(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 December 2005 (29.12.2005)

PCT

(10) International Publication Number
WO 2005/125280 A2

(51) International Patent Classification[7]: H04R 29/00

(21) International Application Number: PCT/US2005/020825

(22) International Filing Date: 13 June 2005 (13.06.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/579,420 14 June 2004 (14.06.2004) US

(71) Applicant (*for all designated States except US*): **JOHNSON & JOHNSON CONSUMER COMPANIES, INC.** [US/US]; 199 Grandview Road, Skillman, NJ 08558 (US).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **BURROWS, Mark** [US/US]; 127 Liberty Drive, Newtown, PA 18940 (US). **CRONIN, John** [US/US]; 11 Marian Way, Jericho, VT 05465 (US). **NARSANA, Tushar** [US/US]; 2604 Whitehall Lane, Naperville, IL 60564 (US). **SINGARAYAR, John, Anthony** [US/US]; 89 Green Meadow Road, Skillman, NJ 08558 (US).

(74) Agent: **ZONERAICH, Davy, E.**; Norris McLaughlin & Marcus, PA., P.O. Box 1018, Somerville, NJ 08876 (US).

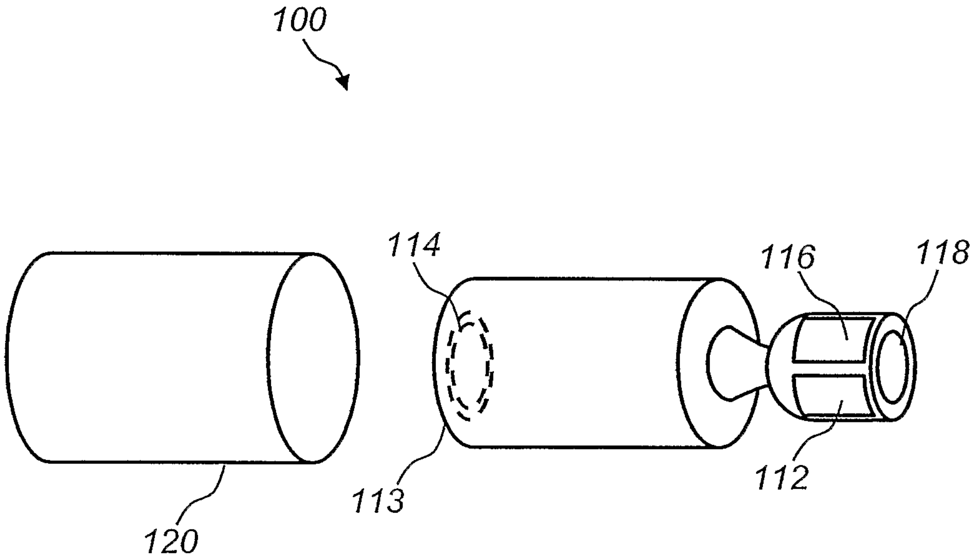
(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ,*

[Continued on next page]

(54) Title: HEARING AID DEMONSTRATION UNIT AND METHOD OF USING



(57) **Abstract:** The present invention is a programmable hearing aid unit and a method of using the programmable hearing aid unit for demonstration purposes on an individual with a hearing deficiency. The unit is demonstrated on the individual prior to the individual's purchase of a customized hearing aid unit, thereby educating the individual on what to expect after receiving his/her purchased hearing aid unit, and thereby increasing the individual's satisfaction with the purchased hearing aid unit.

WO 2005/125280 A2

CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

HEARING AID DEMONSTRATION UNIT AND METHOD OF USING

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/579,420 filed June 14, 2004, assigned to the assignee of this application and incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to programmable hearing aid units. More particularly, the present invention relates to a programmable hearing aid unit that is used for demonstration purposes.

BACKGROUND OF THE INVENTION

More than 25 million Americans have hearing loss, including one out of four people older than 65. Hearing loss may come from infections, strokes, head injuries, some medicines, tumors, other medical problems, or even excessive earwax. It can also result from repeated exposure to very loud noise, such as music, power tools, or jet engines. Changes in the way the ear works as a person ages can also affect hearing.

For most people who have a hearing loss, there are ways to correct or compensate for the problem. If an individual has trouble hearing, that individual can visit a doctor or hearing health care professional to find out if he or she has a hearing loss and, if so, to determine a remedy. The U. S. Food and Drug Administration (FDA) and similar governing bodies in other countries have rules to ensure that treatments for hearing loss — medicines, hearing aids, and other medical devices — are tried and tested.

However, most people do not even know that they have a hearing loss. Typical indications that an individual has hearing loss include: (1) shouting when talking to others, (2) needing the TV or radio turned up louder than other people do, (3) often having to ask people to repeat what they say because the individual can't quite hear them, especially in groups or when there is background noise, (4) not being able to hear a noise when not facing the direction it's coming from, (5) seeming to hear better out of one ear than the other, (6) having to strain to hear, (7) hearing a persistent hissing or ringing background noise, and (8) not being able to hear a dripping faucet or the high notes of a violin. If an individual experiences one of more of the above indications, the individual should see his or her doctor or hearing health care professional for further testing for potential hearing loss.

To find out what kind of hearing loss the individual has and whether all the parts of the individuals' ear are functioning, the person's doctor may want him or her to take a hearing test. A health-care professional that specializes in hearing, such as an audiologist, often gives these tests. Audiologists are usually not medical doctors but are trained to give hearing tests and interpret the results. Hearing tests are painless.

If the hearing test shows that the individual has a hearing loss, there may be one or more ways to treat it. Possible treatments include medication, surgery, or a hearing aid. Hearing aids can usually help hearing loss that involves damage to the inner ear. This type of hearing loss is common in older people as part of the aging process. However, younger people can also have hearing loss from infections or repeated exposure to loud noises.

In a well-known method of testing hearing loss in individuals, the threshold of the individual's hearing is typically measured using a calibrated sound-stimulus-producing device and calibrated headphones. The measurement of the threshold of hearing takes place in an isolated sound room, usually a room where there is very little audible ambient noise. The sound-stimulus-producing device and the calibrated headphones used in the testing are known as an audiometer.

A professional audiologist performs a professional hearing test by using the audiometer to generate pure tones at various frequencies between 125 Hz and 12,000 Hz that are representative of a variety of frequency bands. These tones are transmitted through the headphones of the audiometer to the individual being tested. The intensity or volume of the pure tones is varied until the individual can just barely detect the presence of the tone. For each pure tone, the intensity at which the individual can just barely detect the presence of the tone is known as the individual's air conduction threshold of hearing. Although the threshold of hearing is only one element among several that characterizes an individual's hearing loss, it is the predominant measure traditionally used to acoustically fit a hearing compensation device.

Known audiometers are of two main types: the manual and the “automatic” type. In the manual system for and method of testing hearing, a skilled operator adjusts the audiometer controls, thereby sending a plurality of audio signals through either earphones, loudspeakers, or bone vibrators to a subject sitting in a quiet room. The subject is requested to signal to the operator, by activating a switch connected to a pilot light, by raising a hand, or by any other visible or audible means, whenever he or she has heard the sound being sent. The operator watches for the subject’s responses, interprets them, and translates them into written information on a chart. This information is represented by a graph called an audiogram, which represents the threshold of hearing of the subject for a plurality of audio frequencies.

In the automatic method known as the Bekesy method of hearing testing, the audiometer presents automatically changing tone frequencies to the subject while the intensity of the signal is controlled by the subject by means of a pushbutton switch activating a motor controlling the motion of an intensity attenuator. The subject’s responses are also automatically recorded by a writing pen moving over a chart as the test progresses. While the Bekesy method was considered by those skilled in the art of audiology to be a major advance, it still requires the presence of a skilled operator and the use of rather sophisticated mechanical systems. Since the introduction of the Bekesy method, an automatic method of hearing testing has been proposed in U.S. Patent No. 4,107,465, that dispenses with the need for a skilled operator and the use of rather sophisticated mechanical systems.

The audiometer apparatus uses headphones when testing the individual’s hearing. The results of the test will be used to design a hearing aid, which is typically a hearing aid with a digital signal processor (DSP) that uses frequency and amplitude adjustments to create an amplifier and filter that is customized to the patient. However, it is difficult to calibrate the exact adjustment of the hearing-aid device to be worn by the individual based upon the use of headphones in the hearing test. A problem associated with the use of headphones to present tones to the individual is that, due to the unique acoustics of each individual’s ear canal, the individual’s perception of the sound transmitted by the headphones is different from the individual’s perception of sound transmitted by the actual hearing-aid device in the individual’s ear canal.

Once the individual's hearing compensation in the hearing test has been determined, the compensation factors are sent to the manufacturer for programming the DSP of the hearing aid. The hearing aid is manufactured, programmed, and then sent to the audiologist. The audiologist physically fits the hearing aid to the individual's ear and makes any necessary electrical adjustments, such as helping the individual set the volume control, and any other adjustments the hearing aid allows. The hearing aid is adjusted in reference to the results of a second test that the audiologist conducts on the individual with the hearing aid in place. However, the results of the hearing retest may require further frequency versus amplitude adjustments that are not possible after the manufacturer defines the settings. This often happens because, due to differences in acoustics, an individual may respond differently in a hearing test conducted with headphones than in the same hearing test conducted with a programmed hearing aid. Often, the individual is surprised at how different hearing aid use is. The expectations set by the individual can be problematic, and a large number of hearing aids are returned because the devices' performance does not meet those expectations.

To overcome the problems associated with an audiometer apparatus that employs either headphones or a non-customized device that fits into the ear to test for hearing loss, a prior art fitting system employs a programmable hearing aid worn by the individual as the means of generating the tones used to assess the hearing loss. In addition to having programmable parameters for the signal processing circuits that provide hearing compensation, the hearing aid also has various circuit components that may be trimmed to compensate for variations in electrical characteristics.

However, the prior art assumes that a patient has already purchased, or is very close to purchasing, a programmable hearing aid. In most cases, the first time an individual tries a hearing aid is post-purchase, and the sudden difference in hearing capability may confuse the individual. This confusion may lead the individual to be prematurely dissatisfied with the hearing aid and may prompt the individual to not use or return the hearing aid, thereby causing a high rate of return and loss to the hearing aid manufacturer. What is needed is a step-by-step process to transition and train a hearing-deficient individual on the use of a programmable hearing aid prior to the individual's purchase of his or her customized hearing aid.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a hearing aid demonstration unit that can demonstrate the use of a hearing aid to an individual before the individual purchases a customized hearing aid unit. It is yet another object of the present invention to illustrate a method of improving customer satisfaction when buying a hearing aid unit and reducing the rate of return of hearing aid units to manufacturers. The present invention is a hearing aid demonstration unit and a method of using the hearing aid demonstration unit on an individual with a hearing deficiency prior to the individual's purchase of a customized hearing aid unit. Because the individual retakes the hearing test with a programmed hearing aid prior to purchasing a permanent customized hearing aid unit, the individual will be more aware of what to expect from his or her purchased unit. The individual will therefore be more likely to be satisfied with the unit when it arrives, thereby reducing the rate of return of hearing aid units to manufacturers.

Thus, the present invention provides a method for simulating hearing aid operation comprising providing a hearing aid housing sized and configurable for insertion in a human ear, wherein the housing includes a microphone and a speaker and a data signal interface capable of receiving and transmitting hearing aid data signals and coupled to the microphone and the speaker, computing digital signal processor ("DSP") correction factors for a user based on frequency versus amplitude test data (e.g., data can be obtained from a remote database and can further include speech intelligibility and user preference data);

transmitting a word data signal representative of a test word to an external speaker for causing a sound output of the word to be generated;
receiving the sound output of the word and converting the sound output of the word to a detected word sound signal;

transmitting the detected word sound signal at the interface;
modifying at a remote controller/DSP the detected word sound signal with the DSP correction factor corresponding to the word;

transmitting the modified word signal for receipt at the interface; and
generating a sound output from the modified word signal at the speaker of the hearing aid housing.

In a further embodiment, the method includes receiving user feedback data and adjusting the DSP factors based on the feedback data.

Thus, the present invention further provides a hearing aid housing for simulating hearing aid operation, wherein the housing is sized and configurable for insertion in a human ear, wherein the housing includes a data signal interface capable of receiving and transmitting hearing aid data signals and coupled to a microphone and a speaker; wherein the microphone receives sound output and transmits the sound output to the interface as sound output signals, and wherein the speaker generates simulated sound output based on modified sound output signals received at the interface.

In a further embodiment of the hearing aid housing, the interface includes a digital signal processor ("DSP") for modifying the modified sound output signals received at the interface.

In a further embodiment of the hearing aid housing, the interface includes a wireless signal receiver.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will be apparent from the following detailed description of the presently preferred embodiments, which description should be considered in conjunction with the accompanying drawings in which like references indicate similar elements and in which:

Figure 1 is a hearing aid demonstration unit.

Figure 2 is a system that integrates the hearing aid demonstration unit.

Figure 3 is a method of using the hearing aid demonstration unit.

Figure 4 is a hearing correction table.

Figure 5 is an alternate embodiment of the system illustrating the use of a hearing aid demonstration unit.

DETAILED DISCRIPTION OF THE INVENTION

Figure 1 is a hearing aid demonstration unit **100** including an interface **112**, a speaker **114**, an (optional) amplifier **116**, a microphone **118**, a moldable sleeve **120**, and an insert end **113**.

As is commonly done in the art of fitting a hearing aid, hearing aid demonstration unit **100** is configured based on the individual's profile (e.g., physiology and specific hearing loss requirements). Insert end **113** is a standard size and is the portion of hearing aid demonstration unit **100** that is inserted into the individual's ear. Moldable sleeve **120** is a cylinder made of polymeric or foam-based material with an opening that allows it to fit over insert end **113**. Moldable sleeve **120** fits over insert end **113** and is compressible, giving standard-sized insert end **113** a customized fit in the individual's ear.

Interface **112** acts as the electrical connection between hearing aid demonstration unit **100** and external devices such as programming devices. Interface **112**, in its simplest form, is a connector at which speaker **114**, (optional) amplifier **116**, and microphone **118** are connected and accessible to a physical connection to an external device. Speaker **114** plays sounds sent to it via the external device. Optional amplifier **116** amplifies the test sound signal for speaker **114** and microphone **118** in line with interface **112**. Based upon the test requirements and hearing requirements of the individual, amplifier **116** may or may not be applied. For example, if at very low sounds microphone **118** needs pre-amplification before the signals for microphone **118** go through interface **112** to the external devices, amplifier **116** would be used as a pre-amplifier. Microphone **118** receives sound to be transmitted to the individual. There are conventional trade-offs in impedance among microphone **118**, speaker **114**, any external devices, and the length of cabling internal to hearing aid demonstration unit **100** that connects it with the external devices.

Figure 2 is a system **200** consisting of hearing aid demonstration unit **100** from **Figure 1**, a user **205** (shown as an individual's ear), a sound room **208**, a user monitor **233**, a user keyboard **237**, a sound simulator **220**, a DSP **225**, an output device **115**, a PC **230** with a first database **235**, a connection to the Internet **260**, a central hearing health computer system **270** with a second database **275**, an audiologist **250**, an audiologist monitor **253**, and an audiologist keyboard **257**.

User **205** is the individual using hearing aid demonstration unit **100**. User **205** represents the individuals (mass market) on whom a hearing test is to be administered. This is generally any and all individuals, especially the more than 10% of the population (e.g., 25 million Americans) that have hearing loss, including one out of four people older than 65. Hearing loss may come from infections, strokes, head injuries, some medicines, tumors, other medical problems, or even excessive earwax. It can also result from repeated exposure to very loud noise, such as music, power tools, or jet engines. Changes in the way the ear works as a person ages can also affect hearing.

Sound room **208** is a sound-proof room that provides a suitable environment for a hearing test. PC **230** is central input-output processing unit. User monitor **233**, user keyboard **237**, audiologist monitor **253**, and audiologist keyboard **257** are input and output devices for PC **230**. Audiologist **250** is a representation of a professional hearing test administrator. Sound simulator **220** simulates the sound for a hearing test. DSP **225** is a programmable interface for hearing aid demonstration unit **100**. Internet **260** is a network connection and central hearing health computer system **270** is a remote system that is connected to PC **230** through Internet **260**.

Internet **260** is a standard Internet connection or could be a WAN, LAN, etc. Internet **260** is the communication infrastructure between PC **230** and central hearing health computer system **270**. Internet **260** allows central hearing health computer system **270** to remotely administer hearing tests, thereby allowing central hearing health computer system **270** the opportunity to reach a large number of individuals.

PC **230** further contains first database **235** to store information such as user profiles, hearing amplification tables, and user test results.

Output device **115** represents either speakers in sound room **208** or the set of headphones that user **205** would wear.

DSP **225** is a digital signal processor that can be programmed by PC **230**. Essentially, a DSP is a device that can convert analog signals to digital signals, can operate on the digital signals to provide amplification or attenuation to many different frequency ranges, and can accomplish this conversion and attenuation in real time so that the output digital signals can be reconverted to analog signals in real time.

Sound simulator **220** is a high-quality sound card amplifier that uses the output of the DSP to drive output device **115.**

Central hearing health computer system **270** further contains second database **275**, which is a centralized database for storing user profiles, amplifications, and user test results for multiple audiologists and users in multiple locations.

Central hearing health computer system **270** further includes a computer (not shown) with user test programs (not shown) stored in second database **275**.

Central hearing health computer system **270** is a centrally located computer system that is connected to Internet **260**. Central hearing health computer system **270** is a central repository of all current audiological programs, audiological data, audiological research, sound ". wav" files, and speech and other sound simulations files. Central hearing health computer system **270** centralizes information so that all connected audiologists around the world can access current audiological test procedures, new standards, new algorithms for programming the DSP-based hearing aids, etc.

Second database **275** is a memory region of central hearing health computer system **270** that stores user data information such as demographics, age, name, date of birth, etc., and also includes the user's actual responses to the hearing tests.

The computer of central hearing health computer system **270** is a computer that is capable of performing all conventional computer functions of reading and writing data to memory (within the computer), reading and writing data to PC **230** and communicating through modem or network connection and running user test programs.

In the general method of operation, user **205** first takes a hearing test without the assistance of a hearing aid. Audiologist 250 links to central hearing health computer system **270** through PC **230** and Internet **260** to upload any current information from second database **275** and update information that was previously uploaded and stored on first database **235**. Audiologist **250** runs PC **230** using keyboard **257** and monitor **253** to execute the hearing test programs without a hearing aid on user 205, instead using headphones (output device **115**) on user **205**. The program sends sounds (tones) at various amplitudes directly to sound simulator **220** (bypassing DSP **225**), to output device **115** and optionally may send information or questions to user monitor **233.** Audiologist **250** gauges interaction from user 205 through either verbal responses or responses via user keyboard **237**. In addition, speech intelligibility can be tested by a program with pre-defined sentences that is output to user 205 for his or her understanding and response. In this way, user **205** undergoes professional hearing tests. It is further understood that, if user **205** had a code from a low-cost test that he or she had previously taken, the first request of the program would be for user **205** to enter the code using user keyboard **237**.

Once the first hearing test is run at various frequencies and amplitudes, audiologist **250** determines the difference between the norms of a healthy hearing response and the results of the test just taken by user 205. This comparison finds differences in frequency and amplitude ranges that may need more amplification or attenuation. These differences are automatically calculated and presented to audiologist **250** for adjustment. Audiologist **250** may, from other information about the lifestyle of user **205**, choose to override some of the calculated results This modified frequency versus amplitude test data is downloaded from PC 230 to DSP **225** and the test is conducted again (with the headphones on) to ensure that user **205** has improved hearing. This information is also uploaded to central hearing health computer system **270**.

In the second part of the hearing test, central hearing health computer system **270**, through PC **230** and Internet **260**, uploads any current information from first database **235** to second database **275**. Audiologist **250** runs the programs on PC **230** using audiologist keyboard **257** and audiologist monitor **253**. The hearing test programs are executed on user **205** without a hearing aid, instead using hearing aid demonstration unit **100.**

First, hearing aid demonstration unit **100** is fitted in user **205**'s ear by adjusting moldable sleeve **120** on insert end **113**, both of **Figure 1**. The program sends sound signals representative of sounds (tones) at various amplitudes directly through sound simulator **220** (bypassing DSP **225**) to output device **115** (the speakers in sound room **208**) and optionally may send data signals representative of information or questions to user monitor **223**. Any sounds from output device **115** that are picked up by microphone **118** of hearing aid demonstration unit 100 are sent as detected sound signals via interface **112** to PC **230.** PC **230** sends these detected sound signals to DSP **225,** which sends a modified version of the detected sound signals through the sound simulator **220** to speaker **114** of hearing aid demonstration unit **100**. By doing this, the components DSP **225**, interface **112**, and amplifier **116** function as if they were the manufacturer-programmed hearing aid ordered by user **205**. User **205** thus experiences a preview of what would occur when the individually customized manufactured heading aid is fitted, and gets a clear understanding of how much improvement the hearing aid would provide.

As with the first part of the test, audiologist **250** gauges interaction from user **205** through either verbal responses or responses via user keyboard **237**. In addition, speech intelligibility can be tested by a program with pre-defined sentences that are output to user **205** for his or her understanding and response.

Based upon the findings of this second test, audiologist **250** can make real-time final adjustments to hearing aid demonstration unit **100** through DSP **225**. These final adjustments are sent to central hearing health computer system **270** through PC **230** and Internet **260** in order to synchronize the contents stored on first database **235** (the final test results) and second database **275**. The manufacturer can use this information to make an individually customized hearing aid for user **205**.

Figure 3 illustrates a method **300** of operating system **200**, including the steps of:

Step 310: Acquiring test results from audiologist

In this step, audiologist **250**, who is outside sound room **208**, logs onto PC **230.** User **205** enters his or her identification information through user keyboard **237.** PC **230** stores the identification information in first database **235** and logs onto Internet **260** to connect to central hearing health computer system **270**. Central hearing health computer system **270** then sends all previously gathered information about user **205** to PC **230.** Audiologist **250** acquires and views all the information about user **205** on audiologist monitor **253** and uses audiologist keyboard **257** to initiate hearing aid demonstration unit **100**. It is further understood that, if user **205** had a code from a low-cost test that he or she had previously taken, the first request of the program would be for PC **230** to download the code from central hearing health computer system **270**, or for user **205** to enter the code using user keyboard **237**.

Furthermore, if user **205** has previously used a low-cost temporary hearing health aid apparatus, then information pertaining to how the user used the temporary hearing health aid apparatus can also be uploaded by PC **230** from central hearing health computer system **270.** A temporary hearing health aid apparatus with a "patient use diary" feature, can store information on how the user had used the hearing health aid, while it was in the users possession. The "patient use diary" feature can be facilitated via selection switches on the hearing aid. For example, every time the user with hearing health aid watches TV he/she presses a switch to indicate that the hearing health aid is being used while watching TV. In turn, this use information gets stored onto the temporary hearing health aid, and ultimately gets copied onto central hearing health computer system **270** when the user returns the temporary hearing health aid.

Step 315: Running standard hearing test

In this step, audiologist **250** runs the hearing test programs on PC **230** using audiologist keyboard **257** and audiologist monitor **253** to execute the programs. User **205** takes the tests without hearing aid demonstration unit **100** in his or her ear, instead wearing headphones (output device **115**). The program sends sounds (tones) at various amplitudes directly through sound simulator **220** (bypassing DSP **225)** to output device **115** and optionally may send information or questions to user monitor **233.** Audiologist **250** gauges interaction from user **205** through either verbal responses or responses via user keyboard **237.** In addition, speech intelligibility can be tested by a program with pre-defined sentences that is output to user **205** for his or her understanding and response. In this way, user **205** undergoes professional hearing tests.

Step 320: Using tests results to optimize use of hearing aid demonstration unit

In this step, once the hearing test has been run at various frequencies and amplitudes, audiologist **250** determines the difference between the norms of a healthy hearing response and the results of the test just taken by user **205**. This comparison provides differences in frequency and amplitude ranges that may need more amplification or attenuation. These differences are automatically calculated and presented to audiologist **250** for adjustment. Audiologist **250** may, from other information about the lifestyle of user **205**, choose to override some of the calculated results. This modified frequency versus amplitude test data is downloaded from PC **230** to DSP **225** and the test is conducted again (with the headphones on) to ensure that user **205** has improved hearing. This information is also uploaded to central hearing health computer system **270.**

Step 325: Fitting and connecting demonstration earpiece

In this step, hearing aid demonstration unit **100** is fitted in user **205**'s ear by adjusting moldable sleeve **120** on insert end **113**. Interface **112** is connected to PC **230**, and user **205** places and adjusts hearing aid demonstration unit **100** in his or her ear.

Step 330: Testing and calibrating

In this step, the program sends sounds (tones) at various amplitudes directly through sound simulator **220** (bypassing DSP **225**) to output device **115** (speakers in sound room **208**). The program optionally may send information or questions to user monitor **233**.

Any sounds from output device **115** that are picked up by microphone **118** of hearing aid demonstration unit **100** are sent as detected sound signals via interface **112** to PC **230**. PC **230** sends the detected sound signals to DSP **225,** which sends a modified version of the detected sound signals through the sound simulator **220** to the speaker **114** of hearing aid demonstration unit **100**. By doing this, hearing aid demonstration unit **100** functions as if it were the manufacturer-programmed hearing aid ordered by user **205**. User **205** thus experiences a preview of what would occur when the individually customized manufactured heading aid is fitted, and gets a clear understanding of how much improvement the hearing aid would provide. **Figure 4** illustrates an example of the calculations used to compensate for hearing deficiency.

Figure 4 shows a table **400** that is a pre-established amplification table used to calculate the adjustments necessary to compensate for user **205**'s hearing loss determined in the previous test.

For example, the "normal hearing" row illustrates the hearing of an individual with perfect hearing, i.e., with no hearing deficiency. The "patient hearing profile" row illustrates a sample hearing profile of user **205** that has a hearing deficiency that was established during a prior hearing test. The "amplification factor" row shows the amplification required to minimize user **205**'s hearing deficiency.

Audiologist **250** gauges interaction from user **205** through either verbal responses or responses via user keyboard **237**. In addition, speech intelligibility can be tested by a program with pre-defined sentences that is output to user **205** for his or her understanding and response. In this way, user **205** undergoes professional hearing tests.

Based upon the findings of this second test, audiologist **250** can make real-time final adjustments to hearing aid demonstration unit **100** through DSP **225**. These final adjustments are sent to central hearing health computer system 270 through PC **230** and Internet **260** in order to synchronize the contents stored on first database **235** (the final test results) and second database **275**. The manufacturer can use this information to make an individually customized hearing aid for user **205**.

It should be noted that several conventional methods of fitting, connecting, testing, and calibrating a hearing aid device can readily suggest themselves to those with ordinary skill in the art.

Step 335: Ordering user hearing aid

In this step, audiologist **250** uses the optimized calibration profile for user **205** to order an actual hearing aid for user **205**.

Step 340: Fitting final hearing aid

In this step, audiologist **250** receives the actual hearing aid that was ordered for user **205** based on user **205**'s calibration profile. Audiologist **250** then fits and retests the actual hearing aid on user **205** to ensure an appropriate fit.

In this manner, hearing aid demonstration unit **100** of the present invention can be used to demonstrate the function of a customized hearing aid on user **205** prior to his or her purchasing an actual hearing aid unit. Therefore, user **205** is better trained on the actual hearing aid unit and is more satisfied with the actual hearing aid unit after receiving it, which in turn leads to a reduced rate of returns of hearing aid units to manufacturers.

Figure 5 illustrates an alternative embodiment to **Figure 2** in which a system **500** incorporates a DSP **512** that is a programmable interface for hearing aid demonstration unit **100.** DSP **512** replaces interface **112** and DSP **225** of **Figure 2.** The functioning of all other components remains the same as in **Figure 2**. There are several uses of DSP **512**; for example, DSP **512** can be useful when hearing aid demonstration unit **100** is more mobile and needs to be calibrated through remote programming techniques such as wireless programming.

Although preferred embodiments of the present invention have been described and illustrated, it will be apparent to those skilled in the art that various modifications may be made without departing from the principles of the invention.

WHAT IS CALIMED IS:

1. A hearing aid demonstration unit for simulating hearing aid operation to an individual, the unit comprising

a housing sized and configurable for insertion in an ear of the individual;

the housing includes a data signal interface capable of receiving and transmitting hearing aid data signals and coupled to a microphone and a speaker.

2. The hearing aid demonstration unit of claim 1, wherein the microphone receives sound output and transmits the sound output to the interface as sound output signals.

3. The hearing aid demonstration unit of claim 1, wherein the speaker generates simulated sound output based on modified sound output signals received at the interface.

4. The hearing aid demonstration unit of claim 1, wherein the interface includes a digital signal processor ("DSP") for modifying the modified sound output signals received at the interface.

5. The hearing aid demonstration unit of claim 1, wherein the interface includes a wireless signal receiver.

6. A method of demonstrating to an individual user a hearing aid unit which simulates hearing aid operation comprising the steps of

providing a hearing aid housing including a microphone and a speaker and a data signal interface capable of receiving and transmitting hearing aid data signals and coupled to the microphone and the speaker;

sizing and configuring the hearing aid housing for inserting in the user's ear;

computing digital signal processor ("DSP") correction factors based on frequency versus amplitude test data;

transmitting a word data signal representative of a test word to an external speaker for causing a sound output of the word to be generated;

receiving the sound output of the word and converting the sound output of the word to a detected word sound signal;

transmitting the detected word sound signal at the interface;

modifying at a remote controller/DSP the detected word sound signal with the DSP correction factor corresponding to the word;

transmitting the modified word signal for receipt at the interface; and

generating a sound output from the modified word signal at the speaker of the hearing aid housing.

7. The method of claim 6, further comprising a step of:

receiving the individual's feedback data and adjusting the DSP factors based on the feedback data.

8. The method of claim 6, further providing the computing step including obtaining test data from a remote database.

9. The method of claim 6, further providing the computing step which includes speech intelligibility and user preference data.

10. The method of claim 6, further providing the data signal interface which is capable of receiving and transmitting hearing aid data signals.

11. The method of claim 7, further providing coupling of the data signal interface coupled to the microphone and the speaker.

12. The method of claim 10, further providing the interface including a wireless signal receiver.

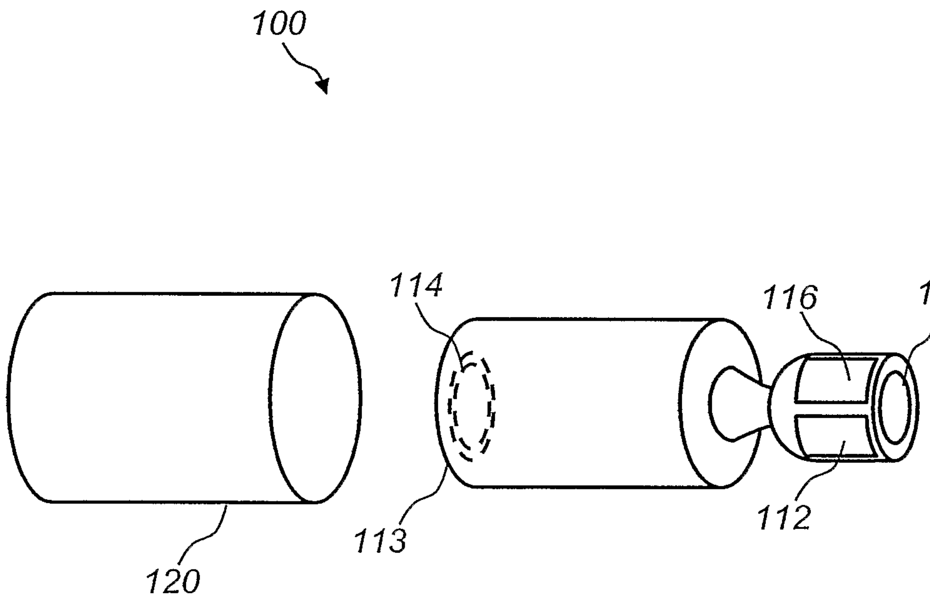


FIG. 1

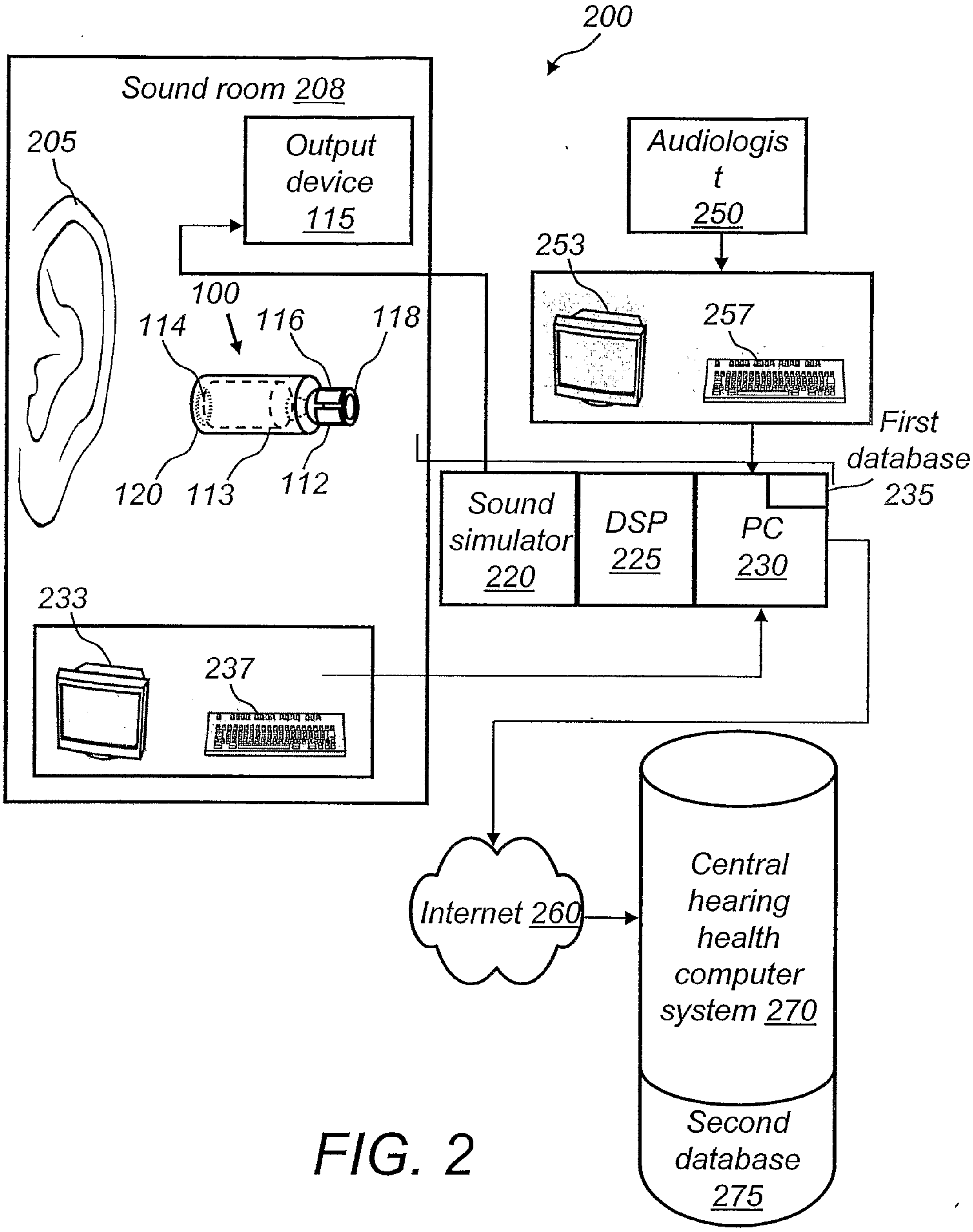

200
Sound room 208
205
Output device 115
100
114
116
118
120
113
112
233
237
Audiologis t 250
253
257
First database 235
Sound simulator 220
DSP 225
PC 230
Internet 260
Central hearing health computer system 270
Second database 275

FIG. 2

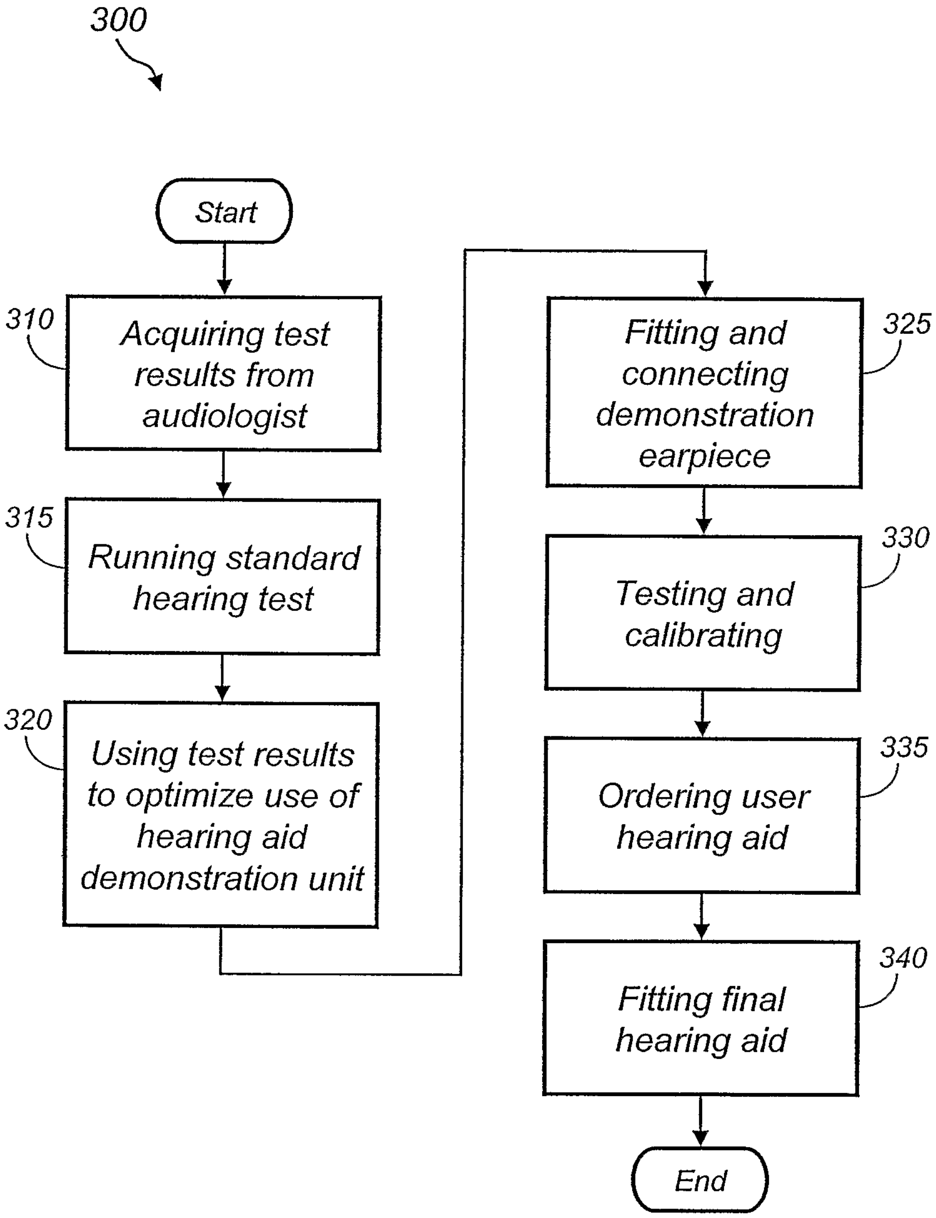

300
Start
310
Acquiring test results from audiologist
315
Running standard hearing test
320
Using test results to optimize use of hearing aid demonstration unit
325
Fitting and connecting demonstration earpiece
330
Testing and calibrating
335
Ordering user hearing aid
340
Fitting final hearing aid
End

FIG. 3

400

	Decibels							
Normal Hearing	100	110	120	110	100	90	90	70
Patient Hearing Profile	70	80	90	110	60	50	30	10
Amplification Factor	30	30	30	0	40	40	50	60

FIG. 4

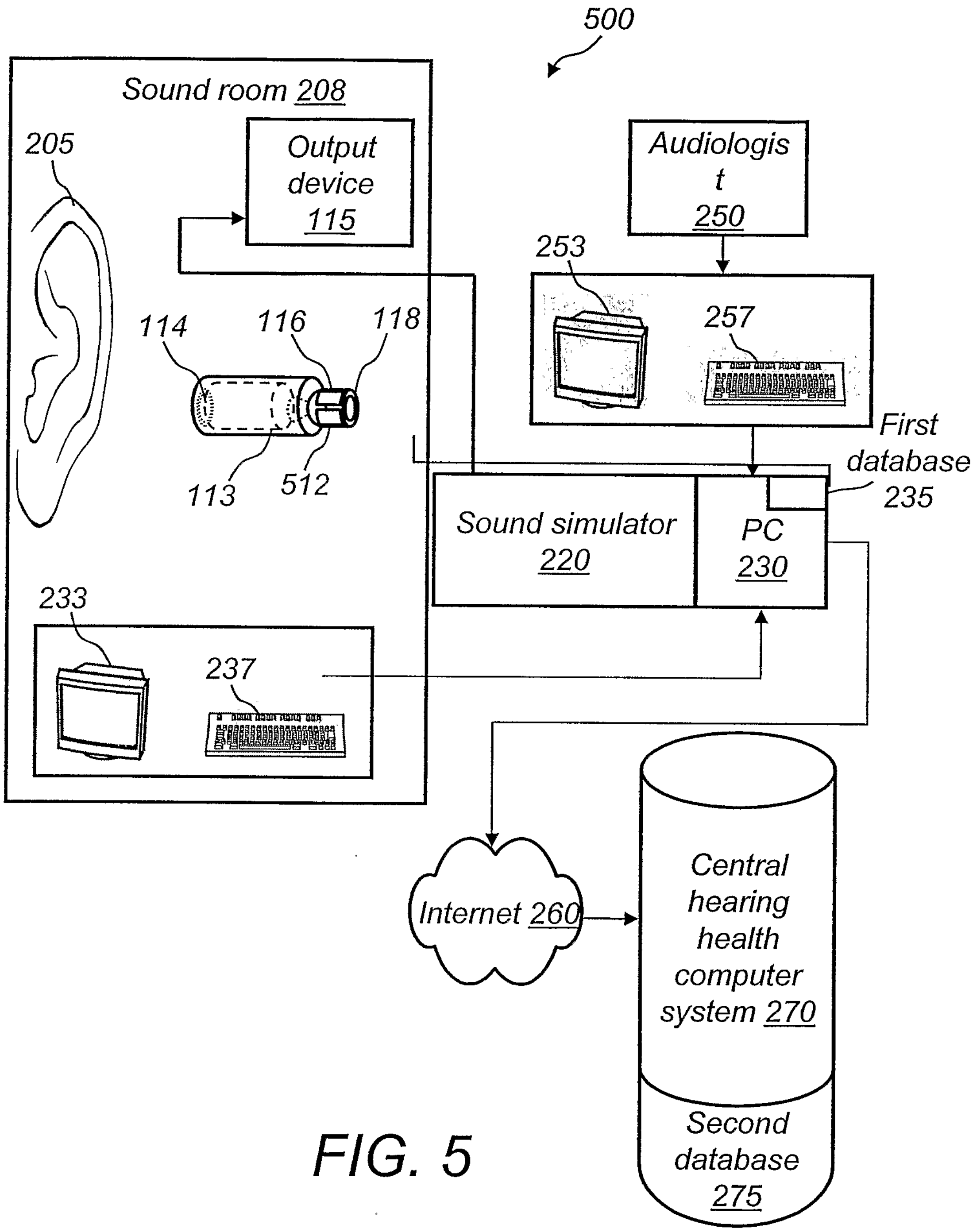

500
Sound room 208
205
Output device 115
114
116
118
113
512
233
237
Audiologis t 250
253
257
First database 235
Sound simulator 220
PC 230
Internet 260
Central hearing health computer system 270
Second database 275

FIG. 5