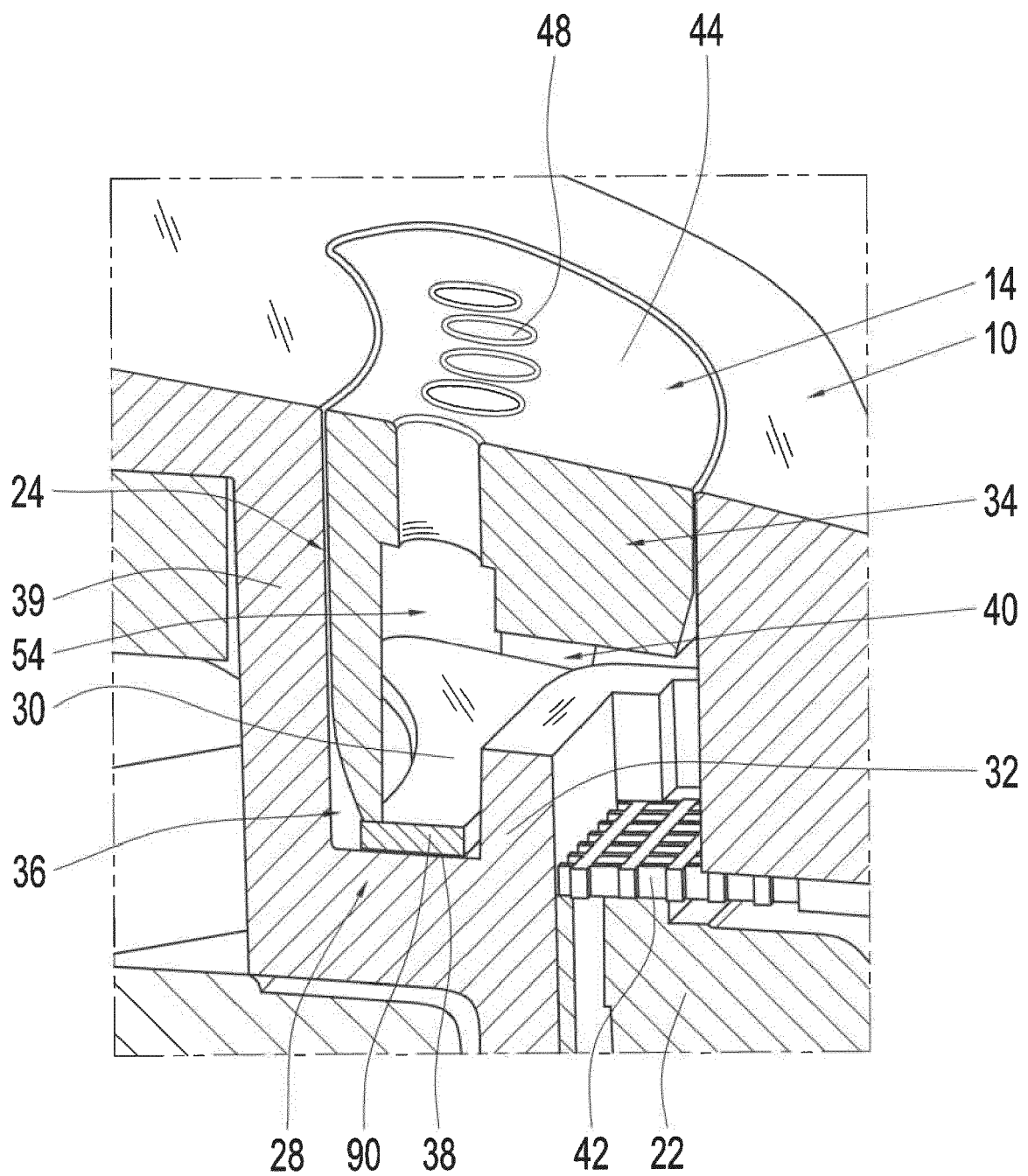


Fig. 5

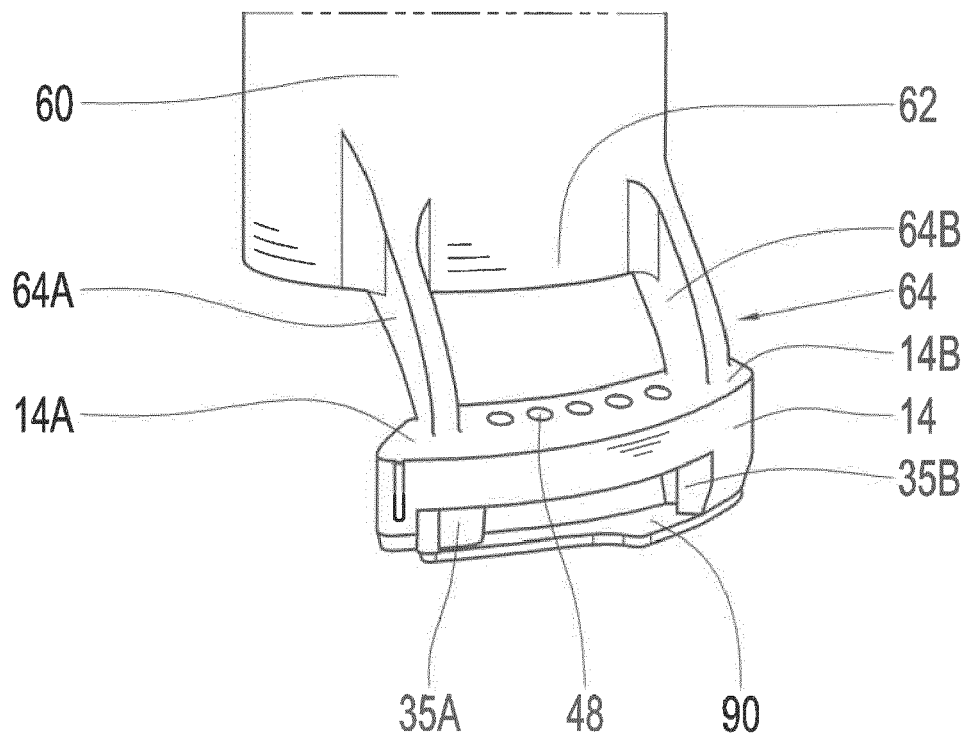


Fig. 6

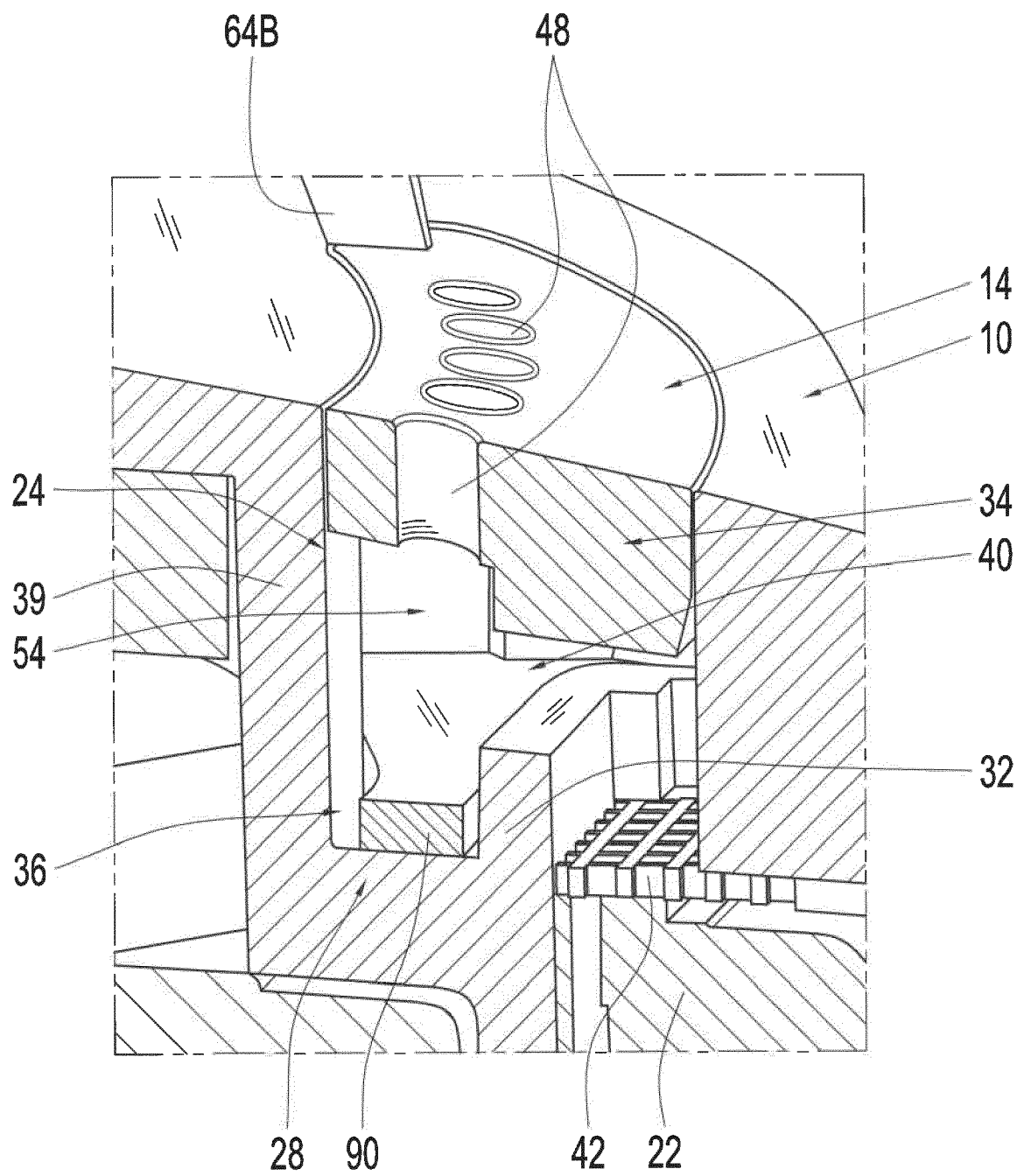


Fig. 7

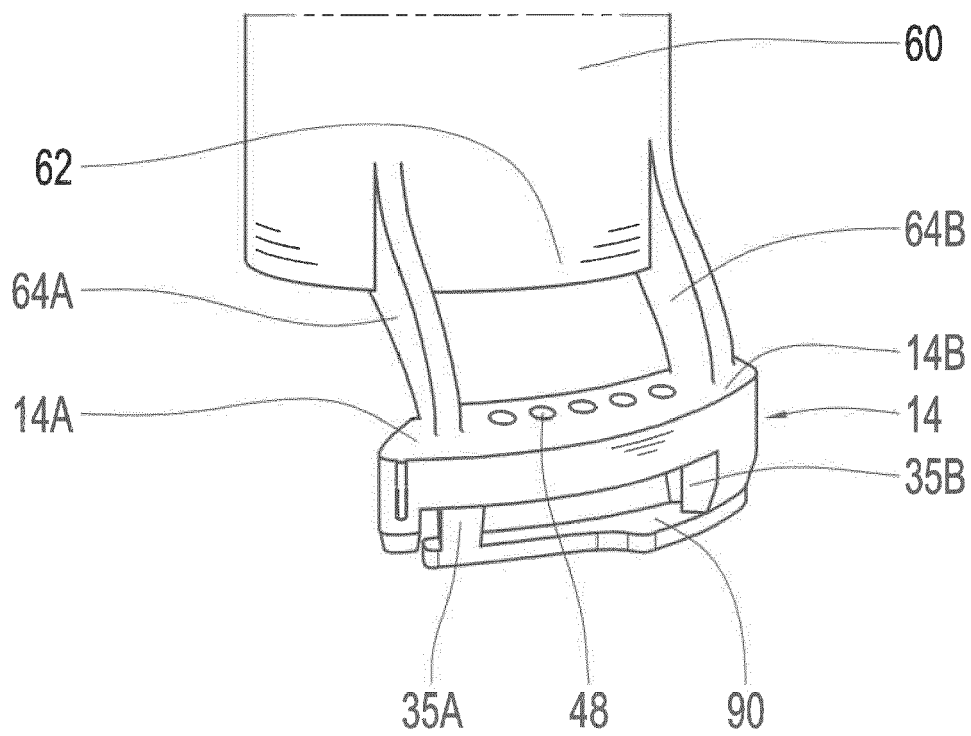


Fig. 8

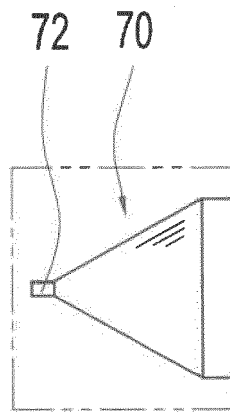


Fig. 9A

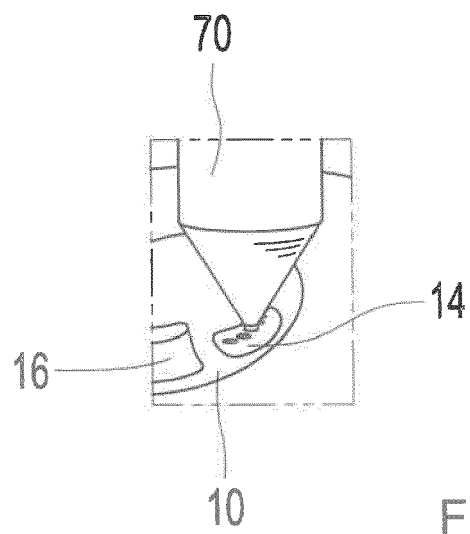


Fig. 9B

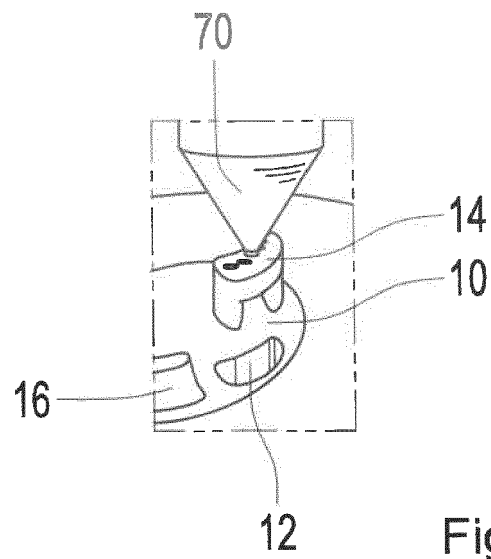
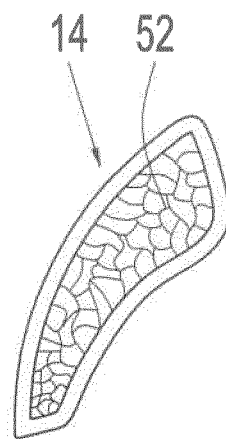
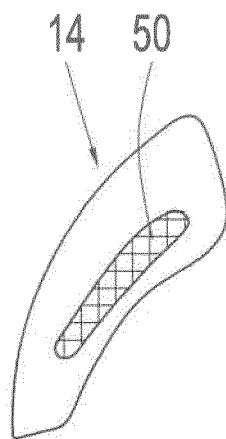
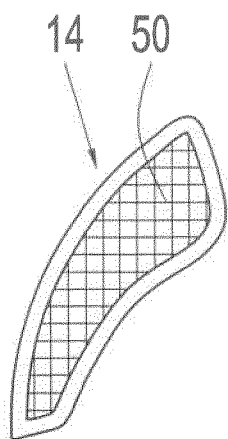
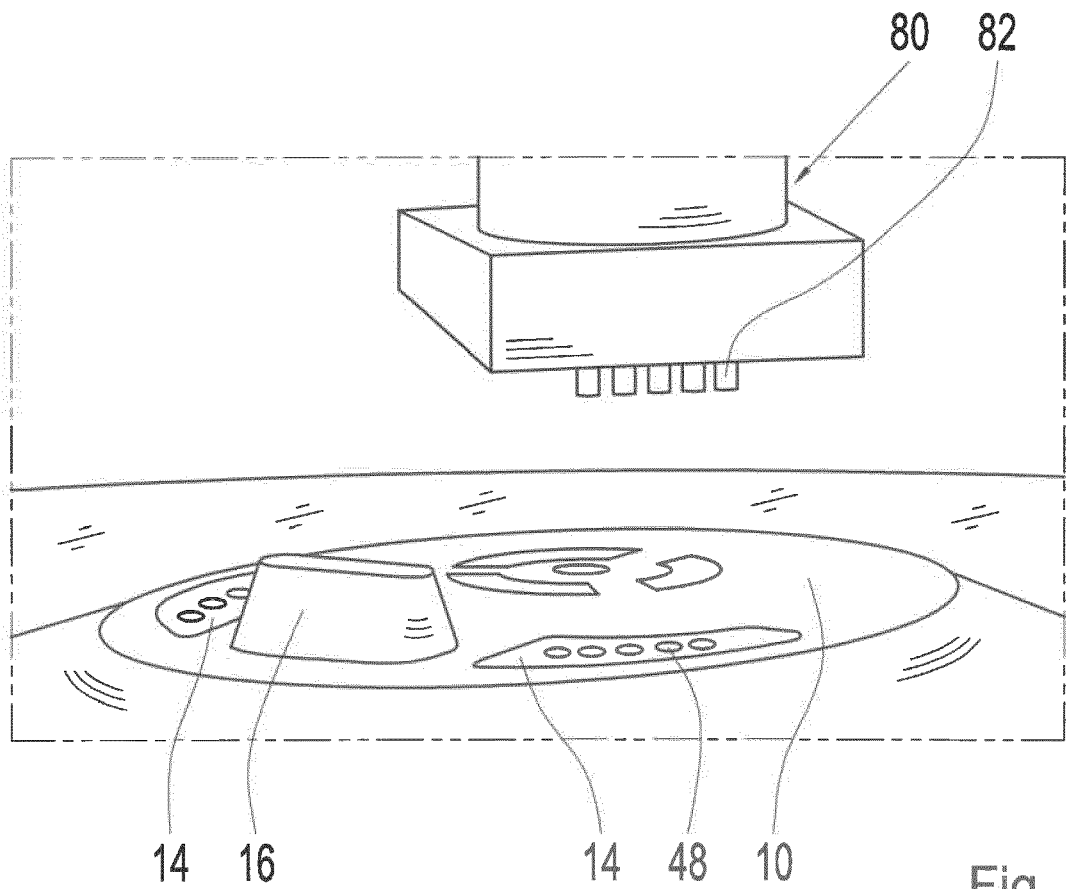


Fig. 9C





EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 101 04 129 A1 (GREINER E A OLAF [CH]) 14 August 2002 (2002-08-14) * paragraph [0004] - paragraph [0005]; figure 10 * * paragraph [0039] - paragraph [0044]; figures 1-4 * * claim 1 * -----	1-10	INV. H04R25/00
A	US 2016/165334 A1 (GROSSMAN ALEX [US]) 9 June 2016 (2016-06-09) * paragraph [0014] - paragraph [0026]; figures 1-4 * -----	1-10	
A	US 2016/165368 A1 (STEWART JAY [US]) 9 June 2016 (2016-06-09) * paragraph [0011]; figure 3 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			H04R
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 July 2023	Examiner Guillaume, Mathieu
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

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- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

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- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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see sheet B

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- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

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- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

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- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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1-10

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- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 23 15 4414

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-10

An in-the-ear hearing device comprising a microphone and a microphone protector element, with the microphone being laterally off-set with regard to a trough comprised in the microphone protector element, the trough for collecting residual cerumen having passed through the microphone protector device, and wherein the microphone protector element forms a lateral opening allowing sound to propagate towards the microphone.

2. claims: 11-15

An in-the-ear hearing device comprising a microphone protector element with provision of tools for facilitating handling of the microphone protector element.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 15 4414

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-07-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10104129 A1	14-08-2002	NONE	
US 2016165334 A1	09-06-2016	TW 201633798 A	16-09-2016
		US 2016165334 A1	09-06-2016
		WO 2016089671 A1	09-06-2016
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REFERENCES CITED IN THE DESCRIPTION

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- WO 2008154954 A1 [0002]
- US 2009014978 A1 [0002]
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