(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 835 983 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.02.2015 Bulletin 2015/07

(51) Int Cl.:
H04R 1/10 *(2006.01)* ***H04R 25/00*** *(2006.01)*

(21) Application number: **13193426.7**

(22) Date of filing: **19.11.2013**

(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

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(54) Hearing instrument presenting environmental sounds

(57) A hearing instrument (2) is disclosed. The hearing instrument (2) comprised: transmitting means (2, 36) for transmitting an audio signal into at least one of the ears (6) of a user (4); output means (2, 50) for providing an audible signal to the user (4) and means (44) for detecting sound signals (20) from the surroundings of the user (4). The hearing instrument (2) comprises analysing means (46) for analysing the detected sound signals (20) and comparing the detected sound signals (20) with a number of predefined environmental sound detection constraints (54). The hearing instrument (2) provides the detected sound signals (20) processed or directly (unprocessed) to the user (4) by means of the transmitting means (2, 36), if the detected sound signals (20) comply with the predefined environmental sound detection constraints (54). The detected sound signals (20) are not transmitted to the user (4) if the detected sound signals (20) do not comply with the predefined environmental sound detection constraints (54). The hearing instrument (2) supports means of triggering a more permanent change of general operational state following detection of sound signals (20) that comply with the predefined environmental sound detection constraints (54).

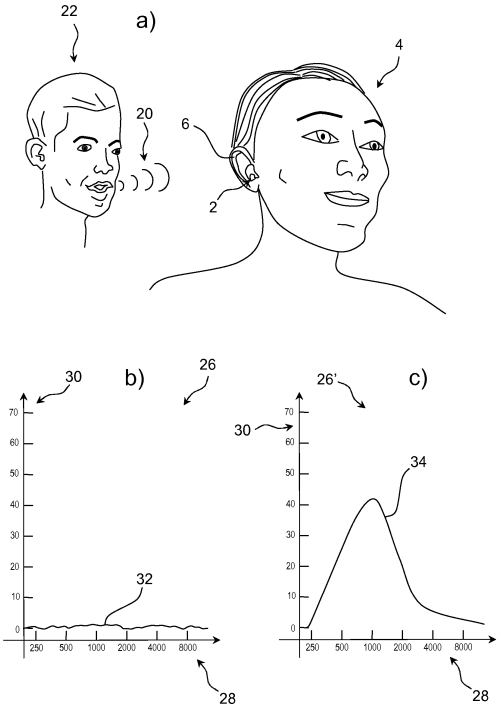

Fig. 2

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Description

Field of invention

[0001] The present invention generally relates to a hearing instrument adapted to be worn in or at an ear of a user. The present invention more particularly relates to a hearing instrument that is capable of providing additional environmental sounds for the user while using the hearing instrument. The present invention also relates to a method for supporting context awareness of a user when using a hearing instrument.

Prior art

[0002] The prior art hearing instruments includes hearing instruments for hearing impaired persons and hearing instruments for persons without hearing loss. Some of these hearing instruments use some sort of earplugs to attenuate disturbing sounds in the environment for relaxation purposes or for listening to audio signals such as speech or music. When these hearing instruments are used to present audio signals to the user of the hearing instrument through a set of ear pieces (e.g. ear phones or headphones), the user of the hearing instrument may at least partly loose audible contact with and awareness of what is happening in the surroundings.

[0003] Accordingly, the use of hearing instruments introduces the risk for not hearing important acoustic events in the surroundings. This is in particularly a problem when the hearing instruments includes occluding earpieces with high attenuating effect of context sounds and with loud streamed audio that may at least partially mask the context sounds.

[0004] Thus, there is need for a hearing instrument that reduces or even eliminates these drawbacks of the prior art.

[0005] EP2472907A1 describes a system that eases the acknowledgement of 'alarm signals', as e.g. issued by alarm indicators, in the environment of a user in difficult listening situations. The system comprises a listening device adapted to be worn at or in an ear of a user, and an alerting device adapted to detect or receive an external alarm signal, wherein the listening device and the alerting device each comprise at least one communication interface allowing to establish a communication link between them. The system is configured to allow a user to take notice of alarms from normal indicators even in case of a hearing impairment and/or when located in a noisy environment.

[0006] It is an object of the present invention to provide a hearing instrument that reduces the risk for not hearing important acoustic events in the surroundings during usage of the hearing instrument.

[0007] It is also an object of the present a method for supporting context awareness when using a hearing instrument.

Summary of the invention

[0008] The object of the present invention can be achieved by a hearing instrument as defined in claim 1 and by a method as defined in claim 12. Preferred embodiments are defined in the dependent sub claims and explained in the following description and illustrated in the accompanying drawings.

[0009] The hearing instrument according to the invention comprises:

- transmitting means for transmitting an audio signal into at least one of the ears of a user;
- output means for providing an audible signal to the user;
- means for detecting sound signals from the surroundings of the user. The hearing instrument comprises means for analysing the detected sound signals and comparing the detected sound signals with a number of predefined environmental sound detection constraints, where the hearing instrument provides the detected sound signals processed or directly (unprocessed) to the user by means of the transmitting means if the detected sound signals comply with the predefined environmental sound detection constraints. The detected sound signals are not transmitted to the user if the detected sound signals do not comply with the predefined environmental sound detection constraints.

[0010] In an embodiment, the hearing instrument supports means of triggering a more permanent change of a general operational state following detection of sound signals that comply with the predefined environmental sound detection constraints.

[0011] Hereby it is achieved that the hearing instrument eliminates the risk for the user of not hearing important acoustic events in the surroundings while using the hearing instrument. Accordingly, the context awareness of the user of the hearing instrument is supported.

[0012] The hearing instrument may be any suitable type of hearing instrument or hearing aid, e.g. a behind-the-ear (BTE) hearing aid or an in-the-ear (ITE) hearing aid or any combination thereof, by way of example.

[0013] In the present context, a "hearing instrument" refers to a device, such as e.g. a hearing aid, a listening device or an active ear-protection device, which is adapted to improve, augment and/or protect the hearing capability of a user by receiving acoustic signals from the user's surroundings, generating corresponding audio signals, possibly modifying the audio signals and providing the possibly modified audio signals as audible signals to at least one of the user's ears.

[0014] A "hearing instrument" further refers to a device such as an earphone or a headset adapted to receive audio signals electronically, possibly modifying the audio signals and providing the possibly modified audio signals as audible signals to at least one of the user's ears. Such

audible signals may e.g. be provided in the form of acoustic signals radiated into the user's outer ears, acoustic signals transferred as mechanical vibrations to the user's inner ears through the bone structure of the user's head and/or through parts of the middle ear as well as electric signals transferred directly or indirectly to the cochlear nerve and/or to the auditory cortex of the user.

[0015] A hearing instrument may be configured to be worn in any known way, e.g. as a unit arranged behind the ear with a tube leading air-borne acoustic signals into the ear canal or with a loudspeaker arranged close to or in the ear canal, as a unit entirely or partly arranged in the pinna and/or in the ear canal, as a unit attached to a fixture implanted into the skull bone, as an entirely or partly implanted unit, etc. A hearing instrument may comprise a single unit or several units communicating electronically with each other.

[0016] More generally, a hearing instrument comprises an input transducer for receiving an acoustic signal from a user's surroundings and providing a corresponding input audio signal and/or a receiver for electronically receiving an input audio signal, a signal processing circuit for processing the input audio signal and an output means for providing an audible signal to the user in dependence on the processed audio signal. Some hearing instruments may comprise multiple input transducers, e.g. for providing direction-dependent audio signal processing. In some hearing instruments, the receiver may be a wireless receiver. In some hearing instruments, the receiver may be e.g. an input amplifier for receiving a wired signal. In some hearing instruments, an amplifier may constitute the signal processing circuit. In some hearing instruments, the output means may comprise an output transducer, such as e.g. a loudspeaker for providing an air-borne acoustic signal or a vibrator for providing a structure-borne or liquid-borne acoustic signal. In some hearing instruments, the output means may comprise one or more output electrodes for providing electric signals.

[0017] In some hearing instruments, the vibrator may be adapted to provide a structure-borne acoustic signal transcutaneously or percutaneously to the skull bone. In some hearing instruments, the vibrator may be implanted in the middle ear and/or in the inner ear.

[0018] In some hearing instruments, the vibrator may be adapted to provide a structure-borne acoustic signal to a middle-ear bone and/or to the cochlea. In some hearing instruments, the vibrator may be adapted to provide a liquid-borne acoustic signal in the cochlear liquid, e.g. through the oval window.

[0019] In some hearing instruments, the output electrodes may be implanted in the cochlea or on the inside of the skull bone and may be adapted to provide the electric signals to the hair cells of the cochlea, to one or more hearing nerves and/or to the auditory cortex.

[0020] A "hearing instrument" may refer to a system comprising one or two hearing instruments. A "hearing instrument" may be "binaural hearing system" refers to a system comprising one or two hearing instruments and being adapted to cooperatively provide audible signals to both of the user's ears. Hearing systems or binaural hearing systems may further comprise "auxiliary devices", which communicate with the hearing instruments and affect and/or benefit from the function of the hearing instruments. Auxiliary devices may be e.g. remote controls, remote microphones, audio gateway devices, mobile phones, public-address systems, car audio systems or music players. Hearing instruments, hearing systems or binaural hearing systems may e.g. be used for compensating for a hearing-impaired person's loss of hearing capability, augmenting or protecting a normal-hearing person's hearing capability and/or conveying electronic audio signals to a person.

[0021] The transmitting means may be any suitable means for transmitting an audio signal into at least one of the ears of a user. The transmitting means may include an ear hook, a hook or a tube, and/or a pair of electric conductors for propagating an audio signal to an output transducer, e.g. a loudspeaker (receiver).

[0022] The output means may be any suitable means for providing an audible signal to the user (including providing stimuli *perceived* by the user as sound). The output means may include one more receivers.

[0023] The means for detecting sound signals from the surroundings of the user may be any suitable means including microphones integrated within the hearing instrument and microphones provided elsewhere.

[0024] The analysing means may be any suitable means for analysing the detected sound signals and comparing the detected sound signals with a number of predefined environmental sound detection constraints. These analysing means may be provided within a processer of the hearing instruments, within the amplifier of the hearing instrument or elsewhere in the hearing instrument. In an embodiment, the analysing means comprises a frequency analysing unit allowing an analysis of the detected sound signals in the frequency domain.

[0025] The predefined environmental sound detection constraints may be of any suitable type and kind. The predefined environmental sound detection constraints may include frequency ranges and sound pressure levels and combinations of frequency ranges and sound pressure levels. In an embodiment, the predefined environmental sound detection constraints comprises a threshold value of a measure of the modulation of the detected sound signals. In an embodiment, the predefined environmental sound detection constraints comprises a degree of similarity the detected sound signals with predefined stored sound signals (e.g. based on a correlation measure, e.g. cross-correlation).

[0026] It may be an advantage that the hearing instrument comprises means for processing the detected sound signals.

[0027] Hereby it is possible to provide e.g. frequency dependent amplification, noise reduction, equalisation or directionality related processing so that the sound provided to the user of the hearing instrument suits the user

in an optimum manner.

[0028] The means for processing the detected sound signals may be any suitable means, e.g. a standard or customized processing circuit.

[0029] It may be beneficial that the hearing instrument comprises means for receiving streamed audio signals from an external device and/or means for streaming audio signals from the hearing instrument itself.

[0030] Hereby the hearing instrument may be used to stream music or other types of audio sources either from an external device or from the hearing instrument itself.

[0031] Streamed audio source signals may be received from an external device by using a wired connection or by using a wirelessly connection.

[0032] In the present context, the term 'streamed audio' is taken to mean electric signals comprising audio that are continuously received or transmitted from an audio source, e.g. sound from a live audio performance or sound from an audio source stored in a memory or received via network connection (e.g. from the Internet) or a radio or TV-set. The term 'audio signal' is in the present context taken to mean an electric signal comprising frequencies in the human audible frequency range (e.g. between 20 Hz and 20 kHz).

[0033] It may be advantageous that the hearing instrument comprises means for muting the hearing instrument and hereby bringing the hearing instrument in a mute state, and that the hearing instrument comprises means for transmitting the detected sound signals to the user by means of the transmitting means, if the detected sound signals comply with the predefined environmental sound detection constraints when the hearing instrument is in the mute state.

[0034] Hereby it is achieved that the mute function of the hearing instrument can be safely used since important (predefined) sound signals from the surrounding will be provided to the user although the hearing instrument is muted.

[0035] This may be a major advantage when using the mute function for relaxation purposes by way of example. It may be advantageous that the hearing instrument(s) resume(s) a non-muted operating state in relation to detecting sound signals complying with the predefined environmental sound detection constraints while the hearing instrument is in the mute state.

[0036] It may be an advantage that the hearing instrument comprises means for blending detected sound signals with streamed sound such as streamed audio source signals from an external device or from the hearing instrument itself.

[0037] Hereby it is possible to provide an optimum mix between the detected sound signals and the streamed sound. It may be preferred that the means for blending detected sound signals with streamed sound can be individually adjusted in order to meet individual requirements.

[0038] Hereby a personalised, balanced improvement of context awareness can be achieved during an acoustic event such as the presence of speech, a ring of a doorbell or a fire alarm.

[0039] It may be beneficial that the hearing instrument comprises means for verifying if the sound signals are within a predefined range of frequencies and/or sound pressure levels.

[0040] Hereby it is possible to provide the required verification and the hearing instrument will present the detected sound signal in a predefined manner.

[0041] The means for verifying if the sound signals are within a predefined range of frequencies and/or sound pressure levels may be any suitable means including a processor.

[0042] It may be advantageous that the hearing instrument comprises a microphone integrated in the hearing instrument, where the microphone is adapted to detect sound signals from the surroundings of the user.

[0043] Hereby it is possible to detect the sound signals from the surroundings of the user by reliable and simple means.

[0044] It may be beneficial that the hearing instrument comprises an amplifier that comprises processing means capable of processing the sound signal detected by the microphone.

[0045] The processing means may be adapted to provide any suitable processing of the signals such as directionality related processing or noise reduction.

[0046] It may be an advantage that the hearing instrument comprises a separate processor capable of processing the sound signal detected by the microphone.

[0047] It may be advantageous that the hearing instrument comprises means for setting and/or changing the predefined environmental sound detection constraints.

[0048] Hereby it is possible to set and/or change the predefined environmental sound detection constraints.

[0049] The objects of the invention may be achieved by a method for supporting context awareness of a user using a hearing instrument, where the method comprises the step of detecting the presence of a sound signal, where the method further comprises the step of receiving streamed audio source signals from an external device or streaming audio source from the hearing instrument itself. The method further comprises the step of analysing the detected sound signal and processing the detected sound signal according to predefined processing rules and further providing the processed sound signal to the user of the hearing instrument.

[0050] It may be advantageous that the method applies a hearing instrument according to one of the claims 1-10.

Description of the Drawings

[0051] The invention will become more fully understood from the detailed description given herein below. The accompanying drawings are given by way of illustration only, and thus, they are not limitative of the present invention. In the accompanying drawings:

Fig. 1 shows a schematic view of a hearing instrument according to an embodiment of the invention when applied by a user;

Fig. 2 a) shows a schematic view of another hearing instrument according to an embodiment of the invention applied by a user while another person in the room starts talking;

Fig. 2 b) is a graph showing the detected sound signal during a quiet time period;

Fig. 2 c) is a graph showing the detection of a sound signal;

Fig. 3 a) shows a schematic view of a user wearing a hearing instrument according to an embodiment of the invention and another speaking person;

Fig. 3 b) shows a close-up view of the hearing instrument shown in Fig. 3 a);

Fig. 3 c) is a graph showing an example of the environmental sound detection constraints of the hearing instrument shown in Fig. 3 a);

Fig. 4 a) shows a schematic view of a BTE hearing instrument according to an embodiment of the invention;

Fig. 4 b) shows a user wearing the hearing instrument shown in Fig. 4 a);

Fig. 5 a) shows a user wearing a hearing instrument according to an embodiment of the invention while a phone is ringing; and

Fig. 5 b) is a graph showing that the detected phone sound signal is exceeding the environmental sound threshold of the hearing instrument shown in Fig. 5 a).

Detailed description of the invention

[0052] Referring now in detail to the drawings for the purpose of illustrating preferred embodiments of the present invention, different views of a hearing instrument 2 according to the invention is illustrated in Fig. 1.

[0053] Fig. 1 illustrates a schematic view of a hearing instrument 2 according to an embodiment of the invention. A user 4 is wearing the hearing instrument 2 that comprises earplugs 8 inserted into the ears 6. The user 4 of the hearing instrument 2 may be listening to music or another audio signal received by a first device 12. The first device 12 receives wireless signals 24 from a second device 14.

[0054] The hearing instrument 2 may receive audio signals from any suitable source 12, 14. Accordingly, other figurations than the one shown in Fig. 1 is possible. The second device 14 may, by way of example, be a sending unit placed on a speaker (not shown), e.g. a wireless microphone unit for picking up sounds from the speaker and transmitting the signal to the user (either directly to the hearing instrument 2 or via the first device 12).

[0055] The audio signal may be sent via the wires 10, 10' from the first device 12 to receivers (speaker units) placed in the (respective left and right) earplugs 8. Instead of earplugs 8 the user may apply ear phones (not shown).

[0056] The user 4 may choose to mute the audio signals received by the device 12 (and/or via a possible microphone of the hearing instrument 8 itself), e.g. in order to relax. The user may alternatively choose to continue to listen to the audio signals received by the device 12.

[0057] A door 18 and an appertaining doorbell 16 are shown behind the user 4. The doorbell 16 is activated and sends out a sound signal 20. If the user is listening to music and if the sound signal 20 sent by the doorbell 16 are not loud enough, the user 4 may not hear the sound signal 20, if he uses a prior art hearing instrument.

[0058] However, the hearing instrument 2 according to the invention comprises means for detecting the presence of environmental sound signals within a predefined range of frequencies and intensities. The hearing instrument 2 according to the invention moreover comprises means for prioritise and present the detected sound signals in a predefined manner.

[0059] When the doorbell signal 20 is detected by the hearing instrument 2, the hearing instrument 2 will verify that the sound signal lies within the predefined range of frequencies and sound pressure levels and therefore, the hearing instrument 2 will present the detected sound signal in a predefined manner. Accordingly, the hearing instrument 2 calls attention to the user 4 about the doorbell signal.

[0060] The hearing instrument 2 may be set to detect and present different sound signals for the user 4 of the hearing instrument 2. It may be preferred to detect phone calls, door bells, speech or any other suitable type of sound signals.

[0061] The detection of sound signals may be conducted in any suitable manner, e.g. by using a microphone (not shown) contained in the hearing instrument or outside the hearing instrument. A microphone may be integrated in the first device 12 and/or in the second device 14.

[0062] The hearing instrument 2 according to the invention makes it possible to detect important acoustic events 16 in the surroundings even when the hearing instrument 2 is muted or when the user of the hearing instrument 2 is listening to audio. The hearing instrument 2 further makes it possible to present detected signals 16 in a predefined way. It is possible to process the detected sound signal 16 e.g. by applying noise reduction or directionality related processing.

[0063] Accordingly, the hearing instrument 2 according to the invention reduces the risk for the user of not hearing important acoustic events in the surroundings during use of the hearing instrument 2.

[0064] Fig. 2 a) illustrates a schematic view of another hearing instrument 2 according to an embodiment of the invention. The hearing instrument 2 is an ITE hearing aid 2 inserted into the ear(s) 6 of a user 4.

[0065] Another speaking person 22 is standing behind

the user 4. The speech 20 from the other person 22 is detected as a sound signal by the microphones (not shown) in the ITE hearing aid 2.

[0066] Fig. 2 b) illustrates a graph 26 showing the detected sound signal 32 in a given situation. The detected Sound Pressure Level (SPL dB) 30 is depicted as a function of frequency 28 (measured in Hz, logarithmic scale). The reference Sound Pressure is 20 μPa.

[0067] It can be seen that the curve 32 is almost flat. This is the case because the curve 32 reflects a situation without any speech.

[0068] Fig. 2 c) illustrates another graph 26' showing the detected sound signal 20 in a situation in which the other person 22 is speaking. Like in Fig. 2 b) the detected Sound Pressure Level 30 (SPL dB with a reference Sound Pressure of 20 μPa) is depicted as a function of frequency 28 (measured in Hz).

[0069] The curve 34 shows that the speech 20 has significant content at frequencies around 1000 Hz (> 20 dB between 500 Hz and 2 kHz).

[0070] If the user 4 of the hearing aid 2 shown in Fig. 2 a) listens to music or another audio source or if the hearing aid 2 is muted, the user 4 will not be able to hear the sound signal 20 when using a prior art hearing aid.

[0071] Since the hearing instrument 2 according to an embodiment of the invention comprises means for detecting the presence of environmental sound signals within a predefined range of frequencies and sound pressure levels and means for prioritising and presenting these detected sound signals to the user of the hearing instrument 2, the hearing instrument 2 according to the invention will present the user of the hearing instrument 2 with a sound signal that includes at least some of the speech 20.

[0072] The hearing instrument 2 may comprise a processor for processing the detected sound signal 20 (e.g. amplification, noise reduction or directionality) in order to provide the most useful information (presented as a sound signal) for the user of the hearing instrument 2 (e. g. via a loudspeaker).

[0073] When the other person 22 is speaking the speech 20 is detected by the hearing instrument 2 (e.g. via a microphone and a voice activity detector and/or a frequency analyser), the hearing instrument 2 will verify that the sound signal 20 lies within the predefined range of frequencies and sound pressure level (e.g. > 20 dB in a range between 500 Hz and 2 kHz) and therefore, the hearing instrument 2 will present the detected sound signal 20 in a predefined (e.g. amplified and/or processed in order to reduce noise) manner.

[0074] Fig. 3 a) illustrates a schematic view of a user 4 wearing a hearing instrument 2 according to an embodiment of the invention and another speaking person 22. The hearing instrument 2 is a BTE hearing aid 2 attached behind the ear 6 of the user 4. The speaking person 22 is standing behind the user 4 of the hearing aid 2.

[0075] The hearing instrument 2 comprises means for detecting the presence of environmental sound signals like the speech 20 from the speaking person 22 within a predefined range of frequencies and sound pressure levels. The hearing instrument 2 also comprises means for prioritising and presenting these detected sound signals 20 to the user 4 of the hearing instrument 2 in a predefined manner (e.g. processed by using noise reduction).

[0076] When a microphone of the BTE hearing aid 2 detects the speech 20 the detected signal 20 will processed according to predefined rules and settings and then the sound signal will be provided for the user 4 by means of an output transducer of the BTE hearing aid 2. The hearing aid 2 may comprise means for setting and/or changing these rules and settings, e.g. via a user interface, e.g. implemented in a remote control device, e.g. as an APP of a SmartPhone.

[0077] Fig. 3 b) illustrates a close-up view of the hearing instrument 2 shown in Fig. 3 a). The hearing instrument 2 is a BTE hearing aid 2 attached behind the ear 6 of the user 4 of the BTE hearing aid 2. The BTE hearing aid 2 comprises an ear mould 36 that is connected to the casing of the BTE hearing aid 2 by means of a tube 38.

[0078] Fig. 3 c) is a graph 26 showing an example of the environmental sound detection constraints 54 of the BTE hearing aid 2 shown in Fig. 3 a) and in Fig. 3 b). The environmental sound detection constraints 54 of the BTE hearing aid 2 is a frequency dependent level threshold curve 54 indicated with a dotted line.

[0079] The graph 26 shows the detected Sound Pressure Level (SPL dB with a reference Sound Pressure of 20 μPa) depicted as a function of frequency 28 (measured in Hz). The curve 34 shows that the detected sound signal (speech signal 20) contains frequencies up till about 8000 Hz. Since the hatched area 56 exceeds the threshold curve 54, the BTE hearing aid 2 processes the detected signal 20 according to predefined rules and settings. Accordingly, the sound signal 20 from the speaking person 22 will be provided for the user 4 by means of an output transducer of the BTE hearing aid 2.

[0080] Fig. 4 a) illustrates a schematically exploded cross-sectional view of a BTE-type hearing aid 2 according to an embodiment of the invention. The BTE hearing aid 2 comprises a casing 52 housing a battery 48 that is electrically connected to an amplifier 46. The amplifier 46 is electrically connected to a microphone (input transducer) 44 and to a receiver (output transducer) 50. The receiver 50 is configured to generate a sound signal that is being transmitted through the hook 42 of the BTE hearing aid 2 and further through the ear hook 40 and through the ear mould 36 into the ear canal of the user 4 of the BTE hearing aid 2. The ear hook 40 is detachably attached to the hook 42 of the BTE hearing aid 2.

[0081] The amplifier 46 may comprise processing means (e.g. a digital processor) capable of processing the sound signal detected by the microphone 44. Alternatively, the BTE hearing aid 2 may, although not shown, comprise other processing means e.g. provided in a separate processor.

[0082] Fig. 4 b) illustrates a user 4 wearing the BTE

hearing aid 2 shown in Fig. 4 a). BTE hearing aid 2 is attached behind the ear 6 of the user 4 of the BTE hearing aid 2.

[0083] Fig. 5 a) illustrates a user 4 wearing a hearing instrument 2 according to an embodiment of the invention while a phone 58 is ringing. The user 4 is a female user wearing a pair of headphones 2. The user 4 is listening to music and is sitting in a position in which she desires to relax. Suddenly the phone 58 arrange behind her rings. The phone sound 20 is not loud enough for the user 4 to hear it. However, since the hearing instrument 2 comprises means (a microphone) for detecting the presence of environmental sound signals 20 including the phone sound 20, within a predefined range of frequencies and sound pressure levels, the hearing instrument 2 actually detects that the phone 58 is ringing.

[0084] The hearing instrument 2 comprises means for prioritising and presenting the detected sound signal 20 to the user 4 of the hearing instrument 2.

[0085] Fig. 5 b) is a graph 26 showing that the detected phone sound signal is exceeding the environmental sound threshold 54 of the hearing instrument 2 shown in Fig. 5 a).

[0086] The environmental sounds detection constraints 54 of the hearing instrument 2 is a threshold curve 54 indicated with a dotted line. The graph 26 has a curve 32 that depicted the detected Sound Pressure Level (30) as a function of frequency 28 (measured in Hz). The curve 34 shows that the frequencies of phone sound 20 lie within the range between 500-1500 Hz. Since the hatched area 56 exceeds the threshold curve 54, the hearing instrument processes the detected signal 20 according to a set of predefined rules and settings and thus, the sound signal 20 from the phone 58 will be provided for the user 4 through the headphones 2.

[0087] In an embodiment, the hearing instrument comprises an analysis unit that is configured to analyse the frequency content of a current sound signal and to classify the current sound signal into a number of predefined types of signals. In an embodiment, the analysis unit is configured to apply different predefined environmental sound detection constraints to different types of sound signals (as classified by the analysis unit).

List of reference numerals

2	-	Hearing instrument
4	-	User
6	-	Ear
8	-	Earplug
10, 10'	-	Wire
12	-	Device
14	-	Device
16	-	Doorbell
18	-	Door
20	-	Sound signal
22	-	Person
24	-	Wireless signal
26, 26'	-	Graph
28	-	Frequency
30	-	Sound pressure level
32	-	Curve
34	-	Curve
36	-	Ear mould
38	-	Tube
40	-	Ear hook
42	-	Hook
44	-	Microphone
46	-	Amplifier
48	-	Battery
50	-	Receiver
52	-	Casing
54	-	Threshold curve
56	-	Area
58	-	Phone

Claims

1. A hearing instrument (2) comprising:

- transmitting means (2, 36) for transmitting an audio signal into at least one of the ears (6) of a user (4);
- output means (2, 50) for providing an audible signal to the user (4);
- means (44) for detecting sound signals (20) from the surroundings of the user (4),

characterised in that the hearing instrument (2) comprises analysing means (46) for analysing the detected sound signals (20) and comparing the detected sound signals (20) with a number of predefined environmental sound detection constraints (54), where the hearing instrument (2) provides the detected sound signals (20) processed or directly (unprocessed) to the user (4) by means of the transmitting means (2, 36) if the detected sound signals (20) comply with the predefined environmental sound detection constraints (54), and where the detected sound signals (20) are not transmitted to the user (4) if the detected sound signals (20) do not comply with the predefined environmental sound detection constraints (54).

2. A hearing instrument (2) according to claim 1, **characterised in that** the hearing instrument (2) comprises means for processing the detected sound signals (20).

3. A hearing instrument (2) according to claim 1 or claim

2, **characterised in that** the hearing instrument (2) comprises means for receiving streamed audio source signals (24) from an external device (14) or means for streaming audio source signals (24) from the hearing instrument (2) itself.

4. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises means for muting the hearing instrument (2) and hereby bringing the hearing instrument (2) in a mute state, and that the hearing instrument (2) comprises means for transmitting the detected sound signals (20) to the user (4) by means of the transmitting means (2, 36) if the detected sound signals (20) comply with the predefined environmental sounds detection constraints (54) when the hearing instrument (2) is in the mute state.

5. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises means for blending detected sound signals (20) with streamed sound such as streamed audio source signals (24) from an external device (14) or from the hearing instrument (2) itself.

6. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises means for verifying if the sound signals (20) are within a predefined range of frequencies and/or sound pressure levels.

7. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises a microphone (44) integrated in the hearing instrument (2), where the microphone (44) is adapted to detect sound signals (20) from the surroundings of the user (4).

8. A hearing instrument (2) according to claim 7, **characterised in that** the hearing instrument (2) comprises an amplifier (46) that comprises processing means capable of processing the sound signal (22) detected by the microphone (44).

9. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises a separate processor capable of processing the sound signal (22) detected by the microphone (44)

10. A hearing instrument (2) according to one of the preceding claims, **characterised in that** the hearing instrument (2) comprises means for setting and/or changing the predefined environmental sound detection constraints (54).

11. A hearing instrument (2) according to claim 10, wherein the means for setting and/or changing the predefined environmental sound detection constraints (54) comprises an APP of a SmartPhone.

12. A method for supporting context awareness of a user (4) using a hearing instrument (2), where the method comprises the step of detecting the presence of a sound signal (20), where the method further comprises the step of receiving streamed audio source signals (24) from an external device (14) or streaming audio source (24) from the hearing instrument (2) itself, **characterised in that** the method further comprises the step of analysing the detected sound signal (20) and processing the detected sound signal (20) according to predefined processing rules and further providing the processed sound signal to the user (4) of the hearing instrument (2).

13. A method according to 14 wherein the hearing instrument (2) is a hearing instrument according to one of the claims 1-10.

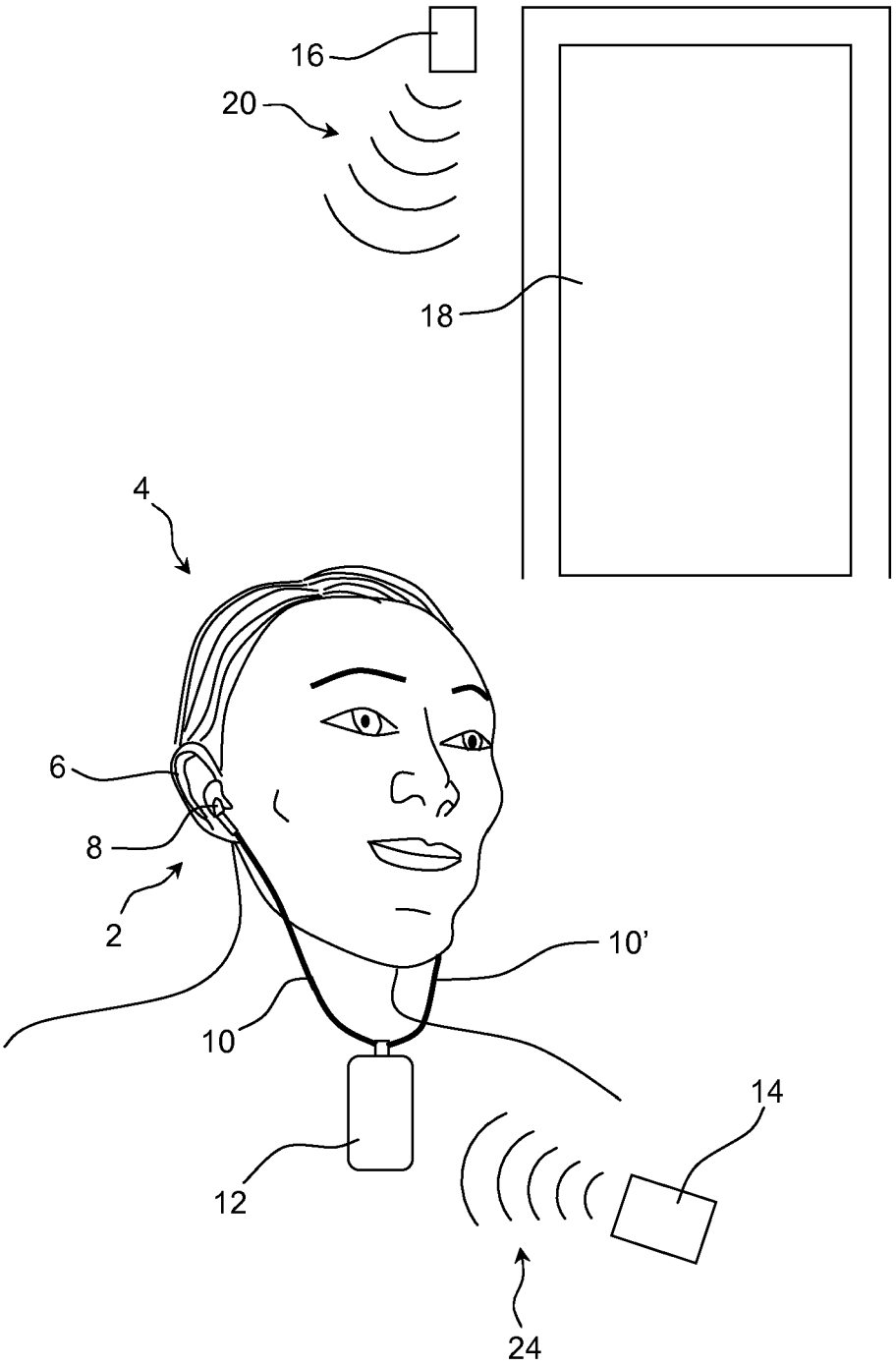
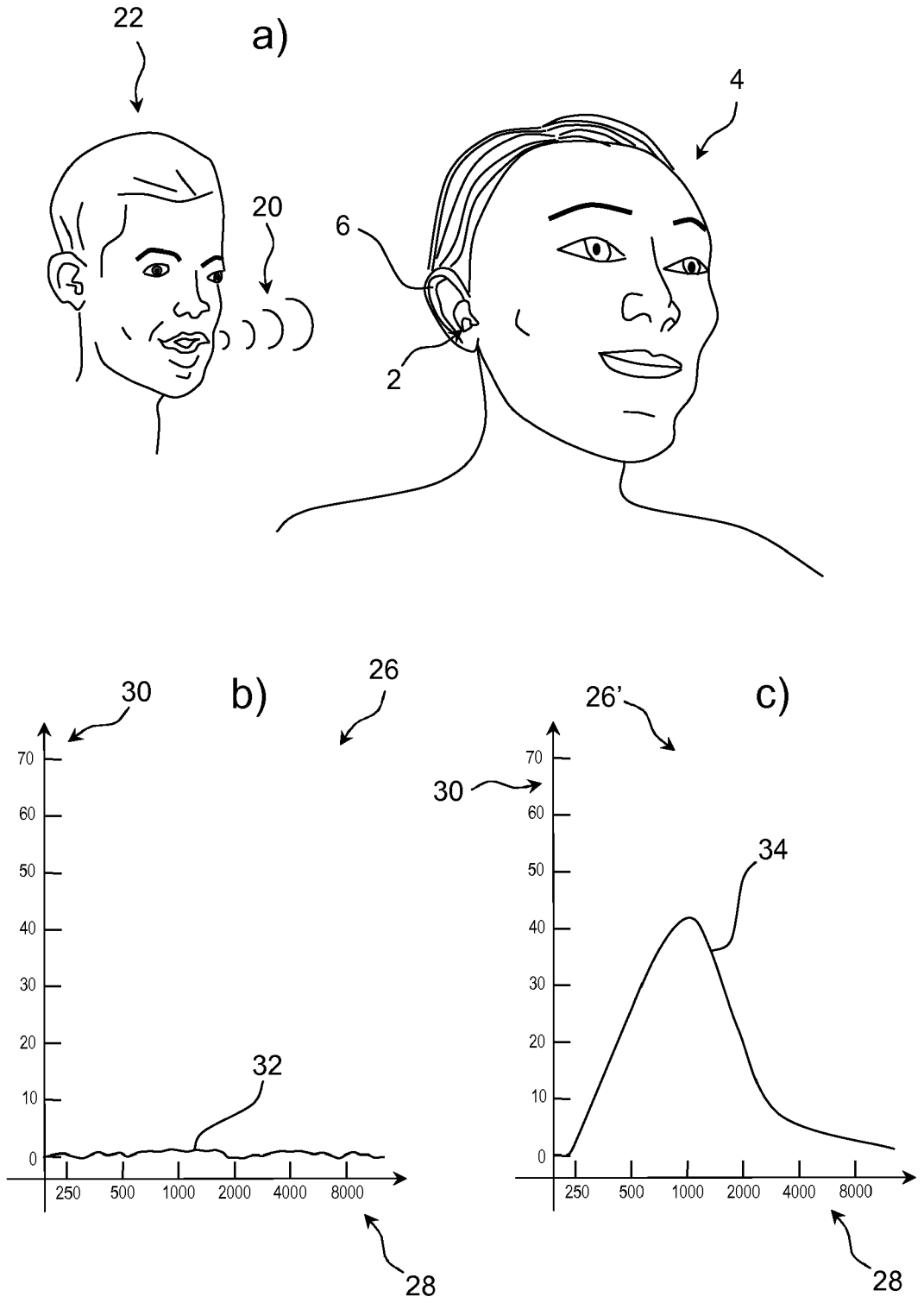


Fig. 1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b)
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70
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32
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8000
28
26'
c)
30
34

Fig. 2

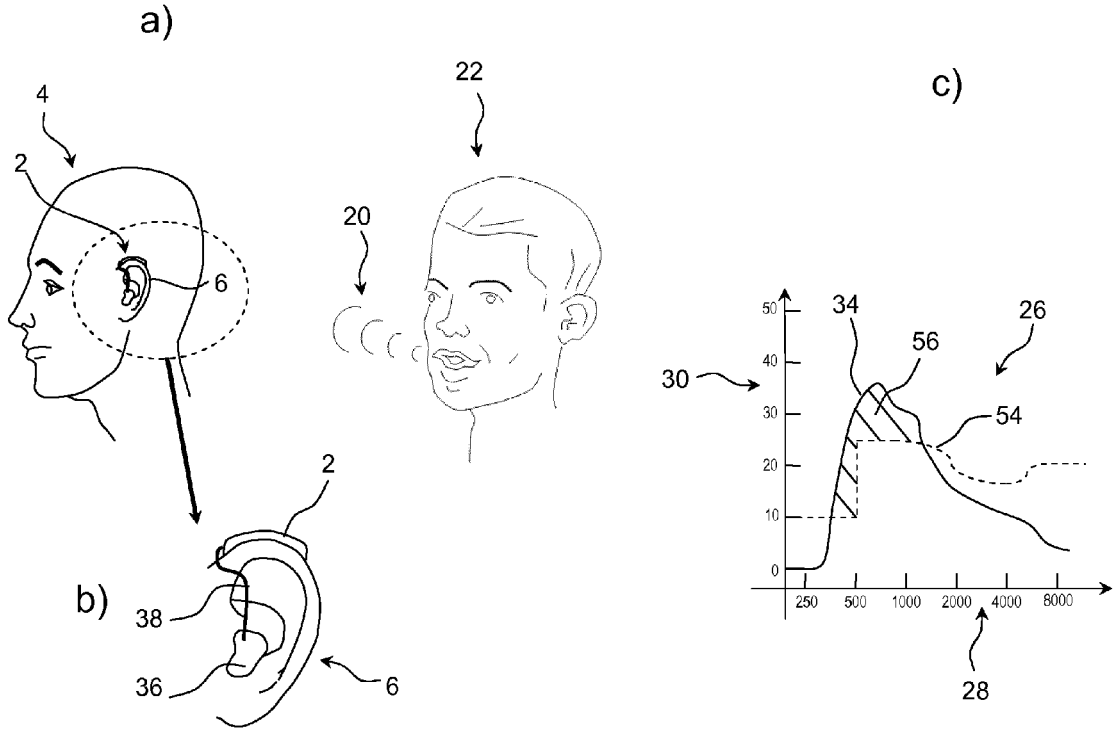
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Fig. 3

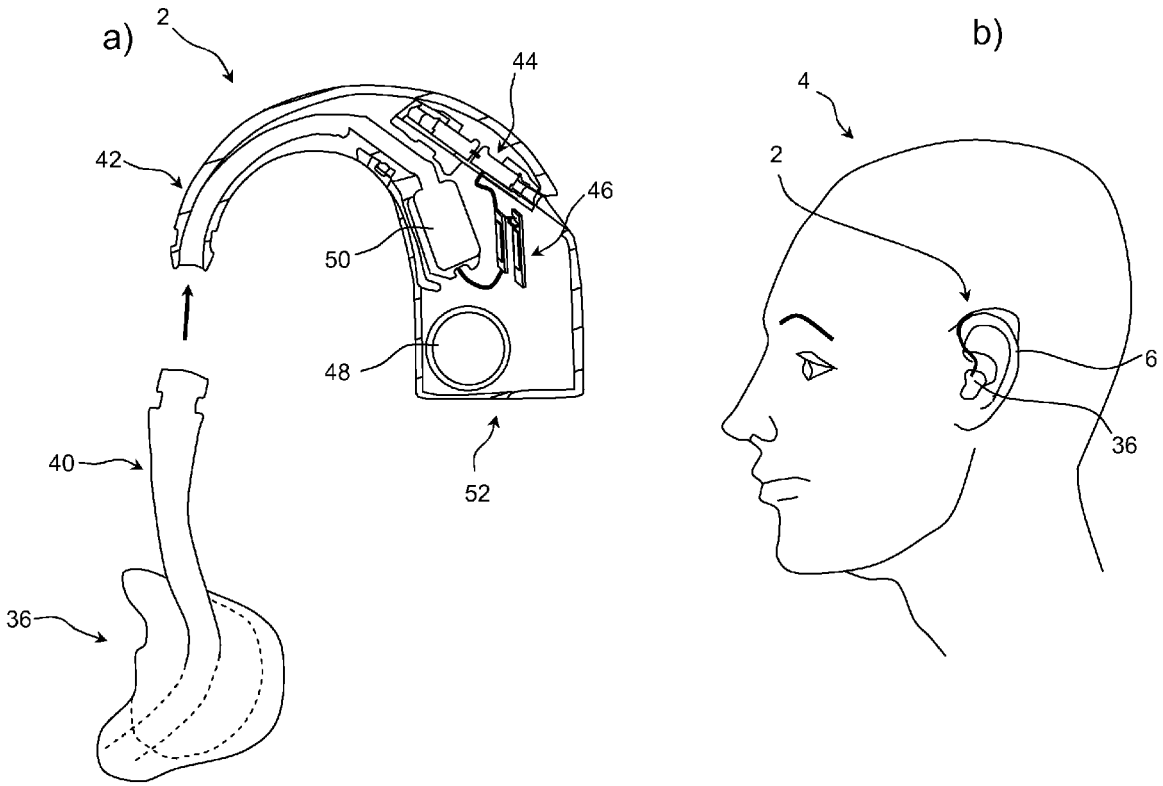

Fig. 4

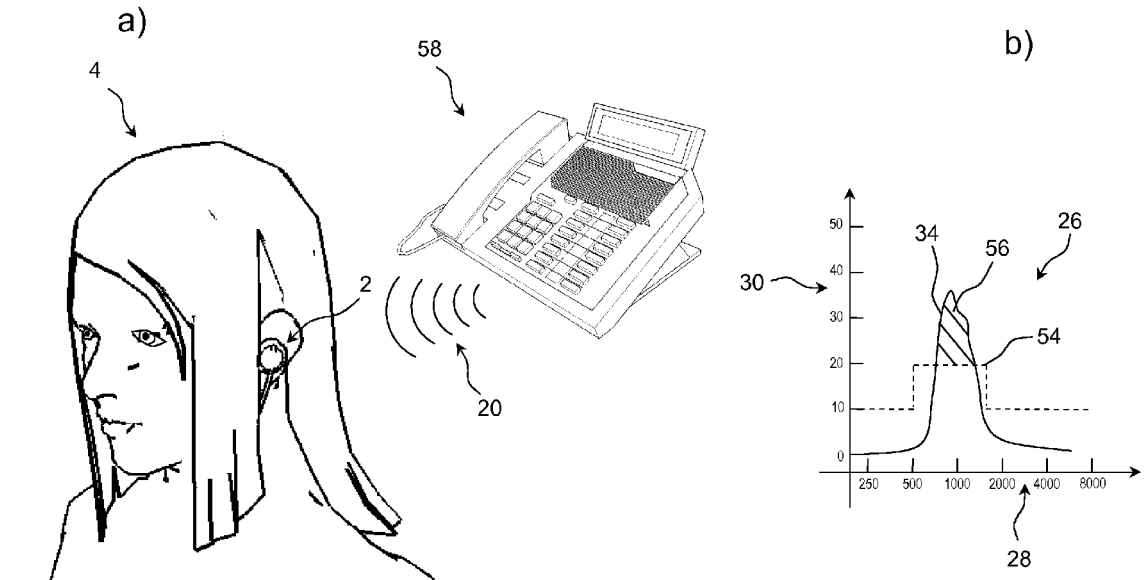
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Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 3426

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	WO 2008/083315 A2 (PERSONICS HOLDINGS INC [US]) 10 July 2008 (2008-07-10) * figure 1 * * paragraphs [0025], [0028] - [0029], [0033], [0034], [0036], [0041], [0043], [0057] *	1-13	INV. H04R1/10 H04R25/00
X	US 2002/141599 A1 (TRAJKOVIC MIROSLAV [US] ET AL) 3 October 2002 (2002-10-03) * figures 2-3 * * paragraphs [0017], [0020] - [0024], [0029] *	1-13	
X	JP 2008 300894 A (SMK KK) 11 December 2008 (2008-12-11) * abstract *	1-4,6,7, 9,12,13	
X	EP 1 646 265 A2 (YAMAHA CORP [JP]) 12 April 2006 (2006-04-12) * paragraphs [0038], [0049], [0053], [0055] *	1,2,6,9, 10	
			TECHNICAL FIELDS SEARCHED (IPC)
X	GB 2 477 809 A (HOSIDEN BESSON LTD [GB]) 17 August 2011 (2011-08-17) * page 3, lines 13-23 * * page 1, lines 22-29 *	1,2,6,9	H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 March 2014	Rogala, Tomasz

CATEGORY OF CITED DOCUMENTS

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18-03-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008083315 A2	10-07-2008	US 2008240458 A1	02-10-2008
		WO 2008083315 A2	10-07-2008
US 2002141599 A1	03-10-2002	EP 1377961 A2	07-01-2004
		JP 2004526375 A	26-08-2004
		KR 20030009504 A	29-01-2003
		US 2002141599 A1	03-10-2002
		WO 02082422 A2	17-10-2002
JP 2008300894 A	11-12-2008	NONE	
EP 1646265 A2	12-04-2006	EP 1646265 A2	12-04-2006
		JP 2006093792 A	06-04-2006
		US 2006083387 A1	20-04-2006
GB 2477809 A	17-08-2011	GB 2477809 A	17-08-2011
		WO 2011101623 A1	25-08-2011

EPO FORM P0459

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Patent documents cited in the description

- EP 2472907 A1 **[0005]**