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

(11) EP 3 621 314 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.03.2020 Bulletin 2020/11

(51) Int Cl.:
H04R 3/04 *(2006.01)*

(21) Application number: **18192859.9**

(22) Date of filing: **06.09.2018**

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

(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(72) Inventor: **YILMAZLAR, Ísmail**
45030 Manisa (TR)

(74) Representative: **Flint, Adam**
Page White & Farrer
Bedford House
John Street
London WC1N 2BF (GB)

(54) AUDIO PROCESSOR AND METHOD OF PROCESSING AN AUDIO SIGNAL

(57) An audio signal (14) is received as an input at an audio processor (12). The audio processor (12) processes the input audio signal (12) to provide an audio signal to be output (16) to a loudspeaker. The processing of the input audio signal (12) reduces the power of the input audio signal (12) at a resonant audio frequency and increases the power of the input audio signal (12) at at least some other audio frequencies other than the resonant audio frequency.

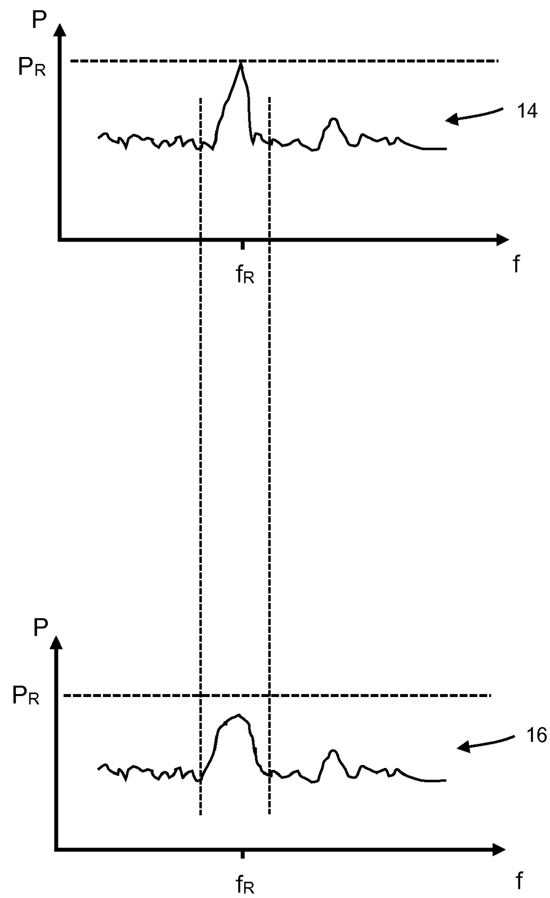

Fig. 4

EP 3 621 314 A1

Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present disclosure relates to an audio processor and a method of processing an audio signal.

Background

[0002] A problem that often occurs with sound reproduction apparatus is that some part of the apparatus, such as a cabinet or casing or the like, vibrates during playback of audio. Common solutions to this include fitting vibration dampeners, such as felt or rubber pads or the like, tightening screws or the like that hold the cabinet together, or simply turning down the playback volume. However, such solutions are often not convenient for the manufacturer and/or user of the apparatus.

Summary

[0003] According to a first aspect disclosed herein, there is provided a method of processing an audio signal, the method comprising:

receiving an audio signal as an input;
processing the input audio signal to provide an audio signal to be output to a loudspeaker, in which the processing of the input audio signal reduces the power of the input audio signal at a resonant audio frequency and increases the power of the input audio signal at at least some other audio frequencies other than the resonant audio frequency.

[0004] The reduction of the power, in particular the instantaneous power, of the input audio signal at the resonant audio frequency can reduce or even entirely eliminate the resonance being caused to some sound reproduction apparatus and therefore the vibration or buzzing that can occur. The increase of the power of the input audio signal at at least some other audio frequencies can help to "disguise" the reduction of the power at the resonant frequency, which makes the reduction in volume at the resonant frequency less noticeable for the user.

[0005] In an example, the resonant frequency is a resonant frequency of a cabinet in which the loudspeaker is mounted, the resonant frequency being identified using a vibration sensor which is attached to a cabinet in which the loudspeaker is mounted.

[0006] In an example, the output of the vibration sensor is subject to a Fast Fourier Transform FFT to identify the resonant frequency.

[0007] In an example, the total or average power of the output audio signal is substantially the same as the total or average power of the input audio signal. For example, the total or average power of the output audio signal may be within around 5% of the total or average power of the input audio signal.

[0008] In an example, the other audio frequencies are frequencies that are within 5% of the resonant frequency. In an example, the other audio frequencies are frequencies that are within 2% of the resonant frequency.

[0009] According to a second aspect disclosed herein, there is provided an audio processor for processing an input audio signal, the audio processor being arranged to: process an input audio signal to provide an audio signal to be output to a loudspeaker, wherein the processor is configured such that the processing of the input audio signal reduces the power of the input audio signal at a resonant audio frequency and increases the power of the input audio signal at at least some other audio frequencies other than the resonant audio frequency.

[0010] In an example, the processor is arranged to obtain the resonant frequency from data storage in which the resonant frequency is stored.

[0011] In an example, the processor is arranged to obtain the resonant frequency using a vibration sensor which is attached to a cabinet in which said loudspeaker is mounted.

[0012] In an example, the output of the vibration sensor is arranged to be subject to a Fast Fourier Transform FFT to identify the resonant frequency.

[0013] In an example, the processor is configured such that the total or average power of the output audio signal is substantially the same as the total or average power of the input audio signal.

[0014] In an example, the processor is configured such that the other audio frequencies are frequencies that are within 5% of the resonant frequency.

[0015] There may also be provided a sound reproduction apparatus, the sound reproduction apparatus comprising an audio processor as described above and at least one loudspeaker which is arranged to receive an output audio signal which is output by the audio processor.

Brief Description of the Drawings

[0016] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows a schematic block diagram of an example of an audio processing arrangement according to the present disclosure;

Figure 2 shows schematically a first example of a sound reproduction apparatus;

Figure 3 shows schematically a second example of a sound reproduction apparatus; and

Figure 4 shows schematically examples of waveforms for an input audio signal and a corresponding output audio signal produced by processing the input audio signal.

Detailed Description

[0017] Examples of the present disclosure are applicable to audio processors for various types of sound reproduction apparatus as well as being applicable to various types of sound reproduction apparatus. Such sound reproduction apparatus typically includes one or more loudspeakers. Herein, the term "loudspeaker" is in general used to describe an electroacoustic transducer which converts an electrical audio signal into a corresponding sound. The loudspeaker may be of the "dynamic cone speaker" type having a diaphragm or cone which is driven to move by a voice coil. In other examples, the loudspeaker may be of another type, including for example a magnetostatic speaker, an electrostatic loudspeaker, etc. The sound reproduction apparatus may be a standalone system, such as a combination of one or more speakers with a separate sound processing unit, or an integrated system of speakers and sound processing unit (often called a "sound bar" or the like). In other examples, the sound reproduction apparatus may be provided as part of some other equipment, such as a television set, a computer, especially a laptop or notebook computer or the like, etc., which has integral and/or separate speakers.

[0018] As mentioned, a problem that often occurs with sound reproduction apparatus is that some part of the apparatus, such as a cabinet or casing or the like, vibrates during playback of audio, often giving rise to an audible buzzing of the equipment. This is usually because of some resonance occurring at one or more resonant frequencies during audio playback. This is often some resonance occurring in the cabinet or casing in which the speakers are housed or some adjacent part of the cabinet or casing owing to the natural frequency of the cabinet or casing or the like being excited.

[0019] Common solutions to this include fitting vibration dampeners, such as felt or rubber pads or the like, or tightening screws or the like that hold the cabinet together. This may be carried out by the manufacturer of the sound reproduction apparatus as a final step in the manufacturing process. However, this is often not convenient and is time-consuming, increasing the manufacturing cost. Moreover, the resonant frequency may change over time and/or when the sound reproduction apparatus is deployed by the end consumer or other user. End consumers or other users may try to fit vibration dampeners or tighten up loose parts of the cabinet, etc., but this is inconvenient and troublesome for the user. Another option for the end user is simply to turn down the playback volume, but inevitably this spoils the enjoyment of the apparatus for the user.

[0020] In examples of the present disclosure, an input audio signal is processed to provide an audio signal to be output to a loudspeaker. The processing of the input audio signal reduces the power of the input audio signal at a resonant audio frequency and increases the power of the input audio signal at at least some other audio frequencies other than the resonant audio frequency. The reduction of the power, in particular the instantaneous power, of the input audio signal at the resonant audio frequency can reduce or even entirely eliminate the resonance being caused to some sound reproduction apparatus and therefore the vibration or buzzing that can occur. The increase of the power of the input audio signal at at least some other audio frequencies can help to "disguise" the reduction of the power at the resonant frequency, which makes the reduction in volume at the resonant frequency less noticeable for the user. The other audio frequencies, for which the power is increased, may be frequencies close to or adjacent to the resonant frequency. The total or average power of the output audio signal is substantially the same as the total or average power of the input audio signal.

[0021] Referring now to Figure 1, this shows a schematic block diagram of an example of an audio processing arrangement 10 according to the present disclosure. The audio processing arrangement 10 has an audio processor 12. The audio processor 12 receives as an input an input audio signal 14. The audio processor 12 processes the input audio signal 14 and outputs an output audio signal 16. The output audio signal 16 may then be passed to a separate amplifier to be amplified as required before being passed to one or more speakers for audio playback. Alternatively, the audio processor 12 may itself already amplify the output audio signal 16 as necessary.

[0022] The input audio signal 14 may be provided from one of a number of audio sources, depending on for example the equipment in which the audio processor 12 is used. For example, especially in the case that the audio processor 12 is part of a sound reproduction apparatus used in conjunction with or as part of a television set, the input audio signal 14 may be provided by a television broadcast signal (whether satellite, cable or terrestrial), or by a DVD player or Internet source, etc., which is feeding the television set. As other examples, especially in the case that the audio processor 12 is part of or used in conjunction with a computer, the input audio signal 14 may be provided from files stored on the computer, such as video or audio files. As yet other examples, the input audio signal 14 may be provided by a CD or MP3 or other audio or media player. Other examples of sources for the input audio signal 14 are possible.

[0023] Figure 1 also shows the audio processing arrangement 10 having a vibration sensor 18 which provides an output to a processing block 20 which in turn processes the output of the vibration sensor 18 to identify one or more resonant frequencies. In some examples, the processing block 20 may be provided as part of the audio processor 12. There may be a single vibration sensor 18 or plural vibration sensors 18, located at different positions, may be used.

[0024] As will become clear from the following discussion, the sensor 18 and the processing block 20 in some examples are only used during a manufacturing stage to identify one or more resonant frequencies at the time of manufacture. In such a case, of the components shown in Figure 1, only the audio processor 12 needs to be incorporated into a sound reproduction apparatus for end use by a user.

[0025] In other examples, the sensor 18 and the processing block 20 are incorporated with the audio processor 12 into a sound reproduction apparatus for end use by a user.

[0026] In operation of an example, the vibration sensor 18 is fitted to some part of the sound reproduction apparatus to allow one or more resonant frequencies of the sound reproduction apparatus to be determined. The vibration sensor 18 outputs an electrical signal that corresponds to vibration of the sound reproduction apparatus which occurs when sound is being output. A particularly suitable vibration sensor for this purpose is a piezoelectric transducer, though other vibration sensors, including other electroacoustic transducers, may be used.

[0027] The processing block 20 receives the output of the vibration sensor 18 and processes it to identify one or more resonant frequencies of the sound reproduction apparatus when sound is being output. A number of techniques for this are possible. A suitable technique is for the processing block 20 to carry out a Fast Fourier Transform (FFT) to identify the resonant frequency or frequencies. An FFT samples a signal over a period of time and divides it into its frequency components. These components are single sinusoidal oscillations at distinct frequencies each with their own power or amplitude (and phase). Large powers or amplitudes in any frequency or frequencies of the output of the FFT processing block 20 indicate that the sound reproduction apparatus, in particular part of the cabinet or housing or the like, is vibrating a large amount, which can be taken to be vibration owing to resonance at the frequency or frequencies having the large power.

[0028] In the case that the sensor 18 and the processing block 20 are used during a manufacturing stage to identify one or more resonant frequencies, data concerning the identified one or more resonant frequencies may be stored in some data storage associated with or part of the sound reproduction apparatus so as to be accessible later by the audio processor 12 during end use of the sound reproduction apparatus by the end user. An example of such a sound reproduction apparatus is shown schematically in Figure 2. In Figure 2, a sound reproduction apparatus 30, such as a television set, a computer, a sound processing unit, etc., has a cabinet or casing 32 in which are mounted a main processor 34 and data storage 36. In this example, the sound reproduction apparatus 30 has integral loudspeakers 38. In other examples, the loudspeakers 38 are provided separately and connected to the sound reproduction apparatus 30 using wired and/or wireless connections. The sound reproduction apparatus 30 also has an audio processor 12 as described herein. This may be a separate processor or its function may be provided by the main processor 34. In such a case, the vibration sensor 18 and the processing block 20 may be used during the manufacturing stage and are not (necessarily) provided in the end product version of the sound reproduction apparatus 30 which is made available to consumers or other end users.

[0029] Alternatively, the sensor 18 and the processing block 20 may be incorporated into the sound reproduction apparatus for use by the end user. An example of such a sound reproduction apparatus is shown schematically in Figure 3, in which the same reference numerals are used for the same or corresponding parts as in the example of Figure 2 and the description thereof is not repeated here. In the example of Figure 3, the sound reproduction apparatus 30 additionally has a vibration sensor 18 and a processing block 20 as described herein. The processing block 20 may be a separate processor or its function may be provided by the main processor 34 or the audio processor 12. The vibration sensor 18 is fitted to the cabinet or casing 32 to detect vibrations of the cabinet or casing 32. If the loudspeakers 38 are provided separately rather than integrally in the cabinet or casing 32, a vibration sensor 18 may be fitted to one or both loudspeaker cabinets instead of or in addition to a vibration sensor 18 fitted to the main cabinet or casing 32. In any event, in such a case the sensor 18 and the processing block 20 may be used during a preliminary set-up of the sound reproduction apparatus when the sound reproduction apparatus is installed or deployed by the user so as to identify one or more resonant frequencies. Again, the data concerning the identified one or more resonant frequencies may be stored in the data storage 36 so as to be accessible later by the audio processor 12 during end use of the sound reproduction apparatus by the end user. Alternatively or additionally, the sensor 18 and the processing block 20 may be used dynamically, in real time, when the sound reproduction apparatus 30 is being used by the end user.

[0030] In either case, when the sound reproduction apparatus is being used by the end user, the audio processor 12 processes the input audio signal 14 based at least in part on the identified one or more resonant frequencies and outputs the output audio signal 16. The audio processor 12 operates to reduce the power at the resonant frequency, in particular the instantaneous power at the resonant frequency. The objective here is to prevent resonance and therefore vibration of the sound reproduction apparatus occurring at the resonant frequency. As such, the audio processor 12 may only operate to reduce the power at the resonant frequency if the power was greater than some threshold. The threshold may be preset, for example by the manufacturer who determines a suitable threshold for the specific sound reproduction apparatus through testing, and/or may be adjustable by the user so that the user can "fine-tune" this aspect of the operation of the audio processor 12. Alternatively, the audio processor 12 may operate to reduce the power at the resonant frequency regardless of its power in the input audio signal 14. The amount of reduction of the power at the resonant frequency may be by a fixed amount (corresponding for example to a certain number of decibels, say 1 or 2 decibels, or Watts of output power, say 3 to 5 mWatts) or a percentage or proportion of the power at the resonant frequency (of say 5% or 10% or so say).

[0031] At the same time as reducing the power at the resonant frequency, the audio processor 12 processes the input audio signal 14 to increase the power of the input audio signal 14 at at least some other audio frequencies other than the resonant audio frequency. The objective here is to "disguise" the reduction of the power at the resonant frequency, which makes the reduction of volume at the resonant frequency less noticeable for the user. In an example, the reduction of the power at the resonant frequency and the increase of the power of the other frequencies is such that the total power (or, equivalently, the average power) of the output audio signal 16 is the same, or at least substantially the same, as the total (or average) power of the input audio signal 14 (to within 1% or within 5% or less say). Keeping the total (or average) power of the output audio signal 16 to be (at least approximately) the same as the original input audio signal 14 further helps to make the reduction at the resonant frequency less noticeable to the end user.

[0032] The other frequencies which are increased in power may be frequencies that are adjacent to or neighbouring to the resonant frequency. For example, the other frequencies which are increased in power may be frequencies that are within say 1 % or somewhere in the range of say 5% to 10% or so of the resonant frequency.

[0033] This is shown schematically in Figure 4, which show plots of power against frequency of waveforms for audio signals. The upper part of Figure 4 shows schematically an example of a waveform for an input audio signal 14. The lower part of Figure 4 shows schematically an example of the waveform for the corresponding output audio signal 16 produced by processing the input audio signal 14.

[0034] Referring first to the waveform for the input audio signal 14, the output of the processing block 20 shows that there is a large peak at a frequency f_R having a power P_R. The power P_R at this frequency f_R is used as a trigger in this example for the audio processor 12 to reduce the power at that frequency f_R because otherwise it is likely to cause a resonance and therefore vibration or buzzing.

[0035] Referring now to the waveform for the output audio signal 16, this shows that the power of frequency f_R has been reduced by the audio processor 12. In addition, the power of the neighbouring frequencies that are adjacent to the resonant frequency f_R is increased. The neighbouring frequencies whose power are increased extend either side of the resonant frequency f_R in this example.

[0036] The extent of the neighbouring frequencies whose power are increased is indicated schematically by vertical dashed lines in Figure 4. The neighbouring frequencies may extend out by say a percentage of the resonant frequency f_R, such as $\pm 1\%$ or $\pm 2\%$ or so. For example, the resonant frequency f_R may be say 500 Hz and the neighbouring frequencies may be 490 Hz to 510 Hz. In this way, if the resonant frequency f_R is a low frequency, then the neighbouring frequencies whose power is also adjusted extend over a relatively small range of frequencies, whereas if the resonant frequency f_R is a high frequency, then the neighbouring frequencies whose power is also adjusted extend over a relatively large range of frequencies. Alternatively or additionally, the neighbouring frequencies may extend out by a fixed number of Hz, such as 10 Hz or 20 Hz say.

[0037] As mentioned, the reduction of the power at the resonant frequency f_R and the increase of the power of the other, neighbouring frequencies is such that the total (or average) power of the output audio signal 16 is the same, or at least substantially the same, as the total (or average) power of the input audio signal 14 (to within 5% or less say). This may be regarded as increasing the bandwidth of the signal at the resonant frequency f_R and decreasing its peak power so that the overall power is the same, or at least substantially the same. If for example the resonant frequency f_R has an original peak power Po and a bandwidth of Δfo and is adjusted so that its peak power becomes P and its bandwidth increases by Δf on both sides of the frequency f_R, then:

$$Po*\Delta fo = P*(\Delta fo + 2\Delta f)$$

or:

$$P = Po*\Delta fo / (\Delta fo + 2\Delta f)$$

[0038] Moreover, in an example, the power of the neighbouring frequencies that are closest to the resonant frequency f_R may be increased by a greater amount than the neighbouring frequencies that are further from the resonant frequency f_R. The increase in power may for example vary linearly with the distance of the neighbouring frequency from the resonant frequency f_R.

[0039] Examples of the present disclosure help to prevent or eliminate vibration or buzzing that can occur in a sound reproduction apparatus, whilst at the same time reduce the likelihood that the user will notice that the audio signal has been treated to prevent vibration occurring.

[0040] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0041] Reference is made herein to data storage for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory (e.g. a solid-state drive or SSD).

[0042] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A method of processing an audio signal, the method comprising:

receiving an audio signal as an input;
processing the input audio signal to provide an audio signal to be output to a loudspeaker, in which the processing of the input audio signal reduces the power of the input audio signal at a resonant audio frequency and increases the power of the input audio signal at at least some other audio frequencies other than the resonant audio frequency.

2. A method according to claim 1, wherein the resonant frequency is a resonant frequency of a cabinet in which the loudspeaker is mounted, the resonant frequency being identified using a vibration sensor which is attached to a cabinet in which the loudspeaker is mounted.

3. A method according to claim 2, wherein the output of the vibration sensor is subject to a Fast Fourier Transform FFT to identify the resonant frequency.

4. A method according to any of claims 1 to 3, wherein the total or average power of the output audio signal is substantially the same as the total or average power of the input audio signal.

5. A method according to any of claims 1 to 4, wherein the other audio frequencies are frequencies that are within 5% of the resonant frequency.

6. An audio processor for processing an input audio signal, the audio processor being arranged to:
process an input audio signal to provide an audio signal to be output to a loudspeaker, wherein the processor is configured such that the processing of the input audio signal reduces the power of the input audio signal at a resonant audio frequency and increases the power of the input audio signal at at least some other audio frequencies other than the resonant audio frequency.

7. An audio processor according to claim 6, wherein the processor is arranged to obtain the resonant frequency from data storage in which the resonant frequency is stored.

8. An audio processor according to claim 6 or claim 7, wherein the processor is arranged to obtain the resonant frequency using a vibration sensor which is attached to a cabinet in which said loudspeaker is mounted.

9. An audio processor according to claim 8, wherein the output of the vibration sensor is arranged to be subject to a Fast Fourier Transform FFT to identify the resonant frequency.

10. An audio processor according to any of claims 6 to 9, wherein the processor is configured such that the total or average power of the output audio signal is substantially the same as the total or average power of the input audio signal.

11. An audio processor according to any of claims 6 to 10, wherein the processor is configured such that the other audio frequencies are frequencies that are within 5% of the resonant frequency.

12. A sound reproduction apparatus, the sound reproduction apparatus comprising an audio processor according to any of claims 6 to 11 and at least one loudspeaker which is arranged to receive an output audio signal which is output by the audio processor.

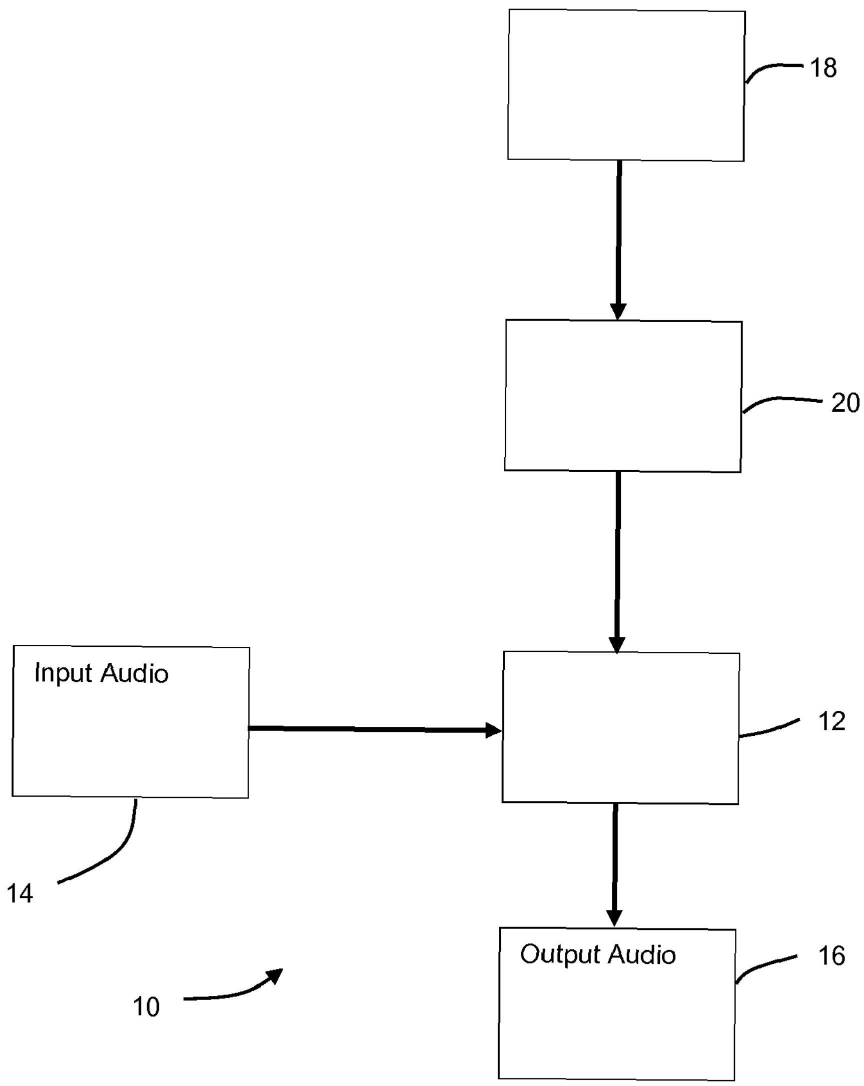

Fig. 1

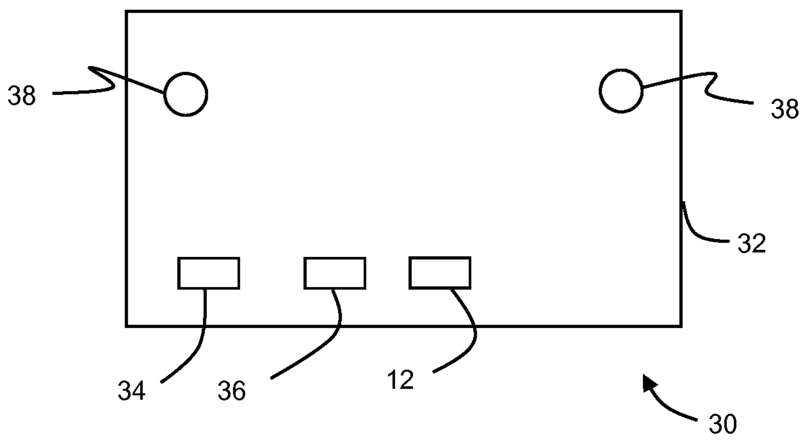

Fig. 2

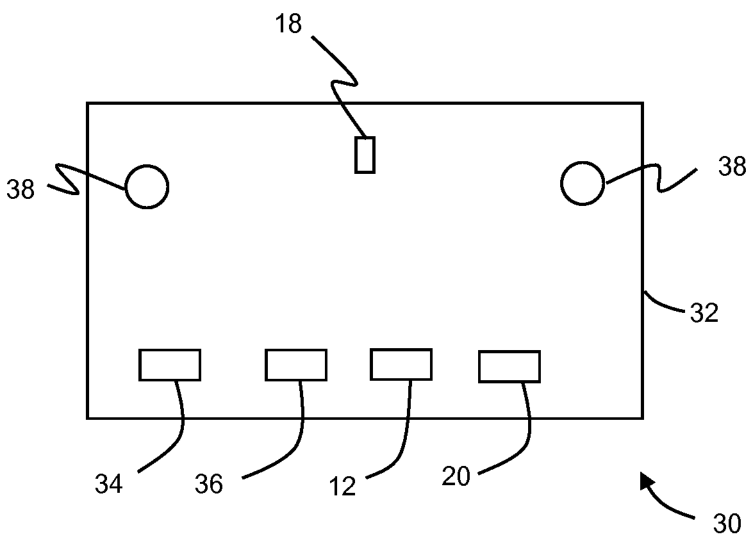

Fig. 3

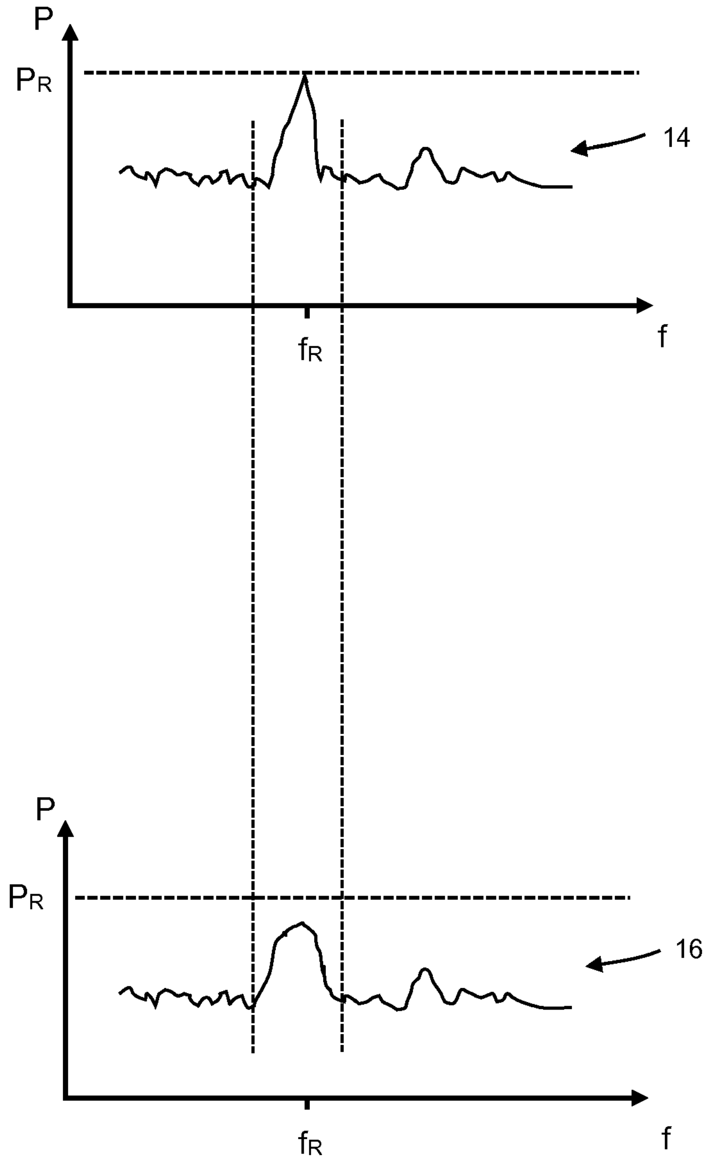

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 19 2859

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2008 085647 A (FUNAI ELECTRIC CO) 10 April 2008 (2008-04-10) * paragraphs [0011] - [0028]; figures 1,2 *	1-12	INV. H04R3/04
X	US 4 831 449 A (KIMURA HISASHI [JP]) 16 May 1989 (1989-05-16) * column 6, line 18 - column 7, line 11; figure 8 *	1,6	
X	JP 2005 223385 A (MATSUSHITA ELECTRIC IND CO LTD) 18 August 2005 (2005-08-18) * abstract; figure 1 *	1,6	

TECHNICAL FIELDS SEARCHED (IPC)
H04R

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 February 2019	Righetti, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 19 2859

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

20-02-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2008085647 A	10-04-2008	NONE	
US 4831449 A	16-05-1989	GB 2204987 A	23-11-1988
		JP 2508716 B2	19-06-1996
		JP S63290082 A	28-11-1988
		KR 960009137 B1	13-07-1996
		US 4831449 A	16-05-1989
JP 2005223385 A	18-08-2005	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82