

March 29, 1938.

S. F. LYBARGER

2,112,569

METHOD AND APPARATUS FOR SELECTING AND PRESCRIBING AUDIPHONES

Filed June 16, 1936

4 Sheets-Sheet 1

Fig. 1.

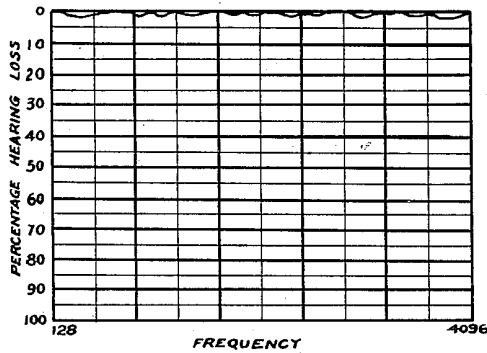


Fig. 2.

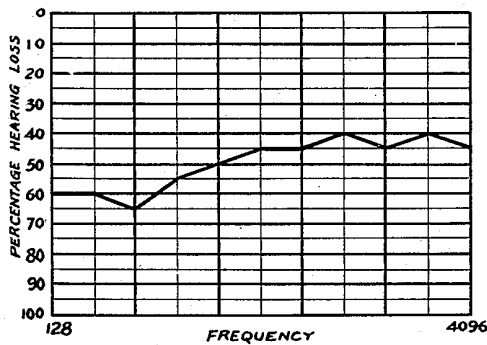


Fig. 3.

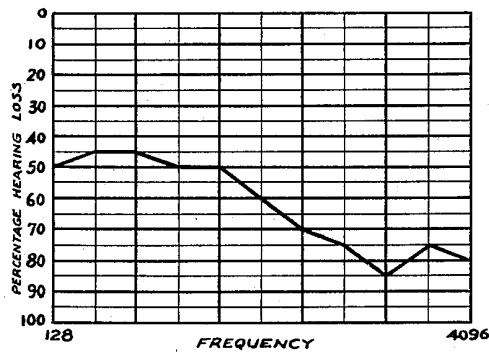


Fig. 4.

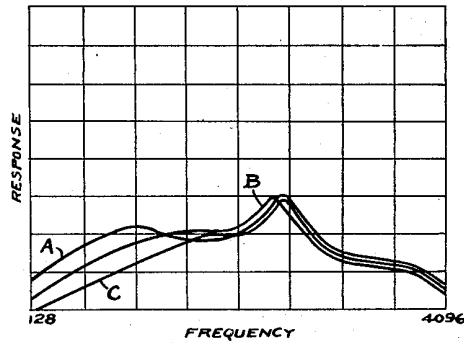


Fig. 5.

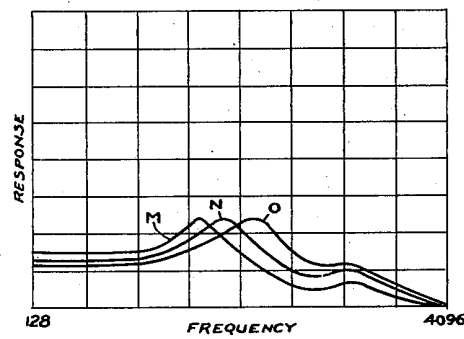
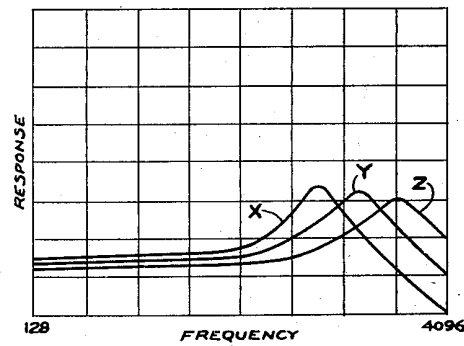


Fig. 6.



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4 Sheets-Sheet 2

Fig. 7.

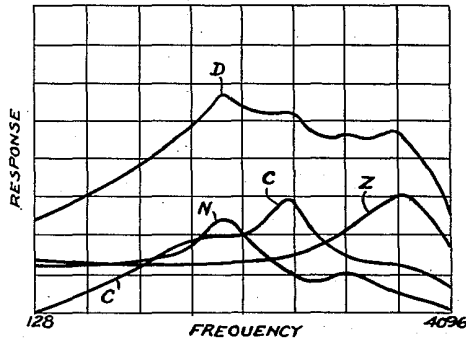


Fig. 8.

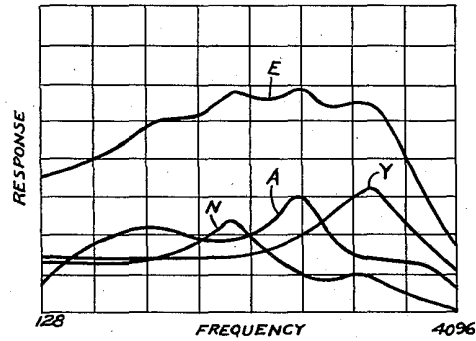


Fig. 9.

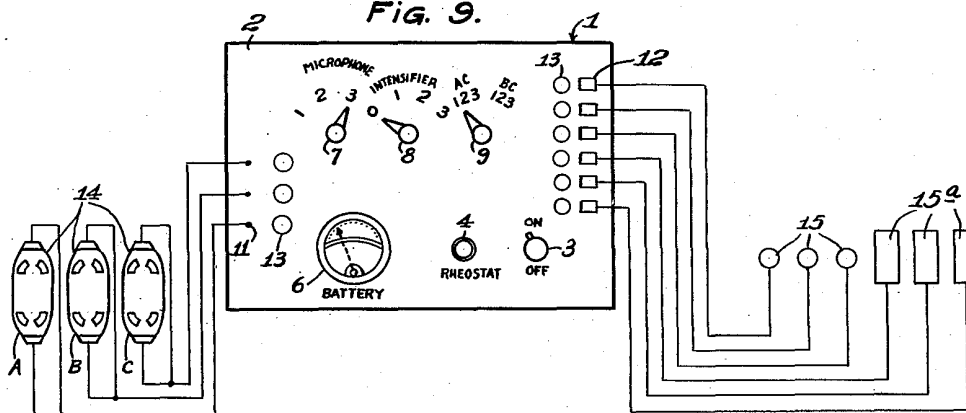
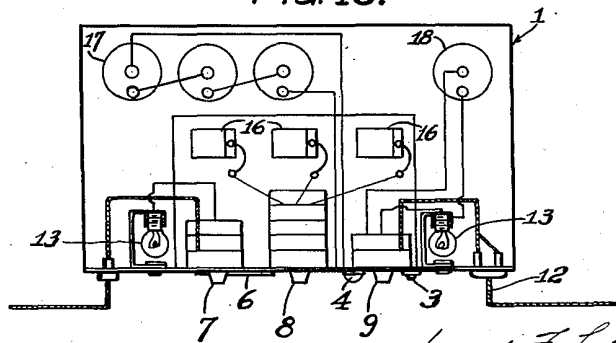


Fig. 10.



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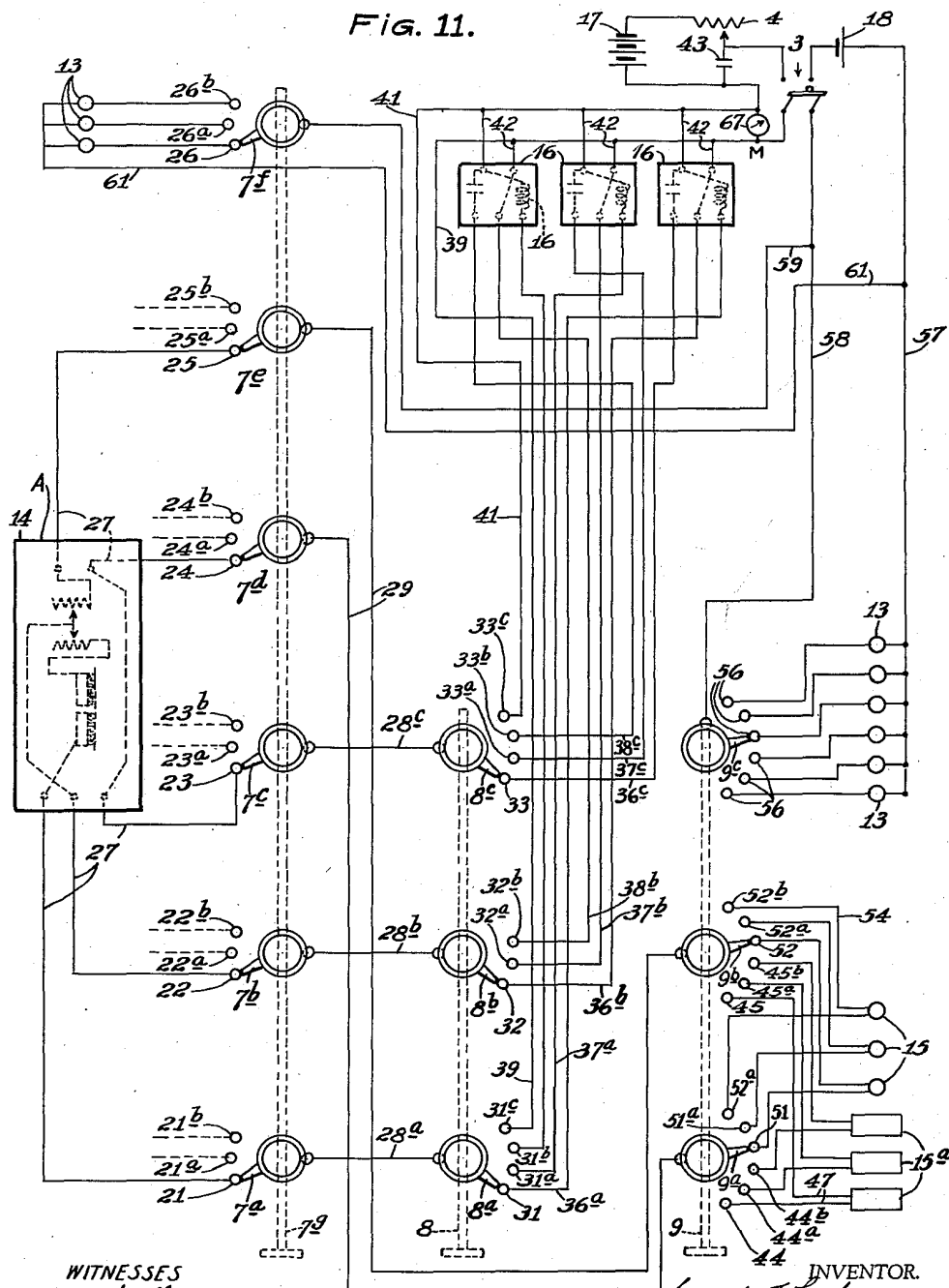
2,112,569

METHOD AND APPARATUS FOR SELECTING AND PRESCRIBING AUDIPHONES

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4 Sheets-Sheet 3

FIG. 11.



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METHOD AND APPARATUS FOR SELECTING AND PRESCRIBING AUDIPHONES

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Fig. 12.

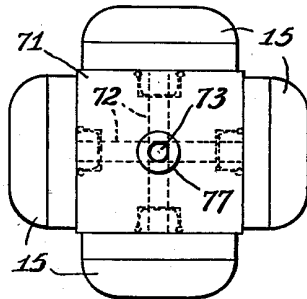


Fig. 13.

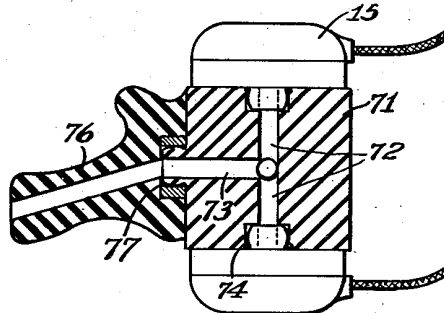


Fig. 14.

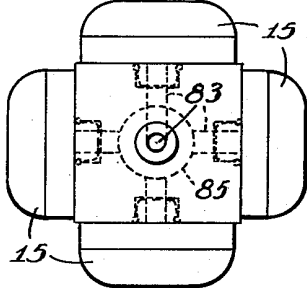


Fig. 15.

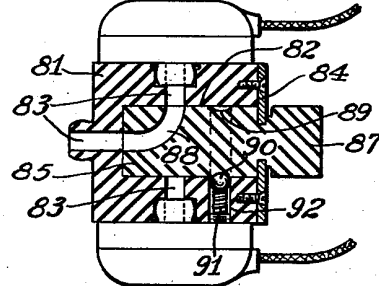


Fig. 16.

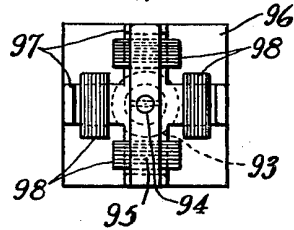


Fig. 17.

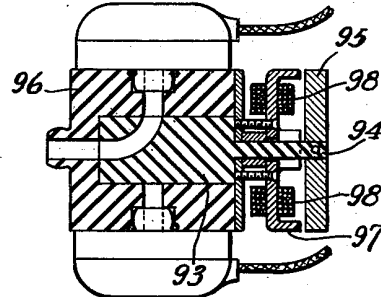
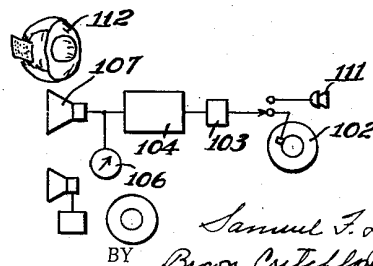
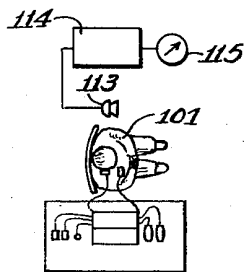


Fig. 18.



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UNITED STATES PATENT OFFICE

2,112,569

METHOD AND APPARATUS FOR SELECTING
AND PRESCRIBING AUDIPHONES

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Application June 16, 1936, Serial No. 85,502

8 Claims. (Cl. 179—107)

This invention relates to a method and apparatus for determining and prescribing the proper hearing aids for people whose hearing is defective.

In the past it has been the customary practice for manufacturers of hearing aid equipment to furnish for all purposes audiphones, or hearing aids as they are commonly referred to, of more or less standard or substantially fixed characteristics. Although such practice has met with a measure of success, it is far from satisfactory and leaves much to be desired. Hearing aids as furnished seldom, if ever, fit the user properly because, among other reasons practically every case of hearing loss is different. For example, one person's impairment may be largely over the higher frequency ranges while another is over the lower frequency ranges, and in substantially all cases they vary widely over the complete hearing ranges. Consequently, while a standard aid may be designed to satisfy as near as possible the average case of hearing impairment, the result is that it actually does not satisfy any properly; and this is true of both the air and bone conduction aids.

It may seem to those unacquainted with the facts that if hearing aids amplified all sounds the same amount, the amplification could be made so as to bring the hearing of the afflicted person up to the normal level and everything would be satisfactory. But this is not the case nor is it possible or desirable. In the first place, no present day portable hearing aid amplifies all sound frequencies the same amount. In the second place, people with impaired hearing become accustomed to a certain amount of distortion with some sounds softer than others even though actually all of those sounds may have the same physical intensity. Consequently, if it is attempted to bring all such sounds up to the same level of amplification the distortion pattern must be changed. This makes it necessary for the patient to cultivate new hearing habits, and the strain thus placed on him by this and by the distortion of the distortion pattern he had become accustomed to are often irritating and nerve-wracking. To avoid this, it is highly desirable that hearing aids be individually fitted and prescribed so that each individual case will receive the hearing aid most suitable for it, that is an aid which affords a user the clearest possible reception with a minimum of nervous irritation.

This invention provides for the use of an accurately calibrated master hearing aid which is capable of being varied over wide ranges to pro-

vide a large number of different amplification characteristics. As will presently appear the amplification characteristics are variable in a logically arranged fashion, so that gradually controlled characteristics in any principal portion of the audible sound spectrum are available. This makes it possible to reproduce for comparison or test, almost any desired amplification characteristic and enables the most satisfactory amplification characteristic by either air or bone conduction to be found for a given hard of hearing person. As a further feature it provides for readily determining the degree of amplification, as well as the shape of the amplification curve. With these factors known, a hearing aid may be produced by any desired means, or by any suitably equipped organization or person, which will satisfy their requirements as determined by the apparatus of this invention.

To attain such end in accordance with this invention, advantage is taken of the fact that the overall characteristics of a hearing aid are determined by the integrated response characteristics of its component parts. These comprise essentially the microphone, the ear-phone, and the amplifier, although in some cases the latter may not be needed. Within limits, it has been found that the response characteristics of these different elements can be readily and controllably varied and that by varying them a variation in the amplification of the aid in different frequency bands can be obtained within a reasonable degree of independence. Consequently, by providing a plurality of these units having various characteristics to select from and properly combining them, an amplification characteristic may be provided which will satisfy most any requirement.

To make it possible for a person needing a hearing aid to actually select by tests the characteristics necessary in an aid to suit it to his own requirements, an apparatus is provided which is equipped with a plurality of both bone and air conduction ear-phones or receivers, a plurality of microphones, and a plurality of amplifiers, all having different response characteristics. To readily connect these elements together for test purposes, they are suitably connected to switches which are adapted to quickly connect any one of the elements in any group to any one of the elements in each of the other groups so that a test hearing aid may be chosen having any desired combination of the response characteristics of the elements provided in the testing apparatus. The total number of different response characteristics or combinations

available is, of course, equal to the product of the number of the microphones, the number of amplifiers, and the number of the receivers provided, plus the product of the number of microphones and receivers. To secure a wide range of different overall amplification characteristics, the response characteristics of each group of these elements are preferably designed to cover a considerable range of tone frequencies.

To facilitate the testing of each group of elements or certain portions thereof they are preferably provided with graduated characteristics so as to make it possible to control the amplification in a given frequency region without appreciably affecting the other portions of the frequency spectrum.

For example, the microphones may be designed to produce the principal changes of amplification characteristics in the frequency regions below 800 cycles per second, the head phones or receivers to produce the principal changes of amplification characteristics in the frequency ranges of from 800 to 1500 cycles per second, and the amplifiers to produce the principal changes of amplification characteristics in the frequency ranges from 1500 to 4000 cycles per second. This may, of course, be otherwise accomplished, as, for example, by modifying the design of the different elements to influence different frequency regions, and such is contemplated by the invention.

When the most satisfactory selection of microphone, receiver and amplifier combination has been made, the operating characteristics of such elements being known, the overall operating characteristics of the selected combination are determined. With this knowledge an audiphone can be readily provided by the manufacturer using any combination of elements which provide the desired characteristics or one can be assembled by including in it elements having the same response characteristics as the element selected by the afflicted person. Among the advantages, it makes it possible for the manufacturer to conveniently and economically provide audiphones identical or substantially identical with the audiphone which a customer has selected as fitting his own particular requirements. In addition, such a method of providing aids not only makes for better results but to a very great extent saves the customer the annoyance of having to use an audiphone which distorts his reception of certain sounds to such an extent as to be irritating, which in the past has been one of the chief sources of criticism of a good share of the audiphones used.

In order to further improve the efficiency of the testing apparatus and also make it possible for the user to select an aid which will give the best satisfaction under normal conditions of usage, it is preferably provided with means for varying the voltage supply for the aid. With such means, a more sensitive test can be run on the elements being selected and an aid can be more accurately selected which will function properly over a greater period of the life of the batteries used in it. In other words, it is desirable to select an aid which will function satisfactorily when a battery is below its maximum charge in order that the aid will give the greatest amount of satisfactory service for the life of the battery. With the minimum voltage at which the instruments can be satisfactorily used known the life of a given type of a battery can be predicted with reasonable accuracy.

With the foregoing in mind it is an object of this invention to provide a method and apparatus for selecting the most satisfactory amplification characteristics to meet individual requirements.

A more specific object is to make available at a minimum cost a wide range of different response characteristics from which an individual may accurately select one which will most effectively satisfy his own requirements. Another object is to make possible for a person to not only have a wide range of characteristics to choose from but to make it possible for him to effectively compare his reaction to different characteristics when making his selection, and also compare his reaction to bone and air conduction receivers.

A further object is to provide in a testing apparatus of the character referred to for varying the value of the voltage supplied to the aid so as to give it a larger degree of testing sensitivity and also make it possible to select an aid which will give the greatest satisfaction over the life of the batteries employed in it.

It is also an object to provide a testing apparatus which is adapted to permit a patient to compare different amplification characteristics with a minimum lapse of time between tests, which is highly desirable because of the inability of a person to accurately recollect his reactions to different tests where they are separated by more than extremely short intervals.

These and various other objects as well as the various other novel features of the invention will be apparent when the following detailed description is read in conjunction with the accompanying drawings of which Fig. 1 is an audiogram of person with perfect hearing; Figs. 2 and 3 audiograms of two different people afflicted with defective hearing; Fig. 4 responsive curves of three differently designed microphones; Figs. 5 and 6 similar curves of three differently designed ear-phones and amplifiers respectively; Figs. 7 and 8 diagrams showing the individual response curves of the microphones, ear-phones and amplifiers employed in two different audiphones together with the resultant response curves of the audiphones themselves; Fig. 9 an elevational view of a testing apparatus constructed in accordance with the invention; Fig. 10 a view looking into the top of the cabinet shown in Fig. 9 with the cover removed; Fig. 11 a circuit diagram for the apparatus shown in Fig. 9; Figs. 12 and 13 a plan and sectional view respectively of an adapter for interchangeably using a plurality of ear-phones with a single ear tip; Figs. 14 and 15 views similar to Figs. 12 and 13 of a modified form of ear-phone adapter; Figs. 16 and 17 a view also similar to Figs. 12 and 13 of still another form of ear-phone adapter; Fig. 18 a schematic view of a system of apparatus for determining what amplification characteristics best suit a patient's hearing loss.

As shown by the audiogram in Fig. 1, wherein the horizontal axis is plotted in terms of frequency or pitch and the vertical axis is plotted in terms of hearing ability, the perfect ear responds uniformly to all audible frequencies as indicated by the straight line *a* which represents the hearing ability at all frequencies. If an impaired ear heard all sounds like the perfect ear except for a uniform loss in intensity, the line of hearing would still be a straight line but below the line obtained from a perfect ear.

This condition, however, rarely ever exists in reality. As in practically all cases of impaired hearing, as previously stated, there is practically never a uniform loss of hearing over all pitches. As illustrated in Figs. 2 and 3, which show the audiograms of two actual cases of defective hearing, the loss of hearing varies quite widely over different frequencies, as, for example, in the case shown in Fig. 2, the hearing loss is high in the low frequencies and low in the high frequencies, which in the case shown in Fig. 3 is practically reversed in these zones.

Theoretically, it would seem that the proper hearing aid for an individual having defective hearing would be one having amplifying characteristics which are just the opposite of the user's loss of hearing as indicated by his or her audiogram, that is, one which would just bring the hearing reception up to normal at all frequencies. In practice, however, this is seldom the case because among other reasons due to the wide variations in loss of hearing at different frequencies and the long period over which a user has become accustomed to such form of hearing, they find that if it is attempted to give them normal hearing over all frequencies the extreme amplification required over the most affected zones is irritating and confusing as well as tiring. Hence if it is attempted to provide such a hearing aid it is usually found to be unsatisfactory for the reasons mentioned.

The properly constructed hearing aid is one which approaches the defective person's amplification requirements as indicated by his audiogram, but which does not produce a nervous reaction or is tiring to the user. As stated hereinbefore, the amplification characteristics of an audiphone are determined by the integrated response characteristics of the microphone, ear-phone, and amplifier going to make up the audiphone. In practicing the present invention a variety of these elements having graduated varying characteristics is provided and these selectively assembled under the guidance of the patients in such a way that the patient is most effectively fitted as determined by his or her requirements.

In fact by properly designing these elements they can be adapted to quite effectively regulate the overall response characteristics of audiphones in only certain frequency bands without greatly modifying the response in the other sound regions. For example, as shown in Fig. 4, wherein the curves A, B, and C designate the response characteristics of three different microphones, the microphones may be designed to vary the response characteristics of an audiphone for tones up to 800 cycles. Likewise, as shown in Fig. 5, wherein the curves M, N, and O designate the response characteristics of three different ear-phones, the ear-phones may be designed to vary the response characteristics of the audiphones for tones from 800 to 1500 cycles. Similarly, as shown in Fig. 6, wherein the curves X, Y, and Z designate the response curves of three different amplifiers, the amplifiers may be designed to vary the response characteristics of an audiphone for tones ranging from 1500 to 3000 or 4000. To secure the widest possible range of amplification characteristics the response characteristics of the elements in each group are preferably made to cover as broad a range of frequencies as is possible within the particular frequency zone which they primarily affect.

The possibilities of a collection of elements

such as designated in Figs. 4, 5, and 6 will be appreciated when reference is had to Figs. 7 and 8. In Fig. 7 the curve D shows the amplification characteristics of an audiphone which is made up of a microphone having a response curve C, an ear-phone having a response curve N, and an amplifier having a response curve Z. In Fig. 8 the curve E shows the amplification characteristics of an audiphone made up of a microphone having a response curve A, an ear-phone having a response curve N, and an amplifier having a response curve Y. With the provision of three different instruments in each group, the response curves for which are preferably furnished, 36 different combinations can, of course, be made up, 27 using the amplifiers and 9 without, and obviously this may be increased or varied by varying the number of instruments in each group. As will be also obvious, a person's audiogram will aid in selecting the proper combination of such elements to satisfy his particular hearing loss because those to be tried out can be limited to the ones which the operator will know correspond most closely with the audiogram. However, through the use of the apparatus to be presently described it is unnecessary to have an audiogram in order to make the proper selections.

Referring to Fig. 9 of the drawings, suitable apparatus for carrying out this invention is shown as comprising a portable cabinet 1 having a front panel 2 on which are mounted a main switch 3, rheostat 4, voltmeter 6, three instrument switches 7, 8, and 9, a set of microphone terminals 11, a set of ear-phone terminals 12, and pilot lamps 13 adjacent the terminals for indicating which terminals are in use. To the microphone terminals are connected a plurality of microphones 14, and to the remaining terminals a plurality of air conduction and bone conduction ear-phones, 15 and 15a, respectively, are connected.

Disposed inside of the cabinet, as shown in Fig. 10, are a plurality of amplifiers 16, batteries 17 for the audiphones, a battery 18 for the pilot lamps, and the necessary wiring for interconnecting the various elements of the apparatus. The wiring diagram for the apparatus is shown in Fig. 11 and will now be described.

The microphone selector switch 7 is a multiple contact type of gang switch equipped with a series of spaced sliding contact arms 7a, 7b, 7c, 7d, 7e, and 7f which are insulated from the common actuating shaft 7g and are disposed to engage a co-operating series of spaced contacts 21, 22, 23, 24, 25, and 26, respectively, or contacts 21a, 22a, 23a, 24a, 25a, and 26a, or 21b, 22b, 23b, 24b, 25b, and 26b. The first series of contacts, except contact 26, are connected by wires 27 to one of the microphones, and the second and third series of contacts are likewise connected, respectively, to the other two microphones, except that contacts 26, 26a, and 26b are each connected to a pilot lamp 13. Switch arms 7a, 7b, and 7c are connected by wires 28a, 28b, and 28c to switch arms 8a, 8b, and 8c, respectively, of the amplifier selector switch 8 which is also of the gang type. Switch arms 7d and 7e are connected by wires 29 to switch arms 9a and 9b, respectively, of the ear-phone selector switch 9.

The arms of the amplifier switch are disposed for engaging any one of four series of contacts 31, 32 and 33; 31a, 32a, and 33a; 31b, 32b, and 33b; or 31c and 33c. Contacts 31, 32 and 33 are connected by wires 36a, 36b and 36c to one of the

amplifiers 16, contacts 31a, 32a, and 33a are connected by wires 37a, 37b and 37c to another of the amplifiers, and contacts 31b, 32b, and 33b are connected by wires 38a, 38b, and 38c to the remaining amplifiers. Contacts 31c and 33c are connected by wires 39 and 41, respectively to batteries 17, and battery wires 39 and 41 are connected by wires 42 to the battery terminals of the amplifiers. Voltmeter 6 is shunted across the battery wires, and rheostat 4 and main switch 3 are connected in series in wire 39. Shunted across the batteries between the rheostat and wire 39 is a condenser 43 which is employed to reduce the effective internal impedance of the supply circuit to a value not exceeding appreciably the internal impedance generally found in a battery, which has the result of preventing oscillation or degeneration in the hearing aid circuit which, if permitted, causes serious distortion in the quality of the transmitted sounds.

The ear-phone switch arms 9a and 9b are disposed for engaging any one of three groups of contacts 44 and 45; 44a and 45a or 44b and 45b that are connected by wires 47 to the three bone conduction receivers 15a. The switch arms are also adapted to engage any one of three groups of contacts 51 and 52; 51a and 52a, or 51b and 52b, that are connected by wires 54 to the three air conduction receivers 15.

The ear-phone switch is also provided with an arm 9c that is adapted to engage a series of contacts 56 connected to one side of six pilot lamps 13 that indicate which ear-phone is in circuit. The other side of the lamp is connected by a wire 57 to one side of battery 18 the opposite terminal of which is connected through switch 3 and wire 58 to switch arm 9c. Wire 58 is also connected by wire 59 to arm 7f of the microphone selector switch, while wire 57 is connected by a wire 61 to the microphone pilot lamps, whereby the latter likewise receive electric current from battery 18.

It will be understood that each of the various microphones, amplifiers and ear-phones used in this apparatus has characteristics known to be different from those of the others. Consequently, a large number of combinations of these characteristics can be obtained by merely operating the three instrument switches to select different combinations of instruments. The number of combinations can be increased by making the cabinet large enough to accommodate more instruments. On the other hand, if desired, the amplifiers can be cut out of the circuit by turning the amplifier switch 8 until contacts 31c and 33c are engaged. This permits the current from batteries 17 to flow through the microphones and receivers without passing through the amplifiers.

In using this apparatus to find the most satisfactory amplification characteristics for any given individual, the various combinations of instruments made possible by the selector switches may be tested under the same normal conditions by attaching a microphone to the clothing of the person with defective hearing, and connecting an ear-phone to this ear. With each combination he is asked to state his reaction to the test sounds, such as their loudness, clarity, pitch, and freedom from nervous irritation. His reaction will, of course, indicate that certain combinations may be eliminated and reduce the tests required. The testing may also be expedited somewhat if an audiogram of the patient's hearing is available, as it will to a certain extent function as a guide for

determining the possible combination which will satisfy the patient. After the most suitable combinations have been determined, the tests can be repeated on these to find the one most satisfactory from all standpoints.

Within the audible sound frequency range the ear-phones in this particular embodiment are designed to be most responsive to variation in the lower zone, the microphones in the middle zone, and the amplifiers in the upper zone. Consequently, amplification in the lower zone is varied primarily by the microphones, in the upper zone it is controlled by the amplifiers, and in the middle zone by the ear-phones. By knowing these facts, an operator can approximately select the instrument that will give the desired amplification in the desired zone. For example, if a particular test combination enables the patient to hear well all sounds except those of low pitch, the operator will switch in another microphone having higher response characteristics because he knows that amplification in the lower frequency zone is controlled by the microphone.

An important feature of this apparatus is that the change from one combination to another can be made so quickly that the patient can accurately compare the results with those of the one just preceding and just succeeding. As far as a change of microphones or amplifiers is concerned this quick change is made by merely turning the microphone and amplifier switches, but with the air conduction ear-phones it is necessary to connect a new one to the patient's ear every time a change is desired. To permit a quick change of air conduction ear-phones the adapter shown in Figs. 12 and 13 may be provided. This device consists of a block 71 provided with passages 72 extending inwardly from its sides to a point from which a passage 73 extends outwardly at right angles to passages 72. The number of passages 72 depends upon the number of receivers that are to be attached to the block, the drawings showing four passages and four receivers 15. The tip 15b of each receiver is mounted in a socket 74 at the outer end of the passage communicating with the receiver. An ear tip 76 that would ordinarily be connected to a receiver is connected to a tip 77 projecting from the block at the outer end of passage 73. Thus, all the air conduction receivers are in communication with the ear tip at all times; however, only one receiver is operated at a time. With this device it is possible to instantly switch from one receiver to the other without removing the ear tip from the ear.

In Figs. 14 and 15 there is shown a modification which has the advantage that only one receiver is in communication with the ear tip at a time, and there is therefore a much smaller column of air in the block 81, and it is impossible for the other receivers to absorb some of the sound coming from the receiver in use. In this embodiment the block 81 is provided with a central bore 82 extending part way through it with which the various passages 83 connect. Rotatably secured in this bore by a plate 84 is a plug valve 85 the outer end of which is knurled to provide a knob 87 for turning it. The inner end of the plug is provided with an arcuate passage 88 which is adapted to connect the passage leading to the ear tip with any one of the passages leading to the receivers. Consequently, only one receiver at a time can be connected with the ear tip, but it is possible to quickly switch from one receiver to another by turning the plug. To hold the

arcuate plug passage in registry with any desired receiver passage the plug is preferably provided around its periphery with shallow recesses 89 into which a ball 90 is pressed by a spring 91 disposed in a bore 92 in the block. The recesses are so positioned that when the ball engages them one of the receiver passages 83 is in communication with a plug passage.

The modification shown in Figs. 16 and 17 is the same as that just described except that instead of being turned manually by a knob, the plug 93 is turned electrically. The outer end of the plug is provided with a shaft 94 to which a permanent bar magnet 95 is rigidly connected. Disposed between block 96 and the magnet is a soft iron core 97 in the form of a cross having outwardly turned ends spaced from the magnet. Each arm of the core is encircled by a coil 98 each of which is connected through a switch (not shown) to a battery. The coils are so wound that when an electric current is passed through any one of them the polarity of the adjoining portion of the core is made such that it attracts one end of the permanent magnet. By connecting the coils to the contacts of the air conduction receiver switch the magnet can be made to automatically turn to the proper position for connecting the desired receiver with the ear tip when the ear-phone selector switch connects that receiver into the hearing aid circuit.

The effectiveness of this apparatus depends to a considerable extent upon the accuracy of testing the ability of the patient to hear with the various test combinations. In Fig. 18 there are shown several different devices for conducting an accurate test of the efficiency of each test combination of instruments. The patient 101 is seated beside the testing apparatus described herein, and the desired microphone and ear-phone are connected to him. Spaced a suitable distance in front of him is a reproducing system consisting of a phonograph turn-table and pick-up 102, volume control 103, amplifier 104, a meter 106 for indicating the electrical output of the amplifier, and a reproducer or loud speaker 107. A record, on which has been recorded a list of sentences, words, numbers or syllables, is placed on the phonograph and as it is played the patient is required to either write down or state what he hears. In this way the intensity of the sound produced for the patient remains uniform as various combinations of instruments are tested by him.

The phonograph record may be supplemented by a microphone 111 into which the operator makes whatever sounds he pleases. The amplifier meter 106 is used to keep the intensity of the sounds coming from the reproducer at a reasonably constant value. The volume control 103 may be used to reduce or increase the intensity of the sounds.

Another way of testing the hearing of the patient which can supplement the method just described, or be used in place of it if desired, is to have the operator 112 speak directly to the patient. However, as it is very difficult for a person to maintain his voice at a constant level over any considerable period of time, which is necessary in order to make an accurate test, a microphone 113 is placed beside the patient and is connected by an amplifier 114 to a meter 115. The speaker can watch the meter 115 as he talks and thereby maintain his voice at substantially the same level throughout the test.

Among the chief advantages of this invention,

as will be appreciated from the foregoing, is the fact that it enables one to determine the most suitable amplification characteristic directly without the necessity of judging or guessing the supposedly proper characteristic from an audiogram, if the audiogram only is available.

Another advantage not previously mentioned is that it provides means for readily determining from time to time as a person's hearing requirements change what modifications are needed in the amplification characteristics he needs to give him continued satisfactory hearing reception.

According to the provisions of the patent statutes, I have explained the principle and mode of practicing my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:—

1. The method of selecting the most suitable audiphone for a hard-of-hearing person, comprising providing a plurality of at least two of the different types of instruments forming an audiphone, the several instruments of each group of like instruments having preselected different response characteristics in a predetermined portion of the frequency range transmitted by the audiphone, said portion being substantially different from the portion of said frequency range in which any other group of the audiphone-forming instruments has preselected different response characteristics, establishing auditory communication between said person and any desired combination of unlike instruments, and forming the combinations by successively combining each of the instruments in one group with one of each of the other types of audiphone-forming instruments to find the instrument having the most suitable response characteristics in a portion of said frequency range and then repeating this procedure with another group to find the instrument having the most suitable response characteristics in another portion of the frequency range.

2. The method of selecting the most suitable audiphone for a hard-of-hearing person, comprising providing a group of microphone instruments having preselected different response characteristics in a predetermined portion of the frequency range transmitted by the audiphone and a group of ear-phone instruments having preselected different response characteristics in another portion of said frequency range, establishing auditory communication between said person and any desired combination of microphones and receivers, and forming the combinations by successively combining each of the instruments in one group with one of the instruments of the other group to find the instrument having the most suitable response characteristics in a portion of said frequency range and then successively combining each of the instruments of the second group with said most suitable instrument of the first group to find the instrument having the most suitable response characteristics in another portion of said frequency range.

3. The method of selecting the most suitable audiphone for a hard-of-hearing person, comprising providing a group of microphone instruments having preselected different response characteristics in a predetermined portion of the frequency range transmitted by the audiphone and a group of ear-phone instruments having

preselected different response characteristics in another portion of said frequency range and a group of amplifier instruments having preselected different response characteristics in the remaining portion of said frequency range, establishing auditory communication between said person and any desired combination of three unlike instruments, and forming the combinations by successively combining each of the instruments in one group with one instrument of each of the other two groups to find the instrument having the most suitable response characteristics in a portion of said frequency range and then repeating this procedure with each other group to find the instruments having the most suitable response characteristics in the other portions of the frequency range.

4. The method of selecting the most suitable audiphone for a hard-of-hearing person, comprising providing a group of microphone instruments having preselected different response characteristics in a relatively low frequency band and a group of amplifier instruments having preselected different response characteristics in a relatively high frequency band and a group of ear-phone instruments having preselected different response characteristics in the intervening frequency band, establishing auditory communication between said person and any desired combination of three unlike instruments, and forming the combinations by successively combining each of the instruments in one group with one instrument of each of the other two groups to find the instrument having the most suitable response characteristics in the frequency band of said one group and then repeating this procedure with each other group to find the instrument having the most suitable response characteristics in the frequency band of each of those groups.

5. Apparatus for selecting and prescribing audiphones comprising a group of microphones differing from each other in response characteristics in a predetermined low frequency portion of the frequency range transmitted by the audiphone, a group of ear-phones differing from each other in response characteristics in the next higher portion of said frequency range, a group of amplifiers differing from each other in response characteristics in the high frequency portion of said frequency range, a source of current supply, and means for selectively connecting each of the instruments in each of said groups of instruments in circuit relation with said source of current supply and with each of the instruments in both of the other groups of instruments to find the instrument having the

most suitable response characteristics in each of said portions of the frequency range.

6. Apparatus for selecting and prescribing audiphones comprising a group of microphones differing in response characteristics up to frequencies of substantially 800 cycles, a group of ear-phones differing from each other in response characteristics in another portion of the frequency range transmitted by the audiphone, a group of amplifiers having response characteristics differing from each other in the remaining portion of said frequency range, a source of current supply, and means for selectively connecting each of the instruments in each of said groups of instruments in circuit relation with said source of current supply and with each of the instruments in both of the other groups of instruments to find the instrument having the most suitable response characteristics in each of said portions of the frequency range.

7. Apparatus for selecting and prescribing audiphones comprising a group of microphones differing from each other in response characteristics in a predetermined low frequency portion of the frequency range transmitted by the audiphone, a group of ear-phones differing from each other in response characteristics in the next higher portion of said frequency range, a group of amplifiers having response characteristics differing from each other above 1500 cycles, a source of current supply, and means for selectively connecting each of the instruments in each of said groups of instruments in circuit relation with said source of current supply and with each of the instruments in both of the other groups of instruments to find the instrument having the most suitable response characteristics in each of said portions of the frequency range.

8. Apparatus for selecting and prescribing audiphones comprising a group of microphones differing from each other in response characteristics in a predetermined portion of the frequency range transmitted by the audiphone, a group of ear-phones differing from each other in response characteristics in the frequency band of from about 800 to 1500 cycles, a group of amplifiers differing from each other in response characteristics in the remaining portion of said frequency range, a source of current supply, and means for selectively connecting each of the instruments in each of said groups of instruments in circuit relation with said source of current supply and with each of the instruments in both of the other groups of instruments to find the instrument having the most suitable response characteristics in each of said portions of the frequency range.

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