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HUGO GERNSBACK Editor

RADIO  
HELPS TEST  
HEARING-AIDS  
See Page 207



New 11-Tube Receiver Introduces "Synchrotronic" Reproduction • New Tubes  
World-Flight Radio Set-Up • Details of a 5-inch Television Receiver!

OVER 50,000 RADIO MEN READ RADIO-CRAFT MONTHLY

# NEW HIGH-FIDELITY HEARING-AIDS

Familiar audio amplifier design, and the use of Rochelle-salt-crystal mikes and ear-units, combine to produce a good sideline item for Servicemen.

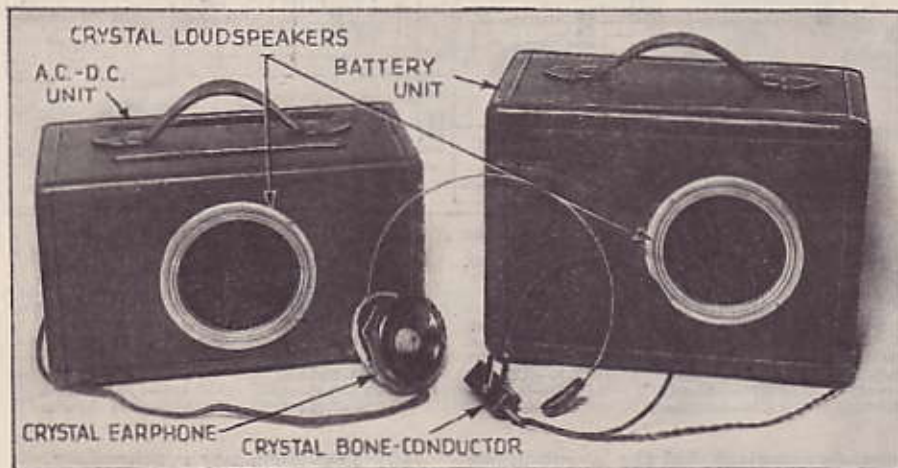


Fig. A. Front view. The line-power unit weighs 4 lbs.; the battery unit, 6.

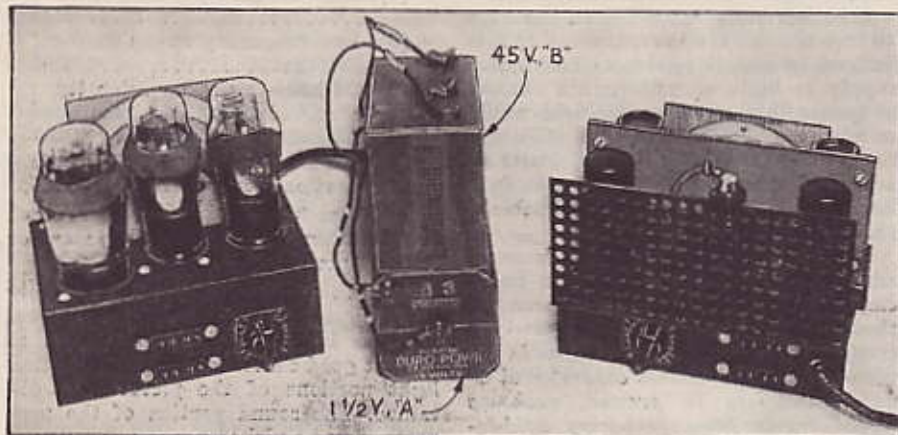


Fig. B. Rear view. Both units have tip-jacks enabling 4 persons to listen-in.

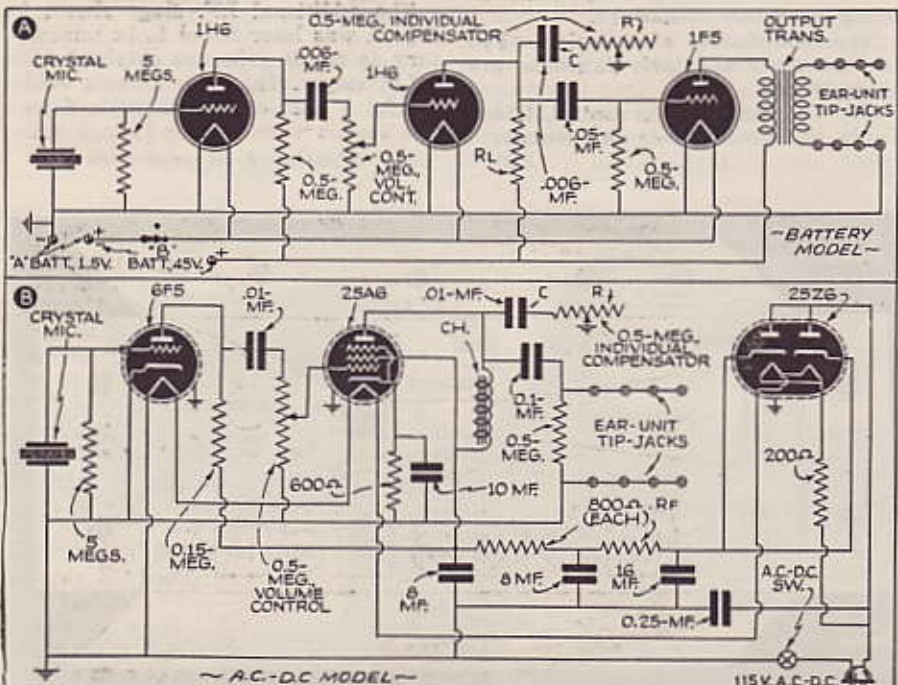


Fig. 1. A frequency compensator affords considerable control of frequency response to suit individual ear-response characteristics.

RADIO technique at long last has come to the aid of the hard-of-hearing. The audio amplifiers that constitute such an essential element in radio reception have been refined to meet the particular needs of those whose hearing is below par. Newest developments in this direction are shown photographically in Figs. A and B, and by circuit in Fig. 1.

## BATTERY PORTABLE

Of the 2 types, both of which have their advantages, the battery unit—shown at the right in Fig. A and at the left in Fig. B—meets the need for a high-fidelity hearing-aid which may be used any place without any dependence whatsoever upon a current source other than its self-contained batteries (which are said to last 1 year). This recommends the unit for use at the theatre, at bridge games, etc.

An outstanding feature of the battery unit, which due to its self-contained batteries is a little larger than the A.C.-D.C. unit, is the exceptional fidelity it affords. First step in achieving the outstandingly excellent reproduction exhibited by the models tested in *Radio-Craft* laboratories is the use of a crystal microphone as shown in circuit A, Fig. 1. Resistance-capacity coupled amplification, the 2nd step, helps maintain this fidelity straight through to the output terminals.

The 3rd and concluding link in this high-fidelity chain is the use of a crystal reproducing unit. This may take the form of a standard ear-phonc with which almost everyone is familiar and which is shown at the left-center in Fig. A; or, it may be a crystal unit of the bone-conductor type, right-center in Fig. A, which is designed to press against the mastoid bone in back of the ear and ordinarily is readily concealed by the hair.

## EAR-RESPONSE COMPENSATOR

No two people have identically the same response characteristics; everyone, even though he may hear exactly the same sounds, mentally interprets these sounds differently. How much different then must be the sound perception characteristics of those whose hearing is impaired; some people hear sounds better in the upper-frequency register, others in the middle register, still others in the lower register, and then of course persons exhibit the numerous possible combinations of these characteristics. For this reason a "compensator" is incorporated in the amplifier circuit. Its terminals are resistor R and condenser C in Fig. 1A. In a radio set this would be called the tone control. In a hearing-aid it becomes an individual compensator, and a convenient

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**NEW HIGH-FIDELITY  
HEARING-AIDS**

(Continued from page 206)

means of adjusting the response characteristic to suit individual ears. Potentiometer R, set by means of a screw-driver from underneath the chassis, when once adjusted to suit the owner of the hearing-aid, does not require further adjustment.

**A.C.-D.C. HEARING-AID**

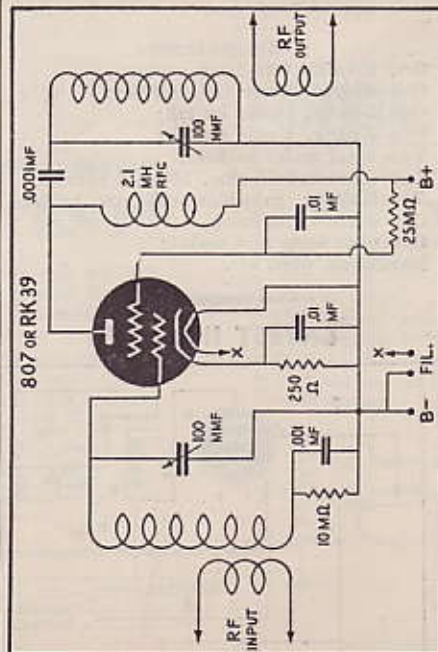
The electric model shown schematically in Fig. 1B has all the circuit elements and features mentioned above in connection with the battery model; except that load resistor R<sub>L</sub> in Fig. 1A is replaced by an impedance, Ch., in the circuit shown in Fig. 1B. The electric model of course may be operated on any 115-V., A.C.-D.C. power line but a power outlet must be conveniently available in order to operate this unit. The economy, compactness and efficiency of this unit recommended it for use by the bed-ridden and for use in offices. In order to reduce the weight to a minimum, filter resistors R<sub>s</sub> are used in place of the iron-core chokes that would otherwise be needed in the power supply.

In conclusion we wish to point out that these hearing-aids do not have the annoying background noise that has accompanied most preceding types of hearing-aids. Furthermore both units are amazingly sensitive with sufficient output to rattle either the earphone or the bone conductor. In practice however the load upon these reproducers afforded by wearing them prevents such rattling (which of course would only occur with the volume control near maximum). A soft-rubber stud, center-perforated, improves the performance of the earphone unit.

Both units can be recommended by Servicemen as being particularly suitable, because of their exceptionally fine response characteristics, for listening to orchestral and other wide-range programs being reproduced by radio sets or electric phonographs.

This article has been prepared from data supplied by courtesy of CrystalEAR, Inc.

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Circuit of Item No. 1677, pg. 227.

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# RADIO HELPS TEST HEARING-AIDS

*This article is devoted particularly to hearing-aids and especially to a newly developed method—using Radio instrumentalities—of making electrically-operated hearing-aids to order in the laboratory. Here's good data for Servicemen interested in sidelines.*

E. J. MYERS

It is well-known that hearing impairments differ very materially in their degree, their physiological nature and their variation over the speech frequency range. Some ears have relatively better hearing at the lower frequencies but poor hearing at the higher frequencies. Others have a relatively uniform loss over the entire frequency range. In some cases, the low-frequency hearing is very poor as compared to the high-frequency sensitivity. In any case, the exact nature of a hearing impairment is peculiar to a given individual. These different types of hearing losses can be charted graphically by means of an audiometer, which measures the threshold of hearing at different frequencies. It is, therefore, obvious that the same type of "hearing-aid" (microphone, amplifier and earphone) characteristic will not provide the maximum help for different individuals.

It is difficult, and in some cases impossible, to predict from an "audiogram" (the audiometer's graphic record), except in a general way, the type of amplification characteristic a hearing-aid should have to give the most satisfactory hearing-aid service to any given individual. One very important item of information not obtained with the audiogram, is the reaction of any individual to the various types of amplification characteristics which may be available. In many instances, this reaction will be a most important factor in whether or not a hearing-aid is satisfactory.

## TEST PROBLEMS

The first problem to be solved in building individual hearing-aids to order in the laboratory was to find a way by which the hearing-aids themselves could actually be made so their characteristics would cover an extremely wide band of entirely different hearing-aid possibilities.

*Mere loudness alone does not necessarily help to solve a hearing problem. More often than not, it is a decided detriment. Loudness must be intelligently applied, and it must compensate to the best possible degree for the individual hearing problem of the person who is to use the hearing-aid. This means that hearing-aids must be built to definitely predetermined characteristics in the laboratory.*

When a method of accomplishing this was perfected, the next and equally difficult problem was to provide some means by which the one person for whom the hearing-aid was to be made, could determine how he was going to hear with it when it was completed. The Radioear "Selex-A-Phone", by E. A. Myers & Sons, was finally developed after years of research, and is an instrument designed to utilize a large number of predetermined hearing-aid amplification characteristics when making an analysis of an individual's hearing-aid requirements. Thus, from a wide range of possible hearing-aid characteristics, the most suitable characteristics can be determined for any given individual.

## PERSONAL TEST

In actual use, 3 different types of carbon microphones are placed on the person of the individual who is having the analysis made. It is important with this type of analysis that these microphones occupy a position similar to that which  
*(Continued on page 250)*

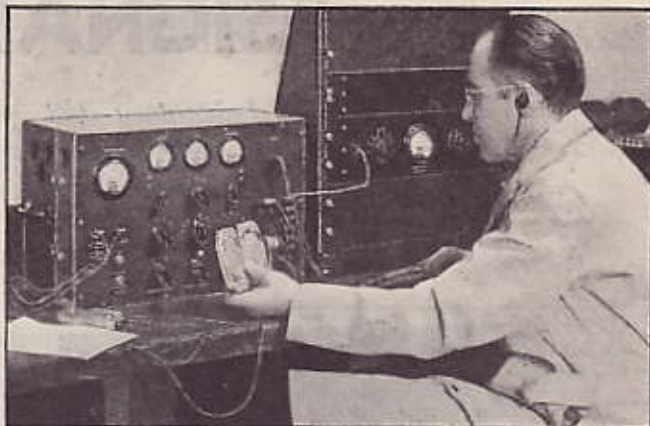


Fig. A. The master "Selex-A-Phone" radio equipment checks hear-aid against human ear for frequency range, intensity, etc.



Fig. B. The client's hearing is classified with this portable Selex-A-Phone.



Fig. C. The "intensifier" (electromechanical amplifier) being checked and adjusted against an oscillator and level indicator (decibel meter).

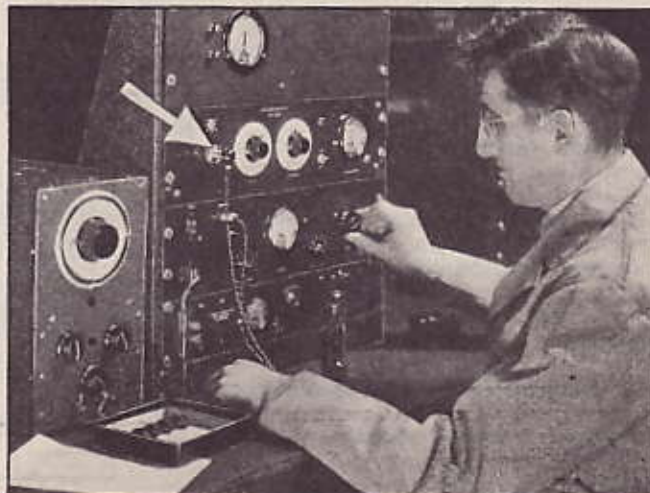


Fig. D. An "artificial ear" (arrow) checks frequency response of completed hear-aid.

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## RADIO HELPS TEST HEARING-AIDS

(Continued from page 207)

would be occupied by the microphone of the completed hearing-aid. Under these conditions, the response of the microphones is not influenced by any sound reflections which might be present if the microphones were to be used in close proximity to a hard plane surface. Each of these microphones is so arranged that it can be connected with any one of a number of *electromechanical amplifier* units which, in turn, can be connected rapidly with any one of a number of different reproducers of both the *air-conduction* ("earphone") and the *bone-conduction* ("oscillator") type.

Since hearing memory is generally rather short, it is highly desirable that these changes in characteristics be produced very rapidly. Provision is made for changing the complete characteristics of the hearing-aid by throwing a single switch. Also, 3 switches may be thrown simultaneously, changing 3 separate circuits, with a correspondingly larger alteration in the characteristics of the hearing-aid. In this way the individual whose hearing-aid characteristics are being analyzed can make an immediate and direct comparison between widely varying characteristics, selecting the one which gives him the greatest degree of articulation. The method and apparatus used in this system and illustrated by Fig. B are covered by United States Patents.

### TESTS ON COMPONENT UNITS

In Fig. E a *microphone testing chamber* is illustrated, with a partially-finished Radioear microphone in place. After it has been made to meet the necessary electrical and acoustical qualifications, it can be accepted for further tests.

An "intensifier" (an *electromechanical, tube-less amplifier*) test is illustrated in Fig. C. This intensifier has been built with certain definite parts designed to produce certain mechanical and electrical results, indicated by the original Selex-A-Phone analysis. One of the adjustments, which is so extremely important that it must be held to within 6/100,000-inch of absolute accuracy (or only 1/67th as thick as a sheet of common writing paper) is made electrically and does not change in service. No attempt is made to change the efficiency or tone quality of the intensifier by adjustment. Changes in tone quality and efficiency are obtained by variations in design and construction which are entirely too complex to be duplicated by means of adjustments.

In the construction of the miniature receivers for use with these hearing-aids, an "artificial ear" as illustrated in Fig. D is employed. This artificial ear reproduces the character and sensitivity of the human ear, so far as its reaction to amplified sound is concerned. "Listening" to each ear-piece, it gives an accurate, measurable indication of its performance under conditions equivalent to those which will be experienced in actual use.

### ASSEMBLY TEST

Having completed 3 units for the construction of the desired hearing-aid, the assembly then goes to one of the Laboratory's Master Selex-A-Phones (see Fig. A), where each unit is subjected to checking with the human ear. No part of the laboratory procedure can depend upon the human ear alone but the human ear is a valuable adjunct to the use of the proper test equipment.

Laboratory technicians then make final tests on the completed hearing-aid. So that

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## ANTI-NOISE COUNTERPOISE ANTENNA SYSTEM

(Continued from preceding page)

method used to evaluate the noise-reduction performance of this antenna system. Measurements were made using the set-up shown in Fig. 5. In this circuit a signal generator is shown being applied to the power cord of the receiver. The sensitivity of the receiver to this signal is then measured both with a normal antenna and with the counter wire noise-reducing antenna.

In Fig. 6 is shown a curve of attenuation vs. frequency; the ratio of these 2 sensitivities is a measure of the effectiveness of the noise-reducing antenna.

### CREDITS

The engineers previously mentioned in this article recognize that considerable work has been done by previous experimenters and acknowledge indebtedness to Messrs. W. L. Carlson, W. H. Conron and D. E. Nason for valuable assistance in this work. Some references to prior art follow:

- Fessenden, 742,780; Taylor, 1,468,049; Conrad, 1,513,223; Weinberger, 1,738,337; Miller, 1,872,487; Loftis, 1,995,152; Alexander, 2,054,645; Beverage, Re-19,784; De Monge (British), 455,187; *Wireless Age*, July 1914, pp. 839-842; *Radio Retailing*, June 1936, pg. 63.

*This article has been prepared from data supplied by courtesy of RCA Mfg. Co., RCA-Victor Div.*

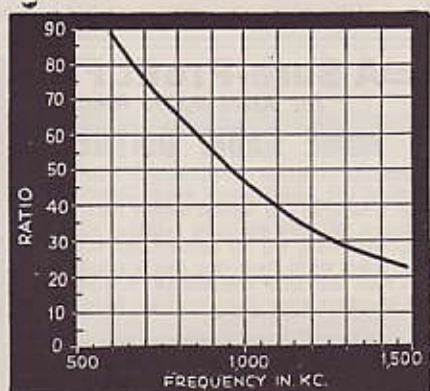


Fig. 6.

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the readings of the various instruments will not be influenced by outside noises, or by improper acoustical conditions within the room itself, the complete hearing-aid is housed within a sound-proof booth. The test frequencies are then introduced within the booth and the efficiency of the hearing-aid is recorded at all of the important frequencies. Frequently instruments which have successfully passed every other test to which they have been subjected fail to measure up to the standards required in this final test.

**A-B-C's FOR "AID" USERS**

In closing this description of a modern hearing-aid laboratory, it is only fair to mention a few words of caution regarding what even the finest of the modern instrumental aids to hearing can and cannot be expected to do.

1st—It won't give anyone natural hearing.

2nd—It won't supply normal hearing.

3rd—It will not provide undistorted hearing.

4th—It can't be expected to operate at peak efficiency in group conversations or in auditoriums where acoustical conditions will influence the results.

5th—It will never deliver its maximum service unless it is given reasonable care—including a check-up at the laboratory about every year.

6th—No aid to hearing is ever the equivalent of the unimpaired ear.

7th—It will prove to be as great a blessing to the user's family and friends as it will to the individual whose hearing is impaired.

8th—Acknowledge your hearing impairment. By attempting to conceal its existence, through a mistaken idea of "pride," you will discover—too late—that you have fooled only the most important individual concerned. That individual is yourself!

9th—Everything which can be done to prevent the progress of a hearing impairment or to alleviate an existing impairment should be undertaken with the guidance and upon the advice of a competent medical authority.

If these facts are known and understood, anyone who finds that he can use a high-quality hearing-aid to advantage, should obtain that hearing-aid at once and use it to the fullest extent of its capabilities.

*This article has been prepared from data supplied by courtesy of E. A. Myers & Sons.*

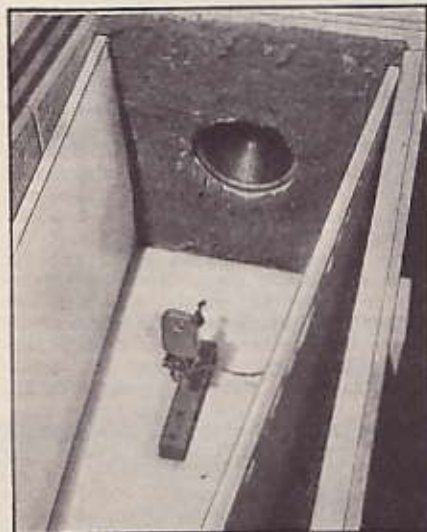


Fig. E. In a sound-proof chamber, test frequencies are picked up by the hear-aid mike.

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