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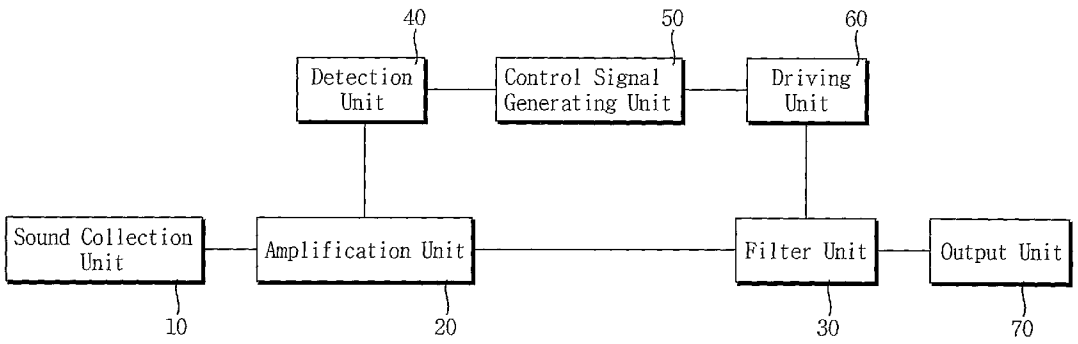
(54) **Title:** ELECTRONIC STETHOSCOP



(57) **Abstract:** Disclosed herein is an electronic stethoscope including a sound collection unit for converting a sound acquired by auscultation into an electrical sound signal; an amplification unit for amplifying or attenuating the electrical sound signal, which includes at least one amplifier; a filter unit for filtering the amplified electrical sound signal, which includes at least one filter; a detection unit for connection to one end of the amplification unit and detecting the level of the electrical sound signal; a control signal generating unit for generating a control signal for attenuating the electrical sound signal according to an output of the detection unit, and outputting the control signal; and a driving unit for connecting to one end of the filter unit, and attenuating the electrical sound signal based on the control signal. The electronic stethoscope can completely prevent from incoming noise irrelevant to the auscultation, noise by hands, or the like.

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ELECTRONIC STETHOSCOPE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electronic stethoscope, and more particularly to an electronic stethoscope which is capable of detecting a level of a sound signal acquired by auscultation, attenuating the sound signal to a predetermined reference level when the detected level of the sound signal exceeds a predetermined level value, and outputting the attenuated sound signal.

Description of the Related Art

A conventional electronic stethoscope has a configuration for collecting auscultated sounds, amplifying the collected sound through an amplification circuit, and filtering the amplified sound in the range of predetermined frequencies, thereby removing unnecessary sounds and outputting only required sound.

Since the configuration of the conventional electronic stethoscope is well known to those skilled in the art, a detail description thereof will thus be omitted.

The collection unit of the electronic stethoscope is a means for collecting auscultated sounds, wherein the means contacts the skin and detects sound generated by internal organs. The collection unit may generally include a hopper shaped encapsulation structure or a piezo-tranducer structure. The collection unit with the hopper shaped encapsulation structure detects sound of the internal organs using a thin plate, amplifies the detected sound signal, and transmits the amplified sound to a condenser microphone. In addition, the collection unit with the piezo-tranducer converts sound transmitted through the skin into a minute current signal.

While a user auscultates a medical examinee using the electronic stethoscope, the user may hear noise which is irrelevant to the auscultation. For example, noise is generated when the electronic stethoscope rubs against the skin or clothes, or is generated when the user takes hold of the electronic stethoscope. In addition, the user may hear general sound which is propagated in the air, wherein the general sound is amplified via the sound collection unit. Thus, since the user feels tired when using the electronic stethoscope rather than a general stethoscope, it is difficult to perform accurate auscultation.

Since the electronic stethoscope in contrast to the general stethoscope has a high amplifying level, the above noise may be high amplified. Thus, the user may feel tired when the user uses the electronic stethoscope for a long time, may not auscultate using the electronic stethoscope, and may lose his hearing.

In order to overcome the above problems of the electronic stethoscope, conventional electronic stethoscope has developed, wherein, by exchanging the physical components in the conventional electronic stethoscope, the sound collection unit of the electronic stethoscope collects a sound which is generated by a part contacting the skin or clothes. In addition, the electronic stethoscope may use new material which does not generate noise in order to decrease noise by hands.

However, since the exchange of the physical components in the conventional electronic stethoscope can not block noise which is inputted through the sound collection unit, and also increases in size, it is difficult to use the conventional electronic stethoscope.

On the other hand, in order to overcome the problems of the conventional electronic stethoscope, a limiter type electronic stethoscope has developed. The limiter type electronic stethoscope limits amplitude of the inputted sound, and removes a part of the amplitude which

exceeds predetermined amplitude with respect to a sound having amplitude above a specific size, thereby decreasing noise.

However, since the conventional limiter type electronic stethoscope removes only noise with large amplitude, a user may hear noise in a specific range or noise by hands irrelevant to auscultation. Thus, the user is also difficult to use the electronic stethoscope for a long time.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide an electronic stethoscope, wherein, by completely blocking incoming noise irrelevant to auscultation, noise by hands, or the like, it is possible to minimize tiredness or indisposition of the user using the electronic stethoscope.

The present invention has been made in view of the above problems, and it is another object of the present invention to provide an electronic stethoscope, wherein, by blocking only noise irrelevant to auscultation, it is possible to perform the function when starting the auscultation.

In accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of an electronic stethoscope is characterized by detecting a level of a sound signal acquired by auscultation, and attenuating the sound signal to a predetermined reference level when the level of the sound signal exceeds a predetermined value, wherein, all sound signals subsequently acquired are attenuated to the predetermined reference level.

In accordance with another aspect of the present invention, there is provided the electronic stethoscope comprising: a sound collection unit for converting a sound acquired by auscultation into an electrical sound signal; an amplification unit for amplifying or attenuating the electrical sound signal, which includes at least one amplifier; a filter unit for filtering the amplified electrical sound signal, which includes at least one filter; a detection unit for connection to one end of the amplification unit and detecting the level of the electrical sound signal; a control signal generating unit for generating a control signal for attenuating the electrical sound signal according to an output of the detection unit, and outputting the control signal; and a driving unit for connecting to one end of the filter unit, and attenuating the electrical sound signal based on the

control signal.

The control signal generating unit may generate the control signal for attenuating the sound signal when the level of the sound signal detected from the detection exceeds the predetermined level, and output the control signal.

The driving unit may include a transistor driven in response to the control signal inputted through the control signal generating unit, the transistor having a collector connected to one end of the filter unit, an emitter connected to a ground, and a base connected to the control signal generating unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic block diagram showing the configuration of an electronic stethoscope according to a preferred embodiment the present invention; and

FIG. 2 is a schematic circuit diagram of an electronic stethoscope according to a preferred embodiment the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be explained in detail with reference to the accompanying drawings.

FIG. 1 is a schematic block diagram showing the configuration of an electronic stethoscope according to a preferred embodiment the present invention.

Referring to FIG. 1, the electronic stethoscope according to a preferred embodiment the present invention includes a sound collection unit 10, an amplification unit 20, a filter unit 30, a detection unit 40, a control signal generating unit 50, a driving unit 60, and an output unit 70.

The sound collection unit 10 is a means for converting a sound acquired by auscultation into an electrical sound signal, wherein the sound collection unit 10 converts vibration or sound transmitted through skin of a medical examinee into an electrical sound signal. The sound collection unit 10 includes various microphones such as a dynamic microphone, a condenser microphone, a contact type microphone using a piezo-film, and the like. Since a technology of the sound collection unit is well known, a

detailed description of the sound collection unit will be omitted.

The amplification unit 20 is a means for amplifying or attenuating the electrical sound signal transmitted through the sound collection unit 10. The amplification unit 20 includes at least one more amplifier, wherein a plurality of amplifiers having different gain values may be connected to each other. The amplification unit 20 adequately amplifies the electrical sound signal converted through the sound collection unit 10, and thereby a user can easily auscultate using the amplified sound signal. It is preferred that the amplification unit 20 can amplify the sound signal as well as electrical power. Of course, the amplification unit 20 can also perform a filtering function for removing any noise such as power noise, or the like.

The filter unit 30 is a means for removing any noise which is included in the sound signal amplified through the amplification unit 20. Herein, noise refers to any unnecessary component except for the sound required by a user. The filter unit 30 filters out unnecessary sound, passing only sound which is required for auscultation, and thereby the user can exactly auscultate. It is preferred that the filter unit 30 include at least one

more low pass filters or high pass filters, and remove any sound sources with no regard to the auscultation.

A configuration of the above amplification unit 20 and filter unit 30 may be exchanged for convenient circuit design, and may be mixed with each other. According to the embodiment of the present invention, the amplification unit 20 and filter unit 30 will be explained through the block diagram, but it is not limited thereto.

The detection unit 40 is a means for detecting a level of the sound signal, which is connected to one end of the amplification unit 20. The detection unit 40 generally detects a voltage component of the sound signal, but it may detect a current or frequency component of the sound signal according to the embodiment of the present invention. The voltage component of the sound signal is detected according to the embodiment of the present invention, wherein the voltage component may be detected using various voltage detectors which are well known in the art.

The control signal generating unit 50 is a means for generating a control signal for attenuating the sound signal according to the output of the detection unit 40. In accordance with a preferred aspect of the present invention, in the case where the level of the sound

signal detected through the detection unit 40 exceeds a predetermined level value, the control signal generating unit 50 outputs the control signal for attenuating the sound signal. Preferably, in the case where the level of the sound signal does not exceed the predetermined level value, the control signal generating unit 50 does not generate the control signal.

In addition, in the case where the control signal generating unit 50 generates the control signal, the control signal generating unit 50 remains to output the corresponding control signal to the predetermined level. Preferably, if the sound signal whose level does not exceed the predetermined level is inputted, the control signal generating unit 50 does not generate the control signal. The explanation thereof will be explained as follows.

The driving unit 60 is a means for attenuating the sound signal according to the control signal which is generated through the control signal generating unit 50, which is connected to one end of the filter unit 30. In accordance with a preferred aspect of the present invention, the driving unit 60 may include a transistor driven in response to the control signal, the transistor having a collector connected to one end of the filter unit

30, an emitter connected to a ground, and a base connected to the control signal generating unit 50.

The output unit 70 is a means for converting the sound signal into an audible sound source, and outputting the audible sound source, wherein the sound signal is amplified through the above amplification unit 20 and filtered through the above filter unit 30. According to a drive state of the driving unit 60, the output unit 70 may output an attenuated sound signal, or may output a sound signal filtered without attenuation. Since the configuration of the output unit 70 is well known in the art, an explanation thereof will thus be omitted.

Referring to FIG. 1, operations of the electronic stethoscope according to the preferred embodiment of the present invention will be explained as follows.

To begin with, when the user starts auscultation using the electronic stethoscope, the sound collection unit 10 changes the sound to an electrical sound signal, and outputs the electrical sound signal, wherein the sound is inputted through the skin or clothes of the medical examinee. The detection unit 40 connected to one end of the amplification unit 20 detects a level of the sound signal amplified through the amplification unit 20.

When the level of the sound signal amplified through the amplification unit 20 exceeds the predetermined level

value, the control signal generating unit 50 generates a control signal for attenuating the sound signal, and outputs the control signal. The control signal generating unit 50 remains to output the control signal until the sound signal whose level does not exceed the predetermined level is detected. While remaining the control signal, if the sound signal whose level does not exceed the predetermined level is detected, the control signal generating unit 50 does not generate the control signal or does not remain to output the control signal.

Thus, if the level of the sound signal detected through the detection unit 40 does not exceed the predetermined level value, the control signal generating unit 50 does not generate the control signal. In this case, the sound signal electrically converted through the sound collection unit 10 is outputted to the output init 70 through the amplification unit 20 and the filter unit 30, thereby performing general auscultation process.

When the control signal generating unit 50 generates the control signal, the driving unit 60 is activated according to the control signal so that the sound signal is attenuated to the predetermined reference level. The driving unit 60 is connected to one end of the filter unit 30, and may reduce the voltage which is applied from the filter unit 30 to the output unit 70, and thereby

attenuate the output voltage. In accordance with an additional aspect of the present invention, the voltage applied to the output unit 70 may be completely blocked.

Thus, in the above auscultation process, when the noise generated irrelevant to the auscultation is detected, or when the noise generated by hands is detected, a user reduces the output of the sound signal, thereby preventing problems associated with the noise.

FIG. 2 is a schematic circuit diagram of an electronic stethoscope according to a preferred embodiment the present invention. FIG. 2 only shows a detection unit 40, a control signal generating unit 50 and a driving unit 60 which are essential components according to the present invention, and does not show an amplification unit 20 and a filter unit 30 which are well known components.

As shown in this drawing, the detection unit 40 connected to one end of the amplification unit 20 receives the sound signal. According to the embodiment of the present invention, the detection unit 40 may be embodied using an amplifier, a detector, a transistor, a Schmidt circuit and a plurality of resistors and capacitors, but it is not limited thereto. For example, various technologies for detecting the voltage may be applied to the detection unit 40.

In the case where the level of the corresponding sound signal exceeds the predetermined level value after detecting the level of the sound signal through the detection unit 40, the control signal generating unit 50 generates the control signal for attenuating the sound signal, and maintains the control signal.

As noted the above, according to the embodiment of the present invention, if the level of the sound signal exceeds the predetermined level value, the control signal generating unit 50 outputs a high logical value, and maintains the high logical value. On the contrary, if the level of the sound signal does not exceed the predetermined level value, the control signal generating unit 50 outputs a low logical value, and maintains the low logical value.

According to the control signal inputted through the control signal generating unit 50, the driving unit 60 attenuates the sound signal or passes the sound signal without attenuating. According to the embodiment of the present invention, the driving unit 60 is embodied using an NPN transistor, but it is not limited thereto. For example, various technologies for reducing the voltage applied from the output terminal of the filter unit 30 to the output unit 70 may be applied to the driving unit 60.

According to the embodiment of the present invention, if the control signal is the high logical value, the control signal with the high logical value is provided to a base terminal of the transistor. Since the transistor is turned-on according to the control signal with the high logical value, current flowing into the output terminal of the filter unit 30 passes to a ground terminal through the transistor. Thus, since the voltage applied to the output unit 70 is reduced according to a gain value of the transistor, the resulting sound signal outputted through the output unit 70 may be attenuated, and thereby the attenuated sound signal may be outputted.

On the contrary, if the control signal is the low logical value, the control signal with the low logical value is provided to a base terminal of the transistor. Since the transistor is turned-off according to the control signal with the low logical value, the resulting voltage may be applied from the filter unit 30 to the output unit 70 without attenuation.

Consequently, when the user is auscultating the medical examinee using the electronic stethoscope, since only the sound required in the auscultation such as a heart sound, a lung sound, or the like, is inputted through the sound collection unit 10, the user can hear the sound without additional attenuation. However, if the

level of the sound exceeds the predetermined level value due to noise generated when the electronic stethoscope rubs against the skin or clothes, or due to noise generated when the user takes hold of the electronic stethoscope, by attenuating the output of the electronic stethoscope, the user can not hear the noise.

Those skilled in the art will appreciate that the present invention can be implemented without using the above-mentioned specific elements.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

As apparent from the above description, the present invention provides an electronic stethoscope, wherein, by completely blocking incoming noise irrelevant to auscultation, noise by hands, or the like, it is possible to minimize tiredness or indisposition of the user using the electronic stethoscope, thereby performing accurate auscultation.

In addition, the present invention provides an electronic stethoscope, wherein, by blocking only noise irrelevant to auscultation, it is possible to perform an

auscultation function the moment the noise is removed, thereby smoothly attenuating the sound such that the user remains unaware of the noise removal.

In addition, the present invention provides an electronic stethoscope, wherein, since it is embodied by adding electrical circuits, it is applicable to most conventional electronic stethoscope technologies.

CLAIMS :

1. An electronic stethoscope characterized by detecting a level of a sound signal acquired by auscultation, and attenuating the sound signal to a predetermined reference level when the level of the sound signal exceeds a predetermined value, wherein, all sound signals subsequently acquired are attenuated to the predetermined reference level.

2. The electronic stethoscope as set forth in claim 1, wherein the electronic stethoscope comprises:

a sound collection unit for converting a sound acquired by auscultation into an electrical sound signal;

an amplification unit for amplifying or attenuating the electrical sound signal, which includes at least one amplifier;

a filter unit for filtering the amplified electrical sound signal, which includes at least one filter;

a detection unit for connection to one end of the amplification unit and detecting the level of the electrical sound signal;

a control signal generating unit for generating a control signal for attenuating the electrical sound signal according to an output of the detection unit, and

outputting the control signal; and

a driving unit for connecting to one end of the filter unit, and attenuating the electrical sound signal based on the control signal.

3. The electronic stethoscope as set forth in claim 2, wherein, the control signal generating unit generates the control signal for attenuating the sound signal when the level of the sound signal detected from the detection exceeds the predetermined level, and outputs the control signal.

4. The electronic stethoscope as set forth in claim 2, wherein the driving unit includes a transistor driven in response to the control signal inputted through the control signal generating unit, the transistor having a collector connected to one end of the filter unit, an emitter connected to a ground, and a base connected to the control signal generating unit.

Fig.1

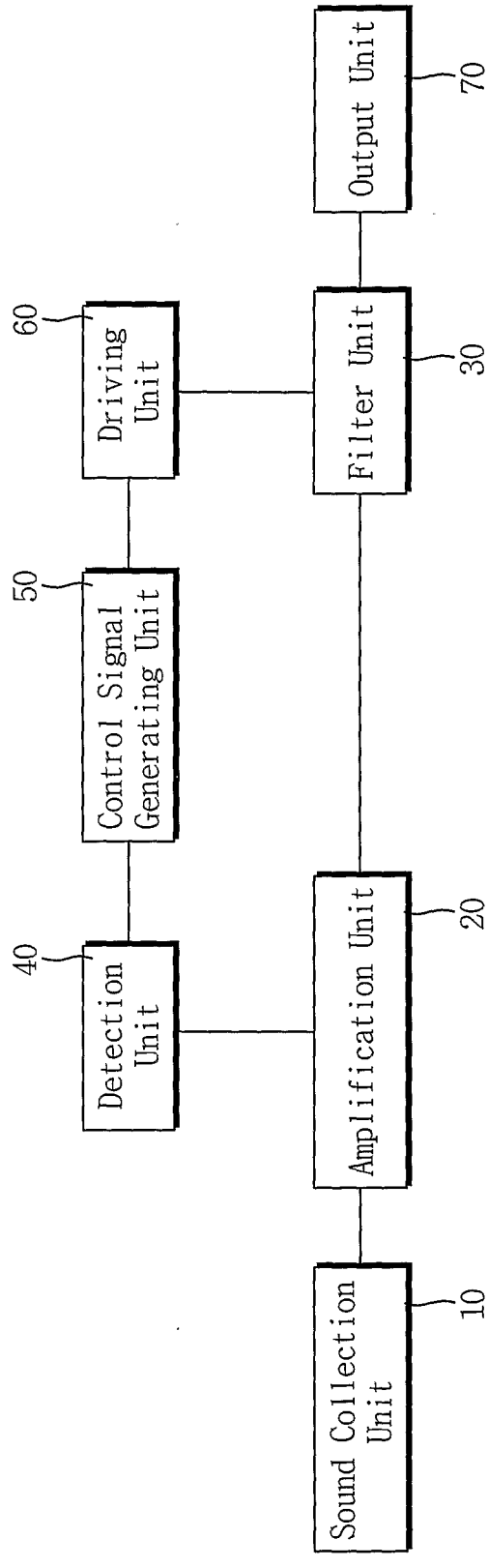
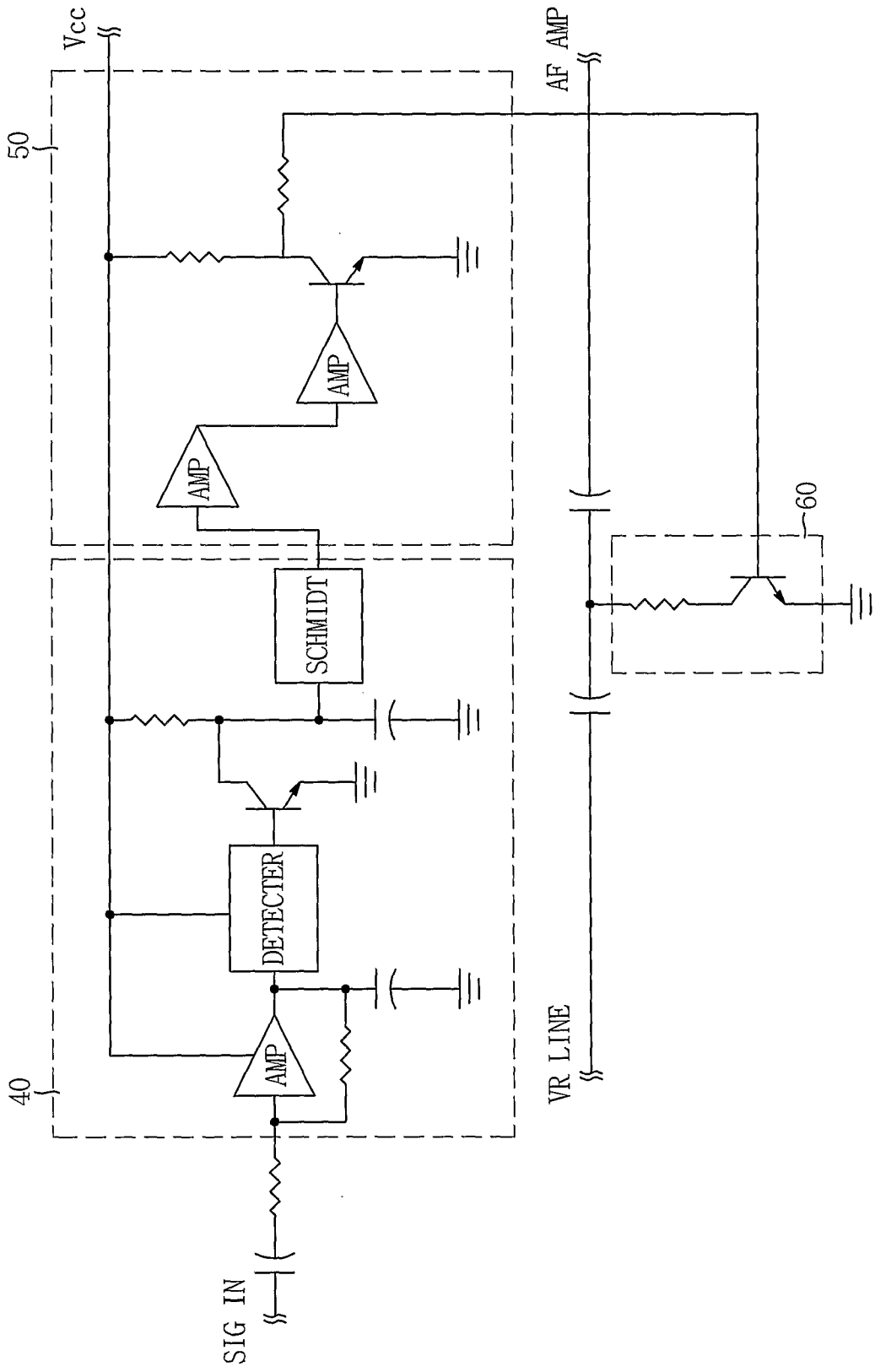

Output Unit
70
Driving Unit
60
Filter Unit
30
Control Signal Generating Unit
50
Detection Unit
40
Amplification Unit
20
Sound Collection Unit
10

Fig.2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/002809

A. CLASSIFICATION OF SUBJECT MATTER

A61B 7/04(2006.01)i

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 8 A61B7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR : IPC as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4731849 A (John W. Bloomfield) Mar. 15, 1988 see the abstract and the claim 1	1-4
X	WO 94/013206 A1 (CURATECHNOLOGIES INC.) Jun. 23, 1994 see the claim 14	1-4
Y	KR 20-0379864 Y1 (CORA TEC Co.) Mar. 24, 2005 see the abstract and the claims 1-3	1-4

☐ Further documents are listed in the continuation of Box C.

☐ 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

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Date of the actual completion of the international search	Date of mailing of the international search report
25 APRIL 2006 (25.04.2006)	**25 APRIL 2006 (25.04.2006)**

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