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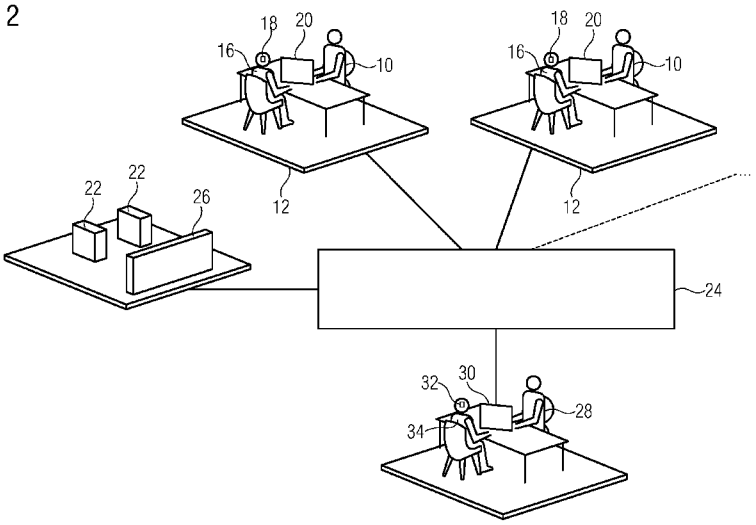
(54) **Title**: METHOD FOR GENERATING A FIRST-FIT-CONFIGURATION FOR A HEARING DEVICE

FIG 2



(57) **Abstract**: The invention provides a fitting device (20, 30) for a hearing device (18, 32), wherein the fitting device (20, 30) comprises a receiving unit for receiving a first-fit-configuration for the hearing device (18, 32), a tuning unit for configuring the hearing device (18, 32) with the first-fit-configuration and for changing at least one parameter value of the configuration in the hearing device (18, 32), and a sending unit for sending a) the at least one parameter value as a last-fit-configuration of the hearing device and/or b) difference data describing the difference between the first-fit-configuration and the last-fit-configuration to an external processing device (22). The invention also provides a method for improving the first-fit-configuration.

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Description of the invention

Method for generating a first-fit-configuration for a hearing device

The invention is concerned with generating an improved first-fit-configuration for a hearing device wherein the first-fit-configuration comprises at least one parameter value for an audio processing unit of the hearing device. The invention also provides a fitting device for configuring a hearing device.

A hearing device provides the possibility to improve an acoustic signal for a user with hearing impairments. In order to comply with the numerous individual needs, different designs of hearing aids are provided, such as behind-the-ear (BTE) hearing aids, hearing aids with an external receiver (RIC: receiver in the canal) and in-the-ear (ITE) hearing aids, e.g. concha hearing aids or completely-in-the-canal (CIC) hearing aids. The hearing aids listed above as examples are worn at or behind the external ear or within the auditory canal. Furthermore, the market also provides bone conduction hearing aids, implantable or vibrotactile hearing aids. In these cases the affected hearing is stimulated either mechanically or electrically. In principle, hearing aids have an input transducer, an amplifier and an output transducer as essential components. The input transducer usually is an acoustic receiver, e.g. a microphone, and/or an electromagnetic receiver, e.g. an induction coil. The output transducer normally is an electro-acoustic transducer e.g. a miniature speaker or an electro-mechanical transducer e.g. a bone conduction transducer. The amplifier usually is integrated into a signal processing unit.

The general structure of a hearing device is shown schematically in FIG 1. A hearing device may comprise a housing 1 for wearing the hearing device, for example, behind the ear (BTE - hearing device) or in the ear canal (ITC - in the canal).

The housing 1 may host one or more microphones 2 for generating an electric microphone audio signal from an acoustic sound. The microphone signal may be processed by an audio processing unit 3, for example an ASIC (application specific integrated circuit). The signal or audio processing unit 3 may be equally integrated into the hearing aid housing 1. The audio processing may involve, for example, the amplification or attenuation of certain frequencies of the audio signal, a compression and an adaptive noise suppression in the audio signal. The audio processing may be configured by means of parameters for the audio processing. Changing a parameter value results in a different processing of the audio signal. The processed audio signal may be emitted as an acoustic sound or as a body sound by a receiver 4. Energy for the hearing device may be provided by a battery 5.

In order to compensate for a given end user's hearing loss effectively, a hearing device must be adapted or fitted to the end user's needs. The fitting is usually performed by a hearing health care professional or audiologist. The audiologist configures the hearing device by changing parameter values of the audio processing unit according to instructions of the end user of the hearing device. For example, the user may report that speech sounds muffled when using the hearing device. In this case the audiologist might increase the gain for the higher frequencies in the audio processing unit. Another reason for muffled sounding speech might be an inadequate choice of a time constant of a noise reduction algorithm. The audiologist might therefore also change this time constant.

The fitting procedure may comprise several sessions at different days. In each session the user describes the difficulties that arose with the hearing device since the last session and the audiologist changes the parameter values of the hearing device in order to improve the configuration of audio device. The fitting process is finished when the audio processing unit is configured to fit the end user's needs. In

connection with the following description the resulting set of parameter values of the audio processing unit is called last-fit-configuration of the hearing device.

At the beginning of the fitting procedure, instead of starting completely from scratch, the audiologist uses a so-called fitting formula in order to generate an initial configuration for the hearing device. The fitting formula may take as input parameters the end user's audiogram values. From these input parameters appropriate parameter values for the audio device are calculated by the fitting formula. These parameter values are then stored in the hearing device as initial configuration. They constitute a starting point for the fitting procedure. In the sequel, such an initial configuration resulting from a fitting formula is called the original first-fit-configuration. A well-known provider for fitting formulas is the institution "National Acoustic Laboratories" (NAL). It provides fitting formulas that are called NAL-NL1 and NAL-NL2.

However, the optimal parameter values for fitting a given hearing device to an end user's needs, i.e. the optimum amount of amplification and/or compression to compensate for the individual hearing loss, might differ significantly from the original first-fit-configuration like it is generated by the fitting formula. Thus the fitting may require an unwanted amount of time and fine-tuning of the parameter values in order to satisfy the individual hearing impaired.

In some cases, the audiologist may be able to compensate for these difficulties. For example, a certain type of hearing device might generally require an unusually high gain for certain frequencies. If an audiologist has fitted several hearing devices of that type for different end users, the audiologist will know from experience that the fist-fit-configuration does not deliver adequate parameter values for these frequencies. The audiologist will therefore immediately adapt the corresponding parameter values of the original

first-fit-configuration once this first-fit-configuration is generated by the fitting formula. After the original first-fit-configuration has been manually improved in this way, the hearing device may be configured directly with the adapted parameter values. In the same way, the audiologist might consider the personal preferences of a certain customer that the audiologist knows from previous fitting procedures. Thus, an audiologist might know from experience how to tweak a certain type of hearing device in order to shorten the duration and/or to reduce the effort of fitting a hearing device. However, the audiologist generally needs several occasions of fitting a certain hearing device in order to gain this experience.

It is the object of the present invention to provide an improved first-fit-configuration that has a higher probability of complying with the needs of an end user of a given hearing device than does an original first-fit-configuration like it is provided by a fitting formula.

A solution is provided by the method according to claim 1 and by a fitting device according to claim 12. Further advantageous improvements of the inventive method are given by the dependent claims.

The inventive method helps improving an original first-fit-configuration that comprises at least one parameter value for an audio processing unit of a certain hearing device which is called "first hearing device" in the following. The improvement is based on knowledge about typical adaptation steps that are necessary for fitting the hearing device when said original first-fit-formula is used as a starting point. For obtaining this knowledge, the inventive method is based on the observation of similar fitting procedures that use the same original first-fit-configuration and that take place before the improved first-fit-configuration is needed for adapting the first hearing device. These fitting procedures may be performed by different audiologists and for users of

other hearing devices (of same or different type) and also at different places. Like was already explained, the at least one other hearing device is configured using the original first-fit-configuration. For each of the other hearing devices, the typical fitting procedure is then performed. In other words, the at least one parameter value of the configuration is changed according to instructions of the respective user of the hearing device. Hereby a last-fit-configuration is created in each of the other hearing devices. Generally, the parameter changed in such a fitting procedure may comprise any parameters that result in a change of the audio processing.

Then, for each of the other hearing devices, difference data are obtained that describe the differences between the original first-fit-configuration and the last-fit-configuration of the respective hearing device. Effectively, these difference data describe the overall changes that were necessary for obtaining the last-fit-configurations from the original first-fit-configuration in the fitting sessions. On the basis of the difference data from all the other hearing devices, a correction value for the at least one parameter value of the original first-fit-configuration is then calculated. The expertise of how to obtain a correctly fitted hearing device from the original first-fit-formula is thus reflected in those correction values for the single parameter values. In other words, if the audiologists had known these correction values at the start of the fitting procedures, they could have saved precious time as they would have known how to tweak the original first-fit-configuration in order to get closer to the final last-fit-configuration without having to ask the patient, i.e. the user of the hearing device. This, of course, is only true in a statistical sense as the intra-individual differences between the different users have to be taken into account.

The inventive method therefore consequently comprises the step of creating an improved first-fit-configuration from the

original first-fit-configuration and the correction value for the at least one parameter value. Then, the improved first-fit-configuration is provided to the first hearing device. It can therefore be expected that there is a high probability that the fitting procedure for the first hearing device needs fewer fitting sessions.

The difference data may comprise the mathematical difference between the at least one parameter value of the original first-fit-configuration and the corresponding parameter value of each last-fit-configuration. In this case, an offset value is calculated from the difference data for each parameter value. Each offset value then functions as a correction value for a parameter value of the original first-fit-configuration value. Using an offset value has the advantage that there is no need to change the original fitting formula like it may be obtained from an external provider like NAL.

In one embodiment of the inventive method, the correction value is calculated as a weighted sum of the respective difference data from the other hearing devices. This has the advantage that the influence of the difference data can be varied according to, for example, the source they come from.

Thus, in one embodiment a contribution of the difference data from one particular hearing device on the correction value for the at least one parameter value is determined in dependence on a level of experience of an audiologist who perform a fitting procedure of the particular hearing device, and/or a level of satisfaction of the user with the last-fit-configuration. This may shorten the time and number of observed fitting procedures that are needed to obtain suitable correction values.

Apart from the knowledge that can be obtained from observing the tuning performed by an audiologist, it may also be advantageous to incorporate the parameter values that are set by a so-called learning algorithm of a hearing device. Whenever a

user of such a hearing device manually adapts parameter values, a learning algorithm may observe and store information on the changes made by the user and on the acoustical environment that caused the user to change the parameter values. Later, when the learning algorithm recognizes the same acoustical environment, it can adapt the parameter values by itself. If the learning algorithm observes that the user manually adapts certain parameters in every acoustical situation (or in almost every acoustical situation) this is a clear hint that the current configuration is not correct. When a learning algorithm is used and the at least one parameter value in the other hearing devices is at least partially changed by means of a learning algorithm, the correction value is also influenced by the settings performed by the learning algorithm. This has the advantage that everyday situations outside the single fitting sessions also contribute to the difference data which leads to more realistic results.

An adapted version of a learning algorithm may also be used to generate the improved first-fit-configuration itself from the original first-fit-configuration and the difference data.

The at least one other hearing device is preferably selected in dependence on a homogeneity criterion regarding at least one property of the user of the respective hearing device. This has the advantage that an improved first-fit-configuration can be provided for users with special hearing impairment.

The homogeneity criterion may constitute that all users of the other hearing devices are identical (or at least coincide to a given degree of tolerance) in at least one of the following properties: their audiogram, their age, their gender, their cognitive abilities (that is, for example, their ability to quickly interpret speech), a further disease or impairment apart from their hearing loss, a first-fit-configuration previously used, the type of hearing device

used, acoustical parameters and additional equipment used with the hearing device (ear moulds, slime tubes, tip, open connection), their country of residence (tropical environment, cold region), personal life style or habits (couch potato, sportive), type of hearing loss, root cause for hearing loss. The incorporation of these properties allows for providing improved first-fit-configurations in dependence on the individual situations of a user of a certain hearing device that has to be adapted.

Accordingly, for easily identifying the improved first-fit-configuration that suits best, the improved first-fit-configuration is preferably provided together with data stating which homogeneity criterion was fulfilled by the users that were observed.

From what was said above, the inventive method may also be used to provide several different improved first-fit-configuration, one each for different groups of user. In other words, the users like they were described so far, constitute a fist group of users. At least one additional group of users comprising at least one user of a hearing device is selected and for each additional group of users a respective improved first-fit-configuration is created in the same manner like in the case of the first group of users.

According to another aspect of the invention, the improvement of the first-fit-configuration is performed iteratively. In other words, the collection of difference data is performed repeatedly and each set of new difference data is used to calculate improved correction values for the original first-fit-configuration. This has the advantage that the quality of the improvement increases over time. Preferably, the difference data from all fitting procedures are considered cumulatively or a moving average value is calculated from the correction values resulting from the different updates.

Like has been explained above, the changing of the parameter value in the hearing device is preferably at least partially performed by an audiologist while fitting the hearing device for an end customer by means of a fitting device. In order to collect the information on the necessary tuning steps form a large number of audiologists, the difference data from the hearing devices are preferably sent from the audiologist's fitting device over the Internet to a central processing device for calculating the correction value for the at least one parameter value.

In this context, the inventive fitting device for a hearing device comprises: a receiving unit for receiving a first-fit-configuration for the hearing device, a tuning unit for configuring the hearing device with the first-fit-configuration and for changing at least one parameter value of the configuration in the hearing device, and a sending unit for sending a) the at least one parameter value as a last-fit-configuration of the hearing device and/or b) the difference data describing the difference between the first-fit-configuration and the last-fit-configuration to an external processing device. Providing several audiologists with the inventive fitting device has the advantage that the original first-fit-configuration may be improved without having to perform expensive listening tests with only a few test persons.

In the following preferred embodiments of the invention are described in connection with the figures. The figures show:

FIG 1 a schematic representation of a hearing device,

FIG 2 a schematic diagram depicting the acquisition of information on last-fit-configurations over the Internet,

FIG 3 a flow chart visualising basic steps of one embodiment of the inventive method, and

FIG 4 a flow chart visualising basic steps of another embodiment of the inventive method.

FIG 2 shows several health care professionals or audiologists 10 who may be situated at different places like different shops 12 or even countries. While in FIG 2 only two audiologists 10 are shown, their number is not limited. This is indicated by the dashed lines.

Each audiologist 10 may interview a user 16 of a hearing device 18 in order to find out which values for parameters of a audio processing unit of the respective hearing device 18 are best suited for the user 16. Each audiologist 10 than changes the parameter values in the hearing device 18 accordingly using a fitting device 20.

As initial values for the parameters, the fitting devices 20 used values which the fitting devices 20 received from a central server computer 22. The fitting devices 20 and the central server computer 22 may be connected over the Internet 24. The central server computer 22 may be protected by a firewall 26.

The interaction between the fitting devices 20 and the central server computer 22 is explained in the following with reference to FIG 2 and FIG 3. All relevant parameters related to one or more fitting processes are submitted by the fitting devices 20 over the Internet 24 in a step S10 (SUB - submission) and stored centrally in the central server 22. Those parameters may comprise as the patients' audiograms, the selected fitting formulas (and its version number), the resulting original first-fit-configuration generated by the chosen fitting formula, and the last-fit-configurations, like they result from the audiologists fine-tuning efforts. These data may be collected online, for example, over the Internet and from several different audiologists and from numerous pa-

tients. The data may be anonymized without limiting the advantageous effects of the method.

For the data from each fitting process, the following evaluation is performed by the central server 22 in a step S12 (IMP - improvement). The difference between the original first-fit-configuration and the last-fit-configuration is determined. This may involve the differences in the frequency responses for different frequencies and (in the case of compressors) for different sound levels. It may also involve the differences in other time-invariant parameters such as compression time-constants or parameters determining the choice of a noise reduction algorithm or parameters concerning a beam-forming algorithm. Adaptive parameters may also be analysed.

Then, a given fitting formula is modified on the basis of the differences found between the original first-fit-configurations generated with this fitting formula and the corresponding last-fit-configurations for a predefined group of audiograms. Thus for a certain group of users with similar audiograms correction values for the different parameters of the original first-fit-configurations can be calculated. Preferably, for calculating the correction values the differences are not taken into account equally, but rather in a weighted manner in order to make the process robust against falsely adapted hearing devices with faulty last-fit-configurations. For example, weighting parameters for a weighted sum of the individual difference values may be applied on the basis of, for example, the hearing health care professional's expertise or experience (the more experienced the larger the weight) and/or the patient's satisfaction rating (the more satisfied, the larger the weight).

If the hearing device comprises learning abilities, the learned settings of the parameter values may also incorporated into the last-fit-configuration. Thus, the advantages

of a learning algorithm may also be included into the calculation of the correction values.

Thirdly, the fitting formula in question may be modified on the basis of the correction values for the parameter values. This may be achieved, for example, by means of an adapted learning algorithm.

The resulting modified fitting formula is then made available to the audiologists 10 via the Internet 24 in a step S14. For this, the server 22 may send the according data to the fitting devices 20. The modification may be made in different ways. The modified fitting formula may comprise the original fitting formula together with an offset for correcting the original first-fit-configurations generated by the original first-fit-configuration. It is also possible to modify the original fitting formula itself.

The modified fitting formula may be provided together with a new version number for identification. For example, the version number may comprise the information on which data set was used to calculate the correction values. This allows for the integration more data by repeating the procedure as outlined above. Thus the originally fitting formula may be continuously adapted in an iterative way on the basis of data collected in several fitting procedures while intermediate results may already be made available.

The step S14 may also comprise sending or submitting (SUB) the data from the server 22 to another audiologist's 28 fitting device 30. When a new hearing device 32 must be adapted to the need of a user the audiologist 28 saves time by using the improved first-fit-configuration distributed over the Internet by the server 22 in step S14.

The example shows that the improvement of a first-fit-configuration may be based on educated experts (i.e. hearing health care professionals or audiologist) rather than unedu-

cated users (i.e. the hearing impaired). Additionally, the improvement may be based on a large population that exceed by far the typical sample size like it is available for the development of a state of the art fitting formula.

Thus, the benefits of the inventive method are an iterative improvement of the fitting formula of generating an improved first-fit-configuration that allows the health care professional to save time during in fitting procedure, e.g. a reduce number of fine tuning sessions may result. This allows the professional to see more customers that is to increase the customer throughput. The inventive method also is "public" in the sense that the result may be made available to a large group of hearing impaired rather than to the one individual only who was satisfied in individual fine-tuning sessions or by the results generated by a learning algorithms.

The inventive method may be realized in various other variants. The improved first-fit-configuration may be generate on difference data from only one specific type of hearing device or from hearing devices produced by one specific company. In turn, the improved first-fit-configuration may be provided to only a group of health care professionals who use the corresponding fitting formula. The health care professionals may also be selected to other criteria, like professionals who contributed to the improved first-fit-configuration by providing last-fit-configuration data or difference data. Thus these professionals would share their expertise among each other.

The last-fit-configuration data and/or the difference data may also be taken from a database, like the NOAH database offered by the Hearing instrument manufacturers' software association. This database provides a large selection of patient data and results of fine-tuning. Using this database may increase the amount of data available for the improvement of the first-fit-configuration.

In another embodiment, the inventive method may be performed in only a limited way, for example on a single fitting device. Similarly, it may be limited to a dedicated user who changes hearing devices over the years.

In another embodiment, the inventive method may also serve customers directly who fit their hearing device at home. Thus no health care professional is required and the users of hearing devices could share their expertise indirectly by providing their last-fit-configuration or the according difference data to a central server.

In the following, a further aspect of the invention is explained in connection with FIG 4. This embodiment of the inventive method deals with the following problem. The audiologist community believes that the fitting of a hearing instrument or hearing device does not only depend on the hearing loss, but also on further individual parameters like gender. However, no statistically significant difference was found so far, as the number of test subject was too small to investigate personal parameters that might have an impact on the fitting quality.

In the embodiment, the inventive method makes use of cloud computing by collecting not only data concerning the last-fit-configuration, but additionally data on other properties of the user. These data can comprise: age, gender, cognitive abilities (results of questionnaires and/or hearing health care professional's estimation), patient profile (live style: active, couch potato), further diseases/impairments, follow-up fitting/ initial fitting, type of hearing instrument, acoustical parameters (ear mould, slime tube and tip), country. Such data are continuously collected, for example, from hearing health care professional worldwide. In a step S16 the data are submitted to a central processing server together with the patient's audiogram, the underlying fitting formula and the patient's last-fit-configuration.

This generates a database that grows with every fitting procedure. By the processing server, the collected data are clustered according to the type of hearing loss (as reflected, for example, by the audiogram) in a step S18 (CLUST - clustering). Further, the patients' data are split into sub-groups. Each sub-group is homogeneous with regard to at least one of the other properties, for example, gender or patient profile.

For each sub-group, a separate improved first-fit-configuration is generated in the described way in a step S20 (CALC - calculation). These are then distributed to the community of health care professionals via the Internet in a step S22. The improved first-fit-configurations may be identified by version numbers. If there is no significant difference between the resulting improved first-fit-configurations of two sub-groups, the two sub-groups can be united.

This embodiment allows to provide individual improved first-fit-configuration for each sub-group. It incorporates the expertise of many hearing health professionals and bases the improvement of the first-fit-configuration on a large sample population.

The benefits of this embodiment are that an iteratively improving first-fit-configuration is provided to the health care professionals. Further, the resulting first-fit-configuration is more individual than the existing ones paving the way to a more personalized fitting.

Claims

1. Method for improving an original first-fit-configuration that comprises at least one parameter value for an audio processing unit of a first hearing device (32), comprising the steps of:
- Configuring at least one other hearing device (18) using the original first-fit-configuration;
- in each other hearing device (18): changing the at least one parameter value according to instructions of the respective user (16) of the other hearing device and hereby creating a last-fit-configuration in each other hearing device (18);
- for each other hearing device (18): Obtaining difference data that describe the difference between the original first-fit-configuration and the last-fit-configuration;
- Calculating a correction value for the at least one parameter value of the original first-fit-configuration on the basis of the difference data from all other hearing devices (18) and creating (S12, S20) the improved first-fit-configuration from the original first-fit-configuration and the correction value for the at least one parameter value;
- Providing (S14, S22) the improved first-fit-configuration to the first hearing device (32).

2. Method according to claim 1, wherein as the difference data a mathematical difference between the at least one parameter value of the original first-fit-configuration and the corresponding parameter value of each last-fit-configuration is calculated and as the correction value for the at least one parameter value of the original first-fit-configuration value an offset value is calculated from the difference data.

3. Method according to claim 1 or 2, wherein the correction value is calculated as a weighted sum of the difference data from the other hearing devices (18).

4. Method according to any of the preceding claims, wherein a contribution of the difference data from one particular of the at least one other hearing device (18) to the correction value for the at least one parameter value is determined in dependence on:
a) a level of experience of an audiologist (10) who performs a fitting procedure at the particular hearing device (18), and/or
b) a level of satisfaction of the user (16) with the last-fit-configuration.

5. Method according to any of the preceding claims, wherein the at least one parameter value in at least one of the at least one other hearing device (18) is at least partially changed by means of a learning algorithm.

6. Method according to any of the preceding claims, wherein the at least one other hearing device (18) is selected in dependence on a homogeneity criterion regarding at least one property of the user (16) of the respective hearing device.

7. Method according to claim 6, wherein the homogeneity criterion constitutes that all users (16) of the at least one other hearing device (18) are identical or at least coincide to a given degree of tolerance in at least one of the following properties: their audiogram, their age, their gender, their cognitive abilities, a further disease or impairment apart from a hearing loss, a first-fit-configuration previously used, a type of hearing device (18) used, acoustical parameters and additional equipment used with the hearing device, country (12) of residence, personal life style or habits, type of hearing loss, root cause for hearing loss.

8. Method according to claim 6 or 7, wherein the improved first-fit-configuration is provided together with data stating which homogeneity criterion was fulfilled.

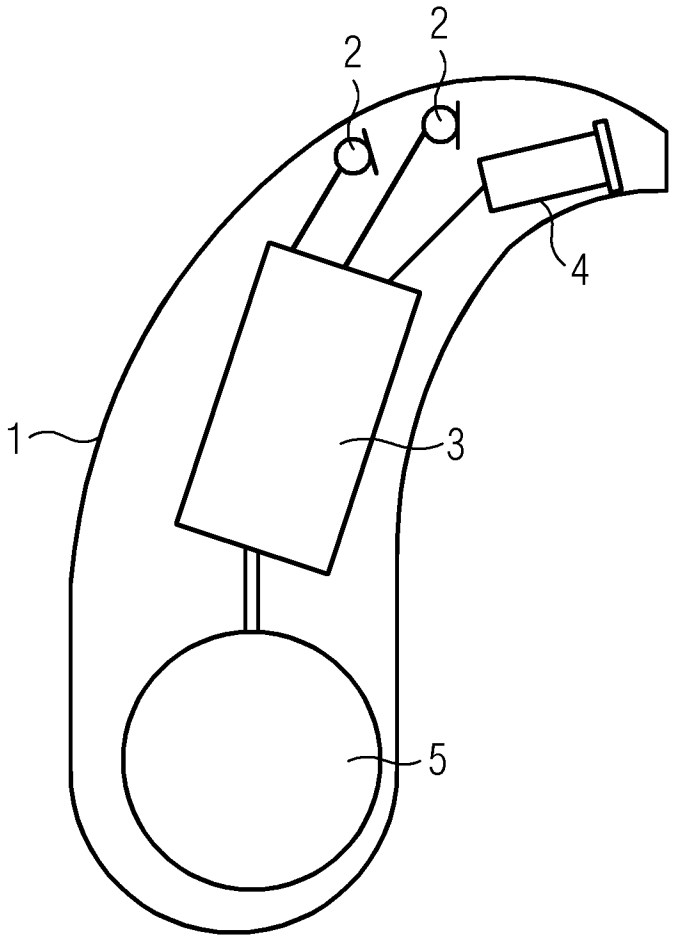
9. Method according to any of the preceding claims, wherein all users (16) of the at least one other hearing device (18) constitute a first group of users and wherein at least one additional group of users comprising at least one user of a hearing device is selected and wherein for each additional group of users a respective improved first-fit-configuration is created in the same manner as in the case of the first group of users (S20).

10. Method according to any of the preceding claims, wherein the improvement of the first-fit-configuration is performed iteratively.

11. Method according to any of the preceding claims, wherein the changing of the at least one parameter value in at least one of the at least one other hearing device (18) is at least partially performed by an audiologist (10) while fitting the hearing device (18) for an end customer (16) by means of a fitting device (20) and wherein the difference data from the hearing device (18) are sent from the fitting device (20) over the Internet (24) to a central processing device (22) for the calculation (S12, S20) of the correction value for the at least one parameter value.

12. Fitting device (20, 30) for a hearing device (18, 32), wherein the fitting device (20, 30) comprises:
- a receiving unit for receiving a first-fit-configuration for the hearing device (18, 32),
- a tuning unit for configuring the hearing device (18, 32) with the first-fit-configuration and for changing at least one parameter value of the configuration in the hearing device (18, 32);
- a sending unit for sending
a) the at least one parameter value as a last-fit-configuration of the hearing device and/or
b) difference data describing the difference between the first-fit-configuration and the last-fit-configuration
to an external processing device (22).

FIG 1



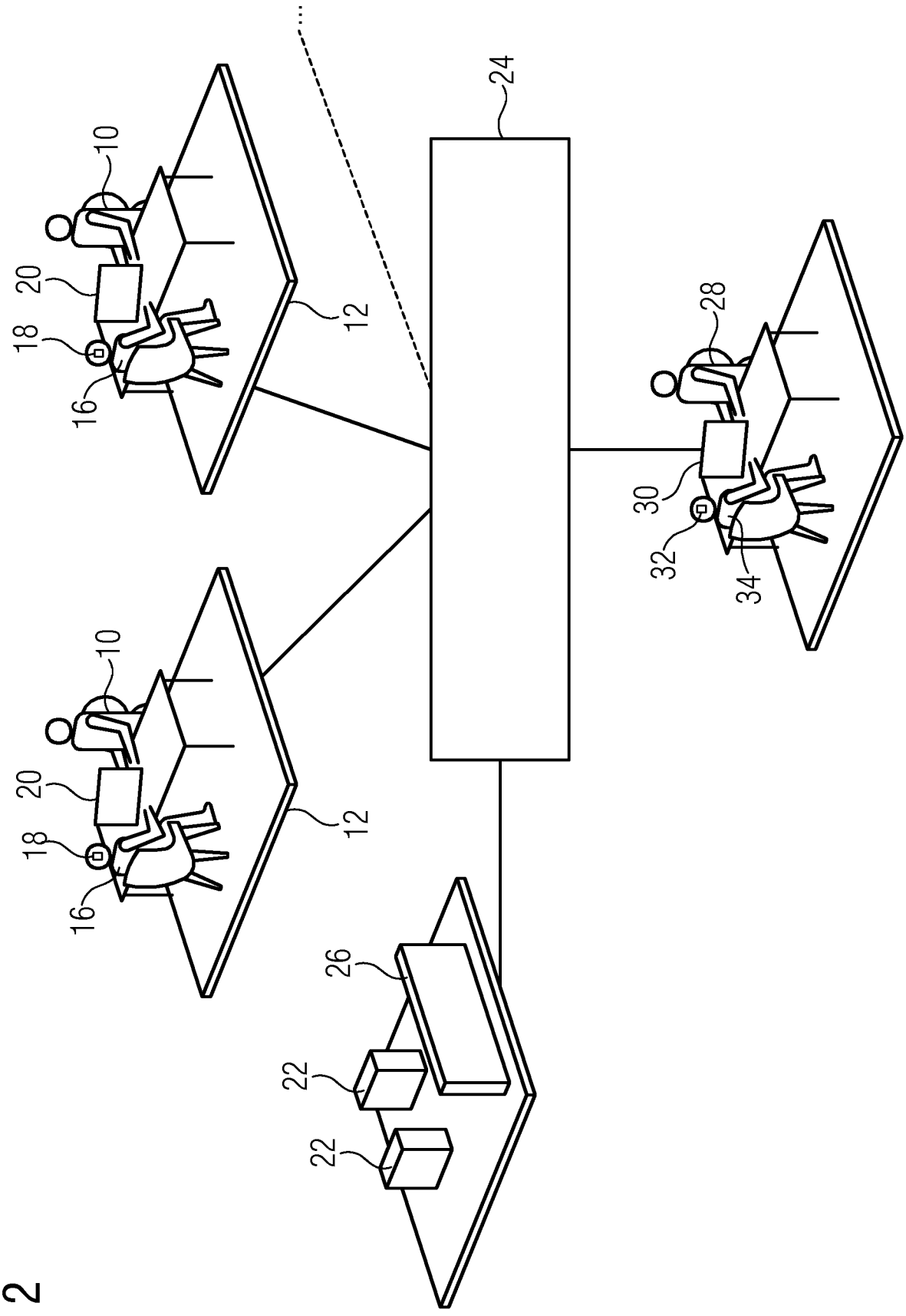
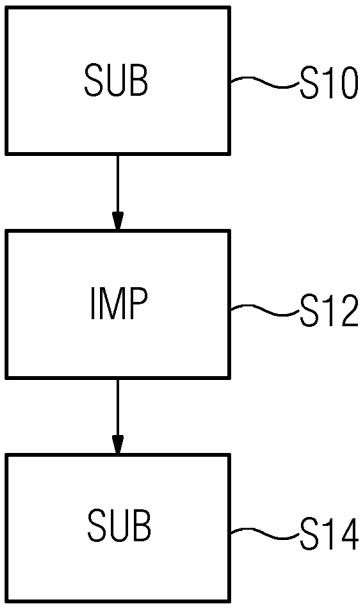


FIG 2

FIG 3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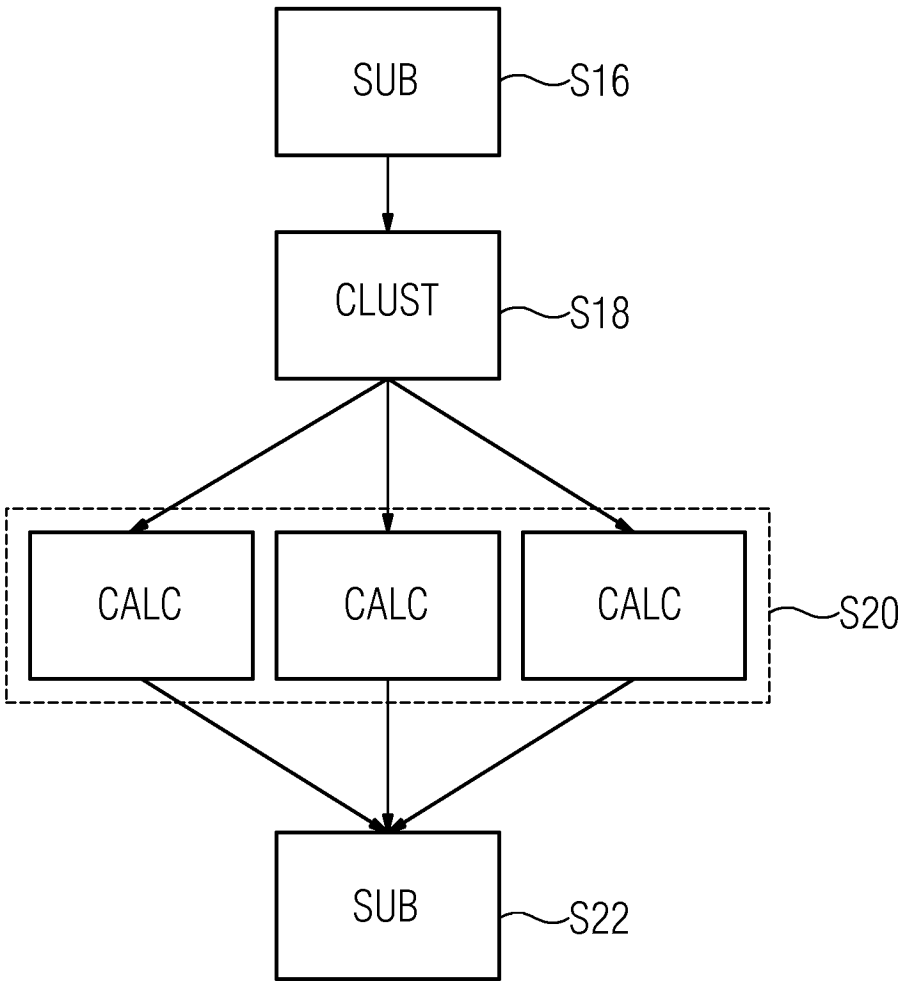
S10
IMP
S12
SUB
S14

FIG 4


SUB
S16
CLUST
S18
CALC
CALC
CALC
S20
SUB
S22

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/065463

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/00
ADD.

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)
H04R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/119382 A1 (PHONAK AG [CH]; WALDMANN BERND [CH]) 9 October 2008 (2008-10-09) page 3 - page 6; claims 1-13; figure 1	1-12
X	US 2007/237346 A1 (FICHTL ELMAR [CH] ET AL) 11 October 2007 (2007-10-11) paragraph [0001] - paragraph [0048]	1-12
A	US 2008/107296 A1 (BACHLER HERBERT [CH] ET AL BAECHLER HERBERT [CH] ET AL) 8 May 2008 (2008-05-08) the whole document	1-12
A	EP 1 933 591 A1 (GEERS HOERAKUSTIK AG & CO KG [DE]) 18 June 2008 (2008-06-18) the whole document	1-12

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

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 July 2013	07/08/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Timms, Olegs

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/065463

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008119382 A1	09-10-2008	EP 2132956 A1	16-12-2009
		US 2010104122 A1	29-04-2010
		WO 2008119382 A1	09-10-2008
US 2007237346 A1	11-10-2007	NONE	
US 2008107296 A1	08-05-2008	NONE	
EP 1933591 A1	18-06-2008	DE 102006058522 A1	26-06-2008
		EP 1933591 A1	18-06-2008