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

(11) EP 1 286 333 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.02.2003 Bulletin 2003/09

(51) Int Cl.[7]: **G10L 21/02**

(21) Application number: **01307118.8**

(22) Date of filing: **21.08.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

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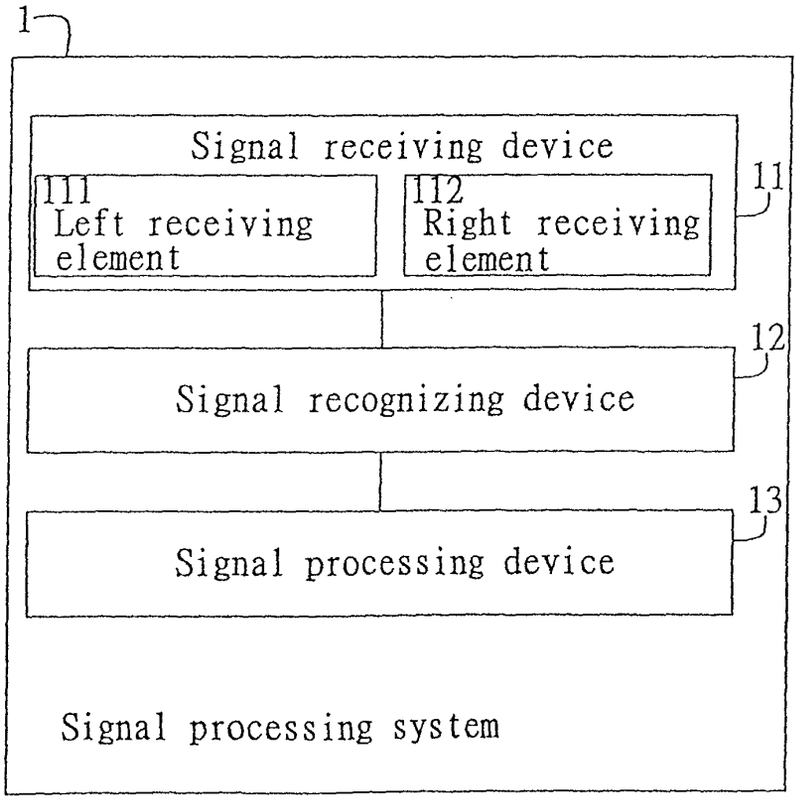
(54) Method and apparatus for processing a sound signal

(57) A system for processing a sound signal includes a signal receiving device (11), a signal recognising device (12) and a signal processing device (13). The signal recognising device (12) is used to distinguish the sound signal received from the signal receiving device (11) into a sound source signal and background interference, so as to eliminate the background interference and transfer only the sound source signal to the signal processing device (13). In this case, the signal processing device (13) only processes and amplifies the sound source signal and thus no filtering circuit is required for the elimination of the background interference.

FIG. 1



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Description

[0001] The present invention relates to methods and apparatus for processing sound signals, preferably to a method of processing a sound signal in which background interference of the sound signal is eliminated, so as to process only a signal from a sound source for amplification.

[0002] A conventional method of elimination interference employs a filter for processing a voltage or current signal through a filtering circuit, in a manner as to allow the signal having a frequency above or below a certain frequency or within a certain frequency range to pass through the circuit, so as to distinguish the signal into a desired signal and an interfering signal. In view of operational principles, such a general filter includes a low pass filter, a high pass filter, a band pass filter and an off-band pass filter. Such a filter allows a signal to be input to a circuit thereof and processes the signal to be differentiated into interference and a desired signal according to characteristics such as signal amplitude and frequency.

[0003] In the conventional technology, a signal cannot be pre-separated into a desired component and an interfering component without being entirely processed by a filter.

[0004] The present invention seeks to provide improved sound signal processing.

[0005] According to an aspect of the present invention, there is provided a method of processing a sound signal as specified in claim 1.

[0006] According to another aspect of the present invention, there is provided a method of processing a sound signal as specified in claim 5.

[0007] According to another aspect of the present invention, there is provided a sound signal processing system as specified in claim 9.

[0008] According to another aspect of the present invention, there is provided a sound signal processing system as specified in claim 10.

[0009] In the preferred embodiment, after the sound signal is distinguished into a sound source signal and background interference, the background interference is eliminated and only the sound source signal is processed.

[0010] The preferred embodiment provides a method of processing a sound signal, which is applied to a signal processing system including a signal receiving device, a signal recognising device and a signal processing device, so as to eliminate background interference and only process a sound source signal for amplification, according to phase change and deviation of the sound signal, intensity of signal amplitude, and frequency change caused by the Doppler effect.

[0011] In accordance with this, the preferred method, which is applied to a signal processing system including a signal receiving device, a signal recognising device and a signal processing device, includes the following steps.

[0012] First, the signal receiving device having a left receiving element and a right receiving element receives a signal containing a sound source signal and background interference, or selectively receives a sound signal from a particular direction by adjusting the left and right receiving elements.

[0013] Then, the signal recognising device distinguishes the received sound signal into the sound source signal and the background interference, which differ from each other in characteristics such as phase, amplitude and frequency. Therefore, the signal recognising device makes use of phase change and deviation of the sound signal, intensity of signal amplitude, and frequency change caused by Doppler effect, so as to differentiate the sound source signal from the background interference.

[0014] After the sound source signal and the background interference are separated from each other, the signal recognising device eliminates the background interference and simply transfers the sound source signal to the signal processing device.

[0015] Upon receiving the sound source signal, the signal processing device processes the sound source signal for amplification, and thus no a filtering circuit is required for the elimination of the background interference.

[0016] Embodiments of the present invention are described below, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram of basic system architecture for a preferred embodiment of signal processing system;

FIG. 2 is a schematic diagram showing the steps involved in eliminating background interference and only amplifying a sound source signal in the signal processing system of FIG. 1;

FIG. 3 is a schematic diagram showing the steps involved in determining phase change and deviation of a sound signal for eliminating background interference and only amplifying a sound source signal in an embodiment of the signal processing system of FIG. 1;

FIG. 4 is a schematic diagram showing the steps involved in determining amplitude of a sound signal for eliminating background interference and only amplifying a sound source signal in another embodiment of the signal processing system of FIG. 1; and

FIG. 5 is a schematic diagram showing the steps involved in determining frequency change caused by Doppler effect for eliminating background interference and only amplifying a sound source signal in a further embodiment of the signal processing system of FIG. 1.

[0017] Illustrated in FIG. 1 is basic system architecture for a signal processing system in the use of the pre-

ferred method of processing a sound signal. As shown in FIG. 1, the signal processing system 1 includes a signal receiving device 11, a signal recognising device 12 and a signal processing device 13, wherein the signal receiving device 11 is coupled to the signal recognising device 12, which is further coupled to the signal processing device 13.

[0018] The signal receiving device 11 has a left receiving element 111 and a right receiving element 112, so as to receive a sound signal containing a sound source signal and background interference, or selectively to receive a sound signal from a particular direction by adjusting the left and right receiving elements 111, 112. The signal receiving device 11 transfers the received sound signal to the signal recognising device 12, which is used to distinguish the received sound signal into the sound source signal and the background, according to phase change and deviation of the sound signal, intensity of signal amplitude, and frequency change caused by the Doppler effect. The signal recognising device 12 then eliminates the background interference and transfers only the sound source signal to the signal processing device 13. Subsequently, the sound source signal is processed by the signal processing device 13 for amplification and thus it is not necessary to employ a filtering circuit for eliminating the background interference.

[0019] FIG. 2 illustrates the steps involved in using the preferred method of processing a sound signal for the signal processing system of FIG. 1.

[0020] As shown in the drawing, first in step 2, the signal receiving device 11 having the left receiving element 111 and the right receiving element 112 receives a signal containing a sound source signal and background interference, or selectively receives a sound signal from a particular direction by adjusting the left and right receiving elements 111, 112. Then, step 3 is followed.

[0021] In step 3, the signal recognising device 12 distinguishes the received sound signal into the sound source signal and the background interference, which differ from each other in characteristics such as phase, amplitude and frequency. Therefore, the signal recognising device 12 makes use of phase change and deviation of the sound signal, intensity of signal amplitude and frequency change caused by the Doppler effect, so as to differentiate the sound source signal from the background interference.

[0022] In step 4, after the sound source signal and the background interference are separated from each other, the signal recognising device 12 eliminates the background interference and transfers only the sound source signal to the signal processing device 13. Then step 5 is followed.

[0023] In step 5, upon receiving the sound source signal, the signal processing device 13 processes the sound source signal for amplification, without using a filtering circuit for eliminating the background interference.

[0024] FIG. 3 illustrates the steps involved in determining phase change and deviation of a sound signal for eliminating background interference and amplifying only a sound source signal in an embodiment of the signal processing system of FIG. 1.

[0025] First, in step 21, the signal receiving device 11 having the left receiving element 111 and the right receiving element 112 receives a signal containing a sound source signal and background interference, or selectively receives a sound signal from a certain (particular) direction by adjusting the left and right receiving elements 111,112 according to phase difference for the received sound signal (for example, phase lead or delay). Then step 22 is followed.

[0026] In step 22, the signal recognising device 12 distinguishes the received sound signal into the sound source signal and the background interference in response to phase difference therebetween. Therefore, the signal recognising device 12 makes use of phase change and deviation of the sound signal so as to differentiate the sound source signal from the background interference.

[0027] In step 23, after the sound source signal and the background interference are separated from each other, the signal recognising device 12 eliminates the background interference and transfers only the sound source signal to the signal processing device 13. Then step 24 is followed.

[0028] In step 24, upon receiving the sound source signal, the signal processing device 13 processes the sound source signal for amplification, without using a filtering circuit for eliminating the background interference.

[0029] FIG. 4 illustrates the steps involved in determining amplitude of a sound signal for eliminating background interference and amplifying only a sound source signal in another embodiment of the signal processing system of FIG. 1.

[0030] First, in step 31, the signal receiving device 11 having the left receiving element 111 and the right receiving element 112 receives a signal containing a sound source signal and background interference, or selectively receives a sound signal from a particular direction by adjusting the left and right receiving elements 111, 112. Then step 32 is followed.

[0031] In step 32, the signal recognising device 12 distinguishes the received sound signal into the sound source signal and the background interference in response to amplitude difference therebetween. Therefore, the signal recognising device 12 makes use of intensity of signal amplitude so as to differentiate the sound source signal from the background interference.

[0032] In step 33, after the sound source signal and the background interference are separated from each other, the signal recognising device 12 eliminates the background interference and transfers only the sound source signal to the signal processing device 13. Then step 34 is followed.

[0033] In step 34, upon receiving the sound source

signal, the signal processing device 13 processes the sound source signal for amplification, without using a filtering circuit for eliminating the background interference.

[0034] FIG. 5 illustrates the steps involved in determining frequency change caused by the Doppler effect for eliminating background interference and amplifying only a sound source signal in another embodiment of the signal processing system of FIG. 1.

[0035] First, in step 41, the signal receiving device 11 having the left receiving element 111 and the right receiving element 112 receives a signal containing a sound source signal and background interference, or selectively receives a sound signal from a particular direction by adjusting the left and right receiving elements 111, 112. Then step 42 is followed.

[0036] In step 42, the signal recognising device 12 distinguishes the received sound signal into the sound source signal and the background interference in response to velocity difference therebetween. Therefore, the signal recognising device 12 makes use of frequency change caused by the Doppler effect so as to differentiate the sound source signal from the background interference.

[0037] In step 43, after the sound source signal and the background interference are separated from each other, the signal recognising device 12 eliminates the background interference, and transfers only the sound source signal to the signal processing device 13. Then step 44 is followed.

[0038] In step 44, upon receiving the sound source signal, the signal processing device 13 processes the sound source signal for amplification, without using a filtering circuit for eliminating the background interference.

[0039] In conclusion, the methods for processing a sound signal described above are applied to the signal processing system including the signal receiving device, the signal recognising device and the signal processing device, in which the signal recognising device is used to distinguish the sound signal received from the signal receiving device into a sound source signal and background interference, the signal processing device. In this case, the signal processing device processes and amplifies only the sound source signal and thus no filtering circuit is required for the elimination of the background interference.

[0040] The invention has been described using exemplary preferred embodiments. However, it is to be understood that the scope of the invention is not limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and similar arrangements. The scope of the claims, therefore, should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

Claims

1. A method of processing a sound signal, applied to a signal processing system including a signal receiving device, a signal recognising device and a signal processing device, so as to eliminate background interference and process a sound source signal for the sound signal; the method including the steps of:

   (1) receiving a sound signal containing a sound source signal and background interference via the signal receiving device;
   (2) distinguishing the sound signal into the sound source signal and the background interference via the signal recognising device;
   (3) substantially eliminating the background interference and transferring substantially only the sound source signal via the signal recognising device to the signal processing device; and
   (4) processing and amplifying the sound source signal via the signal processing device.

2. A method as in claim 1, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to signal phase difference.

3. A method as in claim 1 or 2, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to the difference in signal amplitude intensity.

4. A method as in claim 1, 2 or 3, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to difference in frequency change caused by the Doppler effect.

5. A method of processing a sound signal, applied to a signal processing system including a signal receiving device, a signal recognising device and a signal processing device, so as to eliminate background interference and process a sound source signal for the sound signal; the method including the steps of:

   (1) adjusting the signal receiving device so as to receive selectively a sound signal containing a sound source signal and background interference from a certain direction via the signal receiving device;
   (2) distinguishing the sound signal into the sound source signal and background interference via the signal recognising device;
   (3) substantially eliminating the background in-

terference and transferring substantially only the sound source signal via the signal recognising device to the signal processing device; and

(4) processing and amplifying the sound source signal via the signal processing device.

6. A method as in claim 5, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to signal phase difference.

7. A method as in claim 5 or 6, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to difference in signal amplitude intensity.

8. A method as in claim 5, 6 or 7, wherein in step (2) the signal recognising device distinguishes the sound signal into the sound source signal and background interference according to difference in frequency change caused by the Doppler effect.

9. A sound signal processing system including a signal receiving device, a signal recognising device and a signal processing device and designed substantially to eliminate background interference and to process a sound source signal for the sound signal; wherein:

(1) the signal receiving device (11) is operable to receive a sound signal containing a sound source signal and background interference;

(2) the signal recognising device (12) is operable to distinguish the sound signal into the sound source signal and background interference;

(3) the signal recognising device (12) and the signal processing device (13) being operable substantially to eliminate background interference and to transfer substantially only the sound source signal; and

(4) the signal processing device (13) is operable to process and amplify the sound source signal.

10. A sound signal processing system including a signal receiving device, a signal recognising device and a signal processing device and designed substantially to eliminate background interference and to process a sound source signal for the sound signal; wherein:

(1) the signal receiving device (11) is operable to adjust the signal receiving device so as to receive selectively a sound signal containing a sound source signal and background interference from a certain direction;

(2) the signal recognising device (12) is operable to distinguish the sound signal into the sound source signal and background interference;

(3) the signal recognising device (12) and the signal processing device (13) are operable substantially to eliminate background interference and to transfer substantially only the sound source signal; and

(4) the signal processing device (13) is operable to process and amplify the sound source signal.

FIG. 1

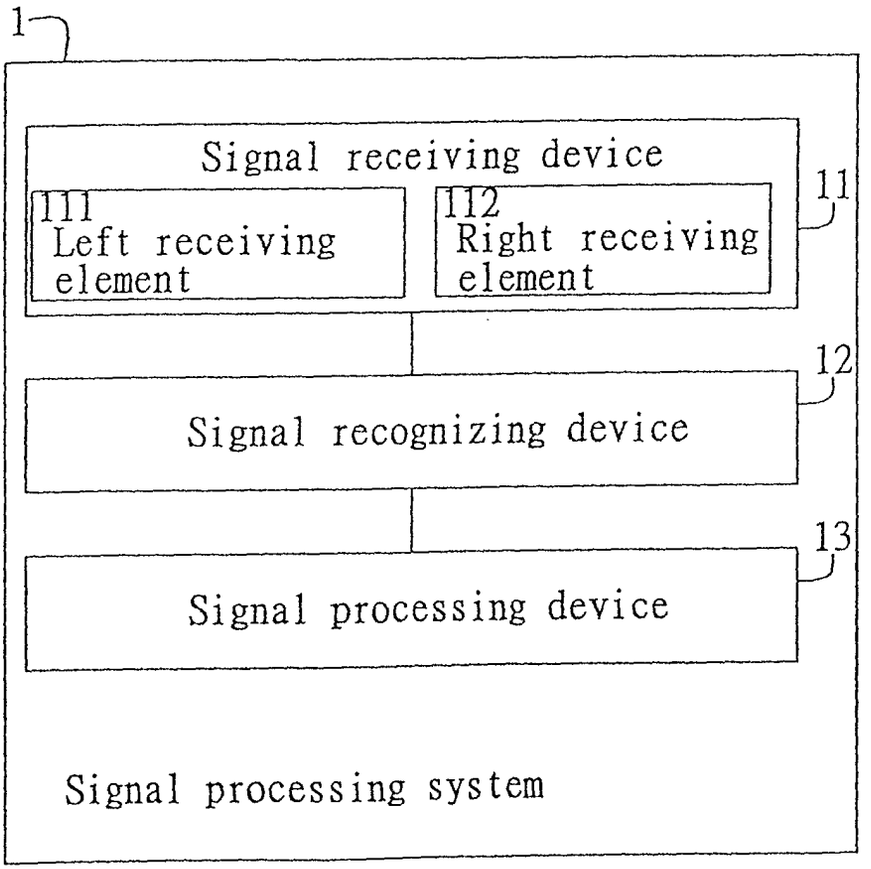

1
Signal receiving device
111
Left receiving element
112
Right receiving element
11
12
Signal recognizing device
13
Signal processing device
Signal processing system

FIG. 2

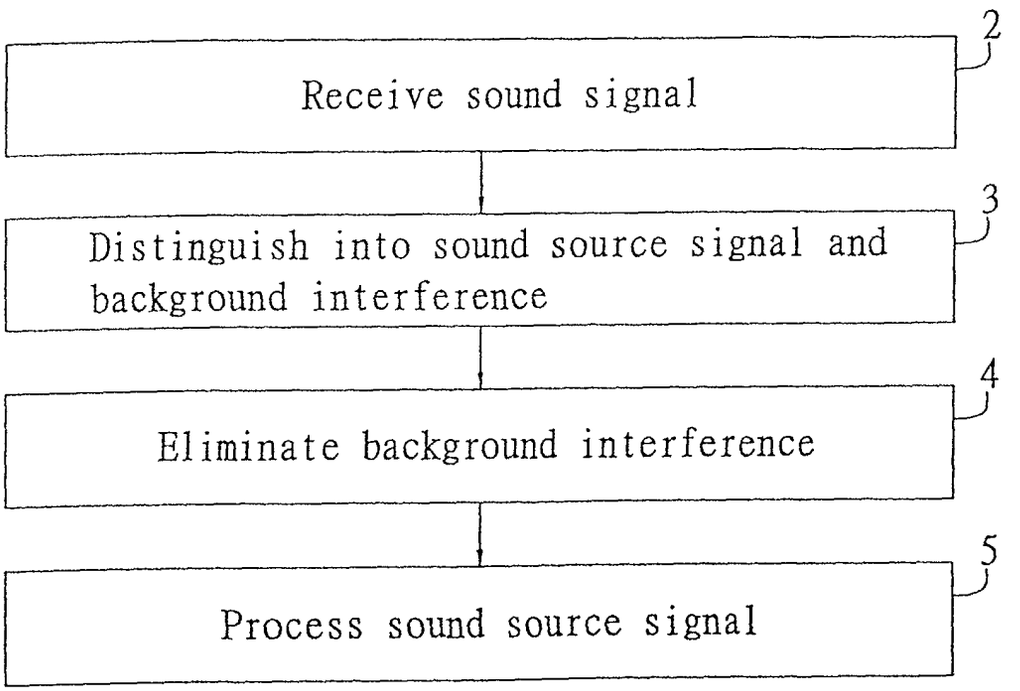

2
Receive sound signal
3
Distinguish into sound source signal and background interference
4
Eliminate background interference
5
Process sound source signal

FIG. 3

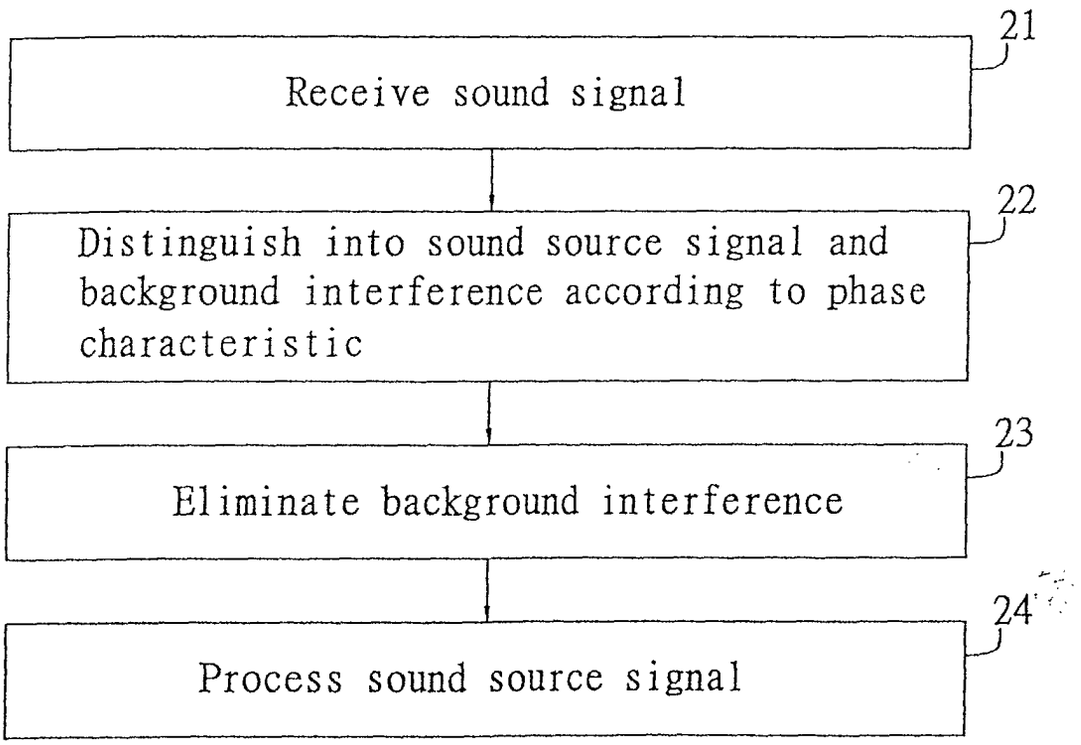

21
Receive sound signal
22
Distinguish into sound source signal and background interference according to phase characteristic
23
Eliminate background interference
24
Process sound source signal

FIG. 4

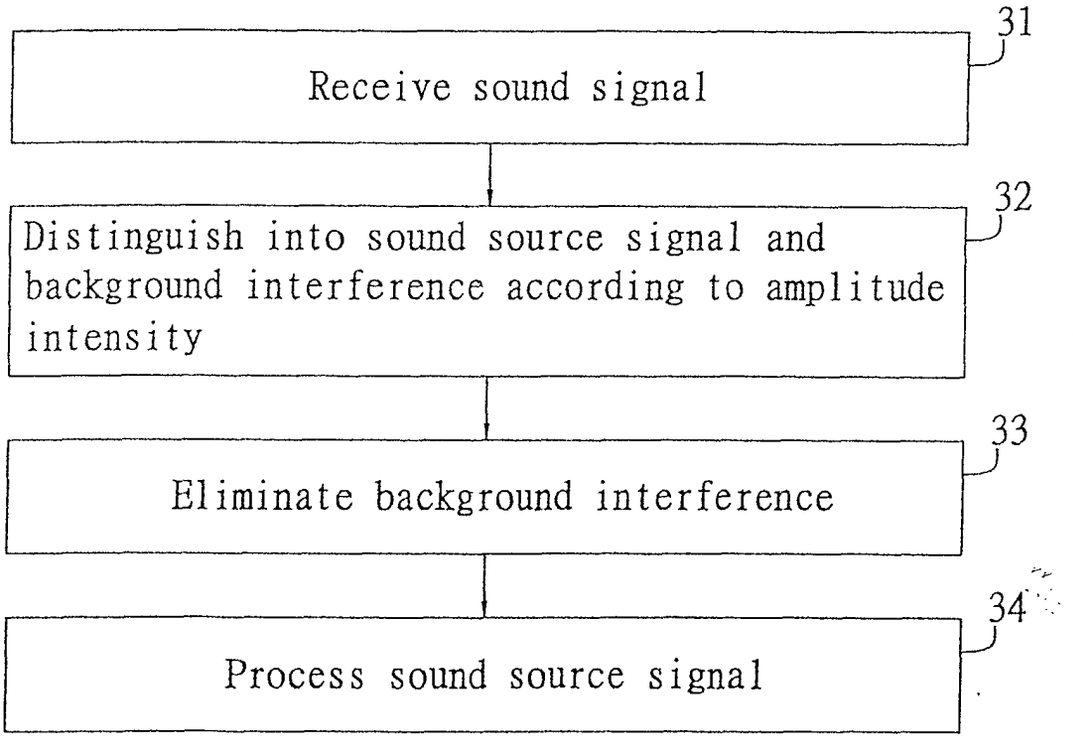
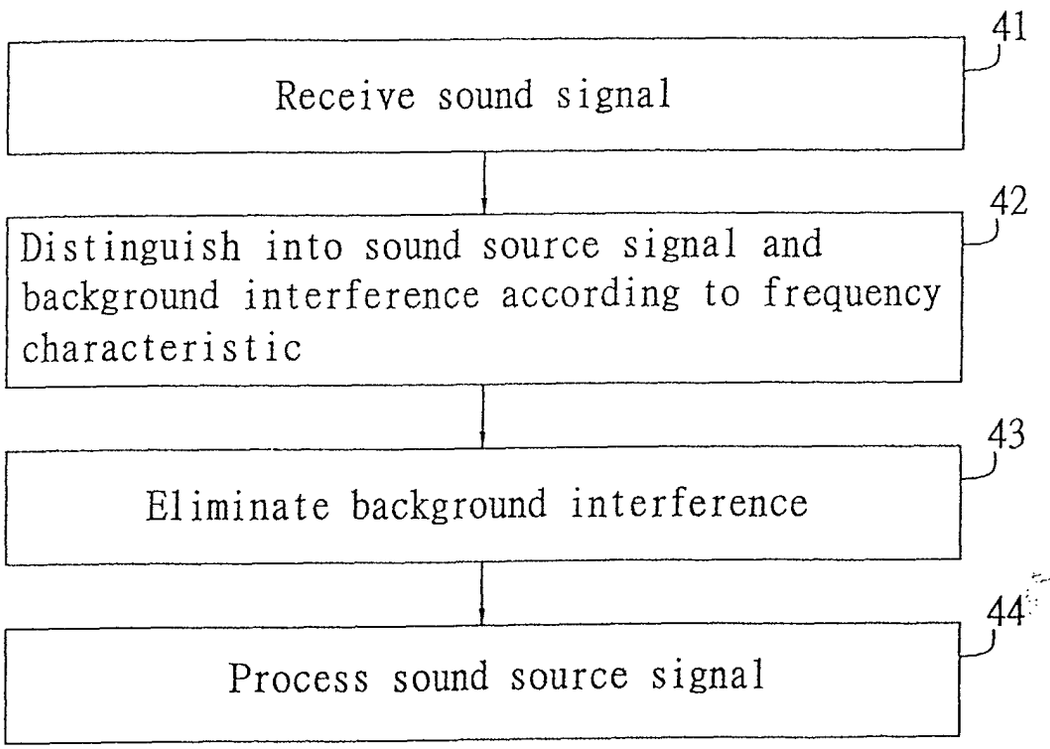

31
Receive sound signal
32
Distinguish into sound source signal and background interference according to amplitude intensity
33
Eliminate background interference
34
Process sound source signal

FIG. 5


41
Receive sound signal
42
Distinguish into sound source signal and background interference according to frequency characteristic
43
Eliminate background interference
44
Process sound source signal

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 7118

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	* column 7, line 8 - column 50, line 55 *	7	
Y	KREBBER W ET AL: "Auditory virtual environments: basics and applications for interactive simulations" SIGNAL PROCESSING, AMSTERDAM, NL, vol. 80, no. 11, 1 November 2000 (2000-11-01), pages 2307-2322, XP004218326 ISSN: 0165-1684 * page 2313, right-hand column, line 9 - line 12 * * page 2319, right-hand column, line 45 - page 2320, left-hand column, line 28 *	4,8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) G10L
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Y	* column 2, line 26 - line 38 * * column 3, line 46 - line 54 *	6	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	17 January 2002	De Vos, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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EUROPEAN SEARCH REPORT

Application Number
EP 01 30 7118

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)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

The present search report has been drawn up for all claims

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MUNICH	17 January 2002	De Vos, L

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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

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 7118

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