INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	2651
	Examiner Name	Lunsee Lao
	Attorney Docket Number	11472-39-5_CONT2-16247186

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Peter A. Chiabotti/	Date (YYYY-MM-DD)	2023-04-07
Name/Print	Peter A. Chiabotti	Registration Number	54603

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	17215804	Filing Date	2021-03-29	Docket Number (if applicable)	11472-39-5_CONT2-1624718	Art Unit	2651
First Named Inventor	Steven Wayne Goldstein			Examiner Name	Lunsee Lao		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 500951

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

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Signature of Registered U.S. Patent Practitioner			
Signature	/Peter A. Chiabotti/	Date (YYYY-MM-DD)	2023-04-07
Name	Peter A. Chiabotti	Registration Number	54603

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/215,804	04/07/2023 07:35:57 PM ET	11472-39-5_CONT2-16247186

Title of Invention

METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9372	FILED BY	Yoshi Hassan
PATENT CENTER #	61889322	AUTHORIZED BY	Peter Chiabotti
CUSTOMER #	150139	FILING DATE	03/29/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Steven Wayne Goldstein

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 500951	E202347J36227110	Yoshi Hassan

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	544.00	1	544.00
			TOTAL AMOUNT:	$544.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

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Espacenet

TWM568011U Audio system with simulated environmental sound effect

Applicants: MOBILE DEVICES INC [TW]

Inventors: LIU SHANG-JIE [TW],HU SHI-CHANG [TW]

Classifications:
IPC ***H04R5/00;***

Priorities: TW107207777U 2018-06-11

Application: TW107207777U·2018-06-11

Publication: TWM568011U·2018-10-01

Published as: TWM568011U

Audio system with simulated environmental sound effect

Abstract

No abstract found. Please consult other publications of this patent family in "Available in", if displayed above.

[Translation]
【Technical field】
This creation is about a voice communication system, especially a voice system for simulating environmental sound effects that can make the other party mistakenly believe that the user is in the environment presented by the background sound effects by adding background sound effects when the user is talking.
【Prior technology】
Press, in the era of technological advancement, mobile phones have become an indispensable electronic product in modern people's lives, allowing users to have two-way conversations with other users who use wired phones or mobile phones anytime, anywhere. However, in the process of using, the user often has to hold a mobile phone to talk to others, but it is quite inconvenient for the user. If the speaker function is turned on to talk to others, not only the confidentiality of the call content is lacking, but also It is easy to disturb others around you.
Therefore, there are currently earphones with a microphone call button on the market. Through the combination of the earphone and a mobile phone, the function of hands-free calling can be achieved. As shown in Figure 5, it is a three-dimensional schematic diagram of a conventional earphone microphone, including One at least one earphone 41, a microphone 42 and a connection terminal 43 and other components, and these components are connected by the earphone wire, and the connection terminal 43 can be combined with a jack of a mobile phone (not shown), To facilitate the user to communicate.
However, when the user finds that he does not have the will to talk to the other person after he connects to the other person's call, he suffers from problems such as finding no reason to terminate the call, or the reason is too far-fetched and causes the other party to feel disgusted.
The reason is that there are still many deficiencies in the above-mentioned existing methods, which are really not a good design and need to be improved urgently.
【New content】
The main purpose of this creation is to provide a voice system for simulating environmental sound effects. Through the mixing unit, the sound recorded by the sound receiving unit is mixed with the background sound effect output by the sound effect storage unit, so as to simulate a sound that can make the other party mistakenly believe that the user is really in the background. The effect of the environment presented by the sound effect. When the user is on a call, because the other party hears the content of the user's speech and the background sound effect at the same time, they mistakenly believe that the user is in the environment presented by the background sound effect and are inconvenient to speak or are disturbed. , so it can provide the specific reason for the user to terminate the call; or when the user does not want the other party to know the environment in which he is, it can make the other party believe that the user is indeed in the environment presented by the background sound effect.
The secondary purpose of this creation is to provide a simulated environmental sound effect voice system, which is to install the receiver unit, sound effect storage unit, mixing unit and transmission unit in the earphone microphone to replace the conventional earphones that do not have the simulated environmental sound effect voice system Microphone, so that the user can directly use it in combination with the communication device; in addition, it also provides a simulated environmental sound effect voice system, in which the sound receiving unit is set on the earphone microphone,

and the sound effect storage unit, the mixing unit and the transmission unit are set on the converter. When the earphone microphone cannot be directly used in combination with the communication device, the earphone microphone can be used indirectly with the communication device through the connection with the adapter, thereby improving the applicability of this creation.
Therefore, in order to achieve the above-mentioned purpose, this work is a kind of simulated environmental sound effect voice system, which includes: a sound receiving unit, which records the sound of an external sound source, and converts it into an audio message; a sound effect storage unit, which stores at least one background sound effect; A sound mixing unit is electrically connected with the sound receiving unit and the sound storage unit, and mixes the audio converted by the sound reception unit with the background sound output by the sound storage unit to form a mixed sound; and a transmission unit , is electrically connected with the audio mixing unit, and transmits the mixed audio to a communication device.
Continuing from the above-mentioned simulated environmental sound effect speech system, wherein the sound receiving unit, the sound effect storage unit, the sound mixing unit and the transmission unit are all arranged in an earphone microphone.
Continuing from the above-mentioned simulated environmental sound effect voice system, the sound receiving unit is set in an earphone microphone, and the sound effect storage unit, the sound mixing unit and the transmission unit are set in a converter.
Continuing from the above-mentioned simulated environmental sound effect speech system, the sound receiving part of the earphone microphone is a skinny conduction microphone.
Continuing from the aforementioned simulated ambient sound effect speech system, wherein the transmission unit is further electrically connected to the sound effect storage unit, so that the background sound effect is stored in the sound effect storage unit by the communication device through the transmission unit.
The above-mentioned simulated environmental sound effect speech system further has a decoding unit, which is electrically connected between the sound effect storage unit and the sound mixing unit, and is used to decode the background sound effect output by the sound effect storage unit, and then decode it. The mixed audio is formed by mixing it with the audio converted by the sound receiving unit by the audio mixing unit.
The above-mentioned simulated environmental sound effect speech system further has a control unit, and is electrically connected to the sound effect storage unit, and the background sound effect output by the sound effect storage unit is switched by the control unit.
Continuing from the above-mentioned simulated environmental sound effects speech system, the transmission unit is one of a wired transmission unit, a wireless transmission unit, or both.
Continuing from the aforementioned simulated environmental sound effect voice system, the communication device is a smart phone, a tablet computer, a portable computer, or a desktop computer.
To sum up, this case is not only truly innovative in terms of spatial form, but also can enhance the above-mentioned multiple functions compared with commonly used items. It should have fully met the statutory new patent requirements of novelty and advancement. I would like to file an application in accordance with the law and sincerely request your approval. This new patent application case is to encourage creation, and I am grateful for it.
【Symbol Description】

10…Simulated environmental sound effect voice system
11…radio unit
12…Audio storage unit
13…mixing unit
14…transmission unit
15…Decoding unit
16…Control Unit
100…Earphone microphone
200…Converter
300…communication device
S…External audio source
40…Headphone microphone
41…Earphones
42…Microphone
43…connection terminal
[Simple description of the diagram]
Figure 1 is a schematic diagram of the first structure of the simulated environmental sound effect voice system created by this invention.
Fig. 2 is the first embodiment diagram of the simulated environment sound effect speech system of this creation.
Fig. 3 is the second embodiment diagram of the simulated environmental sound effect speech system of this creation.
Fig. 4 is a schematic diagram of the second structure of the simulated environmental sound effect voice system of this creation.
Fig. 5 is a three-dimensional schematic diagram of a conventional earphone microphone.
【Implementation】
Please refer to shown in Fig. 1, it is the first schematic diagram of the structure of the simulated environmental sound effect speech system 10 of this creation, which includes: a sound receiving unit 11, which records the sound of an external sound source S (for example: the user's voice), And convert it into an audio message; a sound effect storage unit 12 stores at least one background sound effect, such as: the sound effect of vehicles, the sound effect of children's noise, the sound effect of the vegetable market, the sound effect of office meetings... etc.; a sound mixing unit 13, which is It is electrically connected with the sound receiving unit 11 and the sound effect storage unit 12, and the audio converted by the sound receiving unit 11 is mixed with the background sound output by the sound effect storage unit 12 to form a mixing audio; and a transmission unit 14 is It is electrically connected with the mixing unit 13, and the mixed audio is transmitted to a communication device 300 through wiredor wireless means, wherein the transmission unit 14 is either one or both of the wired transmission unit and the wireless transmission unit Both, the wired transmission unit can adopt Lightning and USB transmission methods, and the wireless transmission unit can adopt Bluetooth or WiFi transmission methods; in addition, the communication device 300 is a smart phone, tablet computer, Portable computers, desktop computers, etc., can be any device as long as the user can make a call, so it will not be described in detail.
Then, please refer to shown in Fig. 2, which is the first embodiment figure of the simulated environmental sound effect speech system 10 of this creation , wherein the sound receiving unit 11, the sound effect storage unit 12, the sound mixing unit 13 and the transmission unit 14 They are all arranged in an earphone microphone 100. Since the transmission unit 14 is a wired transmission unit or a wireless transmission unit, the user can directly

connect the earphone microphone 100 to the communication device 300 in a wired or wireless manner, so that the hybrid The audio unit 13 can transmit the formed mixed audio to the communication device 300 through the transmission unit 14 . For example, when the user talks to the other party, the other party can hear the mixed audio (the sound effect of the traffic), and misidentifies the user's current environment (on the street), or the user can use this as a reason (environment Too noisy, poor reception... etc.), terminate the call with the other party; or when the user does not want the other party to know the environment in which he is (for example: dance hall), because the other party hears background sound effects (for example: conference call sound effects), so it can convince the other party that the user is indeed in the environment presented by the background sound effects.
Or, please refer to shown in Fig. 3, it is the second embodiment diagram of the simulated environmental sound effect voice system 10 of this creation, wherein the sound receiving unit 11 is arranged on an earphone microphone 100 , and the sound effect storage unit 12, the mixing The sound unit 13 and the transmission unit 14 are arranged on a converter 200, in order to prevent the earphone microphone 100 from being connected to the adapter 200 when the earphone microphone 100 cannot be directly used in combination with the communication device 300, Then, by connecting the adapter 200 to the communication device 300 via a wired or wireless method, the audio mixing unit 13 can also transmit the formed mixed audio to the communication device 300 through the transmission unit 14 . For example: when the connection terminal of the headset microphone 100 is a 3.5mm headphone connector, but the communication device 300 only has a Lightning connection hole and does not have a 3.5mm headphone connection hole, it is necessary to connect the headset microphone 100 to a 3.5mm connector. The earphone connector is inserted into the 3.5mm earphone connection hole of the adapter 200, and then the Lightning connector of the adapter 200 is inserted into the Lightning connection hole of the communication device 300, so that the earphone microphone 100 is indirectly combined with the communication device 300 use.
However, whether it is the earphone microphone 100 shown in Fig. 2 or Fig. 3, the sound receiving part of the earphone microphone 100 is a skinny conduction microphone, which can remove the noise in the user's actual environment, so that The other party can clearly hear the user's voice and the matching background sound effect, and simulate a kind of environment where the user is actually presented by the background sound effect.
In addition, in order to store the background sound effect in the sound effect storage unit 12, the transmission unit 14 is further electrically connected to the sound effect storage unit 12, so that the background sound effect is stored in the communication device 300 through the transmission unit 14 In the sound effect storage unit 12. For example: the user first downloads the preset background sound effect through the communication device 300, or records the background sound effect by recording, and then edits the downloaded or recorded background sound effect, and finally passes through the transmission unit 14 The background sound effect is stored in the sound effect storage unit 12, however, how to edit the background sound effect is set according to the user's preferences and needs, and there is no limit.
Finally, please refer to Figure 4, which is a schematic diagram of the second structure of the simulated environmental sound effect speech system 10 of this creation, which further has a decoding unit 15, and is electrically connected to the sound effect storage unit 12 and the sound mixing unit 13, the background sound effect output by the sound effect storage unit 12 is decoded, and after decoding, the sound mixing unit 13 mixes it with the audio

converted by the sound receiving unit 11 to form the mixed sound. In addition , the user can also set the corresponding background sound effect according to different callers through the communication device 300. For example: when caller A calls, the corresponding background sound effect has been set in the communication device 300 for the vehicle traffic. sound effect, so when the user communicates with caller A through the simulated environmental sound effect voice system 10 of this creation, the other party can hear the mixed audio message mixed with the sound effect of the user's voice and the traffic of the vehicle; The corresponding background sound effect is set in the communication device 300 as the sound effect of the vegetable market, so when the user communicates with caller B through the simulated environment sound effect voice system 10 of this creation, the other party can hear the user's voice and the sound effect of the vegetable market Mixing the mixing audio. Not only that, in order to facilitate the user to switch the output background sound effect at any time, the simulated environmental sound effect voice system 10 of the present invention has a control unit 16, and is electrically connected to the sound effect storage unit 12, so that the user can use this The control unit 16 switches the background sound effect output by the sound effect storage unit 16 and has the function of dynamically switching the background sound effect.

Therefore, this creation does provide a simulated environmental sound effect speech system, through the mixing unit, the sound recorded by the sound receiving unit is mixed with the background sound effect output by the sound effect storage unit, so as to simulate a sound that can make the other party mistakenly believe that the user is really in the background sound. The effect in the environment, when the user makes a call, because the other party hears the content of the user's speech and the background sound at the same time, they mistakenly believe that the user is in the environment presented by the background sound and it is inconvenient to speak or hear clearly due to interference. Provide the specific reason for the user to terminate the call; or let the other party believe that the user is indeed in the environment presented by the background sound when the user does not want the other party to know their own environment. Not only that, it also provides a voice system with simulated environmental sound effect, which is to set the receiving unit, sound effect storage unit, mixing unit and transmission unit in the earphone microphone to replace the known earphone microphone without the simulated environmental sound effect voice system, so as to facilitate The user directly uses it in combination with the communication device; in addition, a voice system with simulated environmental sound effects is provided, in which the radio unit is set on the earphone microphone, and the sound effect storage unit, the mixing unit and the transmission unit are set on the converter, when the earphone microphone and the communication When the device cannot be used directly, the headphone microphone can be used indirectly with the communication device through the connection with the adapter, so as to improve the applicability of this creation.

In summary, it is only a better feasible embodiment of this creation, and does not limit the patent scope of this creation. All equivalent structural changes made by using the instructions and drawings of this creation are also included in this creation. Within the scope, agree with Chen Ming.

[Translation]
1. An analog environmental sound effect voice system, which include:
a radio unit, which records the sound of an external sound source and converts it into an audio message;
a sound effect storage unit, which stores at least one background sound effect;
a sound mixing unit, which is electrically connected to the sound receiving unit and the sound effect storage unit, and mixes the audio converted by the sound receiving unit and the background sound output from the sound effect storage unit to form a mixed sound; and a transmission unit , which is electrically connected with the mixing unit and transmits the mixed audio to a communication device.
2. The analog ambient sound effect speech system as described in claim 1, wherein the sound receiving unit, the sound effect storage unit, the sound mixing unit and the transmission unit are all arranged in an earphone microphone.
3. The analog ambient sound effect speech system as described in claim 1, wherein the sound-receiving unit is arranged in an earphone microphone, and the sound-effect storage unit, the mixing unit and the transmission unit are arranged in a converter.
4. The simulated ambient sound effect speech system as described in item 2 or 3 of the patent application scope, wherein the sound-receiving part of the earphone microphone is a skinny conduction microphone.
5. The analog ambient sound effect voice system as described in claim 1, wherein the transmission unit is further electrically connected to the sound effect storage unit, so that the background sound effect is stored in the sound effect by the communication device through the transmission unit in the storage unit.
6. The analog ambient sound effect voice system according to any one of the claims 1, 2, 3, and 5, further comprising a decoding unit that is electrically connected between the sound effect storage unit and the sound mixing unit, The background sound effect output by the sound effect storage unit is decoded, and after decoding, the mixed sound audio is formed by mixing it with the audio converted by the sound receiving unit by the sound mixing unit.
7. The simulated ambient sound effect voice system according to any one of the claims 1, 2, 3, and 5 of the scope of the application, further comprising a control unit, which is electrically connected to the sound effect storage unit through the control unit Switch the background sound output from the sound storage unit.
8. The analog environmental sound effect voice system as described in item 6 of the scope of the application, further comprising a control unit, which is electrically connected to the sound effect storage unit, and is used to switch the background sound output by the sound effect storage unit through the control unit .
9. The analog ambient sound effect voice system as described in claim 1 or 5, wherein the transmission unit is one or both of a wired transmission unit and a wireless transmission unit.
10. The simulated ambient sound effect voice system as described in item 1 or 5 of the patent application scope, wherein the communication device is a smart phone, a tablet computer, a portable computer, or a desktop computer.

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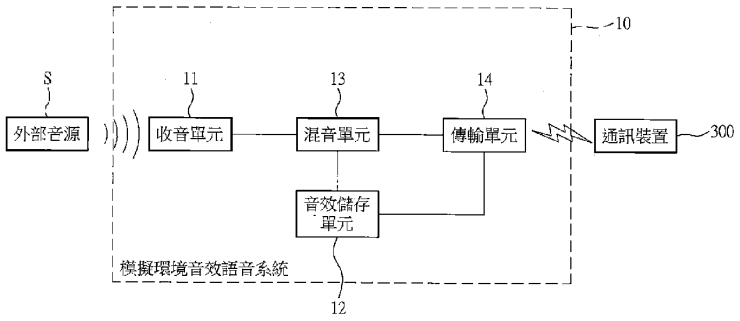
(54)名稱

模擬環境音效語音系統

(57)摘要

本創作為一種模擬環境音效語音系統，其包括：一收音單元，係收錄一外部音源之聲音，並轉換為一音訊；一音效儲存單元，係儲存至少一背景音效；一混音單元，係與該收音單元及該音效儲存單元電性連接，並將該收音單元所轉換之音訊與由該音效儲存單元所輸出之背景音效混合形成一混音音訊；以及一傳輸單元，係與該混音單元電性連接，並將該混合音訊傳輸至一通訊裝置。因此，當使用者進行通話時，能夠讓對方同時聽到使用者說話的內容與背景音效，而誤認使用者處於背景音效所呈現之環境中以至於不便說話或受到干擾聽不清楚，故可提供使用者終止通話的具體理由。

指定代表圖：



第 1 圖

符號簡單說明：

10・・・模擬環境音效語音系統

11・・・收音單元

12・・・音效儲存單元

13・・・混音單元

14・・・傳輸單元

300・・・通訊裝置

S・・・外部音源

新型專利說明書

（本說明書格式、順序，請勿任意更動）

【新型名稱】（中文/英文）

模擬環境音效語音系統

【技術領域】

【0001】 本創作係關於一種語音通訊系統，特別指一種針對使用者通話時加入背景音效以模擬出一種能夠令對方誤認使用者處於背景音效所呈現之環境中之模擬環境音效語音系統。

【先前技術】

【0002】 按，在科技進步的時代下，行動電話已成為現代人在生活中不可或缺的電子產品，讓使用者能夠隨時隨地與其他使用有線電話或行動電話的使用者進行雙向通話。然而，在使用的過程中，使用者往往須以手持行動電話的方式與他人通話，但對使用者而言相當不便利，若是開啟擴音功能與他人通話，不僅缺乏通話內容的保密性，亦容易打擾到周遭旁人。

【0003】 因此，目前市面上已經有具有麥克風通話鍵之耳機出現，透過該耳機與行動電話的結合可以達到免持式通話之功能，如第5圖所示，係為習知耳機麥克風之立體示意圖，包括一至少一耳機41、一麥克風42及一連接端子43等元件，並藉由耳機線將該些元件接合，而該連接端子43可與一行動電話之一插孔相結合(圖未示)，以利使用者進行通話。

【0004】 但是，在使用者接通他人來電後，發現並未具有

與他人通話的意願時，卻苦於找不到理由能夠終止通話，或是理由太過牽強反而造成對方反感等問題。

【0005】 緣是，上述現有方式仍有諸多缺失，實非一良善之設計，而亟待加以改良。

【新型內容】

【0006】 本創作之主要目的，在於提供一種模擬環境音效語音系統，透過混音單元將收音單元所收錄之聲音與音效儲存單元所輸出之背景音效混合，以模擬出一種能夠令對方誤認使用者確實處於背景音效所呈現之環境中的效果，當使用者進行通話時，由於對方同時聽到使用者說話的內容與背景音效，因此誤認使用者處於背景音效所呈現之環境中而不便說話或受到干擾聽不清楚，故可提供使用者終止通話的具體理由；或是當使用者不想讓對方得知自身所處環境時，而讓對方相信使用者確實處於背景音效所呈現之環境中。

【0007】 本創作之次要目的，在於提供一種模擬環境音效語音系統，係將收音單元、音效儲存單元、混音單元及傳輸單元皆設置於耳機麥克風，以取代習知未具有模擬環境音效語音系統之耳機麥克風，以便於使用者直接結合通訊裝置使用；此外，更提供一種模擬環境音效語音系統，係將收音單元設置於耳機麥克風，而音效儲存單元、混音單元及傳輸單元係設置於轉換器，當耳機麥克風與通訊裝置無法直接結合使用時，係可透過與轉接器之連接，將耳機麥克風與通訊裝置間接結合使用，進而提升本創作之應用性。

【0008】 因此，為達上述目的，本創作為一種模擬環境音效語音系統，其包括：一收音單元，係收錄一外部音源之聲音，

並轉換為一音訊；一音效儲存單元，係儲存至少一背景音效；一混音單元，係與該收音單元及該音效儲存單元電性連接，並將該收音單元所轉換之音訊與由該音效儲存單元所輸出之背景音效混合形成一混音音訊；以及一傳輸單元，係與該混音單元電性連接，並將該混合音訊傳輸至一通訊裝置。

【0009】 承上所述之模擬環境音效語音系統，其中該收音單元、該音效儲存單元、該混音單元及該傳輸單元皆設置於一耳機麥克風。

【0010】 承上所述之模擬環境音效語音系統，其中該收音單元係設置於一耳機麥克風，而該音效儲存單元、該混音單元及該傳輸單元係設置於一轉換器。

【0011】 承上所述之模擬環境音效語音系統，其中該耳機麥克風之收音部位係為一骨感傳導式麥克風。

【0012】 承上所述之模擬環境音效語音系統，其中該傳輸單元更與該音效儲存單元電性連接，以令該背景音效係由該通訊裝置透過該傳輸單元儲存於該音效儲存單元中。

【0013】 承上所述之模擬環境音效語音系統，更具有一解碼單元，且電性連接於該音效儲存單元及該混音單元間，係將該音效儲存單元所輸出之背景音效進行解碼，解碼後再藉由該混音單元將其與該收音單元所轉換之音訊混合形成該混音音訊。

【0014】 承上所述之模擬環境音效語音系統，更具有一控制單元，且電性連接於該音效儲存單元，係藉由該控制單元切換該音效儲存單元所輸出之背景音效。

【0015】 承上所述之模擬環境音效語音系統，其中該傳輸單元係為有線傳輸單元、無線傳輸單元兩者其中之一或兩者皆具。

【0016】 承上所述之模擬環境音效語音系統，其中該通訊裝置係為智慧型手機、平板電腦、可攜式電腦、桌上型電腦。

【0017】 綜上所述，本案不但在空間型態上確屬創新，並能較習用物品增進上述多項功效，應已充分符合新穎性及進步性之法定新型專利要件，爰依法提出申請，懇請　貴局核准本件新型專利申請案，以勵創作，至感德便。

【圖式簡單說明】

【0018】

第1圖為本創作之模擬環境音效語音系統之第一架構示意圖。

第2圖為本創作之模擬環境音效語音系統之第一實施例圖。

第3圖為本創作之模擬環境音效語音系統之第二實施例圖。

第4圖為本創作之模擬環境音效語音系統之第二架構示意圖。

第5圖為習知耳機麥克風之立體示意圖。

【實施方式】

【0019】 請參閱第1圖所示，係為本創作之模擬環境音效語音系統10之第一架構示意圖，其包括：一收音單元11，係收錄一外部音源S之聲音(例如：使用者的聲音)，並轉換為一音訊；一音效儲存單元12，係儲存至少一背景音效，例如：車輛往來之音效、小孩吵鬧之音效、菜市場之音效、辦公室開會之音效…等；一混音單元13，係與該收音單元11及該音效儲存單元12

電性連接，並將該收音單元11所轉換之音訊與由該音效儲存單元12所輸出之背景音效混合形成一混音音訊；以及一傳輸單元14係與該混音單元13電性連接，並將該混合音訊透過有線方式或無線方式傳輸至一通訊裝置300，其中該傳輸單元14係為有線傳輸單元、無線傳輸單元兩者其中之一或兩者皆具，該有線傳輸單元可採用Lightning、USB之傳輸方式，而該無線傳輸單元可採用藍芽(Bluetooth)或WiFi之傳輸方式；另外，該通訊裝置300係為智慧型手機、平板電腦、可攜式電腦、桌上型電腦…等，只要能夠令使用者進行通話之裝置皆可，故不贅述。

【0020】 接著，請參閱第2圖所示，係為本創作之模擬環境音效語音系統10之第一實施例圖，其中該收音單元11、該音效儲存單元12、該混音單元13及該傳輸單元14皆設置於一耳機麥克風100，由於該傳輸單元14係為有線傳輸單元或無線傳輸單元，所以使用者可藉由有線方式或無線方式直接將該耳機麥克風100與該通訊裝置300連接，使該混音單元13可透過該傳輸單元14將所形成之混合音訊傳輸至該通訊裝置300。舉例來說，當使用者與對方通話時，對方能夠聽到該混音音訊(車輛往來之音效)，而誤認使用者目前所處的環境(在街道上)，或者使用者可以此為理由(環境太吵、收訊不好…等)，終止與對方之通話；或是當使用者不想讓對方得知自身所處環境(例如：舞廳)時，由於對方聽到具有背景音效(例如：會議中的音效)之混音音訊，因此能夠令對方相信使用者確實處於背景音效所呈現之環境中。

【0021】 或者，請參閱第3圖所示，係為本創作之模擬環境音效語音系統10之第二實施例圖，其中該收音單元11係設置於一耳機麥克風100，而該音效儲存單元12、該混音單元13及該

傳輸單元14係設置於一轉換器200，係為了避免當該耳機麥克風100無法直接與該通訊裝置300結合使用時，而可將該耳機麥克風100與該轉接器200連接，再藉由該轉接器200經由有線方式或無線方式連接至該通訊裝置300，同樣可使該混音單元13透過該傳輸單元14將所形成之混合音訊傳輸至該通訊裝置300。舉例來說：當該耳機麥克風100之連接端子為3.5mm耳機連接頭，但該通訊裝置300只具有Lightning連接孔，並未具有3.5mm耳機連接孔時，就需將該耳機麥克風100之3.5mm耳機連接頭插入該轉接器200之3.5mm耳機連接孔，再使該轉接器200之Lightning連接頭插入該通訊裝置300之Lightning連接孔，進而令該耳機麥克風100與該通訊裝置300間接結合使用。

【0022】 然而，不論是第2圖或第3圖中所示之耳機麥克風100，其中該耳機麥克風100之收音部位係為一骨感傳導式麥克風，可去除掉使用者實際所在環境中之雜音，而令對方能夠清楚聽見使用者的聲音及所搭配之背景音效，而模擬出一種使用者確實於背景音效所呈現之環境裡。

【0023】 此外，為了將該背景音效儲存於該音效儲存單元12中，其中該傳輸單元14更與該音效儲存單元12電性連接，以令該背景音效係由該通訊裝置300透過該傳輸單元14儲存於該音效儲存單元12中。舉例來說：使用者先透過該通訊裝置300下載已預設之背景音效、或是以錄音的方式錄製背景音效，而可將下載或錄音完成之背景音效進行編輯，最後再經由該傳輸單元14將該背景音效儲存於該音效儲存單元12，然而，如何編輯該背景音效係依使用者喜好及需求自行設定，並無限制。

【0024】 最後，請參閱第4圖所示，係為本創作之模擬環境音效語音系統10之第二架構示意圖，其中更具有一解碼單元

15，且電性連接於該音效儲存單元12及該混音單元13間，係將該音效儲存單元12所輸出之背景音效進行解碼，解碼後再藉由該混音單元13將其與該收音單元11所轉換之音訊混合形成該混音音訊。另外，使用者更可透過該通訊裝置300依據不同的來電者設定相對應之背景音效，舉例說明：當來電者A來電時，由於已於該通訊裝置300設定相對應之背景音效為車輛往來之音效，故使用者藉由本創作之模擬環境音效語音系統10與來電者A通話時，對方能夠聽到由使用者的聲音與車輛往來之音效混合之混音音訊；當來電者B來電時，由於已於該通訊裝置300設定相對應之背景音效為菜市場之音效，故使用者藉由本創作之模擬環境音效語音系統10與來電者B通話時，對方能夠聽到由使用者的聲音與菜市場之音效混合之混音音訊。不僅如此，為了便於使用者能夠隨時切換所輸出之背景音效，本創作之模擬環境音效語音系統10更具有一控制單元16，且電性連接於該音效儲存單元12，令使用者可藉由該控制單元16切換該音效儲存單元16所輸出之背景音效而具有動態切換背景音效之功能。

【0025】 故本創作確實提供一種模擬環境音效語音系統，透過混音單元將收音單元所收錄之聲音與音效儲存單元所輸出之背景音效混合，以模擬出一種能夠令對方誤認使用者確實處於背景音效所呈現之環境中的效果，當使用者進行通話時，由於對方同時聽到使用者說話的內容與背景音效，因此誤認使用者處於背景音效所呈現之環境中而不便說話或受到干擾聽不清楚，故可提供使用者終止通話的具體理由；或是當使用者不想讓對方得知自身所處環境時，而讓對方相信使用者確實處於背景音效所呈現之環境中。不僅如此，還提供一種模擬環境

音效語音系統，係將收音單元、音效儲存單元、混音單元及傳輸單元皆設置於耳機麥克風，以取代習知未具有模擬環境音效語音系統之耳機麥克風，以便於使用者直接結合通訊裝置使用；此外，更提供一種模擬環境音效語音系統，係將收音單元設置於耳機麥克風，而音效儲存單元、混音單元及傳輸單元係設置於轉換器，當耳機麥克風與通訊裝置無法直接結合使用時，係可透過與轉接器之連接，將耳機麥克風與通訊裝置間接結合使用，進而提升本創作之應用性。

【0026】 綜上所述，僅為本創作之較佳可行實施例，非因此即侷限本創作之專利範圍，舉凡運用本創作說明書及圖式內容所為之等效結構變化，均理同包含於本創作之範圍內，合予陳明。

【符號說明】

【0027】

10 模擬環境音效語音系統

11 收音單元

12 音效儲存單元

13 混音單元

14 傳輸單元

15 解碼單元

16 控制單元

100 耳機麥克風

200 轉換器

300 通訊裝置

S 外部音源

40 習知耳機麥克風

41 耳機

42 麥克風

43 連接端子

M568011

公告本

新型摘要

【新型名稱】(中文/英文)

模擬環境音效語音系統

【中文】

本創作為一種模擬環境音效語音系統，其包括：一收音單元，係收錄一外部音源之聲音，並轉換為一音訊；一音效儲存單元，係儲存至少一背景音效；一混音單元，係與該收音單元及該音效儲存單元電性連接，並將該收音單元所轉換之音訊與由該音效儲存單元所輸出之背景音效混合形成一混音音訊；以及一傳輸單元，係與該混音單元電性連接，並將該混合音訊傳輸至一通訊裝置。因此，當使用者進行通話時，能夠讓對方同時聽到使用者說話的內容與背景音效，而誤認使用者處於背景音效所呈現之環境中以至於不便說話或受到干擾聽不清楚，故可提供使用者終止通話的具體理由。

【英文】

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申請專利範圍

1. 一種模擬環境音效語音系統，其包括：

一收音單元，係收錄一外部音源之聲音，並轉換為一音訊；

一音效儲存單元，係儲存至少一背景音效；

一混音單元，係與該收音單元及該音效儲存單元電性連接，並將該收音單元所轉換之音訊與由該音效儲存單元所輸出之背景音效混合形成一混音音訊；以及

一傳輸單元，係與該混音單元電性連接，並將該混合音訊傳輸至一通訊裝置。

2. 如申請專利範圍第1項所述之模擬環境音效語音系統，其中該收音單元、該音效儲存單元、該混音單元及該傳輸單元皆設置於一耳機麥克風。

3. 如申請專利範圍第1項所述之模擬環境音效語音系統，其中該收音單元係設置於一耳機麥克風，而該音效儲存單元、該混音單元及該傳輸單元係設置於一轉換器。

4. 如申請專利範圍第2或3項所述之模擬環境音效語音系統，其中該耳機麥克風之收音部位係為一骨感傳導式麥克風。

5. 如申請專利範圍第1項所述之模擬環境音效語音系統，其中該傳輸單元更與該音效儲存單元電性連接，以令該背景音效係由該通訊裝置透過該傳輸單元儲存於該音效儲存單元中。

6. 如申請專利範圍第1、2、3、5項中任一項所述之模擬環境音效語音系統，更具有一解碼單元，且電性連接於該音效儲存單元及該混音單元間，係將該音效儲存單元所輸出之背景音效進行解碼，解碼後再藉由該混音單元將其與該收

音單元所轉換之音訊混合形成該混音音訊。

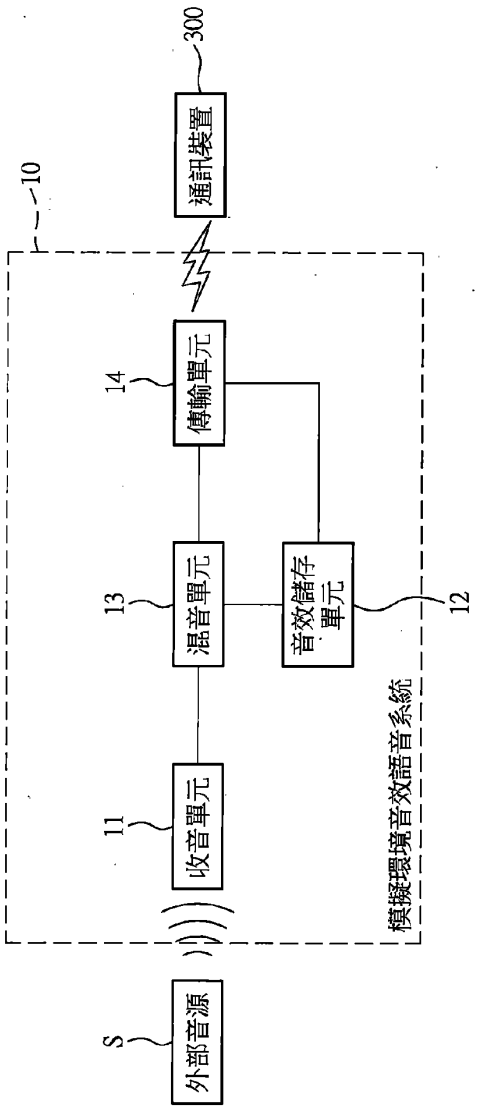
7. 如申請專利範圍第1、2、3、5項中任一項所述之模擬環境音效語音系統，更具有一控制單元，且電性連接於該音效儲存單元，係藉由該控制單元切換該音效儲存單元所輸出之背景音效。

8. 如申請專利範圍第6項所述之模擬環境音效語音系統，更具有一控制單元，且電性連接於該音效儲存單元，係藉由該控制單元切換該音效儲存單元所輸出之背景音效。

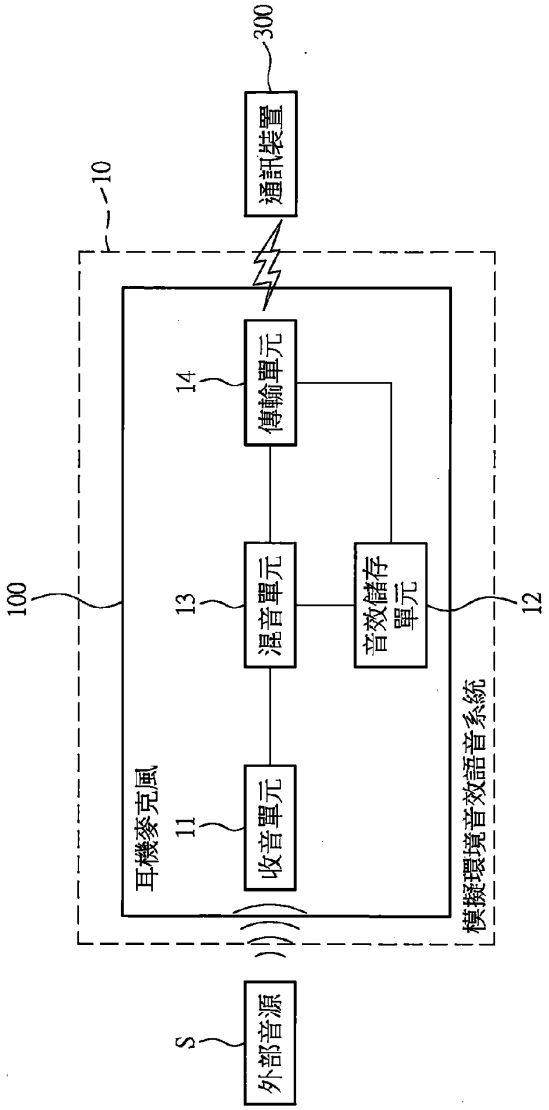
9. 如申請專利範圍第1或5項所述之模擬環境音效語音系統，其中該傳輸單元係為有線傳輸單元、無線傳輸單元兩者其中之一或兩者皆具。

10. 如申請專利範圍第1或5項所述之模擬環境音效語音系統，其中該通訊裝置係為智慧型手機、平板電腦、可攜式電腦、桌上型電腦。

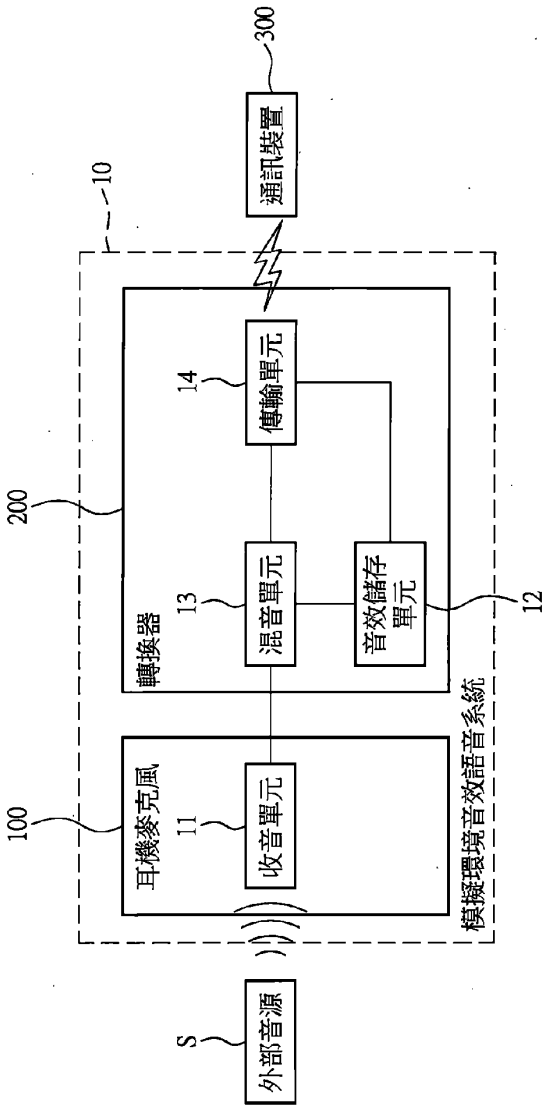
圖式


300
通訊裝置
10
14
傳輸單元
13
混音單元
音效儲存單元
12
11
收音單元
模擬環境音效語音系統
S
外部音源

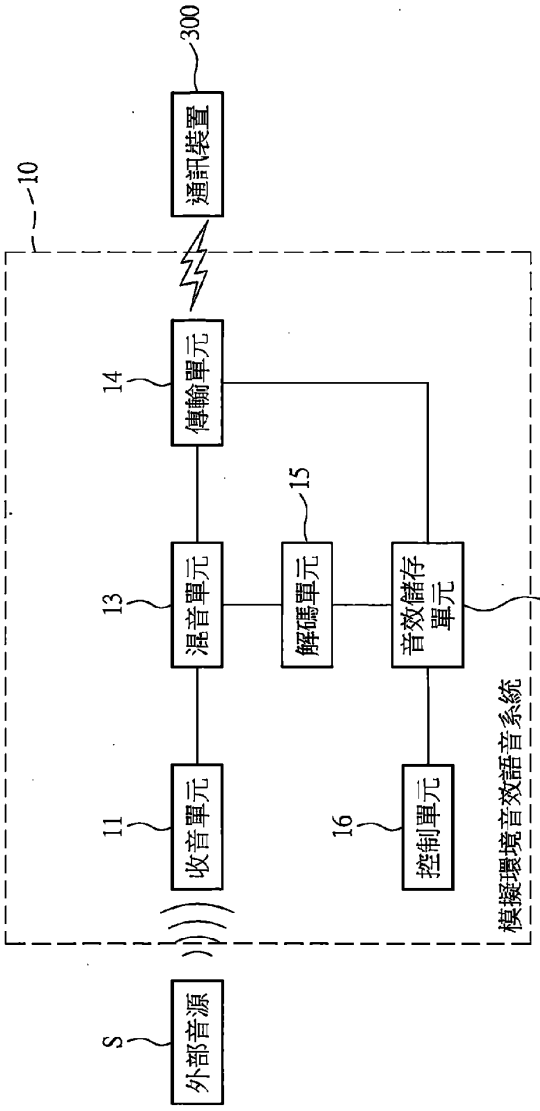
第 1 圖


300
通訊裝置
10
14
傳輸單元
100
13
混音單元
音效儲存單元
12
耳機麥克風
11
收音單元
模擬環境音效語音系統
S
外部音源

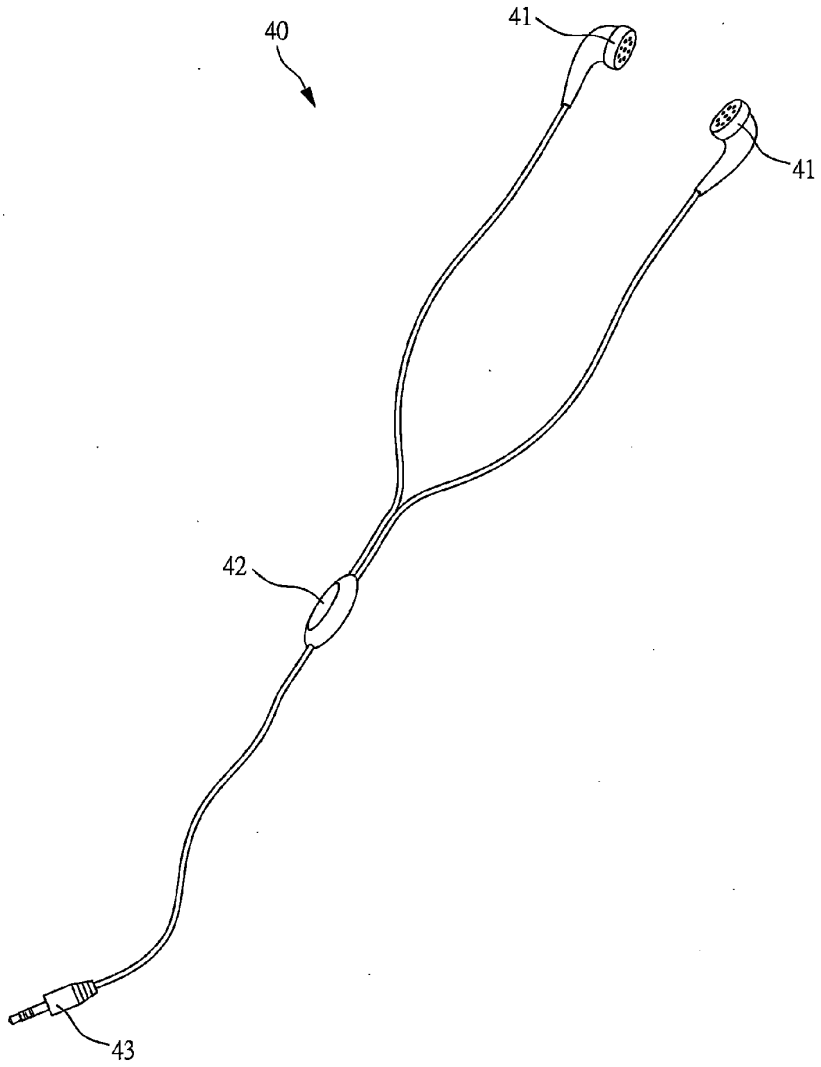
第 2 圖


300
通訊裝置
10
200
轉換器
14
傳輸單元
13
混音單元
音效儲存單元
12
100
耳機麥克風
11
收音單元
模擬環境音效語音系統
S
外部音源

第 3 圖


300
通訊裝置
10
14
傳輸單元
15
13
混音單元
解碼單元
音效儲存單元
12
11
收音單元
16
控制單元
模擬環境音效語音系統
S
外部音源

第 4 圖



第 5 圖

【代表圖】

【本案指定代表圖】：第(1)圖。

【本代表圖之符號簡單說明】：

10 模擬環境音效語音系統

11 收音單元

12 音效儲存單元

13 混音單元

14 傳輸單元

300 通訊裝置

S 外部音源

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(54) External ear canal voice detection

(57) Ear-level full duplex audio communication systems each include one or two ear attachment devices, such as in-the-ear (ITE) or behind-the-ear (BTE) devices, that wirelessly communicates to a remote device such as a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator. When used as a hearing aid, such a system allows a hearing impaired individual to communicate with or through the remote device, such as to talk to another person through a cellular phone. When being used as an ear piece wirelessly extended from the remote device, such system allows an individual with normal hearing to privately communicate with or through the remote device without the need of holding the device or wearing any device wired to the remote device. Each ear attachment device includes a voice operated exchange (VOX), housed within the device, to preserve energy and hence, maximize the period between battery replacement or recharges. The VOX also gates various sounds detected by the system to control possible echoes and ringing.

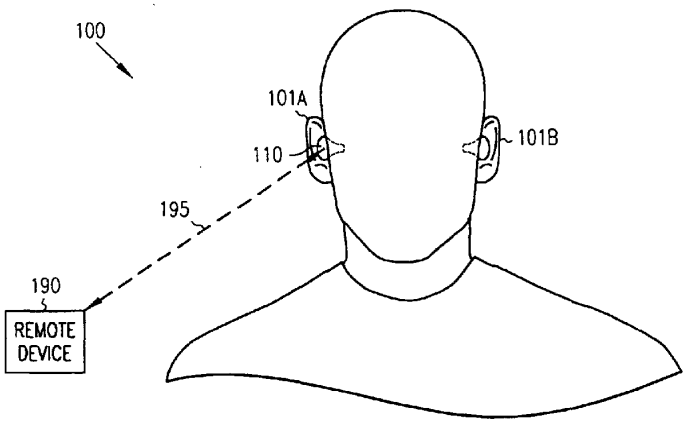


FIG. 1

EP 1 519 625 A2

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Description

[0001] This document generally relates to ear-level communication systems and particularly, but not by way of limitation, to such systems communicating with remote devices via full duplex audio.

[0002] Ear-level communication systems are used for hearing impaired individuals to use a communication device such as a cellular phone or other devices transmitting audio signals. They also allow private, hand-free use of such a communication device by individuals with normal hearing.

[0003] An ear-level communication system generally includes tethered or wireless headsets with a microphone boom or a microphone within a cord of the headset to detect voice of the person wearing the headsets. An alternative way to detect voice is via bone connection. Examples include a "clam" shell device that couples to the helix and a custom carmold with a vibration detector on the outer shell. Voice is picked up by detecting bone vibration caused by, and representative of, the voice of the person wearing the device.

[0004] Bi-directional communication has been achieved by a simplex system including a device in the ear canal that both transmits sound to and picks up sound within the ear canal. The device is tethered to a push-to-talk (PIT) system such as a walkie talkie. It is not full duplex and therefore requires interaction by the user in order to switch from listen mode to talk mode.

[0005] Voice operated exchange (VOX) is used to conserve energy when voice is not being detected or transmitted. For example, a headset system includes two ear pieces - for full duplex communication with one earpiece for transmitting and the other for receiving voice - and uses ear canal voice detection to trigger a VOX circuit in a control unit wired to the headset. The system requires a headset with two headphones and wires connecting the headphone to a control unit such as a device clipped on belt. In another example, a full duplex system includes a single headphone to transmit and receive voice, again with a VOX circuit in a control unit wired to the headphone.

[0006] Such ear-level communication systems are likely to be worn by a person for long periods of time. Users with hearing loss may use such a system on a regular basis, both as a conventional hearing aid allowing communication directly with a person and as a hearing aid allowing communicating through another device. Users with normal hearing may wear such a system to be communicatively connected to another person or facility without the need to hold a device at any time. For appearance or secrecy reasons, minimal visibility is generally desirable. Wired connection between a headset or earpiece and a controller makes the system easily visible and is cumbersome to users who need to communicate white being physically active.

[0007] Thus, there is a need for an ear-level communication system that is not easily visible. A need related to miniaturization is the longevity of the system between battery replacements or recharges.

[0008] Ear-level full duplex audio communication systems each include one or two ear attachment devices, such as in-the-ear (ITE) or behind-the-ear (BTE) devices, that wirelessly communicates to a remote device. Such a system allows a hearing impaired individual to communicate with or through the remote device, such as to talk to another person through a cellular phone. Such a system also functions as an ear piece wirelessly extended from the remote device that allows an individual to privately communicate with or through the remote device without the need of holding the device.

[0009] In one embodiment of the invention, a system includes an earmold configured for use as an ITE device. The earmold houses a microphone for use in an ear canal, a processor, and a wireless transmitter. The microphone receives an occluded sound from about the ear canal. The processor processes the occluded sound. The wireless transmitter receives the processed occluded sound from the processor and transmits a wireless signal representing the occluded sound.

[0010] In one embodiment, a system includes an ITE module and a BTE module attached to the ITE module. The ITE module includes a microphone for use in an ear canal. The microphone receives an occluded sound from about the ear canal. The BTE module includes a processor and a wireless transmitter. The processor processes the occluded sound. The wireless transmitter receives the processed occluded sound from the processor and transmits a wireless signal representing the occluded sound.

[0011] In one embodiment, a system includes a first ear-level device and a second ear-level device for use in two opposite ears. The first ear-level device includes a microphone, a first processor, and a wireless transmitter. The microphone is for use in one ear canal to receive an occluded sound from about that ear canal. The first processor converts the occluded sound to an electrical signal. The wireless transmitter receives the electrical signal and transmits an outgoing wireless signal representing the occluded sound. The second ear-level device includes a wireless receiver, a second processor, and a speaker. The wireless receiver receives an incoming wireless signal representing a remote sound. The second processor converts the incoming wireless signal to the remote sound. The speaker is for use in the opposite ear canal to transmit the remote sound to that ear canal.

[0012] In one embodiment, an occluded sound is detected using a microphone placed in an ear canal. An incoming radio signal representing a remote sound from a remote device is also detected. A voice operated exchange (VOX) housed within an ear-level communication device is started when at least one of the occluded sound and the incoming radio signal is detected if the VOX is not already on. The ear-level communication device includes one of an ITE device and a BTE device.

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When the occluded sound is detected while the incoming radio signal is not detected, the occluded sound is gated on, and remote sound is gated off. When the incoming radio signal is detected while the occluded sound is not detected, the remote sound is gated on, and the occluded sound is gated off.

[0013] Preferred embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

PIG. 1 is an illustration of an embodiment of an ear-level communication system and portions of an environment in which it is used. This ear-level communication system uses a single ear-level device.

FIG. 2 is an illustration of an embodiment of another ear-level communication system and portions of an environment in which it is used. This ear-level communication system uses a pair of ear-level devices.

FIG. 3A is an illustration of one exemplary exterior configuration of an in-the-ear (ITE) device used as the single ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG, 2.

FIG. 3B is an illustration of one exemplary exterior configuration of an in-the-canal (TTC) device used as the single ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 3C is an illustration of one exemplary exterior configuration of a completely-in-the-canal (CIC) device used as the single ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 4A is a block diagram showing one embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the single ear-level device of FIG. 1.

FIG. 4B is a block diagram showing one embodiment of portions of a voice operated exchange (VOX) circuit included in the single car-level device of FIG. 1.

FIG. 5 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the pair of ear-level devices of FIG. 1B.

FIG. 6 is an illustration of one exemplary exterior configuration of an ear-level device including a behind-the-ear (BTE) device used as the single ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 7 is a block diagram showing one embodiment of the circuit of the ear-level device shown in FIG. 6 used as the single ear-level device of FIG. 1.

FIG. 8 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIG. 6 used as the pair of ear-level devices of FIG. 2.

FIG. 9 is a flow chart illustrating an embodiment of a method for audio communication between the single ear-level device or the pair of ear-level devices and a remote device.

FIG. 10 is a flow chart illustrating another embodiment of the method for audio communication between the single ear-level device and a remote device.

[0014] The following embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that the embodiments may be combined, or that other embodiments may be utilized and that structural, logical and electrical changes may be made without departing from the scope of the present invention, as defined by the appended claims.

[0015] It should be noted that references to "an", "one", or "various" embodiments in this disclosure are not necessarily to the same embodiment, and such references contemplate more than one embodiment.

[0016] This document discusses, among other things, ear-level full duplex audio communication systems for communicating with remote devices. These systems each include one or two ear-level devices each worn in or about an ear, such as in-the-ear (ITE) or behind-the-ear (BTE) devices, wirelessly coupled to a remote device such as a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator. When used as a hearing aid, such a system allows a hearing impaired individual to communicate with or through the remote device, such as to talk to another person through a cellular phone. When being used as an ear piece wirelessly extended from the remote device, such system allows an individual with normal hearing to privately communicate with or through the remote device without the need of holding the device or wearing any device wired to the remote device.

[0017] In this document, "voice" includes to the sound of speech made by a person, and sound generally includes an audible signal that includes voice and other signals that can be heard and/or detected by an audio detector. Unless particularly indicated, for example, when voice is distinguished from sound by speech recognition, "voice" and "sound" are used interchangeably throughout thus document because they are not practically separated. For example, detection of a sound refers to the same action as detection of a voice because, while the purpose is to detect the voice, other sounds are picked up as well.

[0018] FIG. 1 is an illustration of an embodiment of an ear-level communication system 100 and portions of an environment in which it is used. System 100 includes an ear-level device 110 attached to an ear 101A. Bar-level device 110 communicates with a remote device 190 through a wireless telemetry link 195. The other ear 101B is free of device attachment. Ear-level device 110 is a self-contained device including its own power source such as a replaceable or rechargeable battery. To maximize battery life or period between recharges, at least a portion of the circuit of ear-level device 110 is voice activated. That is, ear-level device 110 is activated only when it detects a need to transmit or receive a

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sound.

[0019] Ear-level device 110 is a full duplex audio device that allows two-way simultaneous conversation between ear 101A and remote device 190. In one embodiment, when being worn by a person having ear 101A, ear-level device 110 picks up sound from the ear canal of ear 101A and delivers sound to the same ear canal. It detects the occluded sound from the ear canal when the person speaks and transmits to the same ear canal a sound received from remote device 190 and/or a sound picked up from the environment surrounding the person. In one embodiment, as illustrated in FIG. 1, ear-level device 110 is configured for right ear attachment. In an alternative embodiment, ear-level device 110 is configured for left ear attachment.

[0020] FIG. 2 is an illustration of an embodiment of an ear-level communication system 200 and portions of an environment in which it is used. System 200 includes a pair of ear-level devices 210A, attached to an ear 101 A, and 210B, attached to ear 101B. Ear-level devices 210A and 210B communicate with a remote device 290 through a wireless telemetry link 295. Ear-level devices 210A and 210B are each a self-contained device including its own power source such as a replaceable or rechargeable battery. To maximize battery life or period between recharges, at least a portion of the circuit of each of ear-level devices 210A and 210B is voice activated. That is, ear-level devices 210A and 210B are each activated only when a need to transmit or receive a sound is detected by the device itself.

[0021] In one embodiment, ear-level device 210A is an audio transmitter that picks up sound from the ear canal of ear 101A, and ear-level device 210B is an audio receiver that delivers sound to the same ear canal. Ear-level device 210A is activated when it detects a sound from the ear canal. Ear-level device 210B is activated when it detects a signal from remote device 290. When both are being worn by a person, ear-level devices 210A and 210B supports full duplex audio allowing two-way simultaneous conversation between the person and remote device 290. In one embodiment, as illustrated in FIG. 2, ear-level device 210A is configured for right ear attachment, and ear-level device 210B is configured for left ear attachment. In an alternative embodiment, ear-level device 210A is configured for left ear attachment, and ear-level device 210B is configured for right ear attachment.

[0022] FIGS. 3A, 3B, and 3C are illustrations of exemplary exterior configuration of ear-level device 110 or one of ear-level devices 210A and 210B. For the purpose of this document, only a device attached to a right ear is shown for each exemplary exterior configuration. It is to be understood that each of ear-level devices 110, 210A, and 210B can be either a device configured for right ear attachment or a device configured for left ear attachment. Generally, a device configured for right car attachment has an exterior configuration that is substantially symmetrical to that of a device of the same type configured for left ear attachment. In system 100, a single ear-level device 110 is a device configured either for right ear attachment or for left ear attachment. In system 200, either one of car-level device 210A and 210B is a device configured for right ear attachment, while the other is a device configured for left ear attachment.

[0023] An occluded sound 305, an ambient sound 306, and a remote sound 307 are illustrated in each of FIGS. 3A, 3B, and 3C. Remote sound 307 is represented by a wireless radio signal transmitted to ear-level device 110. In this document, "occluded sound" includes occluded sound 305, "ambient sound" includes ambient sound 306, and "remote sound" includes remote sound 307.

[0024] FIG. 3A is an illustration of an exemplary exterior configuration of an in-the-ear (ITE) device 310A used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3A, ITE device 310A is attached to an ear 101 with a pinna 302 and an ear canal 303. ITE device 310A includes a portion inserted into ear canal 303 and another portion fit into the cavity formed by pinna 302.

[0025] FIG. 3B is an illustration of an exemplary exterior configuration of an in-the-canal (ITC) device 310B used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3B, ITC device 310B is attached to ear 101 with pinna 302 and ear canal 303. ITC device 310B is a form of ITE device that also includes a portion inserted in ear canal 303 and another portion fit into the cavity formed by pinna 302, but the latter portion is smaller than that of ITE device 310A. Its overall size is therefore generally smaller than that of ITE deviee 310A.

[0026] FIG. 3C is an illustration of an exemplary exterior configuration of a completely-in-the-canal (CIC) device 310C used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3C, CIC device 310C is attached to ear 101 with pinna 302 and ear canal 303. CIC device 310C is a form of ITC device but includes only a portion that is completed inserted into ear canal 303. Its overall size is therefore generally smaller than that of ITC device 310B.

[0027] In one embodiment, each of ITE device 310A, ITC device 310B, and CIC device 310C includes a custom earmold. In another embodiment, each of ITE device 310A, ITC device 310B, and CIC device 310C includes a modular earmold. In one embodiment, the earmold is fully occluded to maximize audio efficiency. In another embodiment, the earmold is vented to remove undesirable low frequency sound.

[0028] The choice of a device type, such as from the types shown in FIGS. 3A, 3B, and 3C, depends on the need of individual users. For example, ITE device 310A has a relatively large size to accommodate a relatively large amplifier to serve the need of individuals suffering severe hearing loss. The relatively large size can also be utilized to house a relatively large size battery. On the other hand, CIC device 310C is almost invisible,

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while the room for the circuit and the battery is very limited. Generally, the selection of the device type is a compromise among considerations such as the user's degree of hearing loss (if applicable), ear canal size, desire of invisibility, desired longevity between battery replacements or recharges, and cost.

[0029] FIG. 4A is a block diagram showing one embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the single ear-level device 110. The circuit is housed in an earmold configured for use as one of the device types illustrated as ear-level devices 310A, 310B, or 310C.

[0030] Ear-level device 110 includes an external microphone 420, an ear canal microphone 440, an car canal speaker 470, a processor 460, a wireless transceiver 450, an antenna 455, a voice operated exchange (VOX) circuit 430, and a battery 480. External microphone 420 picks up ambient sound such that a hearing impaired person wearing ear-level device 110 is not "isolated" when communicating to remote device 190. Thus, ear-level device enables the hearing impaired person to talk to another person either directly (if the other person is nearby) or through a device such as a cell phone. Ear canal microphone 440 detects sound from the ear canal. The sound includes primarily speech of the person wearing ear-level device 110. Ear canal speaker 470 transmits sound received from remote device 190 and/or external microphone 420 to the same ear canal. In one embodiment, ear canal microphone 440 and ear canal speaker 470 are implemented as one physical device. Processor 460 converts the sound picked up from the ear canal to an electrical signal to be transmitted to remote device 190, and converts the signals received from remote device 190 and/or external microphone 420 to a sound audible to the person wearing ear-level device 110. In one embodiment, processor 460 includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art In one embodiment, processor 460 includes a speech recognition module to enhance the audio signal received by and/or transmitted from ear-level device 110. Wireless transceiver 450 and antenna 455 form a telemetry interface supporting telemetry link 195 between ear-level device 110 and remote device 190. Wireless transceiver 450 includes a wireless transmitter and a wireless receiver. The wireless transmitter receives the electrical signal representing the sound picked up from the ear canal from processor 460 and transmits an outgoing wireless signal representing the same sound to remote device 190. The wireless receiver receives an incoming wireless signal representing a remote sound from remote device 190 and transmits an electrical signal representing the remote sound to processor 460. Telemetry link 195 provides for bi-directional communication allowing simultaneous signal transmission, in both directions, between ear-level device 110 and remote device 190. VOX circuit 430 activates a major portion of ear-level device 110 only when sound is detected by at least one of external microphone 420, ear canal microphone 440, end wireless transceiver 450. In one embodiment, VOX circuit 430 includes a voice-controlled switch connecting between battery 480 and the portions of ear-level device 110 that are voice activated. The switch is driven by the sound detected by at least one of external microphone 420, ear canal microphone 440, and wireless transceiver 450. It is turned on when sound detected by external microphone 420 exceeds a predetermined threshold, when sound detected by ear canal microphone 440 exceeds another predetermined threshold, and/or when wireless transceiver 450 receives the incoming wireless signal representing the remote sound. In one embodiment, as discussed with respect to FIG. 4B below, VOX circuit 430 gates or attenuates one or more sounds detected by external microphone 420, ear canal microphone 440, and wireless transceiver 450, to eliminate or reduce echo and ringing caused by the loop formed by ear canal speaker 470 and ear canal microphone 440. Battery 480 supplies the power needed for the operation of ear-level device 110. In one embodiment, battery 480 is a rechargeable battery that can be recharged without being taken out from ear-level device 110.

[0031] FIG. 4B is a block diagram showing one embodiment of portions of VOX circuit 430. In this embodiment, VOX circuit 430 includes an ambient sound gating module 421 that blanks or attenuates the sound detected by external microphone 420, an occluded sound gating module 441 that blanks or attenuates the sound detected by ear canal microphone 440, a remote sound gating module 451 that blanks or attenuates the sound detected by wireless transceiver 450, and controller 431 to coordinate the states of the gating modules. Because ear canal microphone 440 is capable of detecting the sound delivered to the ear canal from ear canal speaker 470, there is a need to avoid echo and/or ringing. For example, a remote sound from remote device 190 delivered to the ear canal may be detected as an occluded sound and transmitted back to remote device 190, causing echo. The gating modules function in a coordinated manner to eliminate or reduce such echo and/or ringing caused by breaking, or applying resistance into, the audio loop formed by ear canal speaker 470 and ear canal microphone 440.

[0032] For the purpose of description, each of the gating modules is "on" when sound is "gated on" and "off" when the sound is "gated off" A sound is "gated on" when it is allowed to pass and be processed, and is "gated off' when it is blanked or substantially attenuated. Blanking refers to a substantially complete blockage of a sound, or in other words, that a detected sound is practically ignored by processor 460 such that it does not cause any echo or ringing that is audible by an ear. Substantial attenuation refers to an attenuation after which the attenuated sound does not cause any echo

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or tinging having an intolerable intensity.

[0033] Ambient sound gating module 421 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a detected ambient sound with a predetermined threshold for the ambient sound. When the amplitude of the detected ambient sound exceeds the threshold for the ambient sound, and when controller 431 permits, ambient sound gating module 421 is turned on. When the amplitude of the detected ambient sound drops below the threshold for the ambient sound, ambient sound gating module 421 is turned off. In one embodiment, after the amplitude of the detected ambient sound drops below the threshold for the ambient sound, ambient sound gating module 421 is turned off after a predetermined delay.

[0034] Occluded sound gating module 441 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a detected occluded sound with a predetermined threshold for the occluded sound. When the amplitude of the detected occluded sound exceeds the threshold for the occluded sound, and when controller 431 permits, occluded sound gating module 441 is turned on. When the amplitude of the detected occluded sound drops below the threshold for the occluded sound, occluded sound gating module 441 is turned off. In one embodiment, after the amplitude of the detected occluded sound drops below the threshold for the occluded sound, occluded sound gating module 441 is turned off after a predetermined delay.

[0035] In one embodiment, remote sound gating module 451 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a remote sound with a predetermined threshold for the remote sound. When the amplitude of the detected remote sound exceeds the threshold for the remote sound, and when controller 431 permits, remote sound gating module 451 is turned on. When the amplitude of the detected remote sound drops below the threshold for the remote sound, remote sound gating module 451 is turned off. In one embodiment, after the amplitude of the detected remote sound drops below the threshold for the remote sound, remote sound gating module 451 is turned off after a predetermined delay.

[0036] In another embodiment, remote sound gating module 451 includes a switch or attenuator driven by the detection of the incoming wireless signal representing the remote sound. Remote sound gating module 451 is turned on upon detection of the incoming wireless signal when controller 431 permits, and turned off when the incoming wireless signal is no longer detected. In one embodiment, remote sound gating module 451 is turned off after the incoming wireless signal is absent for a predetermined period.

[0037] Controller 431 coordinates the on/off states of all the gating modules so the sounds are processed in an orderly fashion. Even if a sound is detected, the gating module corresponding to that sound is turned on only when controller 431 permits. In one embodiment, assuming that sounds A and B are gated by gating modules A and B, respectively, if both sounds A and B are detected, whichever sound is detected earlier is gated on. That is, if sound A exceeds its threshold first, gating module A is turned on and remain on until sound A drops below threshold A. Then, gating module B is turned only if sound B exceeds its threshold after gating module A has been turn off.

[0038] In one embodiment, controller 431 coordinates the on/off states of all the gating modules according to predetermined or programmed gating coordination rules. According to one exemplary rule, ambient sound gating module 421 is off, occluded sound gating module 441 is off, and remote sound gating module 451 is on. This rule allows only the transmission of the remote sound to ear canal 303, and prevents the remote sound from being detected by ear canal microphone 440 and echoed back to remote device 190. According to another exemplary rule, ambient sound gating module 421 is on, occluded sound gating module 441 is off, and remote sound gating module 451 is on. This rule allows the transmission of both the remote sound and the ambient sound to ear canal 303, and prevents the remote sound from being detected by ear canal microphone 440 and echoed back to remote device 190. This also prevents the ambient sound from being transmitted to remote device 190. According to yet another exemplary rule, ambient sound gating module 421 is off, occluded sound gating module 441 is on, and remote sound gating module 451 is off. When the person wearing ear-level device 110 speaks, both external microphone 420 and ear canal microphone 440 detect the voice. The voice as detected by ear-level device 110 is first transmitted to remote device 190. Without the gating modules (or when ambient sound gating module 421 and occluded sound gating module 441 are both on), the same voice as detected by external microphone 420 is transmitted to ear canal 303, and therefore again detected by ear canal microphone 440, and again be transmitted to remote device 190. This rule allows only the transmission of the occluded sound to remote device 190, and prevents the same sound from being transmitted to remote device 190 twice. Other rules are applied as a person skilled in the art should see fit based on an understanding after reading this entire document.

[0039] FIG. 5 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as each of ear-level devices 210A and 210B. The circuit of each of ear-level devices 210A and 210B is housed in an earmold configured for use as of one of the device types illustrated as ear-level devices 310A, 310B, or 310C.

[0040] Ear-level device 210A is an audio transmitter that includes an ear canal microphone 540, a processor 560A, a wireless transmitter 550A, an antenna 555A, a transmitter VOX circuit 530A, and a battery 580A. Ear canal microphone 540 detects sound from the ear canal.

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The sound includes primarily speech of the person wearing ear-level device 210A. Processor 560A converts the sound picked up from the ear canal to an electrical signal to be transmitted to remote device 290. In one embodiment, processor 560A includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art. In one embodiment, processor 560A includes a speech recognition module used to enhance the sound transmitted from ear-level device 210A. Wireless transmitter 550A and antenna 555A form a telemetry interface supporting signal transmission from ear-level device 210A to remote device 290. Wireless transmitter 550A receives the electrical signal representing the sound picked up from the ear canal from processor 560A and transmits an outgoing wireless signal representing the same sound to remote device 290. VOX circuit 530A activates a major portion of ear-level device 210A only when sound is detected by ear canal microphone 540. In one embodiment, VOX circuit 530A includes a voice-controlled switch connecting between battery 580A and the portions of ear-level device 210A that are voice activated. The switch is driven by the sound detected by ear canal microphone 540. It is turned on when sound detected by ear canal microphone 540 exceeds a predetermined threshold. In one embodiment, VOX circuit 530A activates processor 560A when the sound is detected. In one further embodiment, VOX circuit 530A also activates wireless transmitter 550A when the sound is detected. Battery 580A supplies the power needed for the operation of ear-level device 210A. In one embodiment, battery 580A is a rechargeable battery that can be recharged without being taken out from ear-level device 210A.

[0041] Ear-level device 210B is an audio receiver that includes an external microphone 520, an ear canal speaker 570, a processor 560B, a wireless receiver 550B, an antenna 555B, a receiver VOX circuit 530B, and a battery 580B. External microphone 520 picks up ambient sound such that the person wearing ear-level devices 210A and 210B is not "isolated" when communicating to remote device 290. It allows that person to talk to a nearby person directly, without the need to take off ear-level devices 210A and/or 210B. Bar canal speaker 570 transmits sound received from remote device 290 and/or external microphone 520 to the same ear canal. Processor 560B converts the signals received from remote device 290 and/or external microphone 520 to a sound audible to the person wearing ear-level device 210B. In one embodiment, processor 560B includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art. In one embodiment, processor 560B includes a speech recognition module used to enhance the audio signals received by ear-level device 210B. Wireless receiver 550B and antenna 555B form a telemetry interface supporting signal transmission from remote device 290 to ear-level device 210B. Wireless receiver 550B receives an incoming wireless signal representing a remote sound from remote device 290 and transmits an electrical signal representing the remote sound to processor 560B. VOX circuit 530B activates a major portion of ear-level device 110 only when sound is detected by at least one of external microphone 520 and wireless receiver 550B. In one embodiment, VOX circuit 530B includes a voice-controlled switch connecting between battery 580B and the portions of ear-level device 210B that are voice activated. The switch is driven by the sound detected by at least one of external microphone 520 and wireless receiver 550B. It is turned on when sound detected by external microphone 520 exceeds a predetermined threshold and/or when wireless transceiver 550B receives the incoming wireless signal representing the remote sound. In one embodiment, VOX circuit 530B activates processor 560B when the sound is detected. In one further embodiment, VOX circuit 530B also activates ear-level speaker 570 when the sound is detected. Battery 580B supplies the power needed for the operation of ear-level device 210B. In one embodiment, battery 580B is a rechargeable battery that can be recharged without being taken out from ear-level device 210B.

[0042] System 200 accommodates a larger overall circuit size without necessarily increasing the size of each ITE device. While two separate ear-level devices are required, because system 200 includes separate audio transmitter (ear-level device 210A) and receiver (ear-level device 210B) disposed in the ear canals of opposite ears, ear canal speaker 570 and ear canal microphone 540 do not form a loop causing echo and ringing.

[0043] FIG. 6 is an illustration of an exemplary exterior configuration of an ear-level device including a behind-the-ear (BTE) device 610 used as ear-level device 110 or one of ear-level devices 210A and 210B. BTE device 610 is attached to ear 101 with pinna 302 and ear canal 303. In one embodiment, BTE device 610 is used when none of ITE device 310A, PTC device 310B, and CIC device 310C provides sufficient space accommodating the required circuit and battery sizes. For the purpose of this document, only a device attached to a right ear is shown for each exterior structure. It is to be understood that each of ear-level devices 110, 210A, and 210B can be either a BTE device configured for right ear attachment or a BTE device configured for left ear attachment. Generally, a BTE device configured for right ear attachment has a substantially symmetrical appearance to a device of the same type configured for left ear attachment In system 100, ear-level device 110 is a device configured either for right ear attachment or for left ear attachment. In system 200, either one of ear-level device 210A and 210B is a device structured for right

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ear attachment, while the other is a device structured for left ear attachment.

[0044] BTE device 610 includes a behind-the-ear-module (BTE module) 611 and an in-the-ear module (ITE module) 612. ITE module 612 includes a custom or modular earmold. In one embodiment, the earmold is fully occluded to maximize audio efficiency. In another embodiment, the earmold is vented to remove undesirable low frequency sound.

[0045] FIG. 7 is a block diagram showing one embodiment of the circuit of ear-level device shown in FIG. 6 used as ear-level device 110. The exterior configuration of ear-level device 110 is of the type illustrated as BTE device 610.

[0046] Ear-level device 110 configured as BTE device 610 differs from ear-level device 110 configured as ITE/ITC/CIC devices 310A/310B/310C primarily in the physical arrangement of device components. By way of example, but not by way of limitation, FIG. 7 illustrates one embodiment in which BTE module 611 includes external microphone 420, processor 460, wireless transceiver 450, antenna 455, VOX circuit 430, and battery 480, and ITE module 612 includes ear canal microphone 440 and ear canal speaker 470. Other possible embodiments depend on size and other considerations that are known to those skilled in the art. In one embodiment, behind-ear portion 611 includes only battery 480 to maximize the duration of use of ear-level device 110 between battery replacements or recharges.

[0047] FIG. 8 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIG. 6 used as each of ear-level devices 210A and 210B. The exterior configuration of each of ear-level devices 210A and 210B is of the type illustrated as BTE device 610.

[0048] Ear-level devices 210A/210B configured as BTE device 610 differ from ear-level devices 210A/210B configured as ITE/ITC/CIC devices 310A/310B/310C primarily in the physical arrangement of device components. By way of example, but not by way of limitation, FIG. 8 illustrates one embodiment of ear-level device 210A including a BTE module 611A and an ITE module 612A, and ear-level device 210B including a BTE module 611B and an ITE module 612B. BTE module 611A includes processor 560A, wireless transmitter 550A, antenna 555A, transmitter VOX circuit 530A, and battery 580A. ITE module 612A includes ear canal microphone 540. Behind-the-ear portion 611B includes external microphone 520, processor 560B, wireless receiver 550B, antenna 555B, receiver VOX circuit 530B, and battery 580B. ITE module 612B includes ear canal speaker 570. Other possible embodiments depend on size and other considerations that are known to those skilled in the art. In one embodiment, BTE modules 611A and 611B include only batteries 580A and 580B, respectively, to maximize the duration of use of ear-level devices 210A and 210B, respectively, between battery replacements or recharges.

[0049] FIG. 9 is a flow chart illustrating an embodiment of a method for audio communication using system 100 or system 200. The method provides for private, simultaneous two-way communication between a person and a remote device such as a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator. In this embodiment. VOX is used for power management. A VOX circuit includes a power switch connecting a battery to the portions of the circuit of system 100 or system 200 that are voice activated. The VOX is "on" when the voice-activated portions of the circuit are activated, i.e., when the power switch remains on. It is "started" by turning on the power switch, and "stopped" by turning off the power switch.

[0050] Steps 910-918 illustrate the process of detecting a sound from an ear canal and transmitting it to a remote device. A microphone disposed in an ear canal detects an occluded sound within the ear canal at 910. If the occluded sound is detected at 911, the VOX of the system is started at 912 if it is not already on. The occluded sound is enhanced at 914 with a voice recognition system that improves the signal-to-noise ratio, where the signal is the voice of a speech, and the noise is any sound other than the voice of the speech. The occluded sound is then converted to an outgoing radio signal at 916. The outgoing radio signal representing the occluded sound is transmitted to the remote device at 918.

[0051] Steps 920-928 illustrate the process of detecting a sound sent from the remote device and transmitting it to the ear canal. A radio receiver detects an incoming radio signal representing a remote sound from the remote device at 920. If the incoming radio signal is detected at 921, the VOX of the system is started at 922 if it is not already on. The incoming radio signal is converted to a first incoming audio signal (the remote sound) at 924. The first incoming audio signal is enhanced at 926 with a voice recognition system that improves the signal-to-noise ratio, where the signal is the voice from the remote device, and the noise is any sound other than the voice. A speaker disposed in the ear canal transmits the first incoming audio signal representing the sound from the remote device to the ear canal at 928.

[0052] Steps 930-938 illustrate the process of detecting a sound from the environment and transmit it to the ear canal. A microphone outside the ear canal detects an ambient sound at 930. If the ambient sound is detected at 931, the VOX of the system is started at 932 if it is not already on. The ambient sound is converted to a second incoming audio signal at 934. The second incoming audio signal is enhanced at 936 with a voice recognition system that improves the signal-to-noise ratio, where the signal is any voice included in the ambient sound, and the noise is any sound other than the voice. A speaker disposed in the ear canal transmits the second incoming audio signal representing to the ear canal at 928.

[0053] If no signal (sound or radio signal) is detected

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at 911, 921, and 931, the VOX is stopped at 940. In other words, if no sound is to be processed, the communication system is inactivated except for the portions that must be active for sound detection at all times. In one embodiment, the VOX is stopped after a predetermined period of time to avoid frequent activation/deactivation during a conversation.

[0054] Systems 100 and 200 are each a full duplex system capable of performing steps 910-918, 920-928, and 930-938 are performed in parallel and simultaneously. In an embodiment in which system 100 performs the method, ear-level device 110 performs steps 910-918, 924-928, and 930-938. If a signal is detected at 911, 921, or 931, VOX 430 activates at least portions of device 110 performing steps 914-918, 924-928, or 934-938, respectively. If no signal is detected at 911, 921, or 931, VOX 430 deactivates at least the portions of device 110 performing steps 914-918, 924-928, or 934-938, respectively.

[0055] In an embodiment in which system 200 performs the method, ear-level device 210A performs steps 910-918, and ear-level device 210B performs steps 920-928 and 930-930. If a signal is detected at 911, transmitter VOX 530A activates at least portions of device 210A performing steps 914-918. If a signal is detected at 921 or 931, receiver VOX 530B activates at least portions of device 210B performing steps 924-928 or 934-938, respectively. If no signal is detected at 911, transmitter VOX 530A deactivates at least the portions of device 210A performing steps 914-918. If no signal is detected at 921 or 931, receiver VOX 530B deactivates at least the portions of device 210B performing steps 924-928 or 934-938, respectively.

[0056] FIG. 10 is a flow chart illustrating another embodiment of the method for audio communication using system 100. In this embodiment, in addition to power management, the VOX is also used for gating, i.e., blanking or attenuating, sounds. The VOX circuit includes a power switch connecting a battery to the portions of the circuit of system 100 that are voice activated and gating modules capable of blanking or attenuating the occluded sound, the remote sound, and the ambient sound. Examples of such gating modules include occluded sound gating module 441, remote sound gating module 451, and ambient sound gating module 421, designated for the occluded sound, the remote sound, and the ambient sound, respectively.

[0057] Steps 1010-1019 illustrate the process of detecting the occluded sound from the ear canal and transmitting it to the remote device. The microphone disposed in the ear canal detects the occluded sound within the ear canal at 1010. If the occluded sound is detected at 1011, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1012 if they are not already powered. The VOX determines whether to start gating the occluded sound on at 1013. In one embodiment, the occluded sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. Examples of gating coordination rules are described above with respect to FIG. 4B. If the occluded sound is gated on at 1013, it is processed at 1014 by following steps that are identical or similar to steps 914-916-918. The occluded sound is gated off at 1019 if it has been gated on but is no longer detected. In one embodiment, the occluded sound is gated off after it is not detected for a predetermined period.

[0058] Steps 1020-1028 illustrate the process of detecting the remote sound sent from the remote device and transmitting it to the ear canal. A radio receiver detects the incoming radio signal representing the remote sound from the remote device at 1020. If the remote sound is detected at 1021, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1022 if they are not already powered. The VOX determines whether to start gating the remote sound on at 1023. In one embodiment, the remote sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. In another embodiment, the remote sound is gated on when the incoming radio signal is detected and when the effective gating coordination rules permits. If the remote sound is gated on at 1023, it is processed at 1024 by following steps that are identical or similar to steps 924-926-928. The remote sound is gated off at 1029 if it has been gated on but is no longer detected. In one embodiment, the remote sound is gated off after it is not detected for a predetermined period.

[0059] Steps 1030-1038 illustrate the process of detecting the ambient sound and transmit it to the ear canal. A microphone outside the ear canal detects the ambient sound at 1030. If the ambient sound is detected at 1031, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1032 if they are not already powered. The VOX determines whether to start gating the ambient sound on at 1033. In one embodiment, the ambient sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. If the ambient sound is gated on at 1033, it is processed at 1034 by following steps that are identical or similar to steps 934-936-938. The ambient sound is gated off at 1039 if it has been gated on but is no longer detected. In one embodiment, the ambient sound is gated off after it is not detected for a predetermined period.

[0060] If no signal (sound or radio signal) is detected at 1011,1021, and 1031, the VOX is stopped at 1040. In other words, if no sound is to be processed, the communication system is inactivated except for the portions that must be active for sound detection at all times, In one embodiment, the VOX is stopped after a predetermined period of time to avoid Sequent activation/deactivation during a conversation.

[0061] It is to be understood that the above detailed description is intended to be illustrative, and not restric-

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tive. Other embodiments will be apparent to those of skill in the art upon reading and understanding the above description. For example, two ear-level devices 110, or a pair of devices each being similar to ear-level device 110, can be used to deliver a stereo sound. The scope of the invention should, therefore, be determined with reference to the appended claims.

Claims

1. A system adapted for use in at least one of a first ear having a first ear canal and a second ear having a second ear canal, comprising:

   a first ear-level device including:

   a first microphone adapted for use in one of the first ear canal and the second ear canal, the first microphone receiving an occluded sound from about the one of the first ear canal and the second ear canal;
   a first processor, connected to the first microphone, to process the occluded sound;
   a wireless transmitter, connected to the first processor, to receive the processed occluded sound from the first processor and transmit a first wireless signal representing the occluded sound; and
   a first earmold housing at least the first microphone, at least a portion of the first earmold configured for placement in the one of the first ear canal and the second ear canal.

2. The system according to claim 1, wherein the first earmold houses the first microphone, the first processor, and the wireless transmitter, and wherein the first earmold is configured for use as an in-the-ear (ITE) device.

3. The system according to claim 1, wherein the first ear level device comprises an ITE module including the first microphone and a behind-the-ear (BTE) module attached to the ITE module, the BTE module including the first processor and the wireless transmitter.

4. The system according to any of the preceding claims, further comprising a voice operated exchange (VOX) circuit connected to the first processor.

5. The system according to claim 4, wherein the VOX circuit comprises an occluded sound gating module, coupled to the first microphone, to blank or substantially attenuate the occluded sound.

6. The system according to claim 1, further comprising:

   a wireless receiver, connected to the first processor, to receive a second wireless signal representing a remote sound; and
   a speaker connected to the first processor, the speaker adapted for use in the one of the first ear canal and the second ear canal,

   wherein:

   the first processor further processes the remote sound, and the speaker is adapted to transmit the processed remote sound to the one of the first ear canal and the second ear canal; and
   the first earmold further houses at least the speaker.

7. The system according to claim 6, wherein the first microphone and the speaker include one common device receiving the occluded sound and transmitting the processed remote sound.

8. The system according to any of claims 6 and 7, further comprising a second microphone connected to the first processor, the second microphone adapted to receive an ambient sound from outside the one of the first ear canal and the second ear canal, and wherein:

   the first processor further processes the ambient sound; and
   the speaker is configured to transmit the processed remote and ambient sounds to the one of the first ear canal and the second ear canal.

9. The system according to claim 8, further comprising a voice operated exchange (VOX) circuit connected to the first processor.

10. The system according to claim 9, wherein the VOX circuit comprises an occluded sound gating module, coupled to the first microphone, to blank or substantially attenuate the occluded sound.

11. The system according to any of claims 9 and 10, wherein the VOX circuit comprises a remote sound gating module, coupled to the wireless transceiver, to blank or substantially attenuate the remote sound.

12. The system according to any of claims 9 -11, wherein the VOX circuit comprises an ambient sound gating module, coupled to the first microphone, to blank or substantially attenuate the ambient sound.

13. The system according to any of the preceding

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claims, wherein the first processor comprises a speech recognition module.

14. The system according to any of claims 6 -13, wherein the first earmold houses the first microphone, the first processor, the wireless transmitter, the wireless receiver, and the speaker, and wherein the first carmold is configured for use as an in-the-ear (ITE) device.

15. The system according to claim 14, wherein the first earmold is configured for use as an in-the-canal (ITC) device.

16. The system according to claim 15, wherein the first earmold is configured for use as a completely-in-the-canal (CIC) device.

17. The system according to any of claims 6 - 13, wherein the first ear level device comprises an ITE module including the first microphone and the speaker and a behind-the-ear (BTE) module attached to the ITE module and including the second microphone, the first processor, the wireless transmitter, and the wireless receiver.

18. The system of claim 17, wherein the BTE module comprises a voice operated exchange (VOX) circuit.

19. The system of claim 17, wherein the BTE module comprises a rechargeable battery.

20. The system according to any of claims 6 - 19, further comprising a remote device communicatively coupled to the wireless transmitter and the wireless receiver via a telemetry link providing for simultaneous bi-directional communication between the first ear-level device and the remote device.

21. The system according to claim 20, wherein the remote device comprises at least one of a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator.

22. The system according to claim 1, wherein the first microphone is adapted for use in the first ear canal and receives the occluded sound from about the first ear canal, wherein the at least the portion of the first earmold is configured for placement in the first ear canal, and further comprising a second ear-level device including:

a wireless receiver to receive a second wireless signal representing a remote sound;
a second processor, connected to the wireless receiver, to convert the second wireless signal to the remote sound;
a speaker connected to the second processor, the speaker adapted for use in the second ear canal to transmit the remote sound to the second ear canal; and
a second earmold housing at least the speaker, at least a portion of the second earmold configured for placement in the second ear canal.

23. The system according to claim 22, wherein the second ear-level device further comprises a second microphone connected to the second processor, the second microphone adapted to receive an ambient sound from outside the second ear canal, and wherein:

the second processor further processes the ambient sound; and
the speaker is configured to transmit the remote sound and the processed ambient sound to the second ear canal.

24. The system according to any of claims 22 and 23, wherein the first ear-level device further comprises a first voice operated exchange (VOX) circuit connected to the first processor, and the second ear-level device further comprises a second VOX circuit connected to the second processor,

25. The system according to any of claims 22 - 24, wherein the first processor and the second processor each comprise a speech recognition module.

26. The system according to any of claims 22 - 25, wherein the first and second ear-level devices are each an behind-the-ear (BTE) device.

27. The system according to any of claims 22 - 25, wherein the first and second ear-level devices are each an in-the-ear (ITE) device.

28. The system according to claim 27, wherein the first and second ear-level devices are each an in-the-canal (ITC) device.

29. The system according to claim 28, wherein the first and second ear-level devices are each an completely-in-the-canal (CIC) device.

30. The system according to any of claims 22 - 29, further comprising a remote device communicatively coupled to the first and second ear-level devices.

31. The system according to claim 30, wherein the remote device comprises at least one of a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator.

32. A method, comprising:

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detecting an occluded sound using a first microphone adapted for use in an ear canal;
detecting an incoming radio signal representing a remote sound from the remote device;
starting a voice operated exchange (VOX) housed within an ear-level communication device when at least one of the occluded sound and the incoming radio Signal is detected if the VOX is not already on, the ear-level communication device being one of an in-the-ear (ITE) device and a behind-the-ear (BTB) device;
gating the occluded sound on, and gating the remote sound off, when the occluded sound is detected while the incoming radio signal is not detected; and
gating the remote sound on, and gating the occluded sound off, when the incoming radio signal is detected while the occluded sound is not detected.

33. The method according to claim 32, wherein detecting the occluded sound comprises comparing an amplitude of the occluded sound to an occluded sound threshold, wherein the occluded sound is detected when the amplitude of the occluded sound exceeds the occluded sound threshold.

34. The method according to any of claims 32 and 33, wherein detecting the incoming radio signal comprises comparing an amplitude of the remote sound to a remote sound threshold, wherein the incoming radio signal is detected when the amplitude of the remote sound exceeds the remote sound threshold.

35. The method according to any of claims 32 - 34, further comprising detecting an ambient sound using a second microphone, and wherein starting the VOX comprises starting the VOX when at least one of the occluded sound, the incoming radio signal, and the ambient sound is detected if the VOX is not already on.

36. The method according to claim 35, further comprising gating the occluded sound off, gating the remote sound on, and gating the ambient sound off, when the incoming radio signal is detected while the occluded sound is not detected.

37. The method according to claim 35, further comprising gating the occluded sound off, gating the remote sound on, and gating the ambient sound on, when the incoming radio signal is detected while the occluded sound is not detected.

38. The method according to claim 35, further comprising gating the occluded sound on, gating the remote sound off, and gating the ambient sound off, when the occluded sound is detected while the incoming radio signal is not detected.

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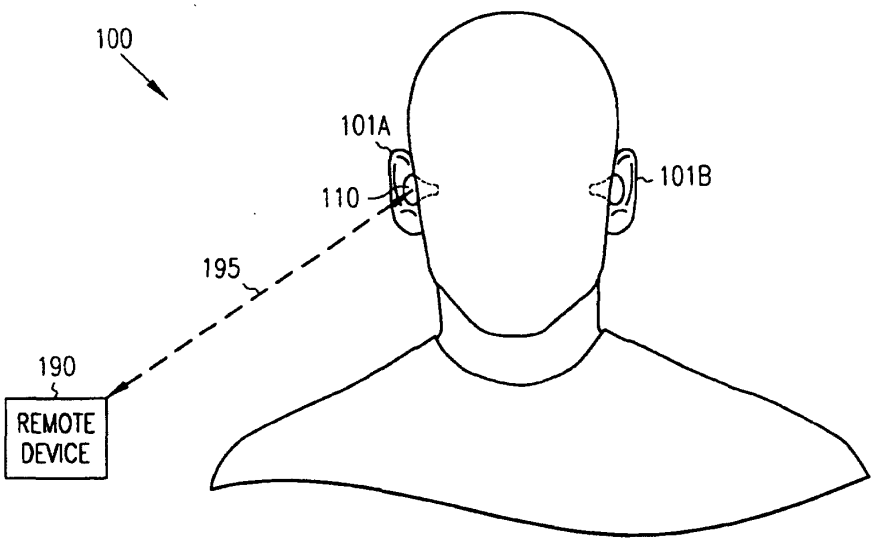


FIG. 1

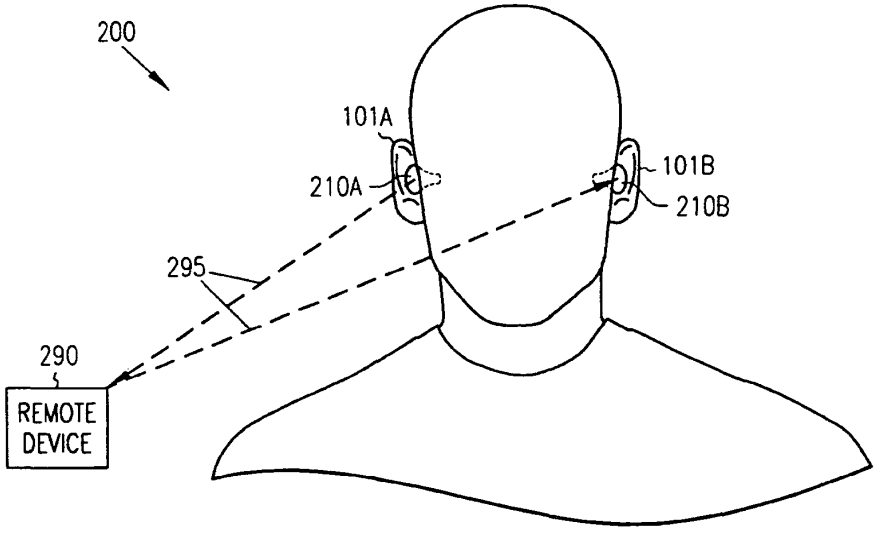


FIG. 2

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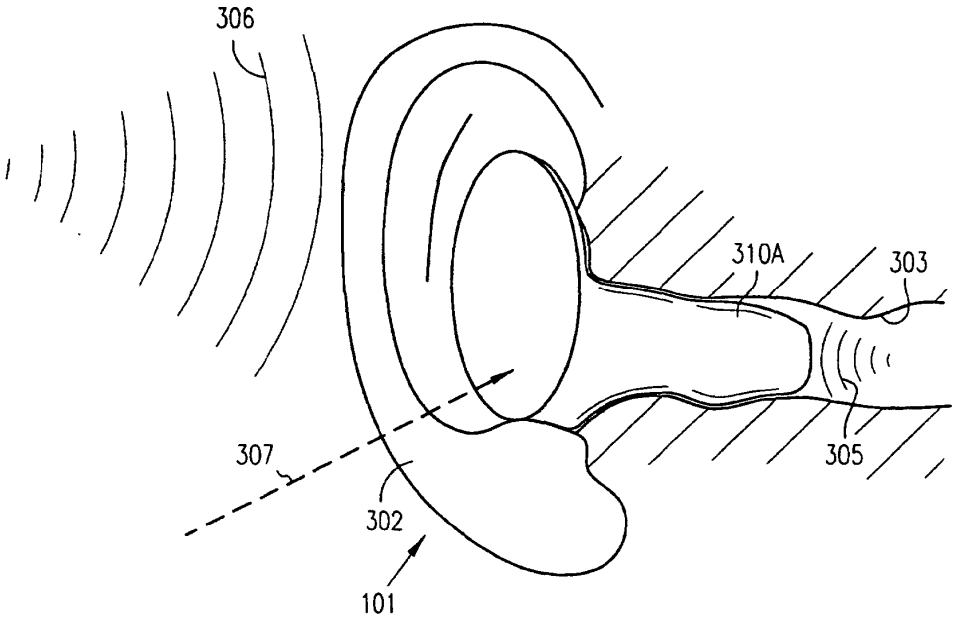


FIG. 3A

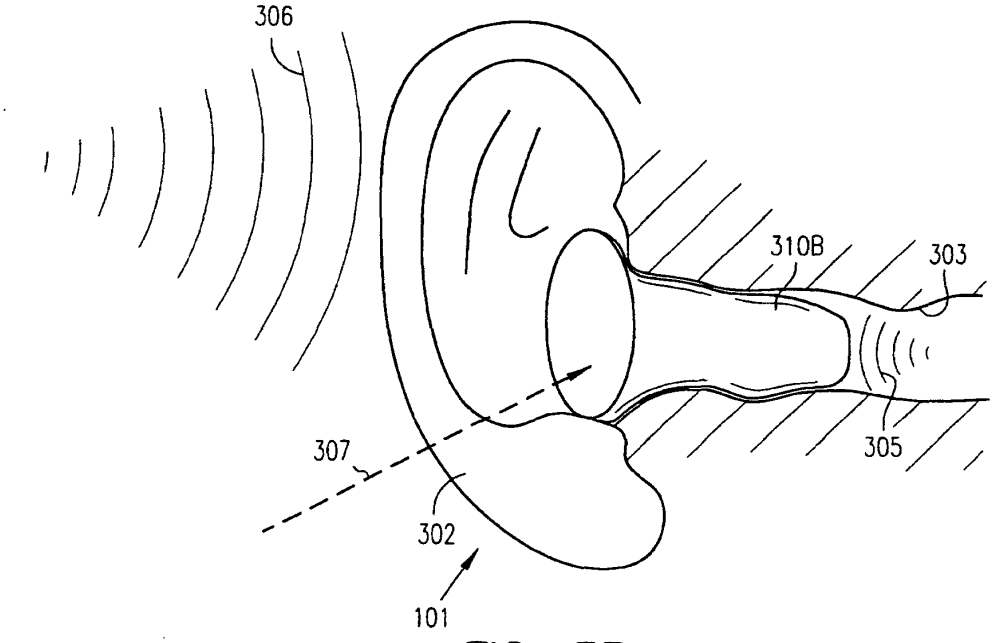


FIG. 3B

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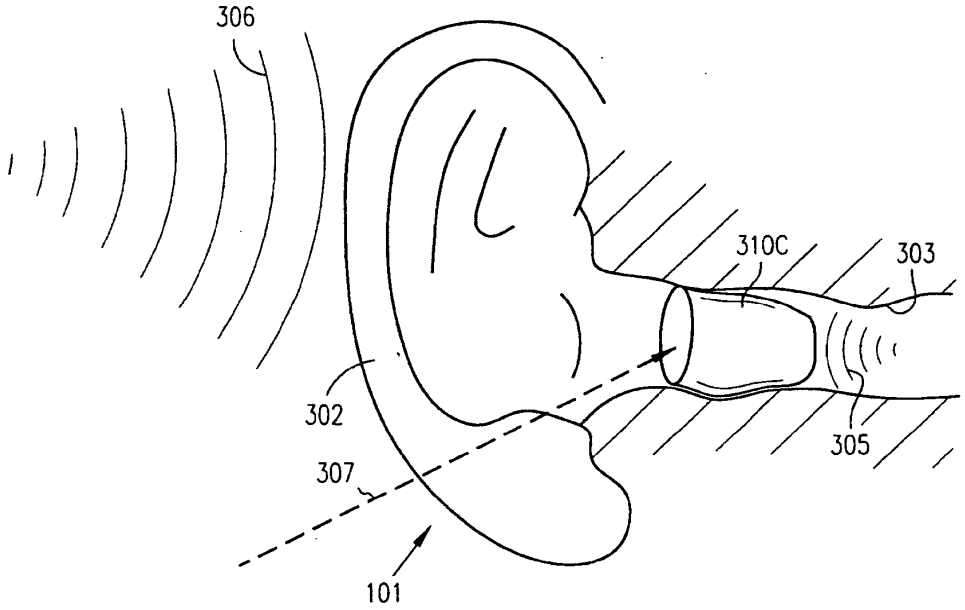


FIG. 3C

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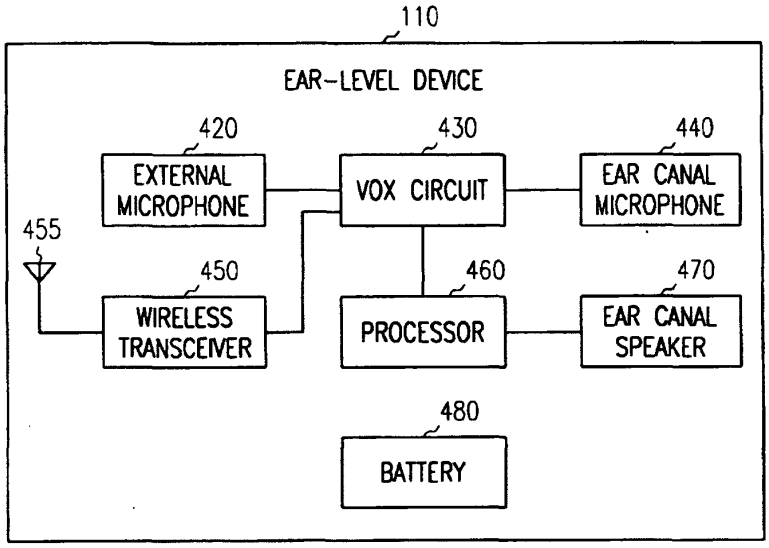


FIG. 4A

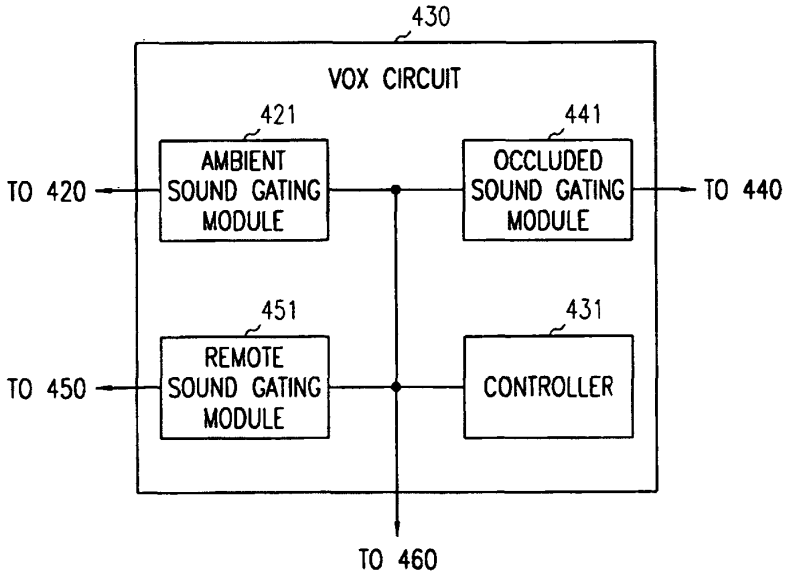


FIG. 4B

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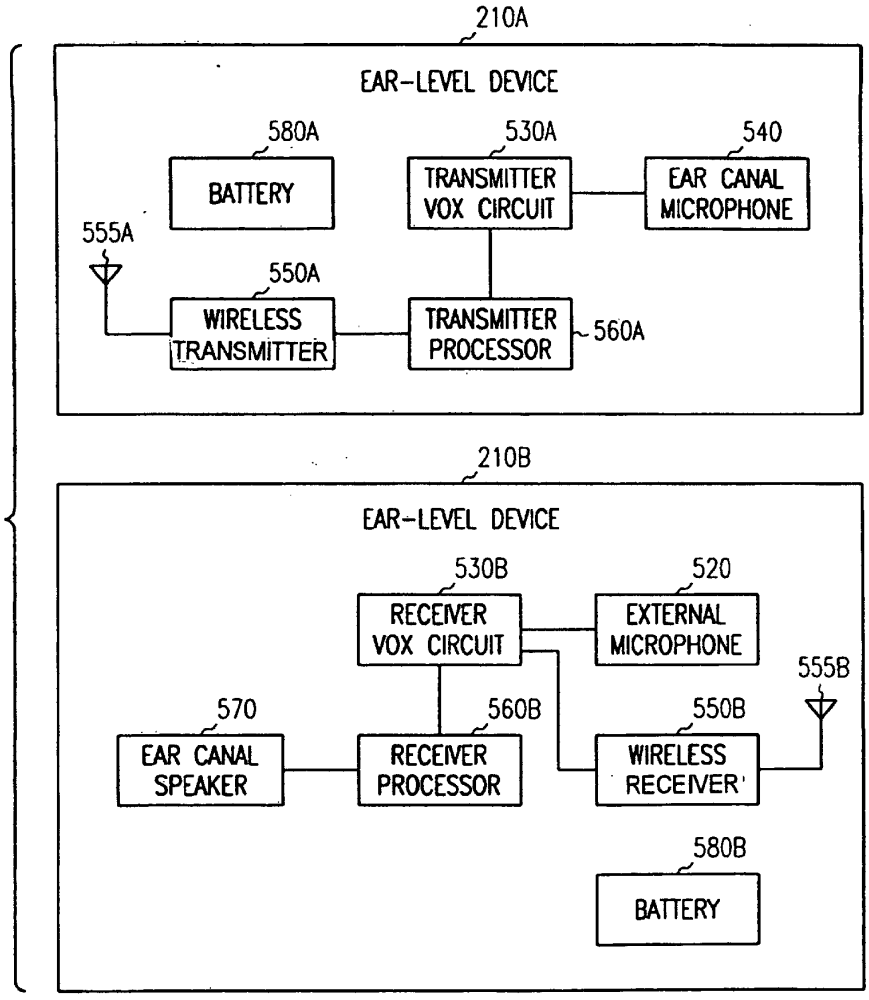


FIG. 5

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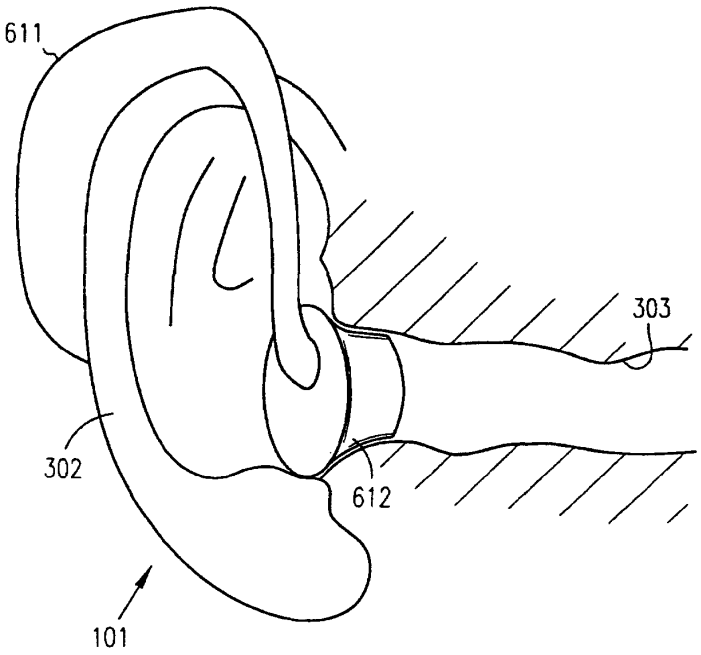

611
303
302
612
101

FIG. 6

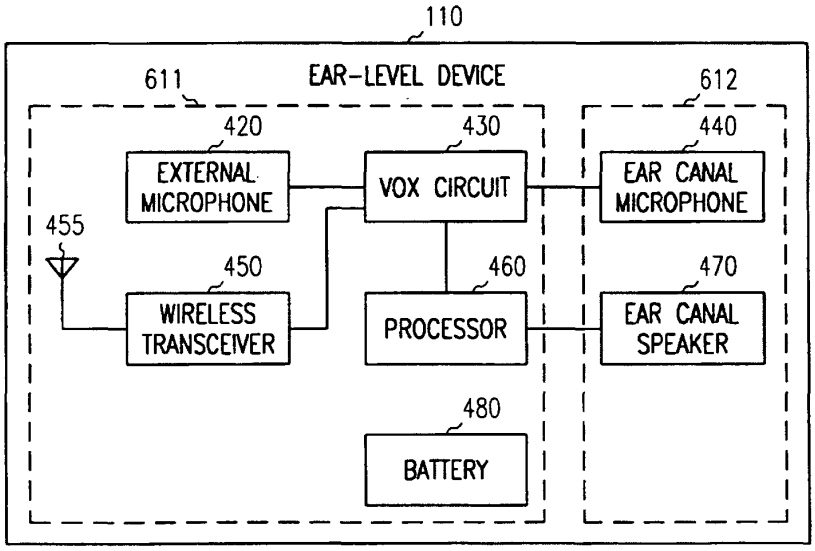

110
611
EAR-LEVEL DEVICE
612
420
430
440
EXTERNAL MICROPHONE
VOX CIRCUIT
EAR CANAL MICROPHONE
455
450
460
470
WIRELESS TRANSCEIVER
PROCESSOR
EAR CANAL SPEAKER
480
BATTERY

FIG. 7

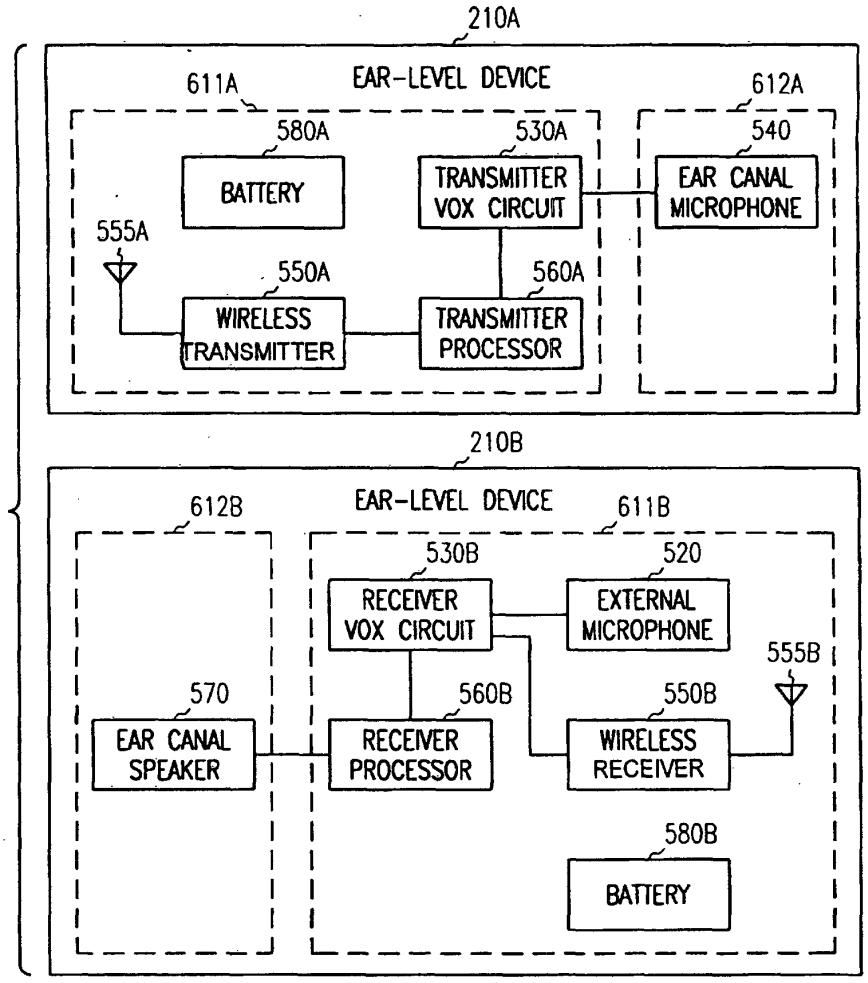


FIG. 8

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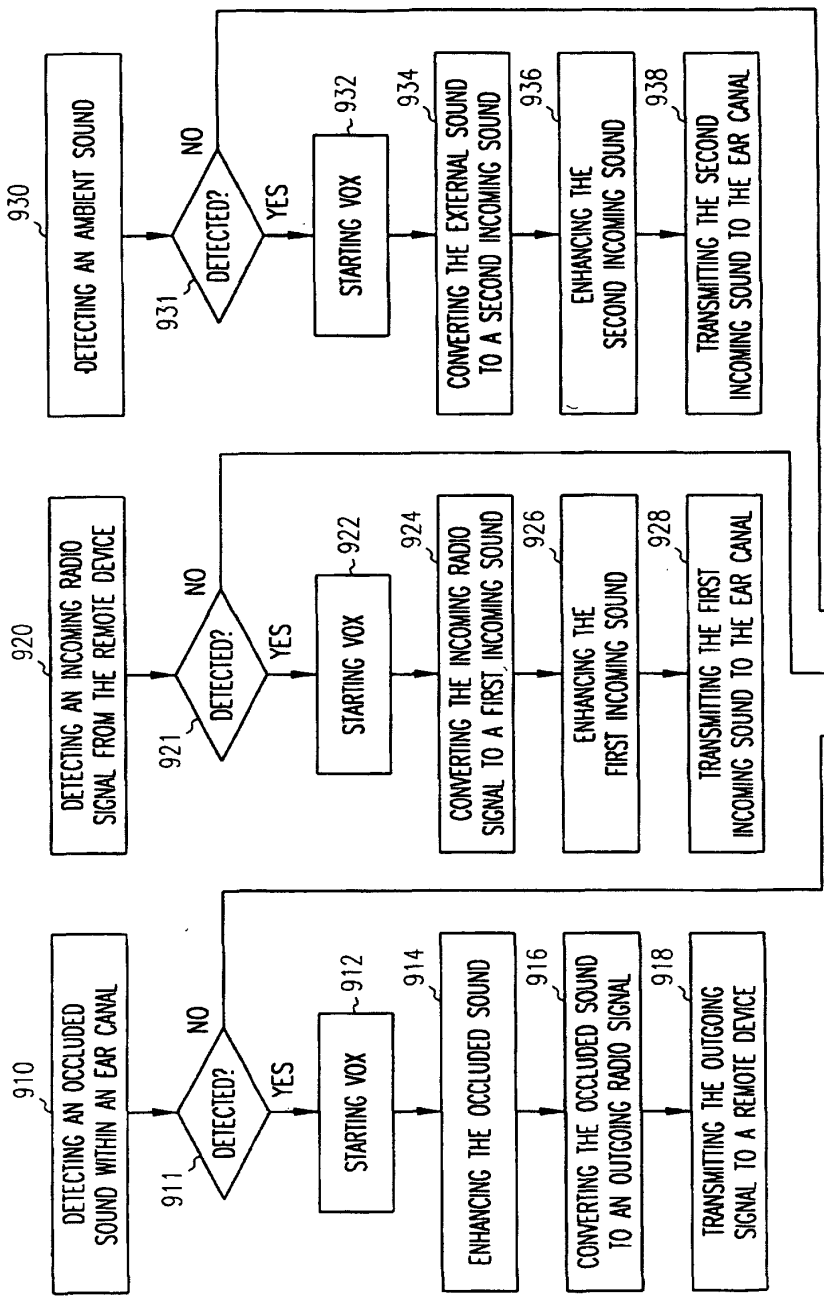


FIG. 9

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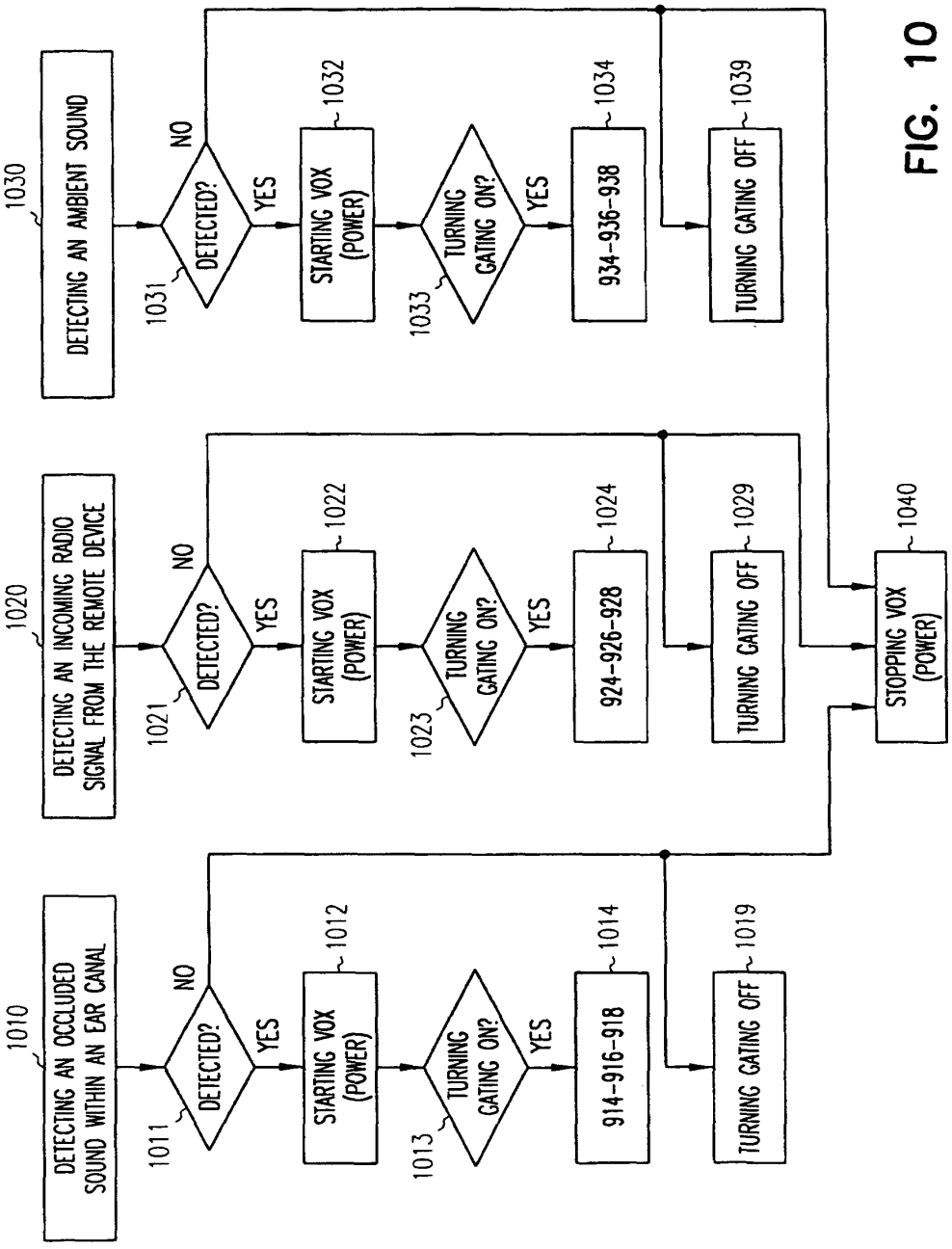


FIG. 10

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The wording below is an initial machine translation of the original publication. To generate a version using the latest translation technology, go to the original language text and use Patent Translate.

[0001] BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to a self-speech detection device, a voice input device, and a hearing aid having a function of distinguishing a voice uttered by a wearer from a voice coming from the outside world.

[0002] 2. Description of the Related Art Conventionally, a device using a bone conduction microphone has been put into practical use as a device for separating and identifying self-utterance, which is a voice uttered by a wearer, from an outside voice.

[0003] The bone conduction microphone detects the vibration of the skull caused by the wearer's voice through the attachment part that is in close contact with the wearer's ear canal.There is no sensitivity to external noise, which is air vibration, and the wearer's self-speech Only the sound can be picked up.

[0004] However, the bone conduction microphone is required to have close contact between the mounting portion and the ear canal in order to pick up the self-speech sound with high sensitivity. For this reason, it is necessary to match the shape of the wearing part with the shape of the ear canal of each wearer, and in the case of a cell type body in which the main body is integrated with the wearing part, it is necessary to replace the whole cell, so each wearer There was a problem that the fitting of was complicated.

[0005] An object of the present invention is to provide a self-speech detection device, a voice input device, and a hearing aid that can detect self-speech with a simpler configuration.

[0006] According to the invention of claim 1 of the present application, a mounting portion that is inserted into the ear canal of a wearer to insulate between the outside world and the ear canal, and a first microphone provided toward the outside world. A second microphone provided toward the ear canal; a delay unit that delays the signal of the first microphone for a predetermined time; a receiver that outputs the signal delayed by the delay unit into the ear canal; and a first microphone. And a signal processing unit that detects the self-utterance of the wearer based on the correlation between the signal waveform of (1) and the signal waveform of the second microphone.

[0007] In the invention of claim 2 of this application, in the invention of claim 1, the signal processing unit calculates a difference between the signal waveform of the first microphone and the signal waveform of the second microphone, and It is a processing unit that detects the wearer's self-utterance based on the correlation with the signal waveform of the microphone 1.

[0008] According to a third aspect of the present application, in the first aspect of the invention, the signal processing unit propagates the signal waveform of the first microphone delayed by the delay means including the ear canal from the receiver to the second microphone. The convolution calculation is performed by the transfer function of the road, the difference between the convolved signal waveform and the signal waveform of the second microphone is calculated, and the wearer's self is calculated based on the correlation between the difference signal waveform and the signal waveform of the first microphone. It is characterized in that it is a processing unit for detecting an utterance.

[0009] According to the invention of claim 4 of this application, in the invention of claim 3, a sound source for generating a test sound signal and inputting it to the delay means, a direct waveform of the

test sound signal and a second microphone output from the receiver are used. It is characterized in that it further comprises means for calculating a transfer function of the propagation path based on the propagation waveform of the received test sound signal.

[0010] According to the invention of claim 5 of this application, a mounting portion that is inserted into the ear canal of the wearer to insulate between the outside world and the ear canal, the first microphone provided toward the outside world, and the inside of the ear canal are provided. A second microphone, a delay unit that delays the signal received by the first microphone for a predetermined time, a receiver that outputs the signal delayed by the delay unit into the ear canal, and a first microphone that is delayed by the delay unit. The signal waveform is convolved with the transfer function of the propagation path including the ear canal from the receiver to the second microphone, the difference signal waveform between this convolutional signal waveform and the signal waveform of the second microphone is extracted, and this difference signal waveform is And a signal processing unit for external output.

[0011] According to the invention of claim 6 of this application, in the invention of claim 5, the sound source for generating a test sound signal and inputting it to the delay means, the direct waveform of the test sound signal and the second microphone output from the receiver are used. It is characterized in that it further comprises means for calculating a transfer function of the propagation path based on the propagation waveform of the received test sound signal.

[0012] According to the invention of claim 7 of this application, a mounting portion that is inserted into the ear canal of the wearer to insulate between the outside world and the ear canal, a first microphone provided toward the outside world, and the inside of the ear canal are provided. The second microphone, the voice speed conversion means for extending the signal received by the first microphone on the time axis, the receiver for outputting the signal delayed by the delay means into the ear canal, and the voice speed conversion means. The signal waveform of the first microphone is convolved with the transfer function of the propagation path including the ear canal from the receiver to the second microphone, and the difference signal waveform between this convolutional signal waveform and the signal waveform of the second microphone and the first And a signal processing unit that detects the self-utterance of the wearer based on the correlation with the signal waveform of the microphone and prohibits the operation of the speech speed conversion means when the self-utterance is detected.

[0013] According to the invention of claim 8 of this application, in the invention of claim 7, a sound source for generating a test sound signal and inputting it to the delay means, a direct waveform of the test sound signal and a second microphone output from the receiver are used. It is characterized in that it further comprises means for calculating a transfer function of the propagation path based on the propagation waveform of the received test sound signal.

[0014] In the present invention, the second microphone receives not only the self-speech sound but also the external voice output from the receiver. On the other hand, the first microphone receives the foreign voice. By canceling the component of the external voice by correlating the signal waveform of the second microphone and the first signal waveform, only the self-speech sound component can be separated and extracted. The foreign voice received by the first microphone includes the self-speech sound uttered by the mouth, but the same processing may be performed.

[0015] Since the signal processing unit can be configured by a DSP or the like, the structure can be simplified even when performing complicated signal processing.

[0016] Therefore, according to the present invention, it is possible to separate and extract only the self-speech sound with a configuration of the mounting portion that is much simpler than that of the bone conduction microphone that only shields the outside world from the ear canal.

[0017] BEST MODE FOR CARRYING OUT THE INVENTION Embodiments of the present invention will be described with reference to the drawings. FIG. 1 is an external view of a self-speech detection device to which the present invention is applied. This self-speech detection device is used for a hearing aid and a voice input device. An earplug 2 which is a mounting portion to be inserted into the ear canal 4 is provided at the tip of the cell 1. The earplug 2 is made of an umbrella-shaped flexible resin, and is in close contact with the external auditory meatus wall 3 to block the external auditory meatus 4 from the outside world and prohibit the propagation of sound between them.

[0018] In the cell 1, a microphone 5 for detecting a sound coming from the outside world, a receiver 6 for outputting a sound to the ear canal 4, a microphone 7 for detecting a sound inside the ear canal 4, and a receiver 6, A pipe hole 8 that spatially connects with the microphone 7 is provided. The microphone 5, the receiver 6 and the microphone 7 are connected to the signal processing unit 9. The signal processing unit 9 is composed of an electronic circuit such as a DSP, analyzes and processes the audio signal input from the microphone 5 and the microphone 7, and outputs the processed audio signal from the receiver 6. Hereinafter, examples of various configurations of the signal processing unit 9 and their operations will be described.

[0019] FIG. 2 shows an example of a self-speech detection device in which the signal processing unit 9 is composed of a delay device 10, a correlation calculation device 11, and a speech determination device 12. In FIG. 2A, the external voice received by the microphone 5 is input to the delay device 10 and the correlation calculation device 11. The delay device 10 delays the input audio signal by a minute time t and outputs it to the receiver 6. The receiver 6 converts this voice signal into voice (air vibration) and emits it into the ear canal 4. The microphone 7 receives both the voice output by the receiver 6 and the voice of the wearer transmitted from the ear canal 4. The audio signal received by the microphone 7 is input to the correlation calculation device 11. The correlation calculation device 11 calculates a correlation value between the audio signal input from the microphone 5 and the audio signal input from the microphone 7.

[0020] With reference to FIGS. 2B and 2C, the signal waveform and the correlation when the external voice arrives will be described. The time when the microphone 5 receives the foreign voice is 0 sec. The input point A waveform of the microphone 5 has a waveform as shown in the upper part of FIG. The delay device 10 delays this audio signal for tsec and outputs it to the receiver 6. The pointB waveform which is the waveform supplied to the receiver 6 is a waveform as shown in the middle part of FIG. 7B in which the waveform of pointA is delayed by tsec. The receiver 6 outputs the delayed audio signal to the ear canal 4. The sound output to the ear canal 4 is also received by the microphone 7. The pointC waveform which is the input of the microphone 7 has a waveform similar to the pointB waveform as shown in the lower part of FIG. The correlation calculation device 11 is a device that in time series examines how similar the point A waveform is to the reference waveform, using the point A waveform as the reference waveform, and outputs a correlation value proportional to the degree of the correlation. In the same figure (C), since there is no voice signal in the ear canal 4 at the time of 0 sec

and the waveform of pointC is flat, the correlation value is 0, but the waveform of the voice delayed to pointC appears at time t. The correlation value at this time t becomes maximum.

[0021] 8B and 8C are diagrams in which the level of the input waveform is modeled, but actually the waveform as shown in FIG. 8 is shown. The same figure (A) shows the waveform of point A, and the same figure (B) shows the waveform of point C. And the same figure (C) is a correlation value. As described above, in the case of an analog waveform, the correlation value does not have a pulse shape, but the peak value also changes after tsec.

[0022] On the other hand, with reference to FIGS. 2D and 2E, the signal waveform and the correlation when self-speech is performed will be described. When the wearer utters, the sound signal is emitted from the mouth to the outside and also propagates into the ear canal 4 through the body propagation path. The sound emitted to the outside world is received by the microphone 5, and the sound propagated to the ear canal 4 is received by the microphone 7. Since the propagation distances of both are extremely short, they are received almost at the same time (0 sec). Therefore, at time 0 sec, a waveform as shown in the upper part of FIG. 9D appears at the point A which is the input of the microphone 5, and at the time 0 sec, a waveform similar to the point A waveform also appears at the time 0 sec. Further, the pointA waveform is delayed by the delay device 10 for tsec (pointB waveform) and then output from the receiver 6 to the ear canal 4, so that the microphone 7 also receives this sound, and the microphone 7 causes the wearer generated in the ear canal. Both the own voice and the delayed voice output from the receiver 6 are received, and the received pointC waveform is a synthesized waveform as shown in the lower part of FIG. At time 0 sec, the waveforms at point A and point C are almost the same, so the correlation calculation device 11 outputs a high correlation value at time 0 sec as shown in FIG.

[0023] 9D and 9E are diagrams in which the level of the input waveform is modeled, the waveforms shown in FIG. 9 are actually shown. The same figure (A) shows the waveform of point A, and the same figure (B) shows the waveform of point C. And the same figure (C) is a correlation value. As described above, in the case of an analog waveform, the correlation value does not have a pulse shape, but it also has a peak value at time 0 and is gradually attenuated.

[0024] Based on the difference in the correlation values described above, when the peak of the correlation value is output at 0 sec, the speech determination device 12 determines that the correlated waveform is due to self-speech, and the peak of the correlation value is output after tsec. Then, it is determined that the waveform is due to the foreign voice.

[0025] FIG. 3 shows an example of a self-speech detection device in which the signal processing unit 9 is composed of a delay device 10, a correlation calculation device 11, a speech determination device 12, and a difference processing device 13. In FIG. 3A, the external voice received by the microphone 5 is input to the delay device 10 and the correlation calculation device 11. The delay device 10 delays the input audio signal by tsec and outputs it to the receiver 6. The receiver 6 converts this voice signal into voice (air vibration) and emits it into the ear canal 4. The signal (pointB) delayed by the delay device 10 is also input to the difference processing device 13. On the other hand, the microphone 7 receives the sound generated in the external auditory meatus 4 and inputs it to the difference processing device 13. The microphone 7 receives both the voice output by the receiver 6 and the voice of the wearer transmitted from the ear canal 4. The difference processing unit 13 cancels the foreign voice component by subtracting the same voice signal waveform as that output from the delay unit 10 to the receiver 6

from the voice signal waveform input from the microphone 7. The speech signal waveform in which the foreign speech component is canceled is input to the correlation calculation device 11. The correlation calculation device 11 calculates a correlation value between the voice signal input from the microphone 5 and the voice signal input from the difference processing device 13.

[0026] With reference to FIGS. 3B and 3C, the signal waveform and the correlation when the foreign voice arrives will be described. The time when the microphone 5 receives the foreign voice is set to 0 sec. Point A, which is the input to the microphone 5, has a waveform as shown in the first stage of FIG. The delay device 10 delays this audio signal for tsec and outputs it to the receiver 6. Since the pointB waveform supplied to the receiver 6 is the pointA waveform delayed by tsec, it has a waveform as shown in the second stage of FIG. The receiver 6 outputs the delayed audio signal to the ear canal 4. The sound output to the ear canal 4 is also received by the microphone 7. The pointC waveform, which is the input signal waveform of the microphone 7, has a waveform similar to the pointB waveform as shown in the third stage of FIG. The difference processing device 13 subtracts the pointC waveform, which is the audio signal waveform input from the microphone 7, from the pointB waveform, which is the audio signal waveform input from the delay device 10. In the case of only foreign voice, since there is no internally generated voice signal, the pointB waveform and the pointC waveform almost match, and the pointD waveform which is the output of the difference processing device 13 is as shown in the fourth stage of FIG. It becomes a flat signal of almost 0 level. The correlation calculation device 11 is a device that in time series examines how similar the point A waveform is to the reference waveform, using the point A waveform as the reference waveform, and outputs a correlation value proportional to the degree of the correlation. In this example, since the waveform of pointD is almost flat, there is almost no correlation with the reference waveform of pointA, and a large correlation value is not output. The utterance determination device 12 determines that there is no self-utterance because a large correlation value is not input.

[0027] On the other hand, a signal waveform and a correlation when a self-speech is performed will be described with reference to FIGS. When the wearer utters, the voice signal is emitted from the mouth to the outside world and also propagates into the ear canal 4 through the body propagation path. The sound emitted to the outside world is received by the microphone 5, and the sound transmitted to the external auditory meatus 4 is received by the microphone 7. Since the propagation distances of both are extremely short, they are received almost at the same time (0 sec). Therefore, the waveform of the point A appears at the microphone 5 at the time 0 sec, and the waveform similar to the point A also appears at the microphone 7 at the time 0 sec. Further, the waveform of the point A is delayed by the delay device 10 for tsec and then emitted from the receiver 6 to the ear canal 4, so that the microphone 7 also receives this voice. That is, the microphone 7 receives both the voice of the wearer himself/herself generated in the ear canal and the delayed voice emitted from the receiver 6, and the synthesized waveform thereof is as shown in the third row of FIG. It becomes the waveform of pointC. The difference processing device 13 subtracts the pointC waveform which is the voice signal waveform input from the microphone 7 and the pointB waveform which is the voice signal waveform input from the delay device 10. Since the pointC waveform is a composite signal of the internally transmitted waveform and the voice waveform output from the receiver 6, when the pointB waveform is subtracted from this, the waveform component of the external voice output from the receiver 6 is canceled, and) As shown in the fourth row, the waveform becomes similar to pointA. The correlation calculation device 11 is a device that in time series examines how similar the point A waveform is to the reference

waveform, using the point A waveform as the reference waveform, and outputs a correlation value proportional to the degree of the correlation. In this example, since the waveform of pointD almost coincides with the waveform of pointA, a large correlation value is output at the timing of 0 sec. The utterance determination device 12 determines that there is a self-utterance started at the timing of 0 sec due to the input of the large correlation value. As described above, in the example of FIG. 3, since the extra signal is eliminated by the difference processing device 13, the correlation value is improved and the error determination can be expected to be reduced.

[0028] The examples of FIGS. 2 and 3 have been described for the case where the signal path is ideal and the frequency characteristics and phase characteristics of the path have almost no effect, but consider the case where the propagation characteristics of the signal path affect the waveform of the audio signal. An example is shown in FIG.

[0029] In the example of FIG. 4, the signal processing unit 9 includes a delay device 10, a correlation calculation device 11, a speech determination device 12, a difference processing device 13, and a transfer function correction device 14.

[0030] In FIG. 4A, the external voice received by the microphone 5 is input to the delay device 10 and the correlation calculation device 11. The delay device 10 delays the input audio signal by tsec and outputs it to the receiver 6. The receiver 6 converts this voice signal into voice (air vibration) and emits it into the ear canal 4. The pointB waveform delayed by the delay device 10 is also input to the transfer function correction device 14. The transfer function correction device 14 filters the input signal and inputs it to the difference processing device 13. This filter is a filter that simulates the impulse response of the ear canal 4 when the device is inserted into the ear canal 4, so that the signal passing through this filter has the same waveform as the signal propagating in the ear canal 4. Is designed. That is, by passing through this filter, the transfer function of the propagation path is convoluted with respect to the signal waveform.

[0031] On the other hand, the microphone 7 receives the sound generated in the external auditory meatus 4 and inputs it to the difference processing device 13. The microphone 7 receives both the voice output by the receiver 6 and the voice of the wearer transmitted from the ear canal 4. The difference processing device 13 subtracts the audio signal waveform input from the transfer function correction device 14 from the audio signal waveform input from the microphone 7 to cancel this component. The audio signal waveform from which the output of the receiver 6 has been canceled is input to the correlation calculation device 11. The correlation calculation device 11 calculates a correlation value between the voice signal input from the microphone 5 and the voice signal input from the difference processing device 13.

[0032] With reference to FIG. 4(B), the signal waveform and the correlation when the foreign voice arrives will be described. The time when the microphone 5 receives the foreign voice is set to 0 sec. Point A, which is the input to the microphone 5, has a waveform as shown in the first stage of FIG. The delay device 10 delays this audio signal for tsec and outputs it to the receiver 6. The pointB, which is the waveform applied to the receiver 6, has a waveform as shown in the second stage of FIG. 7B, which is obtained by delaying the waveform of the pointA by tsec. The receiver 6 outputs the delayed audio signal to the ear canal 4. The sound output to the ear canal 4 is also received by the microphone 7. The point C, which is the input of the microphone 7, has almost the same timing as the point B, but the delay component is superimposed due to the propagation through the external auditory meatus 4, and the

waveform is as shown in the third stage of FIG. Since the waveform obtained by correcting the pointB waveform output from the delay device 10 by the transfer function correction device 14 is input to the difference processing device 13, this waveform is subtracted from the point C which is the audio signal waveform input from the microphone 7. .. Since the waveform of pointB corrected by the transfer function correction device 14 is almost the same as the waveform of pointC, these waveforms almost match and the pointE waveform which is the output of the difference processing device 13 is shown in FIG. As shown in the fifth stage, the signal becomes a flat signal of almost 0 level. The correlation calculating device 11 is a device for checking in time series how similar the point A waveform is to the reference waveform with the point A waveform as the reference waveform, and outputs a correlation value proportional to the degree of the correlation. In this example, since the waveform of point E is almost flat, there is almost no correlation with the reference waveform of point A, and a large correlation value is not output. The utterance determination device 12 determines that there is no self-utterance because a large correlation value is not input.

[0033] On the other hand, with reference to FIG. 4C, the signal waveform and the correlation when self-utterance is performed will be described. When the wearer utters, the sound signal is emitted from the mouth to the outside and also propagates into the ear canal 4 through the body propagation path. The sound emitted to the outside world is received by the microphone 5, and the sound transmitted to the external auditory meatus 4 is received by the microphone 7. Since the propagation distances of both are extremely short, they are received almost at the same time (0 sec). Therefore, the waveform of the point A appears at the microphone 5 at the time 0 sec, and the waveform similar to the point A waveform also appears at the microphone 7 at the time 0 sec. Further, the waveform of the point A is delayed by the delay device 10 for tsec and then emitted from the receiver 6 to the ear canal 4, so that the microphone 7 also receives this voice. The signal emitted from the receiver 6 and received by the microphone 7 is a signal that propagates through the external auditory meatus 4 and is input, so that the reverberation sound component of the external auditory meatus 4 is superimposed. Therefore, the synthesized waveform of the direct sound of the self-utterance received by the microphone 7 and the sound output from the receiver 6 becomes the pointC waveform shown in the third stage of FIG. The sound signal emitted from the receiver 6 and propagated through the external auditory meatus 4 has a gradual rise and fall of the waveform because the reverberation component is superimposed due to the propagation characteristics of the external auditory meatus 4 as described above. Since the waveform output from the transfer function correction device 14 also passes through a filter having the transfer characteristic of the external auditory meatus 4 as a filter coefficient, similar reverberation components are superposed, and this signal is input from the input signal of the microphone 7. By subtracting, only the self-speech sound can be separated (pointE waveform).

[0034] The correlation calculation device 11 is a device that in time series examines how similar the point A waveform is to the reference waveform, using the point A waveform as the reference waveform, and outputs a correlation value proportional to the degree of the correlation. In this example, since the waveform of pointD almost coincides with the waveform of pointA, a large correlation value is output at the timing of 0 sec. The utterance determination device 12 determines that there is a self utterance started at the timing of 0 sec due to the input of the large correlation value.

[0035] In FIG. 4A, if the output of the difference processing device 13 is taken out as it is, it can function as a self-speech detecting microphone.

[0036] Although the transfer function correction device 14 is inserted between the delay device 10 and the difference processing device 13 in the device of FIG. 4A, it may be placed between the microphone 7 and the difference processing device 13 as shown in FIG. Can also In this case, since the transfer function is also convoluted with the self-speech voice generated in the ear canal, the transfer function correction device that restores the waveform of the self-speech sound after the difference processing is the difference processing device 14 and the correlation calculation device 11. To be installed between and.

[0037] Note that, in the examples of FIGS. 3 and 4, the correlation calculation device 11 may be a simple comparison calculation device because it only compares two audio signal waveforms that occur simultaneously. Further, the delay device 10 of FIGS. 4 and 5 may be a signal processing device that digitally delays a signal.

[0038] FIG. 6 is a diagram showing an embodiment in which the present invention is applied to a voice input/output device of a communication terminal. A control device 30 for controlling this device controls the device in a transfer function calculation mode and a normal operation mode. The indicator device 33 includes a switch for the wearer to instruct the controller 30 to turn on/off the device.

[0039] 6, as a system of the microphone 5-delay device 10-receiver 6 of FIGS. 1 and 4A, a microphone 5 (this device also has the same external appearance as that of FIG. 1; the same applies hereinafter), an amplifier 36, An A/D converter 37, a delay device 38, a D/A converter 39, an amplifier 40 and a receiver 6 are provided. A microphone 7-amplifier 41 and an A/D converter 42 are provided as a system of the microphone 7 in FIGS. 1 and 4A. Further, the functions of the transfer function correction device 14, the difference processing device 13, and the comparison operation device 11 of FIG. 4A are implemented by software by the control device 30 and the operation processing device 35. Further, this apparatus has a built-in sound source 34 for generating a test sound signal in a transfer function calculation mode for calculating the transfer function of the ear canal 4. The audio signal formed by the sound source 34 is input to the A/D converter 37 as a test sound signal instead of being input to the microphone 5.

[0040] When the instruction device 33 gives an instruction to turn on, the control unit 30 first sets the transfer function mode, the control device 30 turns on the sound source 34, and instructs the arithmetic processing device 35 to perform a transfer function arithmetic operation. The test sound signal formed by the sound source 34 may be white noise or pink noise, but may be another signal, for example, a waveform of an impulse or a low-frequency signal having a fixed frequency. The test sound signal output from the sound source 34 is emitted into the external auditory meatus 4 via the A/D converter 37, the delay device 38, the D/A converter 39, the amplifier 40, and the receiver 6. The test sound emitted into the ear canal 4 is detected by the microphone 7 provided toward the ear canal 4. The output of the microphone 7 is input to the arithmetic processing unit 35 via the amplifier 41 and the A/D converter 42. The arithmetic processing unit 35 may be configured by a DSP or the like. On the other hand, the arithmetic processing unit 35 is also supplied with a signal obtained by converting the test sound signal formed by the sound source 34 into a digital signal from the A/D converter 37. The arithmetic processing unit 35 compares the pointA signal (the signal input from the A/D converter 37) and the pointB signal (the signal input from the A/D converter 42) as the transfer function operation and compares these signals. A correction coefficient is calculated according to the difference between There are various methods for obtaining the correction coefficient. Then, a function G(k) such that

[0041] $G(k)\cdot A(k)-B(k)=E(k)$ Once obtained, the function G(k) is in a relatively stable state unless the device is removed from the ear canal. You just need to calculate. When the calculation is completed, the

processing unit 35 goes into a standby state. When the control device 30 detects that the arithmetic processing device 35 is in the standby state, the control device 30 stops the sound source 34 and instructs the arithmetic processing device 35 to perform a signal processing operation to switch to the normal operation mode.

[0042] In the normal operation mode, when an external sound is input from the microphone 5, it passes through the amplifier 36, the A/D converter 37, the delay device 38, the D/A converter 39, and the amplifier 40, and after tsec from the receiver 6 to the ear canal 4. Is output. The external sound output to the external auditory meatus 4 is received by the microphone 7 provided toward the external auditory meatus 4, and is input to the arithmetic processing unit 35 via the amplifier 41 and the A/D converter 42. The arithmetic processing unit 35 in which the signal processing operation is set, after convolving the transfer function G(k) obtained above into the pointA signal input from the A/D converter 37, that is, the direct foreign voice signal, The difference calculation processing is performed with the pointB signal, that is, the signal including the external audio signal transmitted through the external auditory meatus 4. By this processing, the foreign voice component is deleted from the pointB signal and only the self-speech voice is extracted. If the extracted self-speech voice is connected to the voice input terminal of the communication device, only a voice signal with little noise can be picked up and sent to the other party even in a place where environmental noise is large.

[0043] In the above example, the output of the A/D converter 37 (pointA signal) is input to the arithmetic processing device 35 as the reference signal, but the output of the delay device 38 may be input.

[0044] FIG. 7 is a diagram showing an embodiment in which the present invention is applied to a hearing aid having a speech speed conversion function. The control device 50 for controlling this device controls the device in the transfer function calculation mode and the normal operation mode. The indicator device 53 includes a switch for the wearer to instruct the controller 50 to turn on/off the device.

[0045] In FIG. 7, as a system of the microphone 5-delay device 10-receiver 6 of FIGS. 1 and 4A, a microphone 5 (this device also has the same external appearance as that of FIG. 1; the same applies hereinafter), an amplifier 56, An A/D converter 57, a speech speed conversion/gain control device 58, a D/A converter 59, an amplifier 60 and a receiver 6 are provided. A microphone 7-amplifier 61 and an A/D converter 62 are provided as a system of the microphone 7 in FIGS. 1 and 4(A). Further, the functions of the transfer function correction device 14, the difference processing device 13, and the comparison operation device 11 of FIG. 4A are realized by software by the control device 50 and the operation processing device 55. Further, this apparatus has a built-in sound source 54 for generating a test sound signal in a transfer function calculation mode for calculating the transfer function of the ear canal 4. The audio signal formed by the sound source 54 is output by the receiver 9 provided outside and is received by the microphone 5.

[0046] When the instruction device 53 gives an instruction to turn on, the control unit 50 first sets the transfer function mode, the control device 50 turns on the sound source 54, and instructs the arithmetic processing device 55 to perform a transfer function arithmetic operation. The test sound signal formed by the sound source 54 may be white noise or pink noise, but may be formed of another signal, for example, an impulse or a waveform of a low frequency signal having a fixed frequency. The test sound signal output from the sound source 54 is output from the receiver 9 and received by the microphone 5 and converted into an electric signal, and then the A/D converter 57, the speech speed conversion/gain

control device 58, and the D/A conversion. It is emitted into the ear canal 4 through the container 59, the amplifier 60, and the receiver 6. The test sound emitted into the ear canal 4 is detected by the microphone 7 provided toward the ear canal 4. The output of the microphone 7 is input to the arithmetic processing unit 55 via the amplifier 61 and the A/D converter 62. The arithmetic processing unit 55 may be composed of a DSP or the like. On the other hand, the arithmetic processing unit 55 is also supplied with the voice source 54 formed by the voice speed conversion/gain control unit 58 and the voice speed converted from the test sound signal output from the receiver 9. The arithmetic processing unit 35 compares the point C signal (the signal input from the speech speed conversion/gain control unit 58) and the point B signal (the signal input from the A/D converter 62) as the transfer function arithmetic operation, and The correction coefficient is calculated according to the difference in the signal of. There are various methods for obtaining the correction coefficient, but for example, the point A signal is A(k), the point B signal is B(k), and the error E(k) between A(k) and B(k) is zero as shown in the following equation. Then, a function G(k) such that

[0047] G(k)·A(k)−B(k)=E(k) Once obtained, the function G(k) is in a relatively stable state unless the device is removed from the ear canal. You just need to calculate. When the calculation is completed, the calculation processing device 55 enters the standby state. When the control device 50 detects that the arithmetic processing device 55 is in the standby state, the control device 50 stops the sound source 54 and instructs the arithmetic processing device 55 to perform a signal processing operation to switch to the normal operation mode.

[0048] In the normal operation mode, when an external sound is input from the microphone 5, it passes through the amplifier 56, the A/D converter 57, the speech speed conversion/gain control device 58, the D/A converter 59, the amplifier 60, and the receiver after tsec. 6 is output to the ear canal 4. The external sound output to the external auditory meatus 4 is received by the microphone 7 provided toward the external auditory meatus 4, and is input to the arithmetic processing unit 55 via the amplifier 61 and the A/D converter 62. The arithmetic processing unit 55 to which the signal processing operation is set convolves the transfer function G(k) obtained above with the pointC signal input from the speech speed conversion/gain control unit 58, that is, the direct foreign voice signal. After that, a difference calculation process is performed with the pointB signal, that is, the signal including the external audio signal transmitted through the external auditory meatus 4. By this processing, the foreign voice component is deleted from the pointB signal and only the self-speech voice component is extracted. When the microphone 5 receives only the foreign voice, the self-speech voice component is 0, but when self-speaking, the component of that level is extracted. When the arithmetic processing device 55 extracts the self-speech voice component, the control device 50 prohibits the voice speed conversion/gain control device 58 from performing the voice speed conversion and controls the gain to be small. As a result, the speech speed conversion for the self-speech is prohibited, and the self-speech is smoothly performed.

[0049] In the above example, the output of the A/D converter 57 (pointA signal) may be input to the arithmetic processing device 55 as a reference signal.

[0050] As a result, the speech speed conversion is desired to be applied to the foreign voice, but not to the vocalized voice. When a person speaks, since the person controls the utterance while listening to his/her own voice, there arises a problem that the person cannot speak well if the uttered speech is delayed. Therefore, it is necessary to detect the utterance section and not apply the speech speed

conversion process to the self-utterance. In addition, since the self-speech voice sounds louder than the foreign voice, it is necessary to control the gain so as to have an appropriate volume.

[0051] In this way, since it is possible to separate the self-speech and the external sound with a simple configuration, when this is used in a speech speed conversion hearing aid, it is used in the same cell regardless of the shape of the ear canal of the wearer. be able to.

[0052] According to the present invention, since the external voice signal is canceled from the input signal of the second microphone provided toward the ear canal to extract only the self-speech sound, the structure is complicated. It is possible to extract only the self-speech voice from which the external voice such as environmental noise is removed without using a bone conduction microphone whose setting is delicate for each wearer.

[0053] Also, if this is used as a hearing aid, the speech speed conversion can be prohibited only in the section of the self-speech voice, and a hearing aid that can easily speak can be configured.

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Abstract

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PROBLEM TO BE SOLVED: To detect one's own uttered sound with simple constitution. SOLUTION: An external environment and an external auditory meatus are cut off and a signal received at the external environment is delayed by a prescribed time and outputted from a receiver 6 of the external auditory meatus. The external auditory meatus is provided with a microphone 7, which picks up a signal outputted from the receiver 6 and a voice signal that is uttered by a wearing person and propagated internally. The external voice signal component is cancelled by subtracting the signal component picked up by the microphone 5 out of the signal received by the microphone 7 so as to detect and extract only one's own uttered voice component.

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最終頁に続く

(54)【発明の名称】　自己発話検出装置、音声入力装置および補聴器

(57)【特許請求の範囲】
【請求項１】　装用者の外耳道に挿入され、外界と外耳道との間を遮音する装着部と、
外界に向けて設けられた第１のマイクと、
外耳道内に向けて設けられた第２のマイクと、
第１のマイクの信号を所定時間遅延する遅延手段と、
遅延手段が遅延した信号を外耳道内に出力するレシーバと、
第１のマイクの信号波形と第２のマイクの信号波形との相関に基づいて装用者の自己発話を検出する信号処理部と、
を備えたことを特徴とする自己発話検出装置。
【請求項２】　前記信号処理部は、第１のマイクの信号波形と第２のマイクの信号波形の差分を計算し、この差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出する処理部である請求項１に記載の自己発話検出装置。
【請求項３】　前記信号処理部は、遅延手段で遅延された第１のマイクの信号波形を、レシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分を計算し、この差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出する処理部である請求項１に記載の自己発話検出装置。
【請求項４】　テスト音信号を発生して前記遅延手段に入力する音源と、
該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする請求項３に記載の自己発話検出装

置。
【請求項５】　装用者の外耳道に挿入され、外界と外耳道との間を遮音する装着部と、
外界に向けて設けられた第１のマイクと、
外耳道内に向けて設けられた第２のマイクと、
第１のマイクが受信した信号を所定時間遅延する遅延手段と、
遅延手段が遅延した信号を外耳道内に出力するレシーバと、
遅延手段で遅延された第１のマイクの信号波形を、レシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分信号波形を抽出し、この差分信号波形を外部出力する信号処理部と、
を備えたことを特徴とする音声入力装置。
【請求項６】　テスト音信号を発生して前記遅延手段に入力する音源と、
該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする請求項５に記載の音声入力装置。
【請求項７】　装用者の外耳道に挿入され、外界と外耳道との間を遮音する装着部と、
外界に向けて設けられた第１のマイクと、
外耳道内に向けて設けられた第２のマイクと、
第１のマイクが受信した信号を時間軸に伸長する話速変換手段と、
遅延手段が遅延した信号を外耳道内に出力するレシーバと、
話速変換手段で伸長された第１のマイクの信号波形を、レシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出し、自己発話が検出されたとき、前記話速変換手段の動作を禁止する信号処理部と、
を備えたことを特徴とする補聴器。
【請求項８】　テスト音信号を発生して前記話速変換手段に入力する音源と、
該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする請求項７に記載の補聴器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、装用者が発した音声と外界から到来した音声とを識別する機能を備えた自己発話検出装置、音声入力装置および補聴器に関する。
【０００２】
【従来の技術】従来、装用者が自ら発声した音声である自己発話を外来の音声から分離識別して検出するための装置として骨伝導マイクを用いたものが実用化されている。
【０００３】骨伝導マイクは、装用者の外耳道に密着させた装着部を介して装用者の発声による頭蓋骨の振動を検出するものであり、空気振動である外来音には感度がなく、装用者の自己発話音のみをピックアップできるものである。
【０００４】
【発明が解決しようとする課題】しかし、骨伝導マイクは、自己発話音を感度よくピックアップするためには装着部と外耳道との密着性が要求される。このため、装着部の形状を各装用者の外耳道の形状に合わせる必要があり、本体が装着部に一体になったセル型のものの場合にはセル全体の交換が必要になるため、装用者毎のフィッティングが面倒であるという問題点があった。
【０００５】この発明は、より簡略な構成で自己発話を検出することができる自己発話検出装置、音声入力装置および補聴器を提供することを目的とする。
【０００６】
【課題を解決するための手段】この出願の請求項１の発明は、装用者の外耳道に挿入され外界と外耳道との間を遮音する装着部と、外界に向けて設けられた第１のマイクと、外耳道内に向けて設けられた第２のマイクと、第１のマイクの信号を所定時間遅延する遅延手段と、遅延手段が遅延した信号を外耳道内に出力するレシーバと、第１のマイクの信号波形と第２のマイクの信号波形との相関に基づいて装用者の自己発話を検出する信号処理部と、を備えたことを特徴とする。
【０００７】この出願の請求項２の発明は、請求項１の発明において、前記信号処理部は、第１のマイクの信号波形と第２のマイクの信号波形の差分を計算し、この差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出する処理部であることを特徴とする。
【０００８】この出願の請求項３の発明は、請求項１の発明において、前記信号処理部は、遅延手段で遅延された第１のマイクの信号波形を、レシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分を計算し、この差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出する処理部であることを特徴とする。
【０００９】この出願の請求項４の発明は、請求項３の発明において、テスト音信号を発生して前記遅延手段に入力する音源と、該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする。

【００１０】この出願の請求項５の発明は、装用者の外耳道に挿入され外界と外耳道との間を遮音する装着部と、外界に向けて設けられた第１のマイクと、外耳道内に向けて設けられた第２のマイクと、第１のマイクが受信した信号を所定時間遅延する遅延手段と、遅延手段が遅延した信号を外耳道内に出力するレシーバと、遅延手段で遅延された第１のマイクの信号波形をレシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分信号波形を抽出し、この差分信号波形を外部出力する信号処理部と、を備えたことを特徴とする。

【００１１】この出願の請求項６の発明は、請求項５の発明において、テスト音信号を発生して前記遅延手段に入力する音源と、該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする。

【００１２】この出願の請求項７の発明は、装用者の外耳道に挿入され外界と外耳道との間を遮音する装着部と、外界に向けて設けられた第１のマイクと、外耳道内に向けて設けられた第２のマイクと、第１のマイクが受信した信号を時間軸に伸長する話速変換手段と、遅延手段が遅延した信号を外耳道内に出力するレシーバと、話速変換手段で伸長された第１のマイクの信号波形をレシーバから第２のマイクに至る外耳道を含む伝搬路の伝達関数で畳み込み演算し、この畳込信号波形と第２のマイクの信号波形の差分信号波形と第１のマイクの信号波形との相関に基づいて装用者の自己発話を検出し、自己発話が検出されたとき前記話速変換手段の動作を禁止する信号処理部と、を備えたことを特徴とする。

【００１３】この出願の請求項８の発明は、請求項７の発明において、テスト音信号を発生して前記遅延手段に入力する音源と、該テスト音信号の直接波形およびレシーバから出力され第２のマイクによって受信されたテスト音信号の伝搬波形に基づいて前記伝搬路の伝達関数を割り出す手段を備えたことを特徴とする。

【００１４】この発明では、第２のマイクは自己発話音以外にレシーバから出力された外来音声も受信する。一方、第１のマイクは外来音声を受信する。第２のマイクの信号波形と第１の信号波形の相関をとることによって外来音声の成分をキャンセルすることにより、自己発話音成分のみを分離抽出することができる。なお、第１のマイクが受信する外来音声には口から発声された自己発話音も含まれるが同様の処理でよい。

【００１５】信号処理部はＤＳＰなどで構成することができるため、複雑な信号処理をする場合でも構造的には簡略なものにすることができる。

【００１６】したがって、この発明によれば、外界と外耳道とを遮音するのみの骨伝導マイクよりも遙に簡略な装着部の構成で自己発話音のみを分離抽出することができる。

【００１７】

【発明の実施の形態】図面を参照してこの発明の実施形態について説明する。図１は、この発明が適用される自己発話検出装置の外観図である。この自己発話検出装置は補聴器や音声入力装置に用いられる。セル１の先端に外耳道４に挿入される装着部である耳栓２が設けられている。耳栓２は傘形の柔軟な樹脂で構成されており、外耳道壁３に密着して外耳道４と外界とを遮断し、相互間の音の伝搬を禁止する。

【００１８】セル１内には、外界から到来する音声を検出するためのマイク５、外耳道４に音響を出力するためのレシーバ６、外耳道４の内部の音声を検出するためのマイク７、および、レシーバ６，マイク７とを空間的に結ぶパイプ孔８が設けられている。また、マイク５，レシーバ６およびマイク７は信号処理部９に接続されている。信号処理部９はＤＳＰなどの電子回路で構成され、マイク５，マイク７から入力された音声信号を分析・処理し、処理された音声信号をレシーバ６から出力する。以下、信号処理部９を種々に構成した例とその動作について説明する。

【００１９】図２は信号処理部９を遅延装置１０、相関演算装置１１、発話判定装置１２で構成した自己発話検出装置の例を示している。図２（Ａ）において、マイク５が受信した外来音声は、遅延装置１０および相関演算装置１１に入力される。遅延装置１０は入力された音声信号を微小時間ｔだけ遅延させてレシーバ６に出力する。レシーバ６はこの音声信号を音声（空気振動）に変換して外耳道４内に放出する。マイク７は、レシーバ６が出力した音声および外耳道４から伝達された装用者の音声の両方を受信する。マイク７が受信した音声信号は相関演算装置１１に入力される。相関演算装置１１は、マイク５から入力された音声信号とマイク７から入力された音声信号の相関値を計算する。

【００２０】図２（Ｂ）、（Ｃ）を参照して外来音声が到来したときの信号波形と相関について説明する。マイク５が外来音声を受信した時刻を０ｓｅｃとする。マイク５の入力であるｐｏｉｎｔＡ波形は、同図（Ｂ）上段のような波形となる。遅延装置１０はこの音声信号をｔｓｅｃ遅延させてレシーバ６に出力する。レシーバ６に供給される波形であるｐｏｉｎｔＢ波形は、ｐｏｉｎｔＡの波形をｔｓｅｃ遅延させた同図（Ｂ）中段のような波形となる。レシーバ６はこの遅延された音声信号を外耳道４に出力する。外耳道４に出力された音声はマイク７にも受信される。マイク７の入力であるｐｏｉｎｔＣ波形は、ｐｏｉｎｔＢ波形とほぼ同様の同図（Ｂ）下段のような波形となる。相関演算装置１１は、ｐｏｉｎｔＡの波形を基準波形とし、ｐｏｉｎｔＣの波形が基準波形にどの程度類似しているかを時系列に検査する装置であり、その相関の程度に比例した相関値を出力する。同

図（Ｃ）において、０ｓｅｃの時点では外耳道４内には音声信号がなくｐｏｉｎｔＣの波形はフラットであるので相関値は０であるが、時刻ｔにｐｏｉｎｔＣに遅延された音声の波形が現れるのでこの時刻ｔの相関値が最大となる。

【００２１】なお、同図（Ｂ），（Ｃ）は入力波形のレベルをモデル化した図であるが、実際には図８のような波形を示す。同図（Ａ）がｐｏｉｎｔＡの波形であり、同図（Ｂ）がｐｏｉｎｔＣの波形である。そして同図（Ｃ）が相関値である。このようにアナログ波形の場合、相関値はパルス状にはならないが、やはりｔｓｅｃ後にピーク値をとるように推移する。

【００２２】一方、図２（Ｄ）、（Ｅ）を参照して自己発話が行われたときの信号波形と相関について説明する。装用者が発声すると、その音声信号は口から外界に放出されるとともに体内伝搬経路によって外耳道４内にも伝搬する。外界に放出された音声はマイク５に受信され、外耳道４に伝搬した音声はマイク７に受信される。双方とも伝搬距離が極めて短いため、ほぼ同時（０ｓｅｃ）に受信される。したがって、時刻０ｓｅｃにマイク５の入力であるｐｏｉｎｔＡには同図（Ｄ）上段に示すような波形が現れ、マイク７にも時刻０ｓｅｃにｐｏｉｎｔＡ波形と類似した波形が現れる。また、ｐｏｉｎｔＡ波形は遅延装置１０でｔｓｅｃ遅延されたのち（ｐｏｉｎｔＢ波形）、レシーバ６から外耳道４に出力されるので、マイク７はこの音声も受信し、マイク７は、外耳道内に発生した装用者自身の音声とレシーバ６から出力される遅延された音声の両方を受信し、受信した波形であるｐｏｉｎｔＣ波形は同図（Ｄ）下段のような合成波形となる。時刻０ｓｅｃではポイントＡとポイントＣの波形はほぼ同様であるため、相関演算装置１１は、同図（Ｅ）のように時刻０ｓｅｃに高い相関値を出力する。

【００２３】なお、同図（Ｄ），（Ｅ）は入力波形のレベルをモデル化した図であるが、実際には図９のような波形を示す。同図（Ａ）がｐｏｉｎｔＡの波形であり、同図（Ｂ）がｐｏｉｎｔＣの波形である。そして同図（Ｃ）が相関値である。このようにアナログ波形の場合、相関値はパルス状にはならないが、やはり時刻０でピーク値をとり、徐々に減衰している。

【００２４】以上説明した相関値の相違に基づき、発話判定装置１２は、０ｓｅｃに相関値のピークが出力されたとき、その相関する波形は自己発話によるものと判定し、ｔｓｅｃ後に相関値のピークが出力されたとき、その波形は外来音声によるものと判定する。

【００２５】図３は信号処理部９を遅延装置１０、相関演算装置１１、発話判定装置１２および差分処理装置１３で構成した自己発話検出装置の例を示す。図３（Ａ）において、マイク５が受信した外来音声は遅延装置１０および相関演算装置１１に入力される。遅延装置１０は入力された音声信号をｔｓｅｃだけ遅延させてレシーバ６に出力する。レシーバ６はこの音声信号を音声（空気振動）に変換して外耳道４内に放出する。遅延装置１０が遅延した信号（ｐｏｉｎｔＢ）は差分処理装置１３にも入力される。一方、マイク７は、外耳道４内に発生した音声を受信して差分処理装置１３に入力する。マイク７は、レシーバ６が出力した音声および外耳道４から伝達された装用者の音声の両方を受信する。差分処理装置１３はマイク７から入力された音声信号波形から遅延装置１０がレシーバ６に出力したものと同じ音声信号波形を減算して外来音声成分をキャンセルする。この外来音声成分がキャンセルされた音声信号波形を相関演算装置１１に入力する。相関演算装置１１は、マイク５から入力された音声信号と差分処理装置１３から入力された音声信号の相関値を計算する。

【００２６】図３（Ｂ）、（Ｃ）を参照して外来音声が到来したときの信号波形と相関について説明する。マイク５が外来音声を受信した時刻を０ｓｅｃとする。マイク５の入力であるｐｏｉｎｔＡは、同図（Ｂ）第１段のような波形となる。遅延装置１０はこの音声信号をｔｓｅｃ遅延させてレシーバ６に出力する。レシーバ６に供給されるｐｏｉｎｔＢ波形は、ｐｏｉｎｔＡ波形をｔｓｅｃ遅延させたものであるため同図（Ｂ）第２段のような波形となる。レシーバ６はこの遅延された音声信号を外耳道４に出力する。外耳道４に出力された音声はマイク７にも受信される。マイク７の入力信号波形であるｐｏｉｎｔＣ波形は、ｐｏｉｎｔＢ波形とほぼ同様の同図（Ｂ）第３段のような波形となる。差分処理装置１３はマイク７から入力された音声信号波形であるｐｏｉｎｔＣ波形と遅延装置１０から入力された音声信号波形であるｐｏｉｎｔＢ波形とを減算する。外来音声のみの場合、内部で発生した音声信号がないため、ｐｏｉｎｔＢ波形とｐｏｉｎｔＣ波形はほとんど一致し、差分処理装置１３の出力であるｐｏｉｎｔＤ波形は、同図（Ｂ）第４段に示すように殆ど０レベルのフラットな信号となる。相関演算装置１１は、ｐｏｉｎｔＡの波形を基準波形とし、ｐｏｉｎｔＤの波形が基準波形にどの程度類似しているかを時系列に検査する装置であり、その相関の程度に比例した相関値を出力する。この例では、ｐｏｉｎｔＤの波形は殆どフラットであるためｐｏｉｎｔＡの基準波形と殆ど相関性がなく、大きな相関値が出力されない。発話判定装置１２は大きな相関値が入力されないことにより、自己発話がないことを判断する。

【００２７】一方、図３（Ｄ）、（Ｅ）を参照して自己発話が行われたときの信号波形と相関について説明する。装用者が発声すると、その音声信号は口から外界に放出されるとともに体内伝搬経路によって外耳道４内にも伝搬する。外界に放出された音声はマイク５に受信され、外耳道４に伝搬した音声はマイク７に受信される。双方とも伝搬距離が極めて短いため、ほぼ同時（０ｓｅｃ）に受信される。したがって、マイク５には時刻０ｓ

ｅｃにｐｏｉｎｔＡの波形が現れ、マイク７にも時刻０ｓｅｃにｐｏｉｎｔＡと類似した波形が現れる。また、ｐｏｉｎｔＡの波形は遅延装置１０でｔｓｅｃ遅延されたのちレシーバ６から外耳道４に放出されるので、マイク７はこの音声も受信する。すなわち、マイク７は、外耳道内に発生した装用者自身の音声とレシーバ６から放出される遅延された音声の両方を受信し、その合成波形は、同図（Ｄ）第３段に示すようなｐｏｉｎｔＣの波形となる。差分処理装置１３は、マイク７から入力された音声信号波形であるｐｏｉｎｔＣ波形と遅延装置１０から入力された音声信号波形であるｐｏｉｎｔＢ波形とを減算する。ｐｏｉｎｔＣ波形は、内部伝達した波形とレシーバ６から出力された音声波形の合成信号であるため、これからｐｏｉｎｔＢ波形を減算すると、レシーバ６から出力された外来音声の波形成分がキャンセルされ、同図（Ｂ）第４段に示すようにｐｏｉｎｔＡと類似した波形となる。相関演算装置１１は、ｐｏｉｎｔＡの波形を基準波形とし、ｐｏｉｎｔＤの波形が基準波形にどの程度類似しているかを時系列に検査する装置であり、その相関の程度に比例した相関値を出力する。この例では、ｐｏｉｎｔＤの波形は殆どｐｏｉｎｔＡの波形と一致しているため、０ｓｅｃのタイミングに大きな相関値が出力される。発話判定装置１２は、大きな相関値が入力されたことにより、０ｓｅｃのタイミングに開始した自己発話があったことを判断する。このように、図３の例では、差分処理装置１３によって余分な信号を排除しているので相関値が改善され誤り判定の減少が期待できる。

【００２８】図２，図３の例は、信号経路が理想的で経路の周波数特性や位相特性の影響がほとんど無い場合について説明したが、信号経路の伝搬特性が音声信号の波形に影響を与える場合を考慮した例を図４に示す。

【００２９】図４の例では、信号処理部９を遅延装置１０、相関演算装置１１、発話判定装置１２、差分処理装置１３に加えて伝達関数補正装置１４で構成している。

【００３０】図４（Ａ）において、マイク５が受信した外来音声は遅延装置１０および相関演算装置１１に入力される。遅延装置１０は入力された音声信号をｔｓｅｃだけ遅延させてレシーバ６に出力する。レシーバ６はこの音声信号を音声（空気振動）に変換して外耳道４内に放出する。遅延装置１０が遅延したｐｏｉｎｔＢ波形は伝達関数補正装置１４にも入力される。伝達関数補正装置１４は入力された信号をフィルタ処理して差分処理装置１３に入力する。このフィルタは、この装置が外耳道４に挿入されているときの外耳道４のインパルス応答をシミュレートしたフィルタであり、このフィルタを通過した信号が外耳道４内を伝搬した信号と同じ波形になるように設計されている。すなわち、このフィルタを通過させることにより、信号波形に対して伝搬路の伝達関数が畳み込み演算される。

【００３１】一方、マイク７は、外耳道４内に発生した音声を受信して差分処理装置１３に入力する。マイク７は、レシーバ６が出力した音声および外耳道４から伝達された装用者の音声の両方を受信する。差分処理装置１３はマイク７から入力された音声信号波形から伝達関数補正装置１４から入力された音声信号波形を減算してこの成分をキャンセルする。このレシーバ６の出力分がキャンセルされた音声信号波形を相関演算装置１１に入力する。相関演算装置１１は、マイク５から入力された音声信号と差分処理装置１３から入力された音声信号の相関値を計算する。

【００３２】図４（Ｂ）を参照して外来音声が到来したときの信号波形と相関について説明する。マイク５が外来音声を受信した時刻を０ｓｅｃとする。マイク５の入力であるｐｏｉｎｔＡは、同図（Ｂ）第１段のような波形となる。遅延装置１０はこの音声信号をｔｓｅｃ遅延させてレシーバ６に出力する。レシーバ６にされる波形であるｐｏｉｎｔＢは、ｐｏｉｎｔＡの波形をｔｓｅｃ遅延させた同図（Ｂ）第２段のような波形となる。レシーバ６はこの遅延された音声信号を外耳道４に出力する。外耳道４に出力された音声はマイク７にも受信される。マイク７の入力であるｐｏｉｎｔＣは、ｐｏｉｎｔＢとタイミングはほぼ同じであるが、外耳道４を伝搬したことによって遅延成分が重畳されており同図（Ｂ）第３段のような波形となる。差分処理装置１３には、遅延装置１０から出力されるｐｏｉｎｔＢ波形を伝達関数補正装置１４で補正した波形が入力されるため、この波形をマイク７から入力された音声信号波形であるｐｏｉｎｔＣから減算する。ｐｏｉｎｔＢの波形を伝達関数補正装置１４で補正したものはほぼｐｏｉｎｔＣの波形と同じになっているため、これらの波形はほとんど一致し差分処理装置１３の出力であるｐｏｉｎｔＥ波形は、同図（Ｂ）第５段に示すように殆ど０レベルのフラットな信号となる。相関演算装置１１は、ｐｏｉｎｔＡの波形を基準波形とし、ｐｏｉｎｔＥの波形が基準波形にどの程度類似しているかを時系列に検査する装置であり、その相関の程度に比例した相関値を出力する。この例では、ｐｏｉｎｔＥの波形は殆どフラットであるためｐｏｉｎｔＡの基準波形と殆ど相関性がなく、大きな相関値が出力されない。発話判定装置１２は大きな相関値が入力されないことにより、自己発話がないことを判断する。

【００３３】一方、図４（Ｃ）を参照して自己発話が行われたときの信号波形と相関について説明する。装用者が発声すると、その音声信号は口から外界に放出されるとともに体内伝搬経路によって外耳道４内にも伝搬する。外界に放出された音声はマイク５に受信され、外耳道４に伝搬した音声はマイク７に受信される。双方とも伝搬距離が極めて短いため、ほぼ同時（０ｓｅｃ）に受信される。したがって、マイク５には時刻０ｓｅｃにｐｏｉｎｔＡの波形が現れ、マイク７にも時刻０ｓｅｃに

ｐｏｉｎｔＡ波形と類似した波形が現れる。また、ｐｏｉｎｔＡの波形は遅延装置１０でｔｓｅｃ遅延されたのちレシーバ６から外耳道４に放出されるので、マイク７はこの音声も受信する。レシーバ６から放出されマイク７が受信する信号は外耳道４を伝搬して入力される信号であるため、外耳道４による残響音成分が重畳されたものになっている。このためマイク７が受信する自己発話の直接音とレシーバ６から出力された音の合成波形は、同図（Ｃ）第３段に示すｐｏｉｎｔＣ波形となる。レシーバ６から放出され外耳道４を伝搬した音声信号は、上述したように外耳道４の伝搬特性によって残響分が重畳されているため、波形の立ち上がりと立ち下がりが緩やかになっている。伝達関数補正装置１４から出力された波形も外耳道４の伝達特性をフィルタ係数として有するフィルタを通過したものであるため、同じような残響成分が重畳されており、この信号をマイク７の入力信号から減算することにより、自己発話音のみを分離することができる（ｐｏｉｎｔＥ波形）。

【００３４】相関演算装置１１は、ｐｏｉｎｔＡの波形を基準波形とし、ｐｏｉｎｔＤの波形が基準波形にどの程度類似しているかを時系列に検査する装置であり、その相関の程度に比例した相関値を出力する。この例では、ｐｏｉｎｔＤの波形は殆どｐｏｉｎｔＡの波形と一致しているため、０ｓｅｃのタイミングに大きな相関値が出力される。発話判定装置１２は、大きな相関値が入力されたことにより、０ｓｅｃのタイミングに開始した自己発話があったことを判断する。

【００３５】なお、図４（Ａ）において、差分処理装置１３の出力をそのまま取り出せば自己発話検出マイクとして機能させることができる。

【００３６】なお、図４（Ａ）の装置では、伝達関数補正装置１４を遅延装置１０と差分処理装置１３の間に挿入したが、図５のように、マイク７と差分処理装置１３の間におくこともできる。この場合、伝達関数が外耳道内に発生した自己発話音声にも畳み込まれてしまうので、差分処理後自己発話音の波形をもとに戻す伝達関数修正装置を差分処理装置１４と相関演算装置１１との間に設ける。

【００３７】なお、図３および図４の例において、相関演算装置１１は、同時に発生する２つの音声信号波形を比較するのみであるため、単純な比較演算装置でもよい。さらに、図４，図５の遅延装置１０は、ディジタル的に信号を遅延させる信号処理装置であってもよい。

【００３８】図６は、この発明を通信端末の音声入出力装置に適用した実施形態を示す図である。この装置を制御する制御装置３０は伝達関数演算モードと通常動作モードで装置を制御する。指示装置３３は装用者がこの装置のオン／オフを制御装置３０に指示するためのスイッチを含んでいる。

【００３９】図６において、図１および図４（Ａ）のマイク５－遅延装置１０－レシーバ６の系統として、マイク５（この装置も外観は図１のものと同様である：以下同じ）、増幅器３６、Ａ／Ｄ変換器３７、遅延装置３８、Ｄ／Ａ変換器３９、増幅器４０およびレシーバ６が設けられている。また、図１および図４（Ａ）のマイク７の系統として、マイク７－増幅器４１、Ａ／Ｄ変換器４２が設けられている。また、図４（Ａ）の伝達関数補正装置１４、差分処理装置１３、比較演算装置１１の機能は、制御装置３０および演算処理装置３５がソフト的に実現する。また、この装置は、外耳道４の伝達関数を割り出す伝達関数演算モードにテスト音信号を発生するための音源３４を内蔵している。この音源３４が形成したオーディオ信号は、テスト音信号としてマイク５の入力に変えてＡ／Ｄ変換器３７に入力される。

【００４０】指示装置３３によってオンが指示されると、制御部３０は最初に伝達関数モードを設定し、制御装置３０は音源３４をオンするとともに、演算処理装置３５に伝達関数演算動作を指示する。音源３４が形成するテスト音信号は、ホワイトノイズやピンクノイズでよいが、他の信号、例えばインパルスや周波数の定まった低周波信号の波形を形成するようにしてもよい。音源３４から出力されたテスト音信号はＡ／Ｄ変換器３７、遅延装置３８、Ｄ／Ａ変換器３９、増幅器４０、レシーバ６を経て外耳道４内に放出される。外耳道４内に放出されたテスト音は外耳道４に向けて設けられたマイク７で検出される。マイク７の出力は増幅器４１、Ａ／Ｄ変換器４２を経て演算処理装置３５に入力される。演算処理装置３５はＤＳＰなどで構成すればよい。一方、この演算処理装置３５には、Ａ／Ｄ変換器３７から音源３４が形成したテスト音信号をディジタル信号に変換したものも供給される。演算処理装置３５は、伝達関数演算動作として、ｐｏｉｎｔＡ信号（Ａ／Ｄ変換器３７から入力される信号）およびｐｏｉｎｔＢ信号（Ａ／Ｄ変換器４２から入力される信号）を比較し、これらの信号の相違に応じた補正係数を算出する。補正係数を求める手法は色々あるが例えば下式のようにｐｏｉｎｔＡ信号をＡ（ｋ）、ｐｏｉｎｔＢ信号をＢ（ｋ）とし、Ａ（ｋ）とＢ（ｋ）間の誤差Ｅ（ｋ）がゼロになるような関数Ｇ（ｋ）を求める。

【００４１】Ｇ（ｋ）・Ａ（ｋ）－Ｂ（ｋ）＝Ｅ（ｋ）

一度求めた関数Ｇ（ｋ）は装置を外耳道から取り外したりしなければ、比較的安定した状態にあるので、動作の最初に計算するのみでよい。演算が終了すると演算処理装置３５は待機状態になる。制御装置３０は演算処理装置３５が待機状態になったことを検出すると、音源３４を停止するとともに、演算処理装置３５に信号処理動作を指示して通常動作モードに切り換える。

【００４２】通常動作モードにおいて、マイク５から外来音声が入力されると、増幅器３６、Ａ／Ｄ変換器３７、遅延装置３８、Ｄ／Ａ変換器３９、増幅器４０を経

て、ｔｓｅｃ後にレシーバ６から外耳道４に出力される。外耳道４に出力された外来音声は外耳道４に向けて設けられたマイク７によって受信され、増幅器４１、Ａ／Ｄ変換器４２を経て演算処理装置３５に入力される。信号処理動作が設定されている演算処理装置３５は、Ａ／Ｄ変換器３７から入力されるｐｏｉｎｔＡ信号、すなわち直接の外来音声信号に上記で求めた伝達関数Ｇ（ｋ）を畳み込んだのち、ｐｏｉｎｔＢ信号、すなわち外耳道４を伝達した外来音声信号を含む信号と差演算処理を行う。この処理によってｐｏｉｎｔＢ信号から外来音声成分は消去され自己発話音声のみが抽出される。抽出された自己発話音声を通信装置の音声入力端子に接続すれば環境雑音が大きな場所でも雑音の少ない音声信号のみをピックアップして相手に送ることができる。

【００４３】なお、上記例では、参照信号としてＡ／Ｄ変換器３７の出力（ｐｏｉｎｔＡ信号）を演算処理装置３５に入力しているが、遅延装置３８の出力を入力するようにしてもよい。

【００４４】図７はこの発明を話速変換機能をもった補聴器に適用した実施形態を示す図である。この装置を制御する制御装置５０は伝達関数演算モードと通常動作モードで装置を制御する。指示装置５３は装用者がこの装置のオン／オフを制御装置５０に指示するためのスイッチを含んでいる。

【００４５】図７において、図１および図４（Ａ）のマイク５－遅延装置１０－レシーバ６の系統として、マイク５（この装置も外観は図１のものと同様である：以下同じ）、増幅器５６、Ａ／Ｄ変換器５７、話速変換・利得制御装置５８、Ｄ／Ａ変換器５９、増幅器６０およびレシーバ６が設けられている。また、図１および図４（Ａ）のマイク７の系統として、マイク７－増幅器６１、Ａ／Ｄ変換器６２が設けられている。また、図４（Ａ）の伝達関数補正装置１４、差分処理装置１３、比較演算装置１１の機能は、制御装置５０および演算処理装置５５がソフト的に実現する。また、この装置は、外耳道４の伝達関数を割り出す伝達関数演算モードにテスト音信号を発生するための音源５４を内蔵している。この音源５４が形成したオーディオ信号は、外部に向けて設けられたレシーバ９によって出力され、マイク５によって受信される。

【００４６】指示装置５３によってオンが指示されると、制御部５０は最初に伝達関数モードを設定し、制御装置５０は音源５４をオンするとともに、演算処理装置５５に伝達関数演算動作を指示する。音源５４が形成するテスト音信号は、ホワイトノイズやピンクノイズでよいが、他の信号、例えばインパルスや周波数の定まった低周波信号の波形を形成するようにしてもよい。音源５４から出力されたテスト音信号は、レシーバ９から出力され、マイク５で受信・電気信号に変換されたのち、Ａ／Ｄ変換器５７、話速変換・利得制御装置５８、Ｄ／Ａ変換器５９、増幅器６０、レシーバ６を経て外耳道４内に放出される。外耳道４内に放出されたテスト音は外耳道４に向けて設けられたマイク７で検出される。マイク７の出力は増幅器６１、Ａ／Ｄ変換器６２を経て演算処理装置５５に入力される。演算処理装置５５はＤＳＰなどで構成すればよい。一方、この演算処理装置５５には、話速変換・利得制御装置５８から音源５４が形成し、レシーバ９から出力されたテスト音信号を話速変換したものも供給される。演算処理装置３５は、伝達関数演算動作として、ｐｏｉｎｔＣ信号（話速変換・利得制御装置５８から入力される信号）およびｐｏｉｎｔＢ信号（Ａ／Ｄ変換器６２から入力される信号）を比較し、これらの信号の相違に応じた補正係数を算出する。補正係数を求める手法は色々あるが例えば下式のようにｐｏｉｎｔＡ信号をＡ（ｋ）、ｐｏｉｎｔＢ信号をＢ（ｋ）とし、Ａ（ｋ）とＢ（ｋ）間の誤差Ｅ（ｋ）がゼロになるような関数Ｇ（ｋ）を求める。

【００４７】Ｇ（ｋ）・Ａ（ｋ）－Ｂ（ｋ）＝Ｅ（ｋ）

一度求めた関数Ｇ（ｋ）は装置を外耳道から取り外したりしなければ、比較的安定した状態にあるので、動作の最初に計算するのみでよい。演算が終了すると演算処理装置５５は待機状態になる。制御装置５０は演算処理装置５５が待機状態になったことを検出すると、音源５４を停止するとともに、演算処理装置５５に信号処理動作を指示して通常動作モードに切り換える。

【００４８】通常動作モードにおいて、マイク５から外来音声が入力されると、増幅器５６、Ａ／Ｄ変換器５７、話速変換・利得制御装置５８、Ｄ／Ａ変換器５９、増幅器６０を経て、ｔｓｅｃ後にレシーバ６から外耳道４に出力される。外耳道４に出力された外来音声は外耳道４に向けて設けられたマイク７によって受信され、増幅器６１、Ａ／Ｄ変換器６２を経て演算処理装置５５に入力される。信号処理動作が設定されている演算処理装置５５は、話速変換・利得制御装置５８から入力されるｐｏｉｎｔＣ信号、すなわち直接の外来音声信号に上記で求めた伝達関数Ｇ（ｋ）を畳み込んだのち、ｐｏｉｎｔＢ信号、すなわち外耳道４を伝達した外来音声信号を含む信号と差演算処理を行う。この処理によってｐｏｉｎｔＢ信号から外来音声成分は消去され自己発話音声成分のみが抽出される。マイク５が外来音声のみを受信しているときは、この自己発話音声成分は０であるが、自己発話しているときには、そのレベルの成分が抽出される。制御装置５０は演算処理装置５５が自己発話音声成分を抽出したとき、話速変換・利得制御装置５８に対して話速変換を禁止し、利得を小さめに制御する。これにより、自己発話に対する話速変換が禁止され、自己発話が滑らかに行われるようになる。

【００４９】なお、上記例では、参照信号としてＡ／Ｄ変換器５７の出力（ｐｏｉｎｔＡ信号）を演算処理装置５５にも入力するようにすればよい。

【００５０】これにより、話速変換は外来音声に作用させたいが、自分の発声音声には作用させたくない。自分が発話するとき、人は自分の声を聞きながら発声を制御しているため、発声音声が遅れて聞こえるとうまく話せないという問題が起こる。そのため、自己発話に対しては、発話区間を検出して話速変換処理を適応しないようにする必要がある。また外来音声に比べ、自己発話音声は大きく聞こえるので適当な大きさになるよう利得制御が必要となる。

【００５１】このように、簡略な構成で自己発話と外来音とを分離することができるため、話速変換補聴器にこれを用いた場合に、装用者の外耳道の形状にかかわらず同じセルでこれを使用することができる。

【００５２】

【発明の効果】この発明によれば、外耳道に向けて設けられた第２のマイクの入力信号から外来音声信号をキャンセルして自己発話音のみを抽出できるようにしたことにより、構造が複雑で装用者毎のセッティングが微妙な骨伝導マイクを用いなくても環境ノイズなどの外来音声を除去した自己発話音声のみを抽出処理することができる。

【００５３】また、これを補聴器にもちいれば自己発話音声の区間のみ話速変換を禁止し、発話が容易な補聴器を構成することができる。

【図面の簡単な説明】

【図１】この発明の実施形態である自己発話検出装置の外観図

【図２】請求項１の発明の実施形態である自己発話検出装置のブロック図および信号波形を示す図

【図３】請求項２の発明の実施形態である自己発話検出装置のブロック図および信号波形を示す図

【図４】請求項３の発明の実施形態である自己発話検出装置のブロック図および信号波形を示す図

【図５】道自己発話検出装置の他の実施形態を示す図

【図６】請求項４の発明の実施形態である音声入力装置のブロック図号波形を示す図

【図７】この発明の自己発話検出装置を補聴器に応用した例を示す図

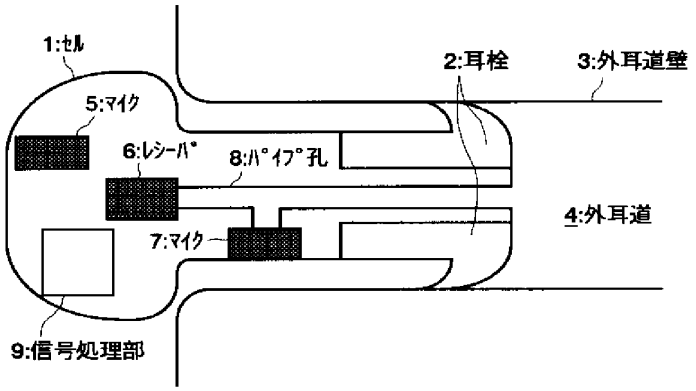
【図８】自己発話検出装置の各部における信号波形の例を示す図

【図９】自己発話検出装置の各部における信号波形の例を示す図

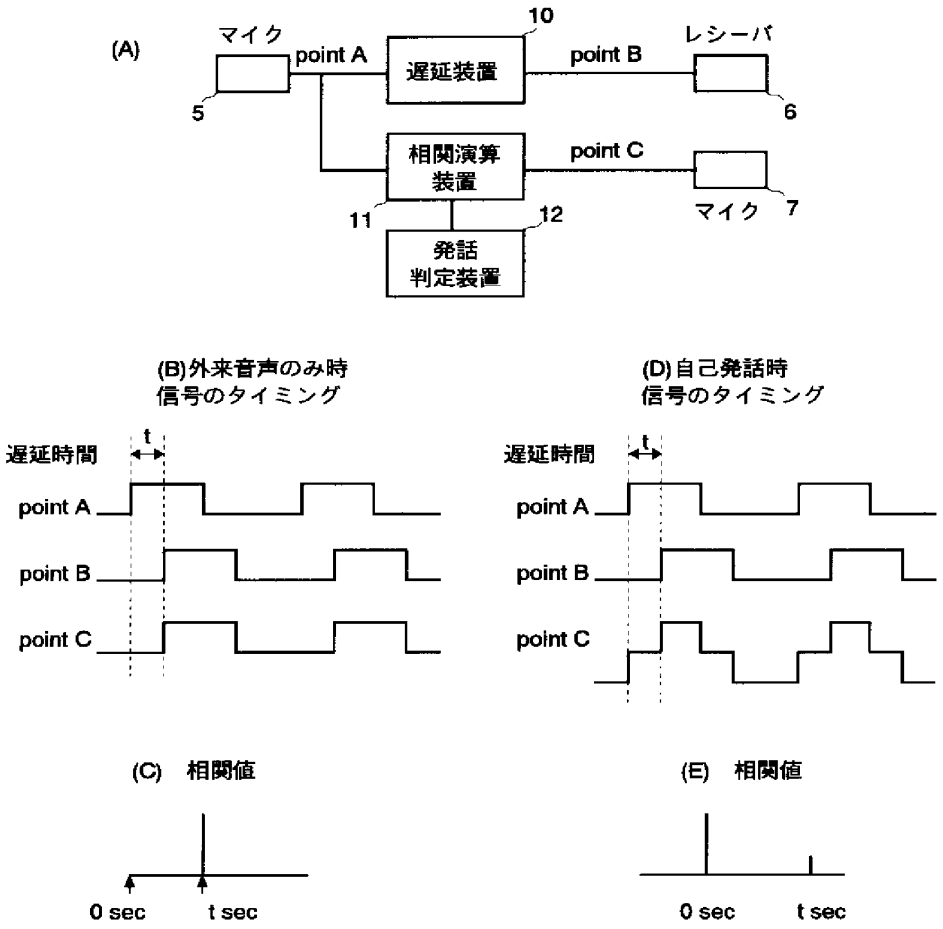
【符号の説明】

１…セル、２…耳栓、３…外耳道壁、４…外耳道、５…（外界に向けられた）マイク、６…レシーバ、７…（外耳道に向けられた）マイク、８…パイプ孔、９…信号処理部、１０…遅延装置、１１…相関演算装置、１２…発話判定装置、１３…差分処理装置、１４…伝達関数補正装置、

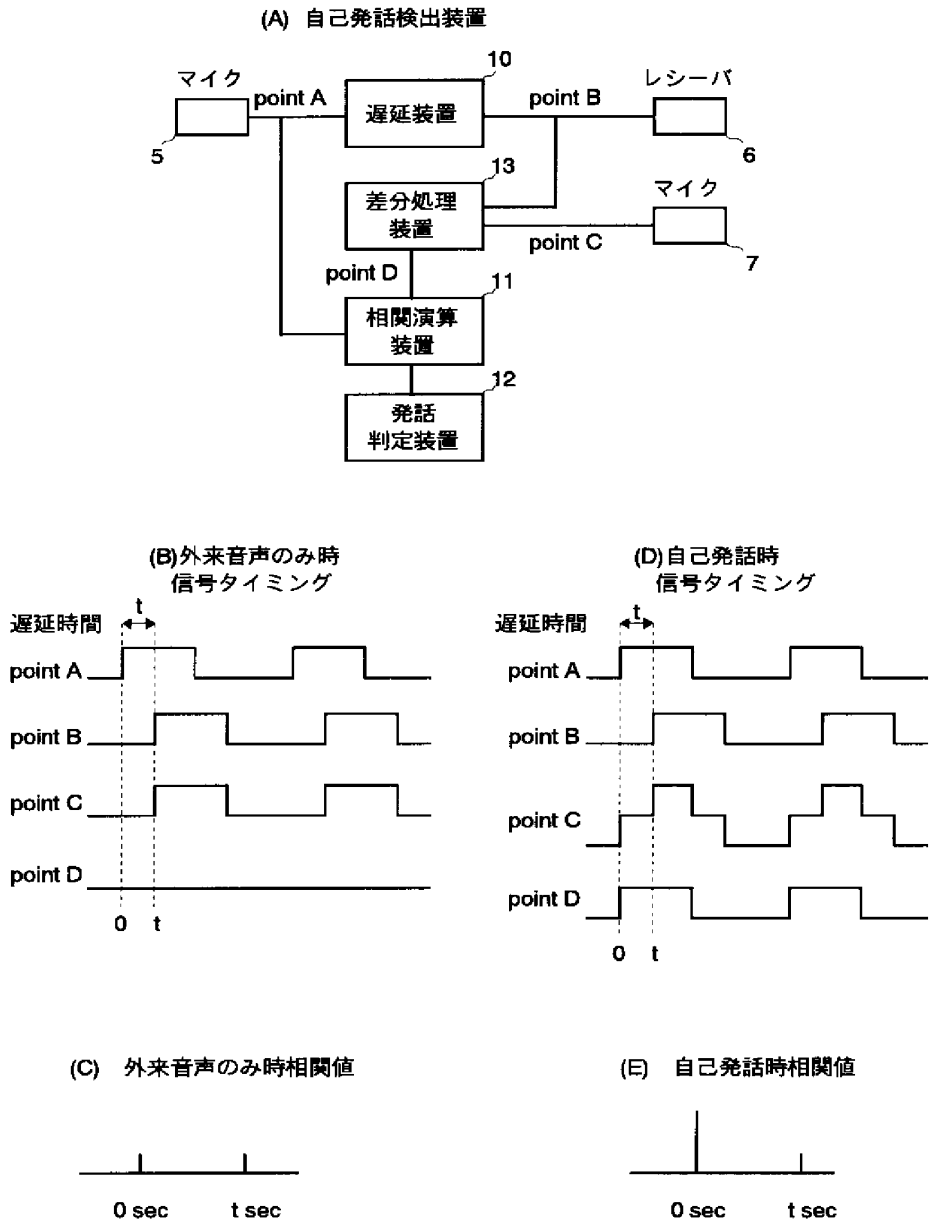
【図１】



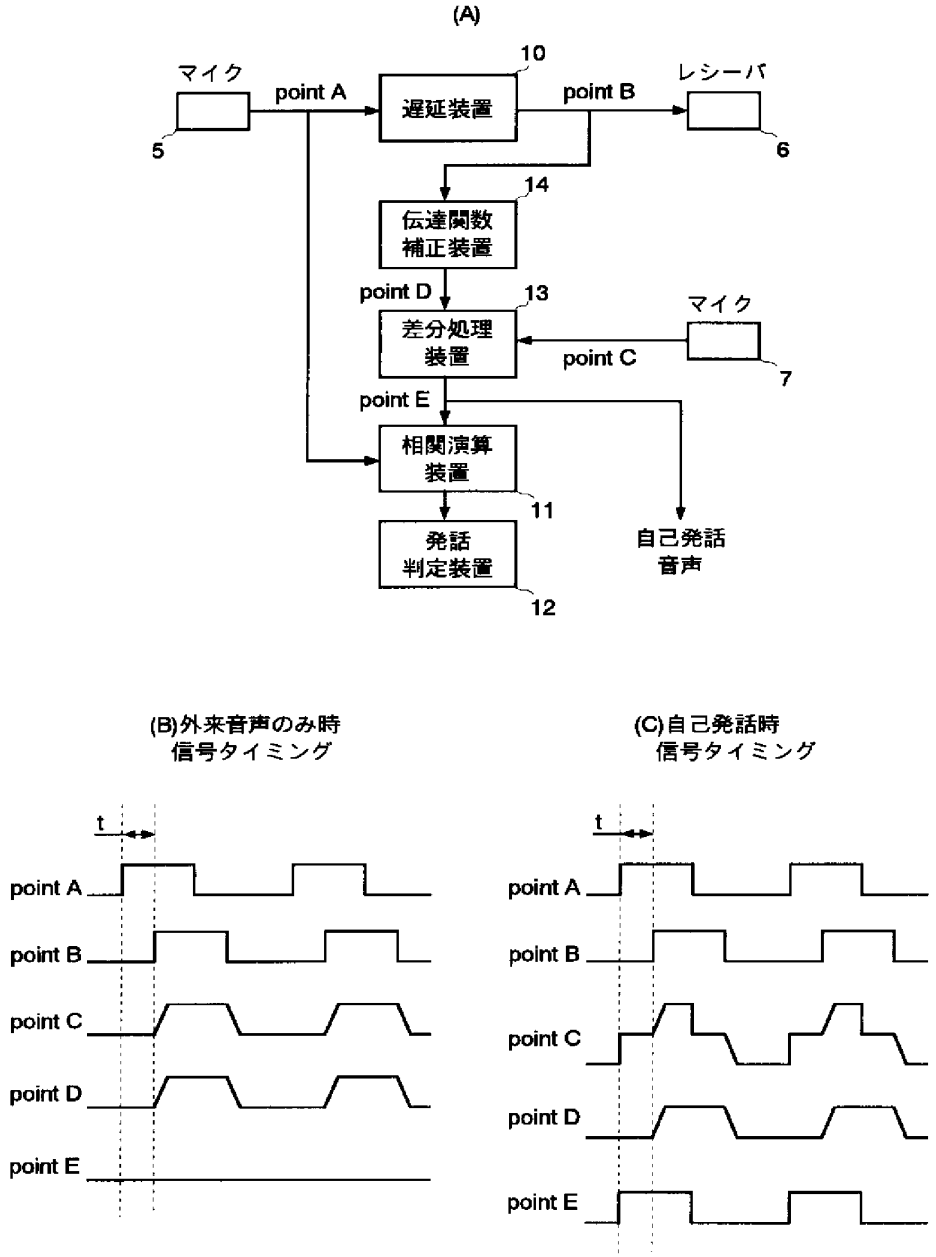
【図２】


(A)
マイク
point A
遅延装置
10
point B
レシーバ
5
6
相関演算
装置
point C
マイク
7
11
12
発話
判定装置
(B)外来音声のみ時
信号のタイミング
遅延時間
t
point A
point B
point C
(D)自己発話時
信号のタイミング
遅延時間
t
point A
point B
point C
(C)　相関値
0 sec
t sec
(E)　相関値
0 sec
t sec

【図３】

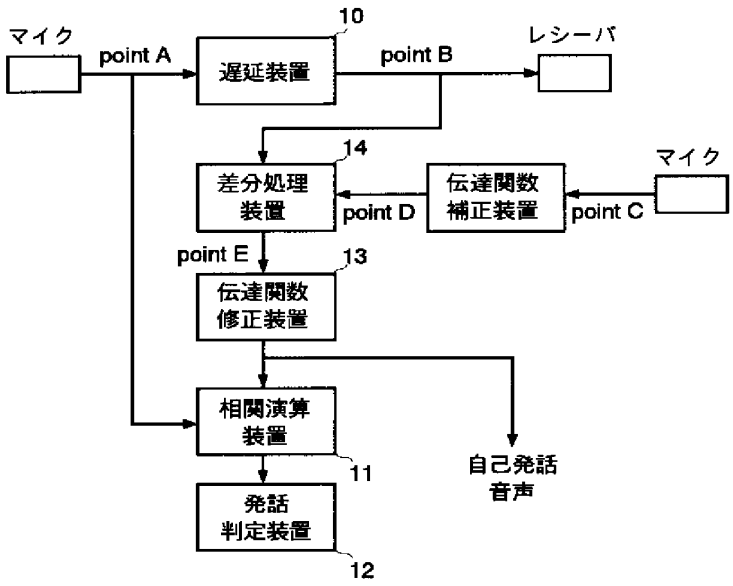

(A) 自己発話検出装置
マイク
point A
遅延装置
10
point B
レシーバ
5
6
差分処理装置
13
マイク
point C
7
point D
11
相関演算装置
12
発話判定装置
(B)外来音声のみ時 信号タイミング
遅延時間
t
point A
point B
point C
point D
0
t
(D)自己発話時 信号タイミング
遅延時間
t
point A
point B
point C
point D
0
t
(C) 外来音声のみ時相関値
0 sec
t sec
(E) 自己発話時相関値
0 sec
t sec

【図４】

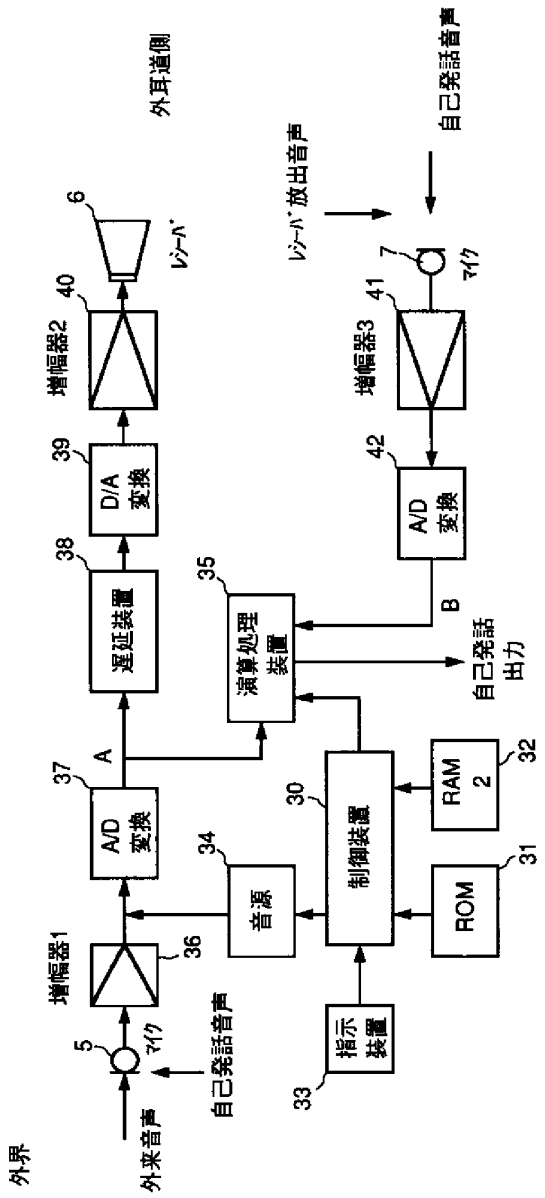

(A)
マイク
point A
10
遅延装置
point B
レシーバ
5
6
14
伝達関数
補正装置
point D
13
差分処理
装置
マイク
point C
7
point E
相関演算
装置
11
発話
判定装置
12
自己発話
音声
(B)外来音声のみ時
信号タイミング
t
point A
point B
point C
point D
point E
(C)自己発話時
信号タイミング
t
point A
point B
point C
point D
point E

【図５】

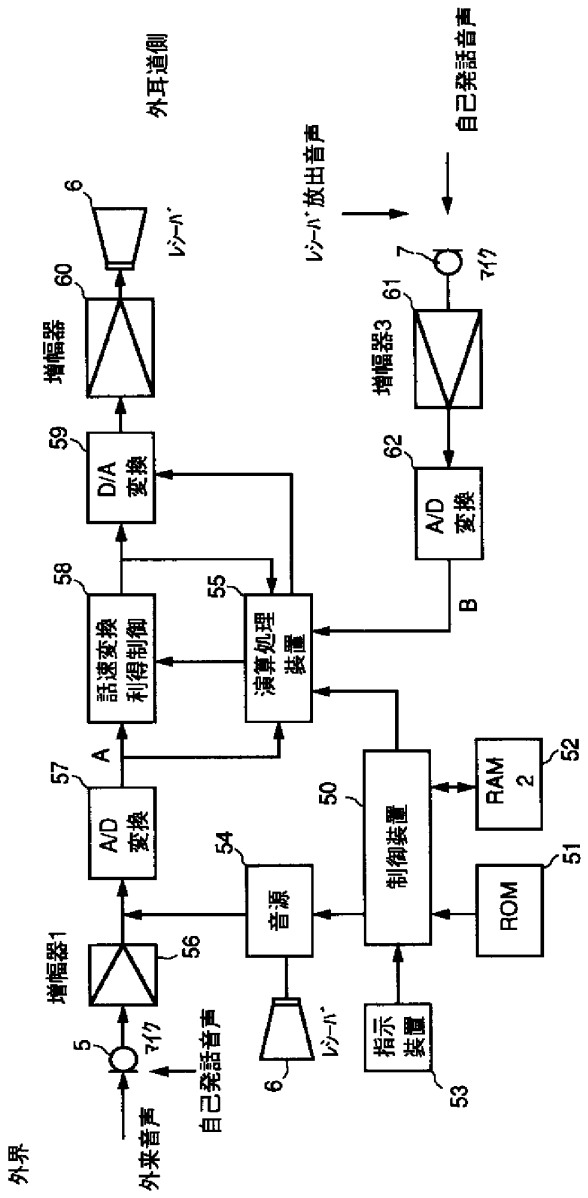
】


マイク
point A
10
遅延装置
point B
レシーバ
14
差分処理
装置
伝達関数
補正装置
マイク
point D
point C
point E
13
伝達関数
修正装置
相関演算
装置
11
自己発話
音声
発話
判定装置
12

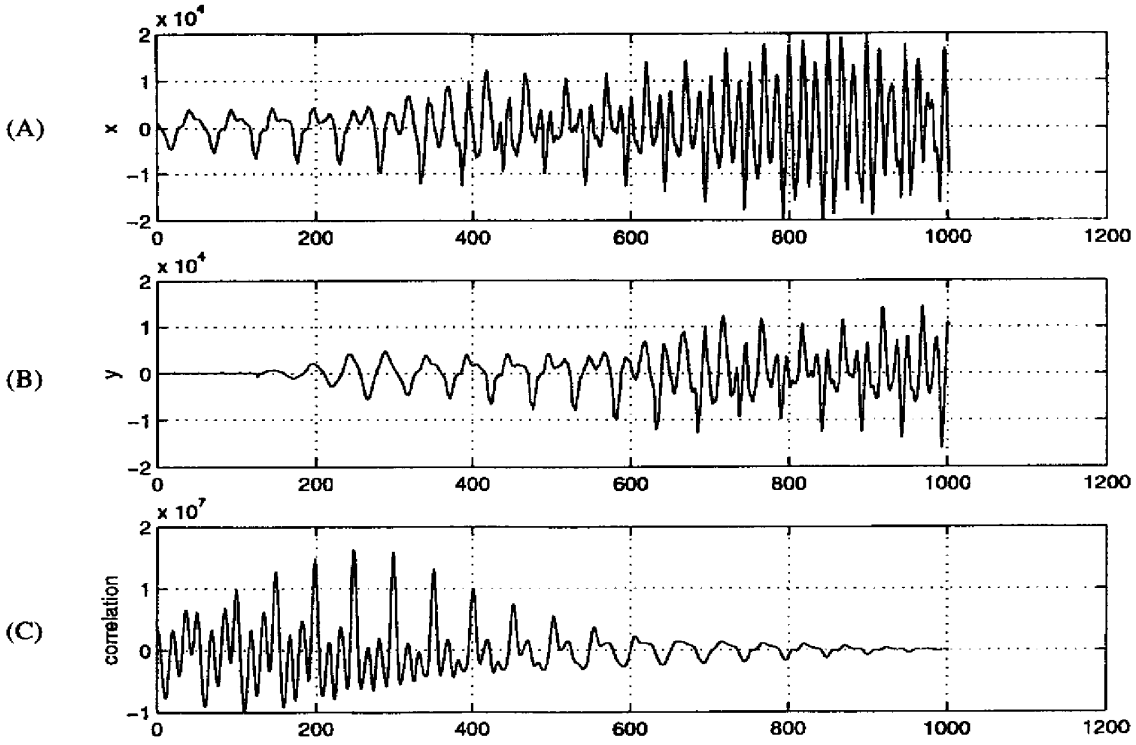
【図６】


外界
外来音声
5
マイク
自己発話音声
増幅器1
36
A/D 変換
37
A
遅延装置
38
D/A 変換
39
増幅器2
40
6
レシーバ
外耳道側
レシーバ放出音声
自己発話音声
7
マイク
増幅器3
41
A/D 変換
42
B
演算処理装置
35
自己発話出力
音源
34
制御装置
30
ROM
31
RAM 2
32
指示装置
33

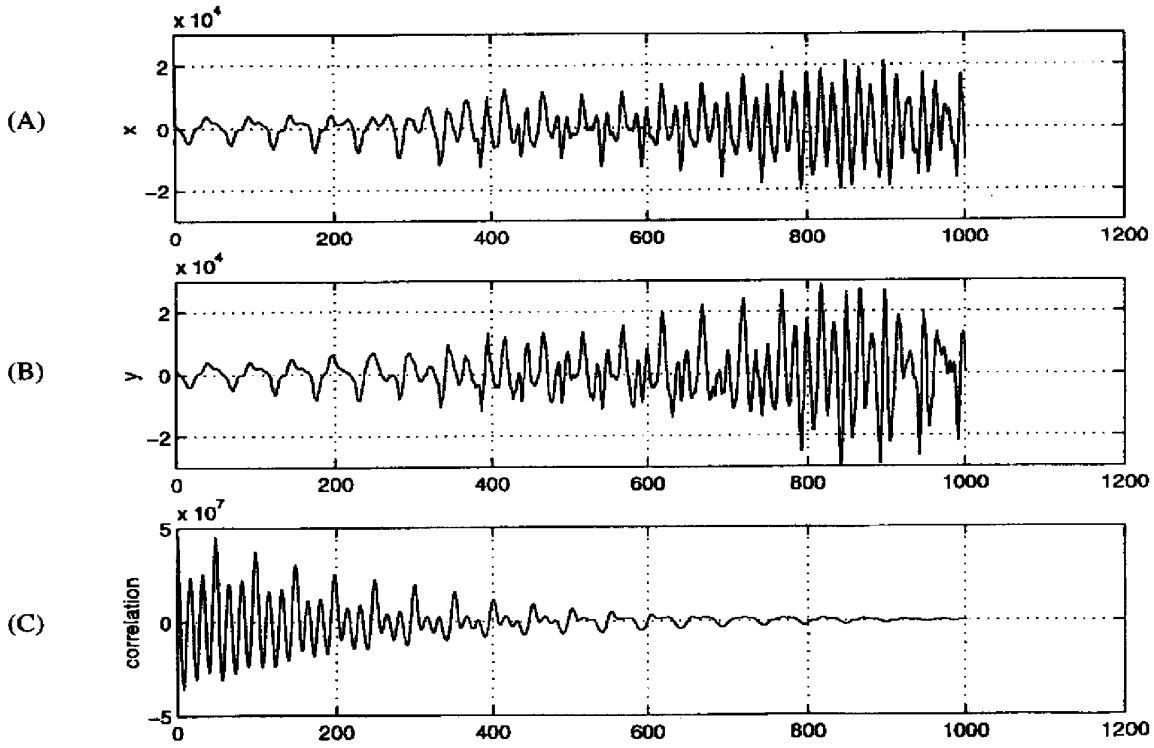
【図７】


外界
外来音声
5
マイク
自己発話音声
増幅器1
56
A/D 変換
57
A
話速変換利得制御
58
D/A 変換
59
増幅器
60
6
レシーバ
外耳道側
レシーバ放出音声
自己発話音声
7
マイク
増幅器3
61
A/D 変換
62
B
演算処理装置
55
音源
54
制御装置
50
ROM
51
RAM 2
52
指示装置
53

【図８】


(A)
x 10^4
x
2
1
0
−1
−2
0
200
400
600
800
1000
1200
(B)
x 10^4
y
2
1
0
−1
−2
0
200
400
600
800
1000
1200
(C)
x 10^7
correlation
2
1
0
−1
0
200
400
600
800
1000
1200

【図９】



フロントページの続き

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特開　平１－93298（ＪＰ，Ａ）
特表　平８－502396（ＪＰ，Ａ）

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H04R　25/00
H04R　3/00

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/215,804	Filing Date 03/29/2021	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	04/07/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 11	Minus	** 20	= 0		x $40 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $192 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ALLYSON PURNELL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE
COMMISSIONER FOR PATENTS
P.O.BOX 1450
ALEXANDRIA VA 22313-1451

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Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

Courtesy Reminder for
Application Serial No: 17/215,804

Attorney Docket No:
11472-39-5_CONT2-16247186
Customer Number: 150139
Date of Electronic Notification: 02/23/2023

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:

personics_docketing@cardinal-ip.com
jp.keady@techiya.co
ip@akerman.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

150139 7590 02/21/2023

Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

EXAMINER
LAO, LUNSEE

ART UNIT	PAPER NUMBER
2651	

DATE MAILED: 02/21/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/215,804	03/29/2021	Steven Wayne Goldstein	11472-39-5_CONT2-16247186	9372

TITLE OF INVENTION: METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0.00	$0.00	$480	05/22/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

150139 7590 02/21/2023
Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/215,804	03/29/2021	Steven Wayne Goldstein	11472-39-5_CONT2-16247186	9372

TITLE OF INVENTION: METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0.00	$0.00	$480	05/22/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
LAO, LUNSEE	2651	381-066000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/215,804	03/29/2021	Steven Wayne Goldstein	11472-39-5_CONT2-16247186	9372

150139 7590 02/21/2023

Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

EXAMINER	
LAO, LUNSEE	
ART UNIT	**PAPER NUMBER**
2651	

DATE MAILED: 02/21/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/215,804	Applicant(s) Goldstein et al.	
	Examiner LUNSEE LAO	Art Unit 2651	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 01-06-2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1,3-6,9-13 and 15 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/LUN-SEE LAO/
Primary Examiner, Art Unit 2651

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Introduction

2. This action responds to the amendment filed on 01-06-2023. Claims 1, 6 and 10-13 have been amended and claims 2, 7, 8, and 14 cancelled and claim 15 has been added. Claims 1, 3-6 9-13 and 15 are pending.

Allowable Subject Matter

3. Claims 1, 3-6 9-13 and 15 are allowed over prior art record.

4. The following is an examiner's statement of reasons for allowance:

The amendment filed on 01-06-2023 have been carefully reviewed with updated search. Consequently, reasons for allowance of Claims 1, 3-6 9-13 and 15 are set forth in according to the applicant's amendment state on pages 7-14.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Yang et al. (US 2019/0227767) is cited to show other related the METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION.

EXAMINER'S COMMENT

6. Applicant should note that this application is co-pending with US number US 2021/0211801 and since it appears that this application may issue first, applicant should take care to address any double-patenting issues that may remain in the 11/215,804 application.

7. Any response to this action should be mailed to:

Mail Stop ____(explanation, e.g., Amendment or After-final, etc.)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Facsimile responses should be faxed to:
(571) 273-8300

Hand-delivered responses should be brought to:
Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lao,Lun-See whose telephone number is (571) 272-7501 The examiner can normally be reached on Monday-Friday from 8:00 to 5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nguyen Duc M(SPE), can be reached on (571) 272-7503.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center 2600 whose telephone number is (571) 272-2600.

/LUN-SEE LAO/
Primary Examiner, Art Unit 2651
US Patent and Trademark Office
Knox
571-272-7501
Date 02-03-2023

Notice of References Cited	Application/Control No. 17/215,804	Applicant(s)/Patent Under Reexamination Goldstein et al.	
	Examiner LUNSEE LAO	Art Unit 2651	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20190227767-A1	07-2019	Yang; Lin	H04M1/725	1/1
*	B	US-20210211801-A1	07-2021	Perez; Moises	H04R1/1041	1/1
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	**Art Unit**
	LUN-SEE LAO	2651

CPC						
Symbol					**Type**	**Version**
H04R	/	3	/	002	F	2013-01-01
H04R	/	25	/	02	I	2013-01-01
H04R	/	1	/	1016	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/LUN-SEE LAO/ Primary Examiner, Art Unit 2651	03 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

U.S. Patent and Trademark Office — Part of Paper No.: 20230203

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	**Art Unit**
	LUN-SEE LAO	2651

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04R3/00	/	3	/	00
H04R25/02	/	25	/	02
H04R1/10	/	1	/	10

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
381	66

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 11	
/LUN-SEE LAO/ Primary Examiner, Art Unit 2651 (Primary Examiner) 03 February 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	**Art Unit**
	LUN-SEE LAO	2651

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	7	10												
	2	8	11												
2	3	9	12												
3	4	10	13												
4	5		14												
5	6	11	15												
	7														
	8														
6	9														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	11	
/LUN-SEE LAO/ Primary Examiner, Art Unit 2651	03 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

U.S. Patent and Trademark Office — Part of Paper No.: 20230203

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	Art Unit
	LUN-SEE LAO	2651

CPC - Searched*		
Symbol	Date	Examiner
H04R1/1016 H04R25/02 H04R3/002 H04R25/453 H04R2460/01 H04R3/02 H04R2201/107 H04R2460/05 H04R3/005 H04R1/1041 H04R1/1083 H04R2460/15 H04M3/568 H04M9/08 G10K11/17819 G10K11/17823 G10K11/17881 G10K11/17885 G10K2210/1081	02/03/2023	L.S.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
381	66, 56-58, 312, 314, 74, 92, 94.1-94.5	02/03/2023	L.S.

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E	02/03/2023	L.S.
CHECK 101	02/04/2023	L.S.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	UPDATE ABOVE SEARCHED	02/03/2023	L.S.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	**Art Unit**
	LUN-SEE LAO	2651

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/19/2022	02/03/2023							
1	1	✓	=							
	2	✓	-							
2	3	✓	=							
3	4	✓	=							
4	5	✓	=							
5	6	✓	=							
	7	✓	-							
	8	✓	-							
6	9	✓	=							
7	10	✓	=							
8	11	✓	=							
9	12	✓	=							
10	13	✓	=							
	14	✓	-							
11	15		=							

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	198	voice SAME activity SAME internal SAME level SAME background SAME noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 02:34 PM
L2	61	voice SAME activity SAME internal SAME level SAME background SAME noise	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:41 PM
L3	59	L2 AND ((H04R3/005 OR H04R1/1016 OR H04R25/02 OR H04R3/00 OR H04R1/1041 OR H04R1/1083 OR H04R2201/107 OR H04R2410/05 OR H04R25/505 OR H04R29/004 OR H04R2460/01 OR H04R3/02 OR H04R1/08 OR H04R2430/01 OR H04R25/50 OR H04R3/002 OR H04R2460/05 OR H04R3/04 OR H04R25/453 OR H04R2499/13 OR H04R1/10 OR H04R2420/07 OR H04R2499/11 OR H04R25/305 OR H04R5/04 OR H04R2460/07 OR H04R2460/15 OR G10L25/78 OR G10L2021/02087 OR G10L21/0264 OR G10L15/20 OR G10L19/00 OR	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:42 PM

		G10L15/22 OR G10L17/00 OR G10L2015/223 OR G10L25/06 OR G10L21/0208 OR H04N1/00411 OR H04N21/4312 OR H04W4/02 OR H04W4/021 OR H04W4/029 OR H04S1/002 OR H04S3/02 OR G10K11/17819 OR G10K11/17823 OR G10K11/17881 OR G10K11/17885 OR G10K2210/1081).cpc.)					
L4	10	generat$3 SAME voice SAME activity SAME (background OR ambient) SAME noise SAME mix$3 SAME ratio SAME ear SAME canal	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:45 PM
L5	10	L4 AND ((H04R1/1016 OR H04R25/02 OR H04R3/002 OR H04R25/453 OR H04R2460/01 OR H04R3/02 OR H04R2201/107 OR H04R2460/05 OR H04R3/005 OR H04R1/1041 OR H04R1/1083 OR H04R2460/15 OR H04M3/568 OR H04M9/08 OR G10K11/17819 OR G10K11/17823 OR G10K11/17881 OR G10K11/17885 OR G10K2210/1081).cpc.)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:48 PM
L6	300	"8600085," "9584896," "9270244," "9936297,9508335," "10499139," "8798283," "9953626"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	OR	ON	ON	2022/10/14 03:51 PM

			JPO; DERWENT; IBM_TDB)				
L7	40	"11057701," "10182289,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:53 PM
L8	10	"11057701"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:55 PM
L9	77	"8526645," "8081780"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:58 PM
L10	18	"20170345406," "20140241553," "20070177741," "20080205664," "20110103606," "20170345406"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2022/10/14 04:02 PM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L11	298	"6804638," "6163508," "6400652," "7433714," "7562020," "9135797," "9123343," "7756285"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:05 PM
L12	1016	"5903868," "3876843," "5208867," "6226389," "8493204," "6661901," "7430299," "6567524," "7107109," "4947440," "9037458"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:13 PM
L13	461	"4054749," "6298323," "6804643," "6163338," "6748238," "6021325," "8750295," "7920557," "20030265246"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:15 PM

L14	74	"20050288057," "20060195322," "20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:17 PM
L15	76	"20160104452," "20040203351," "20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:19 PM
L16	22	"20050123146," "20040125965," "20060083395," "20110264447," "20100296668,"20110293103	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:25 PM
L17	298	"6804638," "6163508," "6400652," "7433714," "7562020," "9135797," "9123343," "7756285"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/10/14 04:33 PM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L18	1016	"5903868," "3876843," "5208867," "6226389," "8493204," "6661901," "7430299," "6567524," "7107109," "4947440," "9037458"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:36 PM
L19	461	"4054749," "6298323," "6804643," "6163338," "6748238," "6021325," "8750295," "7920557," "20030265246"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:37 PM
L20	383	"7177433," "9053697," "7903826," "8150044," "8577062," "8774433," "8855343," "9191740," "9628896," "5577511," "6056698"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:40 PM
L21	1127	"5317273," "8162846," "7280849," "8045840,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/10/14 04:48 PM

		"6028514," "6408272," "20030165246," "20050288057," "20060195322"	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L22	79	"20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097," "20160104452," "20040203351"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:50 PM
L23	76	"20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992," "20050123146," "20040125965"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:52 PM
L24	64	"20060083395," "20110264447," "20100296668," "20110293103," "20100061564," "20050058313," "20140122092," "20090286515," "20060173563," "20090076821," "20050281423"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/10/14 04:54 PM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L25	55	"20030130016," "20050207605," "20070143820," "20110055256," "20060182287," "20030198359," "20070086600," "20060287014," "20100119077"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:02 PM
L26	877	"6359993," "7072482," "7778434," "5524056," "6415034,8014553," "408849," "7209569"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:10 PM
L27	8	(US-20220823-$ | US-6415034-$ | US-6754359-$ | US-20050058313-$ | US-20050168824-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:13 PM
L28	511	"20030161097," "6728385," "6163338," "6804638," "20040042103,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/10/15 03:01 PM

		"20010046304"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L29	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:03 PM
L30	29	"20070021958," "20080037801," "20020111798"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:07 PM
L31	6	"20070021958," "20080037801," "20020111798"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/15 03:08 PM
L32	8	"20060204014," "20050078838"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/15 03:08 PM
L33	877	"6359993," "7072482," "7778434," "5524056," "6415034,8014553," "408849," "7209569"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2022/10/15 03:46 PM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L34	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:49 PM
L35	20	(US-6021207-$ | US-6081732-$ | US-6118878-$ | US-5131032-$ | US-6169912-$ | US-6570985-$ | US-5692059-$ | US-6738482-$ | US-6760453-$ | US-5963901-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:52 PM
L36	873	"6754359," "6021207," "5267321," "7477756," "7450730," "6567524," "6728385," "8140325," "8983081," "5327506"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:55 PM

L37	559	"5933510," "8086093," "7039585," "6606598," "6005525," re3851, "7903825," "8014553," "8160261," "6639987," "5923624"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:58 PM
L38	436	"8160273," "7464029," "7983907," "8254591," "8718305," "8798278," "8917894," "8625818," "9491542," "8218784," "6118877"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:03 PM
L39	295	"7050592," "8401200," "9196247," "7574917," "5276740," "20030165246," "20080037801," "20060204014," "20050078838"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:05 PM
L40	43	"20070036377," "20020165719," "20060140425," "20030152359," "20070003090," "20030165319," "20070255435," "20040264938," "20060264176,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/10/15 04:08 PM

		"20040109579," "20060167687"	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L41	82	"20060083390," "20050068171," "20050028212," "20080145032," "20020098878," "20060188075," "20140023203," "20060188105," "20020076057," "20110116643," "20150215701"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:10 PM
L42	44	"20140163976," "20080137873," "20090122996," "20040086138," "20070021958," "20020111798"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:14 PM
L43	298	"6804638," "6163508," "6400652," "7433714," "7562020," "9135797," "9123343," "7756285"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 05:11 PM
L44	1016	"5903868," "3876843," "5208867," "6226389,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/10/15 05:13 PM

		"8493204," "6661901," "7430299," "6567524," "7107109," "4947440," "9037458"	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L45	461	"4054749," "6298323," "6804643," "6163338," "6748238," "6021325," "8750295," "7920557," "20030265246"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 09:39 AM
L46	74	"20050288057," "20060195322," "20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:26 AM
L47	76	"20160104452," "20040203351," "20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/10/17 10:34 AM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L48	25	"20050123146," "20040125965," "20060083395," "20110264447," "20100296668,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:40 AM
L49	10	"8045840"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:43 AM
L50	16	(US-4809262-$\|US-5259033-$|US-6304648-$\|US-6381572-$|US-6647368-$\|US-6754359-$|US-6870807-$\|US-5999828-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:48 AM
L51	530	"7236580," "7783054," "7986802," "8060366," "8275145," "8380521," "8401178," "8838184,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/10/17 02:44 PM

		"7039195," "8081780," "6728385"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L52	1423	"6738482," "6081732," "6169912," "6570985," "7349353," "5131032," "6760453," "5963901," "6021207," "5692059," "6118878"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 02:50 PM
L53	648	"6631196," "7817803," "8027481," "5796819," "703608," "7004097," "6466666," "20080037801," "20010046304"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 02:53 PM
L54	58	"20030112947," "20040137969," "20050102133," "20060062395," "20070291953," "20080019539," "20090147966," "20120184337," "20130051543," "20140370838," "20150288823"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2022/10/17 03:00 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L55	64	"20090010444," "20050058313," "20050069161," "20070189544," "20040202340," "20090034748," "20070036342," "20060067512"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 03:04 PM
L56	8	(US-20220823-$ | US-6415034-$ | US-6754359-$ | US-20050058313-$ | US-20050168824-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:09 AM
L57	31	"1385324"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:24 AM
L58	6348	Jens.inv. AND background AND noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2022/10/18 10:33 AM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L59	375220	Jens Erik.inv. AND background AND noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:36 AM
L60	18	"6,754,359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 01:09 PM
L61	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2022/10/18 01:09 PM

			IBM_TDB)				
L62	35	"8526645"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 02:06 PM
L63	19	("5182774" | "8526645" | "9173045" | "9729957" | "9749732" | "20070098187" | "20080107287" | "20100002891" | "20110280411" | "20140254828" | "20140294191" | "20150010158" | "20150023515" | "20160232889" | "20170223443" | "20170245045" | "20180122400" | "20180288546" | "20190313196").pn. OR ("11206003").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:06 PM
L64	51	"8081780"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:09 PM
L65	141	("2850012" | "2876767" | "3110356" | "3505999" | "3602654" | "4006796" | "4029083" | "4060080" | "4834211" | "4896679" | "4913165" | "5131411" | "5333622" | "6256396" | "6368288" | "6368289" | "6440102" | "7171371" | "7756281" | "7779844" | "7817803" | "7822219" | "7886745" | "7913696" | "8018328" | "8047207" | "8081780" | "8111839" | "8142870" | "8150043" | "8150044" | "8170228" | "8194864" | "8194865" | "8199919" | "8208644"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:10 PM

		| "8208652" | "8213629" | "8213649" | "8221860" | "8221861" | "8229128" | "8251925" | "8311228" | "8312960" | "8315400" | "8319620" | "8326628" | "8326635" | "8437492" | "8447031" | "8499886" | "9479859" | "9485595" | "10917711" | "11102563" | "20020143242" | "20070270988" | "20080015463" | "20080031475" | "20080037797" | "20080046246" | "20080130906" | "20080137873" | "20080144840" | "20080144841" | "20080144842" | "20080176289" | "20080178088" | "20080181419" | "20080181442" | "20080205660" | "20080212787" | "20080219456" | "20080219486" | "20080240458" | "20080253583" | "20080267416" | "20080299339" | "20080311324" | "20090016541" | "20090016542" | "20090022294" | "20090022353" | "20090028356" | "20090034765" | "20090067661" | "20090071486" | "20090071487" | "20090101433" | "20090130423" | "20090146799" | "20090147966" | "20090154748" | "20090155518" | "20090192407" | "20090214072" | "20090220096" | "20090238374" | "20090238386" | "20090240497" | "20090245530" | "20090264161" |					

		"20090290721" | "20100002897" | "20100012420" | "20100033313" | "20100071707" | "20100074451" | "20100076793" | "20100135502" | "20100142715" | "20100142725" | "20100177918" | "20100241256" | "20100322454" | "20110079227" | "20110085689" | "20110115626" | "20110228963" | "20110235843" | "20110311079" | "20120101514" | "20120103346" | "20120123573" | "20120177209" | "20120177210" | "20120288104" | "20130035608" | "20130039518" | "20130098706" | "20130123919" | "20160057551" | "20190111456" | "20200314519" | "20210152924" | "20210243514").pn. OR ("11477560").urpn. AND (PGPB | USPT | USOC).dbnm.					
L66	98	"6415034"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 03:29 PM
L67	2	"20050168824"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/19 11:53 AM
L68	97	(audio adj3 content) SAME voice SAME	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/10/19 12:14 PM

		activity SAME threshold	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L69	50	(audio adj3 content) SAME (voice adj3 activity) SAME threshold	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/19 12:47 PM
L70	21	(audio adj3 content) SAME (voice adj3 activity) SAME threshold	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:49 PM
L71	36	(audio adj3 content) SAME (voice SAME activity) SAME threshold	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:50 PM
L72	292	(audio adj3 content) SAME (voice adj3 activity)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:51 PM
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		H04R2460/15 OR H04R2499/13 OR H04R29/004 OR H04R1/08 OR H04R29/00 OR H04R25/554 OR H04R2225/55 OR H04R2430/03 OR H04R25/43 OR H04R25/50 OR H04R29/001 OR H04R3/02 OR H04R1/1075 OR H04R1/406 OR H04R3/04 OR H04R2420/01 OR H04R25/407 OR H04R25/453 OR H04R2499/11 OR H04R1/10 OR H04R2225/41 OR H04R2225/43 OR H04R2460/09 OR H04R25/40 OR H04R25/558 OR H04R25/604 OR H04R25/652 OR H04R1/028 OR H04R2201/401 OR H04R2225/61 OR H04R2460/13 OR H04R25/305 OR H04R25/65 OR H04R5/04 OR H04R1/02 OR H04R2225/023 OR H04R2225/025 OR H04R2225/39 OR H04R2430/20 OR H04R2430/21 OR H04R2460/11 OR H04R25/405 OR H04R25/48 OR H04R25/603 OR H04R1/1091 OR H04R2201/028 OR H04R2201/103 OR H04R2201/109 OR H04R2227/003 OR H04R2227/009 OR H04R25/30 OR H04R25/552 OR H04R27/00 OR H04R29/005 OR H04R5/027 OR G10L25/78 OR G10L19/09 OR G10L19/005 OR					

		G10L19/06 OR G10L2019/0011 OR G10L19/012 OR G10L19/002 OR G10L19/0212 OR G10L19/07 OR G10L19/083 OR G10L19/12 OR G10L19/22 OR G10L2019/0002 OR G10L2019/0016 OR G10L21/0208 OR G10L15/22 OR G10L2021/02087 OR G10L15/20 OR G10L21/0264 OR G10L21/02 OR G10L21/0364 OR G10L25/51 OR G10L15/00 OR G10L17/00 OR G10L19/00 OR G10L19/008 OR G10L2015/223 OR G10L15/30 OR G10L17/04 OR G10L21/0216 OR G10L21/0272 OR G10L15/26 OR G10L19/018 OR G10L2021/02082 OR G10L2021/02165 OR G10L2025/937 OR G10L25/84 OR G10L15/065 OR G10L19/04 OR G10L19/107 OR G10L19/26 OR G10L19/265 OR G10L2015/227 OR G10L2015/228 OR G10L2021/02166 OR G10L2021/02168 OR G10L21/0232 OR G10L25/03 OR G10L25/30 OR G10L13/027 OR G10L19/0204 OR G10L2015/088 OR G10L2025/932 OR G10L25/06 OR G10L25/21 OR G10L25/93 OR G10L15/005 OR G10L15/063 OR G10L15/16 OR G10L15/1815 OR G10L15/1822 OR					

		G10L17/08 OR G10L17/24 OR G10L19/032 OR G10L19/035 OR G10L19/167 OR G10L19/173 OR G10L19/24 OR G10L2015/025 OR G10L2019/0014 OR G10L2025/783 OR G10L21/00 OR G10L21/003 OR G10L21/0316 OR G10L21/0324 OR G10L21/0356 OR G10L21/10 OR G10L25/18 OR G10L25/24 OR G10L25/54 OR G10L25/57 OR G10L25/81 OR G10L15/01 OR G10L15/04 OR G10L15/08 OR G10L15/25 OR G10L17/18 OR G10L17/22 OR G10L19/0017 OR G10L19/20 OR G10L2025/786 OR G10L21/034 OR G10L25/60 OR H04M3/568 OR H04M9/08 OR H04M1/6008 OR H04M1/6066 OR H04M1/22 OR H04M1/72412 OR H04M1/82 OR H04M19/04 OR H04M19/048 OR H04M1/60 OR H04M7/0084 OR H04M9/082 OR H04M1/575 OR H04M1/724 OR H04M1/72469 OR H04M2201/41 OR H04M2203/6045 OR H04M2250/12 OR H04M3/567 OR H04M9/085 OR H04M1/0202 OR H04M1/03 OR H04M1/2535 OR H04M1/271 OR H04M1/6083 OR H04M2250/10 OR				

		H04M2250/52 OR H04M3/20 OR H04M3/428 OR H04M3/4285 OR H04M3/56 OR H04N5/23238 OR H04N21/4394 OR H04N5/2628 OR H04N21/44008 OR H04N5/2252 OR H04N5/23267 OR H04N21/8456 OR H04N5/23218 OR H04N13/111 OR H04N21/233 OR H04N21/43072 OR H04N21/4316 OR H04N21/47 OR H04N21/47205 OR H04N21/47217 OR H04N21/4884 OR H04N5/04 OR H04N5/23219 OR H04N5/23254 OR H04N5/76 OR H04N13/117 OR H04N13/359 OR H04N21/23418 OR H04N21/8547 OR H04N5/2251 OR H04N5/2254 OR H04N5/23216 OR H04N5/23232 OR H04N13/106 OR H04N13/239 OR H04N21/251 OR H04N21/42203 OR H04N21/435 OR H04N21/439 OR H04N21/44 OR H04N21/4415 OR H04N21/44227 OR H04N21/8549 OR H04N5/05 OR H04N5/10 OR H04N5/23222 OR H04N5/23258 OR H04N5/2327 OR H04N9/67 OR H04N9/802 OR H04N9/8205 OR H04N1/2133 OR H04N21/242 OR H04N21/43074 OR H04N21/8106 OR H04N21/84 OR H04N21/845 OR H04N21/854 OR					

		H04N5/2253 OR H04N5/23241 OR H04N5/23264 OR H04N5/232933 OR H04N5/23299 OR H04N5/783 OR H04N7/08 OR H04N7/0885 OR H04N9/806 OR H04N9/87 OR H04N13/229 OR H04N13/25 OR H04N13/344 OR H04N21/2335 OR H04N21/2662 OR H04N21/440281 OR H04N21/44209 OR H04N21/4666 OR H04N21/6587 OR H04N5/232 OR H04N5/23203 OR H04N5/247 OR H04N5/265 OR H04N5/272 OR H04L43/0829 OR H04L65/80 OR H04L12/66 OR H04L65/403 OR H04L1/0009 OR H04L1/0014 OR H04L1/007 OR H04L1/08 OR H04L43/00 OR H04L43/0847 OR H04L43/0852 OR H04L43/087 OR H04L43/16 OR H04L65/1083 OR H04L67/104 OR H04L69/10 OR H04L65/612 OR H04L45/74 OR H04L47/2441 OR H04L47/30 OR H04L47/34 OR H04L65/1069 OR H04L65/4015 OR H04L65/60 OR H04L65/75 OR H04L65/762 OR H04L67/01 OR H04L63/0428 OR H04W4/80 OR H04W72/1215 OR H04W72/1242 OR H04W88/06 OR H04W12/02 OR H04H20/28 OR					

		H04H20/423 OR H04H60/07).cpc.)					
L74	0	(third adj3 microphone$1) SAME ambient SAME background SAME noise SAME (reduction OR cancel$4) SAME mix$3 SAME audio SAME content	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/02/03 10:56 AM
L75	0	(third adj3 microphone$1) SAME (ambient OR background) SAME noise SAME (reduction OR cancel$4) SAME mix$3 SAME audio SAME content	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/02/03 10:56 AM
L76	0	(third adj3 microphone$1) SAME (ambient OR background) SAME noise SAME (reduction OR cancel$4) SAME mix$3 SAME content	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/02/03 10:57 AM
L77	3	(third adj3 microphone$1) SAME (ambient OR background) SAME noise SAME (reduction OR cancel$4) SAME mix$3	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/02/03 10:57 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	0	((third adj3 microphone$1) SAME (ambient OR background) SAME noise SAME (reduction OR cancel$4) SAME mix$3 SAME content)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/03 02:51 PM
N2	0	((third adj3 microphone$1) SAME (ambient OR background) SAME noise SAME (reduction OR cancel$4) SAME mix$3 SAME content).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/03 02:51 PM
N3	1	((third adj3 microphone$1) SAME (ambient OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/03 02:51 PM

		background) SAME noise SAME (reduction OR cancel$4) SAME mix$3).clm.					

Bibliographic Data

Application No: 17/215,804

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /LUN-SEE LAO/ Examiner's Signature | Initials

Title: METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/29/2021	381	2651	11472-39-5_CONT2-16247186
RULE			

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John Usher, Devon, UNITED KINGDOM

Jason McIntosh, Sugar Hill, GA, UNITED STATES

CONTINUING DATA

This application is a CIP of 16247186 01/14/2019 PAT 11057701

16247186 is a CON of 13956767 08/01/2013 PAT 10182289

13956767 is a CON of 12170171 07/09/2008 PAT 8526645

12170171 is a CIP of 12115349 05/05/2008 PAT 8081780

12115349 has PRO of 60916271 05/04/2007

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

04/05/2021

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FILING FEE RECEIVED

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Electronic Acknowledgement Receipt

EFS ID:	47327247
Application Number:	17215804
International Application Number:	
Confirmation Number:	9372
Title of Invention:	METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION
First Named Inventor/Applicant Name:	Steven Wayne Goldstein
Customer Number:	150139
Filer:	John Patrick Keady
Filer Authorized By:	
Attorney Docket Number:	11472-39-5_CONT2-16247186
Receipt Date:	06-JAN-2023
Filing Date:	29-MAR-2021
Time Stamp:	00:19:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Arguments/Remarks Made in an Amendment	17215804-ROA-JPK.pdf	544957 42b59362035673ab047b8bf3b40b3a45b5c1f61f	no	15

Warnings:

Information:	
Total Files Size (in bytes):	544957

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	:	17/215,804	CONFIRMATION NO. 9372
APPLICATION OF	:	STEVEN WAYNE GOLDSTEIN	
DATE FILED	:	03/29/2021	
EXAMINER	:	LAO, LUNSEE	
TC/A.U.	:	2651	
DOCKET	:	CONT2-16247186	
TITLE	:	METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION	

RESPONSE TO OFFICE ACTION

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Date: January 6, 2023

Sir:

These remarks are filed in response to the Non Final Office Action dated 25 Oct. 2022. Please amend the above-identified patent application as follows:

- **Amendments to the Claims** begin on page 2 of this paper; and
- **Remarks/Arguments** begin on page 6 of this paper.

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1.(currently amended) An ~~earphone~~ earpiece configured to use multiple microphones for noise control, comprising:

a first ambient microphone configured to generate a first ambient signal, wherein the first ambient microphone is part of an earpiece;

a second ambient microphone configured to generate a second ambient signal, wherein the second ambient microphone is part of the earpiece;

an ear canal microphone configured to generate an ear canal signal, wherein the ear canal microphone is part of the earpiece;

a speaker, wherein the speaker is part of the earpiece;

an eartip, configured to seal the ~~earphone~~ earpiece between a first side and a second side of the ~~earphone~~ earpiece;

a memory that stores instructions; and

a processor, wherein the processor is part of the earpiece, wherein the processor is operatively connected to the first ambient microphone, wherein the processor is operatively connected to the second ambient microphone, wherein the processor is operatively connected to the ear canal microphone, wherein the processor is operatively connected to the speaker, wherein the processor is operatively connected to the memory, wherein the processor is configured to execute the instructions to perform operations, the operations comprising:

receiving a first microphone signal, wherein the first microphone signal is at least one of the first ambient signal or a modified first ambient signal;

receiving a second microphone signal, wherein the second microphone signal is at least one of the ear canal signal or a modified ear canal signal;

receiving a third microphone signal, wherein the third microphone signal is at least one of the second ambient signal or a modified second ambient signal;

generating a background noise reduction signal using either the first and second microphone signals or the second and third microphone signals;

mixing an audio content signal and the background noise reduction signal generating a mixed signal; and

sending ~~the background noise reduction~~ a modified mixed signal to the speaker.

2.(canceled)

3.(original) The earphone according to claim 1, wherein the operations further comprise:

generating an ambient signal from at least one of the first ambient signal or the second ambient signal or a combination of both.

4.(original) The earphone according to claim 3, wherein the operations further comprise:

sending a modified ambient signal to the speaker.

5.(original) The earphone according to claim 4, where the modified ambient signal is the ambient signal.

6.(currently amended) The earphone according to claim 4, wherein the operations further comprise:

generating the modified ambient signal by filtering ~~the~~ an ambient signal, wherein the ambient signal is generated from at least the first ambient sound signal or the second ambient sound signal.

7.(canceled)

8.(canceled)

9.(original) The earphone according to claim 4, wherein the operations further comprise:

generating a modified ambient signal by filtering the ambient signal and modifying an amplitude of at least one frequency of the ambient signal.

10.(currently amended) The earphone according to claim [[8]]1, wherein the modified mixed signal is the mixed signal. ~~step of combining includes combining the audio signal and the modified ambient signal at a predetermined ratio value.~~

11.(currently amended) The earphone according to claim 1[[0]], wherein the operations further comprise:

generating the modified mixed signal by mixing the mixed signal with an ambient signal, wherein the ambient signal is generated from at least one of the first ambient signal, the second ambient signal or a combination of both. ~~the ratio value is multiplied by the modified ambient signal prior to combining with the audio signal.~~

12.(currently amended) The earphone according to claim [[3]]11, wherein the operations further comprise:

analyzing at least one of the ambient signal or the ear canal signal or a combination of both, to detect a user's voice.

13.(currently amended) The earphone according to claim 12, wherein the operations further comprise:

reducing the audio content signal prior to generating the mixed signal if the user's voice is detected.

~~analyzing at least one of the ambient signal or the ear canal signal or a combination of both, to generate a voice activity level.~~

14.(canceled)

15.(new) The earphone according to claim 12, wherein the operations further comprise:

reducing the ambient signal prior to generating the mixed signal if the user's voice is not detected.

REMARKS

The following remarks are made in response to the Office Action dated 25 Oct. 2022 ("OA").

At the time of the Office Action, the Examiner noted that claims 1-14 were pending. Claims 1, 6 and 10-13 have been amended, claims 2, 7, 8, and 14 cancelled and claim 15 is new. Support for the new claim and amended portions of the claims can be found in paragraphs [0005], [0006], [0011], [0013], [0044], [0049], and [0050]. The Examiner has rejected claims 1-14 based upon 35 USC 103.

In view of the arguments set forth below, claims 1, 3-6, 9-13, and 15 are allowable, and the Examiner is respectfully requested to withdraw the rejections and issue a Notice of Allowance.

Note that Applicant may only discuss a single feature difference between the related art and pending claims, which should not be interpreted as Applicant accepting the related art as allegedly showing the remaining features.

I. Pre-AIA Status

The present application claims priority to at least U.S. Patent No. 8,081,780 filed 5 May 2008 and U.S. Patent No. 8,526,645 filed 9 July 2008. The present application includes content from U.S. Patent No. 8,081,780, for example Figures 1-7 of the present application correspond to Figures 1-7 of US 8526645 and Figures 8-12 of the present application correspond to Figures 1-6 of US 8081780. Thus, the present claims are directed to inventive content described at least at early as 5 May 2008, infact as early as U.S. Provisional Application Serial No. 60/916,271, filed on May 4, 2007. Therefore the present claims should be examined under pre-AIA provisions.

II. 35 U.S.C § 103(a)

The Examiner has rejected Claims 1, 3-6 and 9-13 are rejected under 35 U.S.C. 103 as being unpatentable over Hietanen et al., US Patent No. 6,415,034 (hereafter Hietanen), in view of Pedersen et al. (EP 1385324).

The Examiner has rejected Claims 2, 7, and 8 are rejected under 35 U.S.C. 103 as being unpatentable over Hietanen et al., US Patent No. 6,415,034 (hereafter Hietanen), in view of Pedersen et al. (EP 1385324) as applied to claim 1, 3 above, and further in view of Travers et al. (US 2005/0168824). Note that although claims 2, 7, and 8 have been cancelled, it has not been in response to the rejection but rather amending the claim scope of claim 1.

Applicant directs attention to summaries of several of the references cited:

Hietanen (US 6,415,034)

Hietanen is directed to an earphone unit 11, that can be mounted in an auditory tube 10, that uses an error microphone 14, an inward pointing microphone 13, and a speaker 12, to improve the quality of speech pickup by minimizing noise. The signal sent to the speaker 12 is used to minimize the signal's pickup by the inward pointing microphone 13 and the error microphone 14 is used to minimize the sound leaking past the earphone unit 11 that is picked up by the inward pointing microphone.

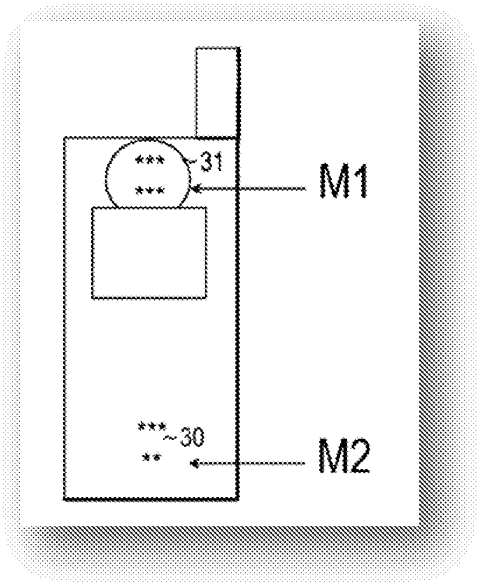
Hietanen states:
"…noise signal 17" caused by external sources of noise 17….." (Hietanen, 5:31-32)
"…Because the transfer function between error microphone 14 and microphone capsule 13 is essentially constant, noise Signal 17' can be subtracted in second stage 25 using subtractor 27 using a method which is explained later …" (Hietanen, 5:41-46)
"…Because the speech signal x(t) transferred by eardrum 16 is wanted to be Solved, the share of ear capsule 12 and of external noise 17 must be subtracted from the microphone Signal…." (Hietanen, 6:49-52)

Hietanen is specifically designed to removing ambient sound that leaks past the earphone unit 11. In fact, Hietanen desires there to be no ambient sound in the auditory tube 10. Thus the system of Hietanen is not designed to specifically introduce ambient sound into the auditory tube 10.

Pedersen (EP1385324)

Pedersen is directed at a system and method for reducing the effect of background noise. Pedersen at Title, ¶ [0007]. Pedersen discloses multiple embodiments aimed at achieving that goal.

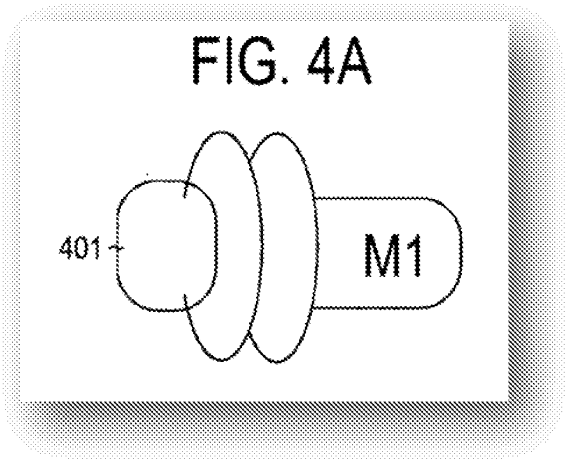
First, in Figure 3, Pedersen discloses a "microphone set-up." *Id.*



Pedersen at Fig. 3.

This set-up includes a mobile phone with a first microphone M1 and a second microphone M2. *Id.* at ¶ [0040].

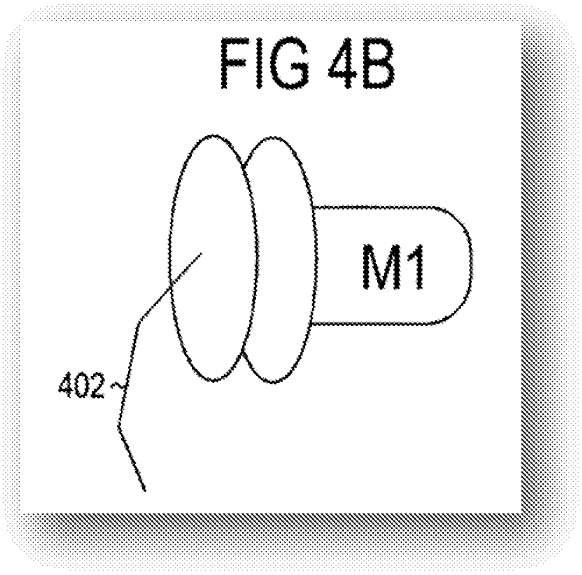
Second, Pedersen discloses "another microphone set-up according to another preferred embodiment" in Figure 4A. *See* Pedersen at ¶ [0015].



Pedersen at Fig. 4A.

A first microphone M1 is located in an earplug-like element and can measure the air vibrations in a user's ear canal. *Id.* at ¶ [0041]. This embodiment does not include a speaker in the earplug. The second microphone is typically located close to the head. *Id.* at ¶ [0043]

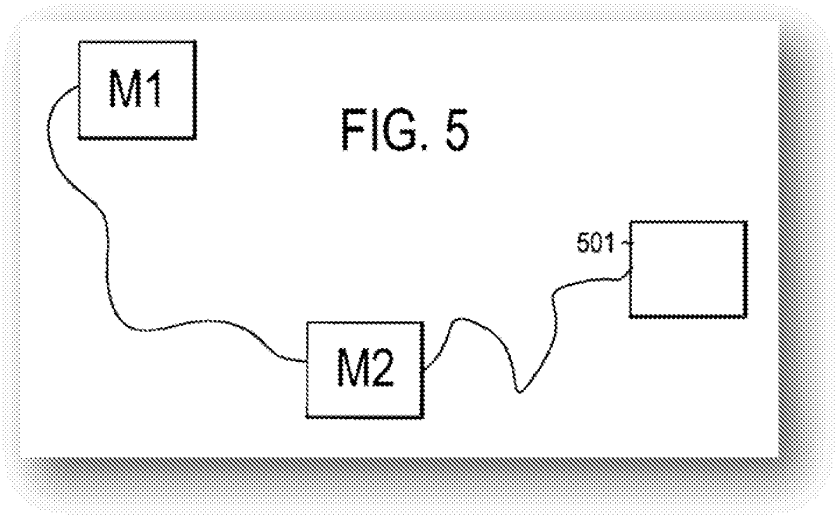
Third, Pedersen discloses a "variation" of the embodiment shown in Figure 4B. *See* Pedersen at ¶ [0015].



Pedersen at Fig. 4B.

In particular whereas the Figure 4A embodiment includes element 401, the Figure 4B embodiment includes element 402. The Figure 4B embodiment also includes first microphone M1 for measuring the air vibrations in the user's ear canal, and does not include a speaker in the earplug.

Fourth, Pedersen discloses "another option for implanting the invention," *i.e.*, an "audio data collection set-up," in Figure 5. *See* Pedersen at ¶¶ [0015], [0045].



Id. at Fig. 5.

Pedersen discloses that the Figure 5 embodiment is "a headset kit of a mobile phone" that provides hands-free operation. Pedersen at ¶ [0045]. Pedersen discloses that the headset may include plug 501 connected to a mobile phone or a car front panel. *Id.* Pedersen further discloses that "[t]he earplug including a loudspeaker ***may*** also include an earplug microphone M1, ***provided that the acoustical separation of the loudspeaker and microphone can be guaranteed***." *Id.* ¶ [0045](emphasis added). **This suggests that Pedersen teaches away from having an ear canal microphone and speaker combination**, although an ambient sound microphone and speaker combination might be allowed.

Travers (US 2005/0168824)

Travers is directed to an imaging device that can include flexible housing 92 connected to a speaker 102.

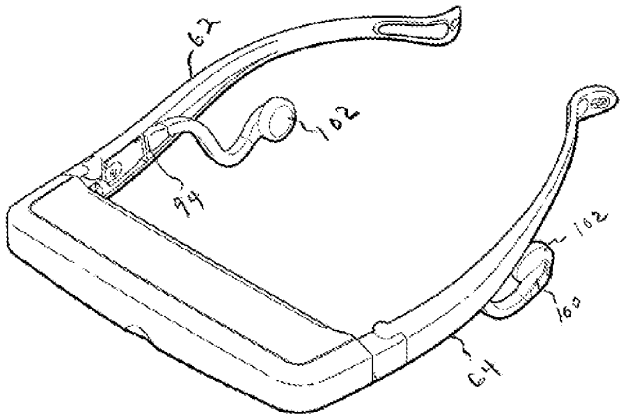


FIG.10

Traver's mentions that "…The imaging device could have two audio jacks, one could be for Stereo. Optionally, there could be a microphone attached to the same jacks or a separate jack. The microphone could be built into the bow…." (Traver, [0025])

ARGUMENT:

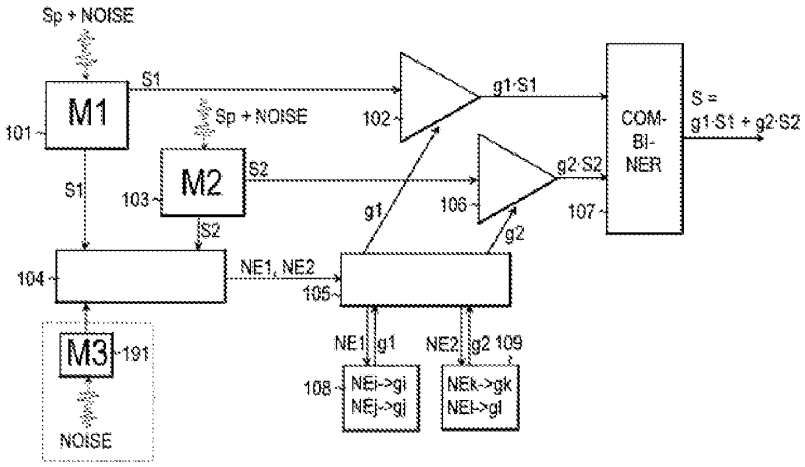
1.) With respect to claims 4, 5, 6, 9, 11, 12, and 13, Hietanen fails to show, suggest or teach sending an ambient signal to the speaker and is not combinable with any reference (Pedersen) that allows an ambient signal to be played by a speaker.

Hietanen is specifically designed to removing ambient sound that leaks past the earphone unit 11. In fact, Hietanen desires there to be no ambient sound in the auditory tube 10. Thus, the system of Hietanen is designed to specifically **not** introduce ambient sound into the auditory tube 10. Thus, Hietanen fails to show suggest or teach the scope of claims 4, 5, 6, 9, 11, 12, 13 and 15, which send an ambient signal to the speaker, nor is it obvious to combine a reference (such as Pedersen) with Hietanen to allow the introduction of ambient sound into the auditory tube 10, frustrating a purpose of Hietanen.

2.) With respect to claims 1, 3-6, 9-13, Hietanen alone or in combination with Pedersen, fails to show, suggest or teach a single earpiece that includes two ambient sound microphones, and ear canal microphone, a processor and memory.

The Examiner uses Pedersen to allegedly show a first ambient microphone (101) and a second ambient microphone (103). Applicant reproduces Fig. 1 of Pedersen below referred to by the Examiner.

FIG 1



Applicant direct attention to Pedersen [0016] which refers to Figure 1 and states in part:

> "…Both microphones **101** and **103** are transducers that convert acoustical or mechanical vibrations to an electric signal, i.e. normally to a small current, and they exhibit different sensitivity to background noise. The reason for the different noise sensitivity may be that the first microphone **101** is a bone conductor microphone or an earplug type microphone, whereas the second microphone **103** is a normal type transducer commonly used as a microphone in mobile terminals,…"

Pedersen does not show, suggest or teach a single earpiece that includes two ambient sound microphones. Pedersen actually suggests one might be in an earpiece (bone

conduction microphone) but the other is not (used in a mobile terminal). This can be seen clearly when looking at Figures 3, 4A, 4B, and 5 of Pedersen, which show the "earplug" with only one microphone M1 and not three. Claim 1 is directed to a single earpiece that includes a first ambient sound microphone, a second ambient sound microphone and an ear canal microphone. Pedersen fails to show, suggest or teach such a combination in a single earpiece, and neither does Hietanen. This combination is important since two ambient sound microphones allow more functionality, for example they can be used for beam sampling to detect voices, or one of the ambient sound microphones can be used with the ear canal microphone to detect voices.

Pedersen further discloses that "[t]he earplug including a loudspeaker ***may*** also include an earplug microphone M1, ***provided that the acoustical separation of the loudspeaker and microphone can be guaranteed***." *Id.* ¶ [0045](emphasis added). This suggests that Pedersen teaches away from having an ear canal microphone and speaker combination in an earplug (no acoustic separation), although an ambient sound microphone and speaker combination might be allowed.

Therefore, Hietanen in combination with Pedersen (although Applicant insists neither are combinable) fails to show, suggest or teach all the elements of claims 1.

Additionally Neither Hietanen nor Pedersen show, suggest or teach, mixing an audio content signal and the background noise reduction and sending a modified mixed signal to a speaker.

Travers fails to show, suggest or teach the missing elements of claim 1 not shown by Hietanen nor Pedersen.

Therefore, for at least the reasons set forth above, independent claim 1, and those claims depending therefrom, claims 3-6, 9-13, and 15 are allowable. Therefore, the

Examiner is respectfully requested to withdraw the rejections of claims under 35 U.S.C. § 103 and issue a Notice of Allowance.

III. Conclusion

For at least the reasons given above, claims 1, 3-6, 9-13, and 15 are allowable, and the Examiner is respectfully requested to withdraw all rejections. Should the Examiner believe that anything further is necessary, the Examiner is respectfully requested to contact the undersigned representative at the telephone number listed below.

Respectfully submitted,

TECHIYA LLC

Date: January 6, 2023

/John P. Keady/

John P. Keady
Ph.D. (Physics), Ph.D. (Comp. Sci.)
CTO and Assistant General Counsel of IP
Reg. No. 56,389
571-606-1291

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/215,804	Filing Date 03/29/2021	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/06/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 11	Minus	** 20	= 0		x $40 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $192 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JULIET MCMILLAN/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/215,804	03/29/2021	Steven Wayne Goldstein	11472-39-5_CONT2-16247186

CONFIRMATION NO. 9372

POA ACCEPTANCE LETTER

150139
Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

OC000000137072482

Date Mailed: 12/29/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/16/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/snguyen/

PTO/SB/80 (11-08)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 150139

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 150139

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Staton Techiya LLC. 16193 Bridlewood Circle, Delray Beach, FL 33445

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	8-14-17
Name	DANIEL C - STATON	Telephone	513-404-0099
Title	MANAGING MEMBER		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/215,804	**12/16/2022 02:04:15 PM ET**	**11472-39-5_CONT2-16247186**

Title of Invention

METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9372	FILED BY	Yoshi Hassan
PATENT CENTER #	61311584	FILING DATE	03/29/2021
CUSTOMER #	150139	FIRST NAMED INVENTOR	Steven Wayne Goldstein
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Peter Chiabotti

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
11472-39-5 POA-Executed.PDF	1	Power of Attorney	69 KB
11472-39-5 Statement Under 37 CFR 3_73.pdf	3	Assignee showing of ownership per 37 CFR 3.73	174 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
11472-39-5 POA-Executed.PDF	C2CCCA2BE90B292249085575444D64DAEB158FDDBE3B9370 702642BE7F5C5A750A87870A48FFA0DA0A5FD2B8B2798EE50

	AF46F9956498999852D56E3EFBDA46F
11472-39-5 Statement Under 37 CFR 3_73.pdf	01A8230844816230CB52895F9A54DC3B7899A8E3FE6D6AFAB98732F3D5D00AC18AD2CFBB56155C1CE8DB49BFFEB7DCC4BBCAC9DE98E13966447231B769A7138C

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Staton Techiya, LLC

Application No./Patent No.: 17/215,804 Filed/Issue Date: March 29, 2021

Titled: METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

Staton Techiya, LLC, a limited liability company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Steven Wayne Goldstein To: PERSONICS HOLDINGS, LLC

   The document was recorded in the United States Patent and Trademark Office at

   Reel 057621, Frame 0622, or for which a copy thereof is attached.

2. From: Marc Andre Boillot To: PERSONICS HOLDINGS, LLC

   The document was recorded in the United States Patent and Trademark Office at

   Reel 057621, Frame 0657, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: John Usher To: PERSONICS HOLDINGS, LLC

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4. From: Jason McIntosh To: PERSONICS HOLDINGS, LLC

The document was recorded in the United States Patent and Trademark Office at
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5. From: PERSONICS HOLDINGS, INC. and PERSONICS HOLDINGS, LLC To: DM STATON FAMILY LIMITED PARTNERSHIP

The document was recorded in the United States Patent and Trademark Office at
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6. From: DM STATON FAMILY LIMITED PARTNERSHIP To: STATON TECHIYA, LLC

The document was recorded in the United States Patent and Trademark Office at
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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Peter A. Chiabotti/	December 16, 2022
Signature	Date
Peter A. Chiabotti	54603
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/215,804	03/29/2021	Steven Wayne Goldstein	CONT2-16247186	9372

150139 7590 10/25/2022

Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

EXAMINER	
LAO, LUNSEE	

ART UNIT	PAPER NUMBER
2651	

NOTIFICATION DATE	DELIVERY MODE
10/25/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip@akerman.com
jp.keady@techiya.co
personics_docketing@cardinal-ip.com

Office Action Summary	Application No. 17/215,804	Applicant(s) Goldstein et al.	
	Examiner LUNSEE LAO	Art Unit 2651	AIA (FITF) Status No

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A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 03-29-2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-14 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-14 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 03-29-2021, 01-20-2022, 06-28-2022.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Introduction

2. This action is response to the application 17/215,804 filed on 03-29-2021. Claims 1-14 are pending.

Claim Rejections - 35 USC § 103

3. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

4 The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 1, 3-6 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over by Hietanen et al. (US PAT. 6,415,034) in view of Pedersen et al. (EP 1385324).

Consider Claim 1, Hietanen teaches an earphone configured to use multiple microphones for noise control(see fig.4), comprising: a first ambient microphone(see fig. 4(14)) configured to generate a first ambient signal;

a second ambient microphone configured to generate a second ambient signal;

an ear canal microphone(see fig. 4(13)) configured to generate an ear canal signal;

a speaker(see fig. 4(12));

an eartip(see fig. 4), configured to seal the earphone between a first side and a second side of the earphone;

a memory that stores instructions(see fig. 4(37)); and a processor(see fig. 4(34)), wherein the processor(see fig. 4(37)) is operatively connected to the ambient microphone(see fig. 4(14)), wherein the processor is operatively connected to the ear canal microphone(see fig. 4(13)), wherein the processor is operatively connected to the speaker, wherein the processor is operatively connected to the memory(see fig. 4(37), wherein the processor(see fig. 4(34)) is configured to execute the instructions to perform operations(see figs.4-10 and col. 5, line 26-col. 6, line 67)., the operations comprising: receiving a first microphone signal(see fig. 4(14)), wherein the first microphone signal is at least one of the first ambient signal or a modified first ambient signal; receiving a second microphone signal(see fig. 4(13)), wherein the second microphone signal is at least one of the ear canal signal or a modified ear canal signal generating a background noise reduction signal using the first and second microphone

signals; and sending the background noise reduction signal to the speaker(see figs.4-10 and col. 8, line 1-col. 10, line 67); but Hietanen does not explicitly a second ambient microphone configured to generate a second ambient signal.

However, Pedersen teaches a first ambient microphone(see fig. 1(101)) configured to generate a first ambient signal; a second ambient microphone(see fig. 1(103)) configured to generate a second ambient signal; an ear canal microphone(see fig. 1(191)) configured to generate an ear canal signal; a speaker(see fig. 5 and paragraph0045]); and

receiving a first microphone signal(see fig. 1(101)), wherein the first microphone signal is at least one of the first ambient signal or a modified first ambient signal; receiving a second microphone signal(see fig. 1(103)), wherein the second microphone signal is at least one of the ear canal signal or a modified ear canal signal generating a background noise reduction signal using the first and second microphone signals; and sending the background noise reduction signal to the speaker(see figs. 1-5 and paragraphs[0020]-[0030]).

Therefore, it would have obvious to one of ordinary skill in the art before the effective filling date the invention was made to combine the teaching of Pedersen in to the teaching of Hictanen to provide acoustical signals are collected with two microphones having different sensitivity to background noise. The level of background noise is estimated, and depending of the level of background noise, i) the amplification gain of the signals is modified before the signals are combined to a combined signal, or ii) the way of combining the signals is changed, to produce a signal that has less background noise than one of the microphones

Consider Claims 3 and 4, Hietanen as modified by Pedersen teaches the earphone wherein the operations further comprise: generating an ambient signal from at least one of the first ambient signal or the second ambient signal or a combination of both(see figs.4-10 and col. 8, line 1-col. 10, line 67); and the earphone wherein the operations further comprise: sending a modified ambient signal to the speaker(see figs.4-10 and col. 8, line 1-col. 10, line 67).

Consider Claims 5 and 6, Hietanen as modified by Pedersen teaches the earphone where the modified ambient signal is the ambient signal(see figs.4-10 and col. 8, line 1-col. 10, line 67); and the earphone wherein the operations further comprise: generating the modified ambient signal by filtering the ambient signal (see figs.4-10 and col. 8, line 1-col. 10, line 67)

Consider Claims 9-11, Hietanen as modified by Pedersen teaches the earphone wherein the operations further comprise: generating a modified ambient signal by filtering the ambient signal and modifying an amplitude of at least one frequency of the ambient signal (see figs.4-10 and col. 8, line 1-col. 10, line 67); and the earphone according to claim 8, wherein the step of combining includes combining the audio signal and the modified ambient signal at a predetermined ratio value(see figs.4-10 and col. 6, line 9-col. 9, line 67); and the earphone according to claim 10, where the ratio value is multiplied by the modified ambient signal prior to combining with the audio signal(see figs.4-10 and col. 6, line 9-col. 9, line 67).

Consider Claims 12 and 13, Hietanen as modified by Pedersen teaches the earphone wherein the operations further comprise: analyzing at least one of the ambient

signal or the ear canal signal or a combination of both, to detect a user's voice (see figs.4-10 and col. 6, line 9-col. 9, line 67); and the earphone wherein the operations further comprise: analyzing at least one of the ambient signal or the ear canal signal or a combination of both, to generate a voice activity level(see figs.4-10 and col. 6, line 9-col. 9, line 67).

7 Claims 2, 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hietanen et al. (US PAT. 6,415,034) as modified by Pedersen et al. (EP 1385324) as applied to claims 1, 3 above, and further in view of Travers et al. (US 2005/0168824).

Consider claim 2, Hietanen does not explicitly teach the earohone wherein the operations further comprise: sending an audio content signal to the speaker. However, Travers teaches the earphone wherein the operations further comprise: sending an audio content signal to the speaker(see figs. 6-10 and paragraphs[0023]-[0032]).

Therefore, it would have obvious to one of ordinary skill in the art before the effective filling date the invention was made to combine the teaching of Travers in to the teaching Hietanen and Pedersen to provide an optional speaker attachable to the imaging device; and the imaging device of the present invention includes a binocular frame for securing the imaging device to the user including two adjustable bows such that the virtual display of the imaging device is adjustable and pivotable to at least viewing positions with respect the line of sight of the user.

Consider claim 7, Hietanen does not explicitly teach the earohone wherein the operations further comprise: sending an audio content signal to the speaker.

However, Travers teaches the earohone wherein the operations further comprise: sending an audio content signal to the speaker (see figs. 6-10 and paragraphs[0023]-[0032]).

Therefore, it would have obvious to one of ordinary skill in the art before the effective filling date the invention was made to combine the teaching of Travers in to the teaching Hietanen and Pedersen to provide an optional speaker attachable to the imaging device; and the imaging device of the present invention includes a binocular frame for securing the imaging device to the user including two adjustable bows such that the virtual display of the imaging device is adjustable and pivotable to at least viewing positions with respect the line of sight of the user.

Consider Claim 8, Hietanen as modified by Pedersen and Travers teaches the earphone wherein the operations further comprise: generating the modified audio content signal by combining an audio content signal with the modified ambient signal (In Travers, see figs. 6-10 and paragraphs[0023]-[0032])

8. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hietanen et al. (US PAT. 6,415,034) as modified by Pedersen et al. (EP 1385324) as applied to claims 1, 3 above, and further in view of Chen et al. (US 2006/0135085).

Consider claim 14, Hietanen does not explicitly teach the earphone wherein the operations further comprise: sending an audio content signal to the speaker if the voice activity level is below a predetermined threshold.

However, Chen teaches the earphone wherein the operations further comprise: sending an audio content signal to the speaker if the voice activity level is below a predetermined threshold(see figs. 4-19 and paragraphs[0010]-[0053]).

Therefore, it would have obvious to one of ordinary skill in the art before the effective filling date the invention was made to combine the teaching of Chen in to the teaching Hietanen and Pedersen to provide a first microphone and a second microphone and a method for processing audio signal in a wireless telephone having a first microphone and a second microphone. The wireless telephone includes a first microphone, a second microphone, and a signal processor, wherein at least one of the first microphone and the second microphone is a unidirectional microphone. The first microphone outputs a first audio signal that includes a voice component and a background noise component. The second microphone outputs a second audio signal. The signal processor increases a ratio of the voice component to the noise component of the first audio signal based on the content of at least one of the first audio signal and the second audio signal to produce a third audio signal.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Kvaloy et al. (US PAT. 6,728,385) is cited to show other related METHOD AND DEVICE FOR IN-EAR ECHO SUPPRESSION.

10. Any response to this action should be mailed to:

Mail Stop ____(explanation, e.g., Amendment or After-final, etc.)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Facsimile responses should be faxed to:
(571) 273-8300
Hand-delivered responses should be brought to:
Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lao, Lun-See whose telephone number is (571) 272-7501 The examiner can normally be reached on Monday-Friday from 8:00 to 5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nguyen Duc M(SPE), can be reached on (571) 272-7503.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center 2600 whose telephone number is (571) 272-2600.

/LUN-SEE LAO/
Primary Examiner, Art Unit 2651
US Patent and Trademark Office
Knox
571-272-7501
Date 10-20-2022

Notice of References Cited	Application/Control No. 17/215,804	Applicant(s)/Patent Under Reexamination Goldstein et al.	
	Examiner LUNSEE LAO	Art Unit 2651	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6728385-B2	04-2004	Kval.o slashed.y; Olav	H04R1/1016	381/328
*	B	US-6415034-B1	07-2002	Hietanen; Jarmo	G10K11/17827	381/151
*	C	US-20050168824-A1	08-2005	Travers, Paul	G02B27/0176	359/630
*	D	US-20060135085-A1	06-2006	Chen; Juin-Hwey	H04M1/6008	455/78
	E					
	F					
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	H					
	I					
	J					
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	M					

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	EP 1385324 A1	01-2004	EUROPEAN	Pedersen, Jens Erik	H04M 9/08
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	**Art Unit**
	LUN-SEE LAO	2651

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/19/2022								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	Art Unit
	LUNSEE LAO	2651

CPC - Searched*		
Symbol	Date	Examiner
H04R1/1016 H04R25/02 H04R3/002 H04R25/453 H04R2460/01 H04R3/02 H04R2201/107 H04R2460/05 H04R3/005 H04R1/1041 H04R1/1083 H04R2460/15 H04M3/568 H04M9/08 G10K11/17819 G10K11/17823 G10K11/17881 G10K11/17885 G10K2210/1081	10/14/2022	L.S.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
381	66, 56-58, 312, 314, 74, 92, 94.1-94.5	10/14/2022	L.S.

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E	10/14/2022	L.S.
CHECK 101	10/14/2022	L.S.
PGR2022-01078 Reviewed Post Grant Review of U.S. Patent No. 11,057701 on Jul.6 2021	10/18/2022	L.S.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/215,804	Goldstein et al.
	Examiner	Art Unit
	LUNSEE LAO	2651

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17/215,804 - GAU: 2651
Filing Date	
First Named Inventor	Steven Wayne Goldstein
Art Unit	
Examiner Name	
Attorney Docket Number	

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	4809262		1989-02-28	Klose et al.	
/L.S/	2	5259033		1993-11-02	Goodings et al.	
/L.S/	3	5999828		1999-12-07	Sih et al.	
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/L.S/	7	6754359		2004-06-22	Svean et al.	
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	Art Unit	
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	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
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	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	20080037801		2008-02-14	Alves et al.	
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	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
	Examiner Name	
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/L.S/	13	20150288823		2015-10-08	Burnett et al.	

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	Filing Date	
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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/L.S/	20	20070036342		2007-02-15	Boillot et al.	
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	1							

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	Application Number	17/215,804 - GAU: 2651
	Filing Date	
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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EXAMINER SIGNATURE

Examiner Signature	/LUN-SEE LAO/	Date Considered	10/17/2022

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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17/215,804 - GAU: 2851

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/John P. Keady/	Date (YYYY-MM-DD)	2021-03-29
Name/Print	John P. Keady	Registration Number	56389

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
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Application Number	17215804
Filing Date	2021-03-29
First Named Inventor	Steven Wayne Goldstein
Art Unit	2651
Examiner Name	LAO, LUNSEE
Attorney Docket Number	CONT2-16247186

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	6359993		2002-03-19	Brimhall	
/L.S/	2	7072482		2006-07-04	Van Doorn et al.	
/L.S/	3	7778434		2010-08-17	Juneau et al.	
/L.S/	4	5524056		1996-06-04	Killion et al.	
/L.S/	5	6415034		2002-07-02	Hietanen	
/L.S/	6	8014553		2011-09-06	Radivojevic et al.	
/L.S/	7	4088849		1978-05-09	Usami et al.	
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/L.S/	9	6754359		2004-06-22	Svean et al.	
/L.S/	10	6021207		2000-02-01	Puthuff et al.	
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/L.S/	31	8160273		2012-04-17	Visser	
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/L.S/	1	20030165246		2003-09-04	Kvaloy et al.	
/L.S/	2	20080037801		2008-02-14	Alves et al.	
/L.S/	3	20060204014		2006-09-14	Isenberg et al.	
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/L.S/	27	20140163976		2014-06-12	Park		
/L.S/	28	20080137873		2008-06-12	Goldstein		
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/L.S/	30	20040086138		2004-05-06	Kuth		
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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	8045840		2011-10-25	Murata	

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/L.S/	1	2006054698	WO		2006-05-26	Murata		X
/L.S/	2	2009023784	WO		2009-02-19	Usher		☐
/L.S/	3	2012097150	WO		2012-07-19	Usher		☐

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/L.S/	4	H0877468	JP		1996-03-22	Keizaburo		☒
/L.S/	5	H10162283	JP		1998-06-19	Masahiro		☒
/L.S/	6	EP1519625	EP	A2		Victorian		☐
/L.S/	7	2006037156	WO	A1		Mejia et al.		☐
/L.S/	8	EP1401240	EP			Jensen		☐
/L.S/	9	2008050583	WO			Kitada		☐
/L.S/	10	2007092660	WO			Moberly		☐
/L.S/	11	2004114722	WO			Pedersen		☐
/L.S/	12	EP1385324	EP			Pedersen		☐
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/L.S/	1	Olwal, A. and Feiner S. Interaction Techniques Using Prosodic Features of Speech and Audio Localization. Proceedings of IUI 2005 (International Conference on Intelligent User Interfaces), San Diego, CA, Jan 9-12, 2005, p. 284-286.	
/L.S/	2	Bernard Widrow, John R. Glover Jr., John M. McCool, John Kaunitz, Charles S. Williams, Robert H. Hearn, James R. Zeidler, Eugene Dong Jr, and Robert C. Goodlin, Adaptive Noise Cancelling: Principles and Applications, PROCEEDINGS OF THE IEEE, VOL. 63, NO. 12, DECEMBER 1975	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	2651
	Examiner Name	LAO, LUNSEE
	Attorney Docket Number	CONT2-16247186

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/John P. Keady/	Date (YYYY-MM-DD)	2022-06-29
Name/Print	John P. Keady	Registration Number	56389

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Bibliographic Data

Application No: 17/215,804

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /LUN-SEE LAO/ Examiner's Signature | Initials

Title: METHOD AND DEVICE FOR IN EAR CANAL ECHO SUPPRESSION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/29/2021	381	2651	CONT2-16247186
RULE			

APPLICANTS

Staton Techiya LLC, Lighthouse Point, FL, UNITED STATES

INVENTORS

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Marc Andre Boillot, Plantation, FL, UNITED STATES

John Usher, Devon, UNITED KINGDOM

Jason McIntosh, Sugar Hill, GA, UNITED STATES

CONTINUING DATA

This application is a CIP of 16247186 01/14/2019 PAT 11057701

16247186 is a CON of 13956767 08/01/2013 PAT 10182289

13956767 is a CON of 12170171 07/09/2008 PAT 8526645

12170171 is a CIP of 12115349 05/05/2008 PAT 8081780

12115349 has PRO of 60916271 05/04/2007

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Attorney Docket Number	CONT2-16247186

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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/L.S/	2	6163508		2000-12-19	Kim et al.	
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/L.S/	2	7072482		2006-07-04	Van Doorn et al.	
/L.S/	3	7778434		2010-08-17	Juneau et al.	
/L.S/	4	5524056		1996-06-04	Killion et al.	
/L.S/	5	6415034		2002-07-02	Hietanen	
/L.S/	6	8014553		2011-09-06	Radivojevic et al.	
/L.S/	7	4088849		1978-05-09	Usami et al.	
/L.S/	8	7209569		2007-04-24	Boesen	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	9	6754359		2004-06-22	Svean et al.	
/L.S/	10	6021207		2000-02-01	Puthuff et al.	
/L.S/	11	5267321		1993-11-30	Langberg	
/L.S/	12	RE38351		2003-12-16	Iseberg et al.	
/L.S/	13	7477756		2009-01-13	Wickstrom et al.	
/L.S/	14	7450730		2008-11-11	Bertg et al.	
/L.S/	15	6567524		2003-05-20	Svean et al.	
/L.S/	16	6728385		2004-04-27	Kvaloy et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	20030165246		2003-09-04	Kvaloy et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	2	20080037801		2008-02-14	Alves et al.		
/L.S/	3	20060204014		2006-09-14	Isenberg et al.		
/L.S/	4	20050078838		2005-04-14	Simon		

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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EXAMINER SIGNATURE

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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/John P. Keady/	Date (YYYY-MM-DD)	2022-01-10
Name/Print	John P. Keady	Registration Number	56389

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	198	voice SAME activity SAME internal SAME level SAME background SAME noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 02:34 PM
L2	61	voice SAME activity SAME internal SAME level SAME background SAME noise	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:41 PM
L3	59	L2 AND ((H04R3/005 OR H04R1/1016 OR H04R25/02 OR H04R3/00 OR H04R1/1041 OR H04R1/1083 OR H04R2201/107 OR H04R2410/05 OR H04R25/505 OR H04R29/004 OR H04R2460/01 OR H04R3/02 OR H04R1/08 OR H04R2430/01 OR H04R25/50 OR H04R3/002 OR H04R2460/05 OR H04R3/04 OR H04R25/453 OR H04R2499/13 OR H04R1/10 OR H04R2420/07 OR H04R2499/11 OR H04R25/305 OR H04R5/04 OR H04R2460/07 OR H04R2460/15 OR G10L25/78 OR G10L2021/02087 OR G10L21/0264 OR G10L15/20 OR G10L19/00 OR	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:42 PM

		G10L15/22 OR G10L17/00 OR G10L2015/223 OR G10L25/06 OR G10L21/0208 OR H04N1/00411 OR H04N21/4312 OR H04W4/02 OR H04W4/021 OR H04W4/029 OR H04S1/002 OR H04S3/02 OR G10K11/17819 OR G10K11/17823 OR G10K11/17881 OR G10K11/17885 OR G10K2210/1081).cpc.)					
L4	10	generat$3 SAME voice SAME activity SAME (background OR ambient) SAME noise SAME mix$3 SAME ratio SAME ear SAME canal	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:45 PM
L5	10	L4 AND ((H04R1/1016 OR H04R25/02 OR H04R3/002 OR H04R25/453 OR H04R2460/01 OR H04R3/02 OR H04R2201/107 OR H04R2460/05 OR H04R3/005 OR H04R1/1041 OR H04R1/1083 OR H04R2460/15 OR H04M3/568 OR H04M9/08 OR G10K11/17819 OR G10K11/17823 OR G10K11/17881 OR G10K11/17885 OR G10K2210/1081).cpc.)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/14 02:48 PM
L6	300	"8600085," "9584896," "9270244," "9936297,9508335," "10499139," "8798283," "9953626"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	OR	ON	ON	2022/10/14 03:51 PM

			JPO; DERWENT; IBM_TDB)				
L7	40	"11057701," "10182289,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:53 PM
L8	10	"11057701"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:55 PM
L9	77	"8526645," "8081780"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 03:58 PM
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			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L11	298	"6804638," "6163508," "6400652," "7433714," "7562020," "9135797," "9123343," "7756285"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:05 PM
L12	1016	"5903868," "3876843," "5208867," "6226389," "8493204," "6661901," "7430299," "6567524," "7107109," "4947440," "9037458"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:13 PM
L13	461	"4054749," "6298323," "6804643," "6163338," "6748238," "6021325," "8750295," "7920557," "20030265246"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:15 PM

L14	74	"20050288057," "20060195322," "20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:17 PM
L15	76	"20160104452," "20040203351," "20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:19 PM
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			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
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L22	79	"20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097," "20160104452," "20040203351"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:50 PM
L23	76	"20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992," "20050123146," "20040125965"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 04:52 PM
L24	64	"20060083395," "20110264447," "20100296668," "20110293103," "20100061564," "20050058313," "20140122092," "20090286515," "20060173563," "20090076821," "20050281423"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/10/14 04:54 PM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L25	55	"20030130016," "20050207605," "20070143820," "20110055256," "20060182287," "20030198359," "20070086600," "20060287014," "20100119077"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:02 PM
L26	877	"6359993," "7072482," "7778434," "5524056," "6415034,8014553," "408849," "7209569"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:10 PM
L27	8	(US-20220823-$ | US-6415034-$ | US-6754359-$ | US-20050058313-$ | US-20050168824-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/14 05:13 PM
L28	511	"20030161097," "6728385," "6163338," "6804638," "20040042103,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/10/15 03:01 PM

		"20010046304"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L29	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:03 PM
L30	29	"20070021958," "20080037801," "20020111798"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:07 PM
L31	6	"20070021958," "20080037801," "20020111798"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/15 03:08 PM
L32	8	"20060204014," "20050078838"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/15 03:08 PM
L33	877	"6359993," "7072482," "7778434," "5524056," "6415034,8014553," "408849," "7209569"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2022/10/15 03:46 PM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L34	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:49 PM
L35	20	(US-6021207-$ | US-6081732-$ | US-6118878-$ | US-5131032-$ | US-6169912-$ | US-6570985-$ | US-5692059-$ | US-6738482-$ | US-6760453-$ | US-5963901-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:52 PM
L36	873	"6754359," "6021207," "5267321," "7477756," "7450730," "6567524," "6728385," "8140325," "8983081," "5327506"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:55 PM

L37	559	"5933510," "8086093," "7039585," "6606598," "6005525," re3851, "7903825," "8014553," "8160261," "6639987," "5923624"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 03:58 PM
L38	436	"8160273," "7464029," "7983907," "8254591," "8718305," "8798278," "8917894," "8625818," "9491542," "8218784," "6118877"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:03 PM
L39	295	"7050592," "8401200," "9196247," "7574917," "5276740," "20030165246," "20080037801," "20060204014," "20050078838"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:05 PM
L40	43	"20070036377," "20020165719," "20060140425," "20030152359," "20070003090," "20030165319," "20070255435," "20040264938," "20060264176,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/10/15 04:08 PM

		"20040109579," "20060167687"	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L41	82	"20060083390," "20050068171," "20050028212," "20080145032," "20020098878," "20060188075," "20140023203," "20060188105," "20020076057," "20110116643," "20150215701"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:10 PM
L42	44	"20140163976," "20080137873," "20090122996," "20040086138," "20070021958," "20020111798"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 04:14 PM
L43	298	"6804638," "6163508," "6400652," "7433714," "7562020," "9135797," "9123343," "7756285"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/15 05:11 PM
L44	1016	"5903868," "3876843," "5208867," "6226389,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/10/15 05:13 PM

		"8493204," "6661901," "7430299," "6567524," "7107109," "4947440," "9037458"	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L45	461	"4054749," "6298323," "6804643," "6163338," "6748238," "6021325," "8750295," "7920557," "20030265246"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 09:39 AM
L46	74	"20050288057," "20060195322," "20070043563," "20010046304," "20070189544," "20060092043," "20020106091," "20040109668," "20020118798," "20040042103," "20030161097"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:26 AM
L47	76	"20160104452," "20040203351," "20080165988," "20070291953," "20110096939," "20060067551," "20090024234," "20090010456," "20070086600," "20040190737," "20040196992"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2022/10/17 10:34 AM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L48	25	"20050123146," "20040125965," "20060083395," "20110264447," "20100296668,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:40 AM
L49	10	"8045840"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:43 AM
L50	16	(US-4809262-$\|US-5259033-$|US-6304648-$\|US-6381572-$|US-6647368-$\|US-6754359-$|US-6870807-$\|US-5999828-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 10:48 AM
L51	530	"7236580," "7783054," "7986802," "8060366," "8275145," "8380521," "8401178," "8838184,"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/10/17 02:44 PM

		"7039195," "8081780," "6728385"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L52	1423	"6738482," "6081732," "6169912," "6570985," "7349353," "5131032," "6760453," "5963901," "6021207," "5692059," "6118878"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 02:50 PM
L53	648	"6631196," "7817803," "8027481," "5796819," "703608," "7004097," "6466666," "20080037801," "20010046304"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 02:53 PM
L54	58	"20030112947," "20040137969," "20050102133," "20060062395," "20070291953," "20080019539," "20090147966," "20120184337," "20130051543," "20140370838," "20150288823"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2022/10/17 03:00 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L55	64	"20090010444," "20050058313," "20050069161," "20070189544," "20040202340," "20090034748," "20070036342," "20060067512"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/17 03:04 PM
L56	8	(US-20220823-$ | US-6415034-$ | US-6754359-$ | US-20050058313-$ | US-20050168824-$).DID.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:09 AM
L57	31	"1385324"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:24 AM
L58	6348	Jens.inv. AND background AND noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2022/10/18 10:33 AM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L59	375220	Jens Erik.inv. AND background AND noise	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 10:36 AM
L60	18	"6,754,359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 01:09 PM
L61	183	"6754359"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2022/10/18 01:09 PM

			IBM_TDB)				
L62	35	"8526645"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/18 02:06 PM
L63	19	("5182774" | "8526645" | "9173045" | "9729957" | "9749732" | "20070098187" | "20080107287" | "20100002891" | "20110280411" | "20140254828" | "20140294191" | "20150010158" | "20150023515" | "20160232889" | "20170223443" | "20170245045" | "20180122400" | "20180288546" | "20190313196").pn. OR ("11206003").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:06 PM
L64	51	"8081780"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:09 PM
L65	141	("2850012" | "2876767" | "3110356" | "3505999" | "3602654" | "4006796" | "4029083" | "4060080" | "4834211" | "4896679" | "4913165" | "5131411" | "5333622" | "6256396" | "6368288" | "6368289" | "6440102" | "7171371" | "7756281" | "7779844" | "7817803" | "7822219" | "7886745" | "7913696" | "8018328" | "8047207" | "8081780" | "8111839" | "8142870" | "8150043" | "8150044" | "8170228" | "8194864" | "8194865" | "8199919" | "8208644"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 02:10 PM

		| "8208652" | "8213629" | "8213649" | "8221860" | "8221861" | "8229128" | "8251925" | "8311228" | "8312960" | "8315400" | "8319620" | "8326628" | "8326635" | "8437492" | "8447031" | "8499886" | "9479859" | "9485595" | "10917711" | "11102563" | "20020143242" | "20070270988" | "20080015463" | "20080031475" | "20080037797" | "20080046246" | "20080130906" | "20080137873" | "20080144840" | "20080144841" | "20080144842" | "20080176289" | "20080178088" | "20080181419" | "20080181442" | "20080205660" | "20080212787" | "20080219456" | "20080219486" | "20080240458" | "20080253583" | "20080267416" | "20080299339" | "20080311324" | "20090016541" | "20090016542" | "20090022294" | "20090022353" | "20090028356" | "20090034765" | "20090067661" | "20090071486" | "20090071487" | "20090101433" | "20090130423" | "20090146799" | "20090147966" | "20090154748" | "20090155518" | "20090192407" | "20090214072" | "20090220096" | "20090238374" | "20090238386" | "20090240497" | "20090245530" | "20090264161" |					

		"20090290721" | "20100002897" | "20100012420" | "20100033313" | "20100071707" | "20100074451" | "20100076793" | "20100135502" | "20100142715" | "20100142725" | "20100177918" | "20100241256" | "20100322454" | "20110079227" | "20110085689" | "20110115626" | "20110228963" | "20110235843" | "20110311079" | "20120101514" | "20120103346" | "20120123573" | "20120177209" | "20120177210" | "20120288104" | "20130035608" | "20130039518" | "20130098706" | "20130123919" | "20160057551" | "20190111456" | "20200314519" | "20210152924" | "20210243514").pn. OR ("11477560").urpn. AND (PGPB | USPT | USOC).dbnm.					
L66	98	"6415034"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/18 03:29 PM
L67	2	"20050168824"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/19 11:53 AM
L68	97	(audio adj3 content) SAME voice SAME	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/10/19 12:14 PM

		activity SAME threshold	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L69	50	(audio adj3 content) SAME (voice adj3 activity) SAME threshold	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/19 12:47 PM
L70	21	(audio adj3 content) SAME (voice adj3 activity) SAME threshold	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:49 PM
L71	36	(audio adj3 content) SAME (voice SAME activity) SAME threshold	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:50 PM
L72	292	(audio adj3 content) SAME (voice adj3 activity)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 12:51 PM
L73	274	L72 AND ((H04R3/005 OR H04R1/1041 OR H04R1/1016 OR H04R1/1083 OR H04R2420/07 OR H04R3/00 OR H04R25/505 OR H04R2410/05 OR H04R25/02 OR H04R3/002 OR H04R2201/107 OR H04R2430/01 OR H04R29/008 OR H04R2460/01 OR H04R2460/05 OR	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/19 01:03 PM

		H04R2460/15 OR H04R2499/13 OR H04R29/004 OR H04R1/08 OR H04R29/00 OR H04R25/554 OR H04R2225/55 OR H04R2430/03 OR H04R25/43 OR H04R25/50 OR H04R29/001 OR H04R3/02 OR H04R1/1075 OR H04R1/406 OR H04R3/04 OR H04R2420/01 OR H04R25/407 OR H04R25/453 OR H04R2499/11 OR H04R1/10 OR H04R2225/41 OR H04R2225/43 OR H04R2460/09 OR H04R25/40 OR H04R25/558 OR H04R25/604 OR H04R25/652 OR H04R1/028 OR H04R2201/401 OR H04R2225/61 OR H04R2460/13 OR H04R25/305 OR H04R25/65 OR H04R5/04 OR H04R1/02 OR H04R2225/023 OR H04R2225/025 OR H04R2225/39 OR H04R2430/20 OR H04R2430/21 OR H04R2460/11 OR H04R25/405 OR H04R25/48 OR H04R25/603 OR H04R1/1091 OR H04R2201/028 OR H04R2201/103 OR H04R2201/109 OR H04R2227/003 OR H04R2227/009 OR H04R25/30 OR H04R25/552 OR H04R27/00 OR H04R29/005 OR H04R5/027 OR G10L25/78 OR G10L19/09 OR G10L19/005 OR					

		G10L19/06 OR G10L2019/0011 OR G10L19/012 OR G10L19/002 OR G10L19/0212 OR G10L19/07 OR G10L19/083 OR G10L19/12 OR G10L19/22 OR G10L2019/0002 OR G10L2019/0016 OR G10L21/0208 OR G10L15/22 OR G10L2021/02087 OR G10L15/20 OR G10L21/0264 OR G10L21/02 OR G10L21/0364 OR G10L25/51 OR G10L15/00 OR G10L17/00 OR G10L19/00 OR G10L19/008 OR G10L2015/223 OR G10L15/30 OR G10L17/04 OR G10L21/0216 OR G10L21/0272 OR G10L15/26 OR G10L19/018 OR G10L2021/02082 OR G10L2021/02165 OR G10L2025/937 OR G10L25/84 OR G10L15/065 OR G10L19/04 OR G10L19/107 OR G10L19/26 OR G10L19/265 OR G10L2015/227 OR G10L2015/228 OR G10L2021/02166 OR G10L2021/02168 OR G10L21/0232 OR G10L25/03 OR G10L25/30 OR G10L13/027 OR G10L19/0204 OR G10L2015/088 OR G10L2025/932 OR G10L25/06 OR G10L25/21 OR G10L25/93 OR G10L15/005 OR G10L15/063 OR G10L15/16 OR G10L15/1815 OR G10L15/1822 OR					

		G10L17/08 OR G10L17/24 OR G10L19/032 OR G10L19/035 OR G10L19/167 OR G10L19/173 OR G10L19/24 OR G10L2015/025 OR G10L2019/0014 OR G10L2025/783 OR G10L21/00 OR G10L21/003 OR G10L21/0316 OR G10L21/0324 OR G10L21/0356 OR G10L21/10 OR G10L25/18 OR G10L25/24 OR G10L25/54 OR G10L25/57 OR G10L25/81 OR G10L15/01 OR G10L15/04 OR G10L15/08 OR G10L15/25 OR G10L17/18 OR G10L17/22 OR G10L19/0017 OR G10L19/20 OR G10L2025/786 OR G10L21/034 OR G10L25/60 OR H04M3/568 OR H04M9/08 OR H04M1/6008 OR H04M1/6066 OR H04M1/22 OR H04M1/72412 OR H04M1/82 OR H04M19/04 OR H04M19/048 OR H04M1/60 OR H04M7/0084 OR H04M9/082 OR H04M1/575 OR H04M1/724 OR H04M1/72469 OR H04M2201/41 OR H04M2203/6045 OR H04M2250/12 OR H04M3/567 OR H04M9/085 OR H04M1/0202 OR H04M1/03 OR H04M1/2535 OR H04M1/271 OR H04M1/6083 OR H04M2250/10 OR				

		H04M2250/52 OR H04M3/20 OR H04M3/428 OR H04M3/4285 OR H04M3/56 OR H04N5/23238 OR H04N21/4394 OR H04N5/2628 OR H04N21/44008 OR H04N5/2252 OR H04N5/23267 OR H04N21/8456 OR H04N5/23218 OR H04N13/111 OR H04N21/233 OR H04N21/43072 OR H04N21/4316 OR H04N21/47 OR H04N21/47205 OR H04N21/47217 OR H04N21/4884 OR H04N5/04 OR H04N5/23219 OR H04N5/23254 OR H04N5/76 OR H04N13/117 OR H04N13/359 OR H04N21/23418 OR H04N21/8547 OR H04N5/2251 OR H04N5/2254 OR H04N5/23216 OR H04N5/23232 OR H04N13/106 OR H04N13/239 OR H04N21/251 OR H04N21/42203 OR H04N21/435 OR H04N21/439 OR H04N21/44 OR H04N21/4415 OR H04N21/44227 OR H04N21/8549 OR H04N5/05 OR H04N5/10 OR H04N5/23222 OR H04N5/23258 OR H04N5/2327 OR H04N9/67 OR H04N9/802 OR H04N9/8205 OR H04N1/2133 OR H04N21/242 OR H04N21/43074 OR H04N21/8106 OR H04N21/84 OR H04N21/845 OR H04N21/854 OR					

		H04N5/2253 OR H04N5/23241 OR H04N5/23264 OR H04N5/232933 OR H04N5/23299 OR H04N5/783 OR H04N7/08 OR H04N7/0885 OR H04N9/806 OR H04N9/87 OR H04N13/229 OR H04N13/25 OR H04N13/344 OR H04N21/2335 OR H04N21/2662 OR H04N21/440281 OR H04N21/44209 OR H04N21/4666 OR H04N21/6587 OR H04N5/232 OR H04N5/23203 OR H04N5/247 OR H04N5/265 OR H04N5/272 OR H04L43/0829 OR H04L65/80 OR H04L12/66 OR H04L65/403 OR H04L1/0009 OR H04L1/0014 OR H04L1/007 OR H04L1/08 OR H04L43/00 OR H04L43/0847 OR H04L43/0852 OR H04L43/087 OR H04L43/16 OR H04L65/1083 OR H04L67/104 OR H04L69/10 OR H04L65/612 OR H04L45/74 OR H04L47/2441 OR H04L47/30 OR H04L47/34 OR H04L65/1069 OR H04L65/4015 OR H04L65/60 OR H04L65/75 OR H04L65/762 OR H04L67/01 OR H04L63/0428 OR H04W4/80 OR H04W72/1215 OR H04W72/1242 OR H04W88/06 OR H04W12/02 OR H04H20/28 OR					

		H04H20/423 OR H04H60/07).cpc.)					

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17215804
Filing Date	2021-03-29
First Named Inventor	Steven Wayne Goldstein
Art Unit	OPAP
Examiner Name	UNKNOWN
Attorney Docket Number	CONT2-16247186

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	6804638		2004-10-12	Fiedler; Mark	
/L.S/	2	6163508		2000-12-19	Kim et al.	
/L.S/	3	6400652		2002-06-04	Goldberg et al.	
/L.S/	4	7433714		2008-10-07	Howard et al.	
/L.S/	5	7562020		2009-06-14	Le et al.	
/L.S/	6	9135797		2015-09-15	Couper et al.	
/L.S/	7	9123343		2015-09-01	Kurki-Suonio	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Steven Wayne Goldstein
	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	9	5903868		1999-05-11	Yuen et al.	
/L.S/	10	3876843		1975-04-08	Moen	
/L.S/	11	5208867		1993-05-04	Stites, III	
/L.S/	12	6226389		2001-05-01	Lemelson et al.	
/L.S/	13	8493204		2013-07-23	Wong et al.	
/L.S/	14	6661901		2003-12-09	Svean et al.	
/L.S/	15	7430299		2008-09-30	Armstrong et al.	
/L.S/	16	6567524		2003-05-20	Svean et al.	
/L.S/	17	7107109		2006-09-12	Nathan et al.	
/L.S/	18	4947440		1990-08-07	Bateman et al.	
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	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	20	4054749		1977-10-18	Suzuki et al.	
/L.S/	21	6298323		2001-10-02	Kaemmerer	
/L.S/	22	6804643		2004-10-12	Kiss	
/L.S/	23	6163338		2000-12-19	Johnson et al.	
/L.S/	24	6748238		2004-06-08	Lau	
/L.S/	25	6021325		2000-02-01	Hall	
/L.S/	26	8750295		2014-06-10	Liron	
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	20030165246		2003-09-04	Kvaloy et al.	

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	2	20050288057		2005-12-29	Lai et al.	
/L.S/	3	20060195322		2006-08-31	Broussard et al.	
/L.S/	4	20070043563		2007-02-22	Comerford et al.	
/L.S/	5	20010046304		2001-11-29	Rast	
/L.S/	6	20070189544		2007-08-16	Rosenberg	
/L.S/	7	20060092043		2006-05-04	Lagassey	
/L.S/	8	20020106091		2002-08-08	Furst et al.	
/L.S/	9	20040109668		2004-06-10	Stuckman	
/L.S/	10	20020118798		2002-08-29	Langhart et al.	
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	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	13	20160104452		2016-04-14	Guan et al.	
/L.S/	14	20040203351		2004-10-14	Shearer et al.	
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/L.S/	16	20070291953		2007-12-20	Ngia et al.	
/L.S/	17	20110096939		2011-04-28	Ichimura	
/L.S/	18	20060067551		2006-03-30	Cartwright et al.	
/L.S/	19	20090024234		2009-01-22	Archibald	
/L.S/	20	20090010456		2009-01-08	Goldstein et al.	
/L.S/	21	20070086600		2007-04-19	Boesen	
/L.S/	22	20040190737		2004-09-30	Kuhnel et al.	
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	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

/L.S/	24	20050123146		2005-06-09	Voix et al.	
/L.S/	25	20040125965		2004-07-01	Alberth Jr., et al.	
/L.S/	26	20060083395		2006-04-20	Allen et al.	
/L.S/	27	20110264447		2011-10-27	Visser et al.	
/L.S/	28	20100296668		2010-11-25	Lee et al.	
/L.S/	29	20110293103		2011-12-01	Park et al.	
/L.S/	30	20100061564		2010-03-11	Clemow et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/L.S/	1	EP1519625	EP	A2		Victorian		
/L.S/	2	2006037156	WO	A1		Mejia et al.		

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	Application Number	17215804
	Filing Date	2021-03-29
	First Named Inventor	Steven Wayne Goldstein
	Art Unit	OPAP
	Examiner Name	UNKNOWN
	Attorney Docket Number	CONT2-16247186

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
/L.S/	1	Olwal, A. and Feiner S. Interaction Techniques Using Prosodic Features of Speech and Audio Localization. Proceedings of IUI 2005 (International Conference on Intelligent User Interfaces), San Diego, CA, Jan 9-12, 2005, p. 284-286.	
/L.S/	2	Bernard Widrow, John R. Glover Jr., John M. McCool, John Kaunitz, Charles S. Williams, Robert H. Hearn, James R. Zeidler, Eugene Dong Jr, and Robert C. Goodlin, Adaptive Noise Cancelling: Principles and Applications, PROCEEDINGS OF THE IEEE, VOL. 63, NO. 12, DECEMBER 1975	
/L.S/	3	Mauro Dentino, John M. McCool, and Bernard Widrow, Adaptive Filtering in the Frequency Domain, PROCEEDINGS OF THE IEEE, VOL. 66, NO. 12, DECEMBER 1978	

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Examiner Signature	/LUN-SEE LAO/	Date Considered	10/17/2022

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/John P. Keady/	Date (YYYY-MM-DD)	2022-01-10
Name/Print	John P. Keady	Registration Number	56389

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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Doc description: Information Disclosure Statement (IDS) Filed

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Application Number	17215804
Filing Date	2021-03-29
First Named Inventor	Steven Wayne Goldstein
Art Unit	2651
Examiner Name	LAO, LUNSEE
Attorney Docket Number	CONT2-16247186

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	Examiner Name	LAO, LUNSEE
	Attorney Docket Number	CONT2-16247186

/L.S/	1	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00282, December 21, 2021	
/L.S/	2	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00242, December 23, 2021	
/L.S/	3	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00243, December 23, 2021	
/L.S/	4	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00234, December 21, 2021	
/L.S/	5	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00253, January 18, 2022	
/L.S/	6	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00324, January 13, 2022	
/L.S/	7	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00281, January 18, 2022	
/L.S/	8	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00302, January 13, 2022	
/L.S/	9	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00369, February 18, 2022	
/L.S/	10	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00388, February 18, 2022	
/L.S/	11	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-00410, February 18, 2022	

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/L.S/	12	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-01078, June 9, 2022	
/L.S/	13	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-01099, June 9, 2022	
/L.S/	14	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-01106, June 9, 2022	
/L.S/	15	SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS, AMERICA, INC., v. STATON TECHIYA, LLC, IPR2022-01098, June 9, 2022	

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Signature	/John P. Keady/	Date (YYYY-MM-DD)	2022-06-29
Name/Print	John P. Keady	Registration Number	56389

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First Named Inventor	Steven Wayne Goldstein
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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.S/	1	8600085		2013-12-03	Shaohai Chen, et al.	
/L.S/	2	9584896		2017-02-28	Lethinal Kennedy	
/L.S/	3	9270244		2016-02-23	John Usher, et al.	
/L.S/	4	9936297		2018-04-03	George Joseph Dennis	
/L.S/	5	9508335		2016-11-29	Benjamin D. Benattar, et al.	
/L.S/	6	10499139		2019-12-03	Alaganandan Ganeshkumar	
/L.S/	7	8798283		2014-08-05	Daniel M. Gauger, et al.	
/L.S/	8	9953626		2018-04-24	Daniel M. Gauger, Jr., et al.	

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/L.S/	1	20170345406		2017-11-30	Archiveades Georgiou, et al.	
/L.S/	2	20140241553		2014-08-28	Victor Tiscareno, et al.	
/L.S/	3	20070177741		2007-08-02	Matthew Williamson	
/L.S/	4	20080205664		2008-08-28	Ju Yun Kim, et al.	
/L.S/	5	20110103606		2011-05-05	Michael W. Silber	
/L.S/	6	20170345406		2017-11-30	Archiveades Georgiou, et al.	

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/L.S/	1	20080111004	KR		2008-12-22	요한 부르스마		
/L.S/	2	2013501969	JP		2013-01-17	アーチビーディス ジョージョウアントニー ゼノノス		

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/L.S/	3	TWM568011U	TW		2018-10-01	劉上杰胡世昌		
/L.S/	4	WO2008077981	WO		2008-07-03	Farzin Tahmassebi		
/L.S/	5	ES2273616	ES		2007-12-16	Farzin Tahmassebi		
/L.S/	6	CN105554610	CN		2019-01-04	刘崧赵剑		
/L.S/	7	EP2963647	EP		2019-07-31	James M. Kirsch, et al.		
/L.S/	8	CN203761556	CN		2014-08-06	许季明		
/L.S/	9	CN105637892	CN		2020-03-13	D·S·布里格斯T·E·泰勒		
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Filing Date	2021-03-29
First Named Inventor	Steven Wayne Goldstein
Art Unit	2651
Examiner Name	LAO, LUNSEE
Attorney Docket Number	CONT2-16247186

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	1	Olwal, A. and Feiner S. Interaction Techniques Using Prosodic Features of Speech and Audio Localization. Proceedings of IUI 2005 (International Conference on Intelligent User Interfaces), San Diego, CA, Jan 9-12, 2005, p. 284-286.	
	2	Bernard Widrow, John R. Glover Jr., John M. McCool, John Kaunitz, Charles S. Williams, Robert H. Hearn, James R. Zeidler, Eugene Dong Jr, and Robert C. Goodlin, Adaptive Noise Cancelling: Principles and Applications, PROCEEDINGS OF THE IEEE, VOL. 63, NO. 12, DECEMBER 1975	
	3	Mauro Dentino, John M. McCool, and Bernard Widrow, Adaptive Filtering in the Frequency Domain, PROCEEDINGS OF THE IEEE, VOL. 66, NO. 12, DECEMBER 1978	

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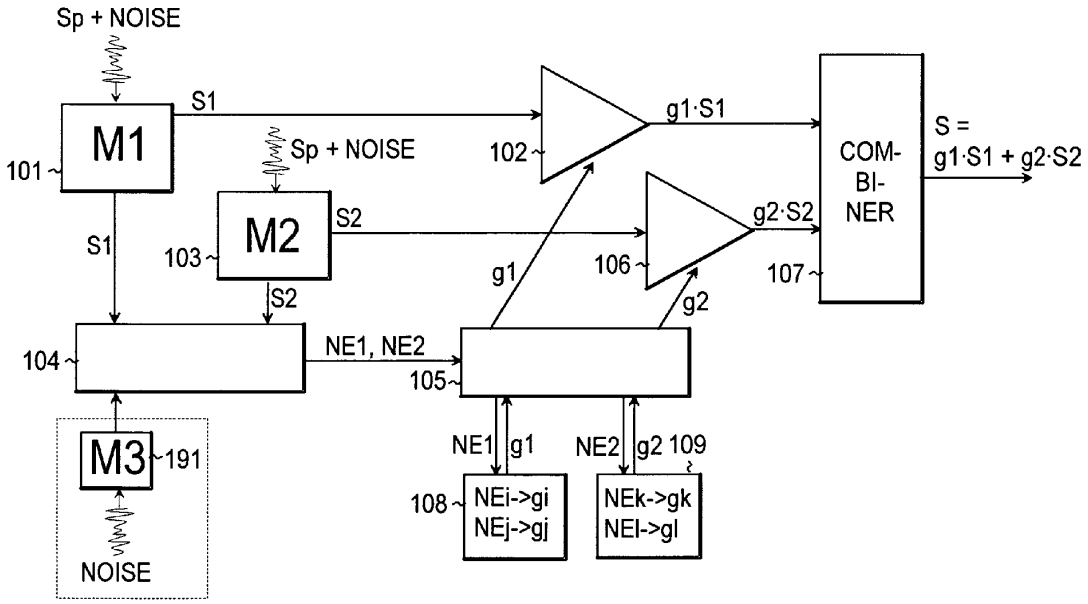
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(54) A system and method for reducing the effect of background noise

(57) Acoustical signals are collected with two microphones having different sensitivity to background noise. The level of background noise is estimated, and depending of the level of background noise, i) the amplification gain of the signals is modified before the signals are combined to a combined signal, or ii) the way of combining the signals is changed, to produce a signal that has less background noise than one of the microphones.

FIG 1



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Description

Field of the invention

[0001] The invention relates generally to enhancing speech quality in a telecommunications system, and more specifically to reducing the effect of background noise in the communication between users.

Background of the invention

[0002] Due to the recent explosive increase in the mobile device penetration, it is no more surprising to see people going on the sidewalk or pedestrian area with a mobile phone on their ear. The mobile phone is considered as a practical tool and it is supposed to be carried with to almost anywhere. People are supplied with means for being within reach in principle independently of time and location. As a consequence it may sometimes happen that the surroundings are not optimal for convenient telephoning. In fact, the sight of people trying to make a phone call in noisy places, such as restaurants or street corners, is getting more common all the time.

[0003] Technically, to provide the user with a microphone system which operates in a difficult acoustic environment has not been a difficult task in many years. For example, U.S. patent 5,327,506 discloses a speaker/microphone system that should be applicable in background noise levels up to far beyond over 100 decibels. Such a system is suitable for persons in high ambient noise environments, such as for helicopter pilots. The idea in 506 is that the outgoing voice sounds are taken from the air within the external auditory canal of a person while substantially eliminating audio vibration pickup of sound transmitted by bone conduction.

[0004] Another approach for high background noise microphone arrangements is found in U.S. patent 5,659,620. Here the microphone holder is designed for arrangement in its entirety in the outer ear outside the auditory meatus, and the microphone unit being mounted in vibration transmitting tissue contact in a part of the edge of the holder facing the bottom of tragus. As one of the benefits, all surround tones are not cut off thus increasing the comfort of wearing such a device. When people talk, vibrations in the throat and vocal cords are generated. The vibrations propagate through the bony and liquid-filled tissue, and the idea in 620 is that the jawbone which passes near the front part of the outer ear produces a strong transmission and transfers considerably more of the persons speech than if the signal were collected in the throat.

[0005] The idea of getting almost a background free aural image from inside the ear has also been adapted within the area of mobile communications, as illustrated in the international patent application WO 02/07477. In order to reduce and isolate bone conduction of sound, a sound isolation cup serves as a jacket that surrounds a miniature transducer inside the housing of a microphone/loudspeaker element that is placed in the ear.

[0006] However, under low background noise circumstances, the solutions above suffer from a poorer acoustical quality than an ordinary microphone system. In the 620 approach discussed above, the low spectrum dominates the transmitted sound spectrum because of the acoustical properties of the tissue. This means that in order to keep the sound quality acceptable, or at least to have a proper balance in the sound, the low frequencies have to be filtered. In the other two approaches discussed above, because the acoustic conduct from the speech producing organs to the ear is far from optimal, the sound quality gets badly distorted. Hence, prior art solutions can only be considered as enabling solutions, and in order to keep in pace with the challenging market, the wishes of the quality-conscious consumers of a mobile device with a good sound quality and a possibility to use the device also under high background noise conditions need to be fulfilled. The prior art solutions do not serve this purpose.

[0007] It is an object of the invention to bring about a system and method which provides the users of mobile devices with the best possible audio quality under high background noise circumstances and otherwise reduces the effect of the background noise.

Summary of the invention

[0008] This and other objectives of the invention are accomplished in accordance with the principles of the present invention by providing a system in which the processing of collected audio information is changed according to the estimated level of background noise thus reducing its overall effect.

[0009] More specifically, audio information is collected with two transducers having different sensitivity to the background noise. The background noise is estimated and i) amplification gain of the signals is modified before the signals are combined to a combined signal, or ii) the way of combining the signals is changed, which can be done either digitally or analogously.

[0010] According to the first embodiment of the invention, gain of at least one of the amplifiers adapted to amplify the detected signal is adjusted based on the noise estimate. The signal is then amplified using the adjusted gain thus producing at least one amplified signal. After this step, a combined signal is constructed from one or more of the amplified signals, and in the combined signal, the proportion of background noise is less than in one of the detected signals.

[0011] According to one aspect of the present invention, the system has also storage means for storing at least one noise estimate, and, correspondingly, also comparison means to compare said stored noise estimate with a predefined threshold value. After the comparison, a differential noise estimate is passed to gain control means.

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[0012] According to another aspect of the present invention, the system comprises storage means for storing at least two gain control parameters and comparison means for comparing at least two stored gain control parameters. The result of the comparison may be a differential gain parameter to be passed to the amplification means.

[0013] According to another aspect of the present invention, the gain control is adjusted to change the gain between the first and second microphones so that the gain of the first microphone is increased whereas the gain of the second microphone is decreased if the noise estimate indicates that the background noise level is above a first threshold value. Further, the gain control can be adjusted to change the gain of the second microphone substantially close to zero value if the background noise estimate shows that the background noise level is above a second threshold value. Respectively, they can be adapted to adjust the relative gain of the first microphone substantially close to one if the background noise estimate shows that the background noise level is above a pre-set threshold value.

[0014] In one preferred embodiment of the invention the first microphone is to be placed in the auditory canal of a user of the mobile handset; also a jawbone microphone can be used. The second microphone may be a microphone mounted in the mobile handset or in a vehicle, or it may be fixed in a hands-free set of a mobile handset. Examples of such mobile handsets where the invention may be used are mobile phones, PDA devices, laptop computers, dictation machines and so forth.

Brief Description of the Drawings

[0015] In the following, the invention and its preferred embodiments are described more closely referring to the examples shown in FIG. **1-7** in the appended drawings, wherein:

FIG. **1** illustrates one system for reducing the effect of background noise,

FIG. **2** illustrates another system for reducing the effect of background noise,

FIG. **3** shows one microphone set-up according to a preferred embodiment of the invention,

FIG. **4A** shows another microphone set-up according to another preferred embodiment of the invention,

FIG. **4B** illustrates a variation of the set-up shown in FIG. **4A**,

FIG. **5** shows one audio data collection set-up including two microphones,

FIG. **6** illustrates the relationship between noise level estimate and gains with which the signals detected by the microphones are amplified, and

FIG. **7** illustrates how a switch can be included into the system.

Detailed description of the invention

[0016] FIG. **1** illustrates a first system for reducing the effect of background noise, for example, in a microphone. Mechanical vibrations or pressure variations, preferably originating from speech $\mathbf{S_p}$ distorted by noise, is collected with a first transducer serving as a microphone **101**, producing a signal $\mathbf{S_1}$ which is then amplified with a gain $\mathbf{g_1}$ using an amplifier **102** to produce an amplified signal $\mathbf{g_1S_1}$. The system also includes another microphone **103** and a corresponding amplifier **106**, the microphone **103** similarly being exposed to speech $\mathbf{S_p}$ and background noise and producing first a signal $\mathbf{S_2}$ which is after amplification denoted by $\mathbf{g_2S_2}$, where $\mathbf{g_2}$ corresponds to the gain of the amplifier **106**. Both microphones **101** and **103** are transducers that convert acoustical or mechanical vibrations to an electric signal, i.e. normally to a small current, and they exhibit different sensitivity to background noise. The reason for the different noise sensitivity may be that the first microphone **101** is a bone conductor microphone or an earplug type microphone, whereas the second microphone **103** is a normal type transducer commonly used as a microphone in mobile terminals, and therefore more sensitive to noise than the aforementioned types of microphones.

[0017] Preferably, the microphones **101** and **103** are assembled to receive human speech $\mathbf{S_p}$, and in particular such a speech that is going to be further processed in a mobile terminal to be sent to a remote party of the discussion. It is by no means necessary that the speech $\mathbf{S_p}$ to be collected by the microphone (**101** or **103**) is originating from a single person, but may be originating from a conference call etc.

[0018] The output signals $\mathbf{S_1}$ and $\mathbf{S_2}$ of the microphones **101** and **103** are transmitted to a noise estimator **104** which includes means adapted to estimate background noise level thus producing noise estimates $\mathbf{NE_1}$ and $\mathbf{NE_2}$. The noise level can be estimated for both microphones **101** and **103** separately, the output signals **S1** and **S2** of both microphones **101** and **103** may be used to obtain a combined signal from which the noise is estimated, or only the output of the microphone **103** more sensitive to background noise may be used for noise estimation. In the latter two cases only one noise estimate is produced.

[0019] For example, the noise estimation can be done by averaging short periods of the signal **S1** or **S2**. During a silent period, i.e. when the user does not speak, the measured signal level is a good approximation of the

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background noise. This kind of approach is commonly used in the Discontinuous Transmission DTX widely used in the Global System for Mobile communications GSM, when instead of the coded silence only so called DTX parameters describing the nature of the background noise are sent, thus reducing obsolete usage of the air interface. The DTX parameters are received in the remote end or in the network between persons talking to each other and some noise similar to background is generated, calling this generated noise Comfort Noise. The idea of Comfort Noise comes from the observation that if during a telephone conversation the loudspeaker gets silent while one person is talking, he or she does not feel comfortable. Modern GSM mobile phones, for example, thus already have means for estimating and describing background noise. Similar means can be applied in the noise estimator 104 for serving the implementation of the invention.

[0020] The noise estimates $\mathbf{NE_1}$ and $\mathbf{NE_2}$ generated are passed to a gain control means **105**. The gain control means **105** adjust the gain $\mathbf{g_1}$, $\mathbf{g_2}$ of the both amplifiers **102** and **106**. In the adjustment, a noise estimate $\mathbf{NE_1}$ or $\mathbf{NE_2}$ is used to determine the desired amplification gain. For this purpose the system may include storage means for noise-amplification relationships, including means **108** and **109**, e.g. tables or functions which respond with a desired gain level $\mathbf{g_x}$ to a query including a corresponding noise level $\mathbf{NE_x}$. For example, means 108 return a gain value $\mathbf{g_1}$ in response to noise estimate $\mathbf{NE_1}$, and means **109** return a gain value $\mathbf{g_2}$ in response to noise estimate $\mathbf{NE_2}$.

[0021] In other words, means **108** and **109** tell the gain control means **105** what is the optimal relation between a noise estimate NE_x and an amplifier gain g_x. Means **108** and **109** are preferably microphone specific, i.e. there are two tables in the system. The gain control means **105** get the noise estimate NE_x, retrieve the gain values g_x corresponding the estimate of present noise NE_x and determine how the gain $\mathbf{g_1}$ and $\mathbf{g_2}$ of the amplifiers **102** and **106** is to be adjusted. In principle, the gain values $\mathbf{g_1}$ and $\mathbf{g_2}$ get values between 0 and 1 so that $g_1 + g_2 = 1$.

[0022] After passing the gain adjustment information $\mathbf{g_1}$ and $\mathbf{g_2}$ to the amplifiers **102** and **106**, the amplifiers amplify the signals S_1 and S_2 using the amplifier gain set based on the gain adjustment information. After amplifying, a combined signal **S** is constructed in the combining means **107**, the construction being made using the amplified signals $\mathbf{g_1S_1}$ and $\mathbf{g_2S_2}$. This may include changing the delay and phase of at least one of the signals g_xS_x so that the distortion resulting from the amplification and the signal path is minimised, and finally summing up the signals g_xS_x so that the combined signal **S** represents a linear combination of the signals $\mathbf{S_1}$ and $\mathbf{S_2}$ detected by the microphones **101** and **103**. This constructed signal S is then ready for being processed further, including all of the numerous steps necessary for transmitting the audio information over the air interface. The combined signal **S** has a smaller proportion of background noise than the output signal $\mathbf{S_2}$ of microphone **103** collected. In this way the effect of background noise can be reduced.

[0023] Preferably, the tables **108** and **109** are generated so that corresponding to a change ΔNE $(=NE_{t=t2}-NE_{t=t1})$ in the noise level NE_x there is a corresponding change Δg $(=g_{t=t2}-g_{t=t1})$ in the gain value g_x. As characteristic to one aspect of the present invention, the gain adjustments of the amplifiers **102**, **106** are opposed to each other; i.e. when the background noise is increasing, the gain $\mathbf{g_1}$ of the signal detected by the first (low-noise) microphone **101** is increased whereas the gain $\mathbf{g_2}$ of the signal detected by the second (more sensitive to background noise) microphone **103** is decreased. It is favourable to normalise the gains so that the relative gain for the both microphones equals to 1.

[0024] In other words, the means **108** and **109** are modified to correspond to the different noise behaviour of the two transducers so that the linear combination of the signals $\mathbf{S = g_1S_1 + g_2S_2}$ detected by the two transducers serving as microphones **101** and **103** can be subjectively (by listening) considered optimal. This may include different threshold values: The first threshold value corresponds to the value of at least one of the noise estimates, at which value the quality of signal $\mathbf{S_2}$ of the second microphone **103** that is more sensitive to background noise starts to deteriorate; this is the point where the relative gain of the first microphone **101** is increased from substantially zero gain value to a small value. The second threshold value corresponds to the value of at least one of the noise estimates NE_x at which the quality of the detected signal of the second microphone **103** is so much worse than the quality of the signal $\mathbf{S_1}$ detected by the first microphone **101** that the relative gain $\mathbf{g_2}$ of the second microphone **103** is set to substantially zero gain.

[0025] As an example, if the first microphone detects a background noise level of 2,0 mV (corresponding to a noise 70 dB) and the second microphone detects a background noise level of 5,0 mV (corresponding to a noise of 72 dB), the average noise level estimated in the noise estimator may be between 70 and 72 dB. The relative gains for the microphones read from the table are then 0,4 and 0,6, respectively. This is not straightforward, because the sensitivity of the microphone plays a significant role; the signal levels may need to be adjusted to correspond some reference level. The relative gains are then to be understood against this reference level only.

[0026] When the detected background noise jumps to 2,2 mV (71 dB) and 7,0 mV (76 dB), the average noise level may be estimated to be between 71 and 76 dB. The relative gains for the microphones read from the table are then 0,95 and 0,05, respectively. The second microphone is more sensitive to the background noise, i. e. the background noise generates a bigger impulse in the microphone. Secondly, the second microphone is

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not yet shut-off completely, because the noise level is not above a defined shut-off threshold value for background noise.

[0027] The transition at different moments of time between subsequent values of the relative signal $\mathbf{S_1}$ and $\mathbf{S_2}$ proportions in the combined signal **S** defined by a ratio $\mathbf{g_1/g_2}$ (when $g2 \neq 0$) can thus be made smooth or at least to correspond small steps in order to avoid abrupt transitions that might be considered annoying by the listener. This corresponds to successive changes of $\mathbf{g_1}$ and $\mathbf{g_2}$. Nevertheless, it is to be noted that this is not necessary, but the transition may resemble a step function, i.e. the gain $\mathbf{g_1}$ for the signal detected by the first microphone **101** is zero below a threshold value and one otherwise, and the gain $\mathbf{g_2}$ for the signal detected by the second microphone is then reversed, i.e. it obtains values $1\text{-}\mathbf{g_1}$.

[0028] FIG. **6** shows an example of the relation between estimated noise level $\mathbf{NE_2}$ estimated from the signal $\mathbf{S_2}$, and the amplifier gain g_1. In this case, $g_2=1\text{-}\mathbf{g_1}$. At times preceding **TA**, $\mathbf{NE_2}$ is smaller than the first threshold value. Correspondingly, $\mathbf{g_1}=0$ and $g_2=1$. At **TA**, the value of $\mathbf{NE_2}$ is increasing, so $\mathbf{g_1}$ is stepwise increased. At **TB**, $\mathbf{NE_2}$ has reached the second threshold value, and $\mathbf{g_1}$ is set to one. At **TC**, $\mathbf{NE_2}$ is again smaller than the second threshold value, so the value of **g1** must be decreased. At **TD**, $\mathbf{NE_2}$ falls below the first threshold value and **g1** is set to zero value. At the time interval $\mathbf{P_1}$ the change in $\mathbf{NE_2}$ is less than the threshold $\Delta\mathbf{NE}$ set for the change of **NE**, so during this interval $\mathbf{g_1}$ is not changed. Immediately after $\mathbf{P_1}$, when the change in $\mathbf{NE_2}$ is larger than the threshold value, the $\mathbf{g_1}$ is changed by $\Delta\mathbf{g}$. During the interval $\mathbf{P_2}$, $\mathbf{g_1}$ is not changed because $\mathbf{NE_2}$ shows sharp peaks; this may present some distortion so the changes are neglected.

[0029] The second predefined threshold value can be chosen to be a fixed value as well. The value may be experimentally determined to correspond to the level of background noise in which the input signal of the second microphone **103** has been deteriorated in such a bad way that in order to get a better signal quality for the signal **S**, only the input signal $\mathbf{g_1S_1}$ is used.

[0030] FIG 7 shows how a second system according to the invention, the system having only a stepwise transition for the value of $\mathbf{g_1}$. Speech **Sp** and noise are detected by microphones **101** and **103** producing signals **S1** and **S2**. Background noise is collected by a third microphone **191** directly connected to noise estimator **104**. The noise estimator estimates the level **NE** of background noise and passes it to gain control means **705**. The gain control means **705** are adapted to compare the noise level estimate **NE** with a predefined threshold value. If the value of **NE** is less than the threshold value, **g1** is set to zero, otherwise **g1** gets the value of 1. The value of **g1** indicates the position of a switch **SW1** controlled by the gain control means **705**, the switch **SW1** being so arranged that the terminals **TE1** and **TE2** are connected when **g1=1**; **TE1** and **TE3** are connected in all other cases. The terminal **TE1** leads to amplification means **702** which produce an amplified signal **AS**. Because only one signal is fed (S1, if TE1 and TE2 are connected) to the amplifier, no literal combining of the signals (S1, S2) need to be performed.

[0031] The switch turns the relative gain $\mathbf{g_2}$ of the second microphone to zero and the relative gain of the first microphone $\mathbf{g_1}$ to one. In this case the function of the switch **SW1** and amplification means **702** may be understood as linear amplification with amplification factor 1.0 when the signal received by a microphone is amplified and zero otherwise.

[0032] Further, in order to avoid annoying abrupt transitions between the first and second microphones, or to avoid fluctuations in the microphone gains, the system like presented in FIG. **1** may comprise also storing means adapted for storing noise parameters in order to form a noise history. The noise parameters can be calculated for one microphone, both microphones separately or they can be obtained by combining the values computed from the inputs of the both microphones. One possibility is to use the second microphone input as the preferable source for noise estimation, as the first microphone is less sensitive to background noise.

[0033] If history data is collected, the system may further be adapted to have a hysteresis effect, i.e. if the noise level is having fluctuations back and forth, the system can adapt the threshold value to correspond a larger shift in the background noise. In order to have a hysteresis effect, there are storage means and comparison means; the hysteresis information may be obtained from a stored table, the table being read in a way taking into account the noise level history.

[0034] Similarly, the history data may be used for making prognoses or extrapolations for the noise level, and in this way the system may, based on the noise level measured at least in two earlier moments of time, predict a noise level in the future thus making the possibly larger transitions in gains over a longer period of time.

[0035] A third microphone **191** is optionally included in the system. Its main purpose is to detect background noise. It may be located in the vicinity of the noise estimation means **104** so that the transmitting of the signal to the noise estimation means **104** from the microphone **191** is straightforward. In this case the signals $\mathbf{S_1}$ and/or $\mathbf{S_2}$ need not to be passed from the other two microphones **101** and **103** to the noise estimator **104**. This makes the system simpler, as the signal from microphones **101** and **103** need only travel the path to amplifiers **102** and **106**. For example, in a wireless hands-free set the microphone **101** is located in one ear of the user, whereas the second microphone **103** is fixed in the car of the user. The amplifiers are located close to the microphones, especially because the signals are to be transmitted over the air interface to the combiner means **107**. This means that the noise estimator **104** and gain control means **105** need to instruct the amplifiers **102** and **106** separately; the noise may be measured by the

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microphone **191**, and the gain parameters $\mathbf{g_1}$ and $\mathbf{g_2}$ be broadcast to the amplifiers **102** and **106**.

[0036] FIG. **2** shows a third system according to the present invention. The transducers **101** and **103** are exposed to speech signal $\mathbf{S_p}$ distorted by background noise. They detect acoustical vibrations, i.e. mechanical vibrations or pressure changes. Amplifiers **202** and **206** amplify the signals $\mathbf{S_1}$ and $\mathbf{S_2}$ with constant gains thus producing amplified signals $\mathbf{AS_1}$ and $\mathbf{AS_2}$, respectively. An Analog to Digital Converter ADC **207** converts the signals $\mathbf{AS_1}$ and $\mathbf{AS_2}$ pre-amplified by amplifiers **102** and **106** into a digital form. In addition to performing this step, the **ADC** may further include combining means to form a combined signal S from at least one of the amplified signals $\mathbf{AS_1}$ and $\mathbf{AS_2}$ in such a manner that the relative ratio of the signals may be altered. The combining may be performed digitally, thus possibly including multiplication and summing operations, or it may be performed for the analog signals before the conversion.

[0037] The noise level is detected in noise estimator **204**, including tables **208** and **209** showing noise responses of the microphones **101** and **103** in a manner similar to the tables discussed above. The noise estimates NE_x are then used to deduce the target gain factors g_x. The target gain factors $\mathbf{g_1}$ and $\mathbf{g_2}$ which correspond to combining parameters are lead to the combining means of the ADC **207**, where the ADC either, based on the combining parameters g_1 and g_2, performs the conversion and only after that digitally multiplies the converted signal by the gain factor, or, uses the target gain factor to change the relative strength of the signals before the conversion.

[0038] In a fourth system according to the present invention, the system may have storage means for storing at least one noise estimate $\mathbf{NE_1}$ or $\mathbf{NE_2}$ in the noise estimator **104**, whereas the system otherwise corresponds to the system already discussed with reference to FIG. **1**. This means that at least one noise estimate $NE_t=_{tpast}$ value may be stored, and, correspondingly, at a later point in time $t=t_1$, at least one other noise level estimate $NE_{t=t1}$ may be stored as well. The stored noise estimates may be compared using comparison means located preferably in the noise estimator **104**. The comparison may involve computing a noise level difference $\Delta NE = NE_{t=t1}-NE_{t=tpast}$ describing the changing of the background noise level. This difference may be transmitted then to gain control means **105** which change gains according to a function $\Delta g=f(\Delta NE)$. It is also possible that the difference is not passed to gain control means **105** if it does not exceed a preset threshold value, i.e. if $\Delta NE < \Delta NE_{threshold}$; only changes in the gain when the change in the background noise level is larger than the threshold value are passed to the amplifier **102** or **106**. In this case the older value measured at t_{past} may remain stored in the register and newer noise estimates $NE_{t=t1'}$ calculated at times $t_1' > t_1$ are overwritten on the value $NE_{t=t1}$.

[0039] A fifth system in accordance with the present invention, the system comprises storage means such as a register in the gain control means **204** in addition to other components as discussed with reference to FIG. **2**. The storage meansmay be used for storing at least two gain control parameters. Further, the system may also include comparison means for comparing at least two stored gain control parameters. Like discussed above, the comparison of the parameters may include performing some mathematical operations, like calculating the difference between a newer and an older gain parameter value, and, in the case that a pre-set threshold value for the difference is exceeded, which can be checked again by comparison, the system may calculate a new gain to be passed to the ADC **207**. The new gain may also be selected from a plurality of different gain set-ups, if the system is to be kept simple and fast.

[0040] FIG. **3** shows a microphone set-up according to one preferred embodiment of the present invention. The mobile phone in the figure has two microphones **M1** and **M2**. The second microphone **M2** is an ordinary microphone denoted by asterisks **30** describing holes in the cover of the bottom half of the phone. The first microphone **M1** is located close to the loudspeaker which is denoted by asterisks, whereas the microphone **M1** is denoted by arc **31**. Because the loudspeaker is - usually - placed close to the ear, using a jawbone contact element as the microphone **M1**, the vibrations in the jawbone of the user can be detected thus producing a signal S_1. The sensitivity of **M1** to disturbances from the loudspeaker is reduced because **M1** detects mechanical vibrations from the jawbone of the user.

[0041] FIG. **4A** further illustrates a microphone set-up according to one other preferred embodiment of the present invention. The first microphone **M1** is located in an earplug-like element which can measure the air vibrations in the ear canal (i.e. auditory canal) of the user of the mobile device. Depending of the actual realisation of the invention, this earplug microphone can be similar to those disclosed in the referenced publications. Some of the prior art earplug microphones have a wireless transmitter, such as a BLUETOOTH transmitter.

[0042] A solution according to FIG. **4A** is especially suitable for different hands-free applications. For example, many countries in Europe have recently adopted restrictions for usage of mobile phones while driving a vehicle. In order to comply with the legislation, a driving mobile user willing to receive a phone call need either to stop or to have a hands-free equipment installed in his or her car.

[0043] Some hands-free equipment sets include a speaker, a microphone and then some wiring systems, possibly with an extra antenna. The speaker is typically mounted somewhere in the cabin, whereas the microphone is located close to the head of the driver. As known, even though some of the different speech codecs widely used in the mobile devices enhance the speech quality in noisy environments, such as in a moving car, the background noise may still be annoying and,

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depending of the car, even make the discussion impossible, depending on the circumstances such as other traffic, speed of the vehicle, road conditions etc. This drawback can be eliminated if the user is supplied with an earplug-like device in addition to the normal hands-free set installed in the car. As an alternative, a jawbone microphone can be used as well, while there are some of them available on the market already. Preferably the first microphone (either earplug or jawbone) is equipped with a wireless transmitter. Then either the mobile handset or the hands-free set includes a receiver to receive the transmitted audio information, such as BLUETOOTH low-power RF data.

[0044] The transmitter needs not to be wireless but may be a conventional earplug microphone as well like illustrated in FIG. **4B**, where there is a wire including two lines, one for the signal and one for the ground level. In the other end the wires may be connected to the front panel of the car, the panel supplying a plug-in for the microphone data and further connected to the hands-free set, or directly to the mobile handset.

[0045] FIG. 5 illustrates another option for implementing the invention. Here the first and second microphones are included in a headset kit of a mobile phone. Typically, the headset kit includes a plug **501** which is connected to a mobile phone or a car front panel. The handset provides hands-free operation and may also include an answer/end button located in the second microphone **M2** or somewhere else in the cable. The earplug including a loudspeaker may also include an earplug microphone **M1**, provided that the acoustical separation of the loudspeaker and microphone can be guaranteed, or a jawbone microphone, where the acoustical separation should be a minor problem.

[0046] For a person skilled in the art it is also clear that no implicit tables like those described with reference to FIG. **1** and **2** are necessary. Depending on the number of steps for different amplifications needed, the system can be coded directly if the number is low, otherwise also a numerical model which interpolates some experimentally tested values may also be used.

[0047] Although the invention was described above with reference to the examples shown in the appended drawings, it is obvious that the invention is not limited to these, but it may be modified by those skilled in the art without departing from the scope and the spirit of the invention.

Claims

1. A system for reducing the effect of background noise especially in a mobile handset, the system comprising

   - a first transducer (101) for detecting an acoustical signal producing a first signal detected (S1),
   - a second transducer (103) for detecting an acoustical signal producing a second signal detected (S2), the first and second transducers having different sensitivities to background noise,
   - amplifier means (102, 106) for amplifying the first and/or second signal (S1, S2) detected thus producing at least one amplified signal (g1S1, g2S2),
   - noise estimator means (104) adapted to estimate a background noise level present at least in one of the detected signals (S1, S2) or in a signal measured by a third transducer (191) thus producing at least one noise estimate (NE1, NE2),
   - gain control means (105), responsive to said noise estimator means (104, 204), adapted to adjust gain (g1, g2) of the amplification means (102, 106, 207), the adjustment being made depending on at least one noise estimate (NE1, NE2), and
   - combining means (107), adapted to form a combined signal (S) from at least one amplified signal (g1S1, g2S2) thus reducing the effect of background noise.

2. A system according to claim 1, **wherein** the noise estimator means are connected to the first and/or second transducer (101, 102) for receiving noise level information.

3. A system according to claim 1 or 2, the system further **comprising**

   - storage means for storing at least one noise estimate, and
   - comparison means for comparing the stored noise estimate with a predefined threshold value, the comparison producing a differential noise estimate to be passed to gain control means (105).

4. A system according to claim 1 or 2, the system further **comprising**

   - storage means for storing at least two gain control parameters, and
   - comparison means for comparing the two gain control parameters, the comparison producing a differential gain parameter to be passed to the amplification means.

5. A system according to claim 1 or 2, **wherein** the gain control means (105) are adapted to adjust gain (g1, g2) between the first and second amplifiers (102, 106) so that the gain (g1) of the first amplifier (102) is increased whereas the gain (g2) of the second amplifier (106) is decreased if the noise esti-

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mate (NE1, NE2) indicates that the background noise level is above a first threshold value.

6. A system according to claim 1, 2 or 5, **wherein** the gain control means (105, 207) are adapted to adjust gain (g2) of the second amplifier substantially close to zero value if the background noise estimate (NE) shows that the background noise level is above a second threshold value.

7. A system according to claim 1, 2, 5 or 6, **wherein** the gain control means (105, 207) are adapted to adjust the relative gain of the first transducer substantially close to one if the background noise estimate (NE) shows that the background noise level is above a pre-set threshold value.

8. A system according to claim 1, **wherein** the construction is performed by adding the amplified signals (g1S1, g2S2).

9. A system according to any one of the preceding claims, **wherein** the first transducer (101) is a microphone to be located in the auditory canal of a user of the mobile handset.

10. A system according to any one of the preceding claims, **wherein** the first transducer (101) is a jawbone microphone.

11. A system according to claim 9 or 10, **wherein** the second transducer (103) is a microphone mounted in the mobile handset.

12. A system according to claim 9 or 10, **wherein** the second transducer (103) is a microphone fixed in a hands-free set of a mobile handset.

13. A system according to claim 1 or 2, **wherein** said gain control means (105, 207) are located in the mobile handset or in the hands-free set of a mobile handset.

14. A method for reducing the effect of background noise especially in a mobile handset, the method **comprising** the steps of

- collecting a first acoustical signal (S1),
- collecting a second acoustical signal (S2), whereby in the collected signals (S1, S2) a different level of background noise is present,
- estimating background noise level from at least one of the signals (S1, S2) collected,
- in response to said estimating step, adjusting gain (g1, g2) of at least one amplifier (102, 106) adapted to amplify signals collected (S1, S2),
- in response to said adjustment step, amplifying said collected first and/or second signal (S1, S2) to produce at least one amplified signal (g1S1, G2S2), and
- in response to said amplifying step, constructing a combined signal (S) from at least one amplified signal (g1S1, g2S2) thus reducing the effect of background noise in the combined signal.

15. A method according to claim 14, further **comprising** the steps of

- producing and storing at least one noise estimate (NE1, NE2) in the background noise estimation step, and
- comparing said stored noise estimate (NE1, NE2) with a predefined threshold value, the comparison result being used in the gain adjustment step.

16. A method according to claim 14, further **comprising** the steps of

- in the gain adjusting step, storing at least two gain control parameters, and
- comparing at least two stored gain control parameters in order to decide whether the gain adjusting step is to be taken, the gain adjusting step being performed only if the comparison result shows that a gain control parameter being larger than a predefined threshold value.

17. A method according to claim 14, **wherein** the gain adjustment step is adapted to adjust amplification balance between the signals detected by first and second transducers (101, 103) so that the gain (g1) of the amplifier (101) amplifying the first signal (S1) collected is increased whereas the gain (g2) of the amplifier (106) amplifying the second signal (S2) is decreased if in the noise estimation step it is detected that the background noise level is higher than a first threshold value.

18. A method according to claim 14, **wherein** the gain adjustment step is adapted to adjust gain (g2) of the amplifier amplifying the second signal (S2) substantially close to zero value if the background noise estimate (NE) shows that the background noise level is above a second threshold value.

19. A method according to claim 14, **wherein** the construction step includes adding the amplified signals (g1S1, g2S2).

20. A method according to any one of claims 14-19, **wherein** the first signal is collected using a microphone to be located in the auditory canal of a user of the mobile handset.

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21. A method according to any one of claims 14-19, **wherein** the first signal is collected using a jawbone microphone.

22. A system for reducing the effect of background noise especially in a mobile handset, the system **comprising**

- a first transducer (101) for detecting an acoustical signal producing a first signal detected (S1),
- a second transducer (103) for detecting an acoustical signal producing a second signal detected (S2), the first and second transducer (101, 103) having different sensitivity to background noise,
- amplification means (202, 206) for amplifying the first and/or second signal (S1, S2) detected thus producing at least one amplified signal (AS1, AS2),
- combining means (207) adapted to form a combined signal (S) from at least one of the amplified signals (AS1, AS2) using at least one combining parameter (g1, g2) thus reducing the effect of background noise,
- noise estimator means (204) adapted to estimate background noise level present at least in one of the detected signals (S1, S2) or in a signal measured by a third transducer (191) thus producing at least one noise estimate (NE1, NE2),
- combining parameter generation means (208, 209) adapted to generate at least one combining parameter (g1, g2) in response to at least one noise estimate (NE1, NE2), and
- means (204) for passing the generated combining parameter (g1, g2) to the combining means (207).

23. A method for reducing the effect of background noise especially in a mobile handset, the method **comprising** the steps of

- collecting a first acoustical signal (S1),
- collecting a second acoustical signal (S2), whereby in the collected signals a different level of background noise is present,
- estimating background noise level (NE1, NE2) from at least one of the signals collected or from a third acoustical signal,
- in response to the background noise estimating step, using at least one background noise level parameter (NE1, NE2) for selecting at least one combining parameter (g1, g2), and
- in response to said selecting step, using said summing parameter for combining the first and acoustical signals (S1, S2) to form a combined signal (S) which has less background noise than the second signal collected.

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FIG 1

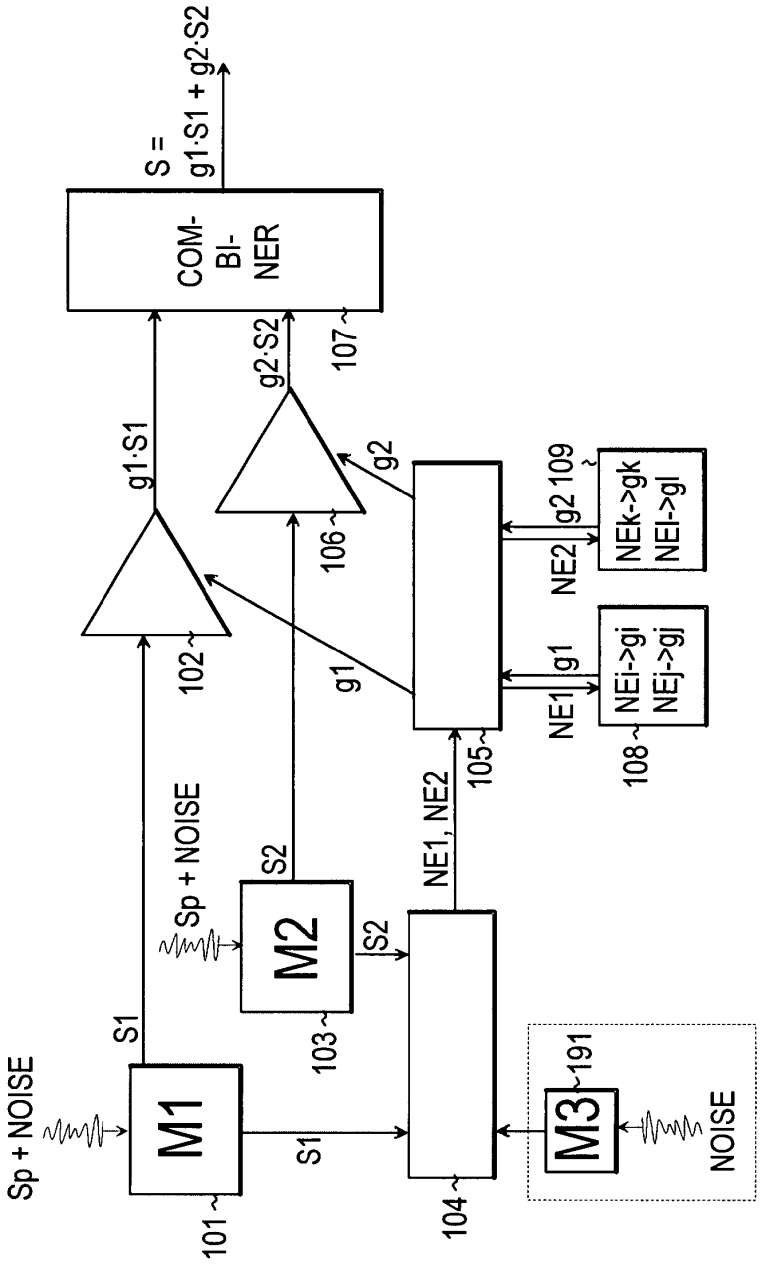


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FIG 2

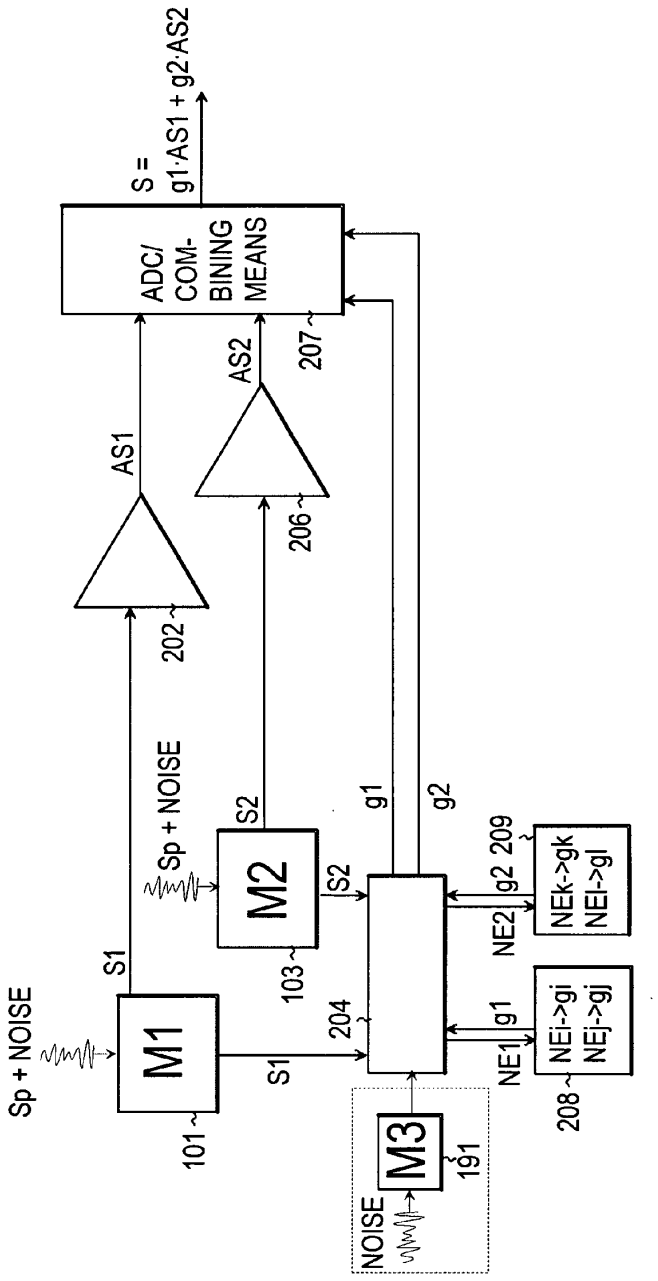


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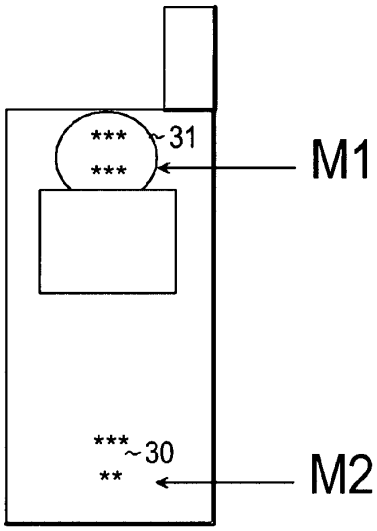


FIG 3
(LEFT)

FIG. 4A

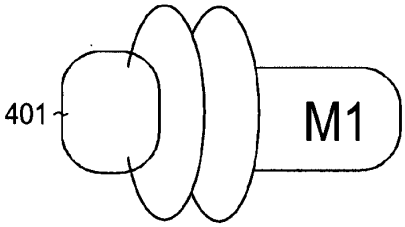
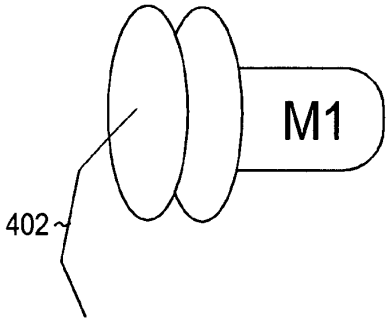


FIG 4B



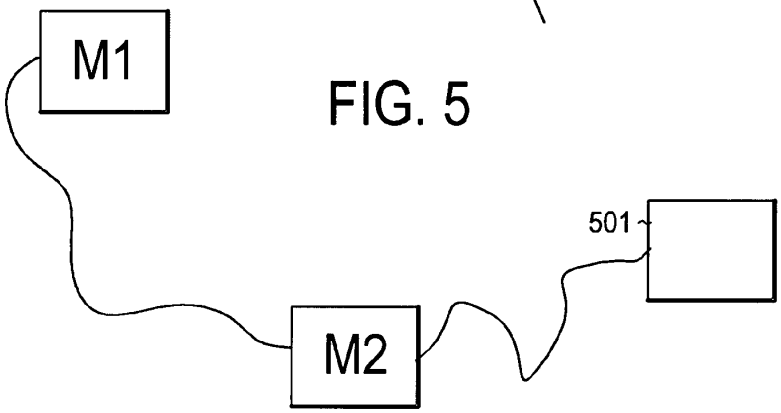


FIG. 5

FIG 6

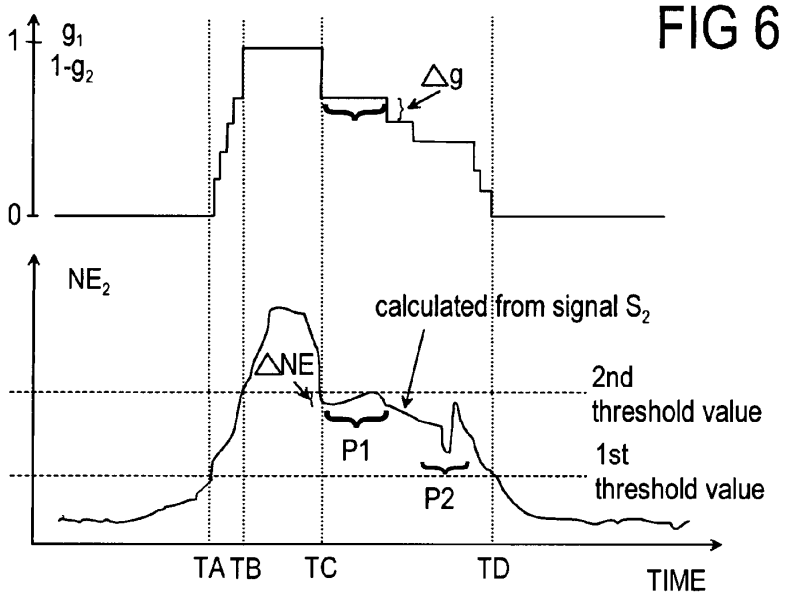


FIG 7

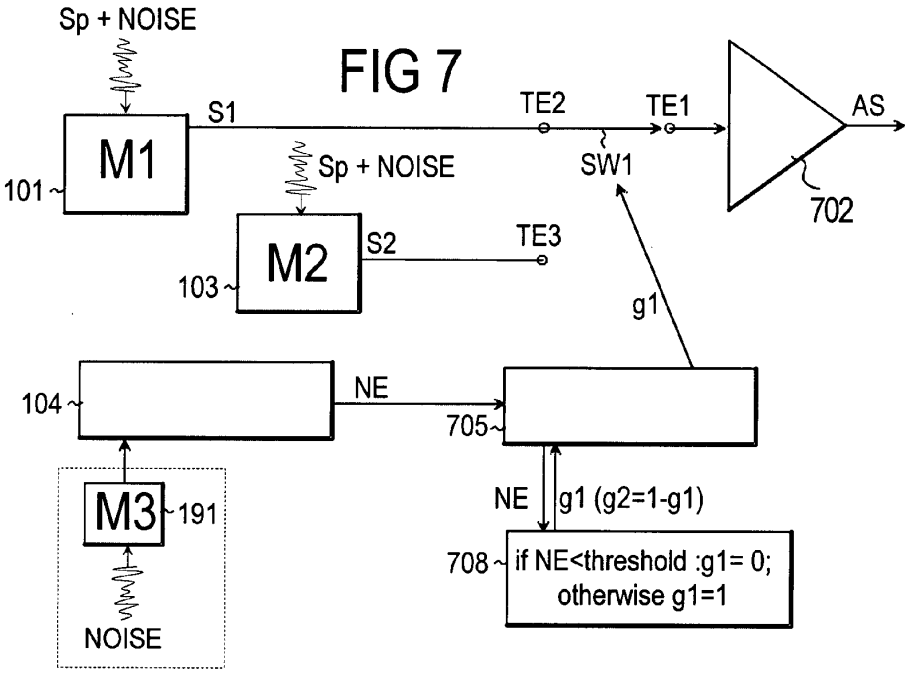


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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 6435

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 640 450 A (WATANABE OSAMU) 17 June 1997 (1997-06-17) * abstract * ---	1-23	H04M9/08 H04M1/60
A	EP 0 767 570 A (NOKIA MOBILE PHONES LTD) 9 April 1997 (1997-04-09) * abstract * ---	1-23	
A	WO 99 05840 A (QUALCOMM INC) 4 February 1999 (1999-02-04) * abstract * -----	1-23	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 December 2003	Montalbano, F

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 6435

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
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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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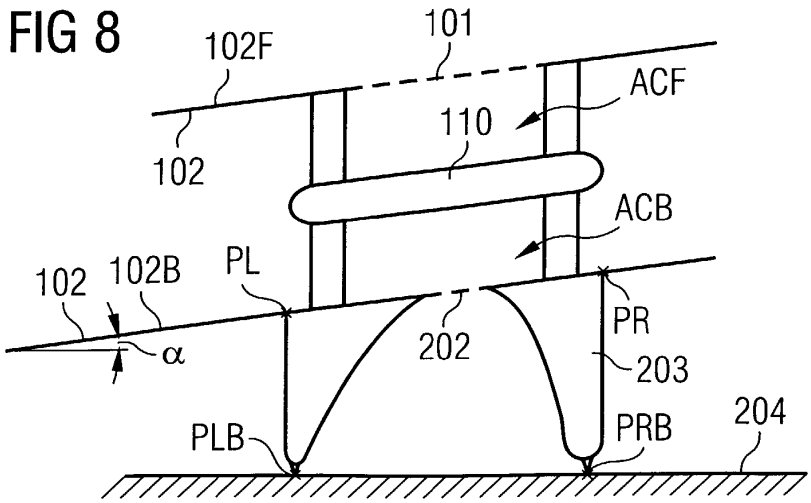
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(54) A dual directional mode mobile terminal and a method for manufacturing of the same

(57) A mobile terminal is equipped with an acoustoelectrical transducer arranged in a housing of the mobile terminal, the housing comprising i) a user sided first inlet aperture in communication with the acoustoelectrical transducer, ii) a second inlet aperture also in communication with the acoustoelectrical transducer, and iii) sealing means for sealing the second inlet aperture when the mobile terminal is placed on an external surface or object. As a result, the mobile terminal has selectable directional characteristics.

FIG 8



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Description

Field of the invention

[0001] The invention relates generally to enhancing speech quality in a telecommunications system, and, more specifically, to enhancing directional properties of a microphone in a mobile terminal.

Background of the invention

[0002] The mobile device boom of the recent years has resulted in different new uses for the mobile terminals widely used in telecommunications. The users expect their new devices to be usable in many different situations. The expectations regarding to the acoustical quality of the device are high, and because the device may be used for various purposes, this sets very high requirements for the design of the terminals.

[0003] As an example of the dual use of the mobile handset, it is very common that the terminal, in addition to its normal use as a handset, is used as a hands-free device. This may be the case when the user is willing to use the mobile terminal in a vehicle, for example, or use it for conference calling. Typically, in the latter case, the mobile terminal is set on a table, the persons willing to speak then usually grouping around the terminal.

[0004] From the acoustical design point of view, the latter kind of use requires quite different acoustical and directional properties of the microphone than the first use mentioned. In conference calling, it is very critical that the microphone shows omni-directional characteristics so that the position of the person speaking does not influence too radically on the sound quality, and when one person is speaking, also comments from the background should be carefully detected.

[0005] On the other hand, when a mobile terminal is used as a handset, it is preferable that the background noise is not detected by the microphone. Normally, the mouth and other sound producing organs of the mobile user are within a predetermined distance from the microphone when he or she is speaking to his or her mobile handset. If human anatomy factors are taken into account, it is easier to design a phone in such a way that the mouth of an average male/female user is quite close to the centre of inlet of the microphone. Thus the microphone should preferably show unidirectional characteristics in order to receive the speech of the user but not noise from his or her background.

[0006] Figure 1 illustrates a prior art mobile terminal 100. The terminal 100 includes housing 102, wherein a microphone 110 is assembled. For the microphone 110 an aperture 101 is important so that the energy of acoustic signals is not attenuated too much which would be the case if the acoustic signals had to traverse through the housing 102.

[0007] Having both omni- and unidirectional characteristics in the acoustical parts of one mobile terminal is not a straightforward task. Some prior art solutions that might be applicable to at least some extent can be found, but they present drawbacks which both an ordinary user and an acoustics designer would find annoying.

[0008] International patent publication WO 01/69967 A2 shows one example of implementing a selectivity switch between a directional mode and an omni-directional mode in a hearing aid device. The switch includes a switch body having a port aperture therein in communication with one of the ports of the microphone, and a switch actuator moveably connected to the switch body and moveable to a first position wherein the port aperture is generally unobstructed by the actuator and a second position wherein the actuator covers the port aperture.

[0009] In the modern mobile lifestyle, a mobile terminal sometimes presents some values of the user of the terminal. Thus, the aesthetic design is very important, and the switch does not support the purpose of creating an aesthetically enjoyable device. Secondly, the shape and form of a hearing aid device is quite different to a mobile phone, basically because the hearing aid device is located in the ear of the user, so the mechanics of the device can be designed in a completely different manner. Therefore the '967 solution cannot be without problems used for ordinary mobile terminals.

[0010] Another solution from U.S. patent 5,933,510, despite of its many advantages, fits only poorly for the acoustical design of a mobile terminal. In '510, a microphone housing includes apertures and a switch; the user may select with the switch, whether or not he or she is willing to use the microphone in omni- or unidirectional mode. Firstly, it is difficult to make the switch and sealing elements to comply with the decorative design desired for the terminal. Secondly, the design of a rotating sleeve for the microphone housing in the manner described in '510 is also extremely challenging.

[0011] It is an object of the invention to bring about a mobile terminal equipped with a sound receiving system having selectable directional characteristics.

Summary of the invention

[0012] This and other objectives of the invention are accomplished in accordance with the principles of the present invention by providing in accordance with any one of the independent patent claims.

[0013] A dual directional mode mobile terminal includes a microphone having been assembled in a housing. The housing includes a first and a second aperture, of which the first aperture is on the user side when the terminal is used as a handset, the first and second apertures forming acoustical conduits to the both sides of the microphone. The housing further includes sealing means for sealing the second aperture together with an external surface, when the mobile terminal is placed on said surface, thereby enabling in the mobile terminal a

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second acoustical directivity mode.

[0014] A method for manufacturing a dual directional mode mobile terminal, includes the steps of i) assembling a microphone into a housing, wherein the housing includes at least a first and a second apertures, of which the first aperture is designed to be on the user side when the terminal is used as a handset, the first and second apertures thus forming acoustical conduits to both sides of the microphone, and ii) assembling the housing with sealing means for sealing at least one of the apertures together with an external surface, when the mobile terminal is placed on said surface, thereby enabling in the mobile terminal a second acoustical directivity mode.

[0015] A mobile terminal which is equipped with an acoustoelectrical transducer arranged in a housing of the mobile terminal, wherein the housing comprises i) a user sided first aperture in communication with the acoustoelectrical transducer, ii) a second aperture also in communication with the acoustoelectrical transducer, and iii) sealing means for sealing the second aperture when the mobile terminal is placed on an external surface or object.

Brief Description of the Drawings

[0016] In the following, the invention and its preferred embodiments are described more closely referring to the examples shown in Figure 2-11 in the appended drawings, wherein:

Figure 1	shows a conventional microphone arrangement in a mobile terminal,
Figure 2	shows a dual-mode mobile terminal according to one aspect of the invention,
Figure 3	illustrates one embodiment of the present invention where acoustic sealing is enhanced by a second support member,
Figure 4	depicts the traverse design aspects in accordance with the invention,
Figure 5	further illustrates one embodiment of the invention,
Figure 6	illustrates a cut of a sealing member 203 from Figure 2,
Figure 7	illustrates the sealing member 203 seen from above,
Figure 8	shows the second acoustical mode closer,
Figure 9A and 9B	show how the directivity mode of the mobile terminal is changed according to one aspect of the present invention,
Figure 10	shows a first measurement result of the mobile terminal in the first directional mode, and
Figure 11	shows a second measurement result of the mobile terminal in the second directional mode.

[0017] Same reference numbers denote similar elements throughout the figures.

Detailed description of the invention

[0018] Figure 2 illustrates one embodiment of the present invention. The mobile terminal has a housing 200, and, as shown in Figure 1 described above, there is also an aperture 101 provided for the speech. The aperture 101 leads sound waves to a microphone 110 that is assembled inside the housing 200. In the housing 200 there is also a second aperture 202. The second aperture 202 is preferably located on the opposite side of the housing 200 so that the apertures 101 and 202 provide acoustic conduits leading to both sides of the microphone.

[0019] For sake of clarity, there are three points marked in the housing. PL and PR are the points where sealing means 203 are attached to the housing 200, and the point PA illustrates the point of the housing that supports the lower end of the housing against a flat surface 204 when the mobile terminal is tilted on said sealing means 203. The sealing means 203 are not drawn to scale; according to one aspect of the present invention their height is some millimetres. Depending on the aesthetic goals of the designer, sealing means 203 that are higher or lower can be used.

[0020] According to one embodiment of the present invention the mobile terminal can be placed on a table 205, for example, or other flat surface 204, so that the sealing means 203 together with the flat surface 204 seal the second aperture 202. The sealing of the second aperture 202 has the effect that the mobile terminal is in omni-directional mode where the microphone 110 receives voice signals mostly through the aperture 101 thus losing some of its directional sensitivity.

[0021] Normally, the microphone 110 is directionally sensitive when both apertures 101 and 202 are open. When both apertures 101, 102 are open, the sound waves coming from the background noise can be understood to cancel each other, i.e. the microphone shows unidirectional characteristics and is well suitable for to be used as a handset of a mobile terminal.

The uni- and omni-directional characteristics of the microphone 110 are herewith referred with the term acous-

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tical modes of the microphone.

[0022] Figure 3 shows another example of implementing the present invention. Instead of only having sealing means 303 such as a sealing member, the mobile terminal now also has a support member 304. In addition, the marked point PB illustrates the effective support point of the support member 304 that is comparable to point PA with reference to Figure 2.

[0023] One function of the support member 304 is to increase the pressure between the sealing means 303 and the flat surface 204. The sealing means 303 are located close to the second aperture 202 which is further located at the spot of the microphone. As the mobile terminal of Figure 2, the mobile terminal can as well be placed on a flat surface 204 thus giving omni-directional characteristics for the mobile terminal. The position PB which is also the position of the second support member 304 may be located based on the weight distribution of the mobile terminal. To the weight distribution influences the weight of the contents of the mobile terminal, i.e. the battery, different electrical parts, the display, and so forth. The PB can be positioned so that the torque caused by the weight of the mobile terminal causes a stronger or greater force on the sealing means 303 and so enhances the sealing made by the sealing means 303 and the flat surface 204. If the sealing means 303 are made of a soft material showing high elastic properties, a good sealing can be provided.

[0024] Figure 4 depicts a cross sectional cut of a mobile terminal. The terminal has a microphone 110 which is positioned inside the housing 200. In the housing 200 there are apertures 101 and 202. The apertures 101, 202 act as inlet holes which form acoustical conduits to both sides of the microphone 110. It is to be noted that the apertures 101, 202 need not to be on opposite sides of the mobile terminal; the only limiting condition is that the acoustical conduits lead to both sides of the microphone. Further, there are support and sealing means 203 at the bottom side of the housing. The design of the sealing means 203 may involve taking into account the curvature of the housing 200. In some mobile terminal models, the housing 200 is strongly curved and, therefore, it is impossible to provide a good enough sealing with sealing means 203 that do not take into account the shape of the bottom of the housing 200.

[0025] Further, Figure 5 illustrates the mobile terminal viewed from below. In the sealing means 203 that is upper part of the mobile terminal housing 200 the aperture 202 and the sealing means 203 are shown.

[0026] Figure 6 illustrates closer the sealing means 203. First, the sealing means 203 have a hole 600 for the acoustical inlet. The contact part 601 of the sealing means 203 has been only marked with a box on the right-hand side, but it preferably extends through the sealing means 203. For example, if the sealing means 203 have the form of a ring like in Figure 5, the part 601 extends around the bottom of the ring.

[0027] Further, aperture part 603 has similarly been marked with a box. The acoustical signals coming from outside the mobile phone in order to reach the inlet hole 600 and to further proceed into the microphone 110 traverse beyond this part. In its design one must take into account the acoustical considerations: Special curvature may be needed in order to provide a proper distortion free acoustical transmission characteristics.

[0028] The sealing means 203 are connected to the mobile terminal using the aperture part 605 of the sealing means 203. On the left-hand side the height of the sealing means 203 is denoted with h' and on the right-hand side with h. The difference (h'- h) between h' and h is denoted with Δ. If the microphone is located as usually at the bottom part of the mobile terminal and if the tilting of the housing because of the height difference of the sealing means and the bottom part of the housing is like in Figure 2, h is larger than h'. The tilting may therefore depend on the distance between PA and PL, and partially as well on the distance between PL and PR. In the case of a mobile terminal with a support element like in Figure 3 there is no need for this kind of asymmetry and h' can equal h. The size of Δ may be adapted to make the sealing proper taking into account the tilting angle of the between the bottom part of the housing and the surface where the mobile terminal is lying.

[0029] Another possibility to achieve an asymmetric elastic behaviour is to use elastic materials asymmetrically, i.e. a more elastic material on the h' side and a stiffer material on the opposite side. This can in principle be achieved with e.g. block copolymers where the ratios of different polymer materials exhibit small changes along the bottom part of the sealing means. In this way it is also possible to ensure a good enough sealing. Another option, for example, is to use some other material that has spatially non uniform elasticity constant.

[0030] Figure 7 shows the sealing means from bottom. 600 is the inlet and 601 is the contact part. The profile of the aperture part 603 with its curvature is not visible in the figure.

[0031] Figure 8 presents the mobile terminal when the second acoustical directivity mode is activated. The mobile terminal 102 is placed on a flat surface 204. In the figure only the portion of the mobile terminal which illustrates the housing means and their vicinity is shown. The sealing means 203 have a contact with the flat surface 204 at aperture points PLB and PRB. Preferably, the sealing means extend from the housing of the mobile phone in such a way that in the figure left-hand side contact point PL acts as the outermost aperture point for the sealing means at part PLB and, respectively, the point PR at as the contact point of the sealing means for the point PRB.

[0032] The housing 200 is usually constructed from two parts; 102F is the front part and 102B is the back part. Between the front and back part 102F, 102B of the housing 200 there is a microphone 110. In the front part 102F at the spot of the microphone 110 there is at least one opening for the aperture 101 and on the back side

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part of the housing there is correspondingly at least one aperture 202 leading to the bottom side of the microphone.

[0033] Between the housing and the microphone there is sealing on both sides of the microphone 110. Preferably, the sealing is obtained with the help of an elastic gasket, such as a sealing ring. The first purpose of the sealing is to enable the propagation of sound from the exterior of the housing to the microphone, disabling propagation of the sound inside the housing, whereas the second purpose is to reduce the distortions caused by the loudspeaker of the mobile terminal.

[0034] Below the microphone 110 there is a resonance cavity ACB which is consists of smaller cavities formed by i) space limited by the microphone 110, possible sealing between the microphone, and bottom part 102 of the housing 200, and ii) acoustically well conductive part of the housing 200 including at least one aperture 202, sealing means 203, and the flat surface S. Respectively, another resonance cavity ACF is formed in between the microphone and the front part of the housing.

[0035] As already discussed with reference to Figures 2 and 6, the mobile phone may be tilted. To serve this purpose the sealing means are designed in the manner described with reference to Figure 6, the distance between PL and PLB may be shorter than the distance between PR and PRB. This means that the PL, PLB part could be more elastic than the PR and PRB so that the PL, PLB part of the sealing means compresses more. The aperture between the flat surface 204 and the sealing means 203 shall be preferably good in order to enhance the omni-directional mode. It is possible that if the sealing is not proper the direction and sensitivity of microphone is reduced to correspond the unidirectional microphone.

[0036] The tilting angle α corresponds to the tilting of the mobile terminal with respect to the flat surface 204. In practice, it may get almost any target value, the target value being thus between a very small angle and a substantially large angle. The magnitude of α has an impact on the aesthetic design of the mobile terminal, and, secondly, it may influence on the contact force between the contact part 601 and the flat surface 204 thus leading to further elasticity considerations. The more the mobile terminal is tilted, the smaller the contact force in the support means is, so requiring more elastic material.

[0037] Figure 9A illustrates another way to realise the invention. The mobile terminal has a housing 200 which includes a battery cover 901. The battery cover may be removable; usually the mobile terminal battery is stored under the cover. For some manufacturers the cover and the battery are combined to a single element. The aperture 202 is marked with a dot in the figure. When the inlet hole is open the mobile phone is in unidirectional directivity mode.

[0038] Figure 9B shows the aperture 202 covered with removable sealing means 1001 according to one aspect of the present invention.

[0039] The removable sealing means 1001 can be stored under the battery cover or back cover 901. Preferably, the aperture 202 and the sealing means 1001 are designed in such a way that the sealing means are tightly matched with the aperture 202. This may be realised, for example, by supplying the sealing means with attaching means and sealing means, so that the sealing means 1001 correspond partially to a flat surface 204. As shown in Figure 8, this mode of the invention is particularly usable when the table 205 or other surface is not essentially flat so that it would not provide a uniform enough flat surface 204 for the sealing means 203 to match at points PLB and PRB shown in Figure 8. Further, the external surface can be used for causing this kind of extra pressure for pushing the sealing means 203 stronger against the housing 200 of the mobile terminal, because the sealing means 1001 would not necessarily be able to cause the sealing to be tight enough hence the weight of the mobile terminal can be used for this purpose to increase the sealing.

[0040] Figure 10 illustrates a measurement result of the spectral energy density versus the frequency of a signal output at a reference point close to the telephone. The measurement has been performed for the inventive mobile phone assembly in unidirectional mode, and in Loudness Rating Guarding Position LRGP in accordance with the standard 3G TS 26.132 (TSG SA; Codec Working Group; Terminal Acoustic Characteristics for Telephony).

[0041] The energy spectrum measured is presented as observed by the codec of the mobile terminal. The upper piecewise linear curve corresponds to the maximal allowed spectral density values, whereas the lower piecewise linear curve illustrates the minimum acceptable spectral energies. As can be seen from the measurement results, the observed spectra lies clearly between the allowed values.

[0042] Figure 11 shows the acoustic behaviour of the same mobile terminal when it is in the second acoustical directivity mode. The spectral energy density shows again that the values are allowed, i.e. that the spectra lies clearly between the agreed limits.

[0043] Both measurements were conducted with a the mobile terminal lying head up on the table, positioned 50 cm from the reference mouth and with 30° azimuth. For the measurements the mobile terminal input gain was not adjusted, though this is not visible in the figure. In practice, because of the different resonance cavities caused by the differences in the acoustical apertures when the mobile terminal is in different acoustical modes, the gain must be adjusted between the modes. The adjustment may be done automatically by detecting the measured signal strength in the codec.

[0044] To summarise, according to one aspect of the present invention, the mobile phone can be made to show dual mode characteristics. First, a microphone is assembled into a housing that includes at least two inlet

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holes. At least one of the apertures is designed to be on the user side when the terminal is used as a handset, and the apertures together form acoustical conduits to the both sides of the microphone. The housing is further assembled to include sealing means; with the sealing means at least one of the inlet holes may be sealed together with an external surface, such as a table or any other flat surface. When the mobile terminal is placed on said flat surface, one acoustical aperture is thus closed and the mobile terminal shows acoustical omni-directional characteristics as a second acoustical directivity mode.

[0045] According to one further aspect of the present invention, the assembling step may include the assembling of an elastic gasket. Preferably, said elastic gasket is asymmetric, and the height of the lower part of the gasket being smaller than the height of the higher part of the gasket, the difference being adapted to make the sealing proper taking into account the elevation angle between the bottom of housing and the surface.

[0046] According to still another aspect of the present invention, in addition to the sealing means, the housing may further include a support member to increase the pressure between the sealing means and the surface.

[0047] Although the invention was described above with reference to the examples shown in the appended drawings, it is obvious that the invention is not limited to these, but it may be modified by those skilled in the art without departing from the scope and the spirit of the invention. For example, instead of a microphone, any other transducer or sound detector may be used in connection with the embodiments of the inventive sealing mechanism.

Reference numbers used in the description:

[0048]

100	mobile terminal
101	aperture
102	housing
110	microphone
200	housing
202	second aperture
203	sealing means
204	flat surface
205	table
303	sealing means
304	support member
600	hole for the acoustic inlet
601	contact part
603	aperture part
901	battery cover
1001	removable sealing means

Claims

1. A dual directional mode mobile terminal including a microphone (110), said microphone (110) having been assembled in a housing (200),
characterised in that
   - the housing (200) includes at least a first and a second aperture (101, 202), of which the first aperture (101) is on the user side when the terminal is used as a handset, the first and second apertures (101, 202) forming acoustical conduits (ACF, ACB) to the both sides of the microphone (110); and
   - the housing (200) further includes sealing means (203, 303, 1001) for sealing the second aperture (202) together with an external surface (204), when the mobile terminal is placed on said surface, thereby enabling in the mobile terminal a second acoustical directivity mode.

2. A mobile terminal according to claim 1,
characterised in that
the sealing means (203) include an elastic gasket.

3. A mobile terminal according to claim 2,
characterised in that
the elastic gasket is asymmetric, the height h' of a lower part of the gasket being smaller than the height h of a higher part of the gasket, the difference $\Delta = h' - h$ being adapted to make the sealing proper taking into account an elevation angle (α) between a backside surface (102B) of the housing (200) and the external surface (204).

4. A mobile terminal according to claim 1,
characterised in that
in addition to the sealing means (303), the housing (200) further includes a support member (304) to increase the pressure exerted on the sealing means (303) by the external surface (204).

5. A mobile terminal according to claim 1,
characterised in that
the sealing means (1001) further have means adapted for connecting the sealing means to the inlet hole (202) in an acoustically proper way.

6. A mobile terminal according to claim 5,
characterised in that
the mobile terminal has means (200) for storing the sealing means (1001).

7. A method for manufacturing a dual directional mode mobile terminal, the method
characterised in that
it includes the steps of:

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- assembling a microphone (110) into a housing (200), wherein the housing (200) includes at least first and second apertures (101, 202), of which a first aperture (101) is designed to be on the user side when the terminal is used as a handset, the first and second apertures thus forming acoustical conduits to both sides of the microphone (110); and
- assembling the housing (200) with sealing means (203) for sealing the second aperture (202) holes together with an external surface (204), when the mobile terminal is placed on said external surface (204), thereby enabling in the mobile terminal a second acoustical directivity mode.

8. A method according to claim 7, **characterised in that** the assembling step includes the assembling of an elastic gasket.

9. A method according to claim 8, **characterised in that** said elastic gasket is asymmetric, the height h' of the lower part of the gasket being smaller than the height h of the higher part of the gasket, the difference Δ = h'- h being adapted to make the sealing proper taking into account the elevation angle (α) between the bottom (102B) of housing and the external surface (204).

10. A method according to claim 7, **characterised in that** in addition to the sealing means (303), the housing further includes a support member (304) to increase the pressure between the sealing means (303) and the surface (204).

11. A method according to claim 7, wherein the sealing means (1001) are further adapted to be connected to the inlet hole (202) in an acoustically proper way.

12. A method according to claim 11, wherein the sealing means (1001) are stored in the mobile phone, and when used, manually placed into the aperture (202).

13. A mobile terminal equipped with an acoustoelectrical transducer (110) arranged in a housing (200) of the mobile terminal, **characterised in that** the housing (200) comprises:

- a user sided first aperture (101) in communication with the acoustoelectrical transducer (110);
- a second aperture (202) also in communication with the acoustoelectrical transducer (110); and
- sealing means (203) for sealing the second aperture (202) when the mobile terminal is placed on an external surface (204) or an object.

14. A mobile terminal according to claim 13, wherein the sealing means (203) are responsive to an external force or pressure.

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FIG 1 Prior Art

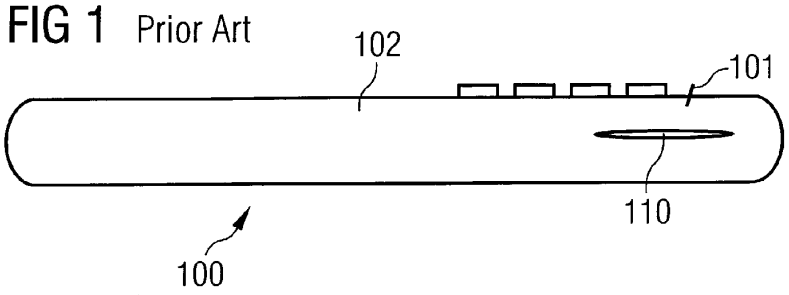


FIG 2

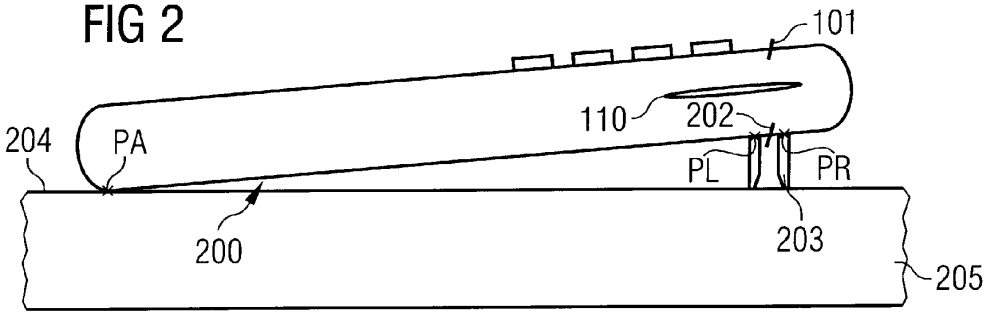


FIG 3

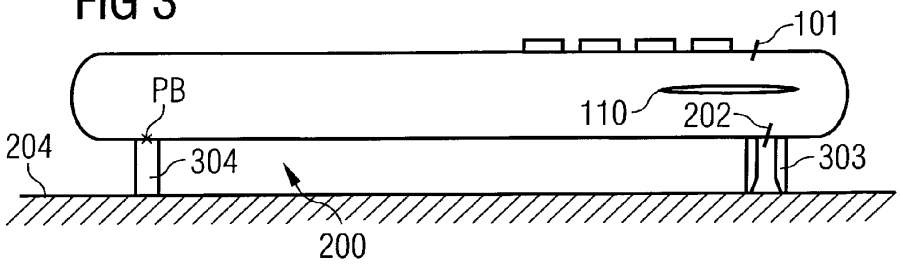


FIG 4

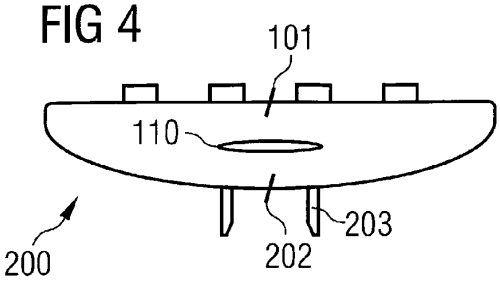


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FIG 5

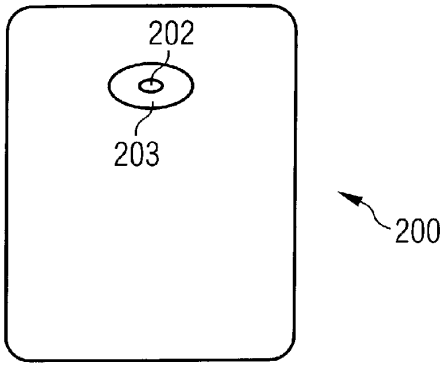


FIG 6

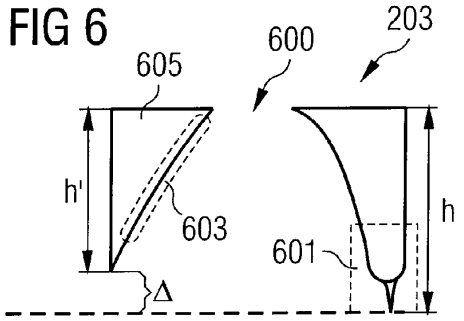


FIG 7

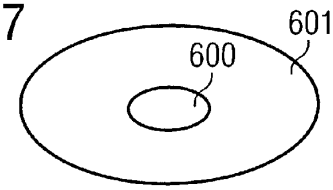


FIG 8

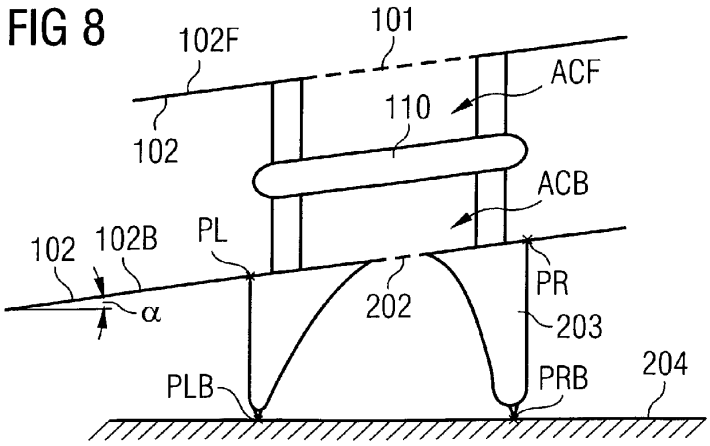


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FIG 9A

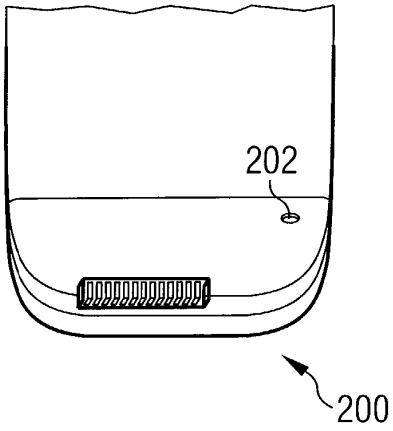


FIG 9B

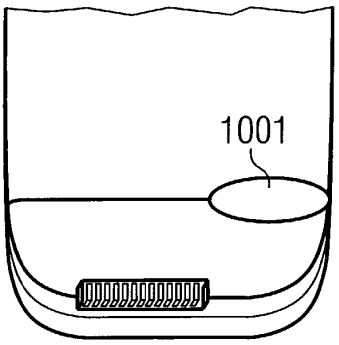


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FIG 10

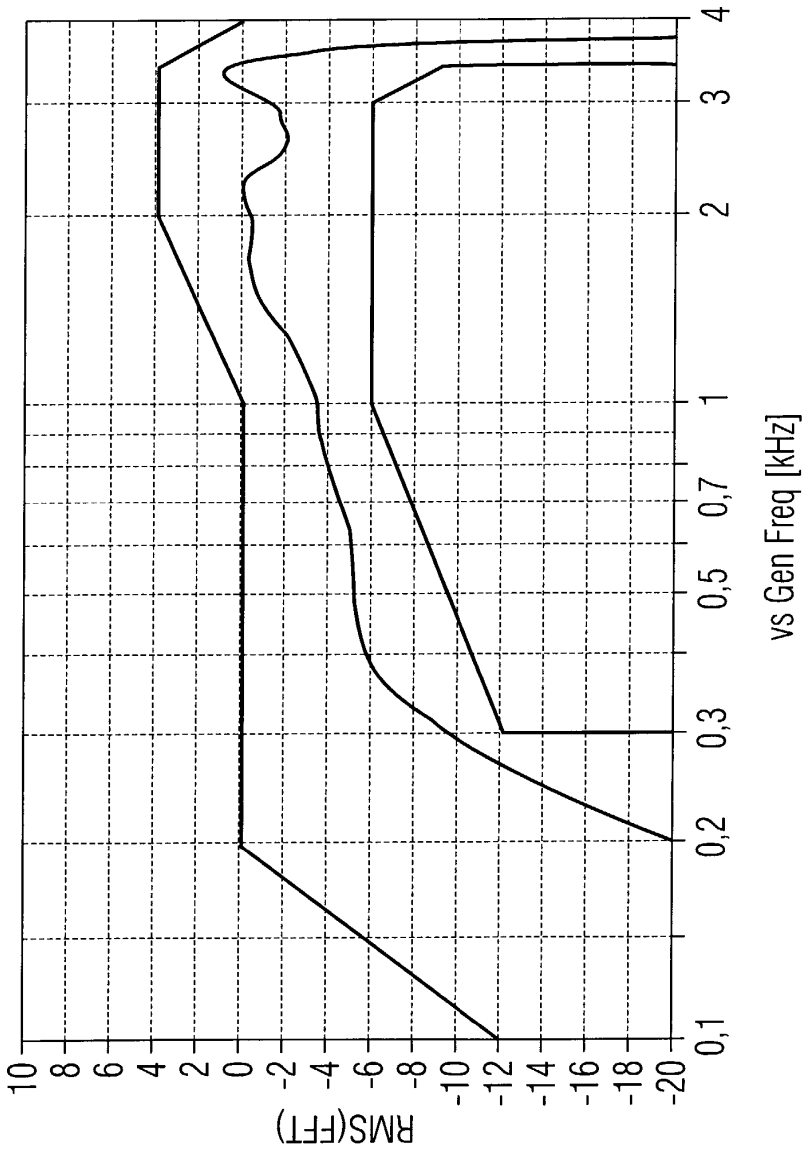


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FIG 11

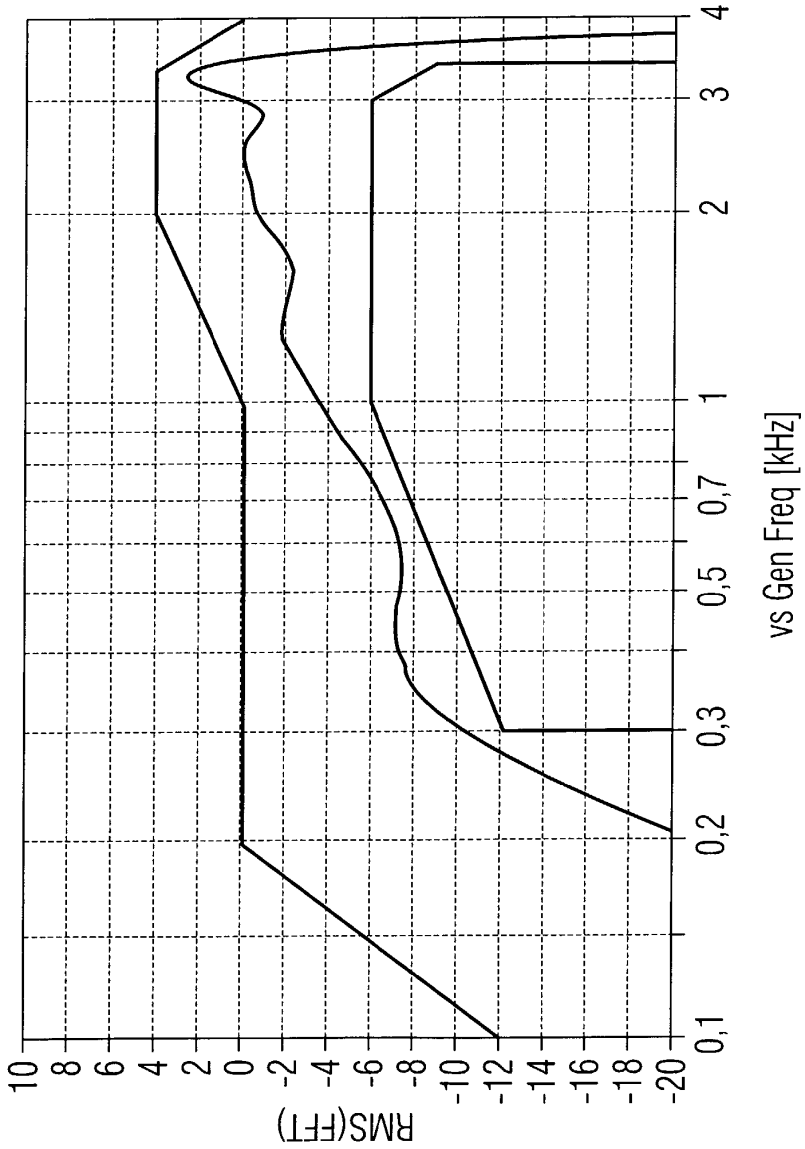


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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 02 0319

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 142 072 A (BERLAND OLE) 27 February 1979 (1979-02-27) * the whole document * ---	1-14	H04R25/00
A	DE 100 50 559 C (FAITA EBERHARD) 4 April 2002 (2002-04-04) * the whole document * ---	1-14	
A	EP 0 984 666 A (RESISTANCE TECHNOLOGY INC) 8 March 2000 (2000-03-08) * abstract * * claims 1,2 * ---	1-14	
A	WO 01 69964 A (RESISTANCE TECHNOLOGY INC ;DARBUT ALEXANDER L (US)) 20 September 2001 (2001-09-20) * page 2, line 26 - page 3, line 9 * * abstract * -----	1-14	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 March 2003	Dionisi, M

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
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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

EPO FORM 1503 03.82 (P04C01)

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 02 0319

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
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31-03-2003

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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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(11) EP 1 519 625 B1

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(54) External ear canal voice detection

Sprachdetektion im Gehörgang

Détection de la voix dans le conduit auditif externe

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Description

[0001] This document generally relates to ear-level communication systems and particularly, but not by way of limitation, to such systems communicating with remote devices via full duplex audio.

[0002] Ear-level communication systems are used for hearing impaired individuals to use a communication device such as a cellular phone or other devices transmitting audio signals. They also allow private, hand-free use of such a communication device by individuals with normal hearing.

[0003] An ear-level communication system generally includes tethered or wireless headsets with a microphone boom or a microphone within a cord of the headset to detect voice of the person wearing the headsets. An alternative way to detect voice is via bone connection. Examples include a "clam" shell device that couples to the helix and a custom carmold with a vibration detector on the outer shell. Voice is picked up by detecting bone vibration caused by, and representative of, the voice of the person wearing the device.

[0004] Bi-directional communication has been achieved by a simplex system including a device in the ear canal that both transmits sound to and picks up sound within the ear canal. The device is tethered to a push-to-talk (PIT) system such as a walkie talkie. It is not full duplex and therefore requires interaction by the user in order to switch from listen mode to talk mode.

[0005] Voice operated exchange (VOX) is used to conserve energy when voice is not being detected or transmitted. For example, a headset system includes two ear pieces - for full duplex communication with one earpiece for transmitting and the other for receiving voice - and uses ear canal voice detection to trigger a VOX circuit in a control unit wired to the headset. The system requires a headset with two headphones and wires connecting the headphone to a control unit such as a device clipped on belt. In another example, a full duplex system includes a single headphone to transmit and receiving voice, again with a VOX circuit in a control unit wired to the headphone.

[0006] Such ear-level communication systems are likely to be worn by a person for long periods of time. Users with hearing loss may use such a system on a regular basis, both as a conventional hearing aid allowing communication directly with a person and as a hearing aid allowing communicating through another device. Users with normal hearing may wear such a system to be communicatively connected to another person or facility without the need to hold a device at any time. For appearance or secrecy reasons, minimal visibility is generally desirable. Wired connection between a headset or earpiece and a controller makes the system easily visible and is cumbersome to users who need to communicate while being physically active.

[0007] Thus, there is a need for an ear-level communication system that is not easily visible. A need related to miniaturization is the longevity of the system between battery replacements or recharges.

[0008] WO 98/45937A discloses a communications apparatus comprising ear units, a control unit and a radio transceiver.

[0009] Ear level full duplex audio communication systems each include one or two ear attachments devices, such as in-the-ear (ITE) or behind-the-ear (BTE) devices, that wirelessly communicates to a remote device. Such a system allows a hearing impaired individual to communicate with or through the remote device, such as to talk to another person through a cellular phone. Such a system also functions as an ear piece wirelessly extended from the remote device that allows an individual to privately communicate with or through the remote device without the need of holding the device.

[0010] WO 03/073790A discloses a system adapted for use in at least one of a first ear having a first ear canal and a second ear having a second ear canal comprising: a first ear-level device configured to be one of an in-the-ear device and a behind-the-ear device, the first ear-level device including: a first microphone adapted for use in one of the first ear canal and the second ear canal, and adapted to receive an occluded sound within the one of the first ear canal and the second ear canal; and a wireless receiver, connected to a first processor, to receive a first wireless signal representing a remote sound; wherein the first processor, is connected to the first microphone, and is adapted to process the occluded sound and the remote sound; the first ear level device further including a speaker adapted for use in the one of the first ear canal and the second ear canal and adapted to transmit the processed remote sound to the one of the first ear canal and the second ear canal; a wireless transmitter, connected to the first processor; a first earmold housing at least the first microphone and the speaker, at least a portion of the first earmold configured for placement in the one of the first ear canal and the second ear canal; and a voice operated exchange (VOX) circuit connected to the first processor.

[0011] In the present invention, the wireless transmitter is adapted to receive the processed occluded sound from the first processor and transmit a second wireless signal representing the occluded sound; and the VOX circuit includes an occluded sound gating module adapted to gate the occluded sound on, and to gate the remote sound off, when the occluded sound is detected while the remote sound is not detected, and a remote sound gating module adapted to gate the remote sound on, and to gate the occluded sound off, when the incoming remote sound is detected while the occluded sound is not detected.

[0012] In a preferred embodiment, a system includes an ITE module and a BTE module attached to the ITE module. The ITE module includes a microphone for use in an ear canal. The microphone receives an occluded sound from within the ear canal. The BTE module includes a processor and a wireless transmitter. The processor processes the occluded sound. The wireless trans-

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mitter receives the processed occluded sound from the processor and transmits a wireless signal representing the occluded sound.

[0013] In a preferred embodiment, a system includes a first ear-level device and a second ear-level device for use in two opposite ears. The first ear-level device includes a microphone, a first processor, and a wireless transmitter. The microphone is for use in one ear canal to receive an occluded sound from within that ear canal. The first processor converts the occluded sound to an electrical signal. The wireless transmitter receives the electrical signal and transmits an outgoing wireless signal representing the occluded sound. The second ear-level device includes a wireless receiver, a second processor, and a speaker. The wireless receiver receives an incoming wireless signal representing a remote sound. The second processor converts the incoming wireless signal to the remote sound. The speaker is for use in the opposite ear canal to transmit the remote sound to that ear canal.

[0014] The present invention also relates to a method comprising: detecting an occluded sound using a first microphone adapted for use in an ear canal; detecting an incoming radio signal representing a remote sound from a remote device; starting a voice operated exchange (VOX) housed within an ear-level communication device when at least one of the occluded sound and the incoming radio signal is detected if the VOX is not already on, the ear-level communication device being one of an in-the-ear (ITE) device and a behind-the-ear (BTE) device; gating the occluded sound on, and gating the remote sound off, when the occluded sound is detected while the incoming radio signal is not detected; and gating the remote sound on, and gating the occluded sound off, when the incoming radio signal is detected while the occluded sound is not detected.

[0015] Preferred embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

FIG. 1 is an illustration of an embodiment of an ear-level communication system and potions of an environment in which it is used. This ear-level communication system uses a single ear-level device.

FIG. 2 is an illustration of an embodiment of another ear-level communication system and portions of an environment in which it is used. This ear-level communication system uses a pair of ear-level devices.

FIG. 3A is an illustration of one exemplary exterior configuration of an in-the-ear (ITE) device used as the single ear-level device of FIG 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 3B is an illustration of one exemplary exterior configuration of an in-the-canal (ITC) device used as the single ear-level device in FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 3C is an illustration of one exemplary exterior configuration of a completely-in-the-canal (CIC) device used as the single-ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 4A is a block diagram showing one embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the single ear-level device of FIG. 1.

FIG. 4B is a block diagram showing one embodiment of portions of a voice operated exchange (VOX) circuit included in the single car-level device of FIG. 1.

FIG. 5 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the pair of ear-level devices of FIG. 1B.

FIG. 6 is an illustration of one exemplary exterior configuration of an ear-level device including a behind-the-ear (BTE) device used as the single ear-level device of FIG. 1 or one of the pair of ear-level devices of FIG. 2.

FIG. 7 is a block diagram showing one embodiment of the circuit of the ear-level device shown in FIG. 6 used as the single ear-level device of FIG. 1.

FIG. 8 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIG. 6 used as the pair of ear-level devices of FIG. 2.

FIG. 9 is a flow chart illustrating an embodiment of a method for audio communication between the single ear-level device or the pair of ear-level devices and a remote device.

FIG. 10 is a flow chart illustrating another embodiment of the method for audio communication between the single ear-level device and a remote device.

[0016] The following embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that the embodiments may be combined, or that other embodiments may be utilized and that structural, logical and electrical changes may be made without departing from the scope of the present invention, as defined by the appended claims.

[0017] It should be noted that references to "an", "one", or "various" embodiments in this disclosure are not necessarily to the same embodiment, and such references contemplate more than one embodiment.

[0018] This document discusses, among other things, ear-level full duplex audio communication systems for communicating with remote devices. These systems each include one or two ear-level devices each worn in or about an ear, such as in-the-ear (ITE) or behind-the-ear (BTE) devices, wirelessly coupled to a remote device such as a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator. When used as a hearing aid, such a system allows a hearing impaired individual to communicate with or through the remote device, such as to talk to another person through a cellular phone. When being used as an ear piece wirelessly extended from the remote device,

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such system allows an individual with normal hearing to privately communicate with or through the remote device without the need of holding the device or wearing any device wired to the remote device.

[0019] In this document, "voice" includes to the sound of speech made by a person, and sound generally includes an audible signal that includes voice and other signals that can be heard and/or detected by an audio detector. Unless particularly indicated, for example, when voice is distinguished from sound by speech recognition, "voice" and "sound" are used interchangeably throughout thus document because they are not practically separated. For example, detection of a sound refers to the same action as detection of a voice because, while the purpose is to detect the voice, other sounds are picked up as well.

[0020] FIG. 1 is an illustration of an embodiment of an ear-level communication system 100 and portions of an environment in which it is used. System 100 includes an ear-level device 110 attached to an ear 101A. Bar-level device 110 communicates with a remote device 190 through a wireless telemetry link 195. The other ear 101B is free of device attachment. Ear-level device 110 is a self-contained device including its own power source such as a replaceable or rechargeable battery. To maximize battery life or period between recharges, at least a portion of the circuit of ear-level device 110 is voice activated. That is, ear-level device 110 is activated only when it detects a need to transmit or receive a sound.

[0021] Ear-level device 110 is a full duplex audio device that allows two-way simultaneous conversation between ear 101A and remote device 190. In one embodiment, when being worn by a person having ear 101A, ear-level device 110 picks up sound from the ear canal of ear 101A and delivers sound to the same ear canal. It detects the occluded sound from the ear canal when the person speaks and transmits to the same ear canal a sound received from remote device 190 and/or a sound picked up from the environment surrounding the person. In one embodiment, as illustrated in FIG. 1, ear-level device 110 is configured for right ear attachment. In an alternative embodiment, ear-level device 110 is configured for left ear attachment.

[0022] FIG. 2 is an illustration of an embodiment of an ear-level communication system 200 and portions of an environment in which it is used. System 200 includes a pair of ear-level devices 210A, attached to an ear 101 A, and 210B, attached to ear 101B. Ear-level devices 210A and 210B communicate with a remote device 290 through a wireless telemetry link 295. Ear-level devices 210A and 210B are each a self-contained device including its own power source such as a replaceable or rechargeable battery. To maximize battery life or period between recharges, at least a portion of the circuit of each of ear-level devices 210A and 210B is voice activated. That is, ear-level devices 210A and 210B are each activated only when a need to transmit or receive a sound is detected by the device itself.

[0023] In one embodiment, ear-level device 210A is an audio transmitter that picks up sound from the ear canal of ear 101A, and ear-level device 210B is an audio receiver that delivers sound to the same ear canal. Ear-level device 210A is activated when it detects a sound from the ear canal. Ear-level device 210B is activated when it detects a signal from remote device 290. When both are being worn by a person, ear-level devices 210A and 210B supports full duplex audio allowing two-way simultaneous conversation between the person and remote device 290. In one embodiment, as illustrated in FIG. 2, ear-level device 210A is configured for right ear attachment, and ear-level device 210B is configured for left ear attachment. In an alternative embodiment, ear-level device 210A is configured for left ear attachment, and ear-level device 210B is configured for right ear attachment.

[0024] FIGS. 3A, 3B, and 3C are illustrations of exemplary exterior configuration of ear-level device 110 or one of ear-level devices 210A and 210B. For the purpose of this document, only a device attached to a right ear is shown for each exemplary exterior configuration. It is to be understood that each of ear-level devices 110, 210A, and 210B can be either a device configured for right ear attachment or a device configured for left ear attachment. Generally, a device configured for right car attachment has an exterior configuration that is substantially symmetrical to that of a device of the same type configured for left ear attachment. In system 100, a single ear-level device 110 is a device configured either for right ear attachment or for left ear attachment. In system 200, either one of car-level device 210A and 210B is a device configured for right ear attachment, while the other is a device configured for left ear attachment.

[0025] An occluded sound 305, an ambient sound 306, and a remote sound 307 are illustrated in each of FIGS. 3A, 3B, and 3C. Remote sound 307 is represented by a wireless radio signal transmitted to ear-level device 110. In this document, "occluded sound" includes occluded sound 305, "ambient sound" includes ambient sound 306, and "remote sound" includes remote sound 307.

[0026] FIG. 3A is an illustration of an exemplary exterior configuration of an in-the-ear (ITE) device 310A used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3A, ITE device 310A is attached to an ear 101 with a pinna 302 and an ear canal 303. ITE device 310A includes a portion inserted into ear canal 303 and another portion fit into the cavity formed by pinna 302.

[0027] FIG. 3B is an illustration of an exemplary exterior configuration of an in-the-canal (ITC) device 310B used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3B, ITC device 310B is attached to ear 101 with pinna 302 and ear canal 303. ITC device 310B is a form of ITE device that also includes a portion inserted in ear canal 303 and another portion fit into the cavity formed by pinna 302, but the latter portion is smaller than that of ITE device 310A. Its overall

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size is therefore generally smaller than that of ITE deviee 310A.

[0028] FIG. 3C is an illustration of an exemplary exterior configuration of a completely-in-the-canal (CIC) device 310C used as ear-level device 110 or one of ear-level devices 210A and 210B. As shown in FIG. 3C, CIC device 310C is attached to ear 101 with pinna 302 and ear canal 303. CIC device 310C is a form of ITC device but includes only a portion that is completed inserted into ear canal 303. Its overall size is therefore generally smaller than that of ITC device 310B.

[0029] In one embodiment, each of ITE device 310A, ITC device 310B, and CIC device 310C includes a custom earmold. In another embodiment, each of ITE device 310A, ITC device 310B, and CIC device 310C includes a modular earmold. In one embodiment, the earmold is fully occluded to maximize audio efficiency. In another embodiment, the earmold is vented to remove undesirable low frequency sound.

[0030] The choice of a device type, such as from the types shown in FIGS. 3A, 3B, and 3C, depends on the need of individual users. For example, ITE device 310A has a relatively large size to accommodate a relatively large amplifier to serve the need of individuals suffering severe hearing loss. The relatively large size can also be utilized to house a relatively large size battery. On the other hand, CIC device 310C is almost invisible, while the room for the circuit and the battery is very limited. Generally, the selection of the device type is a compromise among considerations such as the user's degree of hearing loss (if applicable), ear canal size, desire of invisibility, desired longevity between battery replacements or recharges, and cost.

[0031] FIG. 4A is a block diagram showing one embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as the single ear-level device 110. The circuit is housed in an earmold configured for use as one of the device types illustrated as ear-level devices 310A, 310B, or 310C.

[0032] Ear-level device 110 includes an external microphone 420, an ear canal microphone 440, an car canal speaker 470, a processor 460, a wireless transceiver 450, an antenna 455, a voice operated exchange (VOX) circuit 430, and a battery 480. External microphone 420 picks up ambient sound such that a hearing impaired person wearing ear-level device 110 is not "isolated" when communicating to remote device 190. Thus, ear-level device enables the hearing impaired person to talk to another person either directly (if the other person is nearby) or through a device such as a cell phone. Ear canal microphone 440 detects sound from the ear canal. The sound includes primarily speech of the person wearing ear-level device 110. Ear canal speaker 470 transmits sound received from remote device 190 and/or external microphone 420 to the same ear canal. In one embodiment, ear canal microphone 440 and ear canal speaker 470 are implemented as one physical device. Processor 460 converts the sound picked up from the ear canal to an electrical signal to be transmitted to remote device 190, and converts the signals received from remote device 190 and/or external microphone 420 to a sound audible to the person wearing ear-level device 110. In one embodiment, processor 460 includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art In one embodiment, processor 460 includes a speech recognition module to enhance the audio signal received by and/or transmitted from ear-level device 110. Wireless transceiver 450 and antenna 455 form a telemetry interface supporting telemetry link 195 between ear-level device 110 and remote device 190. Wireless transceiver 450 includes a wireless transmitter and a wireless receiver. The wireless transmitter receives the electrical signal representing the sound picked up from the ear canal from processor 460 and transmits an outgoing wireless signal representing the same sound to remote device 190. The wireless receiver receives an incoming wireless signal representing a remote sound from remote device 190 and transmits an electrical signal representing the remote sound to processor 460. Telemetry link 195 provides for bi-directional communication allowing simultaneous signal transmission, in both directions, between ear-level device 110 and remote device 190. VOX circuit 430 activates a major portion of ear-level device 110 only when sound is detected by at least one of external microphone 420, ear canal microphone 440, end wireless transceiver 450. In one embodiment, VOX circuit 430 includes a voice-controlled switch connecting between battery 480 and the portions of ear-level device 110 that are voice activated. The switch is driven by the sound detected by at least one of external microphone 420, ear canal microphone 440, and wireless transceiver 450. It is turned on when sound detected by external microphone 420 exceeds a predetermined threshold, when sound detected by ear canal microphone 440 exceeds another predetermined threshold, and/or when wireless transceiver 450 receives the incoming wireless signal representing the remote sound. In one embodiment, as discussed with respect to FIG. 4B below, VOX circuit 430 gates or attenuates one or more sounds detected by external microphone 420, ear canal microphone 440, and wireless transceiver 450, to eliminate or reduce echo and ringing caused by the loop formed by ear canal speaker 470 and ear canal microphone 440. Battery 480 supplies the power needed for the operation of ear-level device 110. In one embodiment, battery 480 is a rechargeable battery that can be recharged without being taken out from ear-level device 110.

[0033] FIG. 4B is a block diagram showing one embodiment of portions of VOX circuit 430. In this embodiment, VOX circuit 430 includes an ambient sound gating module 421 that blanks or attenuates the sound detected by external microphone 420, an occluded sound gating module 441 that blanks or attenuates the sound detected

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by ear canal microphone 440, a remote sound gating module 451 that blanks or attenuates the sound detected by wireless transceiver 450, and controller 431 to coordinate the states of the gating modules. Because ear canal microphone 440 is capable of detecting the sound delivered to the ear canal from ear canal speaker 470, there is a need to avoid echo and/or ringing. For example, a remote sound from remote device 190 delivered to the ear canal may be detected as an occluded sound and transmitted back to remote device 190, causing echo. The gating modules function in a coordinated manner to eliminate or reduce such echo and/or ringing caused by breaking, or applying resistance into, the audio loop formed by ear canal speaker 470 and ear canal microphone 440.

[0034] For the purpose of description, each of the gating modules is "on" when sound is "gated on" and "off' when the sound is "gated off" A sound is "gated on" when it is allowed to pass and be processed, and is "gated off' when it is blanked or substantially attenuated. Blanking refers to a substantially complete blockage of a sound, or in other words, that a detected sound is practically ignored by processor 460 such that it does not cause any echo or ringing that is audible by an ear. Substantial attenuation refers to an attenuation after which the attenuated sound does not cause any echo or tinging having an intolerable intensity.

[0035] Ambient sound gating module 421 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a detected ambient sound with a predetermined threshold for the ambient sound. When the amplitude of the detected ambient sound exceeds the threshold for the ambient sound, and when controller 431 permits, ambient sound gating module 421 is turned on. When the amplitude of the detected ambient sound drops below the threshold for the ambient sound, ambient sound gating module 421 is turned off. In one embodiment, after the amplitude of the detected ambient sound drops below the threshold for the ambient sound, ambient sound gating module 421 is turned off after a predetermined delay.

[0036] Occluded sound gating module 441 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a detected occluded sound with a predetermined threshold for the occluded sound. When the amplitude of the detected occluded sound exceeds the threshold for the occluded sound, and when controller 431 permits, occluded sound gating module 441 is turned on. When the amplitude of the detected occluded sound drops below the threshold for the occluded sound, occluded sound gating module 441 is turned off. In one embodiment, after the amplitude of the detected occluded sound drops below the threshold for the occluded sound, occluded sound gating module 441 is turned off after a predetermined delay.

[0037] In one embodiment, remote sound gating module 451 includes a voice-driven switch or attenuator driven by the output of a comparator that compares the amplitude of a remote sound with a predetermined threshold for the remote sound. When the amplitude of the detected remote sound exceeds the threshold for the remote sound, and when controller 431 permits, remote sound gating module 451 is turned on. When the amplitude of the detected remote sound drops below the threshold for the remote sound, remote sound gating module 451 is turned off. In one embodiment, after the amplitude of the detected remote sound drops below the threshold for the remote sound, remote sound gating module 451 is turned off after a predetermined delay.

[0038] In another embodiment, remote sound gating module 451 includes a switch or attenuator driven by the detection of the incoming wireless signal representing the remote sound. Remote sound gating module 451 is turned on upon detection of the incoming wireless signal when controller 431 permits, and turned off when the incoming wireless signal is no longer detected. In one embodiment, remote sound gating module 451 is turned off after the incoming wireless signal is absent for a predetermined period.

[0039] Controller 431 coordinates the on/off states of all the gating modules so the sounds are processed in an orderly fashion. Even if a sound is detected, the gating module corresponding to that sound is turned on only when controller 431 permits. In one embodiment, assuming that sounds A and B are gated by gating modules A and B, respectively, if both sounds A and B are detected, whichever sound is detected earlier is gated on. That is, if sound A exceeds its threshold first, gating module A is turned on and remain on until sound A drops below threshold A. Then, gating module B is turned only if sound B exceeds its threshold after gating module A has been turn off.

[0040] In one embodiment, controller 431 coordinates the on/off states of all the gating modules according to predetermined or programmed gating coordination rules. According to one exemplary rule, ambient sound gating module 421 is off, occluded sound gating module 441 is off, and remote sound gating module 451 is on. This rule allows only the transmission of the remote sound to ear canal 303, and prevents the remote sound from being detected by ear canal microphone 440 and echoed back to remote device 190. According to another exemplary rule, ambient sound gating module 421 is on, occluded sound gating module 441 is off, and remote sound gating module 451 is on. This rule allows the transmission of both the remote sound and the ambient sound to ear canal 303, and prevents the remote sound from being detected by ear canal microphone 440 and echoed back to remote device 190. This also prevents the ambient sound from being transmitted to remote device 190. According to yet another exemplary rule, ambient sound gating module 421 is off, occluded sound gating module 441 is on, and remote sound gating module 451 is off. When the person wearing ear-level device 110 speaks, both external microphone 420 and ear canal microphone 440 detect the voice. The voice as detected by ear-level

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device 110 is first transmitted to remote device 190. Without the gating modules (or when ambient sound gating module 421 and occluded sound gating module 441 are both on), the same voice as detected by external microphone 420 is transmitted to ear canal 303, and therefore again detected by ear canal microphone 440, and again be transmitted to remote device 190. This rule allows only the transmission of the occluded sound to remote device 190, and prevents the same sound from being transmitted to remote device 190 twice. Other rules are applied as a person skilled in the art should see fit based on an understanding after reading this entire document.

[0041] FIG. 5 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIGS. 3A, 3B, or 3C used as each of ear-level devices 210A and 210B. The circuit of each of ear-level devices 210A and 210B is housed in an earmold configured for use as of one of the device types illustrated as ear-level devices 310A, 310B, or 310C.

[0042] Ear-level device 210A is an audio transmitter that includes an ear canal microphone 540, a processor 560A, a wireless transmitter 550A, an antenna 555A, a transmitter VOX circuit 530A, and a battery 580A. Ear canal microphone 540 detects sound from the ear canal. The sound includes primarily speech of the person wearing ear-level device 210A. Processor 560A converts the sound picked up from the ear canal to an electrical signal to be transmitted to remote device 290. In one embodiment, processor 560A includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art. In one embodiment, processor 560A includes a speech recognition module used to enhance the sound transmitted from ear-level device 210A. Wireless transmitter 550A and antenna 555A form a telemetry interface supporting signal transmission from ear-level device 210A to remote device 290. Wireless transmitter 550A receives the electrical signal representing the sound picked up from the ear canal from processor 560A and transmits an outgoing wireless signal representing the same sound to remote device 290. VOX circuit 530A activates a major portion of ear-level device 210A only when sound is detected by ear canal microphone 540. In one embodiment, VOX circuit 530A includes a voice-controlled switch connecting between battery 580A and the portions of ear-level device 210A that are voice activated. The switch is driven by the sound detected by ear canal microphone 540. It is turned on when sound detected by ear canal microphone 540 exceeds a predetermined threshold. In one embodiment, VOX circuit 530A activates processor 560A when the sound is detected. In one further embodiment, VOX circuit 530A also activates wireless transmitter 550A when the sound is detected. Battery 580A supplies the power needed for the operation of ear-level device 210A. In one embodiment, battery 580A is a rechargeable battery that can be recharged without being taken out from ear-level device 210A.

[0043] Ear-level device 210B is an audio receiver that includes an external microphone 520, an ear canal speaker 570, a processor 560B, a wireless receiver 550B, an antenna 555B, a receiver VOX circuit 530B, and a battery 580B. External microphone 520 picks up ambient sound such that the person wearing ear-level devices 210A and 210B is not "isolated" when communicating to remote device 290. It allows that person to talk to a nearby person directly, without the need to take off ear-level devices 210A and/or 210B. Bar canal speaker 570 transmits sound received from remote device 290 and/or external microphone 520 to the same ear canal. Processor 560B converts the signals received from remote device 290 and/or external microphone 520 to a sound audible to the person wearing ear-level device 210B. In one embodiment, processor 560B includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art. In one embodiment, processor 560B includes a speech recognition module used to enhance the audio signals received by ear-level device 210B. Wireless receiver 550B and antenna 555B form a telemetry interface supporting signal transmission from remote device 290 to ear-level device 210B. Wireless receiver 550B receives an incoming wireless signal representing a remote sound from remote device 290 and transmits an electrical signal representing the remote sound to processor 560B. VOX circuit 530B activates a major portion of ear-level device 110 only when sound is detected by at least one of external microphone 520 and wireless receiver 550B. In one embodiment, VOX circuit 530B includes a voice-controlled switch connecting between battery 580B and the portions of ear-level device 210B that are voice activated. The switch is driven by the sound detected by at least one of external microphone 520 and wireless receiver 550B. It is turned on when sound detected by external microphone 520 exceeds a predetermined threshold and/or when wireless transceiver 550B receives the incoming wireless signal representing the remote sound. In one embodiment, VOX circuit 530B activates processor 560B when the sound is detected. In one further embodiment, VOX circuit 530B also activates ear-level speaker 570 when the sound is detected. Battery 580B supplies the power needed for the operation of ear-level device 210B. In one embodiment, battery 580B is a rechargeable battery that can be recharged without being taken out from ear-level device 210B.

[0044] System 200 accommodates a larger overall circuit size without necessarily increasing the size of each ITE device. While two separate ear-level devices are required, because system 200 includes separate audio transmitter (ear-level device 210A) and receiver (ear-level device 210B) disposed in the ear canals of opposite ears, ear canal speaker 570 and ear canal microphone 540 do not form a loop causing echo and ringing.

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[0045] FIG. 6 is an illustration of an exemplary exterior configuration of an ear-level device including a behind-the-ear (BTE) device 610 used as ear-level device 110 or one of ear-level devices 210A and 210B. BTE device 610 is attached to ear 101 with pinna 302 and ear canal 303. In one embodiment, BTE device 610 is used when none of ITE device 310A, PTC device 310B, and CIC device 310C provides sufficient space accommodating the required circuit and battery sizes. For the purpose of this document, only a device attached to a right ear is shown for each exterior structure. It is to be understood that each of ear-level devices 110, 210A, and 210B can be either a BTE device configured for right ear attachment or a BTE device configured for left ear attachment. Generally, a BTE device configured for right ear attachment has a substantially symmetrical appearance to a device of the same type configured for left ear attachment In system 100, ear-level device 110 is a device configured either for right ear attachment or for left ear attachment. In system 200, either one of ear-level device 210A and 210B is a device structured for right ear attachment, while the other is a device structured for left ear attachment.

[0046] BTE device 610 includes a behind-the-earmodule (BTE module) 611 and an in-the-ear module (ITE module) 612. ITE module 612 includes a custom or modular earmold. In one embodiment, the earmold is fully occluded to maximize audio efficiency. In another embodiment, the earmold is vented to remove undesirable low frequency sound.

[0047] FIG. 7 is a block diagram showing one embodiment of the circuit of ear-level device shown in FIG. 6 used as ear-level device 110. The exterior configuration of ear-level device 110 is of the type illustrated as BTE device 610.

[0048] Ear-level device 110 configured as BTE device 610 differs from ear-level device 110 configured as ITE/ITC/CIC devices 310A/310B/310C primarily in the physical arrangement of device components. By way of example, but not by way of limitation, FIG. 7 illustrates one embodiment in which BTE module 611 includes external microphone 420, processor 460, wireless transceiver 450, antenna 455, VOX circuit 430, and battery 480, and ITE module 612 includes ear canal microphone 440 and ear canal speaker 470. Other possible embodiments depend on size and other considerations that are known to those skilled in the art. In one embodiment, behind-ear portion 611 includes only battery 480 to maximize the duration of use of ear-level device 110 between battery replacements or recharges.

[0049] FIG. 8 is a block diagram showing another embodiment of the circuit of ear-level device shown in FIG. 6 used as each of ear-level devices 210A and 210B. The exterior configuration of each of ear-level devices 210A and 210B is of the type illustrated as BTE device 610.

[0050] Ear-level devices 210A/210B configured as BTE device 610 differ from ear-level devices 210A/210B configured as ITE/ITC/CIC devices 310A/310B/310C primarily in the physical arrangement of device components. By way of example, but not by way of limitation, FIG. 8 illustrates one embodiment of ear-level device 210A including a BTE module 611A and an ITE module 612A, and ear-level device 210B including a BTE module 611B and an ITE module 612B. BTE module 611A includes processor 560A, wireless transmitter 550A, antenna 555A, transmitter VOX circuit 530A, and battery 580A. ITE module 612A includes ear canal microphone 540. Behind-the-ear portion 611B includes external microphone 520, processor 560B, wireless receiver 550B, antenna 555B, receiver VOX circuit 530B, and battery 580B. ITE module 612B includes ear canal speaker 570. Other possible embodiments depend on size and other considerations that are known to those skilled in the art. In one embodiment, BTE modules 611A and 611B include only batteries 580A and 580B, respectively, to maximize the duration of use of ear-level devices 210A and 210B, respectively, between battery replacements or recharges.

[0051] FIG. 9 is a flow chart illustrating an embodiment of a method for audio communication using system 100 or system 200. The method provides for private, simultaneous two-way communication between a person and a remote device such as a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator. In this embodiment. VOX is used for power management. A VOX circuit includes a power switch connecting a battery to the portions of the circuit of system 100 or system 200 that are voice activated. The VOX is "on" when the voice-activated portions of the circuit are activated, i.e., when the power switch remains on. It is "started" by turning on the power switch, and "stopped" by turning off the power switch.

[0052] Steps 910-918 illustrate the process of detecting a sound from an ear canal and transmitting it to a remote device. A microphone disposed in an ear canal detects an occluded sound within the ear canal at 910. If the occluded sound is detected at 911, the VOX of the system is started at 912 if it is not already on. The occluded sound is enhanced at 914 with a voice recognition system that improves the signal-to-noise ratio, where the signal is the voice of a speech, and the noise is any sound other than the voice of the speech. The occluded sound is then converted to an outgoing radio signal at 916. The outgoing radio signal representing the occluded sound is transmitted to the remote device at 918.

[0053] Steps 920-928 illustrate the process of detecting a sound sent from the remote device and transmitting it to the ear canal. A radio receiver detects an incoming radio signal representing a remote sound from the remote device at 920. If the incoming radio signal is detected at 921, the VOX of the system is started at 922 if it is not already on. The incoming radio signal is converted to a first incoming audio signal (the remote sound) at 924. The first incoming audio signal is enhanced at 926 with a voice recognition system that improves the signal-to-noise ratio, where the signal is the voice from the remote device, and the noise is any sound other than the voice.

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A speaker disposed in the ear canal transmits the first incoming audio signal representing the sound from the remote device to the ear canal at 928.

[0054] Steps 930-938 illustrate the process of detecting a sound from the environment and transmit it to the ear canal. A microphone outside the ear canal detects an ambient sound at 930. If the ambient sound is detected at 931, the VOX of the system is started at 932 if it is not already on. The ambient sound is converted to a second incoming audio signal at 934. The second incoming audio signal is enhanced at 936 with a voice recognition system that improves the signal-to-noise ratio, where the signal is any voice included in the ambient sound, and the noise is any sound other than the voice. A speaker disposed in the ear canal transmits the second incoming audio signal representing to the ear canal at 928.

[0055] If no signal (sound or radio signal) is detected at 911, 921, and 931, the VOX is stopped at 940. In other words, if no sound is to be processed, the communication system is inactivated except for the portions that must be active for sound detection at all times. In one embodiment, the VOX is stopped after a predetermined period of time to avoid frequent activation/deactivation during a conversation.

[0056] Systems 100 and 200 are each a full duplex system capable of performing steps 910-918, 920-928, and 930-938 are performed in parallel and simultaneously. In an embodiment in which system 100 performs the method, ear-level device 110 performs steps 910-918, 924-928, and 930-938. If a signal is detected at 911, 921, or 931, VOX 430 activates at least portions of device 110 performing steps 914-918, 924-928, or 934-938, respectively. If no signal is detected at 911, 921, or 931, VOX 430 deactivates at least the portions of device 110 performing steps 914-918, 924-928, or 934-938, respectively.

[0057] In an embodiment in which system 200 performs the method, ear-level device 210A performs steps 910-918, and ear-level device 210B performs steps 920-928 and 930-930. If a signal is detected at 911, transmitter VOX 530A activates at least portions of device 210A performing steps 914-918. If a signal is detected at 921 or 931, receiver VOX 530B activates at least portions of device 210B performing steps 924-928 or 934-938, respectively. If no signal is detected at 911, transmitter VOX 530A deactivates at least the portions of device 210A performing steps 914-918. If no signal is detected at 921 or 931, receiver VOX 530B deactivates at least the portions of device 210B performing steps 924-928 or 934-938, respectively.

[0058] FIG. 10 is a flow chart illustrating another embodiment of the method for audio communication using system 100. In this embodiment, in addition to power management, the VOX is also used for gating, i.e., blanking or attenuating, sounds. The VOX circuit includes a power switch connecting a battery to the portions of the circuit of system 100 that are voice activated and gating modules capable of blanking or attenuating the occluded sound, the remote sound, and the ambient sound. Examples of such gating modules include occluded sound gating module 441, remote sound gating module 451, and ambient sound gating module 421, designated for the occluded sound, the remote sound, and the ambient sound, respectively.

[0059] Steps 1010-1019 illustrate the process of detecting the occluded sound from the ear canal and transmitting it to the remote device. The microphone disposed in the ear canal detects the occluded sound within the ear canal at 1010. If the occluded sound is detected at 1011, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1012 if they are not already powered. The VOX determines whether to start gating the occluded sound on at 1013. In one embodiment, the occluded sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. Examples of gating coordination rules are described above with respect to FIG. 4B. If the occluded sound is gated on at 1013, it is processed at 1014 by following steps that are identical or similar to steps 914-916-918. The occluded sound is gated off at 1019 if it has been gated on but is no longer detected. In one embodiment, the occluded sound is gated off after it is not detected for a predetermined period.

[0060] Steps 1020-1028 illustrate the process of detecting the remote sound sent from the remote device and transmitting it to the ear canal. A radio receiver detects the incoming radio signal representing the remote sound from the remote device at 1020. If the remote sound is detected at 1021, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1022 if they are not already powered. The VOX determines whether to start gating the remote sound on at 1023. In one embodiment, the remote sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. In another embodiment, the remote sound is gated on when the incoming radio signal is detected and when the effective gating coordination rules permits. If the remote sound is gated on at 1023, it is processed at 1024 by following steps that are identical or similar to steps 924-926-928. The remote sound is gated off at 1029 if it has been gated on but is no longer detected. In one embodiment, the remote sound is gated off after it is not detected for a predetermined period.

[0061] Steps 1030-1038 illustrate the process of detecting the ambient sound and transmit it to the ear canal. A microphone outside the ear canal detects the ambient sound at 1030. If the ambient sound is detected at 1031, the VOX of the system is started to power the voice-activated portions of the circuit of system 100 at 1032 if they are not already powered. The VOX determines whether to start gating the ambient sound on at 1033. In one embodiment, the ambient sound is gated on when its amplitude exceeds a predetermined threshold and when the effective gating coordination rule permits. If the

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ambient sound is gated on at 1033, it is processed at 1034 by following steps that are identical or similar to steps 934-936-938. The ambient sound is gated off at 1039 if it has been gated on but is no longer detected. In one embodiment, the ambient sound is gated off after it is not detected for a predetermined period.

[0062] If no signal (sound or radio signal) is detected at 1011,1021, and 1031, the VOX is stopped at 1040. In other words, if no sound is to be processed, the communication system is inactivated except for the portions that must be active for sound detection at all times, In one embodiment, the VOX is stopped after a predetermined period of time to avoid Sequent activation/deactivation during a conversation.

[0063] It is to be understood that the above detailed description is intended to be illustrative, and not restrictive. Other embodiments will be apparent to those of skill in the art upon reading and understanding the above description. For example, two ear-level devices 110, or a pair of devices each being similar to ear-level device 110, can be used to deliver a stereo sound. The scope of the invention should, therefore, be determined with reference to the appended claims.

Claims

1. A system adapted for use in at least one of a first ear (101A) having a first ear canal (303) and a second ear (101B) having a second ear canal (303) comprising:

   a first ear-level device (110, 210A) configured to be one of an in-the-ear (ITE) device and a behind-the-ear (BTE) device, the first ear-level device including:

   a first microphone (440) adapted for use in one of the first ear canal and the second ear canal, and adapted to receive an occluded sound (305) within the one of the first ear canal (303) and the second ear canal (303); and
   a wireless receiver, connected to a first processor (460), to receive a first wireless signal representing a remote sound;

   wherein the first processor (460) is connected to the first microphone (440) and is adapted to process the occluded sound (305) and the remote sound; the first ear level device further including:

   a speaker adapted for use in the one of the first ear canal (303) and the second ear canal (303) and adapted to transmit the processed remote sound to the one of the first ear canal (303) and the second ear canal (303);
   a wireless transmitter, connected to the first processor (460) and adapted to receive the processed occluded sound from the first processor (460) and transmit a second wireless signal representing the occluded sound;
   a first earmold housing at least the first microphone (440) and the speaker (470), at least a portion of the first earmold configured for placement in the one of the first ear canal (303) and the second ear canal (303); and
   a first voice operated exchange (VOX) circuit (430) connected to the first processor (460);
   the first VOX circuit (430) including:

   an occluded sound gating module (441) adapted to gate the occluded sound on, and to gate the remote sound off, when the occluded sound is detected while the remote sound is not detected; and
   a remote sound gating module (451) adapted to gate the remote sound on, and to gate the occluded sound off, when the incoming remote sound is detected while the occluded sound is not detected.

2. A system according to claim 1, wherein the first earmold houses the first microphone (440), the first processor (460) and the wireless transmitter, and wherein the first earmold is configured for use as the ITE device (310A).

3. A system according to claim 1, wherein the first ear level device (110,210A) comprises an ITE module including the first microphone (440) and a BTE module attached to the ITE module, the BTE module including the first processor and the wireless transmitter.

4. A system according to claim 1, wherein the first microphone (440) and the speaker (470) are implemented as one common device receiving the occluded sound and transmitting the processed remote sound.

5. A system according to claim 4, further comprising a second microphone (420) connected to the first processor (460), the second microphone (420) adapted to receive an ambient sound from outside the one of the first ear canal (303) and the second ear canal (303), and wherein:

   the first processor (460) further processes the ambient sound; and
   the speaker (470) is configured to transmit the processed remote and ambient sounds to the one of the first ear canal (303) and the second ear canal (303).

6. A system according to claim 5, wherein the first VOX

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circuit (430) comprises an ambient sound gating module (421), coupled to the first microphone (420), to blank or substantially attenuate the ambient sound.

7. A system according to any of the preceding claims, wherein the first processor (460) comprises a speech recognition module.

8. A system according to any of claims 4 - 7, wherein the first earmold houses the first microphone (440), the first processor (460), the wireless transmitter, the wireless receiver, and the speaker (470), and wherein the first earmold is configured for use as the ITE device.

9. A system according to claim 8, wherein the first earmold is configured for use as an in-the-canal (ITC) device (310B).

10. A system according to claim 9, wherein the first earmold is configured for use as a completely-in-the-canal (CIC) device (310C).

11. A system according to any of claims 4 - 7, wherein the first ear level device (110,210A) comprises an ITE module including the first microphone (440) and the speaker (470) and a BTE module attached to the ITE module and including the second microphone (420), the first processor (460), the wireless transmitter and the wireless receiver.

12. A system according to claim 11, wherein the BTE module comprises the first voice operated exchange (VOX) circuit (430).

13. A system according to claim 11, wherein the BTE module comprises a rechargeable battery (480).

14. A system according to any of claims 7 - 13, further comprising a remote device (190, 290) communicatively coupled to the wireless transmitter and the wireless receiver via a telemetry link (195, 295) providing for simultaneous bidirectional communication between the first ear-level device (110, 210A) and the remote device (190, 290).

15. A system according to claim 14, wherein the remote device (190, 290) comprises at least one of a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator.

16. A system according to claim 1, wherein the first microphone (440) is adapted for use in the first ear canal (303) and receives the occluded sound within the first ear canal (303), wherein the at least the portion of the first earmold is configured for placement in the first ear canal (303), and further comprising a second ear-level device (210B) including:

a wireless receiver to receive a first wireless signal representing a remote sound;
a second processor (260), connected to the wireless receiver, to convert the first wireless signal to the remote sound;
a speaker (470) connected to the second processor, the speaker adapted for use in the second ear canal (303) to transmit the remote sound to the second ear canal (303); and
a second earmold housing at least the speaker, at least a portion of the second earmold configured for placement in the second ear canal (303).

17. A system according to claim 16, wherein the second ear-level device (210B) further comprises a second microphone (420) connected to the second processor (460), the second microphone (420) adapted to receive an ambient sound from outside the second ear canal (303), and wherein:

the second processor (460) further processes the ambient sound; and
the speaker (470) is configured to transmit the remote sound and the processed ambient sound to the second ear canal (303).

18. A system according to any of claims 16 and 17, wherein the first ear-level device (110,210A) comprises the first voice operated exchange (VOX) circuit (430) connected to the first processor (460), and the second ear-level device (210B) further comprises a second VOX circuit (430) connected to the second processor.

19. A system according to any of claims 16 - 18, wherein the first processor and the second processor each comprise a speech recognition module.

20. A system according to any of claims 16 - 19, wherein the first and second ear-level devices are each the BTE device.

21. A system according to any of claims 16 - 19, wherein the first and second ear-level devices are each the ITE device.

22. A system according to claim 21, wherein the first and second ear-level devices are each an in-the-canal (ITC) device (310B).

23. A system according to claim 22, wherein the first and second ear-level devices are each a completely-in-the-canal (CIC) device (310C).

24. A system according to any of claims 16 - 23, further

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comprising a remote device (190,290) communicatively coupled to the first and second ear-level devices.

25. A system according to claim 24, wherein the remote device (190, 290) comprises at least one of a computer, a personal digital assistant (PDA), a cellular phone, a walkie talkie, or a language translator.

26. A method, comprising:

detecting an occluded sound using a first microphone adapted for use in an ear canal (303);
detecting an incoming radio signal representing a remote sound from a remote device (190, 290);
starting a voice operated exchange (VOX) housed within an ear-level communication device when at least one of the occluded sound and the incoming radio signal is detected if the VOX is not already on, the ear level communication device being one of an in-the-ear (ITE) device and a behind-the-ear (BTE) device;
gating the occluded sound on, and gating the remote sound off, when the occluded sound is detected while the incoming radio signal is not detected; and
gating the remote sound on, and gating the occluded sound off, when the incoming radio signal is detected while the occluded sound is not detected.

27. A method according to claim 26, wherein detecting the occluded sound comprises comparing an amplitude of the occluded sound to an occluded sound threshold, wherein the occluded sound is detected when the amplitude of the occluded sound exceeds the occluded sound threshold.

28. A method according to any of claims 26 and 27, wherein detecting the incoming radio signal comprises comparing an amplitude of the remote sound to a remote sound threshold, wherein the incoming radio signal is detected when the amplitude of the remote sound exceeds the remote sound threshold.

29. A method according to any of claims 26 - 28, further comprising detecting an ambient sound using a second microphone, and wherein starting the VOX comprises starting the VOX when at least one of the occluded sound, the incoming radio signal, and the ambient sound is detected if the VOX is not already on.

30. A method according to claim 29, further comprising gating the occluded sound off, gating the remote sound on, and gating the ambient sound off, when the incoming radio signal is detected while the occluded sound is not detected.

31. A method according to claim 29, further comprising gating the occluded sound off, gating the remote sound on, and gating the ambient sound on, when the incoming radio signal is detected while the occluded sound is not detected.

32. A method according to claim 29, further comprising gating the occluded sound on, gating the remote sound off, and gating the ambient sound off, when the occluded sound is detected while the incoming radio signal is not detected.

Patentansprüche

1. System, das zur Verwendung in einem ersten Ohr (101A) mit einem ersten Gehörgang (303) und/oder einem zweiten Ohr (101B) mit einem zweiten Gehörgang (303) eingerichtet ist, mit:

einer ersten ohrebenen- bzw. ohrseitigen Vorrichtung (110, 210A), die dafür eingerichtet ist, eine In-Ohr-Vorrichtung (ITE) oder eine Hinter-Ohr-Vorrichtung (BTE) zu sein, wobei die erste ohrseitige Vorrichtung beinhaltet:

ein erstes Mikrofon (440), das zur Verwendung in dem ersten Gehörgang oder dem zweiten Gehörgang eingerichtet ist, und das dafür eingerichtet ist, einen verdeckten Ton (305) in jeweils dem ersten Gehörgang (303) oder dem zweiten Gehörgang (303) zu empfangen; und
einen Drahtlosempfänger, der mit einem ersten Prozessor (460) verbunden ist, um ein erstes Drahtlossignal zu empfangen, welches einen Fernton darstellt;

wobei der erste Prozessor (460) mit dem ersten Mikrofon (440) verbunden und dafür eingerichtet ist, den verdeckten Ton (305) und den Fernton zu verarbeiten;
wobei die erste ohrseitige Vorrichtung ferner beinhaltet:

einen Lautsprecher, der zur Verwendung in dem jeweiligen ersten Gehörgang (303) oder dem zweiten Gehörgang (303) eingerichtet ist, und der dafür eingerichtet ist, den verarbeiteten Fernton an den jeweiligen ersten Gehörgang (303) oder den zweiten Gehörgang (303) zu übertragen;
einen Drahtlossender, der mit dem ersten Prozessor (460) verbunden und dafür eingerichtet ist, den verarbeiteten verdeckten Ton von dem ersten Prozessor (460) zu empfangen und ein zweites Drahtlossignal, das den verdeckten Ton darstellt, zu senden;

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ein erstes Ohrformgehäuse wenigstens bei dem ersten Mikrofon (440) und dem Lautsprecher (470), wobei wenigstens ein Teil der ersten Ohrform dafür eingerichtet ist, in dem ersten Gehörgang (303) oder dem zweiten Gehörgang (303) platziert zu werden; und
eine erste stimmbetriebene Austauschschaltung (VOX) (430), die mit dem ersten Prozessor (460) verbunden ist;

wobei die erste VOX-Schaltung (430) beinhaltet:

ein Ausblendmodul (441) für einen verdeckten Ton, das dafür eingerichtet ist, den verdeckten Ton einzublenden und den Fernton auszublenden, wenn der verdeckte Ton bestimmt wird, während der Fernton nicht bestimmt wird; und
ein Ausblendmodul (441) für einen Fernton, das dafür eingerichtet ist, den Fernton einzublenden und den verdeckten Ton auszublenden, wenn der eingehende Fernton bestimmt wird, während der verdeckte Ton nicht bestimmt wird.

2. System nach Anspruch 1, bei dem eine erste Ohrform das erste Mikrofon (440), den ersten Prozessor (460) und den Drahtlossender einschließt, und bei dem die erste Ohrform zur Verwendung als ITE-Vorrichtung (310) eingerichtet ist.

3. System nach Anspruch 1, bei dem die erste ohrseitige Vorrichtung (110, 210A) ein ITE-Modul, das das erste Mikrofon (440) beinhaltet, und ein zweites BTE-Modul, das an das ITE-Modul angebracht ist, beinhaltet, wobei das ITE-Modul den ersten Prozessor und den Drahtlossender beinhaltet.

4. System nach Anspruch 1, bei dem das erste Mikrofon (440) und der Lautsprecher (470) als eine gemeinsame Vorrichtung implementiert sind, die den verdeckten Ton empfängt und den verarbeiteten Fernton sendet.

5. System nach Anspruch 4, ferner mit einem zweiten Mikrofon (420), das mit dem ersten Prozessor (460) verbunden ist, wobei das zweite Mikrofon (420) dafür eingerichtet ist, einen ümgebungston von außerhalb das jeweiligen ersten Gehörgangs (303) oder des zweiten Gehörgangs (303) zu empfangen, und wobei:

der erste Prozessor (460) den Umgebungston ferner bzw. weiterverarbeitet; und
der Lautsprecher (470) dafür eingerichtet ist, den verarbeiteten Fern- und Umgebungston an den jeweiligen ersten Gehörgang (303) und zweiten Gehörgang (303) zu senden.

6. System nach Anspruch 5, bei dem die erste VOX-Schaltung (430) ein Umgebungstonausblendmodul (421) aufweist, das mit dem ersten Mikrofon (420) verbunden ist, um den Umgebungston auf Null zu setzen oder ihn wesentlich zu dämpfen.

7. System nach einem der vorstehenden Ansprüche, bei dem der erste Prozessor (460) ein Spracherkennungsmodul aufweist.

8. System nach einem der Ansprüche 4 bis 7, bei dem die erste Ohrform, das erste Mikrofon (440), den ersten Prozessor (460), den Drahtlossender, den Drahtlosempfänger und den Lautsprecher (470) einschließt, und bei dem die erste Ohrform dafür eingerichtet ist, als die ITE-Vorrichtung verwendet zu werden.

9. System nach Anspruch 8, bei dem die erste Ohrform zur Verwendung als In-Kanal-Vorrichtung (ITC) (310B) verwendet zu werden.

10. System nach Anspruch 9, bei dem die erste Ohrform zur Verwendung als vollständig-In-Kanal-Vorrichtung (CIC) (310C) verwendet zu werden.

11. System nach einem der Ansprüche 4 bis 7, bei dem die erste ohrseitige Vorrichtung (110, 210A) ein ITE-Modul aufweist, das das erste Mikrofon (440) und den Lautsprecher (470) und ein BTE-Modul, das an das ITE-Modul angebracht ist, und das das zweite Mikrofon (420), den ersten Prozessor (460), den drahtlos Sender und den drahtlos Empfänger beinhaltet, beinhaltet.

12. System nach Anspruch 11, bei dem das BTE-Modul die erste sprachbetriebene Austauschschaltung (VOX) (340) aufweist.

13. System nach Anspruch 11, bei dem das BTE-Modul eine widerauflabbare Batterie (480) aufweist.

14. System nach einem der Ansprüche 7 bis 13, das ferner eine entfernte Vorrichtung (190, 290) aufweist, die mit dem Drahtlossender und dem Drahtlosempfänger über eine Telemetrieverbindung (195, 295) in Kommunikationsverbindung steht, um eine gleichzeitige bi-direktionale Kommunikation zwischen der ersten ohrseitigen Vorrichtung (110, 210A) und der entfernten Vorrichtung (190, 290) bereitzustellen.

15. System nach Anspruch 14, bei dem die entfernte Vorrichtung (190, 290) wenigstens einen Computer, einen Personal Digital Assistant (PDA), ein Mobiltelefon, ein Walkie Talkie und/oder einen Sprachübersetzer aufweist.

16. System nach Anspruch 1, bei dem das erste Mikro-

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fon (440) dafür eingerichtet ist, in dem ersten Gehörgang (303) verwendet zu werden, und dieses den verdeckten Ton in dem ersten Gehörgang (303) empfängt, wobei der wenigstens eine Abschnitt der ersten Ohrform zur Anordnung in dem ersten Gehörgang (303) eingerichtet ist, und ferner mit einer zweiten ohrseitigen Vorrichtung (210B), die beinhaltet:

einen Drahtlosempfänger, um ein erstes Drahtlossignal zu empfangen, das einen Fernton darstellt;
einen zweiten Prozessor (260), der mit dem Drahtlosempfänger verbunden ist, um das erste Drahtlossignal in den Fernton umzuwandeln;
einen Lautsprecher (470), der mit dem zweiten Prozessor verbunden ist, wobei der Lautsprecher zur Verwendung in dem zweiten Gehörgang (303) eingerichtet ist, um den Fernton an den zweiten Gehörgang (303) zu übertragen; und
einer zweiten Ohrform, die wenigstens den Lautsprecher einschließt, wobei wenigstens ein Teil der zweiten Ohrform zur Anordnung in dem zweiten Gehörgang (303) eingerichtet ist.

17. System nach Anspruch 16, bei dem die zweite ohrseitige Vorrichtung (210B) ferner ein zweites Mikrofon (420) aufweist, das mit dem zweiten Prozessor (460) verbunden ist, wobei das zweite Mikrofon (420) dafür eingerichtet ist, einen Umgebungston von außerhalb des zweiten Gehörgangs (303) zu empfangen, und bei dem:

der zweite Prozessor (460) den Umgebungston weiterverarbeitet; und
der Lautsprecher (470) dafür eingerichtet ist, den Fernton und den verarbeiteten Umgebungston an den zweiten Gehörgang (303) zu senden.

18. System nach einem der Ansprüche 16 oder 17, bei dem die erste ohrseitige Vorrichtung (110, 210A) die erste sprachbetriebene Austauschschaltung (VOX) (430) mit dem ersten Prozessor (460) verbunden aufweist, und wobei die zweite ohrseitige Vorrichtung (210B) ferner eine zweite VOX-Schaltung (430) aufweist, die mit dem zweiten Prozessor verbunden ist.

19. System nach einem der Ansprüche 16 bis 18, bei dem der erste Prozessor und der zweite Prozessor jeweils ein Spracherkennungsmodul aufweisen.

20. System nach einem der Anspruch 16 bis 19, bei dem die ersten und zweiten ohrseitigen Vorrichtungen jeweils die BTE-vorrichtungen darstellen.

21. System nach einem der Ansprüche 16 bis 19, bei dem die ersten und zweiten ohrseitigen Vorrichtungen jeweils die ITE-Vorrichtungen darstellen.

22. System nach Anspruch 21, bei dem die ersten und zweiten ohrseitigen Vorrichtungen jeweils eine In-Gehörgangs-Vorrichtung (ITC) (310B) darstellen.

23. System nach Anspruch 22, bei dem die ersten und zweiten ohrseitigen Vorrichtungen jeweils Vollständig-In-Gehörgangs-Vorrichtungen (CIC) (310C) darstellen.

24. System nach einem der Ansprüche 16 bis 23, das ferner eine entfernte Vorrichtung (190, 290) aufweist, die kommunikativ mit den ersten und zweiten ohrseitigen Vorrichtungen verbunden ist.

25. System nach Anspruch 24, bei dem die entfernte Vorrichtung (190, 290) wenigstens einen Computer, einen Personal Digital Assistant (PDA), ein Mobiltelefon, ein Walkie Talkie und/oder einen Sprachübersetzer aufweist.

26. Verfahren, das beinhaltet:

Bestimmen eines verdeckten Tons unter Verwendung eines ersten Mikrofons, das zur Verwendung in einem Gehörgang (303) eingerichtet ist;
Bestimmen eines eingehenden Funksignals, das einen Fernton von einer entfernten Vorrichtung (190, 290) darstellt;
Starten einer sprachbetriebenen Austauscheinrichtung (VOX), die in einer ohrseitigen Kommunikationsvorrichtung eingeschlossen ist, wenn der verdeckte Ton und/oder das eingehende Funksignal bestimmt wird, wenn die VOX nicht bereits an ist, wobei die ohrseitige Kommunikationsvorrichtung eine In-Ohr-Vorrichtung (ITE) oder eine Hinter-Ohr-Vorrichtung (BTE) darstellt;
Einblenden des verdeckten Tons und Ausblenden des Ferntons, wenn der verdeckte Ton bestimmt wird, während das eingehende Funksignal nicht bestimmt wird; und
Einblenden des Ferntons und Ausblenden des verdeckten Tons, wenn das eingehende Funksignal bestimmt wird, während der verdeckte Ton nicht bestimmt wird.

27. Verfahren nach Anspruch 26, bei dem das Bestimmen des verdeckten Tons, das Vergleichen einer Amplitude des verdeckten Tons mit einem Schwellwert für einen verdeckten Ton beinhaltet, wobei der verdeckte Ton bestimmt wird, wenn die Amplitude des verdeckten Tones den Schwellwert für den verdeckten Ton überschreitet.

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28. Verfahren nach einem der Ansprüche 26 oder 27, bei dem das Bestimmen des eingehenden Funksignals das Vergleichen einer Amplitude des Ferntons mit einem Ferntonschwellwert beinhaltet, wobei das eingehende Funksignal bestimmt wird, wenn die Amplitude des Ferntons den Ferntonschwellwert überschreitet.

29. Verfahren nach einem der Ansprüche 26 bis 28, das ferner das Bestimmen eines Umgebungstons unter Verwendung eines zweiten Mikrofons beinhaltet, und wobei das Starten der VOX das Starten der VOX beinhaltet, wenn wenigstens der verdeckte Ton, das eingehende Funksignal und/oder der Umgebungston bestimmt wird, während die VOX noch nicht bereits an ist.

30. Verfahren nach Anspruch 29, das ferner das Ausblenden des verdeckten Tons, das Einblenden des Ferntons und das Ausblenden des Umgebungstons beinhaltet, wenn das eingehende Funksignal bestimmt wird, während der verdeckte Ton nicht bestimmt wird.

31. Verfahren nach Anspruch 29, das ferner das Ausblenden des verdeckten Tons, das Einblenden des Ferntons und das Einblenden des Umgebungstons beinhaltet, wenn das eingehende Funksignal bestimmt wird, während der verdeckte Ton nicht bestimmt wird.

32. Verfahren nach Anspruch 29, das ferner das Einblenden des verdeckten Tones, das Ausblenden des Ferntons und das Ausblenden des Umgebungstons beinhaltet, wenn der verdeckte Ton bestimmt wird, während das eingehende Funksignal nicht bestimmt wird.

Revendications

1. Un système adapté en vue d'une utilisation dans au moins une parmi une première oreille (101A) ayant un premier conduit auditif (303) et une seconde oreille (101B) ayant un second conduit auditif (303), comprenant:

   un premier dispositif d'oreille (110, 210A) configuré pour être un parmi un dispositif placé à l'intérieur de l'oreille (ITE) et un dispositif contour d'oreille (BTE), le premier dispositif d'oreille comprenant :

   un premier microphone (440) adapté en vue d'une utilisation dans un parmi le premier conduit auditif et le second conduit auditif, et adapté pour recevoir un son occlus (305) à l'intérieur de celui parmi le premier conduit auditif (303) et le second conduit auditif (303) ; et
   un récepteur sans fil, connecté à un premier processeur (460), pour recevoir un premier signal sans fil représentant un son distant ;

   dans lequel le premier processeur (460) est connecté au premier microphone (440) et est adapté pour traiter le son occlus (305) et le son distant; le premier dispositif d'oreille comprenant en outre :

   un haut-parleur adapté en vue d'une utilisation dans celui parmi le premier conduit auditif (303) et le second conduit auditif (303) et adapté pour transmettre le son distant traité à celui parmi le premier conduit auditif (303) et le second conduit auditif (303) ; un émetteur sans fil, connecté au premier processeur (460) et adapté pour recevoir le son occlus traité du premier processeur (460) et émettre un second signal sans fil représentant le son occlus ;
   un premier embout auriculaire logeant au moins le premier microphone (440) et le haut-parleur (470), au moins une portion du premier embout auriculaire étant configurée en vue d'être placée dans celui parmi le premier conduit auditif (303) et le second conduit auditif (303) ; et
   un premier circuit d'échange à commande vocale (VOX) (430) connecté au premier processeur (460) ;
   le premier circuit VOX (430) comprenant :

   un module de contrôle de son occlus (441) adapté pour laisser passer le son occlus et pour bloquer le son distant lorsque le son occlus est détecté alors que le son distant n'est pas détecté ; et
   un module de contrôle de son distant (451) adapté pour laisser passer le son distant et pour bloquer le son occlus lorsque le son distant entrant est détecté alors que le son occlus n'est pas détecté.

2. Système selon la revendication 1, dans lequel le premier embout auriculaire loge le premier microphone (440), le premier processeur et l'émetteur sans fil, et dans lequel le premier embout auriculaire est configuré pour être utilisé comme dispositif ITE (310 A).

3. Système selon la revendications 1, dans lequel le premier dispositif d'oreille (110, 210A) comprend un module ITE comprenant le premier microphone (440) et un module BTE fixé au module ITE, le module BTE comprenant le premier processeur et l'émetteur sans fil.

4. Système selon la revendication 1, dans lequel le premier microphone (440) et le haut-parleur (470) sont

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mis en oeuvre sous la forme d'un dispositif commun recevant le son occlus et émettant le son distant traité.

5. Système selon la revendication 4, comprenant en outre un second microphone (420) connecté au premier processeur (460), le second microphone (420) étant adapté pour recevoir un son ambiant de l'extérieur de celui parmi le premier conduit auditif (303) et le second conduit auditif (303), et dans lequel :

le premier processeur (460) traite en outre le son ambiant ; et
le haut-parleur (470) est configuré pour transmettre les sons distant et ambiant traités à celui parmi le premier conduit auditif (303) et le second conduit auditif (303).

6. Système selon la revendication 5, dans lequel le premier circuit VOX (430) comprend un module de contrôle de son ambiant (421), couplé au premier microphone (420), pour occulter ou atténuer sensiblement le son ambiant.

7. Système selon l'une quelconque des revendications précédentes, dans lequel le premier processeur (460) comprend un module de reconnaissance vocale.

8. Système selon l'une quelconque des revendications 4 à 7, dans lequel le premier embout auriculaire loge le premier microphone (440), le premier processeur (460), l'émetteur sans fil, le récepteur sans fil, et le haut-parleur (470), et dans lequel le premier embout auriculaire est configuré pour être utilisé comme dispositif ITE.

9. Système selon la revendication 8, dans lequel le premier embout auriculaire est configuré pour être utilisé comme dispositif intra-conduit (ITC) (310B).

10. Système selon la revendication 9, dans lequel le premier embout auriculaire est configuré pour être utilisé comme dispositif complètement intra-conduit (CIC) (310C).

11. Système selon l'une quelconque des revendications 4 à 7, dans lequel le premier dispositif d'oreille (110, 210A) comprend un module ITE comprenant le premier microphone (440) et le haut-parleur (470) et un module BTE fixé au module ITE et comprenant le second microphone (420), le premier processeur (460), l'émetteur sans fil et le récepteur sans fil.

12. Système selon la revendication 11, dans lequel le module BTE comprend le premier circuit d'échange à commande vocale (VOX) (430).

13. Système selon la revendication 11, dans lequel le module BTE comprend une batterie rechargeable (480).

14. Système selon l'une quelconque des revendications 7 à 13, comprenant en outre un dispositif distant (190, 290) couplé en communication à l'émetteur sans fil et au récepteur sans fil via une liaison de télémesure (195, 295) assurant une communication bidirectionnelle simultanée entre le premier dispositif d'oreille (110, 210A) et le dispositif distant (190, 290).

15. Système selon la revendication 14, dans lequel le dispositif distant (190, 290) comprend au moins un parmi un ordinateur, un assistant numérique personnel (PDA), un téléphone cellulaire, un talkie-walkie, ou un traducteur de langue.

16. Système selon la revendication 1, dans lequel le premier microphone (440) est adapté en vue d'une utilisation dans le premier conduit auditif (303) et reçoit le son occlus à l'intérieur du premier conduit auditif (303), ans lequel au moins la portion du premier embout auriculaire est configurée en vue d'être placée dans le premier conduit auditif (303), et comprenant en outre un second dispositif d'oreille (210B) comprenant :

un récepteur sans fil pour recevoir un premier signal sans fil représentant un son distant ;
un second processeur (260), connecté au récepteur sans fil, pour convertir le premier signal sans fil dans le son distant ;
un haut-parleur (470) connecté au second processeur, le haut-parleur étant adapté en vue d'une utilisation dans le second conduit auditif (303) pour transmettre le son distant au second conduit auditif (303) ; et
un second embout auriculaire logeant au moins le haut-parleur, au moins une portion du second embout auriculaire étant configurée en vue d'être placée dans le second conduit auditif (303).

17. Système selon la revendication 16, dans lequel le second dispositif d'oreille (210B) comprend en outre un second microphone (420) connecté au second processeur (460), le second microphone (420) étant adapté pour recevoir un son ambiant de l'extérieur du second conduit auditif (303), et dans lequel :

le second processeur (460) traite en outre le son ambiant ; et le haut-parleur (470) est configuré pour transmettre le son distant et le son ambiant traité au second conduit auditif (303).

18. Système selon l'une quelconque des revendications 16 et 17, dans lequel le premier dispositif d'oreille

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(110, 210) comprend le premier circuit d'échange à commande vocale (VOX) (430) connecté au premier processeur (460), et le second dispositif d'oreille (210B) comprend en outre un second circuit VOX (430) connecté au second processeur.

19. Système selon l'une quelconque des revendications 16 à 18, dans lequel le premier processeur et le second processeur comprennent chacun un module de reconnaissance vocale.

20. Système selon l'une quelconque des revendications 16 à 19, dans lequel les premier et second dispositifs d'oreille sont respectivement le dispositif BTE.

21. Système selon l'une quelconque des revendications 16 à 19, dans lequel les premier et second dispositifs d'oreille sont respectivement le dispositif ITE.

22. Système selon la revendication dans lequel les premier et second dispositifs d'oreille sont respectivement un dispositif intra-conduit (ITC) (310B).

23. Système selon la revendication 22, dans lequel les premier et second dispositifs d'oreille sont respectivement un dispositif complètement intra-conduit (CIC) (310C).

24. Système selon l'une quelconque des revendications 16 à 23, comprenant en outre un dispositif distant (190, 290) couplé en communication aux premier et second dispositifs d'oreille.

25. Système selon la revendication 24, dans lequel le dispositif distant (190, 290) comprend au moins un parmi un ordinateur, un assistant numérique personnel (PDA), un téléphone cellulaire, un talkie walkie, ou un traducteur de langue.

26. Un procédé comprenant les étapes consistant à :

détecter un son occlus au moyen d'un premier microphone adapté en vue d'une utilisation dans un conduit auditif (303) ;
détecter un signal radio entrant représentant un son distant provenant d'un dispositif distant (190, 290) ;
lancer un échange à commande vocale (VOX) logé à l'intérieur d'un dispositif de communication d'oreille lorsqu'au moins un parmi le son occlus et le signal radio entrant est détecté si le VOX n'est pas déjà en marche, le dispositif de communication d'oreille étant un parmi un dispositif placé à l'intérieur de l'oreille (ITE) et un dispositif contour d'oreille (BTE) ;
laisser passer le son occlus, et bloquer le son distant lorsque le son distant occlus est détecté alors que le signal radio entrant n'est pas détecté ; et
laisser passer le son distant, et bloquer le son occlus lorsque le signal radio entrant est détecté alors que le son occlus n'est pas détecté.

27. Procédé selon la revendication 26, dans lequel la détection du son occlus comprend la comparaison d'une amplitude du son occlus avec un seuil de son occlus, dans lequel le son occlus est détecté lorsque l'amplitude du son occlus dépasse le seuil du son occlus.

28. Procédé selon l'une quelconque des revendications 26 et 27, dans lequel la détection du signal radio entrant comprend la comparaison d'une amplitude du son distant avec un seuil de son distant, dans lequel le signal radio entrant est détecté lorsque l'amplitude du son distant dépasse le seuil du son distant.

29. Procédé selon l'une quelconque des revendications 26 à 28, comprenant en outre la détection d'un son ambiant au moyen d'un second microphone, et dans lequel le lancement du VOX comprend le lancement du VOX lorsqu'au moins un parmi le son occlus, le signal radio entrant et le son ambiant est détecté si le VOX n'est pas déjà en marche.

30. Procédé selon la revendications 29, comprenant en outre l'étape consistant à bloquer le son occlus, laisser passer le son distant et bloquer le son ambiant lorsque le signal radio entrant est détecté alors que le son occlus n'est pas détecté.

31. Procédé selon la revendication 29, comprenant en outre l'étape consistant à bloquer le son occlus, laisser passer le son distant et laisser passer le son ambiant lorsque le signal radio entrant est détecté alors que le son occlus n'est pas détecté.

32. Procédé selon la revendication 29, comprenant en outre l'étape consistant à laisser passer le son occlus, bloquer le son distant, et bloquer le son ambiant lorsque le son occlus est détecté alors que le signal radio entrant n'est pas détecté.

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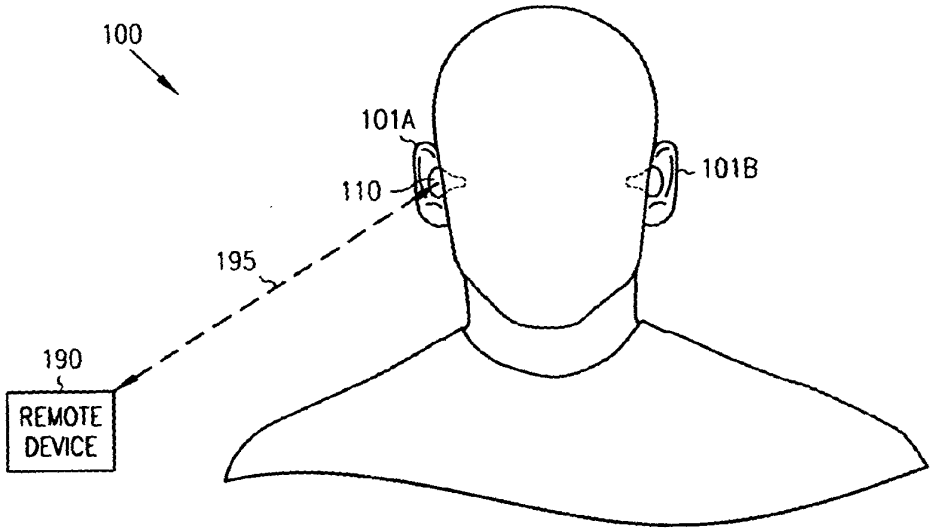


FIG. 1

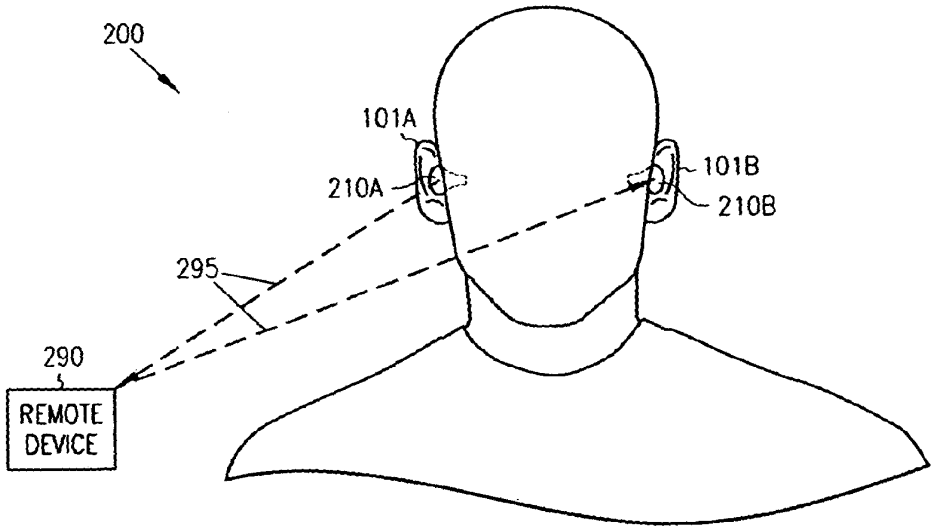


FIG. 2

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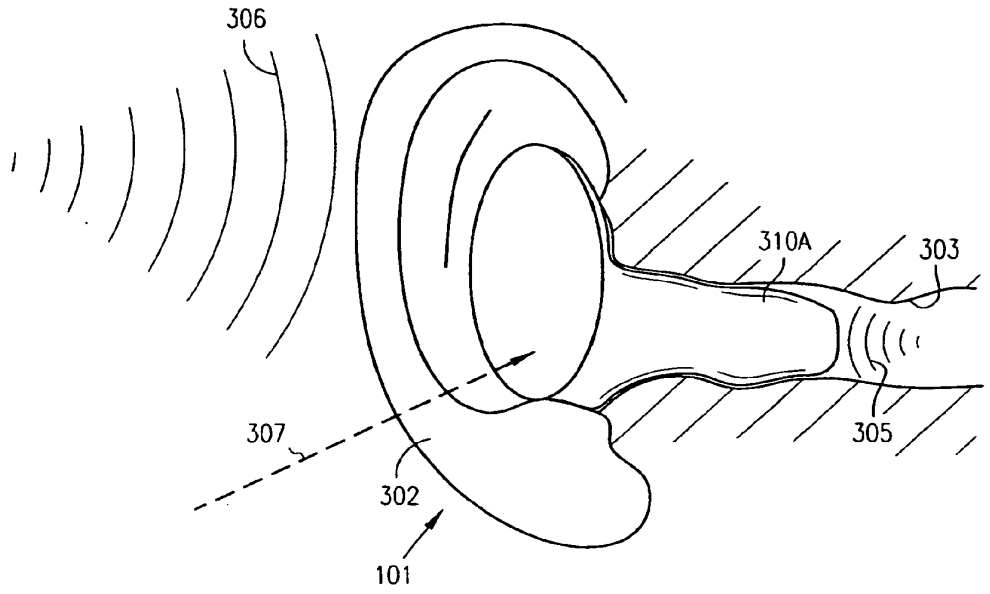


FIG. 3A

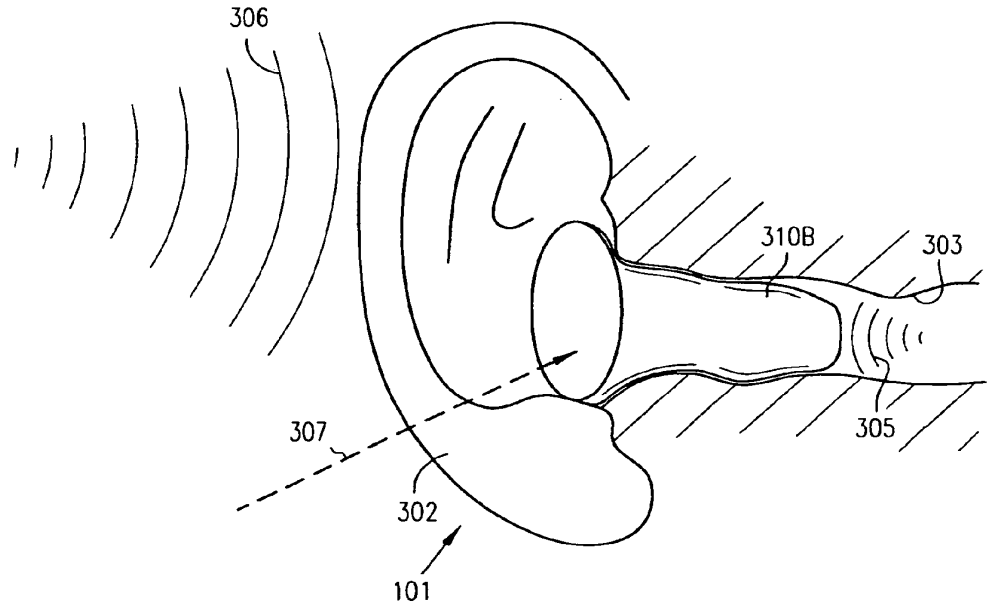


FIG. 3B

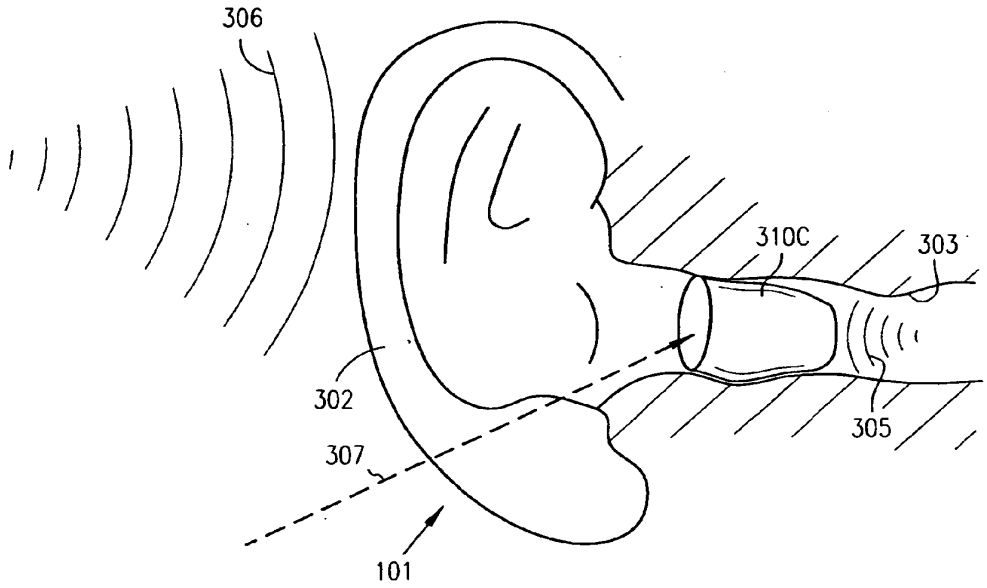


FIG. 3C

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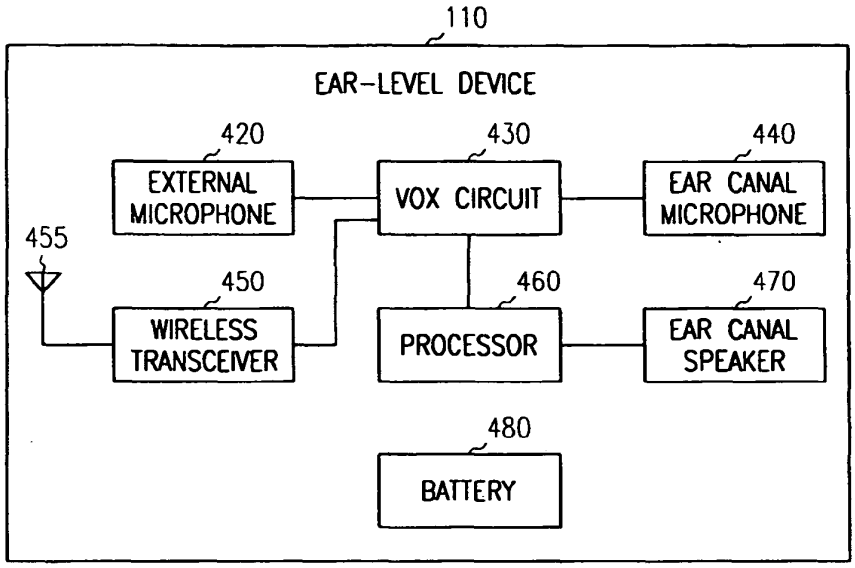


FIG. 4A

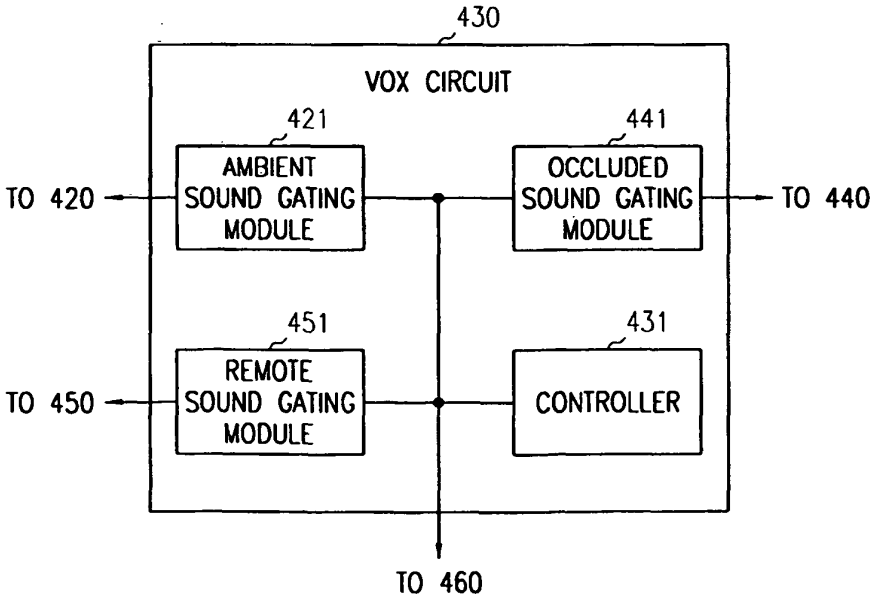


FIG. 4B

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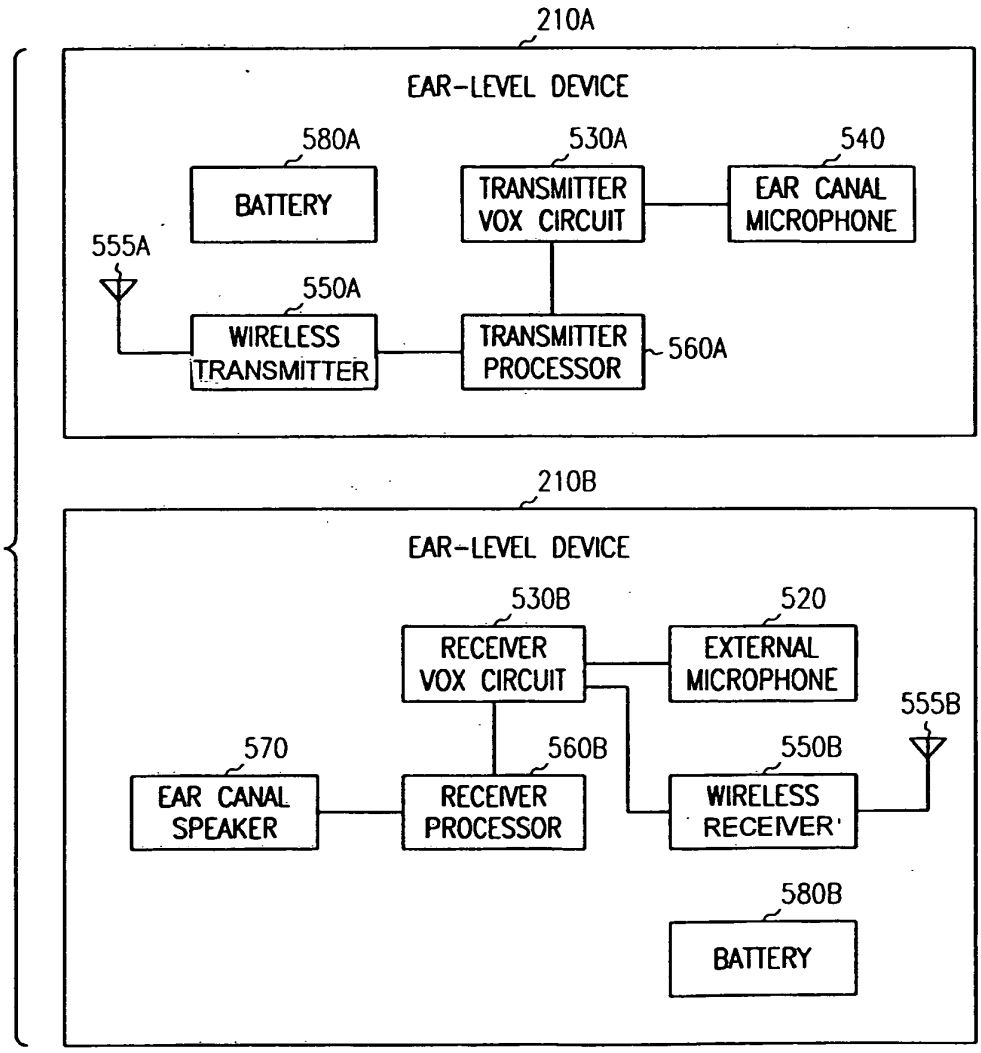


FIG. 5

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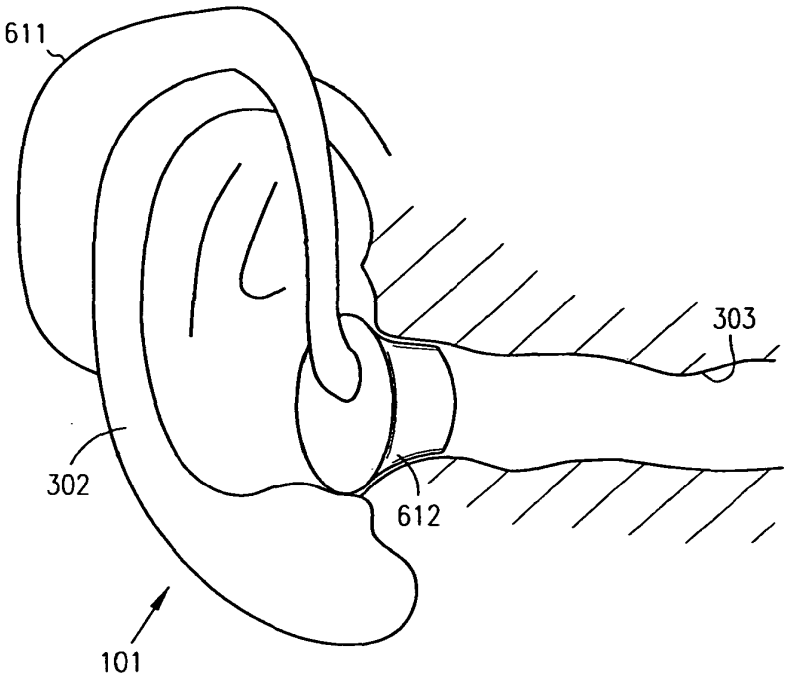

611
303
302
612
101

FIG. 6

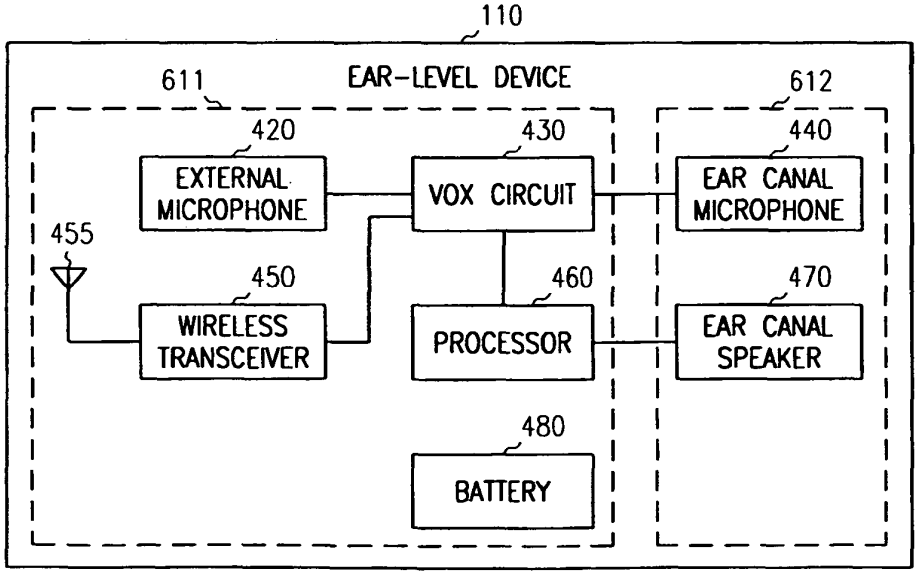

110
611
EAR-LEVEL DEVICE
612
420
EXTERNAL MICROPHONE
430
VOX CIRCUIT
440
EAR CANAL MICROPHONE
455
450
WIRELESS TRANSCEIVER
460
PROCESSOR
470
EAR CANAL SPEAKER
480
BATTERY

FIG. 7

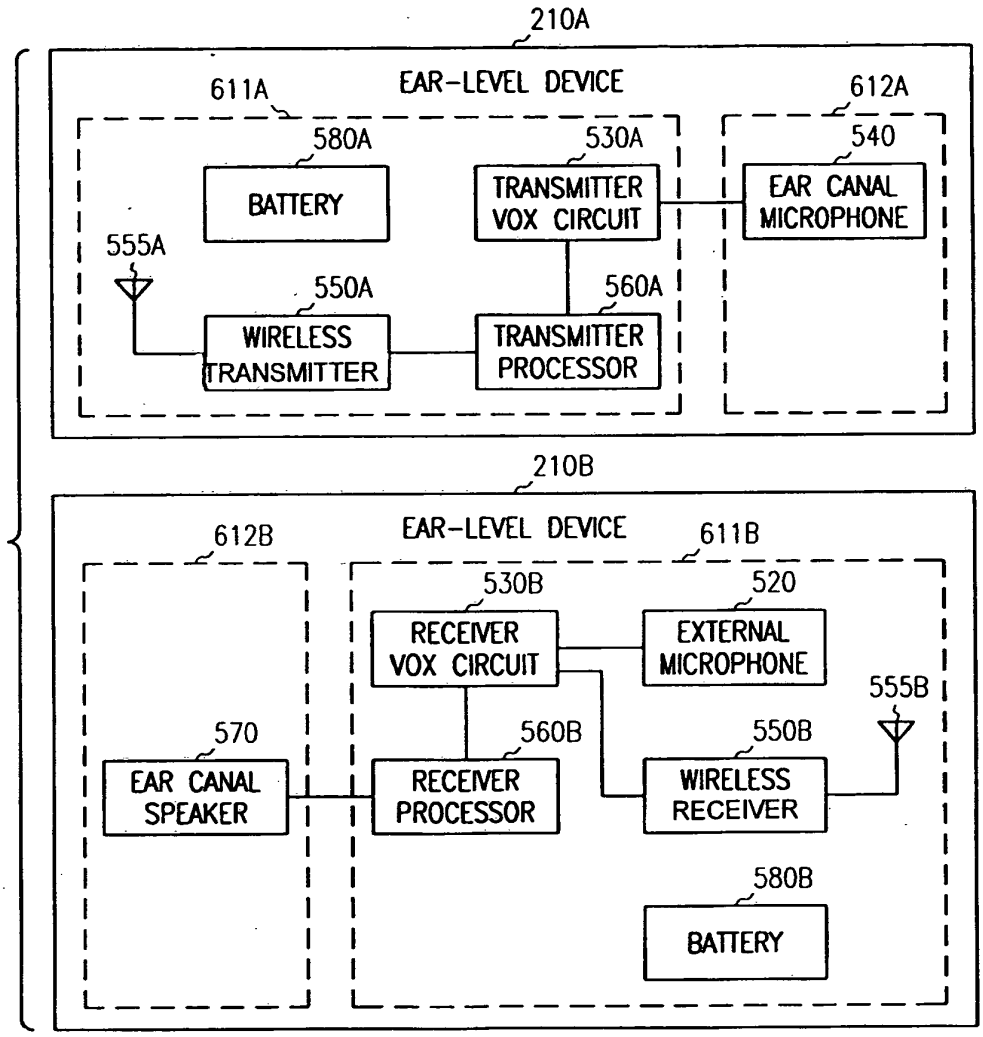

210A
EAR-LEVEL DEVICE
611A
612A
580A
530A
540
BATTERY
TRANSMITTER VOX CIRCUIT
EAR CANAL MICROPHONE
555A
550A
560A
WIRELESS TRANSMITTER
TRANSMITTER PROCESSOR
210B
EAR-LEVEL DEVICE
612B
611B
530B
520
RECEIVER VOX CIRCUIT
EXTERNAL MICROPHONE
555B
570
560B
550B
EAR CANAL SPEAKER
RECEIVER PROCESSOR
WIRELESS RECEIVER
580B
BATTERY

FIG. 8

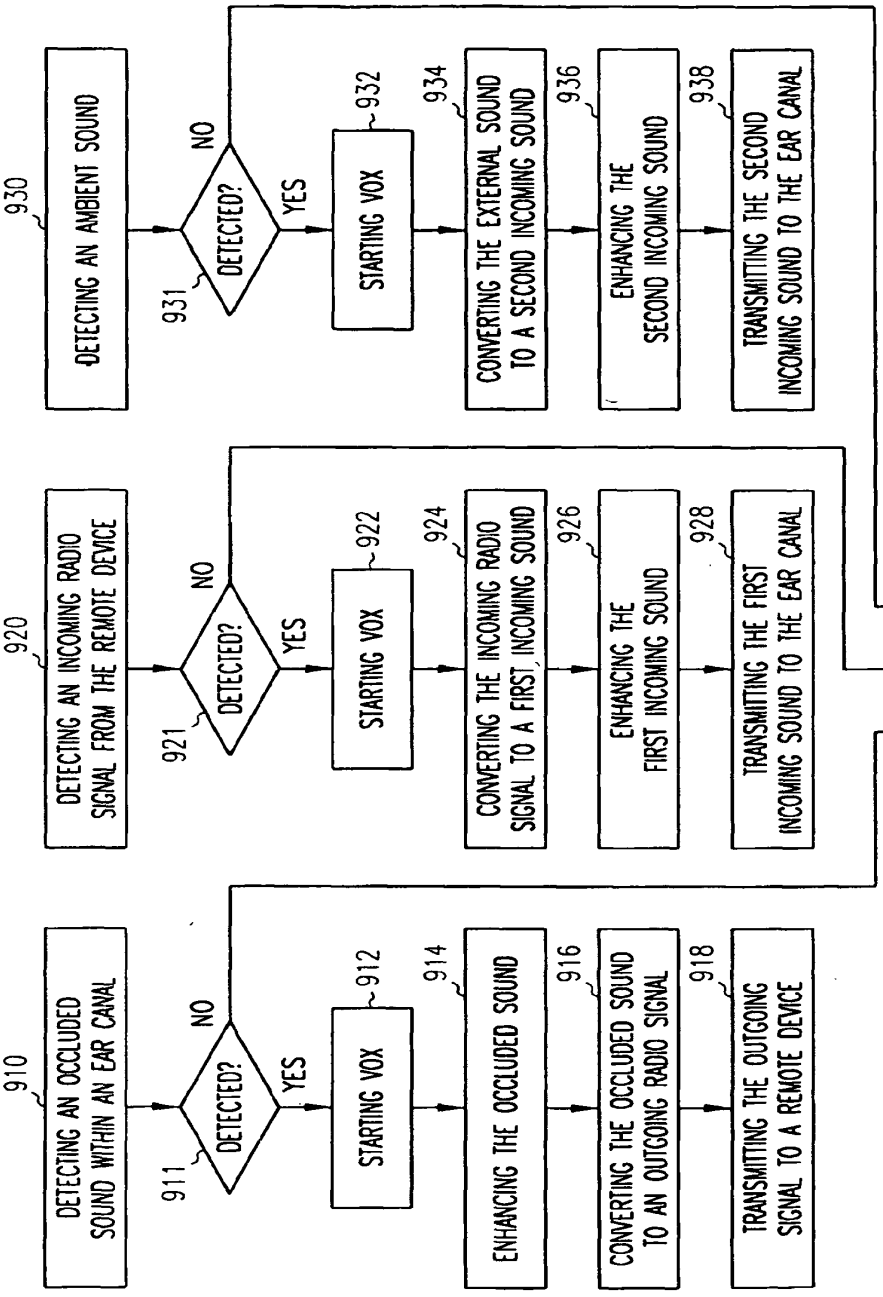


FIG. 9

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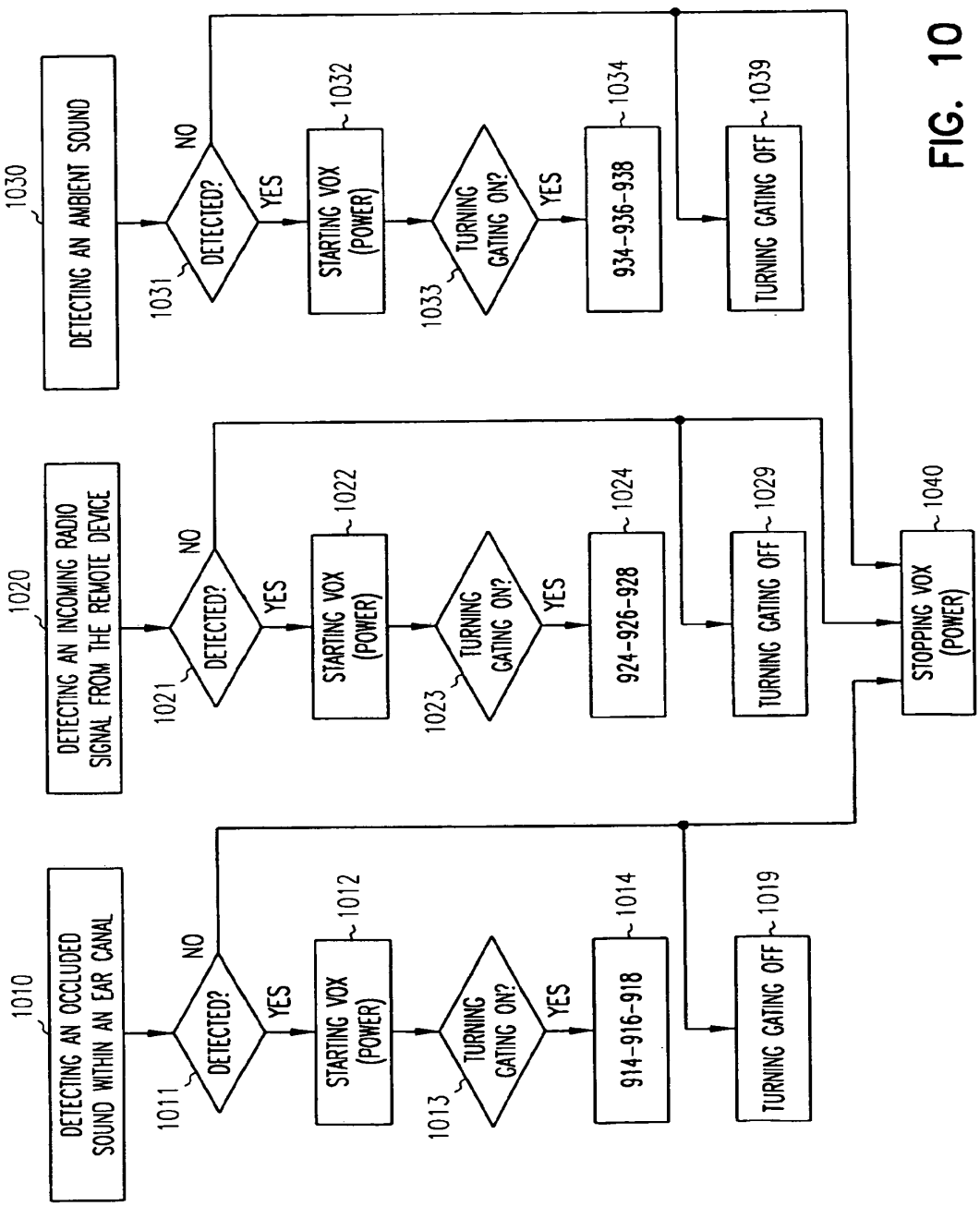


FIG. 10

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REFERENCES CITED IN THE DESCRIPTION

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- WO 03073790 A **[0010]**

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(54) System and method for separation of a users voice from ambient sound

(57) The invention relates to a system for separation of a user's voice from ambient sound, comprising a device (10) to be worn at the user's ear or at least partly in the user's ear canal (12) comprising a first microphone (M1) oriented outwardly towards the environment and a second microphone (M2) oriented inwardly towards the user's ear canal, and an audio signal processing unit (24, 26) for processing audio signals from the first and second microphone by a blind source separation algorithm adapted to separate the user's voice from ambient sound.

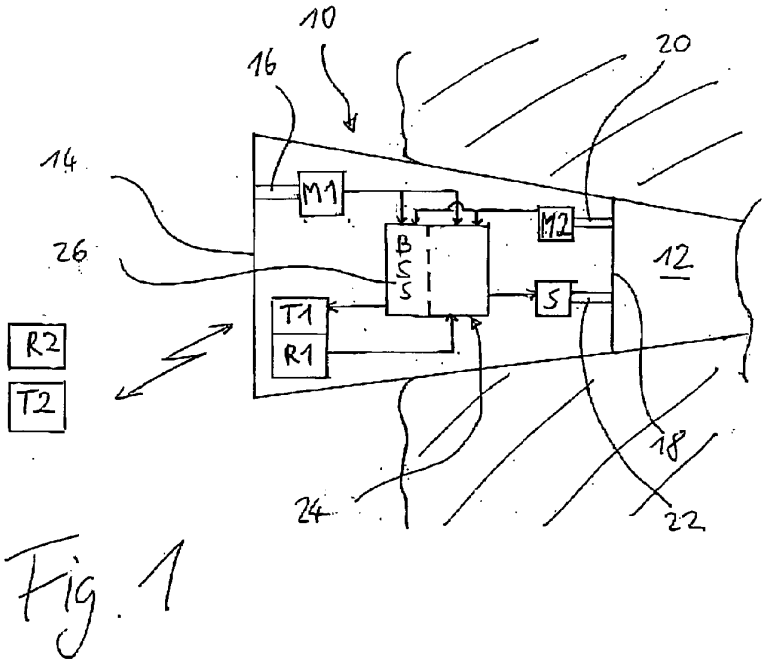


Fig. 1

EP 1 640 972 A1

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Description

[0001] The present invention relates to a system and a method for separation of a user's voice from ambient sound by using at least one device to be worn at the user's ear or at least partly in the user's ear canal.

[0002] For communication purposes, in particular for wireless electronic communication between or from persons exposed to a noisy environment, such as workers in industrial plants, policemen, soldiers, firemen, etc., it is desirable to have a sound pick-up system which is capable at least to some extent to separate the user's voice from ambient noise, or generally ambient sound, in order to improve the intelligibility of the person's speech to the listener, who may be one of the other persons exposed to the noisy environment or who may be a remote person.

[0003] A common approach to achieve such separation of a person's voice is the use of a boom microphone, i.e. a microphone which is placed close to the mouth, carried by a headset, helmet or any other device worn by the person. Such microphone selectively emphasizes the near field around the mouth.

[0004] Other approaches are vibration pick-up devices which are in direct contact with the throat, picking up the vibrations of the vocal chord, or which are in direct contact with the meatus wall or the outer ear canal, picking up the vibrations of the head tissue (i.e. "bone conduction" microphones) or which are in direct contact with the cheek-bone.

[0005] Devices of these types are either fairly sensitive to acoustic noise masking the speech or certain speech sounds are poorly transmitted, especially the high frequency consonant sounds necessary for good intelligibility. Furthermore, for industrial applications boom microphones have the drawbacks that they limit the freedom of movement of the user and that, when combined with a hearing protection device, they will affect the stability and hence the attenuation of the hearing protection device. Bone-conduction microphones have the drawbacks that they have a very limited audio bandwidth which limits the intelligibility of the speech and that they often have to be pressed fairly hard which causes discomfort to the user.

[0006] US 6,661,901 B1 relates to an active hearing protection system comprising an earplug with an outer microphone for picking up ambient sound and an inner microphone which is sealed with respect to ambient sound but is open towards the inner part of the user's ear canal. In an operation mode in which separation of the user's voice from ambient noise is desired only the inner microphone is activated while the outer microphone is not, with the signal from the inner microphone being processed by an electronics unit integrated within the earplug in order to make the user's voice highly natural and intelligible, either for the user himself or his external communication partners.

[0007] Another approach is based on a so-called "blind source separation" (BSS) algorithm in order to separate a person's voice from background noise by corresponding audio signal processing. In this respect, US 2003/0055535 A1 relates to the use of a BSS algorithm for separating the voice of an operator of a vehicle wheel alignment system with a voice audio interface from background noise by using a microphone array in order to avoid the necessity to use a headset. US 2005/0060142 A1 relates in a more general manner to the use of two spaced-apart microphones operated with a BSS algorithm for voice separation from background noise in audio applications.

[0008] It is an object of the invention to provide for a system and a method for separation of a person's voice from ambient sound wherein good intelligibility of speech is achieved while nevertheless discomfort to the person is to be avoided as far as possible.

[0009] According to the invention this object is achieved by a system as defined in claims 1 and 25, and by corresponding methods as defined in claims 28 and 29, respectively.

[0010] The invention is beneficial in that, by using a first microphone and a second microphone, wherein according to the solution of claims 1 and 28 the first microphone is oriented outwardly towards the environment and the second microphone oriented inwardly towards the user's ear canal and according to the solution of claims 25 and 29 the first microphone is located at the right ear and the second microphone is located at the left ear, and by processing the audio signals from the first and second microphone by a blind source separation algorithm, good separation of the user's voice from ambient sound with resulting high intelligibility of the user's speech is achieved without the need for additional restrictions regarding the location of the microphones, so that in particular the need for a boom microphone or a bone-conduction microphone can be avoided. In particular, by orienting the first microphone towards the environment and orienting the second microphone towards the user's ear canal or by locating the first microphone at the right ear and the second microphone at the left ear these two microphones pick up sufficiently differently mixed signals of the ambient sound and the user's voice so that a BSS algorithm will work efficiently.

[0011] Generally, blind source separation (also referred to as "independent component analysis" (ICA)) is a technique for separating mixed source signals (components) which are presumably statistically independent from each other. In its simplified form, blind source separation applies an "un-mixing" matrix of weights to the mixed signals, for example, multiplying the matrix with the mixed signals, to produce separated signals. The weights are assigned initial values, and then adjusted to maximize joint entropy of the signals in order to minimize information redundancy. This weight-adjusting and entropy-increasing process is repeated until the information redundancy of the signals is reduced to a minimum. Because this technique does not require information on the

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source of each signal, it is referred to as "blind source separation". An introduction to blind source separation is found, for example, in US 2005/0060142 A1.

[0012] In the most simple cage, BSS is applied to two different mixtures of two (acoustic) sources, wherein the two different mixtures are obtained by using two spaced apart microphones. Mixing of the two sources can be represented by a matrix A, with the BSS algorithm corresponding mathematically to finding the inverse matrix of A without knowing anything about the matrix nor about the sources, except that they are statistically independent. In the case of a person's voice mixed with background noise the latter assumption usually is valid. The mixtures of the two sources could be different with respect to amplitude and/or phase of the two sources. In other words, by picking up sound signals with two differently oriented microphones the signal of each of these microphones will correspond to a mixture which is different with regard to the difference in amplitude and/or phase of the two acoustic sources (i.e. user's voice on the one hand and ambient noise on the other hand). By orienting one of the microphones outwardly towards the environment and the other microphone inwardly to the ear canal, a particularly large difference between the two mixtures can be obtained in a simple and particularly comfortable manner, i.e. no boom microphones or bone-cunduction microphones which would cause discomfort to the user need to be used.

[0013] According to one embodiment, the two microphones are part of a hearing protection device. With such a configuration, the microphones can be arranged such that the ambient sound reaching the inwardly oriented microphone is attenuated by the hearing protection device relative to ambient sound reaching the outwardly oriented microphone. Although such hearing protection device could be an earmuff, according to a preferred embodiment the hearing protection device is an earplug comprising a shell which is to be inserted at least partially into the user's ear canal. According to one embodiment, the shell is a customized hard shell having an elasticity from shore D85 to D65 and having an outer shape according to the measured inner shape of the user's outer ear and ear canal. According to an alternative embodiment, the shell is a generic soft shell capable of adapting to the shape of the user's outer ear and ear canal.

[0014] Preferably, the inwardly oriented microphone is located at or is open to the inner part of the shell which is to be inserted into the ear canal, with the inwardly oriented microphone preferably being located at the inner end of the shell or within a channel of the shell open to the inner end of the shell.

[0015] Preferably, the outwardly oriented microphone is located at or is open to the outer part of the shell which is not to be inserted into the ear canal, with the outwardly oriented microphone preferably being located at the outer end of the shell or within a channel of the shell open to the outer end of the shell.

[0016] If the hearing protection device is an earmuff, the first microphone is located at or is open to the outer side of the earmuff and the second microphone is located at or is open to the inner side of the earmuff.

[0017] In all embodiments, the device preferably comprises a speaker adapted to provide an external audio signal to the user's ear. Thereby bidirectional communication with the user is achieved. Preferably the speaker is located at or is open to a portion of the device which is to be worn within the user's ear canal, whereby the speaker is brought acoustically close to the user's ear drum so that good intelligibility of the sound provided by the speaker is achieved even in noisy environments.

[0018] Usually the device will be binaural, i.e. it will comprise one unit for the right ear and another unit for the left ear. The speaker and the microphones may be integrated in the same unit, i.e. in at least one of the units, or the speaker may be part of the unit for one ear and the microphones may be part of the unit for the other ear.

[0019] According to one embodiment, the device may be adapted to be worn completely within the user's ear canal, whereby the device can be more or less completely hidden from the views of other persons. According to other embodiments, the device may be any other kind of a wired or wireless headset.

[0020] Preferably the audio signal processing unit is integrated within the device. In an alternative embodiment, the audio signal processing unit may be adapted to be worn behind the user's ear or somewhere at the user's body. In this case, although the device becomes more handy, more space, and hence also more power, is available for the audio signal processing unit, which may reduce the costs an/or may improve the performance of the blind source separation. In such case, the audio signal processing unit may be connected to the microphone either by wires, which is the most simple solution, or via a wireless link, for example, a radio frequency link such as Bluetooth link, an inductive link or an infrared link, which solution would result in enhanced wearing comfort for the user.

[0021] As a further alternative, the audio signal processing unit could be designed to be located remote from the user and is connected to the microphones via a radio frequency link such as Bluetooth link. In this case, there would be even less restrictions regarding the size and power consumption of the audio signal processing unit, which might result in reduced costs and/or increased performance of the blind source separation.

[0022] In all embodiments, the system preferably comprises a radio frequency transmitter for transmitting the processed audio signal output of the audio signal processing unit to a remote radio frequency receiver in order to provide the user's voice to another person. According to one embodiment, the radio frequency transmitter is integrated within the audio signal processing unit, i.e. the radio frequency transmitter may be either integrated within the device or it may be adapted to be worn behind the use's ear or at the user's body or it could be even located remote from the user. However, in an

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alternative embodiment, the radio frequency transmitter could be remote from the audio signal processing unit, in which case the processed audio signal output of the audio signal processing unit would be provided to a radio frequency transmitter by wires or via a radio frequency link, an inductive link or an infrared link. In this case the location of the audio signal processing unit and the radio frequency transmitter can be optimized independently form each other.

[0023] In all embodiments, the blind source separation algorithm preferably works in the frequency domain, i.e. the algorithm is simultaneously carried out in different frequency bands/bins and the outcomes of these bands/bins are combined in an appropriate way.

[0024] In all embodiments, the blind source separation algorithm preferably works with the assumption that the sources are statistically independent, i.e. that the user's voice is independent of the ambient sound.

[0025] In the following, examples of the invention will be explained in detail by reference to the attached drawings.

Fig. 1 shows a schematic view of a first embodiment of a hearing protection earplug system according to the invention inserted into a person's ear canal with a block diagram of the most relevant electronic components;

Fig. 2 shows a schematic view of a modified embodiment of a hearing protection earplug according to the invention;

Figs. 3 and 4 show further modified embodiments of a system according to the invention;

Fig. 5 shows a modification of the embodiment of Fig. 1; and

Fig. 6 shows a modification of the embodiment of Fig. 5.

[0026] The system of Fig. 1 comprises a hearing protection earplug 10 which may have a hard shell with an elasticity from shore D85 to shore D65, which is customized, i.e. it has an outer shape according to the individual measured inner shape of the user's outer ear and ear canal. The hard shell may be manufactured by layer-by-layer laser sintering of a powder material, for example, polyamide powder, or by laser stereo-lithography or photo-polymerization. An overview regarding such additive layer-by-layer build-up processes for manufacturing customized shells of hearing devices can be found, for example, in US 2003/0133583 A1 or US 6,533,062 B1. The inner shape of the person's ear canal and outer ear can be measured, for example, by taking an impression which then undergoes laser scanning or by direct laser scanning of the ear.

[0027] Preferably the hard shell is designed such that it provides for an acoustic attenuation, averaged over the audible frequency range, of at least 10 dB when inserted into the user's ear canal.

[0028] Rather than having a customized hard shell, earplug 10 may have a generic soft shell which adapts to the shape of the users outer ear and ear canal due to its elasticity.

[0029] In Fig. 1 the earplug 10 is shown to be inserted with its inner end portion into a user's ear canal 12. The earplug 10 comprises an outer microphone M1, which is located at the outer part of the earplug 10 and which is open to the outer end 14 of the earplug 10 via a sound channel 16, and an inner microphone M2, which is located at the inner part of the earplug 10 and which is open to the inner end 18 of the earplug 10 via a sound channel 20. The earplug 10 further comprises a speaker S which is likewise located at the inner part of the earplug 10 and is open to the inner end 18 via a sound channel 22. The earplug 10 also includes a digital audio signal processing unit 24 comprising a digital signal processor as well as a radio frequency transmitter unit T1 and a radio frequency receiver unit R1. The audio signal processing unit 24 functionally includes a unit 26 for applying a blind source separation algorithm to the audio signals provided by the microphones M1 and M2. It is evident to the skilled person that the earplug 10 includes additional electrical components, such as amplifiers and analogue-to-digital converters for the audio signals provided by the microphones M1 and M2, a digital-to-analogue converter and an amplifier for the audio signal to be transformed into sound by the speaker S, program and data memory components for the audio signal processing unit 24, a battery for power supply, a demodulator, a modulator, an antenna, etc., which are not shown in Fig. 1 for the sake of simplicity.

[0030] The transmitter T1 of the earplug 10 is adapted to transmit audio signals from the earplug 10 to a remote receiver R2 via a radio link, while the receiver R1 of the earplug 10 is adapted to receive audio signals from a remote transmitter T2. The audio signals received by the receiver R1 are demodulated and then undergo signal processing in the audio signal processing unit 24 as input to the speaker S in order to provide remote audio signals to the user. Such remote audio signals could be the speech of another person picked up by a microphone whose output is sent to the remote transmitter T2 by wires or via, for example, a mobile telephone or mobile radio device.

[0031] The audio signals provided by the microphones M1 and M2 are passed as input to the blind source separation unit 26, in which a processed audio signal output for the transmitter T1 is produced, with the processed audio signal output consisting completely or at least essentially of the user's voice which has been separated from the ambient sound by action of the blind source separation algorithm carried out in the BSS unit 26. Such BSS signal processing utilizes the fact that the sound

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mixtures picked up by the microphone M1 which is oriented towards the environment and M2 which is oriented towards the ear canal 12, respectively, consist - due to the different orientation of the microphones M1 and M2 - of essentially different mixtures of the ambient sound and the user's voice, which are different regarding amplitude ratio of these two signal contributions or sources (i.e. ambient sound on the one hand and user's voice on the other hand) and regarding phase difference of these two signal contributions of the mixture.

[0032] The output signal of the BSS unit 26 is transmitted via the transmitter T1 to the remote receiver R2 which usually will be connected to a remote speaker for presenting the user's voice to another person. The remote speaker and the remote microphone connected to the remote transmitter T2 could be part of an earpiece or an earplug worn by another person, which may be similar or identical to the earplug 10. Thereby in-the-ear hearing protection devices with integrated communication function can be achieved. Such a system could be used by any persons who need to communicate in a noisy environment, such as workers, soldiers, firemen, etc. However, the remote receiver R2 also might serve for communication via a mobile telephone or a mobile radio device.

[0033] In general, the remote receiver R2 / transmitter T2 could be a part of an interface of a standard wireless communication device, such as a mobile telephone device or a mobile radio device Preferably, the wireless link between the transmitter T1 / receiver R1 and the remote receiver R2 / remote transmitter T2 is a Bluetooth link. The remote receiver R2 / transmitter T2 then could be a part of the Bluetooth interface of a standard wireless communication device, such as a mobile telephone device or a mobile radio device.

[0034] According to Fig. 1, the audio signal produced by the microphones M1 and M2, which is used as input to the BSS unit 26, in addition could undergo other audio signal processing within the audio signal processing unit 24, for example, in order to provide the ambient sound picked up by the microphone M1 to the speaker S for enabling perception of desired ambient sounds during times when the noise level is low so that the hearing protection function provided by the earplug 10 is not needed, or to provide for an in-situ measurement of the actual acoustic attenuation provided by the earplug 10 when inserted into the user's ear canal 12 by comparing the sound levels measured by the microphones M1 and M2.

[0035] In Fig. 2 a modified embodiment is shown, wherein the transmitter T1 and the receiver R1 have been removed from the earplug 10 and now are located in an external unit 28 which is connected by wires 30 to the earplug 10 and which is to be worn at an appropriate location at the user's body, for example behind the user's ear or somewhere within or below the user's clothing, for example, within a helmet. The external unit 28 may include further electrical components removed from the earplug 10, for example, the power supply battery.

[0036] In Fig. 3 a further modified embodiment is shown, wherein not only the transmitter T1 and the receiver R1 (and the power supply battery) but in addition also the audio signal processing unit 24 including the BSS unit 26 has been removed from the earplug 10 and is connected via corresponding wires to the microphones M1 and M2 and the speaker S, respectively.

[0037] In Fig. 4 a still further modified embodiment is shown, wherein the wire connection 30 between the earplug 10 and the external unit 28 has been replaced by a bidirectional wireless link 32, which is established by a transmitter T3 and a receiver R3 located in the earplug 10 and a corresponding receiver R4 and transmitter T4 located in the external unit 28. The wireless link 32 could be a radio frequency link, an inductive link or an infrared link. If it is an inductive link, the external unit 28 would have to be located relatively close to the earplug 10, for example at a distance of not more than 20 cm. With an RF link, the distance could be larger; in this case it would be even be possible to locate the external unit 28 at a position remote from the user's body, for example, within a distance of a few meters. Preferably the wireless link 32 of the embodiment of Fig. 4 is a Bluetooth link.

[0038] Although in the embodiments shown is Figs. 1 to 4 the speaker S is shown as being integrated in the same earplug 10 as the microphones M1 and M2, in other embodiments the speaker S may be provided at an earplug other than the earplug at which the microphones M1 and M2 are provided.

[0039] Fig. 5 shows a modified version of the embodiment of Fig. 1, wherein the inwardly oriented second microphone M2 is not part of the earplug 10 — as shown in Fig. 1 — but rather is provided at the earplug 11 for the other ear. The second microphone M2 is located at the inner part of the earplug 11 and is open to the inner end 18 of the earplug 11 via a sound channel 20. In addition, the earplug 11 further comprises a speaker S which is likewise located at the inner part of the earplug 11 and is open to the inner end 18 via a sound channel 22. The microphone M2 and the speaker S of the earplug 11 are connected to the audio signal processing unit 24 located in the earplug 10 via a wire connection 40 which be integrated in a mechanical connection (not shown) between the earplugs 10 and 11 which may be provided for preventing loss of the earplugs 10, 11.

[0040] According to a modification of the embodiment of Fig. 5, the outwardly oriented first microphone M1 may be provided at the earplug 11, while the inwardly oriented second microphone M2 may be provided at the earplug 10 as in Fig. 1.

[0041] An alternative modification of the embodiment of Fig. 5 is shown in Fig. 6, wherein both the first microphone M1 of the earplug 10 and the second microphone M2 of the earplug 11 are outwardly oriented. In this case the differences in the sound mixtures picked up by the microphone M1 of the earplug 10 and the microphone M2 of the earplug 11 are due to the different location of

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the microphone M1 at one ear and the microphone M2 at the other ear (for example, a disturbing noise source usually will be located closer to one of the two ears and hence will contribute more strongly and with different phase to the signal picked up by the microphone located at that ear than to that located at the other ear).

[0042] According to a modification of the embodiment of Fig. 6 both microphones M1 and M2 could be inwardly oriented rather than outwardly oriented.

[0043] While Figs. 5 and 6 and the above-discussed variants thereof are modifications of the embodiment of Fig. 1, according to which both the audio signal processing unit 24 and the transmitter T1 / receiver R1 are part of the earplug 10, it is to be understood that the embodiments of Figs. 2 to 4 may be analogously modified, i.e. by providing the second microphone M2 at the earplug 11 rather than at the earplug 10.

[0044] While the examples discussed so far relate to an application of the communication system to hearing protection earplugs, the invention also may be applied to earmuffs serving as a hearing protection device or generally to any kind of headset, i.e. also to hearing devices which do not provide for a hearing protection function. For example, the headset may consist of a device with a customized or a generic shell which is designed such that it can be worn completely in the ear canal 12 (i.e. as a "CIC device") and which serves exclusively communication purposes, for example, for security persons, policemen, firemen, etc., i.e. for persons who are exposed to a noisy environment, with the noise level, however, being below a threshold value which would require the use of hearing protection devices. Such CIC device generally could have the construction of the earplug of Fig. 1, however, without considerable acoustic attenuation provided due to the material and the design of the shell, and would be reduced in size so that it can be worn completely within the ear canal 12.

[0045] In general, the device need not be designed as an earplug but it may rather be any kind of headset.

Claims

1. A system for separation of a user's voice from ambient sound, comprising a device (10) to be worn at the user's ear or at least partly in the user's ear canal (12) comprising a first microphone (M1) oriented outwardly towards the environment and a second microphone (M2) oriented inwardly towards the user's ear canal, and an audio signal processing unit (24, 26) for processing audio signals from the first and second microphone by a blind source separation algorithm adapted to separate the user's voice from ambient sound.

2. The system of claim 1, wherein the device (10) is designed as a hearing protection device.

3. The system of claim 2, wherein the hearing protection device (10) is designed to provide for an acoustic attenuation, averaged over the audible frequency range, of at least 10 dB.

4. The system of claim 3, wherein the microphones (M1, M2) are arranged such that ambient sound reaching the second microphone (M2) is attenuated by the hearing protection device (10) relative to ambient sound reaching the first microphone (M1).

5. The system of one of claims 2 to 4, wherein the hearing protection device is an earplug (10) comprising a shell which is to be inserted at least partially into the user's ear canal (12).

6. The system of claim 5, wherein the shell is a hard shell having an elasticity from Shore D 85 to Shore D 65 and having an outer shape according to the measured inner shape of the user's outer ear and ear canal (12).

7. The system of one of claims 5 and 6, wherein the second microphone (M2) is located at or is open to the inner part of the shell which is to be inserted into the ear canal (12).

8. The system of claim 7, wherein the second microphone (M2) is located at the inner end of the shell or within a channel (20) of the shell open to the inner end of the shell.

9. The system of one of claims 5 to 8, wherein the first microphone (M1) is located at or is open to the outer part of the shell which is not to be inserted into the ear canal (12).

10. The system of claim 9, wherein the second microphone (M2) is located at the outer end of the shell or within a channel (16) of the shell open to the outer end of the shell.

11. The system of one of claims 1 to 4, wherein the hearing protection device is an earmuff and wherein the first microphone is located at or is open to the outer side of the earmuff and the second microphone is located at or is open to the inner side of the earmuff.

12. The system of one of the preceding claims, wherein the device comprises a speaker (S) adapted to provide an external audio signal to the user's ear.

13. The system of claim 12, wherein the speaker (S) is located at or within a channel open to that end of the device which is to be worn within the user's ear canal.

14. The system of one of the preceding claims, wherein the device is adapted to be worn completely within

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the user's ear canal.

15. The system of one of the preceding claims, wherein the audio signal processing unit (24, 26) is integrated within the device (10).

16. The system of one of claims 1 to 14, wherein the audio signal processing unit (24, 26) is adapted to be worn behind the user' s ear or at the user's body.

17. The system of claim 16, wherein the audio signal processing unit (24, 26) is connected to the microphones (M1, M2) by wires (30) or via a radio frequency link (32) such as a Bluetooth link, an inductive link or an infrared link.

18. The system of one of claims 1 to 14, wherein the audio signal processing unit (24, 26) is designed to be located remote from the user and is connected to the microphones (M1, M2) via a radio frequency link (32) such as a Bluetooth link.

19. The system of one of the preceding claims, wherein the system comprises a radio frequency transmitter (T1) for transmitting the processed audio signal output of the audio signal processing unit (24, 26) to a remote radio frequency receiver (R2) in order to provide the user's voice to another person.

20. The system of claim 19, wherein the remote radio frequency receiver (R2) is part of a Bluetooth interface of a mobile telephone or a mobile radio system.

21. The system of claim 19 or 20, wherein the radio frequency transmitter (T1) is integrated with the audio signal processing unit (24, 26).

22. The system of claim 19 or 20, wherein the radio frequency transmitter (T1) is remote from the audio signal processing unit (24, 26) and wherein the processed audio signal output of the audio signal processing unit is provided to the radio frequency transmitter by wires (30) or via an inductive link.

23. The system of claim 12, wherein the system comprises a radio frequency receiver (R1) for receiving the external audio signal from a remote radio frequency transmitter (T2).

24. The system of claim 23, wherein the remote radio frequency transmitter (T2) is part of a Bluetooth interface of a mobile telephone or a mobile radio system.

25. A system for separation of a user's voice from ambient sound, comprising: a first device (10) to be worn at the user's right ear or at least partly in the user's right ear canal (12), a second device (11) to be worn at the user's left ear or at least partly in the user's left ear canal (12), the first device comprising a first microphone (M1) and the second device comprising a second microphone (M2), and an audio signal processing unit (24, 26) for processing audio signals from the first and second microphone by a blind source separation algorithm adapted to separate the user's voice from ambient sound.

26. The system of claim 25, wherein one of the first microphone (M1) and second microphone (M2) is oriented outwardly towards the environment and the other one of the first microphone and second microphone is oriented inwardly towards the user's ear canal (12).

27. The system of one of claims 25 and 26, wherein the audio signal processing unit (24, 26) is located in one of the first device (10) and the second device (11) or is adapted to be worn behind the user's ear or at the user's body or is designed to be located remote from the user and is connected to the microphones via a radio frequency link (32) such as a Bluetooth link.

28. A method for separation of a user's voice from ambient sound, comprising:

providing the user with a device (10) to be worn at a user's ear or at least partly in the user's ear canal (12) and comprising a first microphone (M1) oriented towards the environment and a second microphone (M2) oriented towards the user's ear canal (12),
picking up sound by the first microphone to create a first audio signal and by the second microphone to create a second audio signal, and
processing the first and second audio signals by a blind source separation algorithm in order to produce a processed audio signal wherein the user's voice is separated from ambient sound.

29. A method for separation of a user's voice from ambient sound, comprising:

providing the user with a first device (10) to be worn at the user's right ear or at least partly in the user's right ear canal (12) and a second device (11) to be worn at the user's left ear or at least partly in the user's left ear canal (12), the first device comprising a first microphone (M1) and the second device comprising a second microphone (M2),
picking up sound by the first microphone to create a first audio signal and by the second microphone to create a second audio signal, and
processing the first and second audio signals by a blind source separation algorithm in order to

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produce a processed audio signal wherein the user's voice is separated from ambient sound.

30. The method of one of claims 28 and 29, wherein the blind source separation algorithm works in the frequency domain.

31. The method of one of claims 28 to 30, wherein the processed audio signal is provided to another person via a wireless link such as a Bluetooth link.

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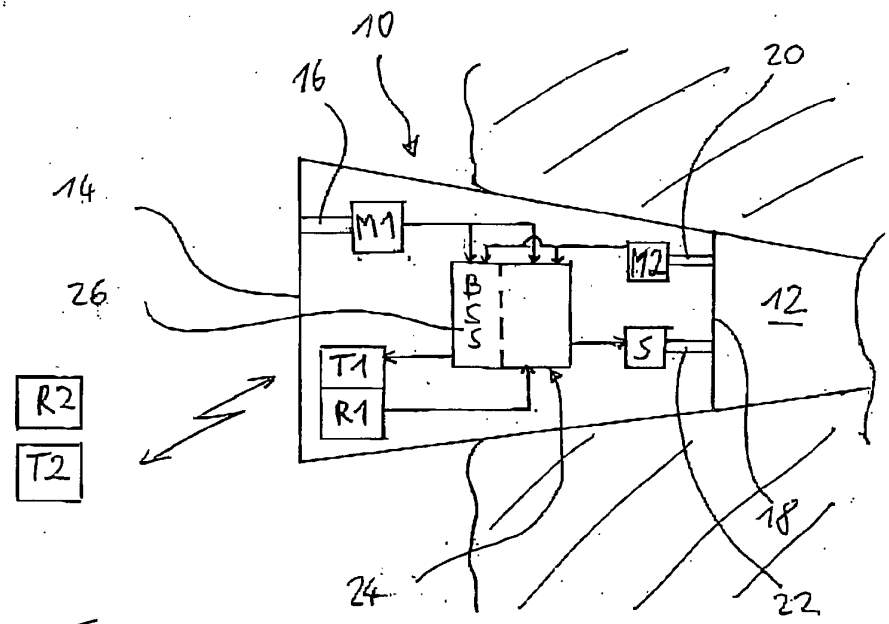


Fig. 1

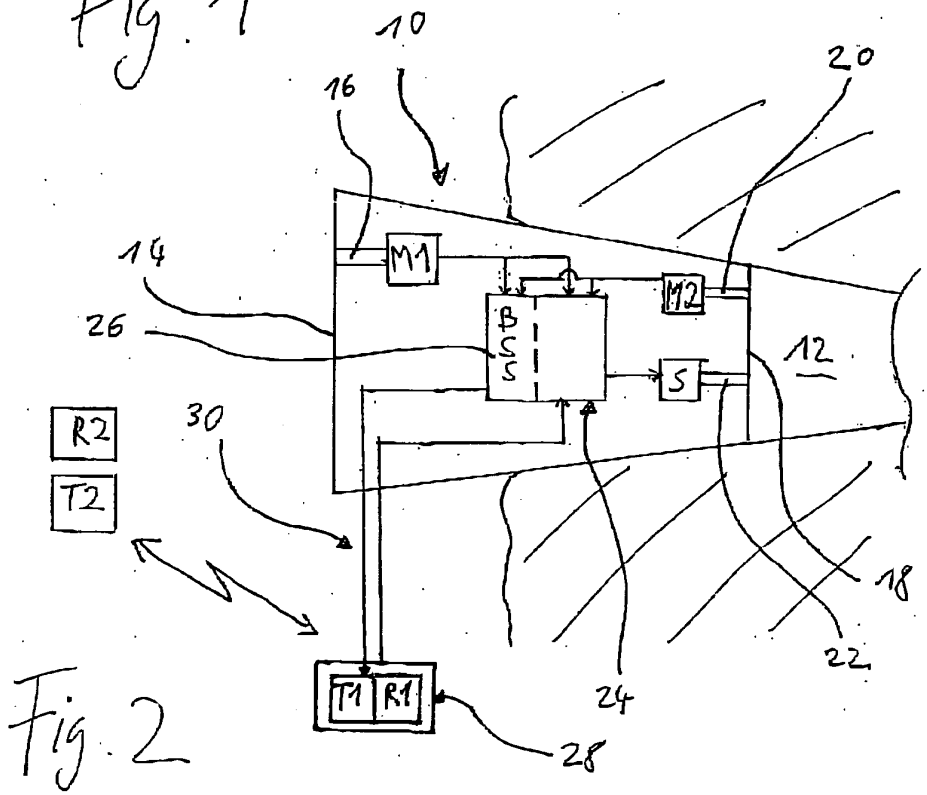


Fig. 2

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Page 0741 of 1251

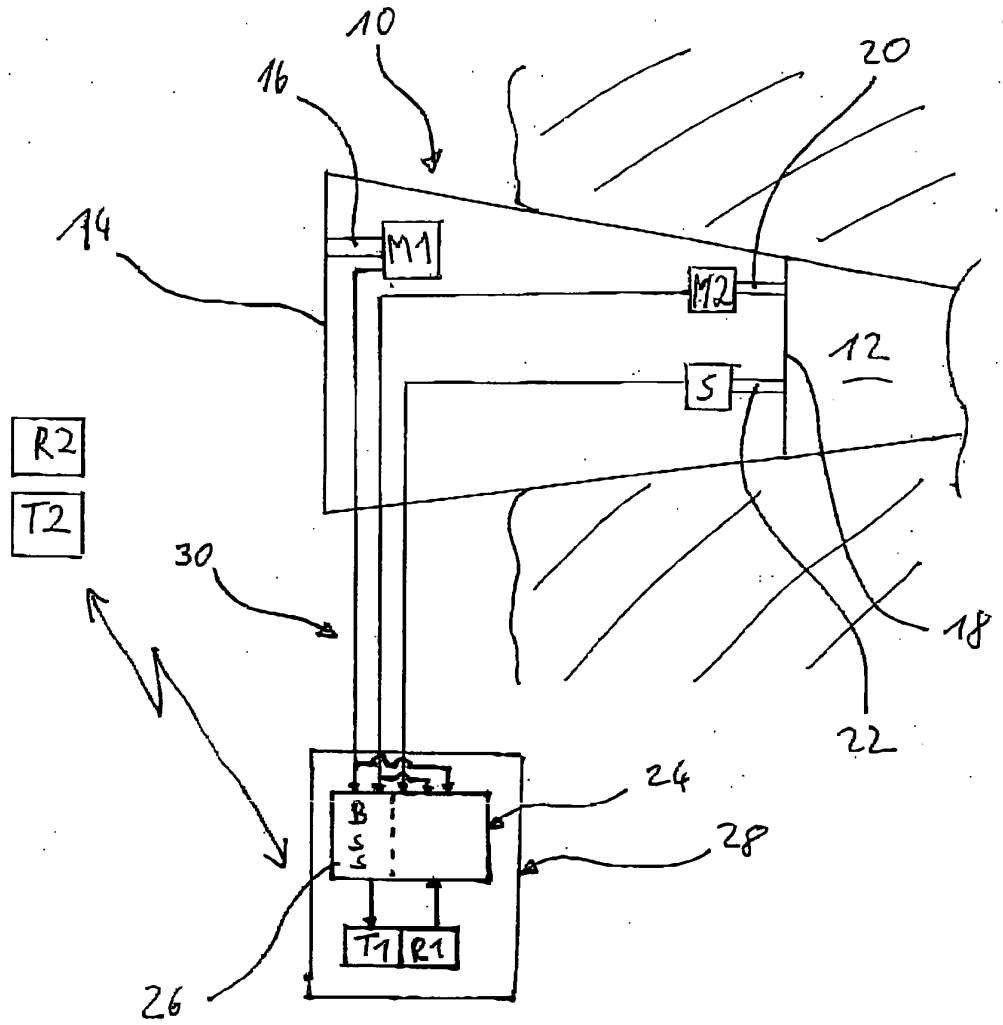


Fig. 3

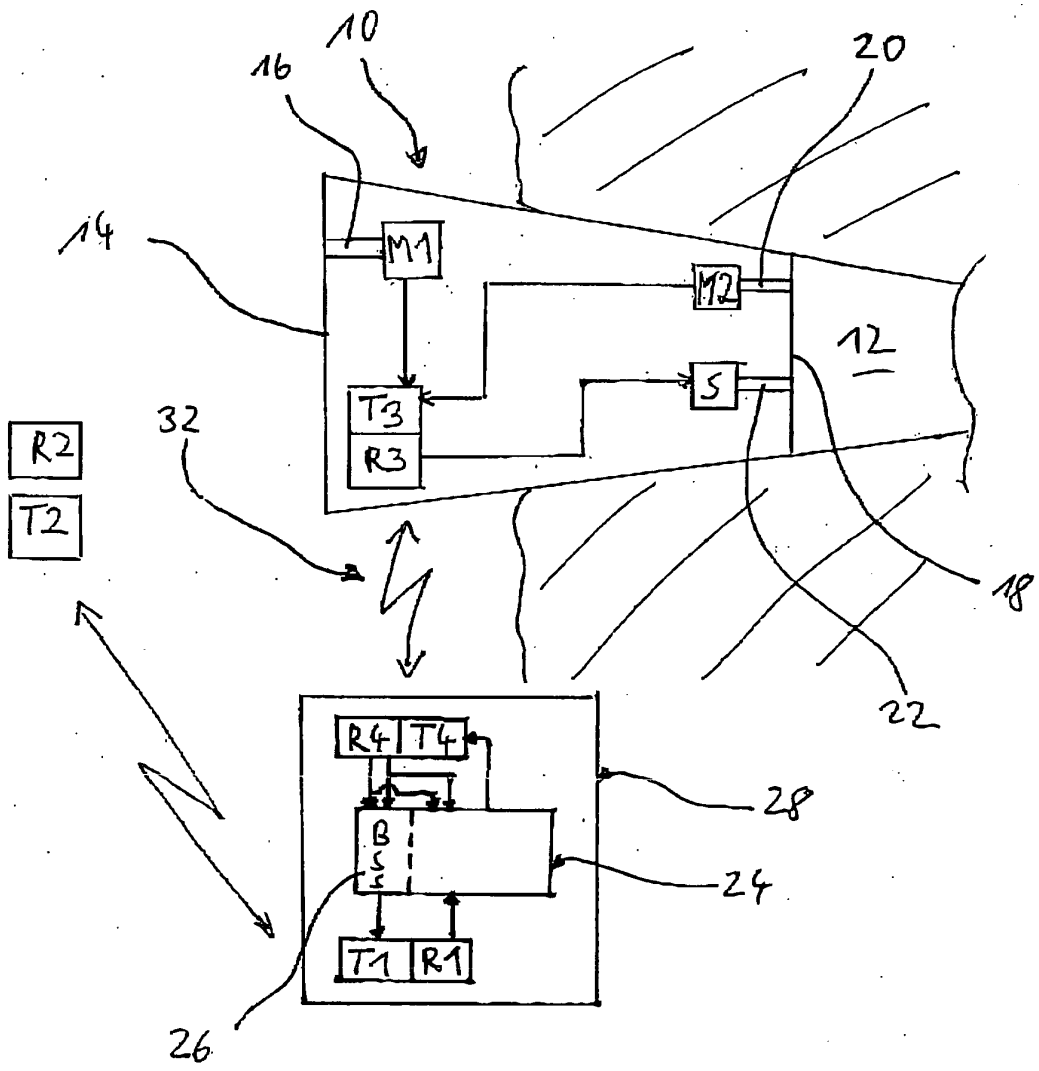


Fig. 4

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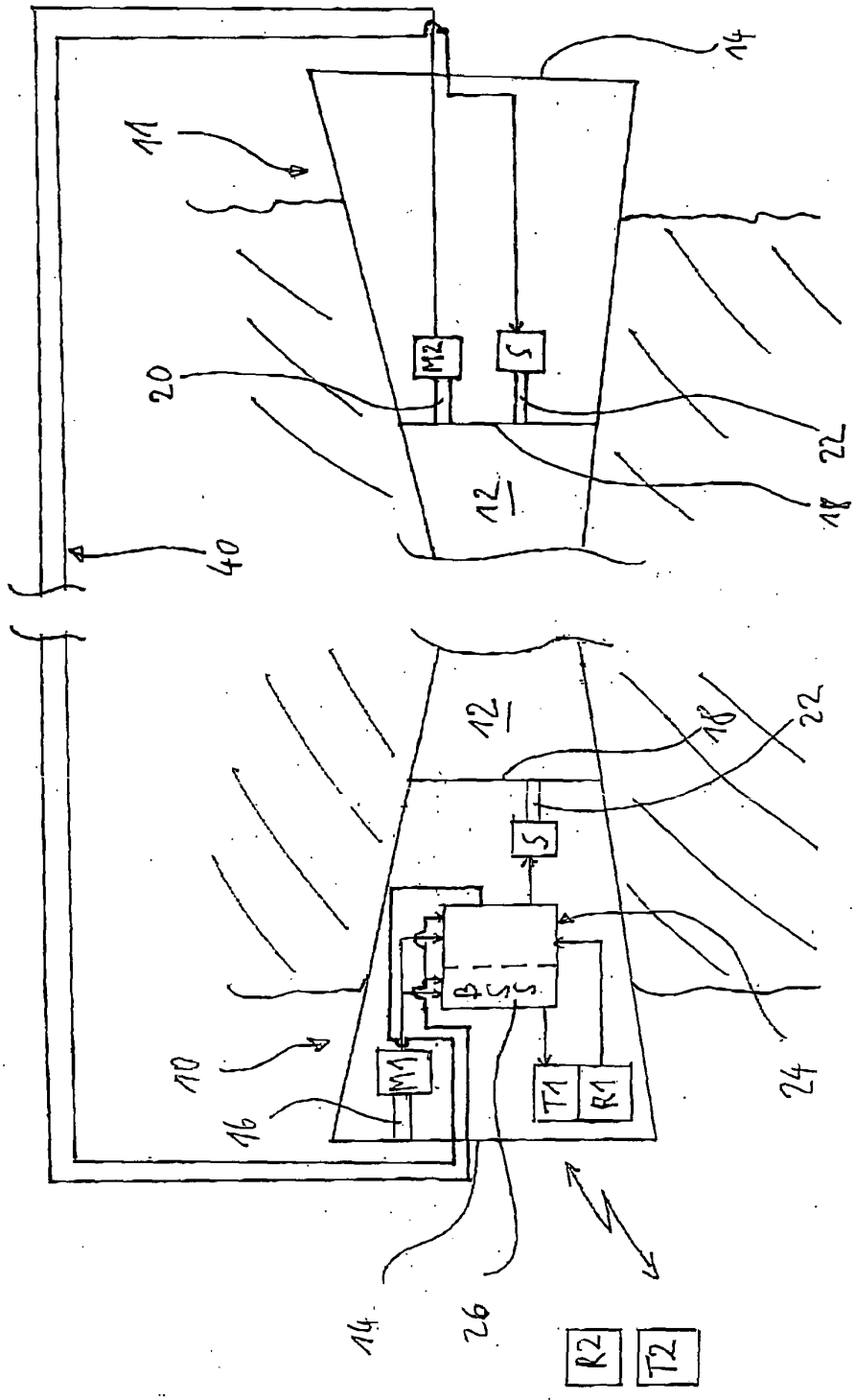


Fig. 5

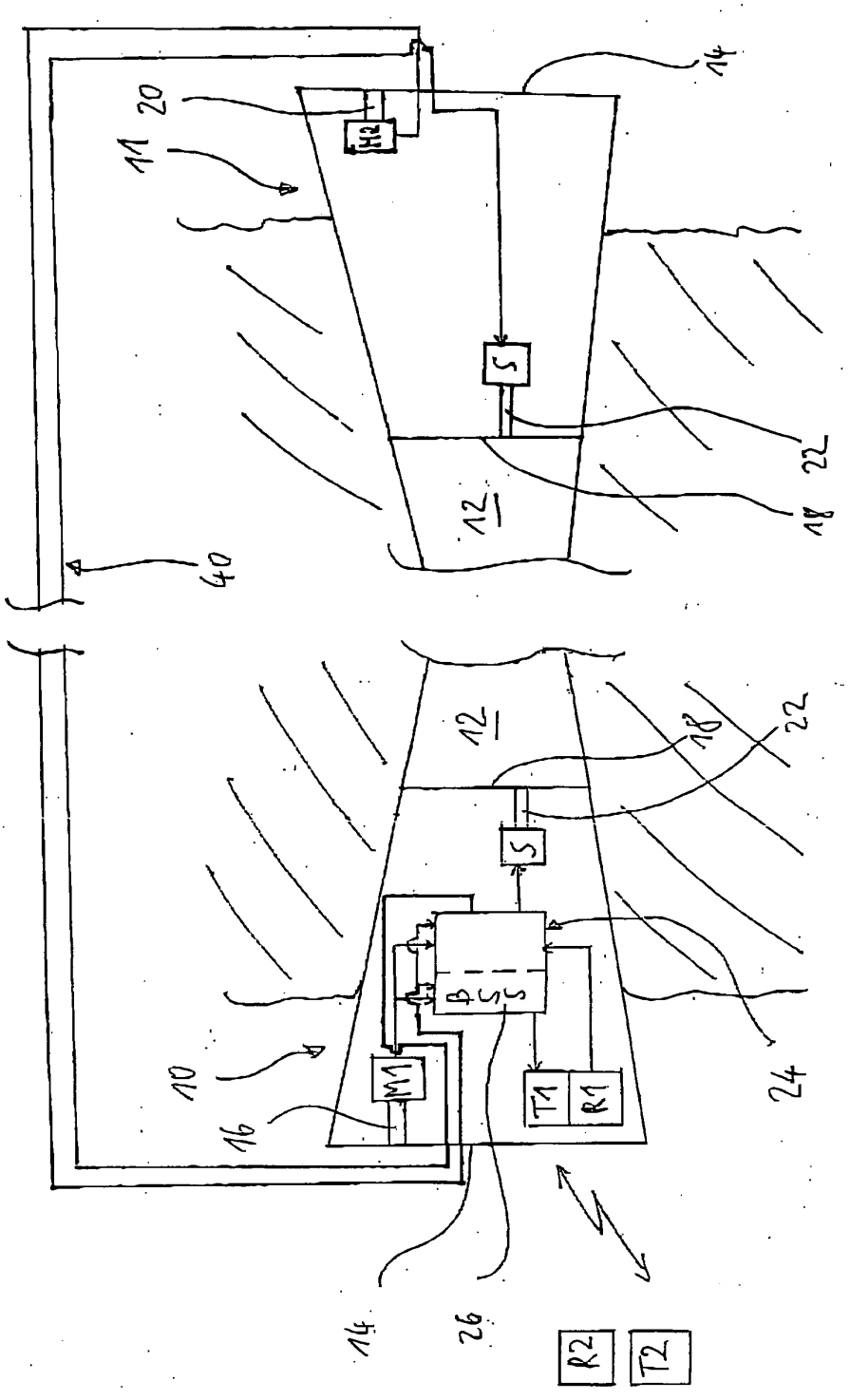


Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 8366

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y,D	US 6 661 901 B1 (SVEAN JARLE ET AL) 9 December 2003 (2003-12-09) * column 1, line 5 - column 2, line 33 * * column 4, line 21 - line 32 * * column 5, line 26 - column 7, line 60 * * column 10, line 52 - column 11, line 40 * * claims 10,11 * -----	1-24, 26-28,31	
Y	US 2005/060142 A1 (VISSER ERIK ET AL) 17 March 2005 (2005-03-17) * page 1, paragraph 5-7 * * page 3, paragraph 19 - page 5, paragraph 37 * * page 8, paragraph 61 * -----	1-24,28	
A	SANG MIN LEE ET AL: "New idea of hearing aid algorithm to enhance speech discrimination in a noisy environment and its experimental results" SAN FRANCISCO, CA, USA 1-5 SEPT. 2004, PISCATAWAY, NJ, USA,IEEE, US, vol. 3, 1 September 2004 (2004-09-01), page 978Vol2, XP010774935 ISBN: 0-7803-8439-3 * the whole document * -----	1-31	

TECHNICAL FIELDS SEARCHED (IPC)
G10L
H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 February 2006	Coda, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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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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Ｈ０４Ｎ　5/915				
			Ｈ０４Ｎ　5/ 91	Ｋ

審査請求　未請求　請求項の数１　ＯＬ　（全 5 頁）

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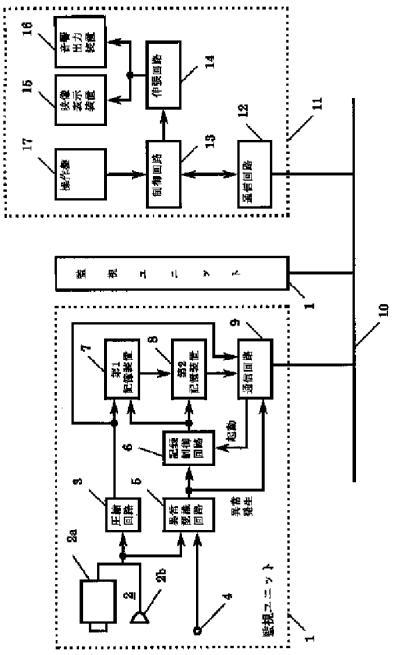
(74)代理人　弁理士　小堀　益

(54)【発明の名称】　監視装置

(57)【要約】

【目的】　重要な事象が発生した前後の情報をリアルタイムで連続的に記録することができると共に、その情報を長期間にわたって確実に保存できるようにすること。

【構成】　監視対象を撮像するビデオカメラ２ａと、監視対象の音を拾うマイクロホン２ｂと、ビデオカメラ２ａからの映像信号とマイクロホン２ｂからの音響信号とを圧縮する圧縮回路３と、この圧縮回路３の出力を所定時間分エンドレスで記録する第１記憶装置７と、この第１記憶装置７からの再生信号を記録し長期間にわたって保存可能な第２記憶装置８と、ビデオカメラ２ａからの映像信号とマイクロホン２ｂからの音響信号の内容を解析して異常事象の発生を検出する異常認識回路５と、この異常認識回路５により異常事象の発生が検出されたときに第１記憶装置７を一定時間再生状態とするとともに、第１記憶装置７の再生期間中に第２記憶装置８を記録状態とする記録制御回路６とを備えている。



【特許請求の範囲】
【請求項１】　監視対象の映像情報を検出する映像情報検出装置と、
監視対象の音響情報を検出する音響情報検出装置と、
前記映像情報検出装置からの映像信号と前記音響情報検出装置からの音響信号とを圧縮する圧縮回路と、
該圧縮回路の出力を所定時間分エンドレスで記録する第１記憶装置と、
該第１記憶装置からの再生信号を記録し長期間にわたって保存可能な第２記憶装置と、
前記映像情報検出装置からの映像信号と前記音響情報検出装置からの音響信号の少なくとも一方の信号の内容を解析して異常事象の発生を検出する異常認識回路と、
該異常認識回路により異常事象の発生が検出されたときに前記第１記憶装置を一定時間再生状態とするとともに、前記第１記憶装置の再生期間中に前記第２記憶装置を記録状態とする記録制御回路とからなることを特徴とする監視装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、商店、銀行等において使用する監視装置に関する。
【０００２】
【従来の技術】商店、銀行等において、防犯のため、或いは、犯罪が発生したときの記録のために、防犯カメラ等の監視装置を設けている。
【０００３】従来の監視装置においては、防犯カメラからの映像信号及び音声信号を、タイム・ラスプ・レコーダと呼ばれる間欠動作型式の磁気記録装置に記録している。このタイム・ラスプ・レコーダは、防犯カメラからの信号を数秒～数十秒の一定時間間隔で１フレームずつ記録するもので、数十時間の連続記録が可能である。
【０００４】
【発明が解決しようとする課題】しかしながら、このタイム・ラスプ・レコーダは、間欠的にしか信号を記録しないので、犯罪発生の瞬間や、被疑者の人相着衣等の重要な情報が記録されていないことがある。また、記録が間欠的であるため被疑者の挙動の詳細を知ることが出来なかった。
【０００５】また、防犯カメラからの信号を連続的に磁気記録装置に記録することも考えられるが、この場合は、使用する磁気テープの長さの制限から、連続記録可能な時間はせいぜい数時間であり、一定時間おきテープを交換しなければならないので実際的ではない。
【０００６】また、人間が操作して記録を開始することも考えられるが、防犯カメラの特性から考えて、記録が必要になったような状態で装置の操作を行なうのは危険性がある。また、操作が煩雑であり操作を忘れやすいため、これも実際的ではない。
【０００７】そこで、本発明は、重要な事象が発生した前後の情報をリアルタイムで連続的に記録することができると共に、その情報を長期間にわたって確実に保存できるようにすることを目的とする。
【０００８】
【課題を解決するための手段】本発明の監視装置は、前記目的を達成するため、監視対象の映像情報を検出する映像情報検出装置と、監視対象の音響情報を検出する音響情報検出装置と、前記映像情報検出装置からの映像信号と前記音響情報検出装置からの音響信号とを圧縮する圧縮回路と、該圧縮回路の出力を所定時間分エンドレスで記録する第１記憶装置と、該第１記憶装置からの再生信号を記録し長期間にわたって保存可能な第２記憶装置と、前記映像情報検出装置からの映像信号と前記音響情報検出装置からの音響信号の少なくとも一方の信号の内容を解析して異常事象の発生を検出する異常認識回路と、該異常認識回路により異常事象の発生が検出されたときに前記第１記憶装置を一定時間再生状態とするとともに、前記第１記憶装置の再生期間中に前記第２記憶装置を記録状態とする記録制御回路と　からなることを特徴とする。
【０００９】
【作用】本発明の監視装置においては、第１記憶装置は、常時記録動作を行っており、定常時には、監視対象近傍の映像情報及び音響情報が一定時間分エンドレスに記録される。異常認識回路により異常事象の発生が検出されると、第１記憶装置における再生動作が開始されるとともに、第２記憶装置の記録動作が開始され、所定時間後元の状態に戻る。したがって、第２記憶装置においては、異常事象の発生前後の監視対象近傍の映像情報及び音響情報が保持される。
【００１０】
【実施例】以下、図面を参照しながら実施例に基づいて本発明の特徴を具体的に説明する。
【００１１】図１は、本発明の監視装置の実施例を示すブロック図である。
【００１２】図において、１は、監視対象となる建物の中の互いに異なった場所に複数個配置された監視ユニットである。各監視ユニット１は、ＣＣＤカメラ等のビデオカメラ２ａとマイクロホン２ｂからなる監視カメラ装置２、ビデオカメラ２ａからの映像信号とマイクロホン２ｂからの音声信号を圧縮する圧縮回路３、人体の存在或いは動きを検出する人体センサ４、ビデオカメラ２ａからの映像信号とマイクロホン２ｂからの音声信号と人体センサ４からの出力が供給され、これらの信号の内容を解析して異常な事態発生したかどうかを検出する異常認識回路５、この異常認識回路５の出力に基づき後述する記憶装置の記録再生動作を制御する記録制御回路６、前記圧縮回路３からの圧縮信号を一定時間分エンドレスで記憶する第１記憶装置７、この第１記憶装置７から再生された情報を記録して長期間にわたって保存可能な第

２記憶装置８、この第２記憶装置８から再生された情報を電話回線等の通信回線１０を介して警備会社の中に設置されている集中管理システム１１に送信すると共に、集中管理システム１１からの各種の指示を受信するための通信回路９等を備えている。

【００１３】前記人体センサ４としては、たとえば、赤外線センサ、ドップラレーダ等が使用される。また、前記第１記憶装置７としては、たとえば、ハードディスク装置や、半導体メモリからなるソリッド・ステート・ファイルが使用され、また、第２記憶装置８としては、たとえば、ビデオ・テープ・レコーダ等の磁気記録再生装置が使用される。

【００１４】集中管理システム１１は、通信回線１０を介して各監視ユニット１と通信するための通信回路１２と、集中管理システム１１全体の制御を行なう制御回路１３と、圧縮された映像信号及び音響信号を伸張して元の信号に復元する伸張回路１４と、復元された映像信号に基づきビデオカメラ２ａで撮像された映像を表示する映像表示装置１５と、復元された音響信号に基づきマイクロホン２ｂで拾われた音響を出力する音響出力装置１６と、各監視ユニット１に対して各種の指示を与えるためのキーボードや異常発生を表示するためのランプやＣＲＴディスプレイを含む操作盤１７とを備えている。前記制御回路１３は、各監視ユニット１からの情報を受信して、伸張回路１４を介して映像出力装置１５及び音響出力装置１６に供給したり、操作盤１７から入力された各種の指示を各監視ユニット１に対して送り出す処理を行なう。

【００１５】次に、上述した監視装置の動作について説明する。ここでは、閉店後の店内を店内の各所に配置された複数の監視ユニット１で監視する場合を例に挙げて説明する。ビデオカメラ２ａからの映像信号とマイクロホン２ｂからの音声信号は圧縮回路３に記録され、符号化等によりデータ量の圧縮が行なわれる。圧縮方式としては種々の方式が採用可能であるが、たとえば、ＭＰＥＧ（ｍｏｖｉｎｇ　ｐｉｃｔｕｒｅ　ｃｏｄｉｎｇ　ｅｘｐｅｒｔｓ　ｇｒｏｕｐ）方式と呼ばれるフレーム内符号化とフレーム間符号化を併用した標準化された符号化方式を採用することができる。

【００１６】圧縮回路３からの圧縮データは、第１記憶装置７に常時供給されている。第１記憶装置７は、記録制御回路６からのモード切り換え信号により記録モードと再生モードの切り換えが可能となっている。通常状態では、第１記憶装置７は記録モードとなっており、第１記憶装置７は圧縮回路３からの一定時間分の圧縮データをエンドレスで記録する。また、第２記憶装置８は、通常状態では停止状態となっており、第１記憶装置７の再生時に記録状態となる。

【００１７】たとえば、第１記憶装置７が半導体メモリからなるソリッド・ステート・ファイルである場合、メモリの先頭アドレスから順番に圧縮データを書き込んでいき、メモリ領域が一杯になったら、最初に書き込んだアドレスから重ねて書き込んでいく。ソリッド・ステート・ファイルは、機械的な可動部品が全くないので、半永久的に使用が可能である。ハードディスク装置の場合も同様に、回転するハードディスク上の各セクタ及びトラックに順次連続的に記録している。ハードディスク装置においては、ハードディスクは常時回転した状態にあり、ハードディスクの回転により発生する空気流により、書き込み・読み取りヘッドはハードディスクの表面から浮いた状態にあるので、ハードディスクの表面が摩耗することはない。したがって、数カ月～数年にわたって極めて長期間の使用が可能となる。

【００１８】これにより第１記憶装置７には、現在の時点から、第１記憶装置７の記憶容量に対応した一定時間だけ遡った時点までの情報が記録されることになる。通常状態においては、上述したように第１記憶装置７の記録内容が、最新の一定期間の情報で常時更新される。すなわち、第１記憶装置７はエンドレスの記憶装置として機能する。

【００１９】次に、店内に不審者が侵入し人体センサ４の近傍を通過した場合には、人体センサ４の出力が異常認識回路５に供給される。異常認識回路５は、人体センサ４から出力があったときには、異常が発生したと判断する。

【００２０】また、窓ガラスが割られたり、ドアがこじ開けられた場合には、その時に発生する音がマイクロホン２ｂにより拾われ、異常認識回路５に供給される。異常認識回路５においては、入力された可聴周波数領域の信号の周波数成分及び振幅成分のパターンが、予め登録されている窓ガラスが割られたときに発生する音のパターンや、ドアがこじ開けられた場合に発生する音のパターンと一致するかどうか判別し、一致したときには、異常が発生したと判断する。

【００２１】また、ビデオカメラ２ａからの映像信号は異常認識回路５に供給され、撮像範囲内で映像の変化があったかどうか、すなわち、撮像範囲内に動体が存在するか否かが判別される。この動体判別は、たとえば、一定時間離れた二つの時点における映像信号の内容の差異の有無を調べることにより検出することができる。すなわち、二つの映像信号の内容に差異があるときには、異常が発生したと判断する。また、映像の内容に予め登録された所定パターン以外のパターンが表れたときに異常が発生したと判断することもできる。

【００２２】上述したように、ビデオカメラ２ａ、マイクロホン２ｂ、人体センサ４の出力を異常認識回路５に供給することにより、各種の状況に対応可能となる。

【００２３】異常認識回路５により異常が発生したと判断されると、異常認識回路５から異常検出信号が記録制御回路６に供給され、第１記憶装置７が記録モードから

再生モードに切り換えられると共に、第２記憶装置８の記録動作が開始され、第１記憶装置７に記録されていた最新の一定期間の情報が第２記憶装置８に記録される。第１記憶装置７に記録されていた情報が第２記憶装置８に記録されると、第１記憶装置７は再度記録モードとされると共に、第２記憶装置８の記録動作が停止される。

【００２４】上述の動作により、異常事象発生毎に第１記憶装置７の一定時間の再生動作と、この再生動作に同期した第２記憶装置８の一定時間の記録動作が繰り返される。したがって、第２記憶装置８には、異常事象発生毎に、異常事象発生直前の一定の映像情報及び音響情報が順次記録されることになる。

【００２５】また、異常認識回路５により異常が発生したと判断されると、異常が発生した事を示す異常発生データが、どの監視ユニットからのデータであるかを示す識別データと共に、通信回路９及び通信回線１０を介して警備会社の中に設置されている集中管理システム１１に対して送信される。この異常発生データは、通信回路１２を介して制御回路１３に供給され、操作盤１７にどこでどのような種類の異常が発生したのが表示される。また、第１記憶装置７に記録されている情報が再生されて第２記憶装置８に記録されると同時に、第１記憶装置７からの再生信号は通信回線１０を介して集中管理システム１１の制御回路１３に供給され、更に、伸張回路１４で元の映像信号及び音響信号に復元され、映像出力装置１５及び音響出力装置１６に供給され、異常事象発生直前の映像及び音が再生される。なお、第１記憶装置７に記録されている情報が再生された後には、ビデオカメラ２ａ及びマイクロホン２ｂからのリアルタイムの情報を自動的に、或いは、操作盤１７からの指示に基づき送信するようにしてもよい。

【００２６】これにより、警備会社は異常の詳細を知ることができ、警備員派遣、所轄の警察署への通報等の適切な処置をとることができる。

【００２７】また、操作盤１７から、異常を検出した監視ユニット以外の監視ユニット１の記録制御回路６に対して起動指示を与えることにより、異常を検出した監視ユニットの近傍の他の監視ユニットにおいても、第２記憶装置８への記録が開始されると共に、リアルタイムの情報が通信回線１０介して送信され、集中管理システム１１側では、侵入者の侵入経路や逃亡経路を容易に把握することができる。

【００２８】また、操作盤１７から監視ユニット１の記録制御回路６に対して第２記憶装置８を再生する指示を与えることにより、集中管理システム１１側で第２記憶装置８に記録されている過去分の異常事象の状態も知ることができる。なお、監視ユニット１の第２記憶装置８に直接テレビモニタを接続して、第２記憶装置８の記録内容を再生することもできる。

【００２９】なお、上述の実施例においては、防犯装置を例に挙げて説明したが、本発明はこれに限定されるものではなく、たとえば、化学プラントや製造工場における異常事象の監視にも適用することができる。

【００３０】

【発明の効果】以上に述べたように、本発明においては、監視対象の状況を第１記憶装置に常時エンドレスに記録しておき、異常事象発生時には第１記憶装置で再生動作を行わせて、この再生信号を長期間の保存が可能な第２記憶装置に記録するようにしている。これにより、エンドレス記録を行なう第１記憶装置の記録可能時間に制限されることなく、異常事象発生時の状況を確実に保持することができる。

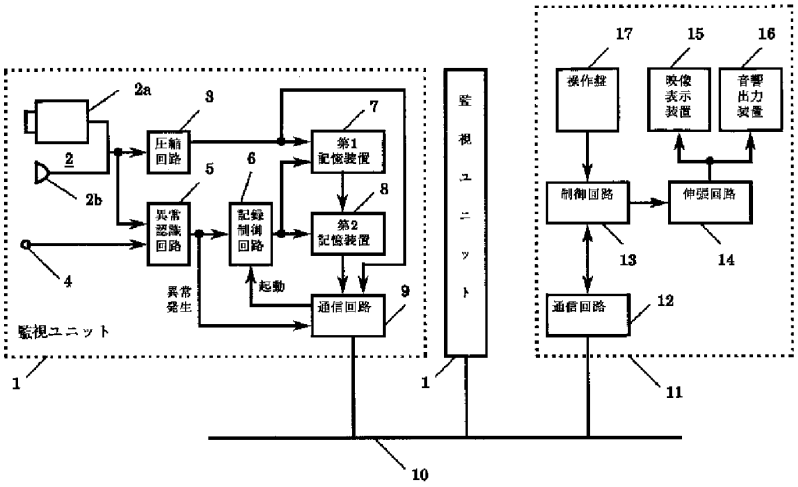
【図面の簡単な説明】

【図１】　本発明の監視装置の実施例を示すブロック図である。

【符号の説明】

１…監視ユニット、２…監視カメラ装置、２ａ…ビデオカメラ、２ｂ…マイクロホン、３…圧縮回路、４…人体センサ、５…異常認識回路、６…記録制御回路、７…第１記憶装置、８…第２記憶装置、９…通信回路、１０…通信回線、１１…集中管理システム、１２…通信回路、１３…制御回路、１４…伸張回路、１５…映像表示装置、１６…音響表示装置、１７…操作盤

【図１】


2a
3
7
2
圧縮回路
第1記憶装置
2b
5
6
8
異常認識回路
記録制御回路
第2記憶装置
4
異常発生
起動
9
通信回路
監視ユニット
1
監視ユニット
1
17
15
16
操作盤
映像表示装置
音響出力装置
制御回路
伸張回路
13
14
通信回路
12
11
10

Espacenet

Bibliographic data: JPH0877468 (A) — 1996-03-22

MONITOR DEVICE

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Applicant(s): ONO DENKI KK ± (ONO DENKI KK)

Classification: **- international:** ***G08B13/196; H04N5/915;*** (IPC1-7): G08B13/196; H04N5/915
- cooperative:

Application number: JP19940214581 19940908

Priority number(s): JP19940214581 19940908

Abstract of JPH0877468 (A)

PURPOSE: To record information before and after an important event occurs successively in real time and securely store the information for a long period. CONSTITUTION: This device is equipped with a video camera 2a which picks up an image of an object to be monitored, a microphone 2b which picks up the sound of the object to be monitored, a compressing circuit 3 which compresses the video signal from the video camera 2a and the sound signal from the microphone 2b, a 1st storage device 7 wherein the output of the compressing circuit 3 is recorded endlessly for a specific time, a 2nd storage device 8 wherein the reproduced signal from the 1st storage device 7 is stored for a long period, an abnormality recognizing circuit 5 which analyzes the contents of the video signal from the video camera 2a and the sound signal from the microphone 2b and detects the occurrence of an abnormal event, and a recording control circuit 6 which places the 1st storage device 7 in a reproduction state for a certain time when the abnormality recognizing circuit 5 detects the abnormal event and places the 2nd storage device 8 in a recording state during the reproduction period of the 1st storage device 7.

JPH0877468A MONITOR DEVICE

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The wording below is an initial machine translation of the original publication. To generate a version using the latest translation technology, go to the original language text and use Patent Translate.

[0001] BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to a monitoring device used in stores, banks and the like.

[0002] 2. Description of the Related Art In a store, a bank or the like, a monitoring device such as a security camera is provided for security or for recording when a crime has occurred.

[0003] In a conventional monitoring apparatus, a video signal and an audio signal from a security camera are recorded in an intermittent operation type magnetic recording apparatus called a time-rasp recorder. The time-rasp recorder records a signal from a security camera one frame at a time at intervals of several seconds to several tens of seconds, and is capable of continuous recording for several tens of hours.

[0004] However, since the time-rasp recorder only records signals intermittently, important information such as the moment of a crime or the clothing of a suspect is not known. It may not be recorded. In addition, since the record was intermittent, it was not possible to know details of the behavior of the suspect.

[0005] It is also conceivable to continuously record signals from a security camera on a magnetic recording device. In this case, however, the continuous recording time is several hours at most due to the limitation of the length of a magnetic tape used. This is not practical because the tape must be changed at regular intervals.

[0006] It is also conceivable that a recording operation is started by a human being. However, there is a danger in operating the apparatus in a state where recording is necessary, in view of the characteristics of the security camera. This is not practical because the operation is complicated and the operation is easy to forget.

[0007] It is therefore an object of the present invention to be able to continuously record information before and after an important event has occurred in real time, and to reliably store the information for a long period of time.

[0008] In order to achieve the above object, a monitoring device according to the present invention has a video information detecting device for detecting video information to be monitored and an audio information for detecting acoustic information to be monitored. A detection device, a compression circuit that compresses a video signal from the video information detection device and an audio signal from the audio information detection device, and a first storage device that stores an output of the compression circuit endlessly for a predetermined time, A second storage device capable of recording a reproduction signal from the first storage device and storing the reproduced signal for a long period of time; and a content of at least one of a video signal from the video information detection device and an audio signal from the audio information detection device. An abnormality recognition circuit that detects the occurrence of an abnormal event by analyzing the first storage device when the occurrence of the abnormal event is detected by the abnormality recognition circuit for a certain period of time, It said second storage device in the serial reproduction period of the first storage device, characterized by comprising a recording control circuit for a recording state.

[0009] In the monitoring apparatus according to the present invention, the first storage device performs a recording operation at all times, and in a steady state, video information and audio information near the monitoring target are recorded endlessly for a fixed time. When the occurrence of an abnormal event is detected by the abnormality recognizing circuit, the reproducing operation in the first storage device is started, and the recording operation in the second storage device is started, and returns to the original state after a predetermined time. Therefore, in the second storage device, video information and audio information near the monitoring target before and after the occurrence of the abnormal event are held.

[0010] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS Hereinafter, the features of the present invention will be specifically described based on embodiments with reference to the drawings.

[0011] FIG. 1 is a block diagram showing an embodiment of a monitoring apparatus according to the present invention.

[0012] Referring to FIG. 1, reference numeral 1 denotes a plurality of monitoring units arranged at different places in a building to be monitored. Each monitoring unit 1 includes a monitoring camera device 2 including a video camera 2a such as a CCD camera and a microphone 2b, a compression circuit 3 for compressing a video signal from the video camera 2a and an audio signal from the microphone 2b, and the presence or movement of a human body. The human body sensor 4 to be detected, the video signal from the video camera 2a, the audio signal from the microphone 2b, and the output from the human body sensor 4 are supplied, and the contents of these signals are analyzed to detect whether an abnormal situation has occurred. An abnormality recognizing circuit 5, a recording control circuit 6 for controlling a recording / reproducing operation of a storage device to be described later based on an output of the abnormality recognizing circuit 5, and a first storage device for storing a compression signal from the compression circuit 3 endlessly for a fixed time. 7, a second storage device 8 capable of recording information reproduced from the first storage device 7 and storing the information for a long period of time; The information reproduced from the device 8 is transmitted to a centralized management system 11 installed in a security company via a communication line 10 such as a telephone line, and various instructions from the centralized management system 11 are received. The communication circuit 9 is provided.

[0013] As the human body sensor 4, for example, an infrared sensor, a Doppler radar, or the like is used. As the first storage device 7, for example, a hard disk device or a solid state file made of a semiconductor memory is used. As the second storage device 8, for example, a magnetic tape device such as a video tape recorder is used. A recording / reproducing device is used.

[0014] The centralized management system 11 includes a communication circuit 12 for communicating with each monitoring unit 1 via the communication line 10, a control circuit 13 for controlling the entire centralized management system 11, a compressed video signal and audio signal. An expansion circuit 14 for expanding the signal to restore the original signal, an image display device 15 for displaying an image captured by the video camera 2a based on the restored image signal, and a microphone 2b based on the restored audio signal. A sound output device 16 for outputting the picked-up sound, and a control panel 17 including a keyboard for giving various instructions to each monitoring unit 1, a lamp for displaying occurrence of abnormality, and a CRT display are provided. . The control circuit 13 receives information from each monitoring unit 1, supplies the information to the video output device 15 and the audio output device 16 via the expansion circuit 14, and receives various instructions input from the operation panel 17. The process of sending out to the monitoring unit 1 is performed.

[0015] Next, the operation of the above-described monitoring device will be described. Here, a case where the inside of the store after the store is closed is monitored by a plurality of monitoring units 1 arranged at various places in the store will be described as an example. The video signal from the video camera 2a and the audio signal from the microphone 2b are recorded in the compression circuit 3, and the data amount is compressed by encoding or the like. Various methods can be adopted as the compression method. For example, it is possible to adopt a standardized coding method that uses both intra-frame coding and inter-frame coding called MPEG (moving picture coding experts group). it can.

[0016] The compressed data from the compression circuit 3 is always supplied to the first storage device 7. The first storage device 7 can switch between a recording mode and a reproduction mode by a mode switching signal from the recording control circuit 6. In the normal state, the first storage device 7 is in the recording mode, and the first storage device 7 records the compressed data from the compression circuit 3 for a certain period of time endlessly. Further, the second storage device 8 is in a stopped state in a normal state, and is in a recording state when the first storage device 7 is reproduced.

[0017] For example, when the first storage device 7 is a solid state file composed of a semiconductor memory, compressed data is written in order from the head address of the memory, and when the memory area is full, the compressed data is written first. Writing is repeated starting from the address. Solid state files can be used semi-permanently because there are no mechanical moving parts. Similarly, in the case of a hard disk device, the data is sequentially and continuously recorded on each sector and track on the rotating hard disk. In a hard disk drive, the hard disk is constantly rotating, and the write / read head is floating above the surface of the hard disk due to the airflow generated by the rotation of the hard disk, so that the surface of the hard disk does not wear. Therefore, it can be used for a very long time over several months to several years.

[0018] As a result, the information from the current time to the time that has been traced back by a certain time corresponding to the storage capacity of the first storage device 7 is recorded in the first storage device 7. In the

normal state, as described above, the recorded contents of the first storage device 7 are constantly updated with the latest information of a certain period. That is, the first storage device 7 functions as an endless storage device.

[0019] Next, when a suspicious person enters the store and passes near the human body sensor 4, the output of the human body sensor 4 is supplied to the abnormality recognition circuit 5. When there is an output from the human body sensor 4, the abnormality recognition circuit 5 determines that an abnormality has occurred.

[0020] When the window glass is broken or the door is opened, the sound generated at that time is picked up by the microphone 2b and supplied to the abnormality recognition circuit 5. In the abnormality recognition circuit 5, the pattern of the frequency component and the amplitude component of the input signal in the audible frequency range is changed to a pattern of a sound generated when a window glass registered in advance is broken or a door is opened. It is determined whether or not the pattern matches the sound pattern generated in the case. If the pattern matches, it is determined that an abnormality has occurred.

[0021] The video signal from the video camera 2a is supplied to the abnormality recognizing circuit 5, and it is determined whether or not the video has changed within the imaging range, that is, whether or not a moving object exists within the imaging range. This moving object discrimination can be detected, for example, by examining the presence or absence of a difference in the content of the video signal at two points separated by a certain time. That is, when there is a difference between the contents of the two video signals, it is determined that an abnormality has occurred. It is also possible to determine that an abnormality has occurred when a pattern other than the predetermined pattern registered in advance appears in the content of the video.

[0022] As described above, by supplying the outputs of the video camera 2a, the microphone 2b, and the human body sensor 4 to the abnormality recognition circuit 5, it becomes possible to cope with various situations.

[0023] When the abnormality recognition circuit 5 determines that an abnormality has occurred, an abnormality detection signal is supplied from the abnormality recognition circuit 5 to the recording control circuit 6, and the first storage device 7 is switched from the recording mode to the reproduction mode, and Then, the recording operation of the second storage device 8 is started, and the information of the latest certain period recorded in the first storage device 7 is recorded in the second storage device 8. When the information recorded in the first storage device 7 is recorded in the second storage device 8, the first storage device 7 is again set to the recording mode, and the recording operation of the second storage device 8 is stopped.

[0024] By the above-described operation, every time an abnormal event occurs, the reproduction operation of the first storage device 7 for a certain time and the recording operation of the second storage device 8 for a certain time synchronized with this reproduction operation are repeated. Therefore, every time an abnormal event occurs, certain video information and audio information immediately before the occurrence of the abnormal event are sequentially recorded in the second storage device 8.

[0025] When it is determined by the abnormality recognition circuit 5 that an abnormality has occurred, the communication circuit 9 provides the abnormality occurrence data indicating that the abnormality has occurred together with the identification data indicating which monitor unit the data originated from. And transmitted to the centralized management system 11 installed in the security company via the communication line 10. The abnormality occurrence data is supplied to the control circuit 13 via the communication circuit 12, and the operation panel 17 displays where and what kind of abnormality has occurred. At the same time as the information recorded in the first storage device 7 is reproduced and recorded in the second storage device 8, the reproduced signal from the first storage device 7 is transmitted to the central management system 11 via the communication line 10. The video signal and the audio signal are restored to the original video signal and the audio signal by the decompression circuit 14 and supplied to the video output device 15 and the audio output device 16 to reproduce the video and the sound immediately before the occurrence of the abnormal event. After the information recorded in the first storage device 7 is reproduced, real-time information from the video camera 2a and the microphone 2b is transmitted automatically or based on an instruction from the operation panel 17. You may.

[0026] As a result, the security company can know the details of the abnormality, and can take appropriate measures such as dispatching a security guard or reporting to a police station in charge.

[0027] Also, by giving an activation instruction from the operation panel 17 to the recording control circuit 6 of the monitoring unit 1 other than the monitoring unit that has detected the abnormality, the other monitoring units

in the vicinity of the monitoring unit that has detected the abnormality can receive a start instruction. Also, the recording in the second storage device 8 is started, real-time information is transmitted via the communication line 10, and the centralized management system 11 can easily grasp the intruding route and the escape route of the intruder. it can.

[0028] Further, by giving an instruction to reproduce the second storage device 8 from the operation panel 17 to the recording control circuit 6 of the monitoring unit 1, the data is recorded in the second storage device 8 on the centralized management system 11 side. The status of abnormal events in the past can also be known. Note that a television monitor can be directly connected to the second storage device 8 of the monitoring unit 1 to reproduce the recorded contents of the second storage device 8.

[0029] In the above-described embodiment, the security device has been described as an example. However, the present invention is not limited to this. For example, the invention can be applied to monitoring of abnormal events in a chemical plant or a manufacturing plant. can do.

[0030] As described above, according to the present invention, the status of a monitoring target is always endlessly recorded in the first storage device, and when an abnormal event occurs, the reproduction operation is performed in the first storage device. Then, the reproduced signal is recorded in the second storage device capable of storing the data for a long time. Thus, the situation at the time of occurrence of the abnormal event can be reliably maintained without being limited by the recordable time of the first storage device that performs the endless recording.

[0031] BRIEF DESCRIPTION OF THE FIGURES

[0032] FIG. 1 is a block diagram showing an embodiment of a monitoring device according to the present invention.

[0033] Explanation of reference numerals

[0034] DESCRIPTION OF SYMBOLS 1 ... Surveillance unit, 2 ... Surveillance camera device, 2a ... Video camera, 2b ... Microphone, 3 ... Compression circuit, 4 ... Human body sensor, 5 ... Abnormality recognition circuit, 6 ... Recording control circuit, 7 ... First storage device, 8 .. 2nd storage device, 9 communication circuit, 10 communication line, 11 centralized management system, 12 communication circuit, 13 control circuit, 14 expansion circuit, 15 video display device, 16 audio display device, 17 …Operation board

JPH0877468A MONITOR DEVICE

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1. A video information detection device that detects video information to be monitored, an audio information detection device that detects audio information to be monitored, and a video signal from the video information detection device and an audio signal from the audio information detection device are compressed. A first storage device for recording an output of the compression circuit endlessly for a predetermined time, a second storage device for recording a reproduction signal from the first storage device and capable of storing the signal for a long period of time, An abnormality recognition circuit that analyzes the content of at least one of the video signal from the information detection device and the audio signal from the audio information detection device to detect the occurrence of an abnormal event; A recording control circuit that, when detected, sets the first storage device to a reproduction state for a certain period of time and sets the second storage device to a recording state during a reproduction period of the first storage device. Monitoring apparatus according to claim and.

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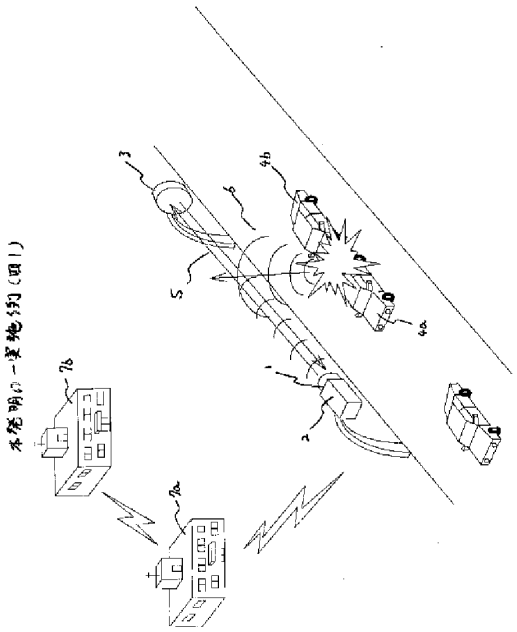
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(54)【発明の名称】　道路状況監視装置

(57)【要約】

【課題】本発明は、道路上での車輌事故等の発生を天候、時間、視界の善し悪しに関係なく、また事故当事者及び目撃者の通報を待つことなく瞬時に警察及び消防署等へ通報すると同時に、後続車輌への警告を発することにより二次災害の発生を防止することを目的としている。

【解決手段】道路上方で車輌の通行を妨げない位置に設置し、空気中に音波を送波又は受波するパラメトリック送受波器と、道路上方に車輌の通行を妨げない位置でパラメトリック送受波器と対向して設置し、パラメトリック送受波器から放射された音波を反射する反射装置と、パラメトリック送受波器に送波信号を送信し、当該反射装置からの反射音波を受信処理して記録又は通報する制御装置とからなり、パラメトリック送受波器から周波数の僅かに異なる音波を送波し、反射装置により反射された音波が道路を走行中の車輌による異常音の影響で変調を受けているかどうかを制御装置で検出する構成とすることにより解決される。



【特許請求の範囲】
【請求項１】道路を走行中の車輌による異常音を検出し、車輌事故等の道路上の異常を監視する装置において、道路上方等で車輌の通行を妨げない位置に設置し、空気中に音波を送波又は受波する音波送受波器と、道路上方等に車輌の通行を妨げない位置で当該音波送受波器と対向して設置し、当該音波送受波器から放射された音波を反射する反射装置と、当該音波送受波器に送波信号を送信し、当該反射装置からの反射音波を受信処理して記録し、交通管制センタ等に通報する制御装置とから成り、当該音波送受波器から送波した音波が当該反射装置で反射されて帰ってくる間に車輌事故等により発生した異常音波と干渉して変調を受けているかどうかを当該制御装置で受信処理し、異常を検出したときは交通管制センタ等に通報することを特徴とした道路状況監視装置。
【請求項２】道路を走行中の車輌による異常音を検出し、車輌事故等の道路上の異常を監視する装置において、道路上方等で車輌の通行を妨げない位置に設置し、空気中に音波を送波又は受波する音波送受波器と、道路上方等に車輌の通行を妨げない位置で当該音波送受波器と対向して設置し、当該音波送受波器から放射された音波を反射する反射装置と、当該音波送受波器に送波信号を送信し、当該反射装置からの反射音波を受信処理して記録し、交通管制センタ等に通報する制御装置と、道路状況を車輌に知らせる情報表示装置とから成り、当該音波送受波器から送波した音波が当該反射装置で反射されて帰ってくる間に車輌事故等により発生した異常音波と干渉して変調を受けているかどうかを当該制御装置で受信処理し、異常を検出したときは交通管制センタ等に通報すると同時に、当該情報表示装置に後続の車輌に注意を促すよう表示させることを特徴とした道路状況監視装置。
【請求項３】道路を走行中の車輌による異常音を検出し、車輌事故等の道路上の異常を監視する装置において、道路上方で車輌の通行を妨げない位置に設置し、空気中に音波を送波する音波送波器と、当該音波送波器に送波信号を送信する送信制御装置と、当該音波送波器と対向して設置し、当該音波送波器から放射された音波を受波する音波受波器と、当該音波受波器の受波信号を処理して記録し、交通管制センタ等に通報する受信制御装置と、当該制御装置で検出した道路状況を表示する情報表示装置とから成り、当該音波送波器から送波した音波を当該音波受波器で受波する間に、車輌事故等により発生した異常音波と干渉して変調を受けているかどうかを当該制御装置で受信処理し、異常を検出したときは交通管制センタ等に通報すると同時に、当該情報表示装置に後続の車輌に注意を促すよう表示させることを特徴とした道路状況監視装置。
【請求項４】請求項１又は請求項２において前記音波送受波器は、例えば圧電セラミック等の電気音響変換素子を用い、周波数の僅かに異なる二種類の音波を送受波し、源周波数よりも周波数が低く且つビーム幅の狭い音波を発生させるパラメトリックアレイを用いることを特徴とした道路状況監視装置。
【請求項５】請求項３において、前記音波送波器及び音波受波器は、少なくともどちらか一方が請求項４記載のパラメトリックアレイを用いることを特徴とした道路状況監視装置。
【請求項６】請求項１、請求項２、請求項３のいずれかにおいて、前記制御装置及び受信制御装置は、請求項４及び請求項５記載のパラメトリックアレイにより受波した音響信号を周波数分析して車輌の衝突音、爆発音及び車輪の軋み音等の車輌事故等の道路通行上異常な音波に特徴的な周波数スペクトルパターンを検出することによりにより事故等の異常を検出、記録及び交通管制センタ等へ通報、情報表示装置に後続車輌に注意を促す表示をさせることを特徴とした道路状況監視装置。
【請求項７】請求項６において、制御装置は受波音響信号を一つ以上のバンドパスフィルタにより車輌事故等に発生する道路通行上異常な音波の周波数帯域に制限した後、予め登録しておいた異常音の信号波形と比較することにより事故等の異常を検出、記録及び交通管制センタ等へ通報、情報表示装置に後続車輌に注意を促す表示をさせることを特徴とした道路状況監視装置。
【請求項８】請求項７において、制御装置は受波音響信号の周波数パターンを記録・蓄積し、当該データを利用することにより、より精度良く異常の検出を可能とすることを特徴とした道路状況監視装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、道路走行における車輌による事故等の異常を検知し、迅速的、且つ自動的に交通管制センタ等へ通報し、また後続車輌への情報表示を行い二次災害発生を防止する為の道路状況監視装置に関するものである。
【０００２】
【従来の技術】従来、車輌の走行中に事故等が発生した場合、事故当事者又は目撃者が、例えば公衆電話機及び非常用電話機等の固定型電話機、車載用電話機及び携帯用電話機等の移動型電話機で警察署や消防署等へ通報するのが一般的である。しかしながら、固定型電話機で通報する場合、事故当事者や目撃者が設置されている場所へ移動するまで多少の時間を要すること、付近に設置されていない場合があること、目撃者が無く事故当事者が通報困難な場合などで事故発生と同時に通報できるとは限らない。移動型電話機においても同様のことが言える。この為事故の発見・通報が遅くなってしまい、負傷者救護の遅れ、事故発生を知らない他の車輌による二次災害発生の恐れがある。
【０００３】これを解決する為に、車輌に衝突事故が発

生したか否かを検知する衝突センサ、車輌の現在位置を検出する車輌位置センサ、車輌の運転者が自分の負傷状態を入力するスイッチ等で構成される入力装置及び通信機を含む車載事故通報装置と、交通管制センタと、警察署及び消防署を含む緊急連絡施設を含むシステムが検討されている。

【０００４】また、車輌に車載事故自動通報装置を携帯させ、事故発生を通報するシステムが考案されている。この例として、特開平８－３０８８５号公報が挙げられる。

【０００５】この方法によれば加速度検出手段、判別手段及び送信手段を１ユニットで構成できるので車輌への搭載が簡単に行える。また、高速道路の入口で貸し出せば全車輌に搭載することができ、万一事故が発生した場合でも警察等への通報、後続車輌への通報が事故発生とほぼ同時に可能となる。

【０００６】

【発明が解決しようとする課題】しかしながら、上記のように車輌にセンサを取り付ける場合、製造段階での取り付けが必要であり、車輌製造業者への負担が増加し、既存車輌への取り付けでは利用者の費用面での負担が増加する。また車輌の運転者が自分の負傷状態を入力するにしても、程度にもよるが、入力不可能である場合が多く、また事故により装置が故障してしまうことがある等の問題がある。

【０００７】車載事故自動通報装置を携帯させる場合は、事故により装置が故障し通報できない場合があること、利用者の負担が増加すること、貸し出す場合には、数量に制限ができてしまうこと、整備・再利用方法等の運用面では解決すべき問題が多々ある。

【０００８】本発明は、この様な種々の問題を解決し、道路上での車輌事故等の発生を天候、時間、視界の善し悪しに関係なく、また事故当事者及び目撃者の通報を待つことなく瞬時に警察及び消防署等へ通報すると同時に、後続車輌への警告を発することにより二次災害の発生を防止することを目的としている。

【０００９】

【課題を解決する為の手段】上記課題は、以下のような装置構成とすることによって解決される。

【００１０】（１）道路上方等で車輌の通行を妨げない位置に設置し、空気中に音波を送波又は受波する音波送受波器と、道路上方等に車輌の通行を妨げない位置で音波送受波器と対向して設置し、音波送受波器から放射された音波を反射する反射装置と、音波送受波器に送波信号を送信し、反射装置からの反射音波を受信処理して記録し、交通管制センタ等に通報する制御装置とで構成することにより解決される。

【００１１】（２）道路上方等で車輌の通行を妨げない位置に設置し、空気中に音波を送波又は受波する音波送受波器と、道路上方等に車輌の通行を妨げない位置で音波送受波器と対向して設置し、音波送受波器から放射された音波を反射する反射装置と、音波送受波器に送波信号を送信し、反射装置からの反射音波を受信処理して記録し、交通管制センタ等に迅速的且つ自動的に通報する制御装置と、道路状況を車輌に知らせる情報表示装置とで構成することにより解決される。

【００１２】（３）道路上方で車輌の通行を妨げない位置に設置し、空気中に音波を送波する音波送波器と、音波送波器に送波信号を送信する送信制御装置と、音波送波器と対向して設置し、音波送波器から放射された音波を受波する音波受波器と、音波受波器の受波信号を処理して記録し、交通管制センタ等に迅速的且つ自動的に通報する受信制御装置と、制御装置で検出した道路状況を表示する情報表示装置とで構成することにより解決される。

【００１３】（４）（１）及び（２）において音波送受波器は、例えば圧電セラミック等の電気音響変換素子を用い、周波数の僅かに異なる二種類の音波を送受波し、源周波数よりも周波数が低く且つビーム幅の狭い音波を発生させるパラメトリックアレイを用いる音波送受波器とすることで解決される。

【００１４】（５）（３）において音波送波器及び音波受波器は、少なくともどちらか一方にパラメトリックアレイを用いることで解決される。

【００１５】（６）（１）、（２）及び（３）において制御装置及び受信制御装置は、（４）及び（５）のパラメトリックアレイにより受波した音響信号を周波数分析して車輌の衝突音、爆発音及び車輪の軋み音等の車輌事故等の道路通行上異常な音波に特徴的な周波数スペクトルパターンを検出することによりにより事故等の異常を検出、記録及び交通管制センタ等へ迅速的且つ自動的に通報、情報表示装置に後続車輌に注意を促す表示をさせることで解決される。

【００１６】（７）（６）において制御装置は受波音響信号を一つ以上のバンドパスフィルタにより車輌事故等に発生する道路通行上異常な音波の周波数帯域に制限した後、予め登録しておいた異常音の信号波形と比較することにより事故等の異常を検出、記録及び交通管制センタ等へ迅速的か辻堂的に通報し、情報表示装置に後続車輌に注意を促す表示をさせることで解決される。

【００１７】（８）（７）において制御装置は受波音響信号の周波数パターンを記録・蓄積し、当該データを利用することにより、より精度良く異常の検出を可能とすることで解決される。

【００１８】

【発明の実施の形態】本発明の実施例を図を用いて以下説明する。

【００１９】図１は本発明における一実施例である。１はパラメトリック送受波器、２は送波信号の生成と受波信号の処理を行う制御装置、３はパラメトリック送受波

器１から送波された音波を反射する反射装置、４ａ及び４ｂは道路を走行する車両、５はパラメトリック送受波器１の送波音波伝搬経路、６は車輌４ａと４ｂが衝突したとき発生する音である。７ａと７ｂは、交通管制センタ、警察署等の緊急連絡施設である。

【００２０】ここで、パラメトリック送波器・受波器についてその原理を簡単に説明しておく。一般に二つの異なった周波数を持つ有限振幅音波を同時に同方向に放射した場合、各々の高調波成分だけでなく、非線形な相互作用によって差音、和音等たくさんの周波数成分が生まれ、例えば、二つの周波数をｆ１、ｆ２とすると、ｆ１，２ｆ１，・・・、ｆ２，２ｆ２，・・・、成分は勿論のこと、ｆ１－ｆ２，ｆ１＋ｆ２，２ｆ１－ｆ２，・・・、の多くの成分が生ずること、これらの成分のうちｆ１－ｆ２の差音の音響特性が極めて優れていることが知られている。この差音を利用する送受波器をパラメトリックアレイと言う。この音源の特徴は、（１）指向性が鋭くしかも副極が存在しないか、たとえあっても非常に小さい、（２）指向性は送波器の寸法に関係しないから送波器を小型軽量化できる、（３）差音は広帯域な周波数特性を持つ。（４）指向性は広い周波数帯域にわたってほぼ一定である、（５）源周波数よりも差音は非常に低いことから、送波器付近での音圧が小さくても差音は遠方まで伝搬する、等である。原理図を図２（ａ）に示す。８は電力増幅器、９は送波器、１０は送波ビームパターンである。

【００２１】パラメトリック受波器について説明すると、図２（ｂ）に示したように、送波器から放射される音波をｆｐ、周囲からの外来信号をｆｓとする。１１は送波器、１２は受波器、１３はフィルタ、１４は受波ビームパターンである。ｆｐの音波の振幅を大きく有限振幅の領域にしたとき、周波数ｆｐ－ｆｓの差音や、ｆｐ＋ｆｓの和音が現れる。差音や和音は信号波の情報を含むことから、信号波を受けなくても送波器に対向して設置した差音、和音を受け適切な処理を施せば信号波に対し指向性の優れた受波器ができる。

【００２２】一般に音波（振動）は、音波送波器の物理的寸法が同一の場合、周波数が高いほど指向性は狭くなるが伝搬距離が短く、周波数が低いと伝搬距離は長くなるが指向性が広くなってしまう。低い周波数で指向性を狭くするには物理的寸法が大きなものとなってしまう。

【００２３】本装置の場合、道路上方あるいは近傍への装置設置を考慮すると、物理寸法は小さくなければならないが、音波送受波器と反射装置の距離を可能な限り広くするためには音波伝搬距離を長くしなければならないと言う矛盾が生ずることになる。この問題を解決するためにはパラメトリック送受波器のように、送受波器の物理寸法は小さくても、差音により低い周波数を発生でき、指向性を狭くできる送受波器が必要になる。

【００２４】さて、図１の動作であるが、道路上方で車輌通行を妨害しない位置に設置した制御装置２で僅かに異なる周波数ｆ１と周波数ｆ２を生成し、同じく道路上方に設置したパラメトリック送受波器１により電気音響変換し空中に送波する。送波された音波は、伝搬経路５をたどり、また同じく道路上方でパラメトリック送受波器１と対向して設置した反射装置３で反射され伝搬経路５を逆にたどってパラメトリック送受波器１に到達する。パラメトリック送受波器１より送波された周波数ｆ１と周波数ｆ２の音波は、和周波数ｆ１＋ｆ２と差周波数ｆ１－ｆ２を形成するが、和周波数ｆ１＋ｆ２は周波数ｆ１と周波数ｆ２より大きい吸収を受けるのでほぼ無視できる。この差周波数ｆ１－ｆ２が伝搬経路５を往復する間に、車輌４ａに車輌４ｂが衝突したとする。このとき発生した異常音ｆ３による非線形音波６が空中を伝搬し、伝搬経路５を伝搬している差周波数ｆ１－ｆ２の音波に干渉して変調せしめ、これが反射音波となってパラメトリック送受波器１にて受波される。変調された差周波数音波は、（ｆ１－ｆ２）－ｆ３音波、（ｆ１－ｆ２）＋ｆ３音波としてパラメトリック送受波器１において受波され、制御装置２において受信処理され周波数スペクトルパターン分析、異常音データと比較され異常発生を検出し、制御装置２内の記録器に記録されると同時に交通管制センタ又は警察署や消防署等の緊急連絡施設へ迅速的且つ自動的に通報される。通報される情報には、差周波数音波から計算した事故発生地点の絶対位置情報が含まれるので、警察及び消防等への的確な情報提供が可能となる。

【００２５】道路上の異常を検知する方法として、道路側方にマイクロホンを並べておく方法も考えられるが、この場合、非常に多数のマイクロホンを設置する必要があり費用がかかるという問題がある。この点本発明の装置では、マイクロホンを多数並べる必要もなく、また道路上方へ設置することができるので、天候の影響、例えば積雪による埋没、等の影響を受けることが無く、また音波を利用するので視界の善し悪し及び時間に関係なく迅速的且つ自動的な通報が可能となる点で非常に優れている。

【００２６】図３は、カーブ等の見通しの悪い道路において、情報表示装置１５を用いた実施例である。４ｃは後続車輌である。

【００２７】上記図１の実施例のごとく、道路上方で車輌通行を妨害しない位置に設置した制御装置２で僅かに異なる周波数ｆ１と周波数ｆ２を生成し、同じく道路上方に設置したパラメトリック送受波器１により電気音響変換し空中に送波する。送波された音波は、伝搬経路５をたどり、また同じく道路上方でパラメトリック送受波器１と対向して設置した反射装置３で反射され伝搬経路５を逆にたどってパラメトリック送受波器１に到達する。パラメトリック送受波器１より送波された周波数ｆ１と周波数ｆ２の音波は、和周波数ｆ１＋ｆ２と差周波

数ｆ１－ｆ２を形成するが、和周波数ｆ１＋ｆ２は周波数ｆ１と周波数ｆ２より大きい吸収を受けるのでほぼ無視できる。この差周波数ｆ１－ｆ２が伝搬経路５を往復する間に、車輌４ａに車輌４ｂが衝突したとする。このとき発生した異常音ｆ３による非線形音波６が空中を伝搬し、伝搬経路５を伝搬している差周波数ｆ１－ｆ２の音波に干渉して変調せしめ、これが反射音波となってパラメトリック送受波器１にて受波される。変調された差周波数音波は、（ｆ１－ｆ２）－ｆ３音波、（ｆ１－ｆ２）＋ｆ３音波としてパラメトリック送受波器１において受波され、制御装置２において受信処理され周波数スペクトルパターン分析、異常音データと比較され異常発生を検出し、制御装置２内の記録器に記録されると同時に交通管制センタ又は警察署や消防署等の緊急連絡施設へ迅速的且つ自動的に通報される。通報される情報には、差周波数音波から計算した事故発生地点の絶対位置情報が含まれるので、警察及び消防等への的確な情報提供が可能となる。また本実施例の場合、情報表示装置１５に前方において事故等の異常があることを表示させ、後続の車輌４ｃ以後に対し、注意を促し４ａ、４ｂに追突する等の二次災害を防ぐことが可能となる。この情報表示装置は、既存の表示装置と兵横死手も構わないし、赤い警告灯が点灯するようにしてもよい。この場合情報表示装置の新規製造・設置の費用削減が可能である。

【００２８】図４は、パラメトリック送受波器１を送波器と受波器に分けた例である。１６は送信制御装置、１７はパラメトリック送波器、１８はパラメトリック受波器、１９は受信制御装置、２０は伝搬経路である。

【００２９】上記図３の実施例のごとく、道路上方で車輌通行を妨害しない位置に設置した送信制御装置１６で僅かに異なる周波数ｆ１と周波数ｆ２を生成し、同じく道路上方に設置したパラメトリック送波器１７により電気音響変換し空中に送波する。送波された音波は、伝搬経路２０をたどり、また同じく道路上方でパラメトリック送波器１７と対向して設置したパラメトリック受波器１８で受波される。パラメトリック受波器１８で受波された差周波数は受信制御装置１９で受信処理される。パラメトリック送波器１７より送波された周波数ｆ１と周波数ｆ２の音波は、和周波数ｆ１＋ｆ２と差周波数ｆ１－ｆ２を形成するが、和周波数ｆ１＋ｆ２は周波数ｆ１と周波数ｆ２より大きい吸収を受けるのでほぼ無視できる。この差周波数ｆ１－ｆ２が伝搬経路２０を伝搬する間に、車輌４ａに車輌４ｂが衝突したとする。このとき発生した異常音ｆ３による非線形音波６が空中を伝搬し、伝搬経路２０を伝搬している差周波数ｆ１－ｆ２の音波に干渉して変調せしめ、これが変調差周波数となってパラメトリック受波器１８にて受波される。変調された差周波数音波は、（ｆ１－ｆ２）－ｆ３音波、（ｆ１－ｆ２）＋ｆ３音波としてパラメトリック受波器１８において受波され、受信制御装置１９において受信処理され周波数スペクトルパターン分析、異常音データと比較され異常発生を検出し、受信制御装置１９内の記録器に記録されると同時に交通管制センタ又は警察署や消防署等の緊急連絡施設へ迅速的且つ自動的に通報される。通報される情報には、差周波数音波から計算した事故発生地点の絶対位置情報が含まれるので、警察及び消防等への的確な情報提供が可能となる。また本実施例の場合図３と同様に、情報表示装置１５に前方において事故等の異常があることを表示させ、後続の車輌４ｃ以後に対し、注意を促し４ａ、４ｂに追突する等の二次災害を防ぐことが可能となる。また、本実施例においては、送波系と受波系を分離し更に前記の実施例よりも小型軽量化が可能となっている。情報表示装置１５に対する情報の表示指示・制御は、交通管制センタ等からでもよいが、受信制御装置１９から指示・制御をするようにすることも可能である。

【００３０】本発明における装置では各制御装置、送波器・受波器はいずれも非常に小型軽量化できるので、道路側方に充分な設置空間が確保できない場合でも、道路上方、走行中の車輌の上空に設置できるので何等問題が無い。

【００３１】上記のいずれの実施例においても、送波周波数を任意に変更可能とすることで、環境等の状況の変化に対応した最適な設定とすることができ、かつ周波数帯域幅を自由に変化させることができるので、検出対象の異常音を限定することや広い範囲を一度に検出するなど検出条件設定に自由度を持たせることが可能である。

【００３２】図５に示すように、道路上で発生する音波を周波数分析すると、通常走行音、衝突音及び車輪の軋み音は各々異なる特徴的な周波数スペクトルパターンを有している。これに着目し道路上の種々の音波の中から異常音を検出するように、パラメトリック受波器で受波した音波をバンドパスフィルタに通し、予め登録しておいた衝突音等の周波数スペクトルパターンと比較して検出するよう受波制御装置を構成している。

【００３３】また、受波音波から得た特徴的な周波数スペクトルパターンは、記録器にて記録データ蓄積を行うようにすることで次に比較検出するときの検出精度向上、異常判定基準の多様化にも対応可能な装置構成とすることができる。

【００３４】

【発明の効果】以上述べたように、本発明によれば、道路上での車輌事故等の発生を天候、時間、視界の善し悪しに関係なく、また事故当事者及び目撃者の通報を待つことなく瞬時に警察及び消防署等へ通報すると同時に、後続車輌への警告を発することにより二次災害の発生を防止する効果がある。

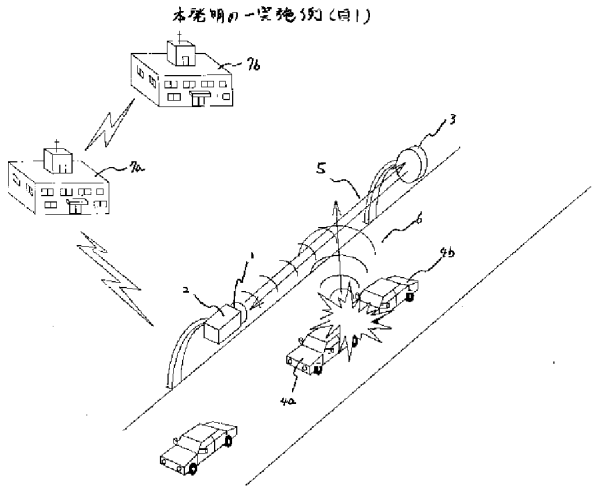
【図面の簡単な説明】

【図１】本発明における一実施例。

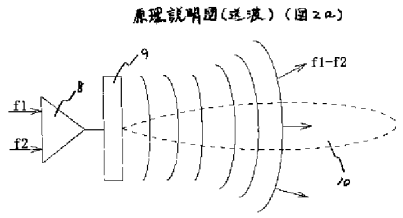
【図２】パラメトリック送波器。受波器の原理説明図。

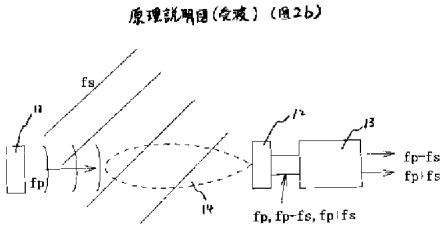
【図３】本発明における一実施例。
【図４】本発明における一実施例。
【図５】周波数スペクトルパターンの例。
【符号の説明】
１・・・パラメトリック送受波器
２・・・制御装置
３・・・反射装置
４ａ、４ｂ、４ｃ・・・車輌
５・・・送波音波往復伝搬経路
６・・・車輌衝突時の発生音
７ａ、７ｂ・・・緊急連絡施設
８・・・電力増幅器
９・・・送波器
１０・・・送波ビームパターン
１１・・・送波器
１２・・・受波器
１３・・・フィルタ
１４・・・受波ビームパターン
１５・・・情報表示装置
１６・・・送信制御装置
１７・・・パラメトリック送波器
１８・・・パラメトリック受波器
１９・・・受信制御装置
２０・・・送波音波伝搬経路
２１・・・通常走行音の周波数スペクトルパターン
２２・・・衝突音の周波数スペクトルパターン
２３・・・車輪軋み音の周波数スペクトルパターン

【図１】

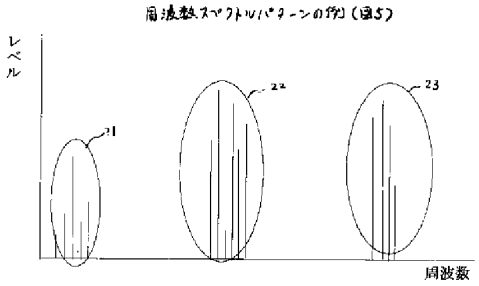


【図２】

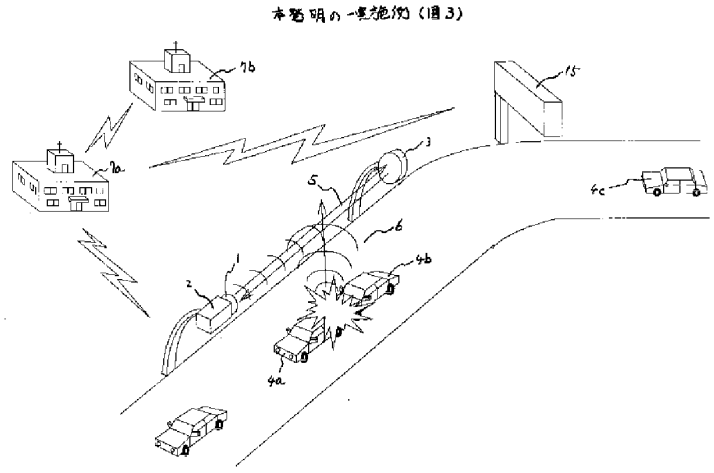




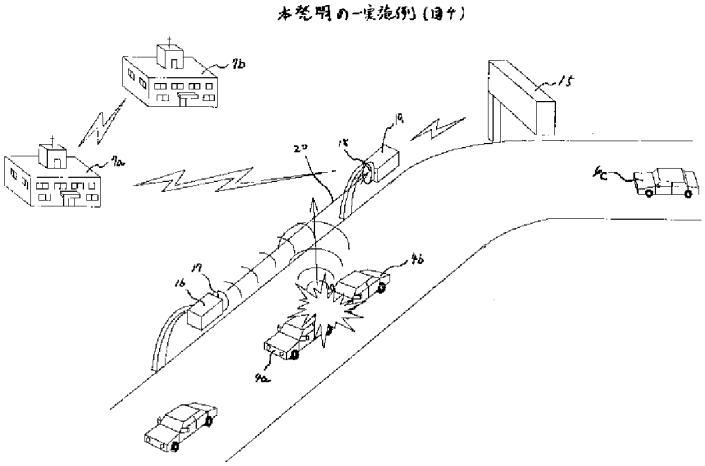
【図５】



【図３】



【図４】



フロントページの続き

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ROAD CONDITION MONITORING DEVICE

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Applicant(s): HITACHI LTD ± (HITACHI LTD)

Classification: **- international:** ***B60W30/00; G01S15/88; G08B21/00; G08B25/04; G08B25/10; G08G1/00;*** (IPC1-7): G01S15/88; G08B21/00; G08B25/04; G08B25/10; G08G1/00

- cooperative:

Application number: JP19960318197 19961128

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Abstract of JPH10162283 (A)

PROBLEM TO BE SOLVED: To instantaneously report the occurrence of car accident to a police and a firehouse and to prevent the occurrence of secondary disaster by simultaneously issuing an alarm to a following vehicle by providing a reflector for reflecting sonic waves and a controller for receiving the reflected sonic waves, recording these sonic waves and reporting them to a traffic control center or the like. SOLUTION: Frequencies f1 and f2 different a little are generated by a controller 2 installed above a road, and sent into air after performing electric/ acoustic transduction through a parametric transmitter/receiver 1. On the assumption that a vehicle 4b collides with a vehicle 4a while this differential frequency f1-f2 is reflected by a reflector 3 and reciprocated through a propagation path 5, a non-linear acoustic wave 6 caused by an abnormal sound f3 generated at such a time is propagated in air, the sonic wave with differential frequency f1-f2 propagated through the propagation path 5 is interferred and modulated, and this sonic wave is turned to a reflected sonic wave and received by the parametric transmitter/receiver 1. Then, the generation of abnormality is detected by a controller 2, recorded and speedily and automatically reported to emergency contact facilities 7a and 7b at the same time.

JPH10162283A ROAD CONDITION MONITORING DEVICE

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[0001] The present invention relates to is, detects an abnormality such as an accident caused by a vehicle in the road traveling, rapid manner, and automatically Problem to the traffic control center or the like, also two performs a display of information to a subsequent vehicle order those related to road condition monitoring apparatus for preventing accidents.

[0002] Conventionally, when the accident or the like during the running of the vehicle has occurred, accident parties or witnesses, for example, public phone and fixed phone of emergency phones, and the like, in-vehicle phone and mobile, such as a portable phone it is general to report to the police station and fire station and the like on the phone. However, if the report at a fixed phone, it takes some time before moving to the location where the accident parties or witnesses are installed, that it may not be installed near, accident parties without witnesses not always possible to report the accident and at the same time, such as when the report difficult. Similarly, in the mobile phone it can be said. Because of this slows down the discovery and reporting of the accident, there is a risk of secondary disaster caused by other vehicles do not know delay of injured relief, the accident occurred.

[0003] To solve this, composed of a switch or the like collision sensor collision in the vehicle for detecting whether or not occurs, the vehicle position sensor for detecting the current position of the vehicle, the driver of the vehicle to enter their wounded a vehicle accident notification apparatus comprising an input device and a communication device is a traffic control center, the system including emergency facilities, including police and fire departments have been studied.

[0004] In addition, to carry a vehicle accident automatic reporting device in the vehicle, it has been devised system to report the accident. Examples of this include Hei 8-30885 JP.

[0005] Acceleration detection means According to this method, mounted to the vehicle can be carried out easily because it constitutes a discrimination means and transmitting means in one unit. Also, Kashidase at the inlet of the highway can be mounted to all vehicles, emergency report to the police or the like even when an accident occurs, reporting to a subsequent vehicle is substantially simultaneously possible with the accident.

[0006] The present invention is, however, if you are installing a sensor in the vehicle as described above, it is necessary to mounting at the manufacturing stage, and increase the burden on the vehicle manufacturer, in the attachment to an existing vehicle users burden on the cost side of the increases. Also even if the driver of the vehicle to enter their wounded, depending on the degree, there is a problem that often is not possible input and device by accident which may cause malfunctioning.

[0007] Case of mobile-vehicle accident automatic reporting device is that it may device by accident can not report a failure, the burden on the user is increased, when lending is that she can limit the quantity, re-establish and operational aspects such as how to use is there are many problems to be solved.

[0008] The present invention, such to solve the various problems, police the occurrence of a vehicle accident on the road weather, time, regardless of the field of view of the quality, also instantly without waiting for the report of the accident parties and witnesses and at the same time report to the fire station or the like, and aims to prevent the occurrence of secondary disasters by issuing a warning to following vehicles.

[0009] The above-mentioned problems, according to means to solve the problem] is solved by the device configuration, such as the following.

[0010] (1) was placed in a position that does not interfere with vehicle traffic in the road upper or the like, a sonic transducer for transmitting or reception waves in the air, sonic wave transceiver at a position that does not interfere with the passage of vehicles on the road upward like vessels facing to be installed, a reflector for reflecting the sound waves emitted from the ultrasonic transducer transmits a transmit signal into sound waves

transducer and recorded by the reception processing the reflected sound wave from the reflecting device, It is solved by configuring by the controller to notify the traffic control center or the like.

[0011] (2) it was placed in a position that does not interfere with vehicle traffic in the road upper or the like, a sonic transducer for transmitting or reception waves in the air, sonic wave transceiver at a position that does not interfere with the passage of vehicles on the road upward like vessels facing to be installed, a reflector for reflecting the sound waves emitted from the ultrasonic transducer transmits a transmit signal into sound waves transducer and recorded by the reception processing the reflected sound wave from the reflecting device, a control device for Problem rapid manner and automatically to a traffic control center or the like, are solved by constructing in an information display device to inform the road condition to the vehicle.

[0012] (3) was placed in a position that does not interfere with vehicle traffic in the road upper, a sonic wave transmitter for transmitting a sound wave into the air, and a transmission control unit for transmitting a transmit signal to the sonic wave transmitter, ultrasonic wave transmission vessels facing to be installed, and ultrasonic wave receiver for reception of sound waves emitted from the ultrasonic wave transmitter, and recorded by processing the received signals of the sonic receivers, rapid manner and the traffic control center or the like a reception control device that automatically notify, is solved by configuring in an information display device for displaying the road conditions detected by the control device.

[0013] (4) (1) and ultrasonic transducer (2), for example using an electro-acoustic transducer of a piezoelectric ceramic or the like, a slightly different two kinds of waves of frequency transmission and reception waves, the source lower than the frequency and it is solved by a sound wave transducer using a parametric array to generate a narrow sound wave of the beam width.

[0014] (5) sonic wave transmitter and ultrasonic wave receiver (3) it is solved by using a parametric array in at least one.

[0015] (6) (1), (2) and the control apparatus and the reception control unit (3) is, (4) and (5) vehicle collision noise acoustic signal by performing frequency analysis with reception by parametric array of explosion detecting an abnormality such as an accident by by detecting the sound and the wheels of the creaking sound such as a vehicle accident such as road traffic on the unusual waves characteristic frequency spectrum pattern of, rapid manner and automatically to the recording and the traffic control center or the like report, be resolved by causing the attention displayed in the following vehicle in the information display device.

[0016] (7) After the controller is limited to the frequency band of the road traffic on abnormal waves generated in a vehicle accident or the like by one or more band-pass filters the reception acoustic signal (6), previously registered abnormal detecting an abnormality such as an accident by comparing the signal waveform of sound, it is resolved by the recording and transportation quick manner or Tsujido to Problem to the control center or the like, be the attention displayed in the subsequent vehicle on the information display device .

[0017] (8) (7) the controller will record and store the frequency pattern of the received wave an acoustic signal in, by utilizing the data, it is solved by allowing a more accurate abnormality detection.

[0018] It is described below with reference to FIG the embodiment of the embodiment of the present invention.

[0019] FIG. 1 is an embodiment of the present invention. 1 parametric transducer, 2 control unit for the processing of generation and received signal of the transmit signal, 3 reflector for reflecting the sound waves transmitted from a parametric transducer 1, 4a and 4b the road traveling vehicle, the transmitting sound wave propagation path of parametric transducer 1 5, 6 is the sound generated when the vehicle 4a and 4b has collided. 7a and 7b, the traffic control center, an emergency contact facilities such as police stations.

[0020] Here, a brief description of the principle for parametric wave transmitter-receivers. In general, when the radiation at the same time in the same direction the finite amplitude waves with different frequencies of the two, not only the harmonic components of each, born difference tone, chord, etc. a lot of frequency components by non-linear interaction, for example, of two If the frequency is f1, f2, f1,2f1, ⋯, f2,2f2, ⋯, component is of course that, f1-f2, f1 + f2,2f1-f2, ⋯, many of the components of the resulting it, acoustic characteristics of the difference tone of f1-f2 of these components are known to be extremely excellent. A transducer to take advantage of this difference tone say parametric array. The feature of this sound source is, (1) or sharp directivity And Vice pole does not exist, even if very small, even, (2) small size and light weight of the wave transmitter since the directivity is not related to the size of the wave transmitter possible reduction, (3) the

difference tone will have a wide-band frequency characteristics. (4) directivity is approximately constant over a wide frequency band, (5) from the difference tone is very low than the source frequency, the difference tone even with a small sound pressure in the vicinity of the wave transmitter is propagated to distant , and the like. The principle diagram shown in FIG. 2 (a). 8 power amplifier, 9 wave transmitter, is 10, which is a transmit beam pattern.

[0021] Referring to the parametric wave receiver, as shown in FIG. 2 (b), the sound waves radiated from the wave transmitter fp, and extraneous signals from the surrounding fs. 11 wave transmitter, 12 receivers, 13 filters, 14 is a receiving beam pattern. When in the area of large finite amplitude of the amplitude of the sound waves of fp, difference tone and the frequency fp-fs, chord of fp + fs appears. Difference tone and chords from it, including the information of the signal wave, excellent difference tone even without receiving a signal wave was set to face the wave transmitter, for the signal wave if Hodokose an appropriate process received a chord of directivity the wave receiver can be.

[0022] Are generally acoustic wave (vibration), if the physical dimensions of the sonic wave transmitter is the same, the directivity higher frequency is shorter propagation distance narrows, the propagation distance frequency is low is but wider directivity long and will. To narrow the directivity in the low frequency becomes physical dimension is a big thing.

[0023] In the case of the present system, in view of the device installation to the road above or near, the physical dimensions are not should be small, to lengthen the sound wave propagation distance in order to widen as much as possible the distance of the reflecting device and ultrasonic transducer so that the inconsistency to say there must be caused. As in parametric transducer in order to solve this problem, physical dimensions of the transducer be small, can generate a lower frequency by the difference tone, it is necessary to transducer capable of narrow directivity.

[0024] Now, the operation of FIG 1, to produce a slightly different frequencies f1 and f2 by a control device 2 installed in a position that does not interfere with vehicle traffic on the road above, likewise the parametric transducer 1 installed in a road upward electro-acoustic transducer and to transmit in the air. Transmitting sound waves will follow the propagation path 5, also similarly reach the propagation path 5 is reflected by the parametric transducer 1 and the opposing reflecting device 3 was placed on the road upward traced back to the parametric transducer 1 to. Almost ignored because waves of frequencies f1 and f2 that has been transmitting from parametric transducer 1, but to form a sum frequency f1 + f2 and the difference frequency f1-f2, sum frequency f1 + f2 is subjected to greater absorption frequencies f1 and f2 it can. During this difference frequency f1-f2 is a round trip propagation paths 5, the vehicle 4b has collided with the vehicle 4a. At this time, non-linear wave 6 is propagated in the air due to the abnormal sound f3 generation, interfere with the sound waves propagation difference frequency that route is 5 propagates through the f1-f2 is allowed to modulation, parametric transducer 1 this becomes a reflected sound wave It is reception at. Modulated difference frequency sound waves, (f1-f2) -f3 waves, (f1-f2) + f3 is reception in parametric transducer 1 as a sound wave, receiving the processed frequency spectral pattern analysis in the control unit 2, abnormal sound data detecting a comparison is abnormal occurrence and, is notified rapid manner and automatically to the emergency contact facilities such as traffic control center or police station and fire station at the same time when it is recorded on the recording device in the control device 2. The information is notified, because it contains the absolute position information of the accident point was calculated from the difference frequency wave, it is possible to accurately provide information to the police and fire the like.

[0025] As a method for detecting an abnormality on the road, a method may be considered to be side-by-side microphone on the road side, in this case, there is a problem in that a very large number of the microphone must be installed expensive. In apparatus of this point the present invention, there is no need to arrange a large number of microphones, and because it can be installed into road upward, the influence of the weather, for example, buried by snow, without being affected etc., also utilize sonic It has a very good point that it is possible to quickly specific and automatic report regardless of the quality and time of sight since.

[0026] 3, in the road with bad visibility, such as curves, an example in which using the information display device 15. 4c is a subsequent vehicle.

[0027] As indicated above Embodiment FIG 1, to produce a slightly different frequencies f1 and f2 by a control device 2 installed in a position that does not interfere with vehicle traffic on the road above, also electricity through parametric transducer 1 installed in a road upward to transmit in the air and acoustic conversion. Transmitting sound waves will follow the propagation path 5, also similarly reach the propagation path 5 is

reflected by the parametric transducer 1 and the opposing reflecting device 3 was placed on the road upward traced back to the parametric transducer 1 to. Almost ignored because waves of frequencies f1 and f2 that has been transmitting from parametric transducer 1, but to form a sum frequency f1 + f2 and the difference frequency f1-f2, sum frequency f1 + f2 is subjected to greater absorption frequencies f1 and f2 it can. During this difference frequency f1-f2 is a round trip propagation paths 5, the vehicle 4b has collided with the vehicle 4a. At this time, non-linear wave 6 is propagated in the air due to the abnormal sound f3 generation, interfere with the sound waves propagation difference frequency that route is 5 propagates through the f1-f2 is allowed to modulation, parametric transducer 1 this becomes a reflected sound wave It is reception at. Modulated difference frequency sound waves, (f1-f2) -f3 waves, (f1-f2) + f3 is reception in parametric transducer 1 as a sound wave, receiving the processed frequency spectral pattern analysis in the control unit 2, abnormal sound data detecting a comparison is abnormal occurrence and, is notified rapid manner and automatically to the emergency contact facilities such as traffic control center or police station and fire station at the same time when it is recorded on the recording device in the control device 2. The information is notified, because it contains the absolute position information of the accident point was calculated from the difference frequency wave, it is possible to accurately provide information to the police and fire the like. In the case of this example, to display that the information display device 15 is abnormal such as an accident at the front, with respect to the subsequent vehicle 4c thereafter, 4a attention, to prevent secondary disasters such as rear-end to 4b it is possible. The information display device, to may be an existing display device and Heiyoko death hand, may be a red warning light is illuminated. Cost savings of the new production and installation of this case information display device are possible.

[0028] Figure 4 is an example of dividing the parametric transducer 1 to the wave transmitter and wave receiver. 16 transmission control device, 17 parametric wave transmitter, 18 parametric receivers, 19 receiving control device, 20 is a propagation path.

[0029] As examples of FIG 3, to produce a slightly different frequencies f1 and f2 in the transmission control apparatus 16 which is installed at a position that does not interfere with vehicle traffic on the road above, likewise the parametric wave transmitter 17 installed in the road upward electro-acoustic transducer and to transmit in the air. Transmitting sound waves follows a propagation path 20, and is received at the parametric wave receiver 18 also installed to face the parametric wave transmitter 17 on the road above. Difference frequency that is received at the parametric receivers 18 are receiving process by the reception control unit 19. Almost ignored because waves of frequencies f1 and f2, which is transmitting from the parametric wave transmitter 17 is to form the sum frequency f1 + f2 and the difference frequency f1-f2, sum frequency f1 + f2 is subjected to greater absorption frequencies f1 and f2 it can. During this difference frequency f1-f2 is propagating in the propagation path 20, the vehicle 4b has collided with the vehicle 4a. At this time, non-linear wave 6 is propagated in the air due to the abnormal sound f3 generation, interfere with the sound waves propagation difference frequency of the route 20 propagating f1-f2 is allowed to modulation, parametric receivers this becomes a modulation difference frequency 18 is reception at. Modulated difference frequency sound waves, (f1-f2) -f3 waves, (f1-f2) + f3 waves are received wave in parametric wave receiver 18 as, receiving the processed frequency spectral pattern analysis in the receiving control unit 19, abnormal sound detecting a comparison is abnormal occurrence and data, it is notified rapid manner and automatically to the emergency contact facilities such as traffic control center or police station and fire station at the same time when it is recorded in a recording device of the receiving control device 19. The information is notified, because it contains the absolute position information of the accident point was calculated from the difference frequency wave, it is possible to accurately provide information to the police and fire the like. Also in the same manner as in the case Figure 3 of the present example, to display that the information display device 15 is abnormal such as an accident at the front, with respect to the subsequent vehicle 4c thereafter, 4a attention, such as the rear-end collision to 4b two it is possible to prevent the following accident. In the present embodiment, it becomes possible to reduce the size and weight than the further above embodiment separates the transmitting system and the reception system. Display instruction and control information to the information display device 15, may be any from the traffic control center or the like, can also be adapted to the instructions and control of the reception control unit 19.

[0030] Each control device in the apparatus of the present invention, since none of the wave transmitter-receivers can be very compact and lightweight, even if a sufficient installation space on the road side can not be secured, the road above, the sky of the vehicle while driving there is no what problems such as so can be installed in.

[0031] In either embodiment described above, by making it possible to arbitrarily change the transmit frequency can be the optimum setting corresponding to the changing conditions in the environment, and changing the

frequency bandwidth free since it is, it is possible to provide a degree of freedom in such detection condition setting detects that and wide range to limit the abnormal sound to be detected at a time.

[0032] As shown in FIG. 5, when the waves generated on the road to frequency analysis, usually running sound, squeak the collision sound and the wheel has a respective different characteristic frequency spectrum pattern. This to detect abnormal sounds from various sound wave on the road by focusing, through a sound wave received at the parametric wave receiver to the bandpass filter, the frequency spectrum pattern such as collision sound that has been previously registered constitute the reception control device to detect compared to the.

[0033] Further, the characteristic frequency spectrum pattern obtained from the reception wave, the detection accuracy at the time of next compare detected by to perform the recording data storage in a recording device, to the diversification of the abnormality judgment reference corresponding can allow device configurations.

[0034] As described above, according to the present invention, according to the present invention, the occurrence of the vehicle accident on the road weather, time, irrespective of the field of view of quality, and without waiting for the notification of an accident parties and witnesses instant and at the same time to report to the police and fire department, etc., there is an effect to prevent the occurrence of secondary disasters by issuing a warning to the following vehicle.

[0035] Brief description of the drawings

[0036] One embodiment in FIG present invention.

[0037] Figure 2 parametric wave transmitter. Explanatory view of the principle of receivers.

[0038] One embodiment shown in FIG. 3 the present invention.

[0039] One embodiment shown in FIG. 4 the present invention.

[0040] The example of FIG. 5 frequency spectrum pattern.

[0041] Description of the code

[0042] 1 ... parametric transducer 2 ... control device 3 ... reflecting device 4a, 4b, 4c ··· vehicle 5 ... transmit sound waves round-trip propagation path 6 ... vehicle collision at the time of the generated sound 7a , 7b ··· emergency contact facility 8 ... power amplifier 9 ... wave transmitter 10 ... transmission beam pattern 11 ... wave transmitter 12 ... wave-receiver 13 ... filter 14, ... reception beam pattern 15 ... information display device 16 ... transmission control device 17 ... parametric wave transmitter 18 ... parametric receivers 19 ... reception control device 20 ... transmitting sound waves frequency spectrum pattern of the propagation path 21 ... usually frequency spectrum pattern of the frequency spectrum pattern 22 ... collision sound of running sound 23 ... the wheels squeak

JPH10162283A ROAD CONDITION MONITORING DEVICE

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1. Detects an abnormal sound due to vehicles traveling on a road, in an apparatus for monitoring abnormality on the road, such as a vehicle accident, was placed in a position that does not interfere with vehicle traffic in the road upward like, transmitting or sound waves in air a sonic transducer which received wave, at a position that does not interfere with the passage of vehicles on the road upward like disposed opposite to the said ultrasonic transducer, a reflector for reflecting the sound waves emitted from the ultrasonic transducer, It sends a transmit signal to the ultrasonic transducer, and recorded receives and processes the reflected sound wave from the reflecting device, consists of a control unit to report to the traffic control center or the like, was transmitted from the ultrasonic transducer traffic control center when whether interfering with the abnormal sound waves generated by the vehicle accidents are receiving the modulated reception processing in the control unit, detects an abnormality while the sound wave comes back after being reflected in the reflecting device road conditions monitoring device is characterized in that report to equal.

2. Detects an abnormal sound due to vehicles traveling on a road, in an apparatus for monitoring abnormality on the road, such as a vehicle accident, was placed in a position that does not interfere with vehicle traffic in the road upward like, transmitting or sound waves in air a sonic transducer which received wave, at a position that does not interfere with the passage of vehicles on the road upward like disposed opposite to the said ultrasonic transducer, a reflector for reflecting the sound waves emitted from the ultrasonic transducer, It sends a transmit signal to the ultrasonic transducer, from recorded receives and processes the reflected sound wave from the reflecting device, and a control device to report to the traffic control center or the like, and the information display device to inform the road conditions in the vehicle becomes, the reception processing whether sound waves transmitted from the ultrasonic transducer is undergoing modulation interferes with abnormal waves generated by the vehicle accident while coming back after being reflected in the reflecting device in the control device and, when detecting abnormality when Problem to traffic control center or the like at the same time, the information display device to the road condition monitoring apparatus characterized thereby alert display on subsequent vehicles.

3. Waves road to detect the abnormal sound by the vehicle while driving, in an apparatus for monitoring the abnormality on the road, such as a vehicle accident, which was placed in a position that does not interfere with the vehicle of the traffic on the road above, to transmit sound waves in the air a wave transmitter, a transmission control unit for transmitting a transmit signal to the sonic wave transmitter, and disposed to face the said ultrasonic wave transmitter, sound waves received for reception of sound waves emitted from the ultrasonic wave transmitter a duplexer, and recorded by processing the reception signal of the ultrasonic wave receiver, consists of a receiving control device to notify the traffic control center or the like, an information display device for displaying the road conditions detected by the control device, the sound waves transmitted from the ultrasonic wave transmitter during the reception in the ultrasonic wave receiver, whether interfering with the abnormal sound waves generated by the vehicle accidents are receiving the modulated reception processing in the control unit, At the same time when detecting an abnormality is reported to the traffic control center or the like, road condition monitoring apparatus characterized thereby alert display subsequent vehicle to the information display device.

4. The acoustic wave transducer according to claim 1 or claim 2, for example using an electro-acoustic transducer of a piezoelectric ceramic or the like, a slightly different two kinds of waves of frequency transmission and reception waves, the source lower than the frequency and beam road condition monitoring apparatus characterized by using a parametric array for generating a narrow wave width.

5. Device according to claim 3, wherein the ultrasonic wave transmitter and ultrasonic wave receiver is traffic condition monitoring apparatus at least one is characterized by using a parametric array according to claim 4.

6. Claim 1, Claim 2, in any one of claims 3, wherein the control device and the reception control device, the vehicle collision by the frequency analyzing acoustic signals received wave by claim 4 and claim 5 parametric array according sound, detecting an abnormality such as an accident by by detecting the characteristic frequency spectrum pattern to road traffic on the abnormal waves such as a vehicle accident of creaking sound, etc. of explosion sound and the wheels, report to the recording and the traffic control center or the like, road conditions

monitoring device is characterized in that the information display device to the attention displayed in the subsequent vehicle.

7. In claim 6, the control device after limiting the frequency band of the road traffic on abnormal waves generated in a vehicle accident or the like by one or more band-pass filter a receive acoustic signals, the abnormal sound is registered in advance detecting an abnormality of an accident such as by comparing the signal waveform, recording and traffic control Problem to center or the like, the information display device to the road condition monitoring apparatus characterized in that to the attention displayed on subsequent vehicles.

8. Method according to claim 7, the control unit will record and store the frequency pattern of the received wave an acoustic signal, by utilizing the data, road condition monitoring apparatus which is characterized in that to enable more accurate abnormality detection.

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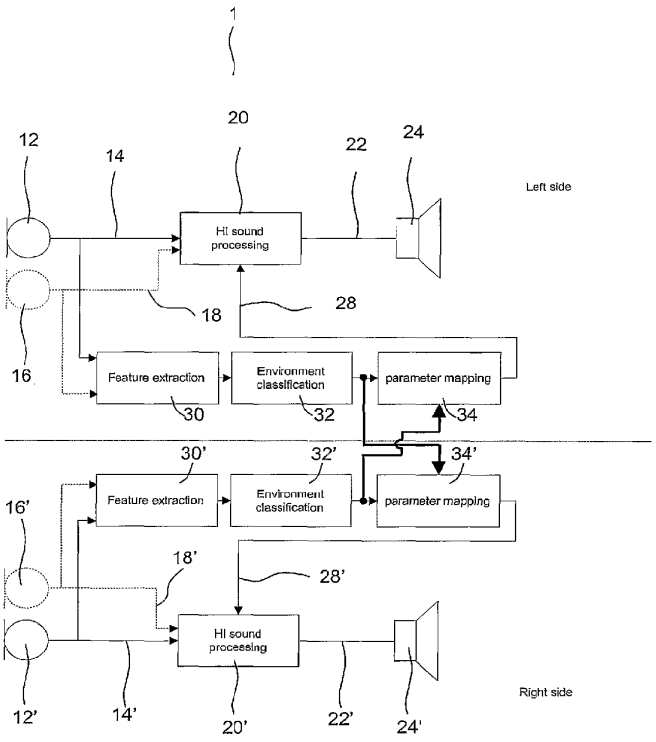
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[Continued on next page]

(54) Title: A BINAURAL HEARING AID SYSTEM WITH COORDINATED SOUND PROCESSING



(57) Abstract: The present invention relates to a binaural hearing aid system comprising a first hearing aid and a second hearing aid, each of which comprises a microphone and an A/D converter for provision of a digital input signal in response to sound signals received at the respective microphone in a sound environment, a processor that is adapted to process the digital input signals in accordance with a predetermined signal processing algorithm to generate a processed output signal, and a D/A converter and an output transducer for conversion of the respective processed sound signal to an acoustic output signal, and a binaural sound environment detector for binaural determination of the sound environment surrounding a user of the binaural hearing aid system based on at least one signal from the first hearing aid and at least one signal from the second hearing aid for provision of outputs for each of the first and second hearing aids for selection of the signal processing algorithm of each of the respective hearing aid processors so that the hearing aids of the binaural hearing aid system perform coordinated sound processing.

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A BINAURAL HEARING AID SYSTEM WITH COORDINATED SOUND PROCESSING

FIELD OF THE INVENTION

The present invention relates to a binaural hearing aid system with a first hearing aid and a second hearing aid, each of which comprises a microphone, an A/D converter for provision of a digital input signal in response to sound signals received at the respective microphone in a sound environment, a processor that is adapted to process the digital input signals in accordance with a predetermined signal processing algorithm to generate a processed output signal, and a D/A converter and an output transducer for conversion of the respective processed sound signal to an acoustic output signal.

BACKGROUND OF THE INVENTION

Today's conventional hearing aids typically comprise a Digital Signal Processor (DSP) for processing of sound received by the hearing aid for compensation of the user's hearing loss. As is well known in the art, the processing of the DSP is controlled by a signal processing algorithm having various parameters for adjustment of the actual signal processing performed. The gains in each of the frequency channels of a multi-channel hearing aid are examples of such parameters.

The flexibility of the DSP is often utilized to provide a plurality of different algorithms and/or a plurality of sets of parameters of a specific algorithm. For example, various algorithms may be provided for noise suppression, i.e. attenuation of undesired signals and amplification of desired signals. Desired signals are usually speech or music, and undesired signals can be background speech, restaurant clatter, music (when speech is the desired signal), traffic noise, etc.

The different algorithms or parameter sets are typically included to provide comfortable and intelligible reproduced sound quality in different sound environments, such as speech, babble speech, restaurant clatter, music, traffic noise, etc. Audio signals obtained from different sound environments may possess very different characteristics, e.g. average and maximum sound pressure levels (SPLs) and/or frequency content. Therefore, in a hearing aid with a DSP, each type of sound environment may be associated with a particular program wherein a particular setting of algorithm parameters of a signal processing algorithm provides processed sound of optimum signal quality in a specific sound environment. A set of such parameters may typically include parameters related to broadband gain, corner frequencies or slopes of frequency-selective filter algorithms and

parameters controlling e.g. knee-points and compression ratios of Automatic Gain Control (AGC) algorithms.

Consequently, today's DSP based hearing instruments are usually provided with a number of different programs, each program tailored to a particular sound environment category and/or particular user preferences. Signal processing characteristics of each of these programs is typically determined during an initial fitting session in a dispenser's office and programmed into the instrument by activating corresponding algorithms and algorithm parameters in a non-volatile memory area of the hearing aid and/or transmitting corresponding algorithms and algorithm parameters to the non-volatile memory area.

Some known hearing aids are capable of automatically classifying the user's sound environment into one of a number of relevant or typical everyday sound environment categories, such as speech, babble speech, restaurant clatter, music, traffic noise, etc.

Obtained classification results may be utilised in the hearing aid to automatically select signal processing characteristics of the hearing aid, e.g. to automatically switch to the most suitable algorithm for the environment in question. Such a hearing aid will be able to maintain optimum sound quality and/or speech intelligibility for the individual hearing aid user in various sound environments.

US 5,687,241 discloses a multi-channel DSP based hearing instrument that utilises continuous determination or calculation of one or several percentile values of input signal amplitude distributions to discriminate between speech and noise input signals. Gain values in each of a number of frequency channels are adjusted in response to detected levels of speech and noise.

However, it is often desirable to provide a more subtle characterization of a sound environment than only discriminating between speech and noise. As an example, it may be desirable to switch between an omni-directional and a directional microphone preset program in dependence of, not just the level of background noise, but also on further signal characteristics of this background noise. In situations where the user of the hearing aid communicates with another individual in the presence of the background noise, it would be beneficial to be able to identify and classify the type of background noise. Omni-directional operation could be selected in the event that the noise being traffic noise to allow the user to clearly hear approaching traffic independent of its direction of arrival. If, on the other hand, the background noise was classified as being babble-noise, the directional listening program could be selected to allow the user to hear a target speech signal with improved signal-to-noise ratio (SNR) during a conversation.

Applying Hidden Markov Models for analysis and classification of the microphone signal may obtain a detailed characterisation of e.g. a microphone signal. Hidden Markov Models are capable of modelling stochastic and non-stationary signals in terms of both short and long time temporal variations. Hidden Markov Models have been applied in speech recognition as a tool for modelling statistical properties of speech signals. The article "A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition", published in Proceedings of the IEEE, VOL 77, No. 2, February 1989 contains a comprehensive description of the application of Hidden Markov Models to problems in speech recognition.

WO 01/76321 discloses a hearing aid that provides automatic identification or classification of a sound environment by applying one or several predetermined Hidden Markov Models to process acoustic signals obtained from the listening environment. The hearing aid may utilise determined classification results to control parameter values of a signal processing algorithm or to control switching between different algorithms so as to optimally adapt the signal processing of the hearing aid to a given sound environment.

The different available signal processing algorithms may change the signal characteristics significantly. In binaural hearing aid systems, it is therefore important that the determination of sound environment does not differ for the two hearing aids. However, since sound characteristics may differ significantly at the two ears of a user, it will often occur that sound environment determination at the two ears of a user differs, and this leads to undesired different signal processing of sounds for each of the ears of the user.

SUMMARY OF THE INVENTION

Thus, there is a need for a binaural hearing aid system wherein sound environment determination does not differ for the two hearing aids so that signal processing in the two hearing aids may be coordinated and the user be provided with desired processed sound in both ears at the same time.

According to the present invention, this and other objects are solved by provision of a binaural hearing aid system of the above-mentioned type wherein the hearing aids are connected either by wire or by a wireless link to at least one binaural sound environment detector for binaural determination of the sound environment surrounding a user of the binaural hearing aid system based on at least one signal from the first hearing aid and at least one signal from the second hearing aid whereby the sound environment is determined and classified based on binaural signals. The one or more binaural sound environment detectors provide outputs for each of the first and second hearing aids for selection of the

signal processing algorithm of each of the hearing aid processors so that the hearing aids of the binaural hearing aid system perform coordinated sound processing.

In this way both hearing aids may process sound in response to a common determination of sound environment. Sound environment determination may be performed by one common environment detector, for example situated in one of the hearing aids or in a remote control, or, by a plurality of environment detectors, such as an environment detector in each of the first and second hearing aids.

In the event that the user has substantially the same hearing loss in both ears and the sound environment is omni-directional, i.e. the sound environment does not change with direction, coordination of sound processing in the hearing aids leads to execution of identical signal processing algorithms in the respective signal processors of the hearing aids. In the event that the hearing aid user suffers from a binaural hearing loss, the signal processing algorithms may desirably differ for compensation of the different binaural hearing losses.

It is an important advantage of the present invention that binaural sound environment detection is more accurate than monaural detection since signals from both ears are taken into account.

It is a further advantage of the present invention that signal processing in the hearing aids of the binaural hearing aid system is coordinated since the sound environment detection is the same for both hearing aids.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 illustrates schematically a prior art monaural hearing aid with sound environment classification,

Fig. 2 illustrates schematically a first embodiment of the present invention,

Fig. 3 illustrates schematically a second embodiment of the present invention,

Fig. 4 illustrates schematically a third embodiment of the present invention, and

Fig. 5 illustrates schematically a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 illustrates schematically a prior art monaural hearing aid 10 with sound environment classification.

The monaural hearing aid 10 comprises a first microphone 12 and a first A/D converter (not shown) for provision of a digital input signal 14 in response to sound signals received at the microphone 12 in a sound environment, and a second microphone 16 and a second A/D converter (not shown) for provision of a digital input signal 18 in response to sound signals received at the microphone 16, a processor 20 that is adapted to process the digital input signals 14, 18 in accordance with a predetermined signal processing algorithm to generate a processed output signal 22, and a D/A converter (not shown) and an output transducer 24 for conversion of the respective processed sound signal 22 to an acoustic output signal.

The hearing aid 10 further comprises a sound environment detector 26 for determination of the sound environment surrounding a user of the hearing aid 10. The determination is based on the output signals of the microphones 12, 16. Based on the determination, the sound environment detector 26 provides outputs 28 to the hearing aid processor 20 for selection of the signal processing algorithm appropriate in the determined sound environment. Thus, the hearing aid processor 20 is automatically switched to the most suitable algorithm for the determined environment whereby optimum sound quality and/or speech intelligibility is maintained in various sound environments.

The signal processing algorithms of the processor 20 may perform various forms of noise reduction and dynamic range compression as well as a range of other signal processing tasks.

The sound environment detector 26 comprises a feature extractor 30 for determination of characteristic parameters of the received sound signals. The feature extractor 30 maps the unprocessed sound inputs 14, 18 sound features, i.e. the characteristic parameters. These features can be signal power, spectral data and other well-known features.

The sound environment detector 26 further comprises an environment classifier 32 for categorizing the sound environment based on the determined characteristic parameters. The environment classifier categorizes the sounds into a number of environmental classes, such as speech, babble speech, restaurant clatter, music, traffic noise, etc. The classification process may consist of a simple nearest neighbour search, a neural network, a Hidden Markov Model system or another system capable of pattern recognition. The output of the environmental classification can be a "hard" classification containing one

single environmental class or a set of probabilities indicating the probabilities of the sound belonging to the respective classes. Other outputs may also be applicable.

The sound environment detector 26 further comprises a parameter map 34 for the provision of outputs 28 for selection of the signal processing algorithms.

The parameter map 34 maps the output of the environment classification 32 to a set of parameters for the hearing aid sound processor 20. Examples of such parameters are amount of noise reduction, amount of gain and amount of HF gain. Other parameters may be included.

Figs. 2-5 illustrate various preferred embodiments of the present invention. The illustrated binaural hearing aid system 1 comprises a first hearing aid 10 and a second hearing aid 10', each of which comprises a first microphone 12, 12 ' and an A/D converter (not shown) and a second microphone 16, 16' and A/D converter (not shown) for provision of a digital input signals 14, 14', 18, 18' in response to sound signals received at the respective microphones 12, 12', 16, 16' in a sound environment, a processor 20, 20' that is adapted to process the digital input signals 14, 18, 14', 18' in accordance with a predetermined signal processing algorithm to generate a processed output signal 22, 22', and a D/A converter (not shown) and an output transducer 24, 24' for conversion of the respective processed sound signals 22, 22' to an acoustic output signal

In the embodiments illustrated in Figs. 2-4, each of the hearing aids 10, 10' of the binaural hearing aid system 1 further comprises a binaural sound environment detector 26, 26' for determination of the sound environment surrounding a user of the binaural hearing aid system 1. The determination is based on the output signals of the microphones 12, 12', 16, 16'. Based on the determination, the binaural sound environment detector 26, 26' provides outputs 28, 28' to the hearing aid processors 20, 20' for selection of the signal processing algorithm appropriate in the determined sound environment. Thus, the binaural sound environment detectors 26, 26' determines the sound environment based on signals from both hearing aids, i.e. binaurally, whereby hearing aid processors 20, 20' is automatically switched in co-ordination to the most suitable algorithm for the determined environment whereby optimum sound quality and/or speech intelligibility is maintained in various sound environments by the binaural hearing aid system 1.

The binaural sound environment detectors 26, 26' illustrated in Figs. 2-4 are both similar to the binaural sound environment detector shown in Fig. 1 apart from the fact that the monaural environment detector only receives inputs from one hearing aid while each of the binaural sound environment detectors 26, 26' receives inputs from both hearing aids. Thus,

according to the present invention, signals are transmitted between the hearing aids 10, 10' so that the algorithms executed by the signal processors 20, 20' are selected in co-ordination, e.g. in case of an omni-directional sound environment, i.e. the sound environment does not change with direction, the algorithms are selected to be identical apart from possible differences in hearing loss compensation of the two ears.

In the embodiment of Fig. 2, the unprocessed signals 14, 14', 18, 18' from the microphones 12, 12', 16, 16' of one hearing aid 10, 10' are transmitted to the other hearing aid and inputted to the respective feature extractor 30, 30'. Thus, feature extraction in each of the hearing aids is based on the identical four input signals so that identical sound environment characteristic parameters will be determined binaurally in both hearing aids 10, 10'.

The signals may be transmitted in analogue form or in digital form, and the communication channel may be wired or wireless.

In the embodiment shown in Fig. 3, the output 36, 36' of the feature extractor 30, 30' of one hearing aid 10, 10' is transmitted to the respective other hearing aid 10', 10. The environment classifier 32, 32' then operates on two sets of features 36, 36' to determine the environment. Since both environment classifiers 32, 32' receive the same data, they will produce the same output.

In the embodiment shown in Fig. 4, the output 38, 38' of the environment classifier 32, 32' of one hearing aid 10, 10' is transmitted to the respective other hearing aid 10, 10'. The parameter map 34, 34' then operates on two inputs 38, 38' to produce the parameters for the processor algorithms, but since both parameter mapping units 34, 34' receive identical inputs, identical parameter values will be produced.

This embodiment has a number of advantages: Usually classification systems take both past and present data into account – they have memory. This makes them sensitive to missing data, since a classification requires a complete data set. Therefore it is required that the data link is safe, in the sense that data is guaranteed to be transmitted. The parameter mapping can be implemented without memory so that only present data is taken into account when generating parameters. This makes the system robust to packet loss and latency, since the parameter mapping may simply re-use old data in the event that data is missing. This will of course delay the correct action, but to the user the systems will appear to be synchronized.

The transmission data rate is low, since only a set of probabilities or logic values for the environment classes has to be transmitted.

Rather high latency can be accepted. By applying time constants to the variables that will change according to the output of the parameter mapping it is possible to smooth out any differences that is caused by latency. As described earlier it is important that signal processing in the two hearing instruments is coordinated. However if transition periods of a few seconds are allowed the system can operate with only 3-4 transmissions per second. Hereby, power consumption is kept low.

A binaural hearing aid system 1 with a remote control 40 is shown in Fig. 5. The environment detector 26 is positioned in the remote control 40. The required signals are transmitted to and from both hearing aids.

CLAIMS

1. A binaural hearing aid system comprising

a first hearing aid and a second hearing aid, each of which comprises

a microphone and an A/D converter for provision of a digital input signal in response to sound signals received at the respective microphone in a sound environment,

a processor that is adapted to process the digital input signals in accordance with a predetermined signal processing algorithm to generate a processed output signal, and

a D/A converter and an output transducer for conversion of the respective processed sound signal to an acoustic output signal, and

a binaural sound environment detector for binaural determination of the sound environment surrounding a user of the binaural hearing aid system based on at least one signal from the first hearing aid and at least one signal from the second hearing aid for provision of outputs for each of the first and second hearing aids for selection of the signal processing algorithm of each of the respective hearing aid processors so that the hearing aids of the binaural hearing aid system perform coordinated sound processing.

2. A system according to claim 1, wherein the binaural sound environment detector having inputs for each of the digital input signals is provided in a remote control of the system.

3. A system according to claim 1, wherein the binaural sound environment detector is provided in one of the hearing aids and provides an output for the other hearing aid.

4. A system according to claim 1, wherein each of the hearing aids comprises a binaural sound environment detector.

5. A system according to any of the preceding claims, wherein the binaural sound environment detector comprises

a feature extractor for determination of characteristic parameters of the received sound signals,

an environment classifier for categorizing the sound environment based on the determined characteristic parameters, and

a parameter map for the provision of outputs for selection of the signal processing algorithms.

6. A system according to claim 4 and 5, wherein each of the feature extractors has inputs for each of the digital input signals.

7. A system according to claim 4 and 5, wherein each of the environment classifiers has inputs connected to each of the feature extractors.

8. A system according to claim 4 and 5, wherein each of the parameter maps has inputs for connected to each of the environment classifiers.

1/5

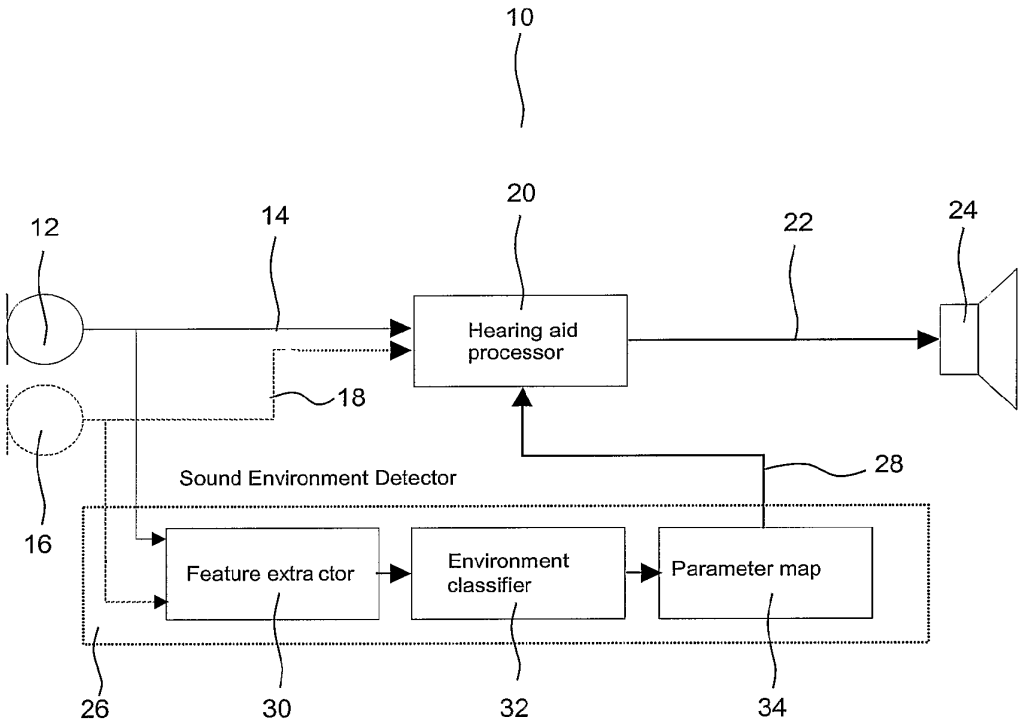

10
12
14
20
22
24
Hearing aid processor
18
16
Sound Environment Detector
28
Feature extra ctor
Environment classifier
Parameter map
26
30
32
34

Fig. 1

2/5

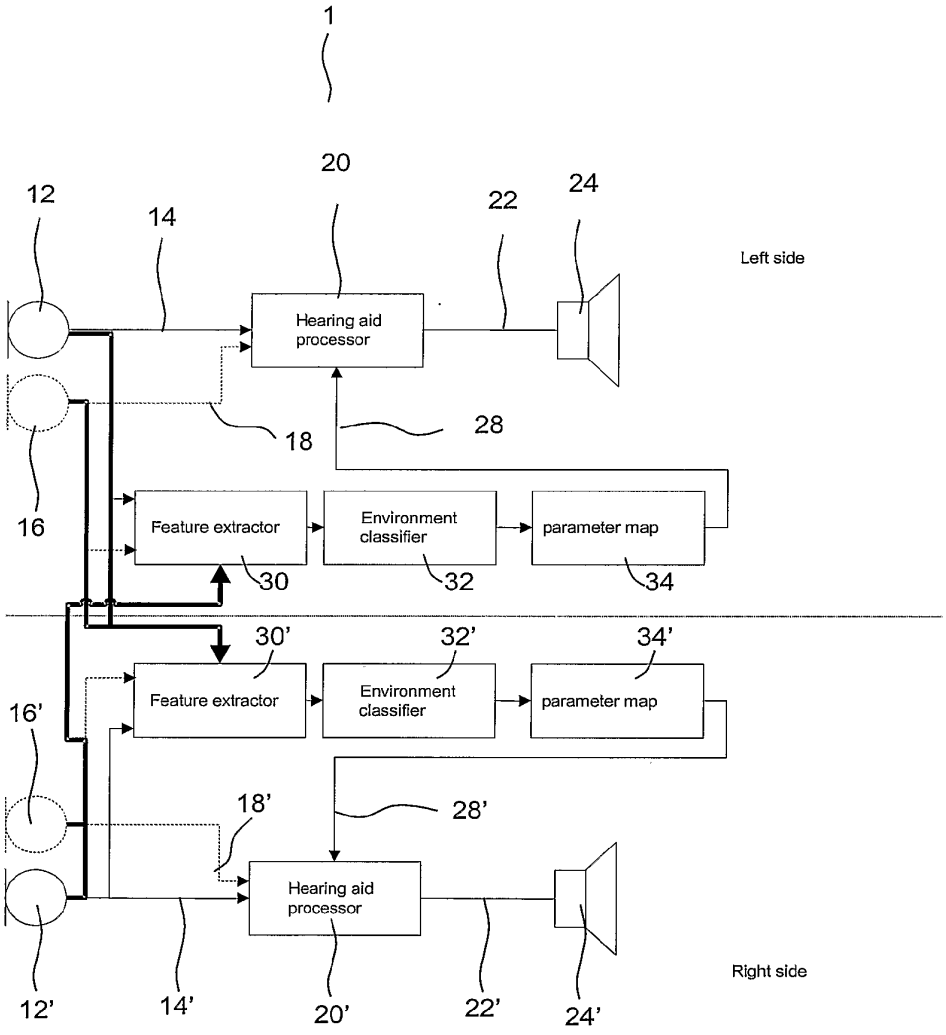

1
20
12
14
22
24
Left side
Hearing aid processor
18
28
16
Feature extractor
Environment classifier
parameter map
30
32
34
30'
32'
34'
Feature extractor
Environment classifier
parameter map
16'
18'
28'
Hearing aid processor
12'
14'
20'
22'
24'
Right side

Fig. 2

3/5

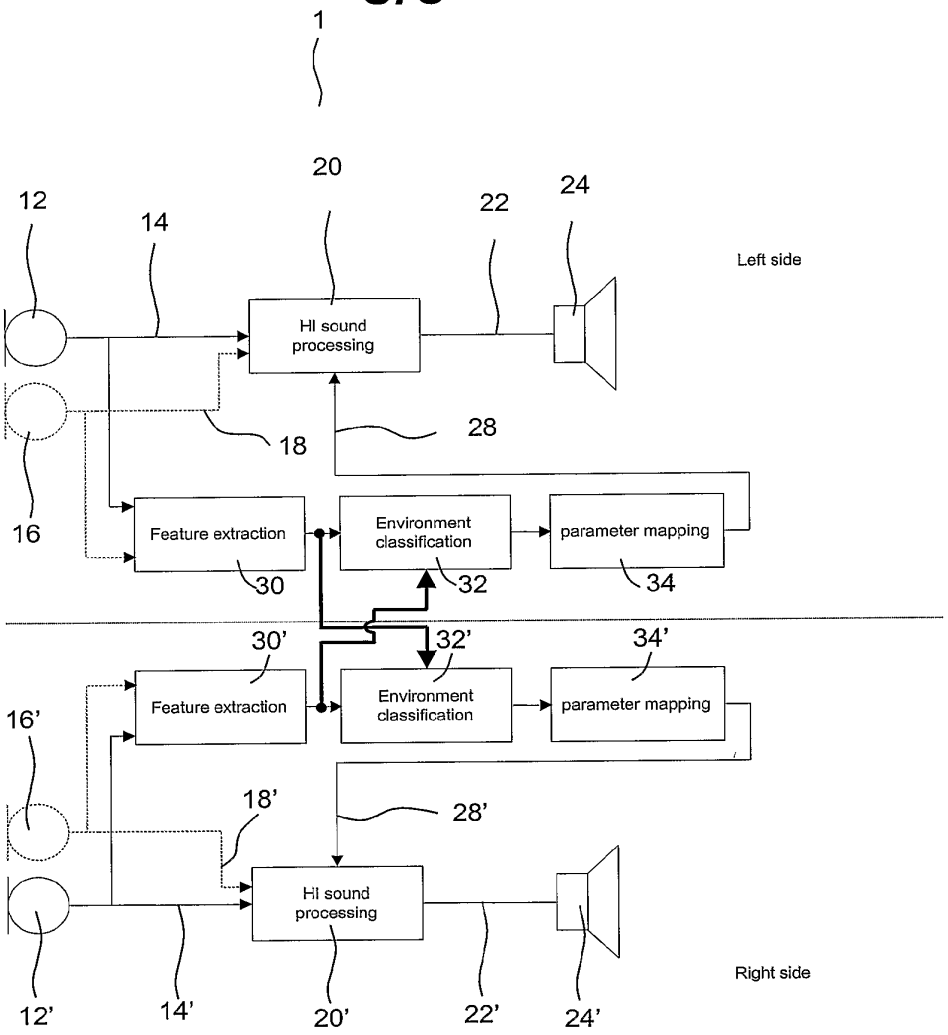

1
20
12
14
22
24
Left side
HI sound processing
18
28
16
Feature extraction
Environment classification
parameter mapping
30
32
34
30'
32'
34'
16'
Feature extraction
Environment classification
parameter mapping
18'
28'
HI sound processing
Right side
12'
14'
20'
22'
24'

Fig. 3

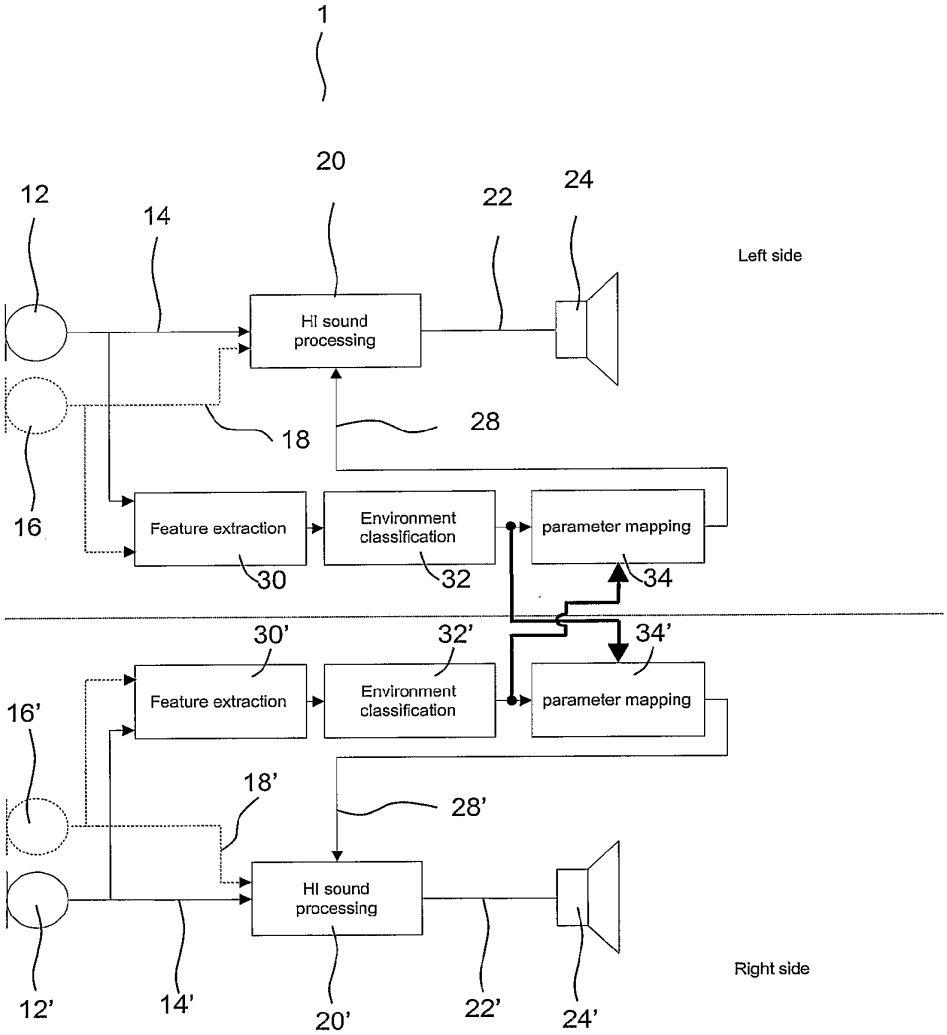

1
20
12
14
22
24
Left side
HI sound processing
18
28
16
Feature extraction
Environment classification
parameter mapping
30
32
34
30'
32'
34'
16'
Feature extraction
Environment classification
parameter mapping
18'
28'
HI sound processing
12'
14'
20'
22'
24'
Right side

Fig. 4

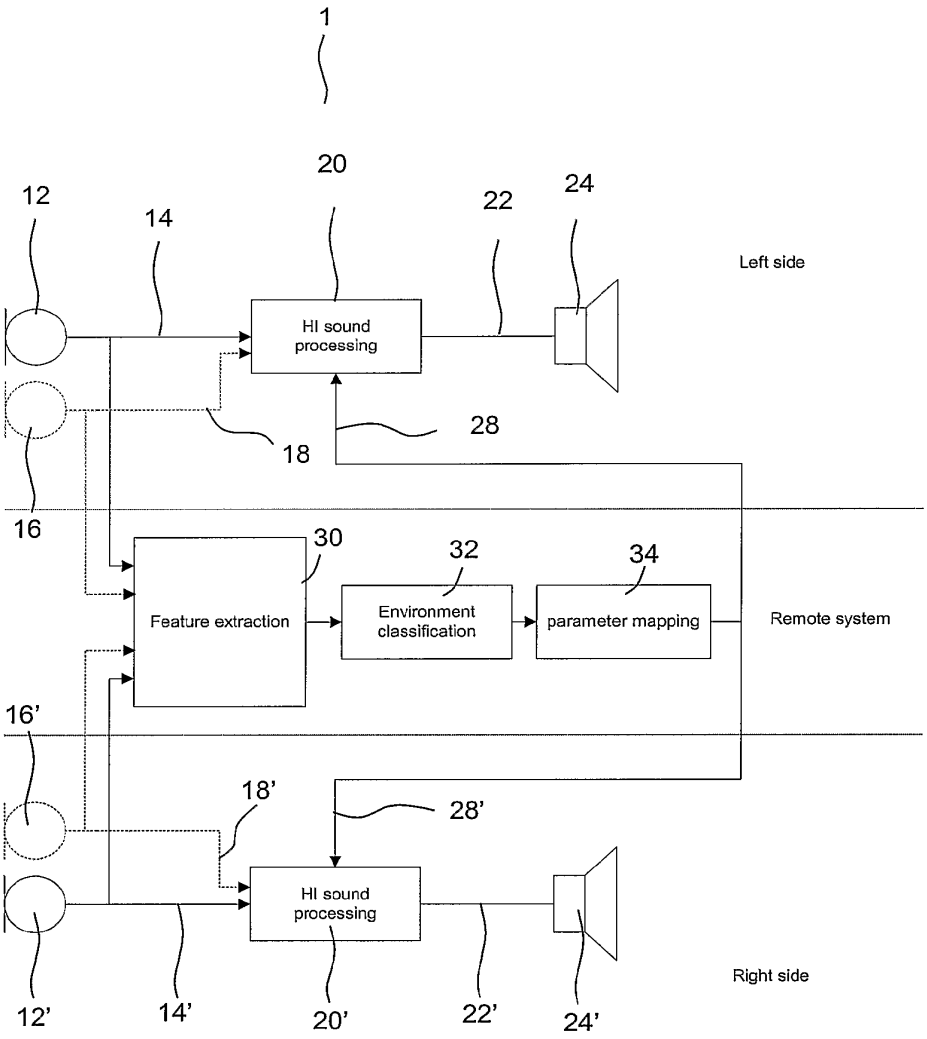

1
20
12
14
22
24
Left side
HI sound processing
28
18
16
30
32
34
Feature extraction
Environment classification
parameter mapping
Remote system
16'
18'
28'
HI sound processing
12'
14'
20'
22'
24'
Right side

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000442

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04R25/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 5 757 932 A (BISGAARD NIKOLAI ET AL) 26 May 1998 (1998-05-26) the whole document	1-8
A	US 6 549 633 B1 (WESTERMANN SOEREN ERIK) 15 April 2003 (2003-04-15) the whole document	1-8
A	US 2002/037087 A1 (ALLEGRO SYLVIA ET AL) 28 March 2002 (2002-03-28) the whole document	5
A	WO 02/32208 A (PHONAK AG ; ALLEGRO SILVIA (CH)) 25 April 2002 (2002-04-25)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
9 November 2004	18/11/2004

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/DK2004/000442

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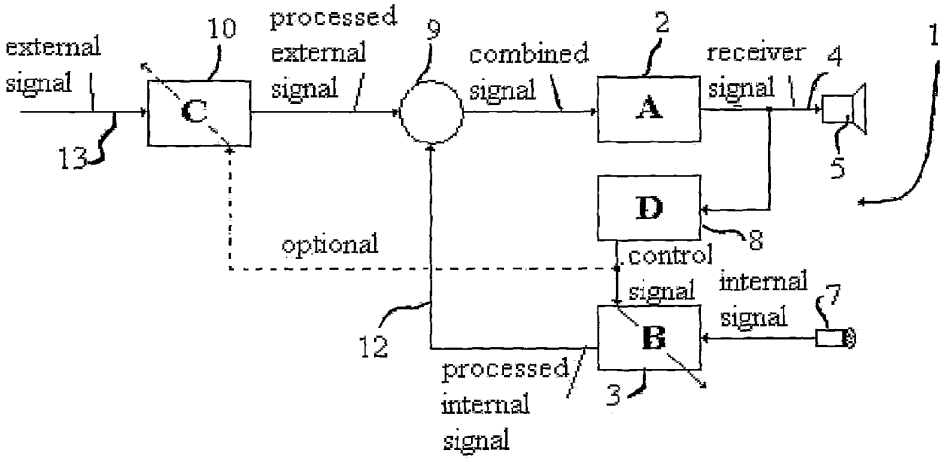
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Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ACOUSTICALLY TRANSPARENT OCCLUSION REDUCTION SYSTEM AND METHOD



(57) Abstract: A system and method that reduces the perceptual effect resulting from ear occlusion is disclosed. It comprises of an electro-acoustic feedback network that produces phase cancelling sounds in the ear, where a receiver and a microphone are located. A novel control mechanism is disclosed that controls the response of the feedback network to minimise distortion in the ear while maintaining a desired frequency response for external signals. Devices producing the external signal include hearing aids, personal sound devices, in ear monitors, communications headsets and hearing protectors. The integration of the present invention with these devices improves the user's perception of their own voice.

WO 2006/037156 A1

Acoustically Transparent Occlusion Reduction System and Method

Field of Invention

The present invention relates to an improved occlusion reduction system for applications such as hearing aids, personal sound devices, in ear monitors, communications headsets and hearing protection devices.

Description of Background Art

An electro-acoustic negative feedback scheme was originally presented by H.F Olson, in 1961 in U.S Patent No 2,983,790. A more comprehensive implementation was later proposed by Bose et al, in 1982 in U.S Patent No 4,494,074 under the title "Feedback Control". Using headphones, Bose proposed the idea of an electro-acoustic feedback in the proximity of the ear canal. The concept was later used by Langberg et al, in 1988 in U.S. Patent No 4,985,925, describing a system functioning as a bilateral transducer drive with a shunt feedback correction network. Later on in 1991, Langberg et al, in U.S Patent No. 5,267,321 entitled "Active Sound Absorption" describes an electro-acoustical feedback system, with the receiver acting as both a diaphragm actuator and motion sensor. In 1996, U.S Patent No. 5,774,565 to Benning et al describes an electro-acoustic feedback subsystem with oscillation prevention circuit in the forward path of the loop. In 2002, U.S Patent Application No. 2003/0012391 A1 to Armstrong et al, entitled "Digital Hearing Aids System" discloses a hearing aid including an occlusion processing subsystem.

The occlusion effect is commonly described as a hollow or echoing like sound of a person's own voice. The occlusion effect results from acoustically sealing or partially sealing the ear, or to a greater effect sealing or partially sealing the ear canal from the external acoustic environment. As a result, the occlusion effect creates discomfort and/or an unnatural sound sensation. This problem is commonly reported to clinicians in the

hearing aid industry as it affects a large number of hearing aid wearers (those with mild low-frequency hearing loss). Until now, there were at least two common schemes to decrease the occlusion effect in hearing aids, either using a vent or by increasing the insertion depth of the earmold into the ear canal. To restore naturalness of a hearing aid wearer's voice, vents of up to 3.5 mm in diameter may be employed. These vents need to be sufficiently large so that the residual sound pressure in the canal due to the occlusion effect is not significant. On the other hand, a sufficiently large vent limits the hearing aid amplification due to oscillations created by positive feedback occurring around the loop defined by an external microphone, amplifier, receiver, and path through the vent back to the external microphone.

The soft tissue in the ear canal is excited by vibration energy propagated by the skull and jaw due to the wearer's voice and this results in an increased sound pressure within the occluded of partially occluded ear relative to an open ear. Another solution is to insert the earmold further into the ear canal to fill the cartilaginous portion of the canal and hence reduce the occlusion effect at its source. However there are a number of practical problems relating to the deep insertion of an earmold, for instance physical discomfort.

While some of the aforementioned patents include methods to alter the response of the electro-acoustic feedback system, none of these patents incorporate methods to compensate for the effect that response alteration within the feedback system has on external signals such as from an external microphone or hearing aid processor. In addition, the aforementioned patents do not provide a mechanism to prevent the receiver from overloading by sensing the level of signal at the optimum point, being the input to the receiver.

Summary of Invention

It is an object of the present invention to provide an improved occlusion reduction system for applications such as hearing aids, personal sound devices, in ear monitors, communications headsets and hearing protection devices.

In accordance with a first aspect of the present invention, there is provided an electro-acoustic system comprising of: an electro-acoustic circuit including a negative-feedback loop comprising of: a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear; a second electronic circuit, (B) for modifying the internal signal to produce a processed internal signal; a combiner for combining the processed internal signal with a processed external signal to produce a combined signal; a first electronic circuit (A), for modifying the combined signal to produce an receiver signal; and a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear; a third electronic circuit (C) for modifying an external signal such as from an external microphone or hearing aid processor to produce an external processed signal; a fourth electronic circuit (D), for estimating the level of the receiver signal optimally from the receiver signal and producing a control signal; wherein the processing performed by the second electronic circuit (B) preferably is controlled by the control signal.

The negative-feedback loop preferably can include a filter that alters the open loop response so that the real component of the response is large and negative at frequencies where the occlusion effect can be typically the greatest. Consequently reducing all signals introduced into the closed loop within this frequency range.

The third electronic circuit (C) preferably can include filtering that provides compensation for the closed loop response of the negative-feedback loop.

Optionally the filtering provided by the third electronic circuit (C) adapts to compensate for changes in the closed response of the negative-feedback loop.

Optionally the control signal can control the response of the first electronic circuit (A) while controlling the response of the third electronic circuit (C).

The microphone for generating the internal signal optionally can be coupled to the occluded or partially occluded ear by a tube. The receiver optionally can be coupled to the occluded or partially occluded ear by a tube. The microphone and receiver optionally can be combined in a single unit or jointly coupled to the occluded or partially occluded ear by a common tube. At least one of the electronic circuits can be implemented digitally. At least one of the digital electronic circuits can performed signal processing at a sampling rate at least four times that of the bandwidth of the signal.

In accordance with a further aspect of the present invention, there is provided an electro-acoustic system including a negative-feedback loop comprising of: a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear; a second electronic circuit (B) for modifying the internal signal to produce a processed internal signal; a combiner for combining the processed internal signal with a processed external signal to produce a combined signal; a first electronic circuit (A) for modifying the combined signal to produce a receiver signal; and a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear; a third electronic circuit (C) for modifying an external signal such as from external microphone to produce a processed external signal; a fourth electronic circuit (D) for estimating the level of the receiver signal and producing a control signal from this estimate; wherein the control signal controls the processing performed by the second

electronic circuit (B) and controls the processing performed by the third electronic circuit (C).

In accordance with a further aspect of the present invention, there is provided an electro-acoustic system including a negative-feedback loop comprising of: a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear; a second electronic circuit (B) for modifying the internal signal to produce a processed internal signal; a combiner for combining the processed internal signal with a processed external signal to produce a combined signal; a first electronic circuit (A) for modifying the combined signal to produce a receiver signal; and a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear; a third electronic circuit (C) for modifying an external signal to produce a processed external signal; a fourth electronic circuit (D) for estimating the level of the receiver signal and producing a control signal from this estimate; wherein the control signal controls the processing performed by first electronic circuit (A) and controls the processing performed by the third electronic circuit (C).

In accordance with a further aspect of the present invention, there is provided a method of providing a negative feedback loop for an electro-acoustic system, the method including the steps of: (a) generating an internal signal representing an acoustical signal located within or closely coupled to an occluded or partially occluded ear; (b) modifying the internal signal to produce a processed internal signal; (c) combining the processed internal signal with a processed external signal to produce a combined signal; (d) modifying the combined signal to produce a receiver signal; (e) generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear; (f) modifying an external signal to produce a processed external

signal; (g) estimating the level of the receiver signal either directly from the receiver signal or from the combined signal and producing a control signal from this estimate; wherein the degree of modification in step (b) is controlled by the control signal. The control signal can be utilised to control the amount of modification occurring in step (f).

In any of the aforementioned aspects of the present invention the fourth electronic circuit (D) optionally produces a control signal using estimates of the signal levels from the internal signal or the processed internal signal and the receiver signal or the combined signal.

Brief Description of the Drawings

Preferred embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of the occlusion reduction scheme of the preferred embodiment;

Fig. 2 is a schematic diagram of an analog electronic circuit for the electro-acoustic negative feedback loop;

Fig. 3 is a schematic diagram of an analog adaptive pre-compensation electronic circuit;

Fig. 4 is a schematic diagram of an analog level estimator and control signal generation electronic circuit;

Fig. 5 is a schematic diagram of a digital implementation of the occlusion reduction scheme;

Fig. 6 is a schematic diagram of an adaptive IIR filter;

Fig. 7 is a schematic diagram of a level estimator and control signal generator ;

Fig. 8 is a graph of the simulated closed loop response in a Zwislocki coupler;

Fig. 9 is a graph of the measured response of the effective gain reduction inside a real ear;

Fig. 10 is a graph of the measured responses from an external signal to a Zwislocki coupler microphone; and

Fig. 11 is an illustration of the occlusion reduction scheme implemented as an in-the-canal hearing aid device.

Detail Description of the Preferred and Other Embodiments

The preferred embodiment operates to reduce the level of signals generated within an electro-acoustic negative feedback loop, such as signals produced by vibration in the ear canal walls due to bone conduction of a user's voice. The reduction occurs in the low to mid audible frequencies, typically ranging from 80 Hz up to 1 kHz, where the occlusion effect is more predominant and perceptually apparent.

A negative feedback scheme is provided which combines a processed externally generated signal such as from an external microphone or a sound system with a processed internal signal such as from a microphone located within or closely coupled to the occluded or partially occluded ear. The combined signal after optional further processing is applied to a receiver located within or closely coupled to the occluded or partially occluded ear. The level of the signal to be applied to the receiver is optimally estimated either from the signal applied to the receiver or from the combined processed external and processed internal signals. Optionally this signal level can be estimated from signals at other points within the scheme. High signal levels applied to the receiver may produce a distorted output from the receiver. This distortion is reduced by applying active gain reduction in the feedback path in response to estimated high signal levels being present. Optionally low signal levels can be detected so that noise inherent in the negative feedback components such as the internal microphone can be minimised by

applying active gain reduction in the feedback path. Thus, the high and the low signal level thresholds for gain reduction in the loop can depend on the dynamic operational range of the discrete components within the system. In addition, an adaptive equalisation filter is applied to the external signal to compensate for variations of the transfer response of the closed loop.

The preferred embodiment includes of a microphone to sense the sound pressure in the ear. The preferred embodiment also includes a novel design of estimating the level of the signal to be applied to the receiver and reducing the gain in the feedback path of the loop when this level is high. This mechanism effectively improves the robustness of the closed loop system by limiting excessive driving levels being applied to the receiver. A filter within the feedback path of the loop yields the necessary phase and gain around the loop to generate a phase cancelling sound in the ear without creating acoustic feedback. This negative feedback response also causes a sound pressure reduction for external signals thus affecting the response from the external processed signal to the receiver signal. As a result, an adaptive pre-compensation filter is provided. The adaptive pre-compensation filter performs adaptive equalisation to maintain a constant frequency response between the external signal and the receiver signal in response to changes in loop response.

In addition, the negative feedback response also causes a reduction in external sounds transmitted through a vent or leakage, thus minimising both effects.

Referring initially to **Fig. 1**, a schematic diagram 1 illustrates the occlusion reduction scheme of the preferred embodiment. This electronic circuit can be encapsulated in an earmold 100 as discussed hereinafter with reference to **Fig. 11**. The earmold optionally contains tubing for coupling the receiver to the ear. The earmold optionally contains tubing for coupling the internal microphone to the ear. The

microphone and receiver optionally can be combined into a single unit or jointly coupled to the occluded or partially occluded ear by a common tube. Optionally these tubes can be protected from wax blockage using wax guards. The lengths of these tubes are preferably as short as possible to minimise delays around the feedback loop, but can be any length. The earmold can optionally contain an open vent to depressurise the ear thus reducing the sensation of stuffiness in the ear. Optionally, the vent can be fitted with an acoustic damper for compensating for the vent resonance that may affect the closed loop response.

The internal signal from an internal microphone 7 is proportional to the ear canal sound pressure. This internal signal is filtered in a feedback loop shown as first electronic circuit **(A)** 2 and second electronic circuit (**B) 3** to produce the receiver signal 4 output to the receiver 5. The aim is to produce cancellation around the loop, limited to a given low to mid frequency band.

An analog implementation of the occlusion reduction scheme is depicted in **Figs. 2-4** and a digital implementation is shown in **Figs. 5-7**.

In addition, **Fig. 1** shows fourth electronic circuit (D) 8 that estimates the level of the receiver signal to produce a control signal. Optionally the input to the fourth electronic circuit (D) 8 can be obtained from the output of a combiner 9 with appropriate compensation for the effects of the first electronic circuit (A) 2. The response of the negative feedback loop is controlled by the control signal. The estimated level of the receive signal 4 can be compared to a reference level which is not shown in this figure. The control signal reduces the gain in the loop as the level of the receive signal increases above the reference level. The reference level is set to a level to minimise distortion occurring within the loop.

The combined signal within the loop results from a combination 9 of processed internal signal 12 and processed external signal. The processed external signal results from a filtered external signal 13. The pre-compensation filter 10 depicted as the third electronic circuit **(C)** 10 in **Fig. 1**, equalises the magnitude of the transfer function from the external signal 13 to the receiver signal 4 so that it is approximately constant across frequency, assuming a fixed closed loop response. Optionally, the filter in the third electronic circuit (C) 10 is adaptively controlled by fourth electronic circuit (D) 8 so that the magnitude of the transfer function from the external signal 13 to the receiver signal 4 is approximately constant across frequency regardless of changes in the closed loop response.

Optionally the fourth electronic circuit (D) uses estimates of signal levels from the receiver signal or combined signal and from the internal signal or processed internal signal to produce a control signal to control the loop response. This control signal can control the loop response by directly applying gain reduction to the first electronic circuit (A) or to the second electronic circuit (B). The control signal produce from this arrangement can be used in combination with the fixed or adaptive third electronic circuit (C).

Analog Implementation

Fig. 2, depicts an analog implementation 20 of the negative feedback loop of **Fig. 1**. Firstly, the internal signal is applied to a high pass filter 21 and lead-lag filter 22 in order to reduce effects from jaw movements and very low frequency instability in the loop. The equations for the transfer function in relation to the corresponding discrete components are shown below:

$$H_{HP}(j\omega) = \frac{j\omega \cdot R_1 C_2}{1 + j\omega \cdot R_1 \times C_1}$$

if $R_4 = R_5, C_2 = C_3$ then the lead lag transfer function equation is shown below

$$H_{Lead-Lag}(j\omega) = \frac{(R_3 + R_6) + j\omega \bullet C_2 \bullet (2R_3R_6 + R_6R_4 + R_3R_4)}{R_6 + j\omega \bullet C_2 \bullet (R_3R_6 + R_6R_4)}$$

The next filtering stage reduces the dominant transducer resonance within the loop and provides greater open loop gain at frequencies at which the occlusion effect is greatest. This is achieved by using a bi-quadratic filter 24, and placing a complex pair of zeros at the dominant transducer resonance frequency followed by a pair of real poles to provide low frequency emphasis in the open loop response.

In the arrangement of Fig. 2, if we allow $R_8 = R_{10}, C_4 = C_6$, $R_9 = R_{11}, C_5 = C_7$ and $R_{12} = R_{13}, C_8 = C_9$,then the biquadratic transfer function equation can be computed as follows

$$H_{bi-quad}(j\omega) = \frac{(j\omega)^2 C_4 R_9 C_5 + j\omega\left(C_4 + \frac{C_5 R_9}{R_8} - C_5\right) + \frac{1}{R_8}}{(j\omega)^2 C_5 R_9 C_8 + j\omega\left(\frac{C_5 R_9}{R_{12}} + C_8\right) + \frac{1}{R_{12}}}$$

To determine the pole zero placement, the biquadratic transfer function equation can be directly related to a well known second order transfer function equation.

$$K(j\omega) = \frac{(j\omega)^2 + 2\xi_z \omega_z j\omega + \omega_z^2}{(j\omega)^2 + 2\zeta_p \omega_p j\omega + \omega_p^2}$$

Where the ω_p and ω_z are the location of the pole and zero frequencies. Similarly ξ_z and ζ_p are the damping factors for the poles and zeros respectively. Thus, this relationship can be used to position the poles and zeros at the desired frequencies with the desired damping.

With appropriate phase compensation, amplification is added to the loop. The gain amplification is chosen in accordance to a well-known gain and phase margin criteria (e.g. Linear Control Systems Analysis and Designs, John J.D'Azzo, Constantine H.

Houpis, 2nd Edition, McGraw-Hill, 1981). A loop gain of less than or equal to –3 dB is chosen at frequencies likely to produce positive feedback. The filtering arrangement of **Fig. 1** shown in **Fig 2**, produces a gain greater than unity, for an open loop response between 80 Hz and 1 kHz and less than unity at other frequencies, where positive feedback may occur. The frequency band ranging from 80 Hz up to 1 kHz is an appropriated choice as the occlusion effect is subjectively more apparent at these frequencies, as described in literature (e.g. Hearing Aids, Harvey Dillon, Boomerang-Press, 2001).

The bi-quadratic filter 24 is followed up by a voltage controlled variable resistance 25, referred to as **VVR**. This control produces up to – 20 dB of gain around the loop, by controlling the voltage at the gate of the JFET. Thus, the gain across the VVR network is found by observing that the JFET is series with R_7 forms a voltage divider, with its gain given by:

$$Gain_{VVR} = \frac{R_{Q1}}{R_7 + R_{Q1}}$$

Where R_{Q1}, is the variable resistance across drain to source junction.

The VVR is followed by a bufferstage 26, that is subsequently followed by a variable resistor, R_{14}. 27. This latter resistor is used to fined tune the gain around the loop manually. The variable resistor 27 is followed by an amplifier and a combiner 9, combining a processed external signal 28 with the processed internal signal 12. Finally, this buffer functions as a voltage controlled voltage source to the receiver, optionally a **class D** amplifier may be used.

Referring now to **Fig. 3**, there is illustrated the precompensation circuit 10 of **Fig. 1** in more detail. The circuit may be used to pre-compensate an external signal 13 to produce a processed external signal 28. The external signal is pre-compensated with a

fixed high pass filter 32, a variable notch filter 33, and an adjustable gain control 34. Note that the notch and the gain are also controlled with voltage variable resistances, using JFET transistors.

If $C_{13} = C_{14}$,then the transfer function equation for the notch filter, positioned between U6 and U7 is shown below

$$H_{Notch}(j\omega) = \frac{1 + j\omega(2R_x C_{13}) + (R_x R_{19} C_{13}^{\ 2}) \cdot (j\omega)^2}{1 + j\omega(R_{19} + 2R_x) C_{13} + (R_x R_{19} C_{13}^{\ 2}) \cdot (j\omega)^2}$$

Where $R_x = R_{20} + R_{Q3} + R_{Q4}$ and $R_{Q3} + R_{Q4}$ is the combined resistance across drain to source junction of the two JFET transistors. Also note that the amplification at U7 is controlled by the source to drain resistance at Q5, and the low pass filter between U5 and U6 is essentially switched on and off by Q2.

The voltage variable resistances shown in **Fig. 2** and **3** are driven by the circuit 40 shown in **Fig. 4**. This circuit functions as a signal level estimator and threshold detector and produces a control voltage 41. In this circuit the receiver signal 4 is compared to a reference voltage 43, shown as v-Ref in the figure, at the negative input of U8 (44). If this voltage does not exceed the reference level, the current source, made up by BJ3 and BJ4 transistor pair pulls down the voltage across the RC tank towards the negative supply voltage, with a time constant equal to the release time. Note that the voltage across the RC tank feeds directly into the gate of the JFET control transistor in **Fig. 2** from U9 buffer (1), resulting in a VVR signal 25. Similarly from U10 and U11 buffer (2) and buffer (3), results is an inverted VVR signal 35, that is directly applied to the gates of all the JFET transistors shown in **Fig. 3**. As the voltage exceeds the threshold reference level, the current source, shown as BJ6 and BJ5 transistor pair, charges the RC tank, towards the base voltage at BJ6, with a time constant set by the attack time. The

attack and release time constants can be approximated by finding the appropriate ratio between resistors R_{31} and R_{30}.

The voltage across the capacitor C_{15} ranges from a voltage at the based of BJ7 , say 0.7V or fully charged to the voltage at the collector of BJ3, say -2.8V or fully discharged, then the change in voltage $\Delta V \approx 3.5V$, from which the current needed to produce the discharging rate can be evaluated as follows:

$$\text{Discharging } I = C_{15} \times \frac{\Delta V}{\text{Re}lease\_Time} = 7uA$$

thus effectively $I_{charging} \approx 11 \times I_{discharging}$

Then $R_{31} = \frac{0.7}{77u} \approx 8.2k$ $\qquad R_{30} = 11 \times R_{31} \approx 91k$

Digital Implementation

A digital implementation of the arrangement of **Fig. 1** typically requires the signal within the loop to be oversampled to reduce the delay introduced into the loop by sampling. The signal processing performed by electronic circuits A, B, C and D and the combiner 9 may be performed digitally. The digital processing optionally is performed by a digital signal processor which is instructed to perform the signal processing. Various techniques are available to those skilled in the art to perform these processes. Examples of these are performing the filtering operations using FIR or IIR filters or modifying the signals in the frequency domain using the short-time Fourier transform techniques. One implementation of the scheme described for **Fig 1** is shown in **Figs. 5-7**.

In **Fig. 5,** after A/D conversion 50, the internal signal is filtered with an IIR filter 51 in order to provide the required gain and phase compensation, with the same criteria applied in the description of **Fig. 2**.

In this digital implementation the level of the receiver signal 4 is directly estimated and the control signal *r(n)* is produced by the level estimator and control signal generator

8 which is shown in greater detailed in **Fig. 7.**. Referring now to **Fig. 7,** the receive signal level is estimated with a digital 1st order switchable time-constant envelope detector. The envelope signal is compared 71 to a threshold value and the maximum of either the ratio of its exceedance of this threshold or unity is produced. This maximum is inverted to produce the control signal. As the level of the envelope signal exceeds the threshold, the control signal shown as *r(n)* decreases at a rate determined by the attack time constant λ_{attack}. As the envelope signal decreases in level, the control signal increases at a rate determined by the release time constant $\lambda_{release}$. Alternative signal level compression strategies employing different envelope detector designs well known to those skilled in the art may be used.

The internal signal, after being filtered by the IIR filter 51, is scaled by the control signal *r(n)* to produce the processed internal signal. The processed external signal is added to the processed internal signal by the combiner 9 to produce the combined signal. The combined signal is scaled 2 to produce the receiver signal 4 which after D/A conversion is applied to the receiver 5.

As in the analog description, the negative feedback loop requires pre-compensation so that the gain response measured from the external signal to the receiver signal is not altered by the closed loop response. In **Fig. 5,** the pre-compensation filter 10 is realised as a cascaded IIR filter, with a structural realisation shown in **Fig. 6** . The first filter stage shown in **Fig. 6** is a high pass filter, comprising of a zero at 0 Hz and a pole at f_{HP}, the coefficient being a function of the sampling rate, Fs. The second stage of the filter shown in **Fig. 6** is adaptive, the locations of poles f_p and zeros f_z of the digital filter are varied in accordance with the output of a mapping function *p(n)* 61. Alternatively the damping factors for the poles and zeros can be controlled by two independent mapping functions derived from the control signal *r(n)*. **Fig. 5** shows *p(n)*

as a single output from a polynomial mapping function with input *r(n)*. The polynomial's coefficients are found using an autoregressive analysis of the required compensating response as a function of the control signal *r(n)*.

Any combination of analog and digital electronic circuits is possible in addition to the all analogue and the all digital implementations described with the appropriate conversions between analogue and digital formats. In particular, electronic circuits B, C and D may be implemented digitally with the combiner and electronic circuit A implemented in analog circuitry. Furthermore, the processed internal and processed external signals may be combined while both in a 1-bit format and applied directly to the receiver without electronic circuit A performing any function or with it simply providing the 1-bit drive current for the receiver.

Referring now to **Fig. 8** the simulated closed loop response in a Zwislocki coupler is shown. The scheme yields approximately 16 dB of occlusion reduction at 300 Hz, and 18 dB at 100 Hz. The occlusion reduction response is a measure of the level difference between the sound level in the coupler with the occlusion reduction system active and the sound level in the coupler without any occlusion reduction. Referring to **Fig. 9** occlusion reduction in a real ear is shown. This was calculated by taking the linear average of the energy in 1/12 octave bands recorded using an in-the-ear-canal microphone while a subject talked for 2 minutes. This signal was recorded while the feedback loop gain is maximum, and then again while the loop was open.

Referring now to **Fig. 10**, three responses measured in a Zwislocki coupler are shown. These are the transfer functions from an external signal to the coupler microphone for the compensated 93 and un-compensated responses 92. Also shown is the natural receiver response 94 employing a voltage controlled voltage source to the receiver. Note that the compensated response is not adversely affected by the occlusion

reduction scheme compared to that of the natural receiver response 94. Also similar responses are derived for minimally open vented cavities with the appropriate changes to the mappings, filtering and gain equalisation in electronic circuits A, B, and C.

Referring now to **Fig. 11**, there is shown one form of actual implementation of the present invention as an in-the-canal hearing aid device 100 placed in a user's ear 101 that substantially eliminates the discomfort associated with the occlusion effect. The device 100 includes a sealed or optionally vented 102 earmold that occludes or partially occludes the ear canal. The earmold encapsulates a hearing aid electronic circuit comprising of: a hearing aid processor 103 directly connected to an external microphone 104 and powered by small battery 105. The hearing aid processor includes occlusion reduction electronic circuits A, B, C, D and the combiner. A separate receiver 5 and an internal microphone 7 are also interconnected. These transducer elements are acoustically coupled to the inside of the ear canal with short tubes 108, 109; and protected from ear wax with wax-guarding devices 110, 111.

The forgoing describes preferred embodiments of the present invention. Modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the invention.

CLAIMS

1. An electro-acoustic system including:

an electro-acoustic circuit including a negative-feedback loop comprising of:

a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear;

a second electronic circuit (B) for modifying the internal signal to produce a processed internal signal;

a combiner for combining the processed internal signal with a processed external signal to produce a combined signal;

a first electronic circuit (A) for modifying the combined signal to produce a receiver signal;

and

a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear;

a third electronic circuit (C) for modifying an external signal to produce a processed external signal;

a fourth electronic circuit (D) for estimating the level of the receiver signal either directly from the receiver signal or from the combined signal and producing a control signal from this estimate;

wherein the processing performed by the second electronic circuit (B) is controlled by the control signal.

2. A system as claimed in claim 1 wherein the negative-feedback loop includes filtering that alters the open loop response so that the real component of the response is large and negative at frequencies where the occlusion effect is most apparent.

3. A system as claimed in claim 2 wherein the third electronic circuit (C) includes filtering that provides compensation for the closed response of the negative-feedback loop.

4. A system as claimed in claim 3 wherein the filtering provided by the third electronic circuit (C) is adaptive and controlled by the control signal.

5. A system as claimed in any previous claim wherein the fourth electronic circuit (D) estimates the level of the internal signal or the level of the processed internal signal and uses this estimate with the estimate of the receiver signal to produce a control signal.

6. A system as claimed in any previous claim wherein the gain of the second electronic circuit (B) is controlled by the control signal.

7. A system as claimed in any previous claim wherein the ear is occluded or partially occluded by an earmold.

8. A system as claimed in claim 7 wherein the earmold contains a vent.

9. A system as claimed in claim 8 wherein the vent contains an acoustic damper

10. A system as claimed in any previous claim wherein the microphone for generating the internal signal is coupled to the occluded or partially occluded ear by a tube.

11. A system as claimed in any previous claim wherein the receiver is coupled to the occluded or partially occluded ear by a tube.

12. A system as claimed in any previous claim wherein the microphone and the receiver are jointly coupled to the occluded or partially occluded ear by a common tube.

13. A system as claimed in any previous claim wherein at least one of the electronic circuits is digital.

14. A system as claimed in any previous claim wherein at least one of the digital electronic circuits uses a sampling rate at least four times that of the bandwidth of the signal.

15. A system as claimed in claims 13 or claim 14 wherein the first electronic circuit (A) includes a digital to analogue converter.

16. A system as claimed in claim 13, claim 14 or claim 15 wherein the second electronic circuit (B) includes an analogue to digital converter.

17. A system as claimed in claim 16 wherein the second electronic circuit (B) includes a digital to analogue converter.

18. A system as claimed in claim 14 wherein at least one of the input signals to the combiner is a binary signal.

19. An electro-acoustic system including a negative-feedback loop comprising of:

a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear;

a second electronic circuit (B) for modifying the internal signal to produce a processed internal signal;

a combiner for combining the processed internal signal with a processed external signal to produce a combined signal;

a first electronic circuit (A) for modifying the combined signal to produce a receiver signal;

and

a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear;

a third electronic circuit (C) for modifying an external signal such as from external microphone to produce a processed external signal;

a fourth electronic circuit (D) for estimating the level of the receiver signal and producing a control signal from this estimate;

wherein the control signal controls the processing performed by the second electronic circuit (B) and controls the processing performed by the third electronic circuit (C).

20. An electro-acoustic system including a negative-feedback loop comprising of:

a microphone for generating an internal signal from an acoustical signal located within or closely coupled to an occluded or partially occluded ear;

a second electronic circuit (B) for modifying the internal signal to produce a processed internal signal;

a combiner for combining the processed internal signal with a processed external signal to produce a combined signal;

a first electronic circuit (A) for modifying the combined signal to produce a receiver signal;

and

a receiver for generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear;

a third electronic circuit (C) for modifying an external signal to produce a processed external signal;

a fourth electronic circuit (D) for estimating the level of the receiver signal and producing a control signal from this estimate;

wherein the control signal controls the processing performed by first electronic circuit (A) and controls the processing performed by the third electronic circuit (C).

21. A method of providing a negative feedback loop for an electro-acoustic system, the method including the steps of:

(a) generating an internal signal representing an acoustical signal located within or closely coupled to an occluded or partially occluded ear;

(b) modifying the internal signal to produce a processed internal signal;

(c) combining the processed internal signal with a processed external signal to produce a combined signal;

(d) modifying the combined signal to produce a receiver signal;

(e) generating an acoustical signal from the receiver signal at a location within or closely coupled to the occluded or partially occluded ear;

(f) modifying an external signal to produce a processed external signal;

(g) estimating the level of the receiver signal either directly from the receiver signal or from the combined signal and producing a control signal from this estimate;

wherein the degree of modification in step (b) is controlled by the control signal.

22. A method as claimed in claim 21 wherein the control signal is utilised to control the amount of modification occurring in step (f).

23. A method substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

24. A system substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

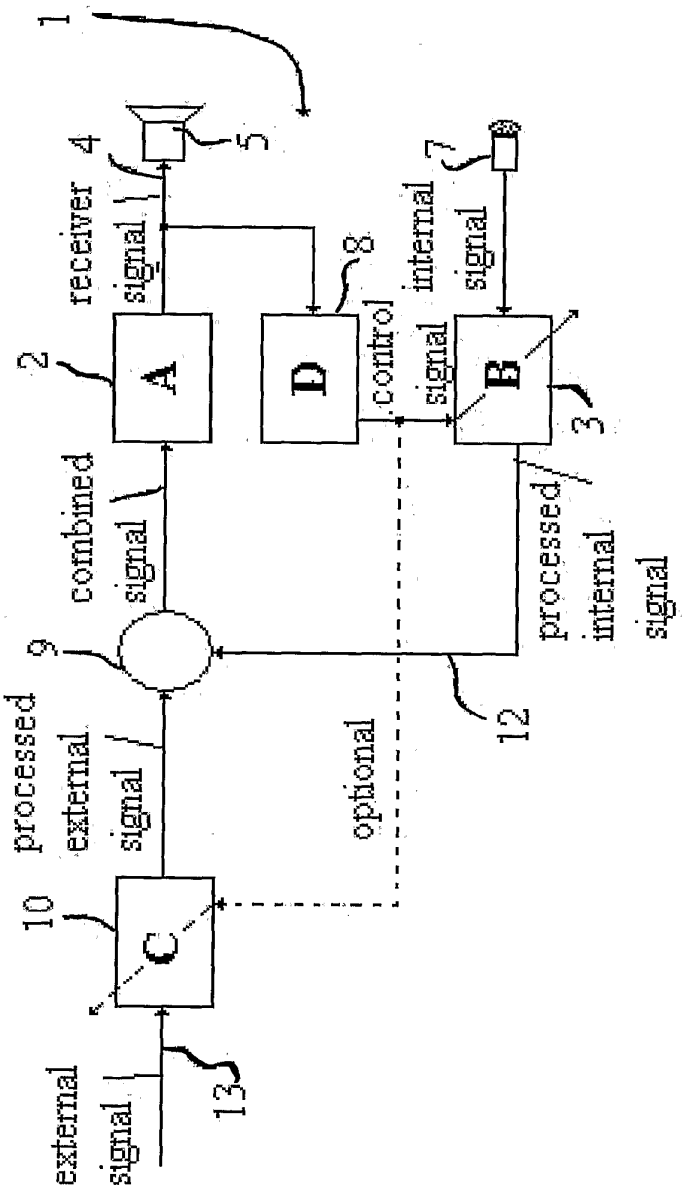

1
receiver
4
5
signal
2
A
D
8
control
signal
internal
signal
7
B
3
combined
signal
9
processed
internal
signal
12
processed
external
signal
optional
10
C
external
signal
13

Fig. 1

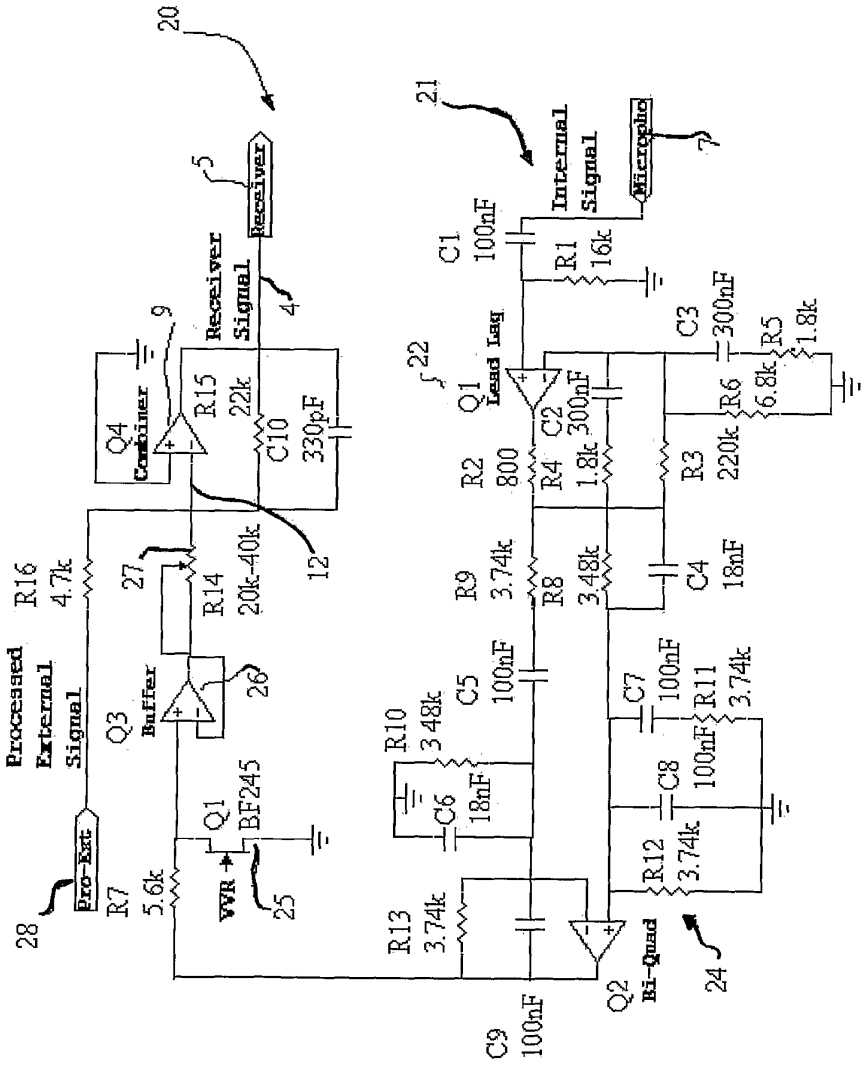

20
21
22
Receiver
Receiver Signal
Combiner
Q4
R15 22k
C10 330pF
Internal Signal
Microphone
C1 100nF
R1 16k
Lead Lag
Q1
C2 300nF
R4 1.8k
R2 800
C3 300nF
R5 1.8k
R6 6.8k
R3 220k
Processed External Signal
Pro-Ext
R16 4.7k
R14 20k-40k
Buffer
Q3
Q1 BF245
VVR
R7 5.6k
R9 3.74k
R8 3.48k
C4 18nF
R10 3.48k
C6 18nF
C5 100nF
C7 100nF
R11 3.74k
C8 100nF
R12 3.74k
R13 3.74k
C9 100nF
Bi-Quad
Q2
24
25
26
27
28
12
4
5
7
9

Fig. 2

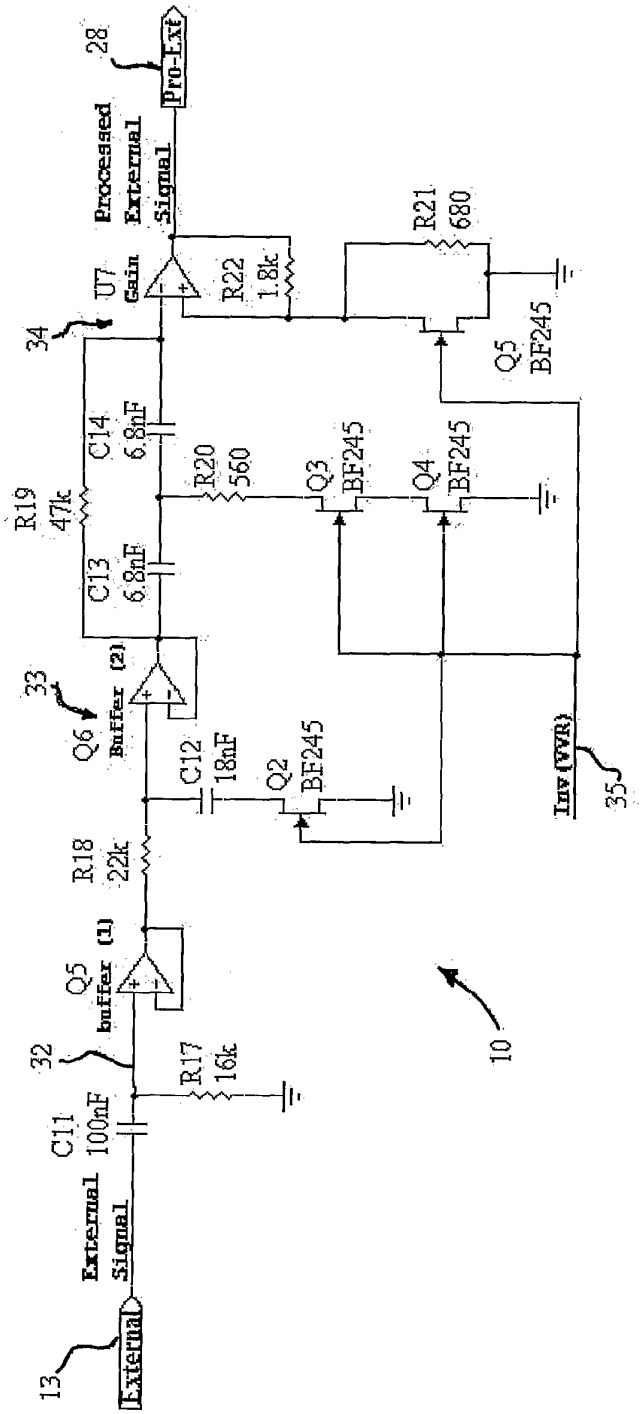

28
Pro-Ext
Processed External Signal
U7
Gain
R22
1.8k
R21
680
Q5
BF245
34
C14
6.8nF
R20
560
Q3
BF245
Q4
BF245
R19
47k
C13
6.8nF
33
Q6
Buffer (2)
C12
18nF
Q2
BF245
Inv (VVR)
35
R18
22k
Q5
Buffer (1)
32
R17
16k
10
C11
100nF
External Signal
13
External

Fig. 3

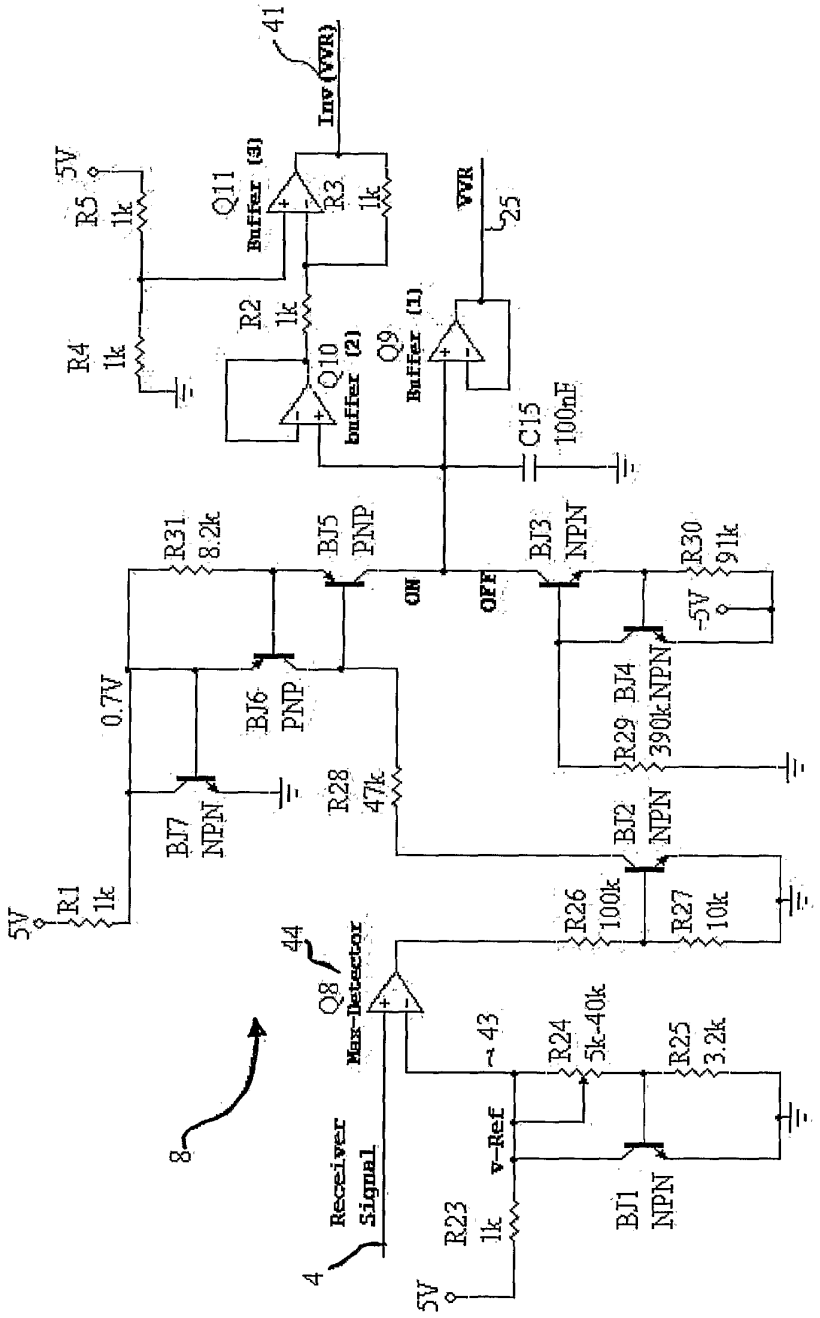

41
Inv (VVR)
5V
R5
1k
Q11
Buffer (3)
R3
1k
VVR
25
R4
1k
R2
1k
Q10
buffer (2)
Q9
Buffer (1)
C15
100nF
R31
8.2k
BJ5
PNP
ON
OFF
BJ3
NPN
R30
91k
-5V
0.7V
BJ6
PNP
BJ4
NPN
R29
390k
R28
47k
BJ7
NPN
BJ2
NPN
5V
R1
1k
R26
100k
R27
10k
44
Q8
Max-Detector
~ 43
R24
5k-40k
R25
3.2k
8
v-Ref
Receiver
Signal
4
R23
1k
5V
BJ1
NPN

Fig. 4

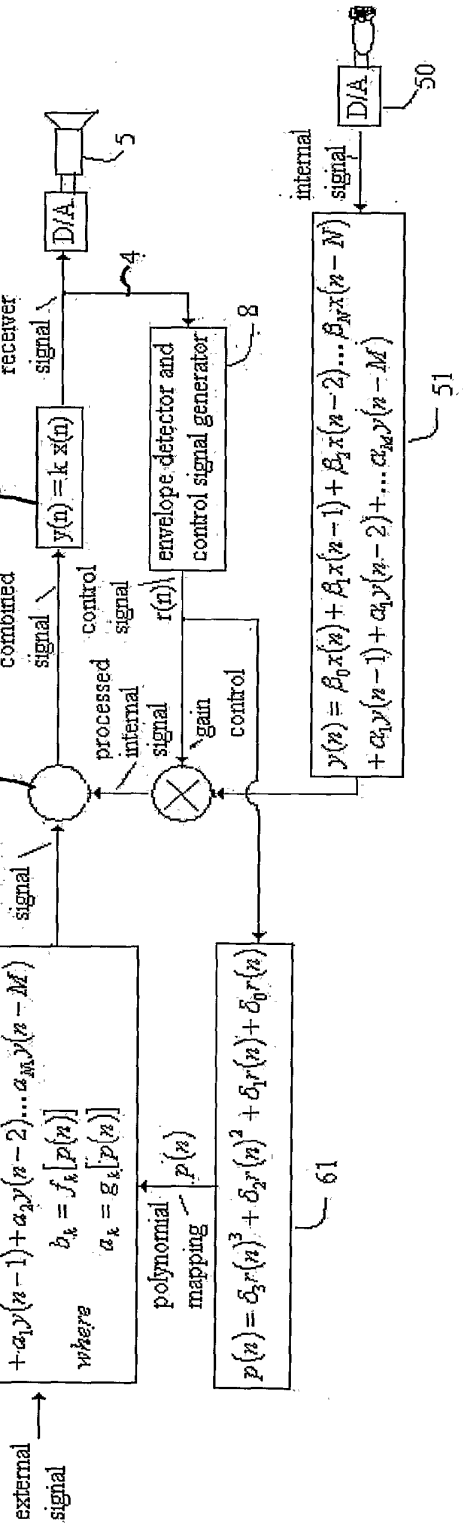

external signal
$y(n) = b_0x(n) + b_1x(n-1) \dots b_Nx(n-N)$
$+ a_1y(n-1) + a_2y(n-2) \dots a_My(n-M)$
where $b_k = f_k[p(n)]$ $a_k = g_k[p(n)]$
10
processed external signal
9
combined signal
processed internal signal
control signal r(n)
gain control
polynomial mapping
p(n)
$p(n) = \delta_3 r(n)^3 + \delta_2 r(n)^2 + \delta_1 r(n) + \delta_0 r(n)$
61
$y(n) = \beta_0 x(n) + \beta_1 x(n-1) + \beta_2 x(n-2) \dots \beta_N x(n-N)$
$+ a_1 y(n-1) + a_2 y(n-2) + \dots a_M y(n-M)$
51
internal signal
D/A
50
y(n) = k x(n)
2
receiver signal
D/A
5
4
envelope detector and control signal generator
8

Fig. 5

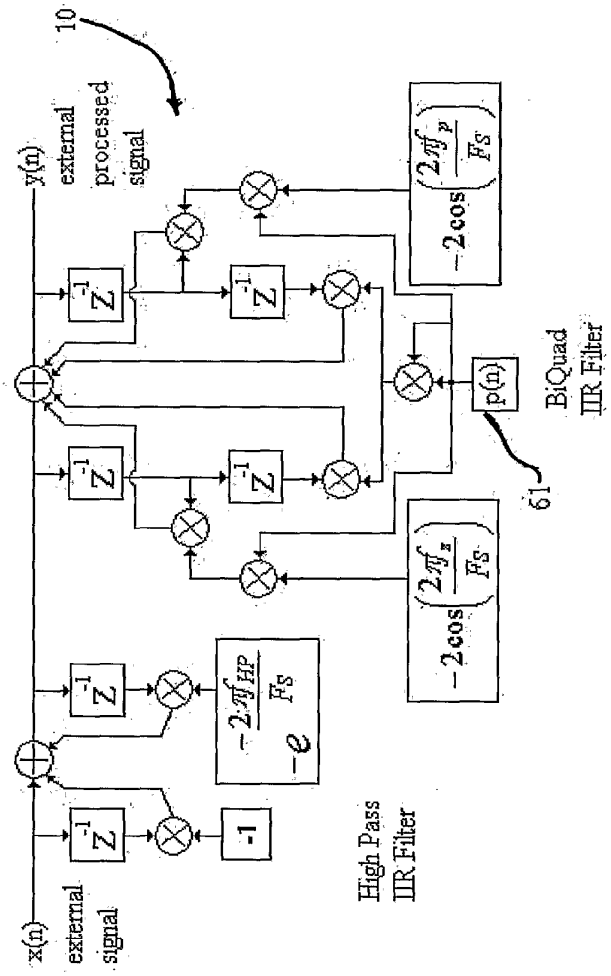

10
y(n)
external
processed
signal
x(n)
external
signal
High Pass
IIR Filter
BiQuad
IIR Filter
p(n)
61
-1
$-2\cos\left(\frac{2\pi f_z}{F_S}\right)$
$-2\cos\left(\frac{2\pi f_p}{F_S}\right)$
$-e^{-\frac{2\pi f_{HP}}{F_S}}$

Fig. 6

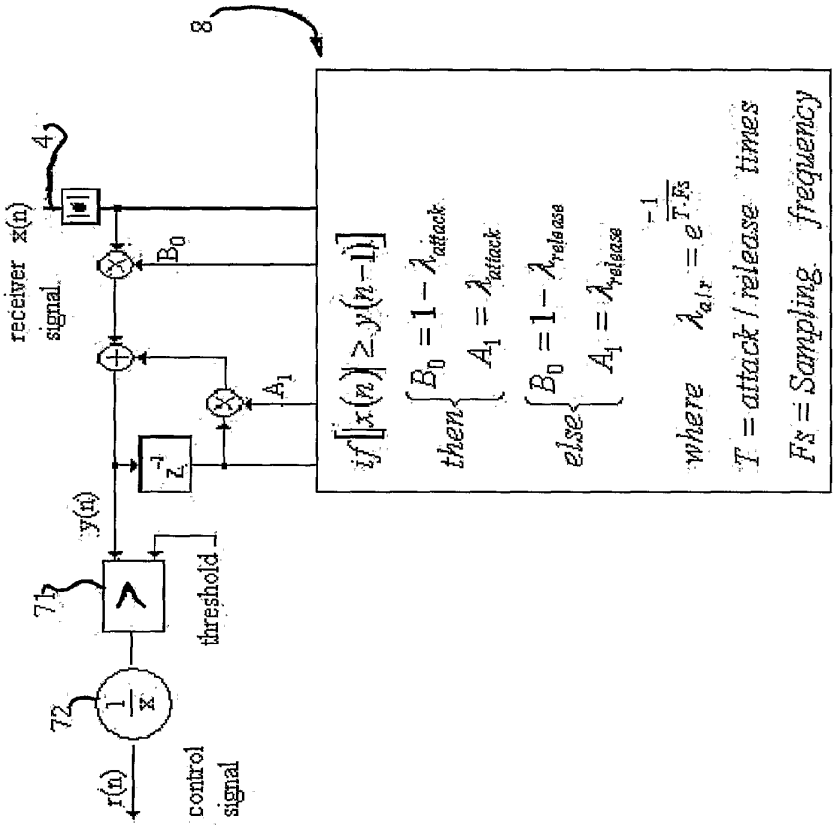

8
4
receiver x(n)
signal
|x|
B_0
A_1
z^{-1}
y(n)
7b
>
threshold
72
$\frac{1}{x}$
r(n)
control
signal
$if\ [|x(n)| \geq y(n-1)]$
$then \begin{cases} B_0 = 1 - \lambda_{attack} \\ A_1 = \lambda_{attack} \end{cases}$
$else \begin{cases} B_0 = 1 - \lambda_{release} \\ A_1 = \lambda_{release} \end{cases}$
$where \quad \lambda_{a/r} = e^{\frac{-1}{T \cdot Fs}}$
$T = attack\ /\ release\ \ times$
$Fs = Sampling\ \ frequency$

Fig. 7

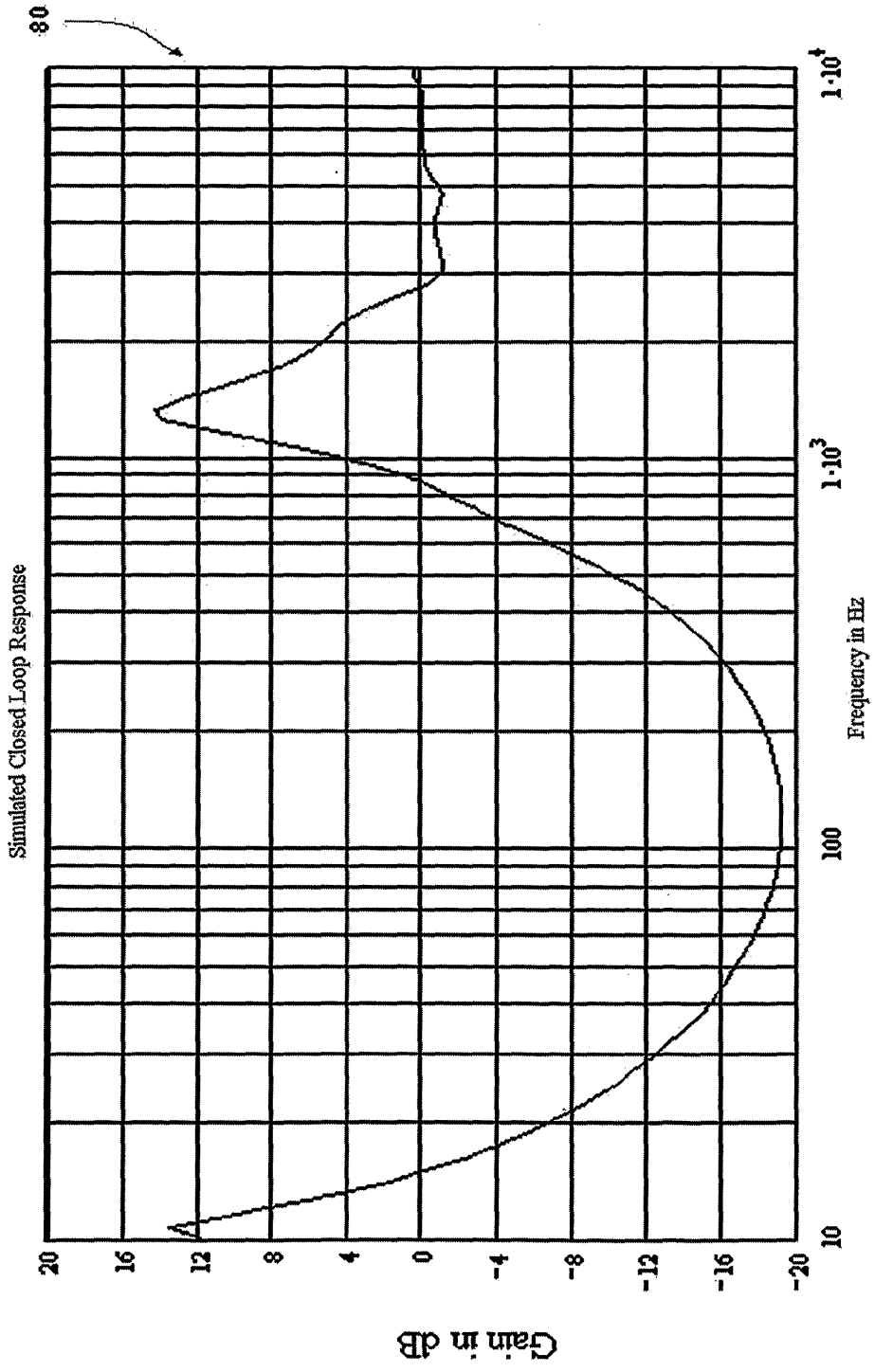

80
Simulated Closed Loop Response
Gain in dB
20
16
12
8
4
0
-4
-8
-12
-16
-20
10
100
1·10^3
1·10^4
Frequency in Hz

Fig. 8

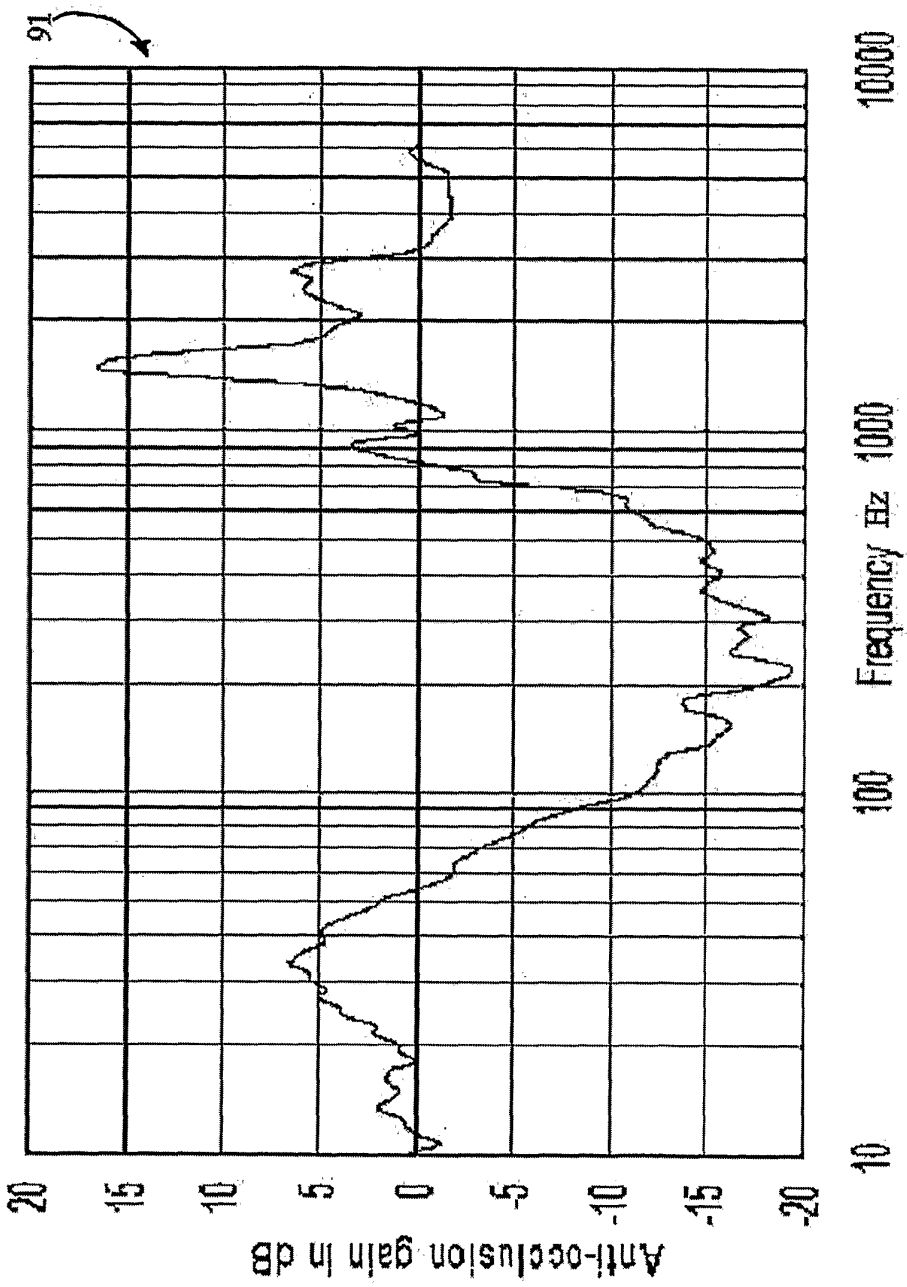

91
Anti-occlusion gain in dB
20
15
10
5
0
-5
-10
-15
-20
10
100
1000
10000
Frequency Hz

Fig. 9

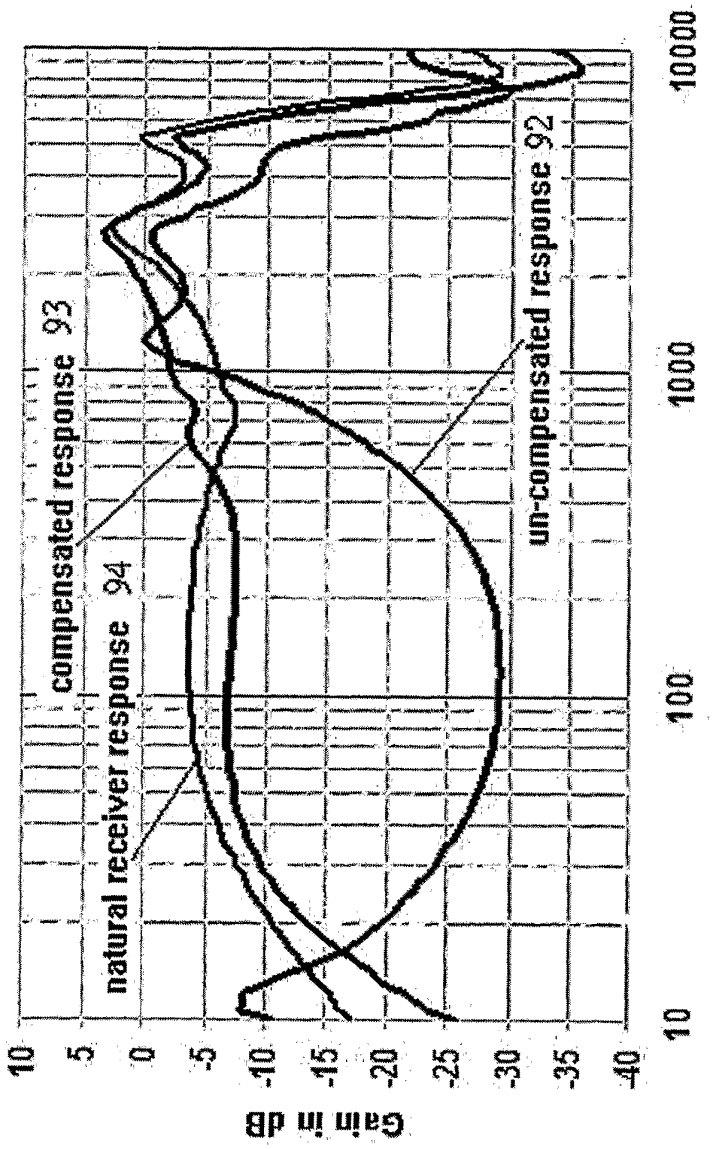

Gain in dB
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
100
1000
10000
Frequency Hz
compensated response 93
natural receiver response 94
un-compensated response 92

Fig. 10

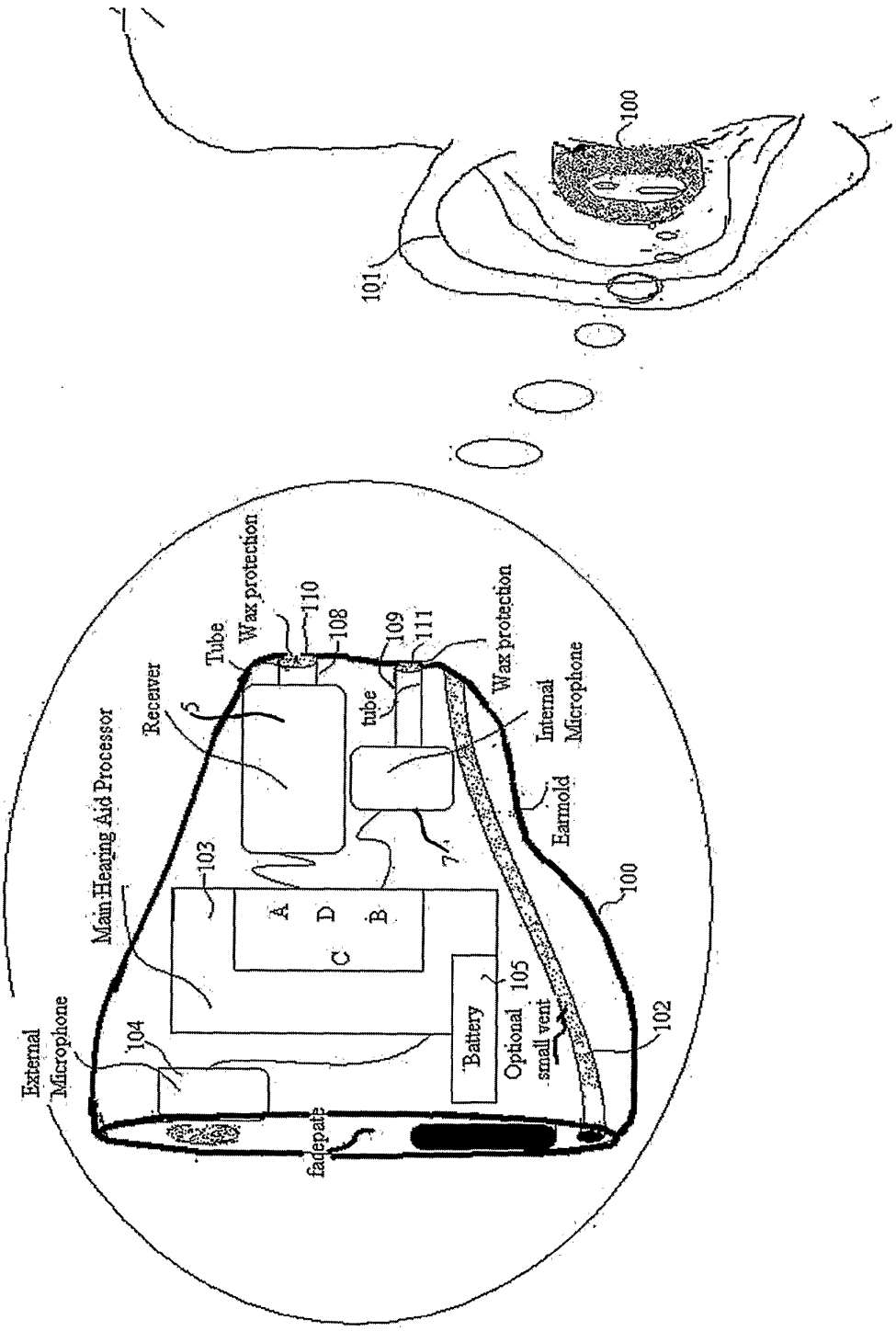

100
101
Wax protection
Tube
110
108
109
111
Wax protection
Receiver
5
tube
Internal Microphone
Earmold
Main Hearing Aid Processor
103
A
D
B
C
100
External Microphone
104
Battery
105
Optional small vent
102
fadepate

Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001506

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: H04R 29/00; A61B 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: hearing aid, occlusion, gain, frequency range, sound level, signal strength and similar terms.
USPTO: hearing aid, occlusion, reduce

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6687377 B2 (VOIX et al.) 3 February 2004 Col. 3 line 33-Col. 6 line 22	1-24
A	WO 2002/085063 A2 (WIDEX A/S et al.) 24 October 2002 Page 4 line 14-Page 10 line 32	1-24
A	US 6766031 B1 (WESTERMANN) 20 July 2004 Col. 2 line 18-Col. 5 line 28	1-24
A	CA 2381516 A1 (GENNUM CORPORATION, CA) 12 October 2002 Page 1 line 20-Page 18 line 2	1-24

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 November 2005	9 NOV 2005

Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**JUZER KHANBHAI** Telephone No : (02) 6283 2176

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001506

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5195139 A (GAUTHIER) 16 March 1993 Col. 1 line 39-Col. 3 line 22	1-24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001506

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6687377	AU	20394/02	CA	2477010	CN	1483298
		EP	1356255	US	2002076057	WO	0250499
		ZA	200305523				
WO	2002/085063	CA	2442538	EP	1250027	US	2002150269
US	6766031	AU	69189/98	CA	2286037	DK	42297
		EP	0980641	WO	9847318		
CA	2381516	N/A					
US	5195139	AU	20280/92	EP	0584259	WO	9221218

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2006 年5 月26 日 (26.05.2006)

PCT

(10) 国際公開番号
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H04S 1/00 (2006.01)

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(22) 国際出願日: 2005 年11 月18 日 (18.11.2005)

(25) 国際出願の言語: 日本語

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特願 2004-335667
2004 年11 月19 日 (19.11.2004) JP
特願 2004-337165
2004 年11 月22 日 (22.11.2004) JP
特願 2004-369406
2004 年12 月21 日 (21.12.2004) JP
特願2005-149276 2005 年5 月23 日 (23.05.2005) JP
特願2005-178919 2005 年6 月20 日 (20.06.2005) JP

(71) 出願人 (米国を除く全ての指定国について): 日本ビクター株式会社 (VICTOR COMPANY OF JAPAN, LIMITED) [JP/JP]; 〒2218528 神奈川県横浜市神奈川区守屋町３丁目１２番地 Kanagawa (JP).

(72) 発明者; および

(75) 発明者/出願人 (米国についてのみ): 村田 寿子 (MURATA, Hisako). 鈴木 琢磨 (SUZUKI, Takuma). 安良 定浩 (YASURA, Sadahiro). 羽石 実希 (HANEISHI, Miki). 長谷川 勝巳 (HASEGAWA, Katsumi). 相崎 正子 (AIZAKI, Naoko). 藤浪 喜久 (FUJINAMI, Yoshihisa). 武田 正美 (TAKEDA, Masami). 菅原 隆幸 (SUGAHARA, Takayuki).

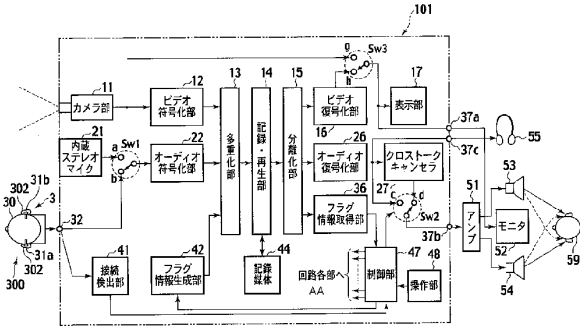
(74) 代理人: 三好 秀和, 外 (MIYOSHI, Hidekazu et al.); 〒1050001 東京都港区虎ノ門１丁目２番８号 虎ノ門琴平タワー Tokyo (JP).

(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR,

[続葉有]

(54) Title: VIDEO/AUDIO RECORDING APPARATUS AND METHOD, AND VIDEO/AUDIO REPRODUCING APPARATUS AND METHOD

(54) 発明の名称: 映像音声記録装置及び方法、並びに、映像音声再生装置及び方法



11 CAMERA PART
21 INTERNALLY-MOUNTED STEREO MICROPHONES
41 CONNECTION DETECTING PART
12 VIDEO ENCODING PART
22 AUDIO ENCODING PART
42 FLAG INFORMATION GENERATING PART
13 MULTIPLEXING PART
14 RECORDING/REPRODUCING PART
44 RECORDING MEDIUM
15 SEPARATING PART
16 VIDEO DECODING PART
26 AUDIO DECODING PART
36 FLAG INFORMATION ACQUIRING PART
AA TO VARIOUS CIRCUIT COMPONENTS
17 DISPLAY PART
27 CROSSTALK CANCELLER
47 CONTROL PART
48 OPERATING PART
51 AMPLIFIER
52 MONITOR

(57) Abstract: A video/audio recording/reproducing apparatus (101) has an internally-mounted stereo microphones (21a,21b) and an external microphone connection terminal (32). The external microphone connection terminal (32) is connected to binaural microphones (3) to be attached to the ears of a recording user (300). In a case of collecting ambient sounds by use of the binaural microphones (3), the user switches the audio signals to be recorded in a recording medium from the audio signals obtained from the internally-mounted stereo microphones (21a,21b) to the binaural audio signals obtained from the binaural microphones (3). The recording user (300) attaches the binaural microphones (3(31a,31b)) to his ears to collect sounds around him including sounds generated from an imaged subject. A camera part (11) images the subject. The binaural audio signals, video signals obtained by imaging the subject, and binaural flag signals are recorded into the recording medium.

[続葉有]

WO 2006/054698 A1

BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各*PCT*ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

(57) 要約: 映像音声記録再生装置（１０１）は内蔵ステレオマイク（２１ａ，２１ｂ）と外部マイク接続端子（３２）を備える。外部マイク接続端子（３２）には撮影者（３００）の耳に装着するバイノーラルマイク（３）が接続されている。バイノーラルマイク（３）で周囲音を集音する場合は記録媒体に記録する音声信号を内蔵ステレオマイク（２１ａ，２１ｂ）からの音声信号からバイノーラルマイク（３）からのバイノーラル音声信号へと切り替える。撮影者（３００）はバイノーラルマイク（３（３１ａ．３１ｂ））を耳に装着して被写体から発せられた音を含む撮影者（３００）の周囲音を集音する。カメラ部（１１）は被写体を撮像する。記録媒体にバイノーラル音声信号と撮像した映像信号とバイノーラルフラグ信号とを記録する。

明 細 書

映像音声記録装置及び方法、並びに、映像音声再生装置及び方法

技術分野

[0001] 本発明は、被写体を撮像した映像信号と被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とを記録する映像音声記録装置及び方法、並びに、記録媒体に記録した映像信号と音声信号とを再生する映像音声再生装置及び方法に係り、特に撮像した映像と共に臨場感のある音声を再生することができる映像音声記録装置及び方法、並びに、映像音声再生装置及び方法に関する。

背景技術

[0002] 被写体を撮像した映像信号と被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とを記録する映像音声記録再生装置(いわゆるビデオカメラ)が普及している。この種の映像音声記録再生装置は音声をステレオ録音するためのステレオマイクを備えている。近年、映像音声記録再生装置は小型化が一段と進んでおり、小型化された映像音声記録再生装置に搭載したステレオマイクでは臨場感のある音声を記録しにくいという問題がある。そこで、より臨場感のある音声を記録することができる映像音声記録再生装置が望まれている。

[0003] 国際公開第96／10884号パンフレットには、映像音声記録再生装置本体の両側に耳構造体を配置することにより、被写体を撮像した映像信号と共に撮影者の周囲の音場をバイノーラル集音した音声を記録することができる映像音声記録再生装置が開示されている。

[0004] しかしながら、上記文献に開示されている、バイノーラルマイクを装置本体に取り付けた映像音声記録再生装置では、装置本体の横幅、即ち左右のマイクの間隔が人頭と同程度でなければ臨場感のある音声を記録することができない。近年製品化されている映像音声記録再生装置本体は、高密度記録技術、ディジタル信号記録技術及び映像圧縮処理技術の進歩に伴って小型化されているので、映像音声記録再生装置本体にバイノーラル集音を目的とするマイクを搭載しても期待するほどの効果が得られない。また、装置の形状が人頭とは大きく異なるので、上記文献に開示され

ているような効果を得ることは困難と考えられる。

発明の開示

[0005] 本発明はこのような問題点に鑑みなされたものであり、装置本体の大きさや形状に関係なく、撮像した映像と共に臨場感のある音声を再生することができる映像音声記録装置及び方法、並びに、映像音声再生装置及び方法を提供することを目的とする。

[0006] また、被写体をズームアップして撮影する場合に、被写体のズームアップに連動してさらに臨場感のある音声を再生することができる映像音声記録装置及び方法、並びに、映像音声再生装置及び方法を提供することを目的とする。

[0007] さらに、再生信号を視聴する視聴者とバイノーラル集音した撮影者とが異なる場合のように、任意の撮影者が撮影して任意の視聴者が視聴する場合でも、違和感のほとんどない臨場感のある音声を受聴することができる映像音声再生装置及び方法を提供することを目的とする。

[0008] 本発明は、上述した従来の技術の課題を解決するため、被写体を撮像した映像信号と、前記被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とを記録する映像音声記録装置において、前記被写体を撮像するカメラ部と、前記周囲音を集音するマイクとして、前記撮影者の耳に装着するバイノーラルマイクを使用するかバイノーラルマイク以外のマイクを使用するかを切り替える切り替え部と、前記カメラ部より出力された映像信号を処理するビデオ処理部と、前記周囲音を集音するマイクより出力された音声信号を処理するオーディオ処理部と、前記切り替え部によって前記周囲音を集音するマイクとして前記バイノーラルマイクに切り替えた場合に、前記周囲音を集音する際の音声モードをバイノーラルモードとして、バイノーラルモードであることを示すバイノーラルフラグ信号を生成するフラグ情報生成部と、前記ビデオ処理部によって処理された映像信号と前記オーディオ処理部によって処理された音声信号と前記バイノーラルフラグ信号とを記録媒体に記録する記録部とを備えて構成したことを特徴とする映像音声記録装置を提供する。

[0009] 本発明によれば、装置本体の大きさや形状に関係なく、撮像した映像と共に臨場感のある音声を再生することができる。また、被写体をズームアップして撮影する場合

、被写体のズームアップに連動してさらに臨場感のある音声を再生することができる。さらに、再生信号を視聴する視聴者とバイノーラル集音した撮影者とが異なる場合のように、任意の撮影者が撮影して任意の視聴者が視聴する場合でも、違和感のほとんどない臨場感のある音声を受聴することができる

この構成において、前記映像音声記録装置に内蔵されている内蔵マイクと、外部マイク接続端子と、前記外部マイク接続端子に接続して使用する外部マイクとして、前記バイノーラルマイクかバイノーラルマイク以外のマイクかを設定する設定部と、前記外部マイク接続端子に外部マイクが接続されているか否かを検出する接続検出部と、前記オーディオ処理部に供給する音声信号として、前記内蔵マイクより出力された音声信号と前記外部マイクより出力された音声信号とを切り替えるスイッチと、前記設定部によって前記外部マイクがバイノーラルマイクに設定され、前記接続検出部によって前記外部マイク接続端子に外部マイクが接続されていることが検出されたとき、音声モードを前記バイノーラルモードとする制御部とを備え、前記制御部は、音声モードが前記バイノーラルモードのとき、前記スイッチが前記外部マイクより出力された音声信号を前記オーディオ処理部に供給するよう前記スイッチを切り替え制御し、前記フラグ情報生成部が前記バイノーラルフラグ信号を生成するよう前記フラグ情報生成部を制御することが好ましい。

[0010] また、前記カメラ部より出力された映像信号を表示する表示部を備え、音声モードが前記バイノーラルモードのとき、前記表示部に前記バイノーラルモードであることを示すバイノーラルマークを表示させる表示制御部を備えることが好ましい。

[0011] さらに、前記カメラ部は前記被写体を拡大して撮像するズーム機能を有し、前記バイノーラルマイクによって集音された音声信号を前記カメラ部における拡大率に応じて増幅する音声ズーム処理部を備えることが好ましい。

[0012] さらにまた、前記カメラ部は前記被写体を拡大して撮像するズーム機能を有し、前記バイノーラルマイクが集音する音声信号の音源を仮想的に受聴者に接近させて仮想音源を形成するための頭部伝達関数を前記仮想音源と前記受聴者との複数の距離に対応させて記憶する伝達関数メモリと、この伝達関数メモリに記憶された複数の頭部伝達関数のいずれかを前記カメラ部における拡大率に応じて選択的に取得す

る関数取得器と、前記バイノーラルマイクによって集音された音声信号に対して前記関数取得器にて取得された頭部伝達関数を畳み込む畳み込み演算器とを有する音声ズーム処理部を備えることが好ましい。

[0013] 本発明は、上述した従来の技術の課題を解決するため、被写体を撮像した映像信号と、前記被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とを記録する映像音声記録方法において、前記被写体を撮像する撮像ステップと、前記周囲音を集音するマイクとして、前記撮影者の耳に装着するバイノーラルマイクを使用するかバイノーラルマイク以外のマイクを使用するかを切り替える切り替えステップと、前記被写体を撮像した映像信号を処理するビデオ処理ステップと、前記周囲音を集音するマイクより出力された音声信号を処理するオーディオ処理ステップと、前記切り替えステップにて前記周囲音を集音するマイクとして前記バイノーラルマイクに切り替えた場合に、前記周囲音を集音する際の音声モードをバイノーラルモードとして、バイノーラルモードであることを示すバイノーラルフラグ信号を生成するフラグ情報生成ステップと、前記ビデオ処理ステップにて処理された映像信号と前記オーディオ処理ステップにて処理された音声信号と前記バイノーラルフラグ信号とを記録媒体に記録する記録ステップとを有することを特徴とする映像音声記録方法を提供する。

[0014] 本発明は、上述した従来の技術の課題を解決するため、被写体を撮像した映像信号と、前記被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とが記録された記録媒体を再生する映像音声再生装置において、前記記録媒体に記録された記録信号を再生する再生部と、前記再生部によって再生された前記記録信号から前記映像信号と前記音声信号とを分離する分離化部と、前記分離化部によって分離された前記映像信号を処理するビデオ処理部と、前記分離化部によって分離された前記音声信号を処理するオーディオ処理部と、前記記録媒体に、前記周囲音を集音するマイクとして前記撮影者の耳に装着するバイノーラルマイクを使用したことを示すバイノーラルフラグ信号が記録されているとき、前記バイノーラルフラグ信号を取得するフラグ情報取得部と、前記フラグ情報取得部が前記バイノーラルフラグ信号を取得したとき、前記オーディオ処理部によって処理された前記音声信号をスピーカによって発音した場合に発生するクロストーク信号を打ち消すよう前記音声信号を処理

するクロストークキャンセラとを備え、前記クロストークキャンセラは前記音声信号に対して予め求めたフィルタ特性を畳み込むフィルタを有し、前記フィルタ特性は、測定信号を円筒型構造体に装着した一対のマイクで集音した音声信号を用いて計測した頭部伝達関数に基づいたフィルタ特性であることを特徴とする映像音声再生装置を提供する。

[0015] また、被写体を撮像した映像信号と、前記被写体から発せられた音を含む撮影者の周囲音を集音した音声信号とが記録された記録媒体を再生する映像音声再生方法において、前記記録媒体に記録された記録信号を再生する再生ステップと、前記再生ステップにて再生された前記記録信号から前記映像信号と前記音声信号とを分離する分離化ステップと、前記分離化ステップにて分離された前記映像信号を処理するビデオ処理ステップと、前記分離化ステップによって分離された前記音声信号を処理するオーディオ処理ステップと、前記記録媒体に、前記周囲音を集音するマイクとして前記撮影者の耳に装着するバイノーラルマイクを使用したことを示すバイノーラルフラグ信号が記録されているとき、前記バイノーラルフラグ信号を取得するフラグ情報取得ステップと、前記フラグ情報取得ステップにて前記バイノーラルフラグ信号を取得したとき、前記オーディオ処理ステップにて処理された前記音声信号をスピーカによって発音した場合に発生するクロストーク信号を打ち消すよう前記音声信号を処理するクロストークキャンセルステップとを有し、前記クロストークキャンセルステップは前記音声信号に対して予め求めたフィルタ特性を畳み込むステップであり、前記フィルタ特性は、測定信号を円筒型構造体に装着した一対のマイクで集音した音声信号を用いて計測した頭部伝達関数に基づいたフィルタ特性であることを特徴とする映像音声再生方法を提供する。

図面の簡単な説明

[0016] [図1]図1は、本発明の第1の実施形態に係る映像音声記録再生装置を示す外観斜視図である。

[図2]図2は、本発明の第1の実施形態に係る映像音声記録再生装置を用いて被写体を撮影している状態を示す図である。

[図3]図3は、本発明の第1の実施形態に係る映像音声記録再生装置の内部構成例

を示すブロック図である。

[図4]図4は、本発明の各実施形態に係る映像音声記録再生装置において音声モードの初期設定を行う表示画面を示す図である。

[図5]図5は、本発明の各実施形態に係る映像音声記録再生装置におけるバイノーラルマイクの表示例を示す図である。

[図6]図6は、本発明の各実施形態に係る映像音声記録再生装置で用いるバイノーラルマイクの変形例を示す図である。

[図7]図7は、本発明の各実施形態に係る映像音声記録再生装置で用いるバイノーラルマイクの変形例を示す図である。

[図8]図8は、本発明の各実施形態に係る映像音声記録再生装置で用いるバイノーラルマイクの変形例を示す図である。

[図9]図9は、本発明の各実施形態に係る映像音声記録再生装置におけるバイノーラルフラグ信号の記述フォーマットの一例を示す図である。

[図10]図10は、本発明の各実施形態に係る映像音声記録再生装置におけるバイノーラルフラグ信号の記述フォーマットの他の例を示す図である。

[図11]図11は、本発明の各実施形態に係る映像音声記録再生装置におけるバイノーラルフラグ信号の記述フォーマットのさらに他の例を示す図である。

[図12]図12は、本発明の第1の実施形態に係る映像音声記録再生装置における記録動作を説明するためのフローチャートである。

[図13]図13は、本発明の第1の実施形態に係る映像音声記録再生装置における再生動作を説明するためのフローチャートである。

[図14]図14は、本発明の各実施形態に係る映像音声記録再生装置で用いるクロストークキャンセラの構成例を示すブロック図である。

[図15]図15は、本発明の各実施形態に係る映像音声記録再生装置で用いるクロストークキャンセラで用いる頭部伝達関数特性を求めるための頭部伝達関数測定装置を示す図である。

[図16]図16は、図15に示す頭部伝達関数測定装置で用いるマイクユニットを取り付けた円筒形構造体と比較のためのダミーヘッドマイクを示す図である。

[図17]図17は、図15に示す頭部伝達関数測定装置で測定したインパルス応答波形を示す波形図である。

[図18]図18は、図15に示す頭部伝達関数測定装置で測定した周波数特性を示す波形図である。

[図19]図19は、ダミーヘッドマイクを用いて測定したインパルス応答波形を示す波形図である。

[図20]図20は、ダミーヘッドマイクを用いて測定した周波数特性を示す波形図である。

[図21]図21は、マイクユニットを取り付けた円筒形構造体を用いて測定した頭部伝達関数に基づくフィルタ特性によるクロストークキャンセル特性を説明するための図である。

[図22]図22は、ダミーヘッドマイクを用いて測定した頭部伝達関数に基づくフィルタ特性によるクロストークキャンセル特性を説明するための図である。

[図23]図23は、マイクユニットを取り付けた円筒形構造体を用いて測定した頭部伝達関数に基づくフィルタ特性によるクロストークキャンセル特性を説明するための図である。

[図24]図24は、ダミーヘッドマイクを用いて測定した頭部伝達関数に基づくフィルタ特性によるクロストークキャンセル特性を説明するための図である。

[図25]図25は、本発明の各実施形態に係る映像音声記録再生装置で用いるクロストークキャンセラの他の構成例を示すブロック図である。

[図26]図26は、本発明の各実施形態に係る映像音声記録再生装置で用いるクロストークキャンセラのさらに他の構成例を示すブロック図である。

[図27]図27は、本発明の各実施形態に係る映像音声記録再生装置におけるヘッドフォンでの再生動作を示すフローチャートである。

[図28]図28は、本発明の第2の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図29]図29は、本発明の第2の実施形態に係る映像音声記録再生装置における音声ズーム処理部の構成例を示すブロック図である。

[図30]図30は、本発明の第2の実施形態に係る映像音声記録再生装置において音声ズーム処理を行う場合の動作を説明するためのフローチャートである。

[図31]図31は、本発明の第2の実施形態に係る映像音声記録再生装置における音声ズーム処理部の他の構成例を示すブロック図である。

[図32]図32は、図31の音声ズーム処理部の他の構成例で用いる頭部伝達関数を求めるための頭部伝達関数測定装置を示す図である。

[図33]図33は、図32の頭部伝達関数測定装置で用いるダミーヘッドマイクを示す断面図である。

[図34]図34は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図35]図35は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図36]図36は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図37]図37は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図38]図38は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図39]図39は、図32の頭部伝達関数測定装置で測定して得られた頭部伝達関数の特性を示す図である。

[図40]図40は、本発明の第2の実施形態に係る映像音声記録再生装置において図31に示す音声ズーム処理部の他の構成例を用いて音声ズーム処理を行う場合の動作を説明するためのフローチャートである。

[図41]図41は、本発明の第3の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図42]図42は、本発明の第3の実施形態に係る映像音声記録再生装置における音声ズーム処理部の構成例を示すブロック図である。

[図43]図43は、本発明の第3の実施形態に係る映像音声記録再生装置における音

声ズーム処理部の他の構成例を示すブロック図である。

[図44]図44は、本発明の第4の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図45]図45は、本発明の第4の実施形態に係る映像音声記録再生装置における音声ズーム処理部の構成例を示すブロック図である。

[図46]図46は、本発明の第4の実施形態に係る映像音声記録再生装置におけるマニュアル音声ズーム処理を説明するためのフローチャートである。

[図47]図47は、本発明の第5の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図48]図48は、本発明の第5の実施形態に係る映像音声記録再生装置における音声ズーム処理部の構成例を示すブロック図である。

[図49]図49は、本発明の第6の実施形態に係る映像音声記録再生装置を示す外観斜視図である。

[図50]図50は、本発明の第6の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図51]図51は、本発明の第6の実施形態に係る映像音声記録再生装置におけるコード収納部の構造例を示す平面図である。

[図52]図52は、本発明の第7の実施形態に係る映像音声記録再生装置を示す外観斜視図である。

[図53]図53は、本発明の第7の実施形態に係る映像音声記録再生装置の内部構成例を示すブロック図である。

[図54]図54は、本発明の第7の実施形態に係る映像音声記録再生装置における無線型バイノーラルマイクと無線送受信部の具体的構成例を示すブロック図である。

[図55]図55は、本発明の第7の実施形態に係る映像音声記録再生装置において無線型バイノーラルマイクが通信可能圏を越えた場合の警告を説明するための図である。

[図56]図56は、本発明の第7の実施形態に係る映像音声記録再生装置において無線型バイノーラルマイクが通信可能圏を越えた場合に表示部に表示させる警告マー

クの例を示す図である。

[図57]図57は、本発明の第7の実施形態に係る映像音声記録再生装置における動作を説明するためのフローチャートである。

発明を実施するための最良の形態

[0017] 以下、本発明の映像音声記録装置及び方法、並びに、映像音声再生装置及び方法の実施の形態について図面を参照しながら説明する。

[0018] ≪第1の実施形態≫

図1は、第1の実施形態である映像音声記録再生装置101の外観構成例を示す斜視図である。

[0019] 図1に示す映像音声記録再生装置101は、カメラ部11、表示部17、内蔵ステレオマイク21a, 21b、外部マイク接続端子32を備えて構成されている。外部マイク接続端子32には無指向性の左右のマイク31a及び31bを有するイヤホン型のバイノーラルマイク3が着脱自在に接続される。ここでは、バイノーラルマイク3を外部マイク接続端子32に接続した状態を図示している。マイク31a, 31bは内部に振動板を備える。映像音声記録再生装置101は後に詳述するように、内蔵ステレオマイク21a, 21bを用いた撮影(音声収録)とバイノーラルマイク3を用いた撮影(音声収録)とを選択的に行うことができるようになされている。なお、撮影とは、単に被写体の映像を撮像するだけでなく、被写体の映像を撮像することと被写体から発せられた音を含む撮影者の周囲音を集音することの双方を意味する場合がある。

[0020] 図2は、撮影者300が映像音声記録再生装置101を用いて図示しない被写体を撮影している状態を示している。バイノーラルマイク3を用いて集音しながら被写体を撮影する場合には、図2に示すように、撮影者300は左右の耳302に左右のマイク31a, 31bを装着する。これにより、撮影者300の頭部30とマイク31a, 31bとの位置関係により与えられるバイノーラル音響特性で被写体から発せられた音を含む撮影者300の周囲音が集音される。撮影者300は、表示部17に表示される被写体のモニタ映像を目視しながら、被写体をカメラ部11で撮影すると共に周囲音をバイノーラルマイク3で集音する。後に詳述するように、カメラ部11で撮像した映像信号とバイノーラルマイク3で集音した音声信号がここでは図示していない記録媒体に記録される。また

、後に詳述するように、記録媒体に記録された映像信号は、視聴者があたかも撮影者300と同じ撮影環境で視聴しているような臨場感を有する音声と共に再生される。

[0021] 図3は、映像音声記録再生装置101の具体的な内部構成例を示すブロック図である。

[0022] 映像音声記録再生装置101は、カメラ部11、ビデオ符号化部12、多重化部13、記録・再生部14、分離化部15、ビデオ復号化部16、表示部17、内蔵ステレオマイク21(21は21a, 21bの総称)、オーディ符号化部22、オーディオ復号化部26、クロストークキャンセラ27、外部マイク接続端子32、フラグ情報取得部36、映像出力端子37a、音声出力端子37b、接続検出部41、フラグ情報生成部42、記録媒体44、制御部47、操作部48、スイッチSw1, Sw2, Sw3を備えて構成されている。なお、記録媒体44としては、ディスク状記録媒体やテープカセットのような着脱自在の記録媒体でもよいし、ハードディスクのように映像音声記録再生装置101内に予め装着されている記録媒体であってもよい。

[0023] 映像出力端子37aにはテレビジョン受像機等のモニタ52が接続される。音声出力端子37bにはアンプ51を介してスピーカ53, 54が接続される。スピーカ53, 54から発音された音声は視聴者59により受聴される。なお、図3では便宜上、撮影者300と視聴者59とを同時に図示しているが、通常は撮影者300による撮影と視聴者59による再生映像・音声の視聴は別個に行われることは言うまでもない。

[0024] ＜記録動作＞

映像音声記録再生装置101における記録動作について説明する。

[0025] まず、撮影者300が操作部48により音声モードの初期設定画像(ウインドウ)を表示させる操作を行うと、制御部47は一例として図4に示すような初期設定画像170を表示部17に表示させる。外部マイク接続端子32には、外部マイクとして、図1, 図2で説明したようなバイノーラルマイク3と通常の外部マイクとのいずれも接続することができる。操作部48による所定の操作により、撮影者300はバイノーラルマイク3を用いて集音する場合には、図4に示すように“バイノーラル”を選択し、通常の外部マイクを用いて集音する場合には“ノーマル”を選択する。制御部47は、外部マイク接続端子32に接続して使用する外部マイクとして、バイノーラルマイク3かバイノーラルマイク

以外のマイクかを設定する設定部となっている。外部マイク入力として“バイノーラル”が選択され、かつ、接続検出部41が外部マイク接続端子32に外部マイクのプラグが挿入されていることを検出した場合に、制御部47は、映像音声記録再生装置101がバイノーラルマイク3を用いた撮影に対応した記録動作を行うよう回路各部を制御する。バイノーラルマイク3を用いて周囲音を集音して、集音した音声信号を記録する音声モードをバイノーラルモードと称することとする。内蔵ステレオマイク21または通常の外部マイクを用いて周囲音を集音して、集音した音声信号を記録する音声モードをノーマルモードとする。

[0026] なお、バイノーラルマイク3のプラグを通常の外部マイクとは異なるバイノーラルマイク3専用の形状とし、外部マイク接続端子32をバイノーラルマイク3専用の接続端子とすれば、前述の音声モードの初期設定を省略することができる。

[0027] 具体的には、図3において、接続検出部41は外部マイク接続端子32に外部マイクが接続されていることを検出すると、検出信号を制御部47に供給する。制御部47は外部マイクが“バイノーラル”に設定された状態で外部マイクが接続されていることを示す検出信号が入力されたら、スイッチSw1を内蔵ステレオマイク21からの音声信号を入力する端子aから、バイノーラルマイク3からの音声信号を入力する端子bへと切り替える。これにより、バイノーラルマイク3からの音声信号がオーディオ符号化部22へと供給される。スイッチSw1は周囲音を集音するマイクとして、撮影者300の耳302に装着するバイノーラルマイクを使用するかバイノーラルマイク以外のマイクを使用するかを切り替える切り替え部となっている。

[0028] また、制御部47は、フラグ情報生成部42がバイノーラルモードであることを示すフラグ情報（バイノーラルフラグ信号）を生成して出力するよう制御する。バイノーラルフラグ信号は多重化部13に入力される。

[0029] このようにバイノーラルモードの設定がされた場合、制御部47は表示部17にバイノーラルモードとなっていることを示すマークを表示させることが好ましい。図5にマークの例を示す。図5（Λ）に示すマーク171はバイノーラルマイク3を使用する撮影者300を模式的に示すマークであり、図5（B）に示すマーク172はバイノーラル音声のスピーカ再生を模式的に示すマークである。バイノーラルモードを示すマークとしては図

5(A), (B)いずれのマークを用いてもよく、勿論これ以外のマークを用いてもよい。これらのマークは、前述の初期設定終了後や外部マイク接続端子32にバイノーラルマイク3が接続された場合にカメラ部11で撮影された映像に重畳して表示部17に表示させればよい。このようなマーク表示により撮影者300はバイノーラルマイク3を使用する際に、音声モードがバイノーラルモードに設定されているか否かを確認することができる。制御部47は、音声モードがバイノーラルモードのとき、表示部17にバイノーラルモードであることを示すバイノーラルマーク(マーク171,172)を表示させる表示制御部となっている。

[0030] バイノーラルマイク3の左右のマイク31a, 31bを左右の耳302に装着した撮影者300は被写体をカメラ部11で撮像する。カメラ部11から出力された映像信号はビデオ符号化部(ビデオ処理部)12及びスイッチSw3の端子gに入力される。映像音声記録再生装置101で撮影(記録)を行っている場合には、スイッチSw3は端子gに切り替えられていて、カメラ部11からの映像信号が表示部17に供給されて被写体の画像が表示される。これと同時に、撮影者300の頭部30とマイク31a, 31bとの位置関係により、マイク31a, 31からは被写体を正中面方向とするバイノーラル集音した音声信号が得られる。この音声信号はスイッチSw1を介してオーディ符号化部(オーディオ処理部)22に入力される。

[0031] ここでは記録媒体44がDVカセットの場合について説明すると、ビデオ符号化部12は入力された映像信号をA/D変換すると共にDV圧縮方式により符号化して符号化映像信号を生成する。オーディ符号化部22は入力された音声信号をA/D変換すると共に非圧縮の音声信号のデータ位置をシャフリングにより並び替えて符号化音声信号を生成する。

[0032] 多重化部13は、入力された符号化映像信号と符号化音声信号とバイノーラルフラグ信号とを民生用ディジタルVCR仕様で定められる信号フォーマットに従って時分割多重して多重化信号を生成する。多重化部13より出力された多重化信号は記録・再生部14に入力される。記録・再生部14は入力された多重化信号を民生用ディジタルVCR仕様で定められた記録フォーマットに従って記録媒体44に記録する。バイノーラルフラグ信号の具体的な記録方法は後に詳述する。

[0033] ここで、バイノーラルマイク3の変形例について説明する。

[0034] ＜バイノーラルマイク3の変形例＞

図6(A)はマイク31a, 31bの第1の変形例であるマイク31cを示しており、図6(B)はマイク31a, 31bの第2の変形例であるマイク31dを示している。図6(A)に示すマイク31cは、撮影者300の耳302に挿入するマイク保持部312と、マイク保持部312の上部に連結して設けられており、振動板等のマイクユニットを収納するマイク収納部311とを備えている。バイノーラルマイク3をマイク収納部311とマイク保持部312とに分離した構造のマイク31cとすることにより、撮影者300はバイノーラルマイク3を装着しても外部から到来する音を良好に聞くことができる。図6(B)に示すマイク31dは、マイク保持部312の下部に連結してマイク収納部311を設けたものである。マイク31dでもマイク31cと同様の効果がある。

[0035] 図7はマイク保持部312の具体的構成例を示す斜視図である。ここではマイク保持部312の上部にマイク収納部311を設けた図6(A)のマイク31cについて示している。図7(A)に示すマイク保持部312は、保持部本体312aに、耳302の内部に向かうに従って径が小さくなるテーパ状の通音孔313aを形成したものである。図7(B)に示すマイク保持部312は、保持部本体312aに円柱状の音孔313bを形成したものである。図7(A)の保持部本体312aは撮影者300の耳302に挿入が容易であり、図7(B)の保持部本体312bは装着時の外音の減衰が小さいという特長を有する。

[0036] 図8は、図6(A)のマイク31cのマイク保持部312の外形を異ならせた例を示している。図8において、(A)は大の外形を有するマイク保持部312、(B)は中の外形を有するマイク保持部312、(C)は小の外形を有するマイク保持部312である。このようにマイク保持部312として複数の大きさのものを用意すれば撮影者300は自分の耳302の大きさに合ったものを選択することができる。なお、図8(A)～(C)はマイク収納部311(マイクユニット)の形状及び大きさは同じであり、マイクユニットの感度及び応答周波数特性も同一である。

[0037] ＜バイノーラルフラグ信号の記録＞

撮影者300がバイノーラルマイク3を装着して集音したバイノーラル音声と内蔵ステレオマイク21で集音したステレオ音声とを識別するため、バイノーラル音声集音時に

はバイノーラル音声と共にバイノーラルフラグ信号を記録媒体44に記録する。バイノーラルフラグ信号はフラグ情報生成部42で生成される。

[0038] まず、記録媒体44がDVカセットの場合のバイノーラルフラグ信号の具体的な記録方法について説明する。

[0039] 図9はDVカセットにオーディオデータを記録する場合のデータフォーマットである。0～89バイトのオーディオデータを記録するに際し、第0，1バイトは同期コードを、第2～4バイトはID(識別)コードを、第5～9バイトはオーディオ用補助データ(AUX)を、第10～81はオーディオデータを、そして第82～89は誤りデータ検出及び訂正用の内符号パリティデータを記録する。フラグ情報生成部42は一例としてバイノーラルモードであればバイノーラルフラグ信号として1を出力し、バイノーラルモードでなければ(ノーマルモードであれば)0を出力する。多重化部13は図9に示すデータフォーマットの信号を生成する。

[0040] 次に、記録媒体44が記録用のディスクの場合のバイノーラルフラグ信号の具体的な記録方法について説明する。記録用のディスクとしては、DVD－RAM,DVD－RW,DVD－Rのような赤色レーザ光を用いて記録再生するディスクと、Blu-ray DiscやHD－DVDのような青色レーザ光を用いて記録再生するディスクがある。ここではこれらの記録用のディスク全般に適用することができるDVDビデオ規格を用いてバイノーラルフラグ信号を重畳する場合について説明する。

[0041] DVDビデオ規格を用いてバイノーラルフラグ信号を重畳する第1の方法としては、DVDビデオ規格におけるDVD-Video zoneにバイノーラルフラグ信号を重畳する方法が考えられる。

[0042] 図10に示すように、DVD規格のボリューム空間(Volume space)は、Volume and File structureとDVD-Video zoneとDVD others zoneとからなる。DVD-Video zoneはVMG(Video Manager)とVTS(Video Title Set)＃1～DVTS＃nを含む。nは2以上の所定の整数である。それぞれのVTSは制御データ(Control Data)とVOBS(Video Object Set)とを含む。VOBSは複数のVOB(Video Object)を含む。VOBSは複数のCELLを含む。CELLは複数のVOBU(Video Object Unit)を含む。VOBUはナビゲーションパック(NV_PACK)，オーディオパック(A_PACK)，ビデオパック(V_PAC

K)を含む。本実施形態では、VOBU内にバイノーラルフラグ信号を含むデータパック(D_PACK)を設ける。

[0043] データパック(D_PACK)は、パックヘッダ, パケットヘッダ, サブストリームID, オーディオフレーム情報, オーディオデータ情報, バイノーラルフラグ信号を含む。バイノーラルフラグを信号は複数のオーディオフレームレイヤからなる。

[0044] このようにDVDビデオ規格に準拠した形式でバイノーラルフラグ信号を含む情報をデータパック(D_PACK)としてパック化し、MPEG多重化する。これにより、DVDビデオ規格との互換性を保ちながら、オーディオ信号のどのオーディオフレーム部分がバイノーラル音声信号であり、どのオーディオフレーム部分が通常のステレオ音声であるのかが分かる。従って、クロストークキャンセル処理をどのオーディオフレーム部分で施せばよいのかを簡単に判別することができる。

[0045] DVDビデオ規格を用いてバイノーラルフラグ信号を重畳する第2の方法としては、DVDビデオ規格におけるDVD others zoneにバイノーラルフラグ信号を重畳する方法が考えられる。DVD others zoneは映像や音声の本体のデータに関連する補助データを記録する領域であり、ユーザデータ記録領域でもある。

[0046] 図10と図11とを比較すれば分かるように、本実施形態ではユーザデータ記録領域であるDVD others zoneのデータ構造をDVD-Video zoneのデータ構造と類似した構造としている。図11に示すように、DVD others zoneもVMG, VTS, VOBS, VOB, CELL, VOBUなる各情報を含んでいる。図11に示すDVD others zoneにおけるそれらの各情報を図10のそれと区別するため、頭にDを付した名称としている。

[0047] 図11に示すように、DVD others zoneはDVMGとDVTS＃1～DVTS＃nを含む。それぞれのDVTSはDVTSI(Video Title Set Information)とDVOBSとを含む。DVOBSは複数のDVOBを含む。DVOBSは複数のDCELLを含む。DCELLは複数のDVOBUを含む。DVOBUは複数のオーディオフレームレイヤを含む。オーディオフレームレイヤはオーディオ信号の符号化パラメータなどのオーディオフレームデータを記録する領域であり、このオーディオフレームレイヤの一部の領域をバイノーラルフラグ信号の記録領域とする。

[0048] このようにDVDビデオ規格に準拠した形式でDVD others zoneにバイノーラルフラ

グ信号を記述することにより、DVD-Video zoneに含まれるオーディオ信号(バイノーラル音声信号または通常のステレオ音声)とバイノーラルフラグ信号とが互いに関連付けられる。DVDビデオ規格との互換性を保ちながら、オーディオ信号のどのオーディオフレーム部分がバイノーラル音声信号であり、どのオーディオフレーム部分が通常のステレオ音声であるのかが分かる。従って、クロストークキャンセル処理をどのオーディオフレーム部分で施せばよいのかを簡単に判別することができる。

[0049] 図10, 図11の場合、例えばスタートボタンを操作して撮影を開始してストップボタンを操作して撮影を終了する間に集音されたオーディオ信号を1または複数のオーディオフレームレイヤとし、それぞれのオーディオフレームレイヤに対して音声モード情報を付加する。そして、音声モード情報内にバイノーラルフラグ信号を記述し、バイノーラル情報パケットとして管理する。バイノーラルフラグ信号をバイノーラル情報パケットとして管理することにより、オーディオフレーム毎に音声モード情報を容易に取得することができる。これにより、記録媒体44を再生する際に、バイノーラル音声信号と通常のステレオ音声信号とが混在して記録されている場合であっても、音声モードに応じて後で詳述するクロストークキャンセラ27の切り替えを適切に行うことができる。音声モード情報の記録は少なくとも撮影を開始する操作毎に行うことが必要であり、所定時間毎に記録することはより好ましい。

[0050] また、記録媒体44として例えば半導体メモリを用いる場合であっても、上記と同様にバイノーラルフラグ信号の記録領域を定義し、記録される音声信号の音声モードを指定することにより、バイノーラルで記録された音声信号を識別し、クロストークキャンセラ27の動作・不動作を適切に切り替えながら音声信号を再生させることができる。

[0051] さらに、MPEGなどの符号化方式の多重化レイヤのユーザデータ内にバイノーラルフラグ信号を記述することも考えられる。一例として、映像及び音声の通信機能を有する携帯電話を用い、送信側の携帯電話からバイノーラルマイク3で集音した音声信号と共に撮影した映像信号を受信側の携帯電話に伝送する場合を想定する。このような場合にも、送信側の携帯電話から受信側の携帯電話へとバイノーラルフラグ信号を伝送することができる。音声信号に対してバイノーラルフラグ信号を付して伝送することにより、バイノーラル音声の場合に臨場感のある音声を再生することが可能となる

。この場合、携帯電話で伝送する映像及び音声パケットデータの所定の箇所にバイノーラルフラグ信号を記述してパケットデータとして伝送する。例えば、MPEG－4で規定される伝送方式を用いる場合には、エレメンタリストリームのユーザデータ記録領域で、図9に示したようなバイノーラルフラグ信号を伝送することができる。MPEG－4標準で規定されるトランスポートストリームを用いる場合には、プライベートデータ領域(private_data_type)にバイノーラルフラグ信号を記述することができる。

[0052] また、映像データ及び音声データを添付ファイルの形式でファイル化されたデータとして伝送する場合は、そのファイルヘッダの部分にバイノーラルフラグ信号を記述するようにしてもよい。

[0053] 映像音声記録再生装置101における記録動作について図12に示すフローチャートを用いてさらに説明する。

[0054] まず、制御部47は、ステップS151にて、図4で説明した初期設定が、外部マイク接続端子32に接続する外部マイクをバイノーラルマイク3に設定されているか否かを判定する。ステップS151で初期設定がバイノーラルに設定されていると判定されれば(YES)、ステップS152に移る。バイノーラルに設定されていると判定されなければ(NO)、制御部47はスイッチSw1を端子aへと切り替え、ステップS154にて、映像音声記録再生装置101は内蔵ステレオマイク21からの音声信号を取得する。制御部47は、ステップS152にて、接続検出部41が外部マイク接続端子32に外部マイクのプラグが挿入されていることを検出しているか否かを判定する。ステップS152で外部マイク接続端子32に外部マイクが接続されている判定されれば(YES)、制御部47は、スイッチSw1を端子bへと切り替え、ステップS153にて、映像音声記録再生装置101はバイノーラルマイク3からの音声信号を取得する。ステップS152で外部マイク接続端子32に外部マイクが接続されていると判定されなければ(NO)、制御部47は、スイッチSw1を端子aへと切り替え、ステップS154にて、映像音声記録再生装置101は内蔵ステレオマイク21からの音声信号を取得する。

[0055] 次に、ステップS155にて、カメラ部11からの映像信号をビデオ符号化部12内の図示しないメモリに一時記憶し、バイノーラルマイク3または内蔵ステレオマイク21からの音声信号をオーディオ符号化部22内の図示しないメモリに一時記憶する。ステッ

プS156にて、ビデオ符号化部12は映像信号を符号化し、オーディオ符号化部22は音声信号を符号化する。テップS157にて、符号化映像信号をビデオ符号化部12内の図示しないバッファに一時記憶し、符号化音声信号をオーディオ符号化部22内の図示しないバッファに一時記憶する。さらに、ステップS158にて、フラグ情報生成部42はバイノーラルモードのとき制御部47の指示に基づいてバイノーラルフラグ信号を生成する。

[0056] そして、多重化部13は、ステップS159にて、符号化映像信号と符号化音声信号とバイノーラルフラグ信号とを多重化し、ステップS160にて、パケット化ストリーム信号を生成する。記録・再生部14は、ステップS161にて、媒体記録44にストリーム信号を記録する。ステップS162にて、ビデオ符号化部12とオーディオ符号化部22は符号化すべき映像信号と音声信号があるか判定し、符号化すべき映像信号と音声信号がまだあると判定されれば(YES)ステップS152に戻り、以上の動作を繰り返す。ステップS162で符号化すべき映像信号と音声信号がまだあると判定されなければ(NO)、処理を終了する。

[0057] ＜再生動作＞

図3に戻り、映像音声記録再生装置101における再生動作について説明する。図3において、操作部48の図示しない再生ボタンが操作されると、記録・再生部14は制御部47の制御により、記録媒体44に記録された記録信号である多重化信号を再生する。記録・再生部14で再生された多重化信号は分離化部15に供給され、分離化部15は入力された多重化信号を符号化映像信号と符号化音声信号とバイノーラルフラグ信号とに分離する。

[0058] 符号化映像信号はビデオ復号化部(ビデオ処理部)16に供給され、符号化音声信号はオーディオ復号化部(オーディオ処理部)26に供給され、バイノーラルフラグ信号はフラグ情報取得部36に供給される。ビデオ復号化部16は入力された符号化映像信号を復号化して映像信号を得る。再生ボタンが操作に伴って、制御部47の制御によりスイッチSw3が端子hに切り替えられる。ビデオ復号化部16より出力された映像信号は表示部17で表示されると共に、映像出力端子37aを介してモニタ52に供給されて表示される。オーディオ復号化部26は入力された符号化音声信号を復号

化して音声信号を得る。音声信号はクロストークキャンセラ27とスイッチSw2の端子cへと供給される。

[0059] クロストークキャンセラ27は、バイノーラル集音された音声信号をスピーカ53, 54で再生する際に発生する、左側のスピーカ54から発音された信号が受聴者59の右側の耳で受聴される第1のクロストーク成分と、右側のスピーカ53から発音された信号が受聴者59の左側の耳で受聴される第2のクロストーク成分とを打ち消すための信号を生成して音声信号に付加することによりクロストーク処理信号を生成する。フラグ情報取得部36は分離化部15で得られたバイノーラルフラグ信号を保持する。制御部47はフラグ情報取得部36がバイノーラルフラグ信号を保持しているか否かによってスイッチSw2を切り替え制御する。即ち、フラグ情報取得部36がバイノーラルフラグ信号を保持していれば、スイッチSw2が端子dに接続してクロストークキャンセラ27からのクロストーク処理信号を音声出力端子37bに対して出力するよう制御し、バイノーラルフラグ信号を保持していなければ、スイッチSw2が端子cに接続してオーディオ復号化部26からのクロストーク処理していない音声信号を音声出力端子37bに対して出力するよう制御する。

[0060] 音声出力端子37bより出力され、アンプ51で増幅された音声信号は左右のスピーカ53, 54から発音される。音声出力端子37bより出力される音声信号がクロストークキャンセラ27から出力されたクロストーク処理信号の場合には、視聴者59は、モニタ52に表示された映像を見ながら、撮影者300が撮影を行った際の撮影者300の周囲音を臨場感のある音声として受聴することができる。このとき、クロストークキャンセラ27は、後に詳述する頭部伝達関数を用いてクロストーク成分を打ち消しているので、撮影者300と視聴者59とが異なる場合でも、任意の撮影者300が撮影して任意の視聴者59が視聴する場合でも、違和感のほとんどない臨場感のある音声を受聴することができる。

[0061] 映像音声記録再生装置101における再生動作について図13に示すフローチャートを用いてさらに説明する。

[0062] 図13において、ステップS181にて、記録・再生部14は記録媒体44を再生し、多重化信号に基づいたストリーム信号を得る。ステップS182にて、記録・再生部14は

ストリーム信号を復号してパケット信号を生成する。ステップS183にて、分離化部15はパケット信号をビデオ信号、オーディオ信号、バイノーラルフラグ信号に分離する。ステップS184にて、ビデオ復号化部16はビデオ信号を復号し、オーディオ復号化部26はオーディオ信号を復号する。ステップS185にて、ビデオ復号化部16とオーディオ復号化部26は復号したビデオ信号とオーディオ信号を図示しないバッファに一時記憶する。ステップS186にて、フラグ情報取得部36はバイノーラルフラグ信号を取得する。

[0063] そして、制御部47は、ステップS187にて、フラグ情報取得部36が取得したバイノーラルフラグ信号に基づいて、再生したオーディオ信号が通常のステレオ音声信号であるかバイノーラル音声信号であるかを判定する。ステップS187でバイノーラル音声信号であると判定した場合には(YES)、ステップS188に移る。ステップS187でバイノーラル音声信号でないと判定した場合には(NO)、ステップS191に移り、制御部47は、スイッチSw2を端子cに切り替えて、ビデオ信号とオーディオ信号を同期再生するよう回路各部を制御する。

[0064] バイノーラル音声信号であれば、ステップS188にて、制御部47は、スイッチSw2を端子dに切り替えることによりクロストークキャンセラ27によるクロストークキャンセル処理を有効な状態とする。ステップS189にて、制御部47は、ビデオ信号とクロストークキャンセラ27によってクロストークキャンセル処理したオーディオ信号を同期再生するよう回路各部を制御する。ステップS190にて、再生すべきビデオ信号とオーディオ信号がまだあると判定されれば(YES)、ステップS182に戻り、以上の動作を繰り返す。ステップS190で再生すべきビデオ信号とオーディオ信号がまだあると判定されなければ(NO)、処理を終了する。

[0065] ＜クロストークキャンセル＞

ここで、図14を用いてクロストークキャンセラ27の具体的構成と動作について説明する。図14に示すように、クロストークキャンセラ27は、フィルタ272a～272d、加算器274a, 274b、フィルタ275a, 275bを備えて構成されている。

[0066] 図14において、バイノーラル音声信号のうち左チャンネルの信号$P_L(t)$はフィルタ272a, 272bに、右チャンネルの信号$P_R(t)$はフィルタ272c, 272dに入力される。フィ

ルタ272a～272dは順に、後述する頭部伝達関数$h_{rs}(t)$, $h_{lo}(t)$, $h_{ro}(t)$, $h_{ls}(t)$に基づいて作成したフィルタ特性(フィルタ係数)を記憶している。フィルタ272a, 272dは頭部伝達関数$h_{rs}(t)$, $h_{ls}(t)$と同等のフィルタ特性を有しており、フィルタ272b, 272cは頭部伝達関数$h_{lo}(t)$, $h_{ro}(t)$を反転したのと同等のフィルタ特性を有する。便宜上、フィルタ272a～272dのフィルタ特性を$h_{rs}(t)$, $-h_{lo}(t)$, $-h_{ro}(t)$, $h_{ls}(t)$と表記する。フィルタ272a～272dは、入力される信号$P_L(t)$, $P_R(t)$にそれぞれのフィルタ特性を与えて出力する。

[0067] 加算器274aはフィルタ272a, 272cから出力される信号を加算し、フィルタ275aは加算された信号にd(t)なるフィルタ特性を与える。加算器274bはフィルタ272b, 272dから出力される信号を加算し、フィルタ275bは加算された信号にd(t)なるフィルタ特性を与える。

[0068] ここで、フィルタ275a, 275bに記憶されているフィルタ特性d(t)は次の(1)式である。

[0069] $$d(t)=\{h_{ls}(t)\times h_{rs}(t)-h_{lo}(t)\times h_{ro}(t)\}^{-1} \quad \cdots(1)$$

フィルタ275a, 275bから出力される信号は、スピーカ53, 54から発音される際にクロストークがキャンセルされるよう、クロストークキャンセル処理が施されたクロストーク処理信号である。フィルタ275a, 275bから出力されたロストーク処理信号は、アンプ51の左チャンネルアンプ51aと右チャンネルアンプ51bでそれぞれ増幅され、スピーカ53, 54から発音される。

[0070] スピーカ53から発音された信号(音声)は視聴者59の左耳で受聴されると共に、発音された信号の一部は破線にて示す第1のクロストーク信号として視聴者59の右耳で受聴される。クロストークキャンセラ27は視聴者59の右耳で受聴される第1のクロストーク信号を打ち消すための第1のクロストーク打消し信号を生成してスピーカ54から発音させる。第1のクロストーク打消し信号により第1のクロストーク信号は打ち消される(減衰される)。同様に、スピーカ54から発音された信号(音声)は視聴者59の右耳で受聴されると共に、発音された信号の一部は破線にて示す第2のクロストーク信号として視聴者59の左耳で受聴される。クロストークキャンセラ27は視聴者59の左耳で受聴される第2のクロストーク信号を打ち消すための第2のクロストーク打消し信号

を生成してスピーカ53から発音させる。第2のクロストーク打消し信号により第2のクロストーク信号は打ち消される(減衰される)。結果として、視聴者59は左耳でクロストークがキャンセルされた音声信号$P_l(t)$を受聴し、右耳でクロストークがキャンセルされた音声信号$P_r(t)$を受聴する。

[0071] ＜頭部伝達関数の測定＞

図15を用いて、フィルタ272a～272d, 275a, 275bに格納する頭部伝達関数特性を求めるための頭部伝達関数測定装置6について説明する。図15に示すように、頭部伝達関数測定装置6は、パーソナルコンピュータ61、増幅器62、スピーカ63、マイクユニット65a, 65b、円筒形構造体65e、増幅器66a, 66bを備えて構成されている。

[0072] 頭部伝達関数の測定方法について説明する。

[0073] まず、パーソナルコンピュータ61により例えばインパルス音よりなる測定信号を生成する。測定信号は増幅器62で増幅される。左側のスピーカ63から発音された測定信号は左右のマイクユニット65a, 65bで受音される。受音して得られた左右の信号は増幅器66a, 66bで増幅されてパーソナルコンピュータ61に入力される。この入力信号はスピーカ63から発音された音声を円筒形構造体65eに取り付けられた左右のマイクユニット65a, 65bで受音した信号の頭部伝達関数$h_{ls}(t)$, $h_{lo}(t)$である。頭部伝達関数$h_{ls}(t)$は左側のスピーカ63から発音された信号が左側のマイクユニット65aで受聴される特性であり、頭部伝達関数$h_{lo}(t)$は左側のスピーカ63から発音された信号が右側のマイクユニット65bで受聴されるクロストーク成分の特性である。

[0074] 同様に、右側のスピーカ64から発音された測定信号は左右のマイクユニット65a, 65bで受音される。受音して得られた左右の信号は増幅器66a, 66bで増幅されてパーソナルコンピュータ61に入力される。パーソナルコンピュータ61は生成した測定信号と受音した信号とを比較することにより、スピーカ64から発音された音声を円筒形構造体65eに取り付けられた左右のマイクユニット65a, 65bで受音した信号の頭部伝達関数$h_{rs}(t)$, $h_{ro}(t)$を求める。頭部伝達関数$h_{rs}(t)$は右側のスピーカ64から発音された信号が右側のマイクユニット65bで受聴される特性であり、頭部伝達関数$h_{ro}(t)$は右側のスピーカ64から発音された信号が左側のマイクユニット65aで受聴さ

れるクロストーク成分の特性である。

[0075] 図16を用いて円筒形構造体65eについて説明する。図16において、(A)は円筒形構造体65eの上面図、(B)は円筒形構造体65eの斜視図であり、(C)は比較のため示すいわゆるダミーヘッドマイクの断面図である。

[0076] 図16(A), (B)に示すように、円筒形構造体65eの表面にはマイクユニット65a, 65bが180° 離間した状態で装着されている。図示のように、マイクユニット65a, 65bは耳介及び外耳道を有していない。マイクユニット65a, 65bの図示しない振動板は円筒形構造体65eの表面とほぼ一致する位置に配置されている。一方、図16(C)に示すダミーヘッドマイク69は、人工頭691の両側部に耳介形部材692a, 692bと耳道693a, 693bとを備え、耳道693a, 693bの奥部にマイクユニット694a, 694bを備えたものである。マイクユニット694a, 694bは人の鼓膜の位置に相当する位置に設けられており、人が聴取する音に近似する音声信号を集音するものである。

[0077] 図16(A), (B)に示す円筒形構造体65eに取り付けられたマイクユニット65a, 65bの受音特性は、人それぞれで大きさや形状が異なる耳介や外耳道により与えられる特性差の影響を受けることがなく、頭部伝達関数を計測することができる特性である。スピーカ63, 64から発音された音波は円筒形構造体65eにより遮蔽されるものの、円筒形構造体65eに添って回折してマイクユニット65a, 65bに到達する。マイクユニット65a, 65bはスピーカ63, 64から発音されて直接到達する音波と円筒形構造体65eに添って回折して到達する音波とよりなる特性を計測することになる。円筒形構造体65eを用いることにより、平均的な頭部遮蔽特性を有する頭部伝達関数を得ることができる。従って、頭部の大きさや形状が異なり頭部遮蔽特性が異なる種々の視聴者がバイノーラル音声信号を受聴しても、違和感のほとんどない臨場感のある音声を受聴することができる。

[0078] 図17(A)～(D)は、前述の音響信号伝達特性測定装置6が発生したインパルス音に、音響信号伝達特性測定装置6によって測定した円筒形構造体65eの頭部伝達関数$h_{ls}(t)$, $h_{lo}(t)$, $h_{rs}(t)$, $h_{ro}(t)$が畳み込まれたインパルス応答波形を示している。図17(D)は前述の(1)式に示すフィルタ特性d(t)を示している。図17(A)～(E)において、縦軸は所定の出力電圧で正規化した信号電圧の振幅を示し、横軸は測

定された信号を48kHzで標本化した場合のサンプルの個数で表した時間を示している。

[0079] 図18(A)～(E)は、図17(A)～(E)に示す信号をフーリエ解析して得られる周波数特性を示している。図18(A)～(E)において、100Hz, 1kHz, 10kHzの周波数位置を破線の縦線で示しており、縦軸の応答特性における2つの破線の横線間の利得差は10dBである。

[0080] 図14のフィルタ272a～272dには、以上のようにして得られた頭部伝達関数$h_{rs}(t)$, $h_{lo}(t)$, $h_{ro}(t)$, $h_{ls}(t)$に基づいたフィルタ特性が与えられる。前述のように、フィルタ272a, 272dには頭部伝達関数$h_{rs}(t)$, $h_{ls}(t)$に相当するフィルタ特性が与えられ、フィルタ272b, 272cには頭部伝達関数$h_{lo}(t)$, $h_{ro}(t)$を極性反転した$-h_{lo}(t)$, $-h_{ro}(t)$に相当するフィルタ特性が与えられる。

[0081] 比較のため、円筒形構造体65eに取り付けたマイクユニット65a, 65bの代わりに図16(C)に示すダミーヘッドマイク69を用いて測定した特性を図19, 図20に示す。図19は図17と同様に測定して得られた特性である。図17と図19とを比較すれば分かるように、円筒形構造体65eに取り付けたマイクユニット65a, 65bを用いて測定したインパルス応答波形は、ダミーヘッドマイク69を用いて測定したインパルス応答波形よりも、測定用入力信号であるインパルス音に近い波形である。

[0082] 図20はダミーヘッドマイク69を用いて測定した周波数応答特性である。図18と図20とを比較すれば分かるように、円筒形構造体65eに取り付けたマイクユニット65a, 65bを用いて得た特性の方が周波数特性の乱れが小さく平坦に近い。図20(A)～(E)に示すそれぞれの特性は、1．5～7kHzの周波数において応答特性が増強されたり減衰されたりしている。図18(A)～(E)に示す特性の方が応答特性の増強及び減衰の程度が小さい。これは円筒形構造体65e取り付けたマイクユニット65a, 65bを用いた場合には耳介や外耳道により生じる特性の乱れがないためである。ダミーヘッドマイク69では、スピーカ63, 64より発音された音波の一部が耳介で反射して、反射した音波と直接到来する音波とが同相で合成されて増強されたり、逆相で合成されて減衰したりする。また、外耳道の共振や反共振などの影響により特定の周波数で増強されたり減衰したりする。円筒形構造体65eに取り付けたマイクユニット65a, 65b

を用いることによりダミーヘッドマイク69を用いた場合のような悪影響を抑えることができる。

[0083] クロストークキャンセラ27のフィルタ272a～272d及びフィルタ275a，275bに、円筒形構造体65eに取り付けたマイクユニット65a，65bを用いて測定した頭部伝達関数に基づいたフィルタ特性（第1の条件とする）と、ダミーヘッドマイク69を用いて測定した頭部伝達関数に基づいたフィルタ特性とを与え（第2の条件とする）、複数の視聴者による両者の比較視聴テストを行った。視聴者の耳道に細い小型マイクを挿入し、その小型マイクで受音される音が視聴者により受聴される音であるとして受音特性を測定した。

[0084] 図21は、第1の条件で、ある視聴者により測定した特性を示している。図21において、（A）は左側の入力信号$P_L(t)$をインパルス信号、右側の入力信号$P_R(t)$を無信号としてスピーカ53，54から発音させ、視聴者の左耳に装着した小型マイクで受音されたインパルス応答信号の波形である。（B）は（A）と同じ条件で発音させ、視聴者の右耳に装着した小型マイクで受音されたクロストーク成分の波形である。図21（A）では大きなレベルのインパルス応答波形が得られ、図21（B）では小さなレベルの波形が得られている。図21（C）は応答波形の周波数分析結果であり、Caは（A）の応答波形を周波数分析した応答特性であり、Cbは（B）の応答波形を周波数分析した応答特性である。100Hz～2kHzで20dBを越えるクロストークキャンセル効果が得られている。

[0085] さらに、図21において、（D）は左側の入力信号$P_L(t)$を無信号、右側の入力信号$P_R(t)$をインパルス信号としてスピーカ53，54から発音させ、視聴者の左耳に装着した小型マイクで受音されたクロストーク成分の波形である。（E）は（D）と同じ条件で発音させ、視聴者の右耳に装着した小型マイクで受音されたインパルス応答の波形である。図21（D）では小さなレベルの波形が得られ、図21（E）では大きなレベルのインパルス応答波形が得られている。図21（F）は応答波形の周波数分析結果であり、Fdは（D）の応答波形を周波数分析した応答特性であり、Feは（E）の応答波形を周波数分析した応答特性である。100Hz～2kHzで16dB程度のクロストークキャンセル効果が得られている。

[0086] 図22は、第2の条件で、図21と同じ視聴者により測定した特性を示している。測定条件は図21と同一である。図22(C)のクロストークキャンセル効果は約14dBであり、図22(F)のクロストークキャンセル効果は約11dBである。第2の条件では第1の条件と比較して効果が劣っていることが分かる。

[0087] 図23は、図21，図22とは異なる視聴者とし、第1の条件にて図21と同一の測定条件で測定した特性を示している。図23(C)のクロストークキャンセル効果は約22dBであり、図23(F)のクロストークキャンセル効果は約18dBである。異なる視聴者であっても良好な効果が得られている。

[0088] 図24は、図23と同じ視聴者で、第2の条件にて図22と同一の測定条件で測定した特性を示している。図24(C)のクロストークキャンセル効果は約14dBであり、図24(F)のクロストークキャンセル効果は約10dBである。異なる視聴者であっても、第2の条件では第1の条件と比較して効果が劣っていることが分かる。さらに異なる視聴者により同様の測定を行い、第1の条件と第2の条件それぞれで上記と同様の効果が得られることを確認した。

[0089] 以上の測定結果より、クロストークキャンセラ27のフィルタ272a～272d及びフィルタ275a，275bに与えるフィルタ特性は、ダミーヘッドマイク69を用いて測定した頭部伝達関数に基づいたフィルタ特性よりも円筒形構造体65eに取り付けたマイクユニット65a，65bを用いて測定した頭部伝達関数に基づいたフィルタ特性の方が、左側のスピーカから発音されて右側の耳で受聴されるクロストーク成分と右側のスピーカから発音されて左側の耳で受聴されるクロストーク成分を打ち消す効果が大きいことが確認された。

[0090] 円筒形構造体65eに取り付けたマイクユニット65a，65bを用いて測定した頭部伝達関数に基づいたフィルタ特性では、高音域での周波数特性の乱れが少な。即ち、円筒形構造体65eを用いることにより、特定の周波数部分で周波数特性が大きく落ち込んだり上昇したりすることを少なくすることができ、音質の劣化を極力抑えることができる。これにより視聴者はほとんど違和感を覚えることなく臨場感のある音声を受聴することが可能となる。

[0091] クロストークキャンセラ27のフィルタ272a～272d及びフィルタ275a，275bに与え

るフィルタ特性を円筒形構造体65eに取り付けたマイクユニット65a，65bを用いて測定した頭部伝達関数に基づいたフィルタ特性とした場合には、クロストークキャンセルを、バイノーラル音声信号を受聴する際の構造体である視聴者59の外耳道入り口近傍で行うことになる。従って、耳介や外耳道の音響特性が異なる複数の視聴者59に対してクロストーク成分の打消しが効果的になされることになる。

[0092] なお、円筒形構造体65eは完全な円筒形に限定されるものではなく、円筒形を若干変形させた形状であってもよい。耳介や外耳道などが与えるような応答特性の変化を与える凹凸部分を有さない形状とするのが好ましく、円筒形構造体65eにマイクユニット65a，65bを取り付けた状態で応答特性の乱れが極力少ないことが好ましい。

[0093] クロストークキャンセラ27は図14に示す構成に限定されることはなく、低域周波数帯域で生じる逆相感をさらに減少させることができる帯域分割型のクロストークキャンセラとしてもよい。帯域分割型のクロストークキャンセラは、全周波数帯域の信号として入力されるバイノーラル音声信号を低域周波数帯域の信号と中高域周波数帯域の信号とに分割し、中高域周波数帯域のバイノーラル音声信号に対してのみクロストークキャンセル処理を行うものである。

[0094] 図25に帯域分割型のクロストークキャンセラ27aを示し、その構成と動作について説明する。図14に示したクロストークキャンセラ27と同一の機能を有する構成部分には同一符号を付し、その説明を省略する。

[0095] 図25に示すように、クロストークキャンセラ27aは、図14のクロストークキャンセラ27と比較して、ローパスフィルタ(LPF)271a，271d、ハイパスフィルタ(HPF)271b，271c、遅延器273a，273b、ゲインコントロールアンプ(GC)276a～276d、加算器277a，277bが追加されている点で相違している。

[0096] クロストークキャンセラ27aに入力されたバイノーラル音声信号のうち、左チャンネルの信号$P_L(t)$はLPF271aとHPF271bに入力され、右チャンネルの信号$P_R(t)$はLPF271dとHPF271cに入力されて、低域周波数帯と中高域周波数帯とに分割される。LPF271a，271dとHPF271b，271cのカットオフ周波数は100～200Hz程度に設定される。

[0097] HPF271b, 271cより出力された中高域周波数帯の信号は、クロストークキャンセラ27と同様に構成されるフィルタ272a～272dと加算器274a, 274bとフィルタ275a, 275bとよりなる回路部分でクロストークキャンセル処理が施される。クロストークキャンセル処理が施された中高域周波数帯の信号はゲインコントロールアンプ276b, 276cに入力され、ゲインが調整される。

[0098] LPF271a, 271dより出力された低域周波数帯の信号は遅延器273a, 273bに入力され、中高域周波数帯の信号に対するクロストークキャンセル処理に要する時間とほぼ同じ時間だけ遅延される。遅延器273a, 273bより出力された低域周波数帯の信号はゲインコントロールアンプ276a, 276dに入力され、中高域周波数帯の信号とのレベル差がなくなるようゲインが調整される。

[0099] そして、加算器277a, 277bは、ゲインコントロールアンプ276a～276dから出力された低域周波数帯の信号と中高域周波数帯の信号とを加算する。加算器277a, 277bより出力された信号は、中高域周波数帯の信号に対してのみクロストークキャンセル処理が施されたクロストーク処理信号である。加算器277a, 277bから出力されたロストーク処理信号は、アンプ51の左チャンネルアンプ51aと右チャンネルアンプ51bでそれぞれ増幅され、スピーカ53, 54から発音される。

[0100] この図25の構成では、低域周波数帯の信号に対してはクロストークキャンセル処理が施されないため、低域周波数帯で逆相感のない信号として再生される。

[0101] 図14に示すクロストークキャンセラ27では、前述の図21～図24にて説明したように、クロストークキャンセラ27によるクロストークキャンセル効果は100Hz以下では十分に得られていない。100Hz以下の低域周波数帯は音源の定位に与える影響が少ない帯域である。クロストークをキャンセルしない信号は逆相の信号として違和感を有して受聴されてしまう。

[0102] 図25に示すクロストークキャンセラ27aでは、100～200Hz以下の低域周波数帯でクロストークキャンセルを行わないようにし、低域周波数帯で逆相信号が生じないようにしたクロストークキャンセラを実現している。

[0103] 図26に、図25とはフィルタの構成方法が異なる周波数帯域分割型のクロストークキャンセラ27bを示し、その構成と動作について説明する。図25に示したクロストークキ

ャンセラ27aと同一の機能を有する構成部分には同一符号を付し、その説明を省略する。

[0104] 図26に示すクロストークキャンセラ27bは、図25のクロストークキャンセラ27aと比較して、フィルタ272a～272d及びフィルタ275a, 275bの代わりにフィルタ278a, 278b及びフィルタ279a, 279bを備える点で相違しており、結線方法も異なっている。クロストークキャンセラ27aはフィルタ特性をフィードフォワード型のFIR(finite impulse response:有限インパルス応答)形で構成しているのに対し、クロストークキャンセラ27bはフィルタ特性をフィードバック型のFIR形で構成している。

[0105] 図26において、HPF271b, 271cより出力された中高域周波数帯の信号は、FIR形のフィルタ278a, 278b, 279a, 279b及び加算器274a, 274bによってクロストークキャンセル処理が施される。頭部伝達関数測定装置6で求められたフィルタ特性は、フィルタ278a, 278b, 279a, 279b内の図示しない記憶領域に格納され、フィルタ278a, 278b, 279a, 279bは入力される信号にそれぞれのフィルタ特性を畳み込んで出力する。クロストークキャンセラ27bによれば、低域周波数帯で逆相信号が生じないようにして違和感を軽減するという点でクロストークキャンセラ27aと同様の作用効果を奏する。図26に示すクロストークキャンセラ27bの方が図25に示すクロストークキャンセラ27aよりも使用するフィルタの次数を少なくすることができ、構成を簡略化できる。なお、FIR形のフィルタの代わりにIIR形(infinite impulse response:無限インパルス応答)のフィルタを用いてもよい。

[0106] 図3に示す構成においては、クロストークキャンセラ27(または27a, 27b)を制御部47とは別構成としているが、制御部47がDSP(Digital signal processor)を備えたマイクロプロセッサの場合には、クロストークキャンセラ27, 27a, 27bの機能を制御部47に実行させてもよい。また、クロストークキャンセラ27, 27a, 27bはハードウェアに限定されず、ソフトウェアによって実現することができる。

[0107] ＜ヘッドフォン再生＞

ところで、図3に示す映像音声記録再生装置101においては、オーディオ復号化部26より出力される音声信号をヘッドフォンでも受聴できるようにしている。バイノーラル音声信号をヘッドフォンで受聴する場合には、上述したクロストーク成分は生じな

い。クロストークキャンセラ27にて処理したクロストーク処理信号をヘッドフォンで受聴するとバイノーラル音声信号の逆相成分が左右の耳で受聴されてしまう。逆相成分は自然界にない音響信号成分であり、受聴上好ましくないため、バイノーラル音声信号をヘッドフォンでも受聴する場合にはクロストークキャンセル処理を行わない。

[0108] そこで、図3に示すように、オーディオ復号化部26より出力された音声信号を、クロストークキャンセラ27を介することなく音声出力端子37cに出力するようにしている。音声出力端子37cから出力された音声信号はヘッドフォン55へ供給される。視聴者59は前述のようにクロストークキャンセラ27より出力されたクロストーク処理信号をスピーカ53，54によって受聴することもできるし、クロストークキャンセラ27による処理を施していない音声信号をヘッドフォン55によって受聴することもできる。

[0109] 図27を用いてバイノーラル音声信号のヘッドフォン55での再生手順について説明する。図13に示すフローチャートと同一の処理には同一の符号を付し、その説明を省略することとする。

[0110] 図27において、ステップS181～S186までは図13で説明した通りであり、ステップS192にて、ヘッドフォン55での再生か否かを判定する。ヘッドフォン55の接続端子である音声出力端子37cにプラグが挿入されているかを図示していない接続検出部によって検出すればよい。ステップS192でヘッドフォン再生であると判定されれば(YES)、ステップS193にて、ビデオ信号に同期してクロストークキャンセル処理を行わないバイノーラル音声信号をヘッドフォン55にて再生して、ステップS190に移る。なお、再生した音声信号がバイノーラル音声信号ではない通常のステレオ音声の場合も同様にオーディオ復号化部26より出力された音声信号をヘッドフォン55に供給すればよい。

[0111] ステップS192でヘッドフォン再生であると判定されなければ(NO)、図13と同様、ステップS187～S190の処理を行う。ステップS189での処理は、ステップS193でのヘッドフォン55による再生処理とは異なり、バイノーラル音声信号をスピーカ53，54によって再生する処理である。

[0112] ≪第2の実施形態≫

撮影者300は左右の耳302にバイノーラルマイク3を装着して集音しながら被写体

の撮影及び記録媒体44への記録を行うことにより、視聴者59は撮影者300が撮影を行った際の全方向の周囲音を受聴することができる。ところが、通常の映像音声記録再生装置(ビデオカメラ)により撮影される映像はカメラ前方約60度の範囲の映像である。ズーム撮影を行う場合にはさらに狭い視野角で撮影される。そこで、ズーム撮影を行う場合には、ズームアップされた被写体の近傍から発音される音声を増強して集音できることが望ましい。第2の実施形態は、被写体のズームアップに併せて、被写体近傍の音声を増強して集音して記録するように構成したものである。

[0113] 図28に第2の実施形態である音声のズーム処理部を備えた映像音声記録再生装置102を示し、その構成と動作について説明する。図3に示した第1の実施形態の映像音声記録再生装置101と同じ機能を有する構成部分には同一符号を付し、その説明を省略する。映像音声記録再生装置102は映像音声記録再生装置101と比較して音声ズーム処理部33を備える点が相違している。なお、図28では、ヘッドフォン55とヘッドフォン55の接続端子である音声出力端子37cの図示を省略している。

[0114] 図28において、外部マイク接続端子32を介して入力されるバイノーラルマイク3からの音声信号は音声ズーム処理部33に入力される。カメラ部11は複数のレンズ(図示せず)を備え、一または複数のレンズを移動させてレンズ間距離を可変することによって被写体をズームアップ/ダウンするズーム機能を有している。操作部48によってズームアップ操作がなされると、制御部47からズームアップ制御信号がカメラ部11に入力されて被写体がズームアップされて撮像されると共に、ズームアップ制御信号が音声ズーム処理部33に入力されて入力された音声信号に対して音声のズームアップ処理が施される。

[0115] 音声ズーム処理部33は、ズームアップ制御信号に基づいて、バイノーラル音声信号のうち被写体近傍から発せられる音声信号を多く含む撮影者300の正中面で集音される音声信号を増強してズームアップ音声信号を生成する。ズームアップ音声信号はスイッチSw1を介してオーディオ符号化部22に入力される。ズームアップ撮像された被写体の映像信号はビデオ符号化部12で符号化され、ズームアップ音声信号はオーディオ符号化部22で符号化され、第1の実施形態と同様に記録媒体44に記録される。

[0116] 図29は音声ズーム処理部33の具体的な構成例である。図29に示すように、音声ズーム処理部33は、ズーム倍率検出器331，係数算出器332，加算器335、可変増幅器337、加算器338a，338bを備えて構成されている。

[0117] 図29において、ズーム倍率検出器331は制御部47から供給されるズームアップ制御信号を基にズーム倍率を検出する。係数算出器332は検出されたズーム倍率に応じて被写体近傍から発せられる音声の増強度を表す係数αを算出する。加算器335は外部マイク接続端子32より入力された左右チャンネルのバイノーラル音声信号を加算する。可変増幅器337は加算器335の出力信号を係数算出器332からの係数αに従って増幅する。加算器338a，338bは、可変増幅器337の出力信号にそれぞれ左，右チャンネルのバイノーラル音声信号を加算する。バイノーラルマイク3のマイク31a，31bを撮影者300の左右の耳302に装着した状態でマイク31a，31b内の振動板はほぼ平行となる。撮影者300の左右方向からの音声は互いに逆相の成分を含むことがあるので、加算器335での左右チャンネルの加算の結果、左右方向からの音声は部分的に相殺されて減衰する。従って、音声ズーム処理部33からは、撮影者300の正中面で集音される音声が増強されたズームアップ音声信号が出力されることになる。

[0118] 図30を用いて、音声ズーム処理部33での動作を含む映像音声記録再生装置102の動作についてさらに説明する。図30において、ステップS201にて、加算器335はバイノーラルマイク3からの左右チャンネルのバイノーラル音声信号を加算して加算信号Sを得る。ステップS202にて、ズーム倍率検出器331は操作部48の操作に応じて制御部47で得られるズーム倍率を検出する。ズーム倍率をカメラ部11のレンズを駆動するモータへの印加電圧と駆動時間との関係から求めるようにしてもよい。ステップS203にて、係数算出器332はズーム倍率に応じて増強度を表す係数αを算出する。ステップS204にて、可変増幅器337は加算器335の出力信号に係数αを乗じてαSを求める。ステップS205にて、加算器338a，338bは、左，右チャンネルのバイノーラル音声信号と可変増幅器337の出力信号(αS)とを加算する。そして、ステップS206にて、ズームアップ音声信号を記録媒体44に記録する。ステップS207にて、制御部47は記録が終了したか判定し、終了していなければ(NO)、ステップ

S201から繰り返す。ステップS207で記録が終了していれば(YES)、音声ズーム処理部33での処理を終了する。

[0119] 図31は、音声ズーム処理部33の他の構成例を示す音声ズーム処理部33aを示している。正中面の音声信号に対して音源が受聴者に接近したような効果を与えるような頭部伝達関数を畳み込むと、カメラ部11での被写体のズームアップに連動して音源があたかも受聴者に接近したように感じられ、さらに臨場感を有する音声信号を受聴することができる。図31に示す音声ズーム処理部33aは、正中面の音声信号に音源を接近させるような効果を与える頭部伝達関数を畳み込むように構成したものである。

[0120] 図31に示す音声ズーム処理部33aは、図29の音声ズーム処理部33と比較して、関数取得器333, 伝達関数メモリ334, 畳み込み演算器336が追加されている点で相違している。

[0121] 図31において、伝達関数メモリ334には音源を仮想的に近接して定位させた仮想音源を形成するための頭部伝達関数を記憶しておく。その頭部伝達関数は仮想音源から発せられる音の受聴特性を得るための関数であり、受聴特性は仮想音源と受聴者との距離によって決まる。

[0122] 関数取得器333は、係数算出器332で算出される係数αに従って想定される音源の定位位置に対応する頭部伝達関数を伝達関数メモリ334から取得する。なお、図29における係数αと図31及び他の図における係数αとは必ずしも同じものではないが、便宜上同一の符号を付す。畳み込み演算器336は、加算器335で生成されたバイノーラル音声の加算信号に関数取得器333で取得された頭部伝達関数を畳み込む。可変増幅器337は、頭部伝達関数が畳み込まれた加算信号を係数算出器332で得られた係数αに従って増幅する。加算器338a, 338bは、左, 右チャンネルのバイノーラル音声信号と可変増幅器337の出力信号とを加算する。ここでは、可変増幅器337を備える構成としたが、音源を仮想的に近接して定位さるのみでも十分に効果的であり、可変増幅器337を省略することも可能である。また、関数取得器333が頭部伝達関数を選択するための係数αと、可変増幅器337における増幅の程度を決める係数αとを別の係数としてもよい。

[0123] 図32を用いて、仮想音源を形成するための頭部伝達関数の測定方法について説明する。

[0124] 図32に示す頭部伝達関数測定装置6aは、パーソナルコンピュータ61、増幅器62、スピーカ63、増幅器66a, 66b、ダミーヘッドマイク68を備えて構成されている。ダミーヘッドマイク68は、人工頭681にマイクユニット684a, 684bを装着している。頭部伝達関数測定装置6aは、図15に示した頭部伝達関数測定装置6と比較して、円筒形構造体65eに装着したマイクユニット65a, 65bの代わりにダミーヘッドマイク68を用いている点、及び、スピーカを左右のスピーカ63, 64の一方のみとして(ここではスピーカ63を使用)ダミーヘッドマイク68の正中面に配置している点で相違している。

[0125] 図33にダミーヘッドマイク68の断面図を示す。ダミーヘッドマイク68は、耳介形部材682a, 682bを備える人工頭681の耳道683a, 683bの入口近傍にマイクユニット684a, 684bを配置したものである。図16(C)に示したダミーヘッドマイク69は、耳道693a, 693bの奥部の人の鼓膜の位置に相当する位置にマイクユニット694a, 694bを配置したものであり、ダミーヘッドマイク68では耳道683a, 683bの入口近傍にマイクユニット684a, 684bを配置している点でダミーヘッドマイク69と相違している。なお、通常、ダミーヘッドマイクとは、図16(C)に示すように耳道693a, 693bの奥部の人の鼓膜の位置に相当する位置にマイクユニット694a, 694bを配置するものをいうが、耳介形部材682a, 682bを備える人工頭681の耳道683a, 683bの入口近傍にマイクユニット684a, 684bを配置した図33のものも便宜上ダミーヘッドマイクと称している。

[0126] ダミーヘッドマイク68を用いることにより、スピーカ63からの音声を耳道683a, 683bによる影響が除かれたバイノーラル音声として集音することができる。

[0127] 図32に戻り、パーソナルコンピュータ61により例えばインパルス音よりなる測定信号を生成する。測定信号は増幅器62で増幅される。スピーカ63から発音された測定信号はダミーヘッドマイク68の左右のマイクユニット684a, 684bで受音される。受音して得られた左右の信号は増幅器66a, 66bで増幅されてパーソナルコンピュータ61に入力される。パーソナルコンピュータ61は生成した測定信号と受音した信号とを

比較することにより、ダミーヘッドマイク68の頭部伝達関数$h_l(t)$, $h_r(t)$を求める。頭部伝達関数$h_l(t)$は左側のマイクユニット684aでの受音信号により求めた頭部伝達関数、頭部伝達関数$h_r(t)$は右側のマイクユニット684bでの受音信号により求めた頭部伝達関数である。スピーカ63とダミーヘッドマイク68との距離Dを、例えば0．5m，1m，2mなどのように設定し、それぞれの距離Dにおける頭部伝達関数を順次求める。

[0128] 図34～図39に、図32に示した頭部伝達関数測定装置6aで測定して得られた頭部伝達関数の特性を示す。

[0129] 図34(A)に示すインパルス応答波形は、スピーカ63とダミーヘッドマイク68との距離Dが50cmの場合に左側のマイクユニット684aで受音された波形である。縦軸は正規化された振幅（電圧）である。横軸は時間であり、標本化周波数が48kHzである信号の標本点の数で示してある。図34（B）は図34（A）に示すインパルス応答波形をパーソナルコンピュータ61でフーリエ解析して得られた周波数応答特性である。横軸が周波数（Hz）であり、縦軸は応答特性である。

[0130] 図35（A）は距離Dが50cmの場合に右側のマイクユニット684bで受音されたインパルス応答波形である。図35（B）は図35（A）に示すインパルス応答波形をフーリエ解析して得られた周波数応答特性である。測定条件は図34と同じである。

[0131] 以下、同様にして、図36（A）は距離Dが1mの場合に左側のマイクユニット684aで受音されたインパルス応答波形、図36（B）はその周波数応答特性である。

[0132] 図37（A）は距離Dが1mの場合に右側のマイクユニット684bで受音されたインパルス応答波形、図37（B）はその周波数応答特性である。

[0133] 図38（A）は距離Dが2mの場合に左側のマイクユニット684aで受音されたインパルス応答波形、図38（B）はその周波数応答特性である。

[0134] 図39（A）は距離Dが2mの場合に右側のマイクユニット684bで受音されたインパルス応答波形、図39（B）はその周波数応答特性である。

[0135] それらの特性を比較すると、図34～図39の（A）に示すインパルス応答波形は距離Dの値を0．5m，1m，2mと増加させると波形の振幅は減少する。図34～図39の（B）に示す周波数応答特性は、距離Dが0．5mの場合は破線の楕円で囲んだ1kHz～