Jan. 13, 1953 R. O. L. CURRY 2,625,233

METHOD OF FITTING HEARING AIDS

Filed Oct. 25, 1949

FIG. 1

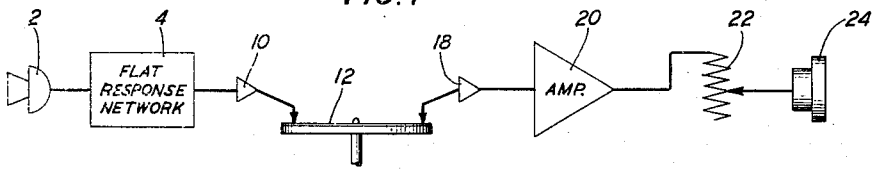


FIG. 2

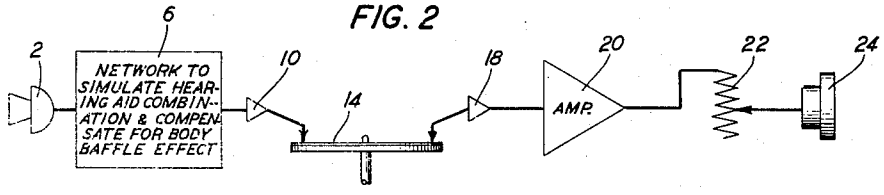
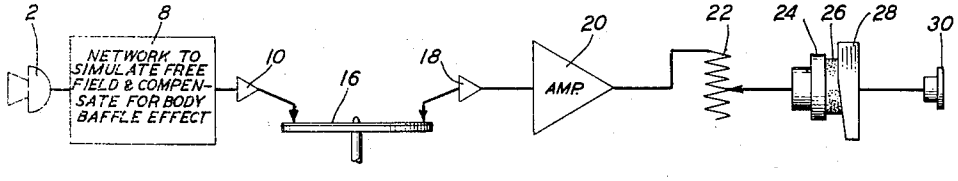


FIG. 3



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Patented Jan. 13, 1953

2,625,233

UNITED STATES PATENT OFFICE

2,625,233

METHOD OF FITTING HEARING AIDS

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Application October 25, 1949, Serial No. 123,316

1 Claim. (Cl. 181—.5)

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This invention relates to a method of fitting hearing aids.

In the fitting of hearing aids it has been the practice for many years to make an audiometric measurement of the subject's hearing loss and then provide him with an arbitrarily-selected hearing aid which should theoretically raise his threshold of hearing to normal. The audiometric measurements are made under artificial conditions, employing pure tones rather than speech and excluding such factors as ordinary background noises. As a result, difficulty is usually encountered by the subject after the fitting when he is confronted with actual speech, and said background noises become apparent. In more recently developed fitting methods some effort has been made to provide test conditions comparable to normal by taking into account the ordinary background noises at the particular test location. However, none of the methods practiced heretofore have employed test conditions sufficiently standardized to permit an accurate fitting and a satisfactory correlation of the accuracy of fittings made in various locations.

Also, in the methods practiced heretofore, the subject has been relied upon to compare for himself the volume and quality of sound provided by commercial or factory finished hearing aids. Experience has indicated that the data obtained by this procedure are unreliable because the subject is influenced by the physical appearance of the hearing aid.

Accordingly, it is an object of the present invention to provide a new and improved method of fitting hearing aids having none of the disadvantages enumerated above.

The method of fitting hearing aids provided in accordance with the present invention is practiced under standard conditions. Thus it is possible to achieve the same accuracy of fitting regardless of the particular location at which the method is practiced.

The present invention also provides means for testing new hearing aid designs in advance of actual production, and means for evaluating the performance of hearing aids and the accommodation of a person to a hearing aid over a period of time.

The method provided in accordance with the present invention includes three steps. The first step comprises the measurement of loss of hearing for speech with a testing system having a flat frequency response, and the selection of an appropriate combination of hearing aid components to provide the required amount of gain.

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The second step comprises the measurement of hearing loss for speech using a testing system having a response simulating the characteristics of the combination chosen as a result of the tests made in step one. The third step comprises a verification of the suitability of the selected hearing aid.

The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a schematic of the apparatus whereby the first step of the present invention may be practiced;

Fig. 2 is a schematic of the apparatus whereby the second step of the present invention may be practiced; and

Fig. 3 is a schematic of the apparatus whereby the third step of the present invention may be practiced.

As shown in Figs. 1, 2, and 3, wherein like reference characters designate similar elements, three different records 12, 14 and 16 are employed. Record 12, which is used in the first step of the hearing aid fitting method is prepared by means of the recording system comprising the transmitter 2, the flat response network 4, and the record cutting element 10. The material recorded comprises spondaic words and specially selected passages of continued speech recorded with special attention to equal perception value as judged by a group of normal hearing persons. The recorded level is adjusted so that, in reproducing, the threshold for normal ears would correspond to zero setting on the attenuator 22. As shown in Figs. 1, 2 and 3 the reproducing system employed in each of the three steps comprises the pick-up element 18, amplifier 20, attenuator 22 and receiver 24. The output of the record 12 is coupled by means of receiver 24 to the ear of the person to be tested. In order to prevent interference from outside noises it is preferred that receiver 24 be of a type which is provided with a soft rubber ear-piece or gasket, designed to fit over the ear.

While it is, of course, understood that other testing techniques might be employed in fitting a hearing aid in accordance with this invention, the following technique has been used and may be recommended.

At the first of the three steps in the procedure the person to be tested is instructed in the general technique to be employed and is requested to repeat aloud each of the words or passages

heard by him through the receiver 24. A suitable silent period of, for example, three seconds should be provided between each word and passage recorded on record 12 so that the listener may have time to repeat the word or passage aloud.

The test is begun at a level which is substantially above the threshold for the subject. Scoring may be done, for example, in groups of five words at a time, reducing the level by 10 decibel steps until the subject begins to miss the test material. At this time the intervals may be reduced to 5 decibel steps and the threshold may be approached from above and from below twice. A score of 50 per cent of the test material correctly repeated aloud may be considered the indication of a threshold reading and noted accordingly for each ear. A concept is thereby obtained of how much gain is necessary to bring the hearing of the person tested back to normal. The amount of gain required to bring the hearing back to normal is correlated with the characteristics of various combinations of hearing aid components. An appropriate combination of hearing aid components is then selected from a chart listing the gain of various combinations of hearing aid components.

The second step in the procedure comprises a new set of threshold of hearing tests. As shown in Fig. 2 the recording system for preparing record 14 comprises the transmitter 2, the record cutting element 10, and the network 6 which includes electrical and/or acoustic networks designed according to the known characteristics of the combination of hearing aid components selected from the chart in the previous step in the procedure. In addition, equalization may also be incorporated during recording to provide compensation for the body baffle effect. Record 14 will also have recorded thereon spondaic words as well as selected passages of continued speech chosen for constancy of loudness. However, this subject-matter will have been recorded with equalization of such nature that the output of the record, when reproduced, will be the original sound modified in accordance with the characteristics of the particular set of hearing aid components, which has been selected. The output of the record 14 is coupled by means of receiver 24 to the ear of the person to be tested. The threshold attenuator setting is again considered to be that at which 50 percent of the test material is missed.

The purpose of this step in the procedure is, firstly, to provide a check of the suitability of the hearing aid combination chosen on the basis of the first step, before the actual hearing aid is presented, and, secondly, to provide a check of the choice of the ear to be fitted. A very important reason for laying emphasis on the procedure of checking the suitability of the combinations chosen on the basis of the first step is that certain types of hearing loss depart markedly from a flat frequency response, and the frequency response used in the tests in the first step is a flat response. It is apparent that at this stage it is possible to include tests of experimental hearing aid types not yet in production.

In the event that a powerful hearing aid combination is chosen it may be of importance to test the tolerance of the subject to high sound levels. This test may be carried out with records of continued speech and with a receiver capable of producing sound pressure levels up to 130 decibels above 0.0002 dyne/cm^2 (as measured on a 6 cubic centimeter coupler). The determination of this so-called "ceiling" of hearing, or upper threshold, is particularly important since it has been found in clinical practice that persons with severe hearing loss may have a low ceiling.

The third step in the procedure comprises a test of the validity of the hearing aid combination selected which is made by measuring the aided threshold for speech with the chosen hearing aid. As shown in Fig. 3, the recording system for preparing record 16 comprises the transmitter 2, the record cutting element 10 and the network 8 which is designed to provide compensation for the body baffle effect, and hearing aid performance substantially the same as that obtained under free-field conditions. Record 16 will also have recorded thereon spondaic words and selected passages of continued speech similar to those recorded on records 12 and 14. However, the subject-matter of record 16 will have been recorded so that when reproduced, with the receiver 24 mounted on the microphone of the hearing aid 28 by means of the acoustic coupler 26, the performance of the hearing aid 28 will be substantially the same as that obtained under free-field conditions. Hearing aid 28 is worn in the normal manner and the hearing aid receiver 30 is equipped with a suitable universal ear mold if a personal mold is not available. The acoustic coupler 26 is preferably a rubber gasket designed to fit the microphone of the hearing aid and thereby provide a suitable mounting for the receiver 24, and a standardized path between the receiver 24 and the microphone of the hearing aid 28.

The determination of the aided threshold for speech may be made as follows. The output of receiver 24 is set at a nominal value of 65 decibels above 0.0002 dyne/cm^2 (as indicated by a special calibration mark on attenuator 22). The subject is then instructed to set the volume control of his hearing aid at a level at which he can hear the test material comfortably (the "comfort level"). Again, a determination is made of the attenuator setting at which 50 per cent of the test material is missed. During this step the available range of gain on the hearing aid volume control may be explored.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

The method of fitting a deafened person with a hearing aid which comprises generating at each of a plurality of successively increasing volume levels a plurality of multifrequency audio signals, identifying as the threshold of normal hearing a volume level at which persons of normal hearing can repeat correctly in their entirety a known percentage of said signals, presenting said signals to a deafened person at each of a plurality of volume levels, observing the volume level at which said deafened person correctly repeats in their entirety said percentage of said signals and identifying the observed volume level as a preliminary threshold measurement, assembling an active network including circuit elements having the predetermined characteristics of a known combination of hearing aid components which will provide the amount of gain indicated by said threshold measurement as nec-

essary to restore normal hearing and compensate for body baffle effect, presenting to said deafened person said multi-frequency audio signals modified by said network, observing the volume level at which said deafened person correctly repeats in their entirety said percentage of said modified signals and identifying the observed volume level as a secondary threshold measurement, comparing said threshold measurements, and then modifying the said network to provide a correctly compensated hearing aid.

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