



(11)

EP 4 340 393 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.03.2024 Bulletin 2024/12

(51) International Patent Classification (IPC):
H04R 25/00 ^(2006.01) **H04R 1/10** ^(2006.01)

(21) Application number: **22195602.2**

(52) Cooperative Patent Classification (CPC):
H04R 25/60; H04R 1/1083; H04R 2225/021;
H04R 2225/0216; H04R 2225/57; H04R 2460/01

(22) Date of filing: **14.09.2022**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Sonova AG**
8712 Stäfa (CH)

(72) Inventor: **KÖHLER, Simon**
8712 Stäfa (CH)

(74) Representative: **Liedtke & Partner Patentanwälte**
Gerhart-Hauptmann-Straße 10/11
99096 Erfurt (DE)

(54) **HEARING DEVICE**

(57) The invention relates to a hearing device (1), comprising a RIC assembly (2) configured to be worn in an ear canal, the RIC assembly (2) having a shell (7) containing a receiver (13), wherein the RIC assembly (2) comprises multiple electrical connection pads (9), the hearing device (1) further comprising an ANC module

(11) configured to be releasably coupled to the RIC assembly (2) and to perform active noise cancelling, the ANC module (11) having electrical connectors (19) configured for electrically contacting the electrical connection pads (9).

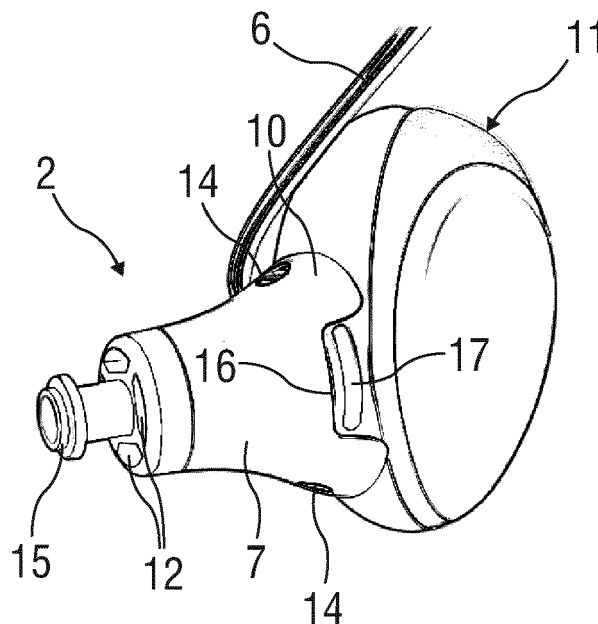


FIG 11

Description

Technical Field

[0001] The invention relates to a hearing device.

Background of the Invention

[0002] Active noise cancelling technology (ANC) in hearing aids can provide a significant increase in hearing performance compared to traditional hearing aid couplings and receivers. The three main use cases, where an ANC hearing aid can provide significant benefit, are:

1. Communication in noise: In a loud and challenging communication scene (e.g. restaurant), ANC can reduce direct sound and occlusion sound at the same time and is therefore able to make the hearing aid audible over the whole frequency range of interest (e.g. 100 Hz - 10 kHz) without adding any dominant disturbing occlusion effect.
2. Tune out: When listening to streamed audio in loud environments (e.g. airplane, train), ANC can attenuate disturbing ambient noise much better compared to a traditional hearing aid coupling without ANC. This results in better comfort in noise.
3. Sound quality: ANC requires a speaker with high output at low frequencies, which means also that the perceived sound quality of streamed audio is increased compared to traditional hearing aid receivers.

[0003] However, ANC typically requires a larger speaker and/or earpiece size compared to traditional hearing aids. Bulky earpieces are typically less in demand, especially if the device is intended to be worn the full day.

Summary of the Invention

[0004] It is an object of the present invention to provide a novel hearing device.

[0005] The object is achieved by a hearing device according to claim 1.

[0006] Exemplary embodiments of the invention are given in the dependent claims.

[0007] According to the invention, a hearing device comprises a RIC assembly, also referred to as a receiver-in-the-canal assembly or earpiece part, configured to be worn in an ear canal, the RIC assembly having a shell containing a receiver, wherein the RIC assembly comprises multiple electrical connection pads, the hearing device further comprising an ANC module, also referred to as an active noise cancelling module, configured to be releasably coupled to the RIC assembly and to perform active noise cancelling, the ANC module having electrical connectors configured for electrically contacting the electrical connection pads.

[0008] In an embodiment, the RIC assembly comprises one or more acoustic ANC canals configured to lead sound from the ANC module into the ear canal bypassing the receiver when the RIC assembly is worn in the ear canal and when the ANC module is coupled to the RIC assembly.

[0009] In an embodiment, the RIC assembly further comprises a cup-shaped receptacle at a lateral end of the shell, the receptacle configured to receive the ANC module or a portion thereof.

[0010] In an embodiment, the ANC module is configured to be retained on the RIC assembly by magnetic force.

[0011] In an embodiment, the magnetic force is provided by one or more magnets arranged on the RIC assembly and/or on the ANC module. The other one of the RIC assembly and the ANC module may also have one or magnets or one or more elements made of a magnetisable material.

[0012] In an embodiment, the one or more magnets are arranged in or on the receptacle.

[0013] In an embodiment, the ANC module is shaped to fit to the lateral end of the RIC assembly.

[0014] In an embodiment, the ANC module is shaped to match the receptacle.

[0015] In an embodiment, the receptacle has a recess and the ANC module has a locator rib matching the recess or vice versa, so that the ANC module couples to the RIC assembly in a defined position such that the electrical connectors of the ANC module connect to the electrical connection pads of the RIC assembly.

[0016] In an embodiment, the hearing device further comprises a BTE assembly, also referred to as a behind the ear assembly, coupled or configured to be coupled to the RIC assembly by a cable.

[0017] In an embodiment, the RIC assembly and/or the BTE assembly are/is configured to automatically detect and activate the ANC module once the electrical connectors contact the electrical connection pads.

[0018] In an embodiment, the ANC module further includes a speaker and two microphones, one of the microphones facing toward the RIC assembly and another one of the microphones facing away from the RIC assembly when the ANC module is coupled to the RIC assembly.

[0019] In an alternative embodiment, the inwards facing microphone could be arranged in the RIC assembly. This would be beneficial from an acoustic point of view; however, more electrical connection pads and electrical connectors may be required.

[0020] In an embodiment, circuitry configured to perform the active noise cancelling is arranged in one of the ANC module, the RIC assembly and the BTE assembly or is distributed over at least two of these components.

[0021] In an embodiment, the ANC module is powered through the RIC assembly from a battery located in the RIC assembly or in the BTE assembly.

[0022] In an embodiment, the RIC assembly further

comprises a dome at a medial end of the shell, the dome having an open coupling.

[0023] The solution according to the invention is a hearing aid system, which can be situationally upgraded with active noise cancelling technology, resulting in better hearing performance when needed and only reduces discreteness in these specific situations. For the rest of the day, the hearing aid system may remain discrete and nicely hidden.

[0024] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Brief Description of the Drawings

[0025] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

Figure 1 is a schematic view of a hearing device,
 Figure 2 is a schematic view of an RIC assembly,
 Figure 3 is another schematic view of the RIC assembly,
 Figure 4 is a schematic view of the hearing device with an ANC module being added to the RIC assembly,
 Figure 5 is a schematic view of the hearing device with the ANC module coupled to the RIC assembly,
 Figure 6 is a schematic view of the RIC assembly with the dome removed from a sound port of the RIC assembly,
 Figure 7 is another schematic view of the RIC assembly with the dome removed, and
 Figure 8 is another schematic view of the RIC assembly with the dome removed,
 Figure 9 is a schematic view of the RIC assembly with the dome attached to the sound port of the RIC assembly,
 Figure 10 is another schematic view of the RIC assembly with the dome attached to the sound port of the RIC assembly,
 Figure 11 is a schematic view of the RIC assembly with the ANC module, and
 Figure 12 is a schematic view of the ANC module with electrical connectors.

[0026] Corresponding parts are marked with the same reference symbols in all figures.

Detailed Description of Preferred Embodiments

[0027] Figure 1 is a schematic view of a hearing device 1, comprising an RIC assembly 2, also referred to as a receiver-in-the-canal assembly 2 or earpiece part, worn in an ear canal of an ear 3 of a user, and a BTE assembly 4, also referred to as a behind the ear assembly 4, coupled to the RIC assembly 2 by a cable 6. **Figures 2 and 3** are schematic views of the RIC assembly 2 which is configured as a small device having a receiver or speaker (not shown) in a shell 7 and a dome 8 at a medial end of the shell 7 with a very open coupling, which means it cannot deliver much performance in challenging situations, but it can sufficiently address a mild to moderate hearing loss in most situations during the day.

[0028] The RIC assembly 2 comprises multiple electrical connection pads 9 at a lateral end of the shell 7, e.g. in a cup-shaped receptacle 10 which may be arranged at the lateral end. The connection pads 9 may be located on a surface of the shell 7 or receptacle 10 or they may be recessed therein.

[0029] Figure 4 is a schematic view of the hearing device 1 of figure 1 with an ANC module 11, also referred to as an active noise cancelling module 11, being added to the RIC assembly 2. When a situational performance upgrade is needed, the user can simply add the ANC module 11 to the RIC assembly 2. The ANC module 11 includes a more powerful speaker 20 and two microphones 21.1, 21.2. One of the microphones 21.2 may face inwards, i.e. toward the RIC assembly 2 when the ANC module 11 is coupled to the RIC assembly 2. Another one of the microphones 21.1 may face outwards, i.e. away from the RIC assembly 2 when the ANC module 11 is coupled to the RIC assembly 2. This configuration provides a so-called hybrid ANC (combination of feedback-ANC and feedforward-ANC). The ANC module 11 is powered through the RIC assembly 2 from a battery which may be located in the BTE assembly 4. Therefore, the ANC module 11 does not require a separate battery. The ANC module 11 might include separate circuitry in order to perform the ANC processing.

[0030] Figure 5 is a schematic view of the hearing device 1 of figure 1 with the ANC module 11 coupled to the RIC assembly 2.

[0031] Since the RIC assembly 2 is designed to be acoustically very open, the sound of the ANC module 11 can easily reach the ear canal through the openings of the RIC assembly 2.

[0032] Figures 6, 7 and 8 show different views of the RIC assembly 2 with the dome 8 removed from a sound port 15 of the RIC assembly 2 for clarity. The open coupling of the RIC assembly 2 is achieved by acoustic ANC canals 12 bypassing the receiver 13 and the related one or more acoustic receiver canals 18.

[0033] Figures 9 and 10 show different views of the RIC assembly 2 with the dome 8 attached to the sound port 15 of the RIC assembly 2.

[0034] In an exemplary embodiment, magnetic force

may be used to connect the RIC assembly 2 with the ANC module 11. The hearing device 1 may be configured to automatically detect the ANC module 11 and activate the ANC mode, once the ANC module 11 is connected to the RIC assembly 2 and electrical connectors (not shown) of the ANC module 11 connect the electrical connection pads 9 of the RIC assembly 2. The magnetic force may be generated by one or more magnets 14 arranged on the RIC assembly 2 and/or on the ANC module 11. In an exemplary embodiment, the magnets 14 may be arranged at the lateral end of the RIC assembly 2, e.g. in or on the receptacle 10.

[0035] Figure 11 is a schematic view of the RIC assembly 2 with the ANC module 11.

[0036] The ANC module 11 may be shaped to fit to the lateral end of the RIC assembly 2. In particular, the ANC module 11 may be shaped to match the receptacle 10. In an exemplary embodiment, the receptacle 10 may have a recess 16 and the ANC module 11 may have a locator rib 17 matching the recess 16 so that the ANC module 11 couples to the RIC assembly 2 in a defined position to ensure that the electrical connectors of the ANC module 11 connect the electrical connection pads 9 of the RIC assembly 2.

[0037] Figure 12 is a schematic view of the ANC module 11 with the electrical connectors 19 configured for contacting the electrical connection pads 9. If the electrical connection pads 9 are recessed in the shell 7 or receptacle 10, the electrical connectors 19 may be configured to protrude sufficiently into the respective recesses to contact the electrical connection pads 9.

[0038] The proposed solution may be experienced by a user similar to putting an earbud/hearable into the ear. With the proposed solution, the components that need to be handled when removing the hearing aid would only be the RIC assembly 2 and the ANC module 11, which may be nicely handled with two hands.

List of References

[0039]

1	hearing device
2	RIC assembly, receiver-in-the-canal assembly
3	ear
4	BTE assembly, behind the ear assembly
6	cable
7	shell
8	dome
9	electrical connection pad
10	receptacle
11	ANC module, active noise cancelling module
12	acoustic ANC canal
13	receiver
14	magnet
15	sound port

16	recess
17	locator rib
18	acoustic receiver canal
19	electrical connector
20	speaker
21.1,21.2	microphone

Claims

1. A hearing device (1), comprising a RIC assembly (2) configured to be worn in an ear canal, the RIC assembly (2) having a shell (7) containing a receiver (13), wherein the RIC assembly (2) comprises multiple electrical connection pads (9), the hearing device (1) further comprising an ANC module (11) configured to be releasably coupled to the RIC assembly (2) and to perform active noise cancelling, the ANC module (11) having electrical connectors (19) configured for electrically contacting the electrical connection pads (9).
2. The hearing device (1) of claim 1, wherein the RIC assembly (2) comprises one or more acoustic ANC canals (12) configured to lead sound from the ANC module (11) into the ear canal bypassing the receiver (13) when the RIC assembly (2) is worn in the ear canal and when the ANC module (11) is coupled to the RIC assembly (2).
3. The hearing device (1) according to claim 1 or 2, the RIC assembly (2) further comprising a cup-shaped receptacle (10) at a lateral end of the shell (7), the receptacle (10) configured to receive the ANC module (11).
4. The hearing device (1) according to any one of the preceding claims, wherein the ANC module (11) is configured to be retained on the RIC assembly (2) by magnetic force.
5. The hearing device (1) according to claim 4, wherein the magnetic force is provided by one or more magnets (14) arranged on the RIC assembly (2) and/or on the ANC module (11).
6. The hearing device (1) according to claim 5, wherein the one or more magnets (14) are arranged in or on the receptacle (10).
7. The hearing device (1) according to any one of the preceding claims, wherein the ANC module (11) is shaped to fit to the lateral end of the RIC assembly (2).
8. The hearing device (1) according to claim 7, wherein the ANC module (11) is shaped to match the receptacle (10).

9. The hearing device (1) according to claim 8, wherein the receptacle (10) has a recess (16) and the ANC module (11) has a locator rib (17) matching the recess (16) so that the ANC module (11) couples to the RIC assembly (2) in a defined position such that the electrical connectors (19) of the ANC module (11) connect to the electrical connection pads (9) of the RIC assembly (2). 5
10. The hearing device (1) according to any one of the preceding claims, further comprising a BTE assembly (4) coupled to the RIC assembly (2) by a cable (6). 10
11. The hearing device (1) according to any one of the preceding claims, wherein the RIC assembly (2) and/or the BTE assembly (4) are/is configured to automatically detect and activate the ANC module (11) once the electrical connectors (19) contact the electrical connection pads (9). 15
12. The hearing device (1) according to any one of the preceding claims, wherein the ANC module (11) further includes a speaker (20) and two microphones (21.1, 21.2), one of the microphones (21.1) facing toward the RIC assembly (2) and another one of the microphones (21.2) facing away from the RIC assembly (2) when the ANC module (11) is coupled to the RIC assembly (2). 20
13. The hearing device (1) according to any one of the preceding claims, wherein circuitry configured to perform the active noise cancelling is arranged in one of the ANC module (11), the RIC assembly (2) and the BTE assembly (4) or is distributed over at least two of these components. 25
14. The hearing device (1) according to any one of the preceding claims, wherein the ANC module (11) is powered through the RIC assembly (2) from a battery located in the RIC assembly (2) or in the BTE assembly (4). 30
15. The hearing device (1) according to any one of the preceding claims, the RIC assembly (2) further comprising a dome (8) at a medial end of the shell (7), the dome having an open coupling. 35

50

55

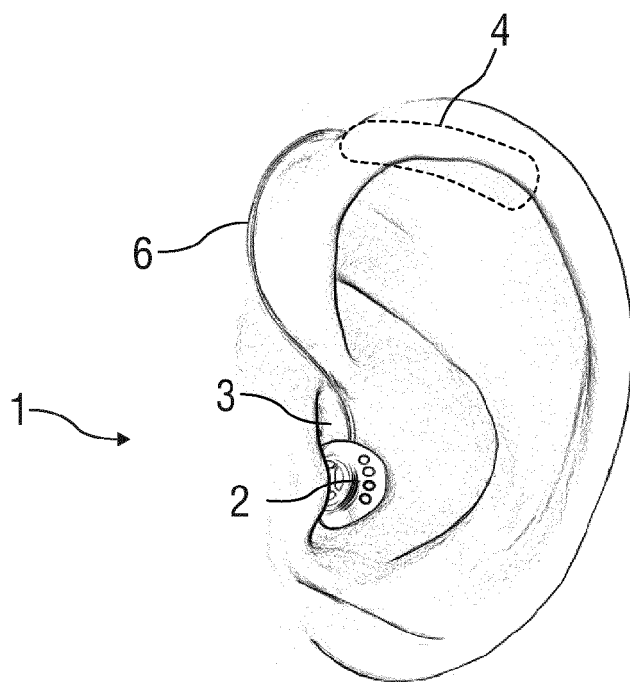


FIG 1

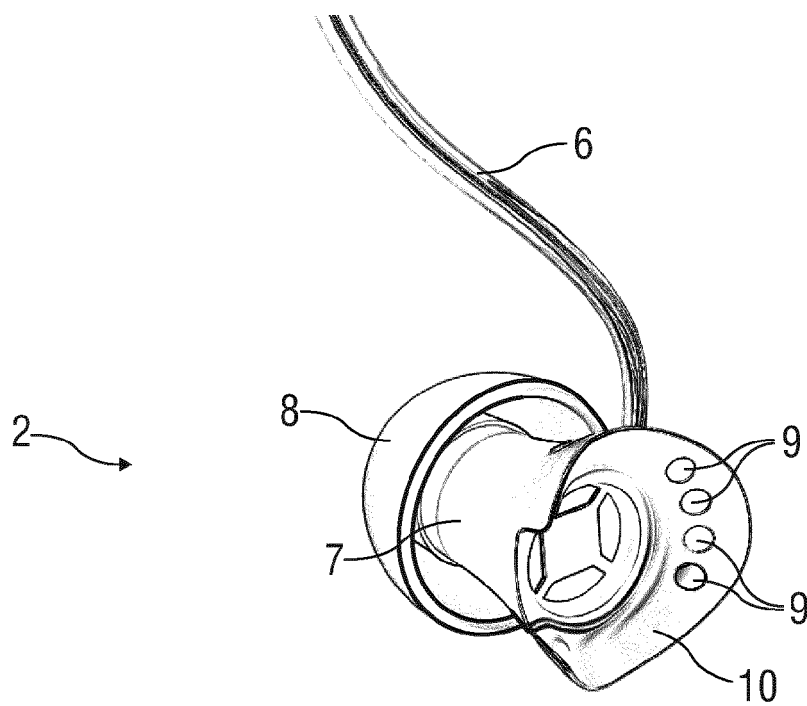
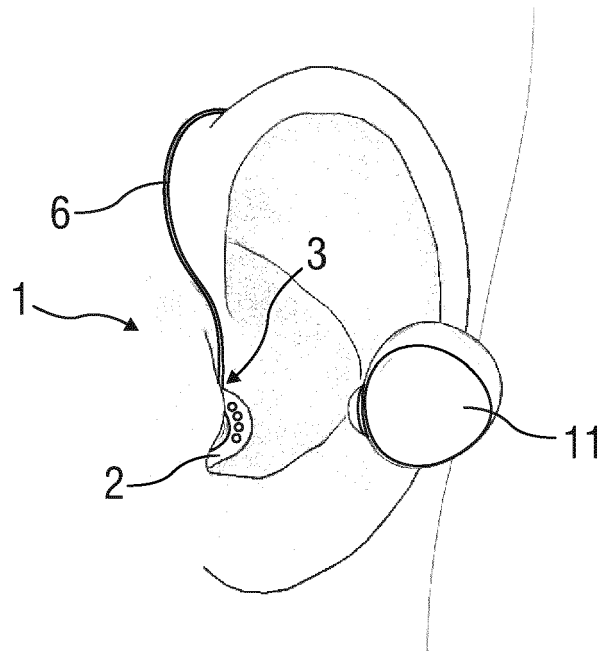
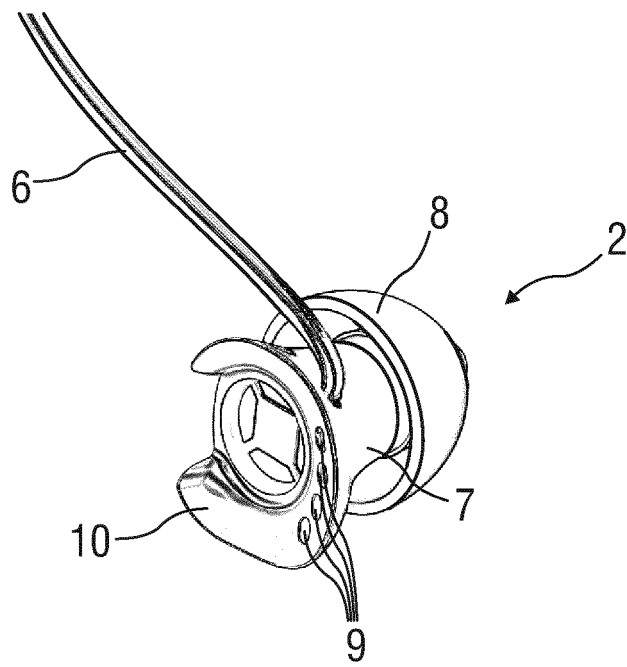


FIG 2



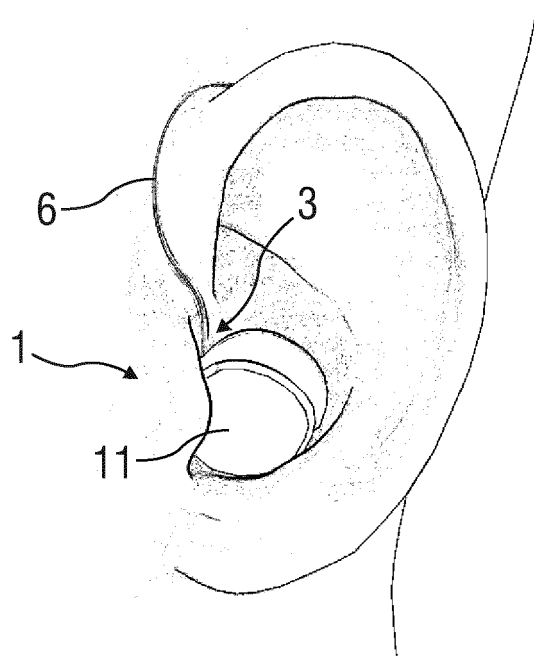


FIG 5

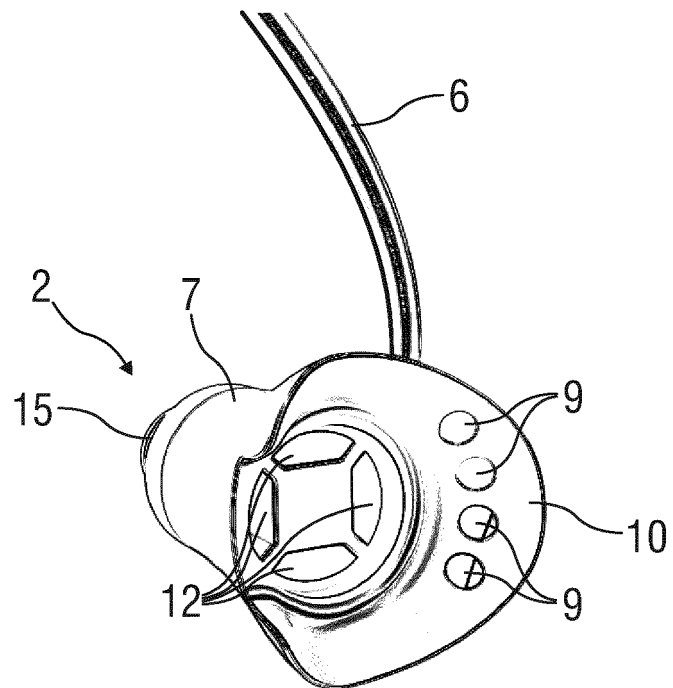


FIG 6

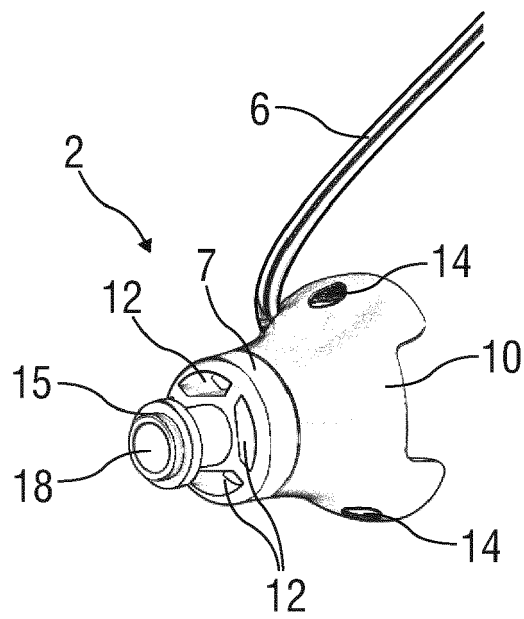


FIG 7

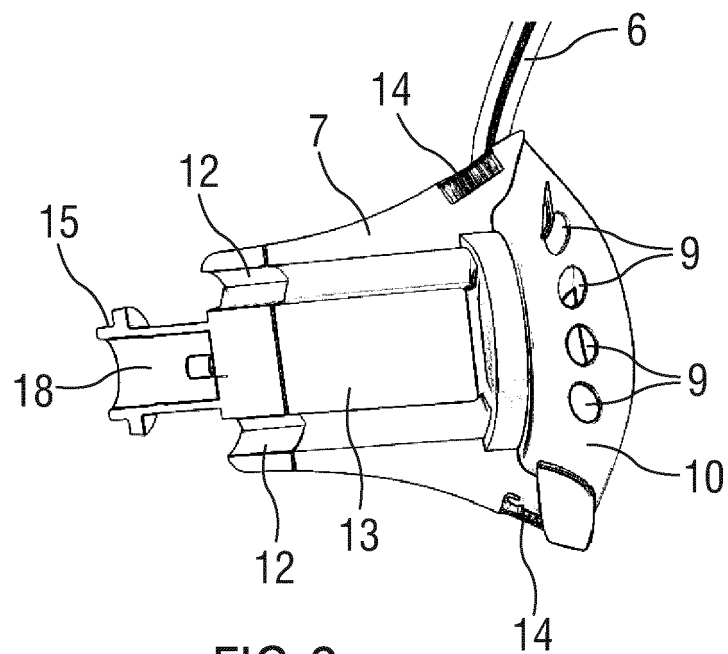


FIG 8

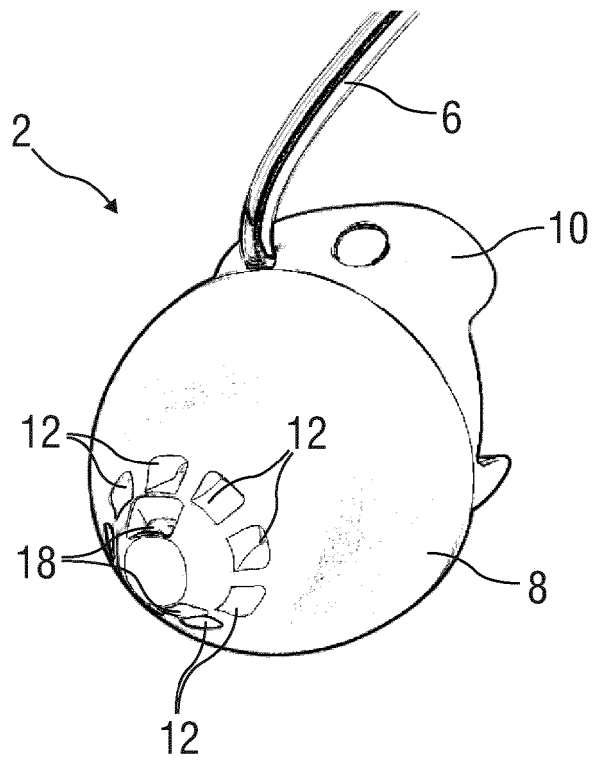


FIG 9

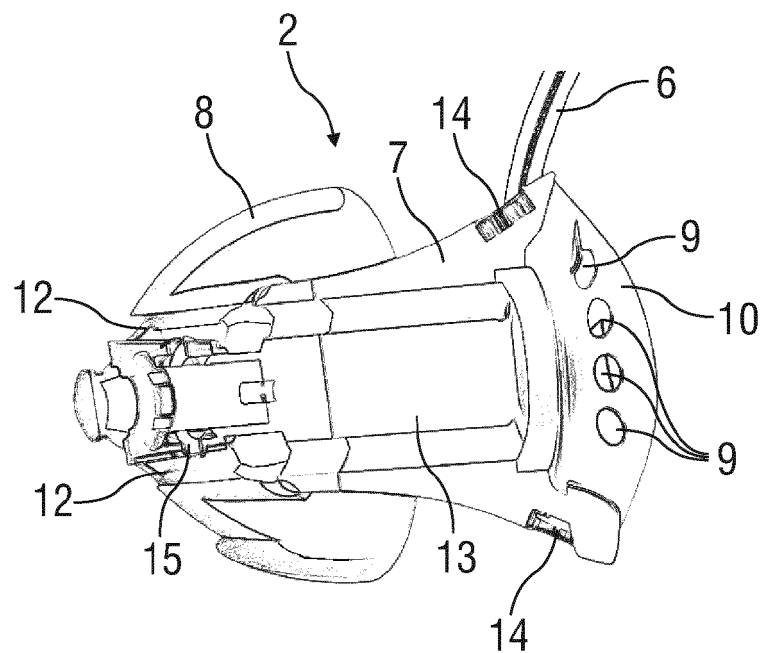


FIG 10

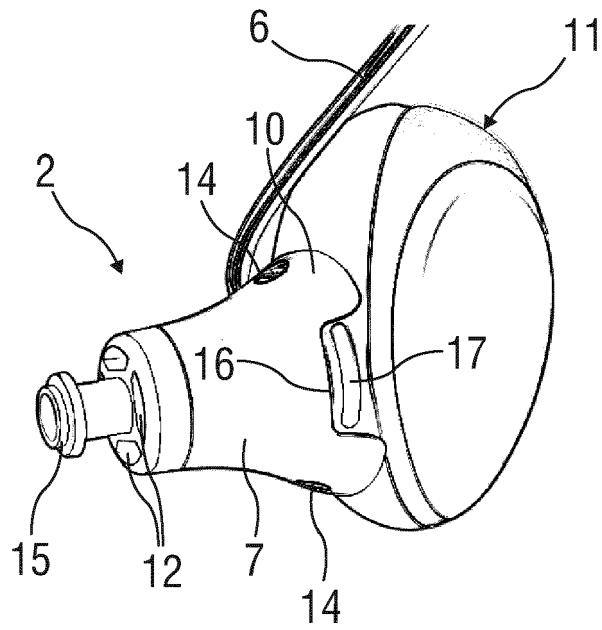


FIG 11

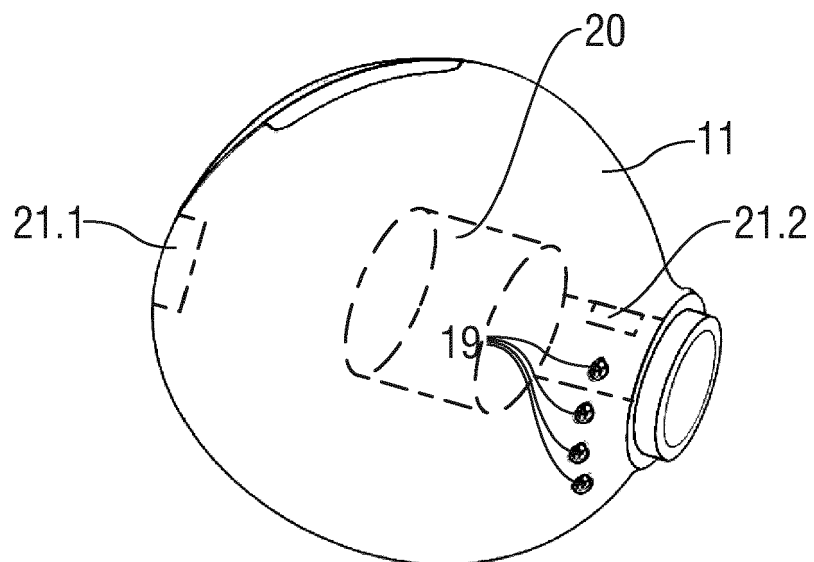


FIG 12



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 5602

5

10

15

20

25

30

35

40

45

50

55

2

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)
Y	WO 2022/035701 A1 (BOSE CORP [US]) 17 February 2022 (2022-02-17) * paragraphs [0080], [0090], [0092]; figures 5A, 7 *	1-15	INV. H04R25/00 H04R1/10
Y	US 2021/099811 A1 (ROECK HANS-UELI [CH] ET AL) 1 April 2021 (2021-04-01) * paragraph [0017]; figure 2B *	1-15	
A	US 2015/172834 A1 (SOLUM JEFFREY PAUL [US]) 18 June 2015 (2015-06-18) * the whole document *	1-15	
A	US 2012/014549 A1 (HIGGINS SIDNEY A [US] ET AL) 19 January 2012 (2012-01-19) * the whole document *	1-15	
A	US 2020/213787 A1 (HOUCEK EARL E [US] ET AL) 2 July 2020 (2020-07-02) * the whole document *	1-15	
			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 13 February 2023	Examiner Kunze, Holger
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	

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

EP 22 19 5602

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.

13-02-2023

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2022035701 A1	17-02-2022	US 2022053259 A1	17-02-2022
		WO 2022035701 A1	17-02-2022

US 2021099811 A1	01-04-2021	CN 213602833 U	02-07-2021
		DE 102020124283 A1	01-04-2021
		US 2021099811 A1	01-04-2021

US 2015172834 A1	18-06-2015	DK 2088804 T3	24-08-2015
		DK 2930951 T3	02-01-2019
		EP 2088804 A1	12-08-2009
		EP 2930951 A1	14-10-2015
		EP 3457718 A1	20-03-2019
		US 2009196444 A1	06-08-2009
		US 2015172834 A1	18-06-2015
		US 2017150279 A1	25-05-2017
		US 2021127218 A1	29-04-2021

US 2012014549 A1	19-01-2012	NONE	

US 2020213787 A1	02-07-2020	CN 212137926 U	11-12-2020
		US 2020213787 A1	02-07-2020
		WO 2020142154 A1	09-07-2020
