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(54) AN AUTOMATIC MUTE SYSTEM AND A METHOD THEREOF FOR HEADPHONE

(57) The present invention refers to an automatic mute system for earphone. The automatic mute system comprises an audio source (1), an amplifier unit (2), a buffer unit (3), at least one earpiece (5) and a comparator (4). The system can detect the availability of backward harmonics (10) due to reflected signal from the ear canal and mute the audio source (1) if they are not available. The amplifier unit (2) is provided for amplifying the audio signal from the audio source (1). The buffer unit (3) is provided in between the amplifier and the earpiece (5) for generating buffered audio signal. The backward harmonics (10) are generated from reflected audio signals from the ear canal and obtained by the earpiece (5). The comparator (4) is provided for detecting backward harmonics (10) by means of input and output buffered audio signal. The comparator (4) can generate a mute signal (7) for turning off the amplifier unit (2) when the backward harmonics (10) is not present.

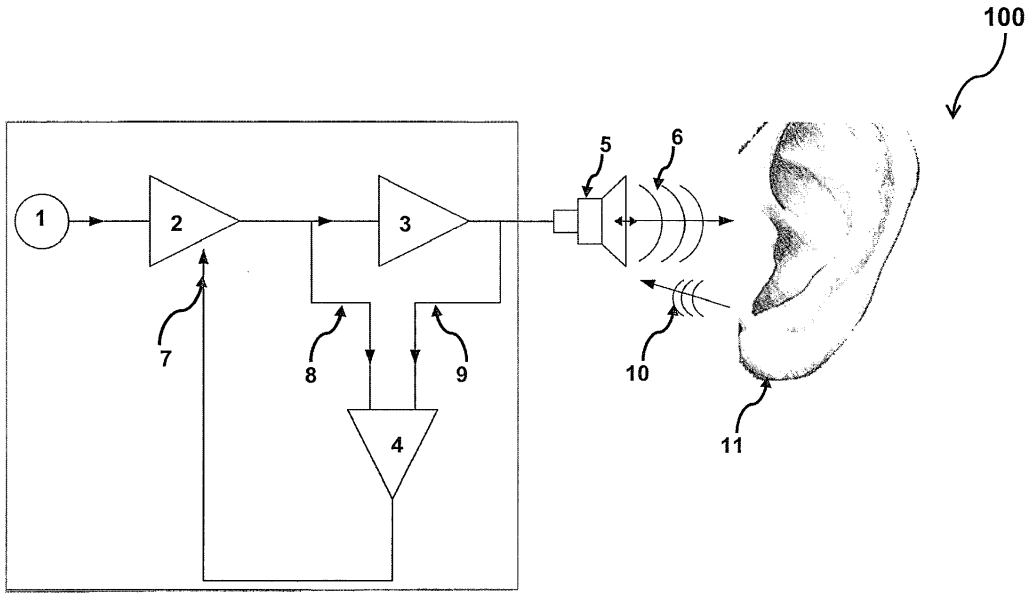

Fig. 1

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Description

[0001] This invention refers to an automatic mute system for headphone according to claim 1 and a method thereof for muting the headphone automatically according to claim 7.

Background of the Invention

[0002] Headphones or earphones are a pair of small size electronic or electric listening devices. Usually it is worn on or around the head over a user's ears. The headphones are electroacoustic transducers, which can convert an electrical signal to a corresponding sound in the user's ear. Headphones are designed to allow a single user to listen to an audio source privately, in contrast to a loudspeaker.

[0003] The main drawback of headphones or earphones (or earpieces in general) is that the headphone can continue to work even after removal of them from the ear, until the audio source is made to stop. After removal of headphone from ear, the audio source may not be stopped automatically and that leads to undesirable and power consuming case while using.

[0004] In the prior art KR20070025167A, the prior art provides an audio volume control apparatus and method for mobile communication device. More specifically, the prior art describes about an apparatus and a method for adjusting an audio volume of a mobile terminal are provided to detect whether a user wears an earphone when an audio sound and a bell sound are to be outputted through the earphone and to output the bell sound with the same volume as the volume of the audio outputted through the earphone. But the apparatus requires a special made earpieces which includes special sensors inside the earpiece that detects whether the earpieces is in use or not. This leads to increase in cost of the headphone and it cannot be used for all earpieces. Further, a special communication is required between source and earpiece.

[0005] In another prior art US2013345842A1, the prior art describes about an earphone removal detection. An aspect provides a method, information handling device and a program product for detecting the earphone removal. The method comprising the steps of detecting that a first earphone and a second earphone are not both positioned in a listening position with respect to a user; generating a signal in response to detecting that a first earphone and a second earphone are not both positioned in a listening position with respect a user; and in response to the generated signal, halting an application on a device providing audio to the first earphone and second earphone. The prior art deals with acoustic and biometric characteristics of the earphone for detecting the presence of earphone in an appropriate position. Further, the US2013345842A1 requires a software program for controlling the system.

[0006] In another prior art WO2015051819A1, the earphone device with optical sensor. An earphone device to be worn in the ear, which earphone device comprising a main body to be arranged in the concha of the outer ear of a user and an optical sensor, which optical sensor comprises a light emitter and a light detector. The earphone device comprises window means through which light emitted by the light emitter can be transmitted. By optical means the earphone removal is detected. Similar to KR20070025167A, the prior art WO2015051819A1 also requires a special made earpieces which includes special sensors inside the earpiece that detects whether the earpieces is in use or not. It cannot be used for all earpieces.

[0007] In the literature, "Considerations in high-fidelity moving-coil earphone design," by White, J. Audio, IEEE Transactions on , vol.11, no.6, pp. 188- 194, Nov 1963 doi: 10.1109/TAU.1963.1161732 describes the characteristics of loudspeakers including backward sound harmonics. The usage of such characteristics in earphone is not described so far.

[0008] The subject-matter of US2013345842A1, KR20070025167A and WO2015051819A1 does not provide an effective solution for automatically muting the earphone without changing the existing design in the earpiece.

Object of the Invention

[0009] It is therefore the object of the present invention to provide a system, in particular an automatic mute system for headphone that can save power and can be adapted to any earpiece without change in design.

Description of the Invention

[0010] The before mentioned object is solved by an automatic mute system for earphone according to claim 1. The automatic mute system according to the present invention preferably comprises an audio source, an amplifier unit, a buffer unit, at least one earpiece and a comparator. The audio source is provided for sending audio signal. The amplifier unit is provided for amplifying the audio signal from the audio source. The buffer unit is provided in between the amplifier and the ear piece for generating buffered audio signal. The earpiece is provided for rendering amplified audio signal to a user. Further, the earpiece is mounted on an ear canal of the user and the earpiece is capable of obtaining backward harmonics. The backward harmonics are generated from reflected audio signals from the ear canal. The comparator provided for detecting backward harmonics by subtracting the input and output buffered audio signal. The comparator generates a mute signal for turning off the amplifier unit when the backward harmonics is not present.

[0011] This solution is beneficial hence the automatic mute system for earphone has a very wide usage area. That is it can be used in every device that have headphone / earphone output. The undesirable power con-

sumption when the earphone is not in use can be avoided by the aforementioned system.

[0012] Further preferred embodiments are subject-matter of dependent claims and/or of the following specification parts.

[0013] According to a preferred embodiment of the present invention, the buffer unit is a unit gain buffer amplifier. That is an output of the buffer unit can be transferred to an output jack of the earpiece. Further, the amplified audio signal is transferred to the earpiece with its cord. The comparator can provide the mute signal to the amplifier unit to turn OFF the amplifier unit. Further, the comparator can detect the backward harmonics by subtracting input and output signal of the buffer unit. In addition to that, the comparator can enable the mute signal to turn off the amplifier unit even for very small level of the backward harmonics. The backward harmonics are created by harmonics on a line between the buffer unit and the earpiece.

[0014] According to a further preferred embodiment of the present invention, the generation of backward harmonics indicates that the earpiece is positioned on the ear of the user. The absence of backward harmonics indicates that the earpiece is not positioned on the ear of the user.

[0015] The before mentioned object is also solved by a method to mute the earphone automatically, according to claim 9. Said method preferably comprises the steps: transmitting audio signal from an audio source to an amplifier unit, checking for mute signal at the amplifier input stage, amplifying the audio signal received at the amplifier unit, if the mute signal is not received, buffering and transmitting the amplified audio signal to an earpiece using a buffer unit, receiving an audio signal at the earpiece that is reflected from an ear canal of a user, detecting the backward harmonics with the buffered audio signal using a comparator, checking whether the backward harmonics is present or not; and keeping a mute signal in hold for turning off , if the backward harmonics is present.

[0016] According to a further preferred embodiment of the present invention, the method for automatically muting headphone further comprising the steps of, sending the mute signal to the amplifier unit, if the backward harmonics is absent and stopping the amplification of the audio signal by turning off the amplifier unit.

[0017] Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which components of the invention are exemplarily illustrated. Components of the devices and method according to the inventions, which match at least essentially with respect to their function can be marked with the same reference sign, wherein such components do not have to be marked or described in all figures.

[0018] The invention is just exemplarily described with respect to the attached figures in the following.

Brief Description of the Drawings

[0019]

Fig. 1 illustrates the functional circuit diagram for automatic mute system for earphone according to an embodiment of the present invention;

Fig. 2 illustrates the method for mute the earphone automatically according to an embodiment of the present invention.

Detailed Description of the Drawings

[0020] Fig. 1 illustrates the functional circuit diagram 100 for automatic mute system for earphone according to an embodiment of the present invention. The automatic mute system according to the present invention preferably comprises an audio source 1, an amplifier unit 2, a buffer unit 3, at least one earpiece 5 and a comparator 4. The audio source 1 is provided for sending audio signal. The amplifier unit 2 is provided for amplifying the audio signal from the audio source 1. The buffer unit 3 is provided in between the amplifier unit 2 and the earpiece 5 for generating buffered audio signal. The earpiece 5 is provided for rendering (output from earpiece) amplified audio signal 6 to a user. Further, the earpiece 5 is mounted on an ear canal of the user and the earpiece 5 is capable of obtaining backward harmonics 10. The backward harmonics 10 are generated from reflected audio signals from the ear canal. The comparator 4 is provided for detecting backward harmonics 10 by subtracting the input and output buffered audio signal. The comparator 4 can generate a mute signal 7 for turning off the amplifier unit 2 when the backward harmonics 10 is not present.

[0021] According to a preferred embodiment of the present invention, the buffer unit 3 is a unit gain buffer amplifier. That is an output 9 of the buffer unit 3 can be transferred to an output jack of the earpiece 5. Further, the output 9 of the buffer unit 3 (amplified audio signal) is transferred to the earpiece 5 with its cord. The comparator 4 can detect the backward harmonics 10 by subtracting input 8 and output 9 of the buffer unit 3. Further, the comparator 4 can provide the mute signal 7 to the amplifier unit 2 to turn OFF the amplifier unit 2. In addition to that, the comparator 4 can enable the mute signal 7 to turn off the amplifier unit 2 even for very small level of the backward harmonics 10.

[0022] According to a further preferred embodiment of the present invention, the backward harmonics 10 are created by harmonics on a line between the buffer unit 3 and the earpiece 5. The generation of backward harmonics 10 indicates that the earpiece 5 is positioned on the ear 11 of the user. The absence of backward harmonics 10 indicates that the earpiece 5 is not positioned on the ear 11 of the user.

[0023] Fig. 2 illustrates the method 200 for mute the

earphone automatically according to an embodiment of the present invention. The method to mute the earphone automatically comprising the steps of transmitting audio signal 12 from an audio source 1 to an amplifier unit 2, checking 13 whether the mute signal 7 is received or not. If the mute signal 7 is not received at the amplifier unit 2 then the amplifier unit can amplify 14 the audio signal. Otherwise, the amplifier unit 2 can be turned off 20 with by the mute signal 7. The amplified signal can be buffered 15 using a buffer unit 3. Further, the buffered audio signal may be transmitted 16 to the earpiece 5. The backward harmonics 10 are received 17 from the earpiece 5. That is the backward harmonics 10 are reflected from an ear canal of the user. The comparator 4 can detect 18 the backward harmonics 10 by means of the input and output buffered audio signal 9. The comparator 4 can detect even very small harmonics by subtracting input 8 and output 9 of buffer unit 3. Before amplification process, the condition for the presence 19 of any backward harmonics 10 is verified. If there may not any presence of backward harmonics 10 then the comparator 4 can generate the mute signal 7. Otherwise, the comparator 4 may not generate any mute signal 7 to turn off the amplifier unit 2.

[0024] Thus, the present invention refers to an automatic mute system for earphone. The automatic mute system preferably comprises an audio source 1, an amplifier unit 2, a buffer unit 3, at least one earpiece 5 and a comparator 4. The system can detect the availability of that backward harmonics 10 due to reflected signal from the ear canal and mute the audio source 1 if they are not available. The amplifier unit 2 is provided for amplifying the audio signal from the audio source 1. The buffer unit 3 is provided in between the amplifier and the earpiece 5 for generating buffered audio signal. The backward harmonics 10 are generated from reflected audio signals from the ear canal and obtained by the earpiece 5. The comparator 4 is provided for detecting backward harmonics 10 by means of input and output buffered audio signal. The comparator 4 can generate a mute signal 7 for turning off the amplifier unit 2 when the backward harmonics 10 is not present.

List of reference numbers

[0025]

1	an audio source
2	an amplifier unit
3	a buffer unit
4	a comparator
5	an earpiece
6	output from earpiece or audio signal to ear canal
7	mute signal
8	input of the buffer unit
9	output of the buffer unit
10	reflected signal from ear canal or backward harmonics
11	user's ear
12	transmitting audio signal from an audio source to an amplifier unit,
13	condition to check whether the mute signal is received or not.
14	amplifying the audio signal received at the amplifier unit.
15	buffering the amplified signal to next stage using a buffer unit.
16	transmitting the buffered audio signal to the earpiece.
17	receiving backward harmonics from the earpiece that is reflected from an ear canal of the user.
18	detecting the backward harmonics with the buffered audio signal using a comparator.
19	condition to check whether there are any backward harmonics.
20	stopping the amplification of audio.
100	the functional circuit diagram for automatic mute system for earphone
200	the method for mute the earphone automatically

Claims

1. An automatic mute system for headphone comprises of,
an audio source (1) provided for sending audio signal;
an amplifier unit (2) provided for amplifying the audio signal from the audio source (1); a buffer unit (3) provided in between the amplifier and the earpiece (5) for generating buffered audio signal;
at least one earpiece (5) provided for rendering amplified audio signal to a user; wherein the earpiece (5) is mounted on an ear canal of the user;
wherein the earpiece (5) is capable of obtaining backward harmonics (10);
wherein the backward harmonics (10) are generated from reflected audio signals from the ear canal;
characterized in that
a comparator (4) provided for detecting backward harmonics (10) by means of input and output buffered audio signal; and
wherein the comparator (4) generates a mute signal (7) for turning off the amplifier unit (2) when the backward harmonics (10) is not present.

2. The system of claim 1, wherein the buffer unit (3) is a unit gain buffer amplifier;
wherein an output (9) of the buffer unit (3) transferred to an output jack of the earpiece (5) and the amplified audio signal transferred to the earpiece (5) with its cord.

3. The system of claim 1, wherein the comparator (4) provides the mute signal (7) to the amplifier unit (2) to turn OFF the amplifier unit (2).

4. The system of claim 1, wherein the comparator (4) detects the backward harmonics (10) by subtracting input (8) and output (9) signal of the buffer unit (3).

5. The system of claim 1, wherein the comparator (4) enables the mute signal (7) to turn off the amplifier unit (2) even for very small level of the backward harmonics (10).

6. The system of claim 1, wherein the backward harmonics (10) are created by harmonics on a line between the buffer unit (3) and the earpiece (5).

7. The system of claim 1, wherein the generation of backward harmonics (10) indicates that the earpiece (5) is positioned on the ear (11) of the user.

8. The system of claim 1, wherein an absence of backward harmonics (10) indicates that the earpiece (5) is not positioned on the ear (11) of the user.

9. A method for automatically muting headphone comprising the steps of
transmitting audio signal from an audio source (1) to an amplifier unit (2);
checking for mute signal (7) at the amplifier input stage;
amplifying the audio signal received at the amplifier unit (2), if the mute signal (7) is not received;
buffering and transmitting the amplified audio signal to an earpiece (5) using a buffer unit (3);
receiving an audio signal at the earpiece (5) that is reflected from an ear canal of a user;
detecting the backward harmonics (10) with the buffered audio signal using a comparator (4);
checking whether the backward harmonics (10) is present or not; and
keeping a mute signal (7) in hold for turning off , if the backward harmonics (10) is present.

10. The method of claim 9, the method for automatically muting headphone further comprising the steps of
sending the mute signal (7) to the amplifier unit (2), if the backward harmonics (10) is absent; and
stopping the amplification of the audio signal by turning off the amplifier unit (2).

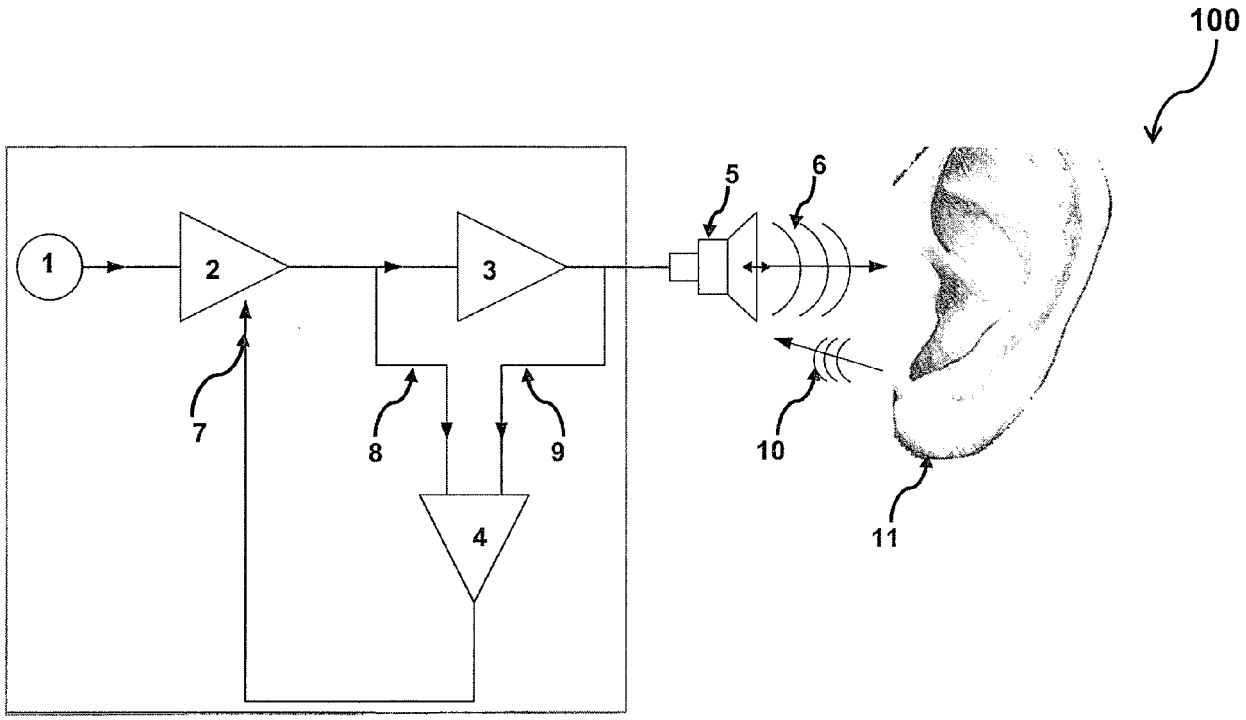

Fig. 1

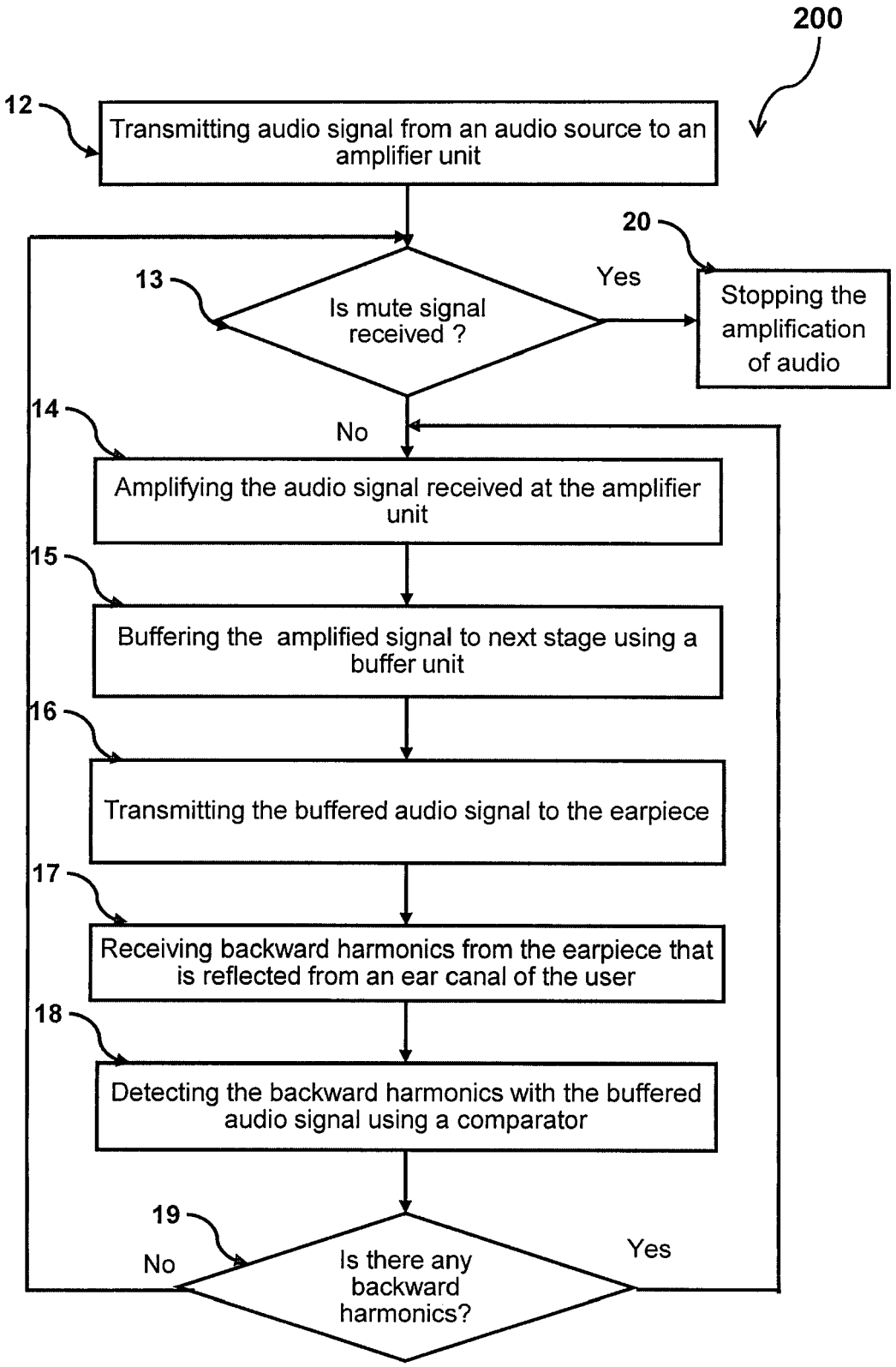
200
12
Transmitting audio signal from an audio source to an amplifier unit
20
13
Is mute signal received ?
Yes
Stopping the amplification of audio
14
No
Amplifying the audio signal received at the amplifier unit
15
Buffering the amplified signal to next stage using a buffer unit
16
Transmitting the buffered audio signal to the earpiece
17
Receiving backward harmonics from the earpiece that is reflected from an ear canal of the user
18
Detecting the backward harmonics with the buffered audio signal using a comparator
19
No
Is there any backward harmonics?
Yes

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 7106

DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2015/063587 A1 (PARK YONGHAHK [KR] ET AL) 5 March 2015 (2015-03-05) * paragraphs [0003], [0008], [0023] * * paragraph [0085] - paragraph [0125] * * figures 3-7 *	1-10	INV. H04R1/10 ADD. H04R25/00
A	US 2004/196992 A1 (RYAN JIM G [CA]) 7 October 2004 (2004-10-07) * paragraphs [0002], [0003], [0005] * * paragraph [0020] - paragraph [0033] * * figures 1-5 *	1-10	
A	US 2007/297634 A1 (HANSSON MAGNUS [SE]) 27 December 2007 (2007-12-27) * paragraph [0001] * * paragraph [0033] - paragraph [0042] * * figures 1-3 *	1-10	
A	US 2012/207319 A1 (TSUCHIYA SHINPEI [JP] ET AL) 16 August 2012 (2012-08-16) * paragraph [0005] - paragraph [0012] * * paragraph [0063] - paragraph [0079] * * figures 3-5 *	1-10	TECHNICAL FIELDS SEARCHED (IPC) H04R
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 September 2017	Valenzuela, Miriam

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- US 2013345842 A1 **[0005] [0008]**
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