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(71) Applicant:

**Siemens Audiologische Technik GmbH, 91058
Erlangen, DE**

(72) Inventor:

Hain, Jens, 91077 Kleinsendelbach, DE

(74) Counsel:

Maier, D., Dipl.-Ing. Univ., Pat.-Ass., 85221 Dachau

(56) Documents considered for the assessment of patentability:

EP 13 98 994 A2

EP 09 41 014 A2

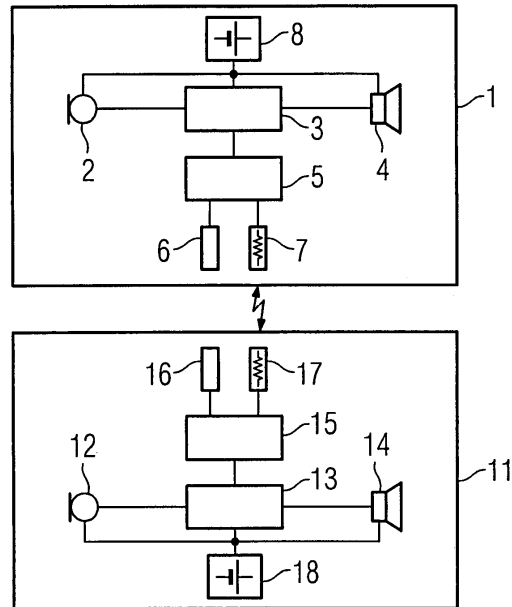
DE 31 09 049 C2

The following information is derived from the documents submitted by the applicant

Examination request pursuant to § 44 PatG [*Patentgesetz* (German Patent Act)] has been filed.

(54) Title: **Hearing aid system with magnetic field sensors**

(57) Abstract: In a hearing aid system with two hearing aids (1, 11) that can be worn on the head, an automatic detection of the hearing situation "telephoning" and an automatic switching off of the hearing aids (1, 11) when they are removed from the head should be implemented. According to the invention, the hearing aids (1, 11) have sensor devices (6, 16) for this purpose, which are used in order to detect whether the relevant hearing aid (1, 11) is in a magnetic field that exceeds a specific field strength. Relevant data in this regard can be exchanged between the hearing aids (1, 11) by means for wireless signal transmission (5, 7; 15, 17). If only one of the two hearing aids (1, 11) detects a magnetic field, it can be deduced that the hearing situation is "telephoning". On the other hand, if both hearing aids (1, 11) detect a magnetic field at the same time, then both hearing aids (1, 11) are located in a storage box equipped with a permanent magnet and are switched off automatically.



Description

[0001] The invention relates to a hearing aid system having a first and a second hearing aid that can be worn on or in the ear of a user, each of which has an input converter for receiving an input signal and converting it into an electrical input signal, a signal processing unit for processing and amplifying the electrical input signal and outputting an electrical output signal, and an output converter for converting the electrical output signal into an output signal that can be perceived by the user as an acoustic signal, wherein the hearing aid system also comprises means for wireless signal transmission between the hearing aids.

[0002] Furthermore, the invention relates to a method for operating such a hearing aid system.

[0003] EP 0 941 014 A2 discloses a hearing aid system having a first and a second hearing aid that can be worn on the head of a user, in which wireless signal transmission takes place between the hearing aids. As a result, for example, control signals can be transmitted between the hearing aids, so that both hearing aids are operated in the same operating mode.

[0004] DE 31 09 049 C2 discloses a hearing aid having a reed contact, by means of which a magnetic field of a specific field strength is detected in the immediate vicinity of the hearing aid. This is used in order to detect whether the hearing aid is in close proximity to a telephone receiver emitting a magnetic field. As a result, the "telephoning" operating mode can be automatically set for the hearing aid in question.

[0005] In order to increase the service life of the voltage source of a hearing aid, it is sensible to switch off the hearing aid immediately after each use. However, the user can easily forget to switch off a hearing aid immediately after use. Furthermore, due to the desired miniaturization of hearing aids, only very small operating elements can be attached to a hearing aid, which makes it difficult to operate them and thus also to switch them off manually.

[0006] The problem addressed by the present invention is to provide a simply implementable and reliable automatic switching off of the devices in a hearing aid system of the aforementioned type.

[0007] This problem is solved by a hearing aid system having the features according to claim 1. Furthermore, this problem is achieved by a method having the method steps according to claim 7.

[0008] In a hearing aid, an input signal is received by an input converter and converted into an electrical input signal. At least one microphone, which receives an acoustic input signal and converts it into an electrical input signal, usually serves as the input converter. Modern hearing aids often comprise a microphone system with a plurality of microphones in order to achieve a reception that is dependent on the direction of incidence of acoustic signals, a directional characteristic. However, telephone

coils or antennas for receiving electromagnetic input signals and converting them into electrical input signals are also common input converters. The input signals converted into electrical input signals by the input converter are fed to a signal processing unit for further processing and amplification. The further processing and amplification takes place in order to compensate for the individual hearing loss of a user, generally based on the signal frequency of the input signal. At its output, the signal processing unit supplies an electrical output signal, which is fed to the hearing aid wearer via an output converter, so that the latter perceives the output signal as an acoustic signal. Receivers that generate an acoustic output signal are typically used as the output converters. However, output converters for generating mechanical vibrations are also known, which directly stimulate certain parts of the ear, such as the auditory ossicles, to vibrate. Furthermore, output converters are known which directly stimulate nerve cells of the auditory system. A hearing aid also comprises a voltage source (battery or accumulator) for supplying voltage to the electronic components. Furthermore, operating elements (on/off switch, program switch, volume control, etc.) can also be present.

[0009] Furthermore, each hearing aid of the hearing aid system according to the invention comprises a signal transmission and control device, by means of which data and control signals can be transmitted between the hearing aids. As a result, the signal processing of the two hearing aids can be matched to one another.

[0010] In addition, the hearing aids according to the invention comprise a respective sensor device, by means of which magnetic fields in which the hearing aids are located and which exceed a specific field strength can be detected. The sensor devices are designed in a particularly simple manner as reed contacts. However, other magnetic field sensors, for example Hall sensors, can also be considered. The respective sensor device can be used in order to determine whether the hearing aid is in the immediate vicinity of a telephone receiver, which emits a detectable magnetic field, so that the hearing aid can be automatically switched to the "telephoning" operating mode, if necessary. The sensitivity of the sensors is dimensioned such that a magnetic field is only detected when the sensor is in the immediate vicinity of the magnet generating the magnetic field. As a result, only the hearing aid that supplies the ear to which the telephone receiver is held is automatically switched to telephoning mode. The hearing aid that supplies the other ear, on the other hand, is not automatically switched to telephoning mode immediately.

[0011] Furthermore, it is desirable for hearing aids to switch off automatically immediately after use. This can also be achieved with a sensor device for detecting an external magnetic field. If, for example, there is a permanent magnet in a storage box for the hearing aid in question, a corresponding sensor device can also determine here that the hearing aid is located in the storage box, so that the hearing aid is switched off automatically. It is also possible for the sensor device to remain active even when it is switched off, which also enables the

relevant hearing aid to be switched on again automatically after it has been removed from the storage box. The power consumption of the sensor device when switched off is very low and can therefore be ignored.

[0012] It becomes problematic when a user wishes to both automatically recognize the hearing situation "telephoning" and automatically switch off of the hearing aid after it has been placed in the storage box. This is because, when detecting an external magnetic field, the sensor device cannot recognize which of the two aforementioned situations is given.

[0013] According to the invention, this problem is solved by a wireless signal transmission between the two hearing aids. At least one of the hearing aids transmits to the other hearing aid the information as to whether an external magnetic field is detected. It therefore provides the information about the presence of an external magnetic field from both hearing aids. If a telephone receiver, from which a magnetic field emanates, is held to an ear supplied with a relevant hearing aid, the magnetic field is only detected by this hearing aid, but not by the hearing aid worn in or on the other ear of the user, due to the distance between the two hearing aids. It is thus established that the hearing situation is "telephoning" and to which of the two hearing aids the telephone receiver is being held. On the other hand, if both hearing aids detect a relatively strong magnetic field in their immediate vicinity, then this is an indication that the hearing aids are located in the storage box and can be switched off.

[0014] The invention can be used with all common hearing aid types, such as hearing aids that can be worn behind the ear (BTE), hearing aids that can be worn in the ear (ITE), etc.

[0015] The invention is explained in further detail below by way of an exemplary embodiment. The following are shown:

[0016] [Fig. 1](#) a hearing aid system according to the invention and

[0017] [Fig. 2](#) a flow chart for carrying out a method according to the invention.

[0018] [Fig. 1](#) shows a hearing aid system having a first hearing aid **1** that can be worn on the head of a user and a second hearing aid **11** that can be worn on the head of a user. The hearing aids **1** and **11** each comprise a microphone **2** or **12** for receiving an acoustic input signal and converting it into an electrical input signal. A signal processing unit **3** or **13** is used for processing and frequency-based amplification of the electrical input signal. The electrical output signal generated by the signal processing unit **3** or **13** is converted into an acoustic output signal by a receiver **4** or **14** and fed to the ear of a user. The signal processing in the signal processing units **3** or **13** can be adapted to different listening environments by setting a large number of parameters. There are, for example, hearing programs or operating modes "speech in quiet", "speech in noise", "telephoning", etc. The setting

of the parameters of the individual hearing programs as well as the settings for the individual compensation of the hearing loss of a user takes place by means of the signal transmission and control units **5** or **15**, to which the transmitting and receiving coils **7** or **17** are connected for wireless data transmission, in conjunction with an external programming unit (not shown). Furthermore, the status of reed contacts **6** and **16** can be queried by the signal transmission and control units **5** and **15**, respectively. If the reed contacts **6** or **16** are in the immediate vicinity of a magnetic field whose field strength exceeds a certain threshold value, the reed contacts **6** or **16** close. From this, the corresponding hearing aid detects in a simple manner whether it is in the immediate vicinity of a magnet. If one of the two hearing aids **1** or **11** detects in the manner described that it is in a magnetic field, this information is transmitted to the other hearing aid by means of the signal transmission and control units **5** or **15** and the transmitting and receiving coils **7** or **17**. If only one of the two hearing aids detects a magnetic field, it is automatically switched to the "telephoning" operating mode. By means of a corresponding control signal transmitted to the other hearing aid, this can optionally also be switched to an operating mode that is adapted to this hearing situation ("telephone receiver on the opposite ear").

[0019] However, if a magnetic field is detected simultaneously by both hearing aids **1** and **11**, it can be concluded that both hearing aids are located in a storage box equipped with at least one corresponding magnet. As soon as this situation is detected, the two hearing aids **1** and **11** switch off automatically. Advantageously, a residual power supply is maintained even in the switched-off state, by which the status of the reed contacts **6** and **16** can continue to be queried. As a result, the hearing aids **1** and **11** detect when they are being removed from the storage box. In this way, the hearing aids **1** and **11** can also be automatically switched on again. This eliminates the need for manually operated on-and-off switches.

[0020] The voltage sources **8** and **18** for supplying voltage to the hearing aids **1** and **11** are preferably rechargeable, and the storage box for the hearing aids **1** and **11** is advantageously designed as a charging device for the voltage sources **8** and **18** at the same time. The hearing aids **1** and **11** are not only automatically switched off when stored in the storage box; rather, they are also recharged.

[0021] [Fig. 2](#) shows a flow chart for automatically detecting the hearing situation "telephoning" and for automatically switching off two hearing aids of a hearing aid system according to the invention. In this case, a hearing aid of a relevant hearing aid system monitors permanently or cyclically for the presence of an external magnetic field. For as long as no magnetic field is detected, the hearing aid is in "normal operation." If a magnetic field is detected, then this information is transmitted to the second hearing aid in the hearing aid system. In addition, the hearing aid checks whether the other hearing aid in the hearing aid system is also sending the information that it is in a magnetic field. If the other hearing aid does not detect a magnetic field, then the

signal processing unit of the hearing aid is switched to a telephoning mode in which parameters for controlling the signal processing are specially adapted to the hearing situation “telephoning.” In addition, an information signal is transmitted to the second hearing aid, which shows that the first hearing aid is in the “telephoning” operating mode. If necessary, the second hearing aid can then also be switched to an operating style that is adapted to this operating mode.

[0022] If it is detected that both hearing aids are in a magnetic field at the same time, this is an indication that the hearing aids are located in a storage box equipped with at least one permanent magnet. The hearing aids are then switched to a switch-off mode in which the hearing aids are largely switched off and only a residual power supply for the sensor device is maintained. As soon as there is no longer an external magnetic field, the hearing aid in question detects that it has been removed from the storage box. It will then turn itself on immediately.

[0023] The process shown allows the hearing aids to detect in a simple manner whether they are in the storage box and whether the hearing situation is “telephoning.” Only a single magnetic field sensor is required in each hearing aid for this distinction.

CITATIONS CONTAINED IN THE DESCRIPTION

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Cited patent literature

- EP 0941014 A2 [\[0003\]](#)
- DE 3109049 C2 [\[0004\]](#)

Claims

1. Hearing aid system having a first and a second hearing aid (1, 11) that can be worn on or in the ear of a user, each having an input converter (2, 12) for receiving an input signal and converting it into an electrical input signal, a signal processing unit (3, 13) for processing and amplifying the electrical input signal and outputting an electrical output signal, and an output converter (4, 14) for converting the electrical output signal into an output signal that can be perceived by the user as an acoustic signal, wherein the hearing aid system also comprises means (5, 7; 15, 17) for wireless signal transmission between the hearing aids (1, 11), characterized in that each of the hearing aids (1, 11) has a sensor device for detecting an external magnetic field that exceeds a specific field strength, wherein data relating to the presence of an external magnetic field can be transferred from at least one of the hearing aids (1, 11) to the other (11, 1).

2. The hearing aid system according to claim 1, wherein the sensor device comprises a reed contact (6, 16).

3. The hearing aid system according to claim 1, wherein the sensor device comprises a Hall sensor.

4. The hearing aid system according to any one of claims 1 to 3, wherein one of the hearing aids (1, 11) can be automatically switched to an operating mode adapted to the hearing situation "telephoning" when its sensor device detects a magnetic field and at the same time the second hearing aid does not detect a magnetic field.

5. The hearing aid system according to any one of claims 1 to 4, wherein both hearing aids (1, 11) can be switched off automatically when their respective sensor devices simultaneously detect a magnetic field.

6. The hearing aid system according to claim 5, wherein the hearing aids (1, 11) each comprise at least one rechargeable voltage source (8, 18) and wherein the hearing aids (1, 11) can be automatically switched to an operating mode for recharging the voltage sources (8, 18) when their respective sensor devices simultaneously detect a magnetic field.

7. A method for operating a hearing aid system having a first and a second hearing aid (1, 11) that can be worn on or in the ear of a user, wherein, in each of the two hearing aids (1, 11), a respective input converter receives an input signal and converts it into an electrical input signal, a signal processing unit (3, 13) processes the electrical input signal and generates an electrical output signal, and an output converter (4, 14) converts the electrical output signal into an output signal that can be perceived by the user as an acoustic signal, and wherein there is a wireless signal transmission between the hearing aids (1, 11), characterized in that each of the hearing aids (1, 11) detects the presence of an external magnetic field that exceeds a specific field strength, and data relating to the presence of an external magnetic field is transferred from at least one of the hearing aids (1, 11) to the other.

8. The method according to claim 7, wherein a hearing aid (1) automatically switches to an operating mode adapted to the hearing situation "telephoning" when it detects a magnetic field and at the same time the other hearing aid (11) does not detect a magnetic field.

9. The method according to claim 7, wherein both hearing aids (1, 11) are switched off automatically when they detect a magnetic field at the same time.

One page of drawings follows

Attached drawings

FIG 1

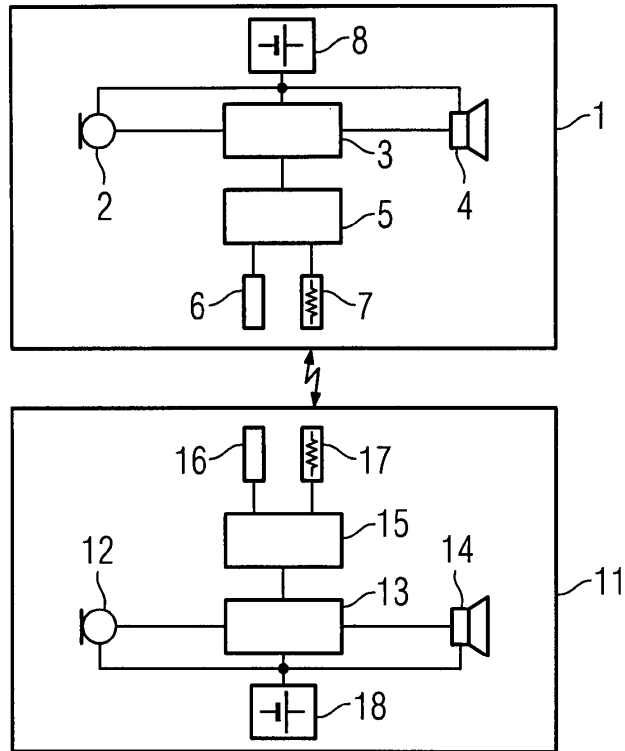


FIG 2

