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Description

The invention relates to a hearing aid system comprising a first and a second hearing aid which may be worn respectively in or on an ear of a user, which re-
5 spectively comprise an input transducer for receiving an input signal and converting into an electrical input signal, a signal processing unit for processing and amplifying the electrical input signal and emitting an electrical output signal, an output transducer for converting the electrical output signal into an output signal which may be perceived by the user as an acoustic signal and means for wire-
10 less signal transmission between the hearing aids.

The invention further relates to a method for operating such a hearing aid system.

15 Hearing aids generally have a manually actuatable switch for switching on and off. In some hearing aids, this switch is incorporated in the battery compartment, so that the hearing aid is switched off as soon as the user pivots the battery compartment slightly out of the normal operating position.

20 As a result of desired miniaturisation, in modern hearing aids there is only relatively little space available for attaching operating elements. Switching on and off such a hearing aid, therefore, requires a certain degree of motor control. Moreover, it is not uncommon for a user to forget to switch off his or her hearing aid, after having removed it from the head for storage.

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A hearing aid system comprising two hearing aids which may be worn on the head, between which a wireless signal transmission is provided, for example for transmitting control signals, is known from EP 0 941 014 A2.

30 Acoustic systems and, in particular, hearing aids which automatically switch between different processing programs are known from DE 10 2004 056 733 A1. In this case it is provided that the signal processing device of a relevant acoustic system has a high frequency detector (HFD) for analysing an input signal,

the output signal thereof being able to be used by the signal processing unit for processing one or more input signals. As a result, the presence of an active mobile phone which emits electromagnetic radiation in the high frequency range may be specifically determined. Consequently, it may be switched to telephone mode with a high degree of reliability, depending on the situation.

A hearing aid is disclosed in the publication DE 31 09 049 C2, in which by the detection of a magnetic field the operating switch of the hearing aid may be switched on or off.

A hearing aid system is known from the publication US 20040131214 A1 in which an analogue integrator monitors the voltage of the current input signal and switches the hearing aid on or off in accordance with a threshold value comparison.

It is the object of the present invention to implement automatic switching on and/or off in a hearing aid system comprising two hearing aids which may be worn on the head.

This object is achieved by a hearing aid system comprising the features as claimed in claim 1. Moreover, the object is achieved by a method comprising the method steps as claimed in claim 12.

In a hearing aid of a hearing aid system according to the invention, an input signal is received by means of an input transducer and transferred into an electrical input signal. At least one microphone generally serves as an input transducer, which picks up an acoustic input signal and converts said input signal into an electrical input signal. Modern hearing aids frequently comprise a microphone system comprising a plurality of microphones, in order to achieve a reception which is dependent on the direction of incidence of acoustic signals, a directional characteristic. However, telephone coils or antennae are also common as input transducers for the reception of wirelessly transmitted input signals and conversion into electrical input signals. The input signals converted by

the input transducer into electrical input signals are fed to a signal processing unit for further processing and amplification. The further processing and amplification takes place to compensate for the individual hearing loss of a user, generally depending on the signal frequency of the input signal. The signal processing unit delivers at its output an electrical output signal, which is fed via an output transducer to the ear of the hearing aid wearer, so that said hearing aid wearer perceives the output signal as an acoustic signal. Earpieces which generate an acoustic output signal are conventionally used as output transducers. However, output transducers are also known for generating mechanical oscillations, which directly excite specific parts of the ear into oscillation, such as for example the small bones in the ear. Moreover, output transducers are known which directly stimulate nerve cells of the ear. Moreover, operating elements (on/off switches, program switches, volume adjusters etc.) may also be present.

Moreover, a hearing aid of a hearing aid system according to the invention comprises means for wireless signal transmission between the hearing aids, for example implemented by a signal transmission and control unit in combination with a transmitting and receiving coil, which are respectively present in both hearing aids.

For the power supply, hearing aids comprise a battery or a rechargeable battery. In order to increase the life of the power source, consideration is given to low energy consumption of all components of the device. Therefore, the transmit power in a hearing aid system which provides wireless signal transmission between the hearing aid devices, is adjusted such that precisely the distance between the two ears of a user may be bridged thereby.

The invention provides, at least in one of the two hearing aids, to determine the field strength of a received signal transmitted by the other hearing aid, from which an indication about the current distance between the two hearing aids relative to one another may be obtained. If both hearing aids are worn at the same time on the head, therefore, the field strength is adjusted such that reliable data transmission between the hearing aids is just possible. If the hearing

aids, however, are located in the vicinity of one another in a storage box, the field strength measured in the hearing aid is many times higher. From the measured field strength, a hearing aid may therefore derive information about whether it is worn on the head or whether it is located in the storage box.

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For the method according to the invention, a relatively approximate determination of the field strength is sufficient. The field strength measurement may, for example, be carried out by using a simple useful signal level measuring device, which is incorporated in one of the receiving filter stages or receiving amplifier stages of the signal transmission unit and detects a voltage value.

Advantageously, the measured field strength is compared with a threshold value. If the field strength is below the threshold value, this is an indication that the two hearing aids are worn on the head. If the measured field strength, however, exceeds the threshold value, this is an indication that the hearing aids are not worn on the head, but are located in the close vicinity of one another for storage, for example in a storage box.

As soon as the measured field strength exceeds the threshold value, the relevant hearing aid is automatically switched off, for example by means of a suitable software control. In the switched-off state, essential power consumers of the hearing aid, such as for example the input transducer, the output transducer as well as the signal processing processor, are disconnected from the power supply. The hearing aid according to the invention, however, is not completely disconnected from the power source, so that at least components for the wireless signal transmission between the hearing aids are still active. Nevertheless, the power consumption is reduced in this switched-off state (sleep mode) in comparison with the fully switched-on hearing aid. In sleep mode, the relevant hearing aid recognises when the measured field strength falls below the threshold value, whereby the hearing aid automatically switches itself on again.

The invention provides the advantage that, in a simple manner, the relevant hearing aid is therefore automatically switched on and off. Thus also a manually

actuatable operating element for switching on and off may be entirely dispensed with. This is in particular also advantageous for the manufacture of a waterproof hearing aid.

- 5 Advantageously, both hearing aids of the hearing aid system according to the invention have a corresponding field strength measuring device. However, it is also possible that only one of the two hearing aids has a field strength measuring device and a control signal is transmitted from this hearing aid to the other hearing aid, which then causes the second hearing aid to be automatically
10 switched on or off.

Naturally, it is possible within the scope of the invention not to measure directly the field strength, at which a signal transmitted by the second hearing aid of a hearing aid system according to the invention is applied to the first hearing aid,
15 but also any other variable dependent on this field strength. For example, the signal level of the signal received by the first hearing aid may be determined.

The invention is described in more detail hereinafter with reference to an embodiment, in which:
20

Figure 1 shows a hearing aid system comprising two hearing aids which may be worn on the head of a user according to the invention in a block diagram and

Figure 2 shows a flow chart for the automatic switching on and off of a corresponding hearing aid.
25

Figure 1 shows a hearing aid system comprising a first hearing aid 1 which may be worn on the head of a user and a second hearing aid 11 which may be worn on the head of a user. The hearing aids 1 and 11 respectively comprise a microphone 2 and/or 12 for receiving an acoustic input signal and converting into
30 an electrical input signal. A signal processing unit 3 and/or 13 serves for the processing and frequency-dependent amplification of the electrical input signal. The electrical output signal generated by the signal processing unit 3 and/or 13

is converted by an earpiece 4 and/or 14 into an acoustic output signal and fed to the ear of a user. The signal processing in the signal processing units 3 and/or 13 may be adapted by the adjustment of a plurality of parameters to different hearing environments. For example, the hearing programs and/or operating modes "speech in low background noise", "speech in interfering noise", "telephoning", etc. are available. The adjustment of the parameters of the individual hearing programs as well as the settings for individually compensating for the hearing loss of a user take place by means of the signal transmission and control units 5 and/or 15, to which the transmitting and receiving coils 7 and/or 17 are connected for wireless data transmission, in combination with an external programming device (not shown).

Moreover, in the hearing aids 1 and 11 the one respective field strength measuring device 6 and/or 16 is present, by means of which the field strength of an electromagnetic signal received by the transmitting and receiving coil 7 and/or 17 and emitted by the transmitting and receiving coil of the respective other hearing aid may be measured. For the decision whether the two hearing aids are currently worn on the head or are stored in the vicinity of one another, a relatively approximate determination of the field strength is sufficient. Preferably, for the field strength measurement a level meter is incorporated in one of the receiving filter stages or receiving amplifier stages arranged downstream of the transmitting and receiving coil 7 and/or 17. Advantageously, the measured signal levels are compared in the signal transmission and control units 5 and/or 15 with a specific threshold value. If the measured field strength exceeds the threshold value, this is an indication that the two hearing aids 1 and/ 11 are at a very short distance from one another. The hearing aids 1 and 11 are therefore, controlled by the signal transmission and control units 5 and/or 15, switched into sleep mode and remain in this state until the measured field strengths fall below the threshold value again. In sleep mode the hearing aid is switched off, i.e. essential components of the hearing aid such as the microphones 2 and/or 12, the signal processing units 3 and/or 13 and the earpieces 4 and/or 14 are disconnected from the power source 8 and/or 18. Only the components required for wireless signal transmission, namely the transmitting and receiving coils 7 and/-

or 17, the field strength measuring devices 6 and/or 16 as well as the signal transmission and control units 5 and/or 15 are still in operation and thus connected to the power sources 8 and/or 18. In order to reduce power consumption further, in sleep mode the signal transmission does not take place continuously
5 between the hearing aids but only at specific times, for example in the form of short pulses, which are periodically repeated in the range of seconds. So that this signal transmission, which is carried out only at specific times, functions, a synchronisation of the hearing aids 1 and/or 11 is required. Advantageously, both hearing aids 1 and 11 are quartz-controlled, so that a relatively good syn-
10 chronisation of the two hearing aids 1 and 11 is provided in any case. Also, the signals transmitted between the hearing aids may be used for synchronisation and, in particular, for fine adjustment during synchronisation.

The invention provides the advantage that in the hearing aids 1 and 11, which
15 are provided for wireless signal transmission, an automatic switching on and off of the hearing aids is implemented at relatively low additional cost. Also corresponding operating elements for manually switching the hearing aids on and off may therefore be dispensed with. This permits further miniaturisation of the devices and increases the operating comfort. Moreover the absence of the opera-
20 ting elements means that production of a waterproof hearing aid is facilitated.

Figure 2 shows by way of example a flow chart for the automatic switching on and off of a hearing aid according to the invention. To this end, continuously or at specific times, an electromagnetic signal emitted by the other hearing aid of
25 the relevant hearing aid system is received by the hearing aid, a synchronisation of the two hearing aids also advantageously taking place using the received signal. Subsequently, the field strength of the electromagnetic signal received by the hearing aid is determined and compared with a threshold value. If the measured field strength is lower than the threshold value, the hearing aid is in
30 normal operation and thus in the switched-on state. If the measured field strength exceeds the threshold value however, the hearing aid is in sleep mode, i.e. in the switched-off state, in which at least essentially only the components required for the wireless signal transmission are operated. This state is main-

tained until the measured field strength of the received electromagnetic signal falls below the threshold value again.

Patentkrav

1. Høreapparatsystem med et første og et andet høreapparat (1, 11), som henholdsvis er indrettet til at kunne bæres i eller på en brugers øre, og som
5 hver for sig omfatter en indgangsomformer til optagelse af et indgangssignal og omformning af dette til et elektrisk indgangssignal, en signalforarbejdningssenhed (3, 13) til forarbejdning og forstærkning af det elektriske indgangssignal og afgivelse af et elektrisk udgangssignal, en udgangsomformer til omformning af det elektriske udgangssignal til et af brugeren som akustisk signal registrerbart
10 udgangssignal og midler (5, 7; 15, 17) til trådløs signaloverføring imellem høreapparaterne (1, 11), **kendetegnet ved**, at mindst det første høreapparat (1) har midler til automatisk til- og/eller frakobling af det første høreapparat (1) i afhængighed af feltstyrken, med hvilken et signal, som overføres trådløst fra det andet høreapparat (11) til det første høreapparat (1), modtages i det første høreapparat.
15 reapparat.
2. Høreapparatsystem ifølge krav 1, hvorved til den automatiske til - og/eller frakobling det i det første høreapparat (1) modtagne signals feltstyrke eller en af feltstyrken afhængig størrelse er i det mindste tilnærmelsesvis bestemmelig ved
20 hjælp af det første høreapparat (1).
3. Høreapparatsystem ifølge krav 2, hvorved den målte feltstyrke og den af feltstyrken afhængige størrelse er sammenlignelig med en første tærskelværdi i det første høreapparat (1) og det første høreapparat (1) automatisk udkobler,
25 hvis feltstyrken eller den af feltstyrken afhængige størrelse overstiger den første tærskelværdi.
4. Høreapparatsystem ifølge krav 2, hvorved den målte feltstyrke og den heraf afhængige størrelse er sammenlignelig med en anden tærskelværdi i det første høreapparat (1), og det første høreapparat (1) lader sig automatisk tilkoble,
30 hvis feltstyrken og den heraf afhængige størrelse kommer ned under den anden tærskelværdi.

5. Høreapparatsystem ifølge et af kravene 1 til 4, hvorved et styresignal er overførligt fra det første høreapparat (1) til det andet høreapparat (11) til den automatiske til- og/eller frakobling af det andet høreapparat (11), styret af det første høreapparat (1).
- 5
6. Høreapparatsystem ifølge et af kravene 1 til 5, hvorved høreapparaterne (1, 11) er indrettet til at kunne synkroniseres.
7. Høreapparatsystem ifølge krav 6, hvorved i en første sovemodus i høreapparaterne (1, 11) et signal er overførligt fra det første høreapparat (1) til det andet høreapparat (11), og feltstyrken ved det signal, som modtages i det første høreapparat (1), eller en af feltstyrken afhængig størrelse er bestemmelig i det første høreapparat (1).
- 10
8. Høreapparatsystem ifølge krav 7, hvorved det andet høreapparat (11) i det mindste i sovemodussen kun sender et signal til det første høreapparat (1) inden for bestemte tidsintervaller, og det første høreapparat (1) kun er tilkoblet i en modtagemodus inden for dette tidsinterval til modtagelsen af det fra det andet høreapparat (11) sendte signal.
- 15
9. Høreapparatsystem ifølge et af kravene 3 til 8, hvorved det første høreapparat (1) har en niveaumåler til bestemmelse af signalniveauet for det signal, som modtages i det første høreapparat (1), eller har et herfra udgående signal.
- 20
10. Høreapparatsystem ifølge krav 9, hvorved niveaumåleren er integreret i et modtagefiltersystem eller modtageforstærkertrin i forbindelse med det første høreapparat (1).
- 25
11. Høreapparatsystem ifølge et af kravene 1 til 10, hvorved ingen af de to høreapparater (1, 11) har en manuel aktiverbar til- og/eller frakobler til til- og/eller frakobling af det respektive høreapparat (1, 11).
- 30

12. Fremgangsmåde til drivning af et høreapparatsystem med et første og et andet høreapparat (1, 11), som er indrettet til at kunne bæres på eller henholdsvis i en brugers øre, ved hver af hvilke et indgangssignal optages og omformes til et elektrisk indgangssignal, hvorved det elektriske indgangssignal for-
5 arbejdes og forstærkes, og der fremstilles et elektrisk udgangssignal, hvorved det elektriske udgangssignal omformes til et af brugeren som akustisk signal registrerbart udgangssignal, og hvorved der imellem høreapparaterne (1, 11) trådløst overføres et signal, **kendetegnet ved**, at mindst det første høreapparat (1) i afhængighed af den feltstyrke, med hvilken et signal, som overføres tråd-
10 løst fra det andet høreapparat (11) til det første høreapparat (1), modtages i det første høreapparat (1), automatisk til- og/eller frakobles.

13. Fremgangsmåde ifølge krav 12, hvorved til den automatiske til- og/eller frakobling bestemmes i det mindste tilnærmelsesvis feltstyrken af det i det første høreapparat (1) modtagne signal eller en heraf afhængig størrelse i det første høreapparat (1).

14. Fremgangsmåde ifølge krav 12 eller 13, hvorved feltstyrken eller den heraf afhængige størrelse sammenlignes med en tærskelværdi, og det første høreapparat (1) frakobles, hvis feltstyrken henholdsvis størrelsen overstiger tærskelværdien.

15. Fremgangsmåde ifølge krav 12 eller 13, hvorved feltstyrken eller den heraf afhængige størrelse sammenlignes med en tærskelværdi, og det første høreapparat (1) tilkobles, hvis feltstyrken eller størrelsen kommer ned under tærskelværdien.

16. Fremgangsmåde ifølge et af kravene 12 til 15, hvorved i afhængighed af feltstyrken et styresignal fremstilles i det første høreapparat (1) og overføres til
30 det andet høreapparat (11) til den automatiske til- og/eller frakobling af det andet høreapparat (11), styret ved hjælp af det første høreapparat (1).

17. Fremgangsmåde ifølge et af kravene 12 til 16, hvorved høreapparater (1, 11) synkroniseres ved hjælp af det signal, som overføres fra det andet høreapparat (11) til det første høreapparat (1).

- 5 18. Fremgangsmåde ifølge et af kravene 12 til 17, hvorved i en sovemodus i høreapparaterne (1, 11) overføres et signal fra det andet høreapparat (11) til det første høreapparat (1), og feltstyrken af det i det første høreapparat (1) modtagne signal eller en heraf afhængig størrelse bestemmes i det første høreapparat (1).

10

19. Fremgangsmåde ifølge krav 18, hvorved det andet høreapparat (11) i det mindste i sovemodussen kun sender et signal til det første høreapparat (1) inden for bestemte tidsintervaller, og det første høreapparat (1) kun kobles til modtagelsen af det fra det andet høreapparat (11) sendte signal i en modtage-

15 modus inden for disse tidsintervaller.

20. Fremgangsmåde ifølge krav 18 eller 19, hvorved det første høreapparat (1) kun inden for bestemte tidsintervaller kobles til modtagelsen af det fra det andet høreapparat (11) sendte signal i en modtagemodus.

20

21. Fremgangsmåde ifølge et af kravene 12 til 20, hvorved som størrelse, som er afhængig af det modtagne signals feltstyrke, bestemmes signalniveauet af et signal, som hidrører fra det modtagne signal i det første høreapparat (1).

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1/1

FIG 1

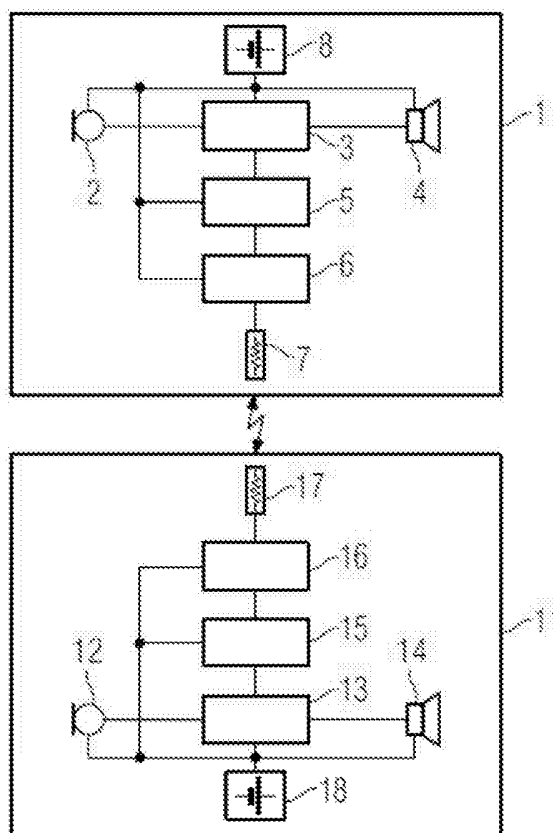


FIG 2

