Handset for the 500-Type Set

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A primary objective of the new 500-type telephone set* — to increase the combined transmitting and receiving performance by about 10 db — is met by the use of a completely new handset with a more efficient transmitter and receiver. Also, in line with the over-all objective of making the new set pleasanter to use, the handset is lighter, easier to handle, and, for more natural reproduction of speech, is capable of transmitting and receiving a wider frequency range.

Like its predecessor, the new G-type handset is of molded phenol plastic but weighs only 12 ounces — 4 ounces less than the present F type. It is ½ inch shorter between the receiver cap and the transmitter mouthpiece, and thus better fits the distribution of head dimensions and brings the transmitter closer to the mouth. As a result of improvements in the contour of the carbon chamber, the modulating efficiency of the new T1 transmitter (Figure 2) is higher than that of the larger F1 transmitter used in the present 302-type telephone set, and is less affected by the position in which the transmitter is used. Furthermore, this higher efficiency is maintained over longer periods through the use of an improved transmitter carbon. This granular carbon is now being manufactured by the Western Electric Company using a superior process recently developed at the Laboratories.

The transmitter is designed so that its response rises uniformly to a broad maximum in the region of 2500 cps as compared to an initial maximum at about 1800 cps for the F1 transmitter (Figure 1). This rising response characteristic not only compensates for the inverse characteristic of the loop but also increases the output at the higher frequencies. In this way the received speech is made to simulate more

Above, H. W. Bryant tests response of T1 transmitter of G1A handset with artificial mouth.

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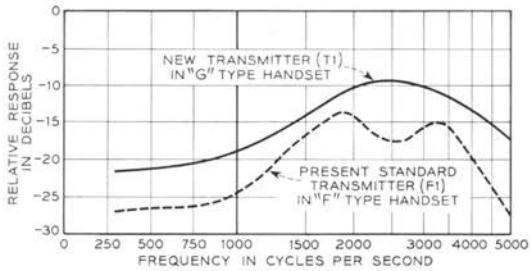

Fig. 1—Transmitter response characteristics.

nearly direct speech as heard by a listener a few feet from a talker.

The desired characteristic is achieved in the T1 transmitter by the introduction of a vibratory system substantially different from that employed in the F1 transmitter, and by the addition of an acoustical network. The new transmitter has a smaller diaphragm which is rigidly clamped at its periphery, whereas the diaphragm of its predecessor is floated between lightly compressed paper rings. The response-frequency characteristic of the new transmitter is controlled by an acoustic network obtained by coupling the chamber behind its diaphragm through a controlled acoustic resistance to the chamber formed by the plastic cup in the transmitter bowl of the handset. Specially woven rayon fabric is used for the acoustic resistance material. The plastic cup also serves as a barrier to prevent acoustic coupling between the transmitter and the receiver through the conduit in the handle.

Improved modulation accounts for about half of the 5 db volume gain obtained with the new transmitter. The other half comes from an increase in the effective acoustic pressure on the diaphragm obtained by locating the transmitter closer to the user's mouth. This reduced mouth-transmitter dis-

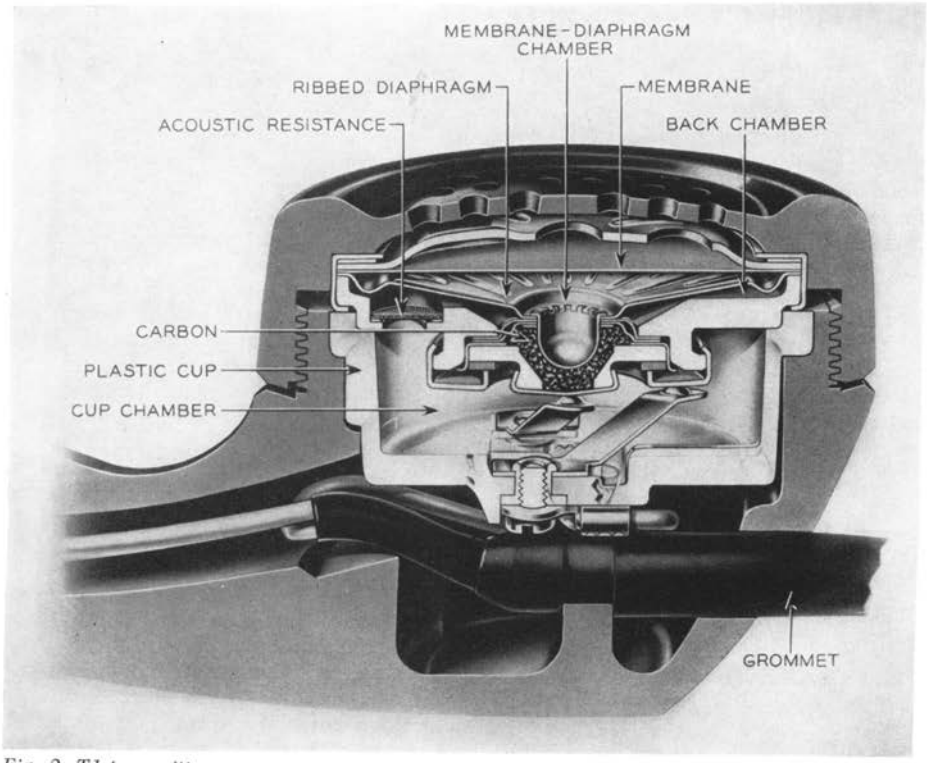

Fig. 2—T1 transmitter.

tance is of particular benefit to women whose head dimensions are smaller and whose voice level is lower than for men.

The improvements in efficiency and frequency response sought for the U1 receiver (Figure 4) are achieved by the use of a new design differing radically from any commercial predecessor. The simple magnetic disc of earlier receivers is replaced by a dome-shaped diaphragm of phenolic impregnated fabric cemented to a peripheral magnetic ring of vanadium permendur. This "ring armature" diaphragm calls for an entirely new type of magnetic system.

The outer edge of the ring armature rests on a circular seat of non-magnetic material. The inner edge is in close proximity to a circular permalloy pole-piece which conducts the flux from a ring-shaped remalloy type permanent magnet. Lighter than its predecessors and with its mass concentrated in the outer metal ring, the new diaphragm provides about a seven-to-one reduction in the mechanical impedance of the new receiver, and a correspondingly large increase in the ratio of effective area to effective mass. This accounts for an improvement in the receiving efficiency of about 5 db, along with an extension of the frequency range. Also, because of the lower mechanical impedance of the diaphragm system,

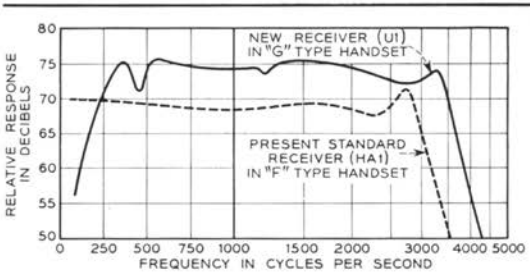

Fig. 3—Receiver response characteristics.

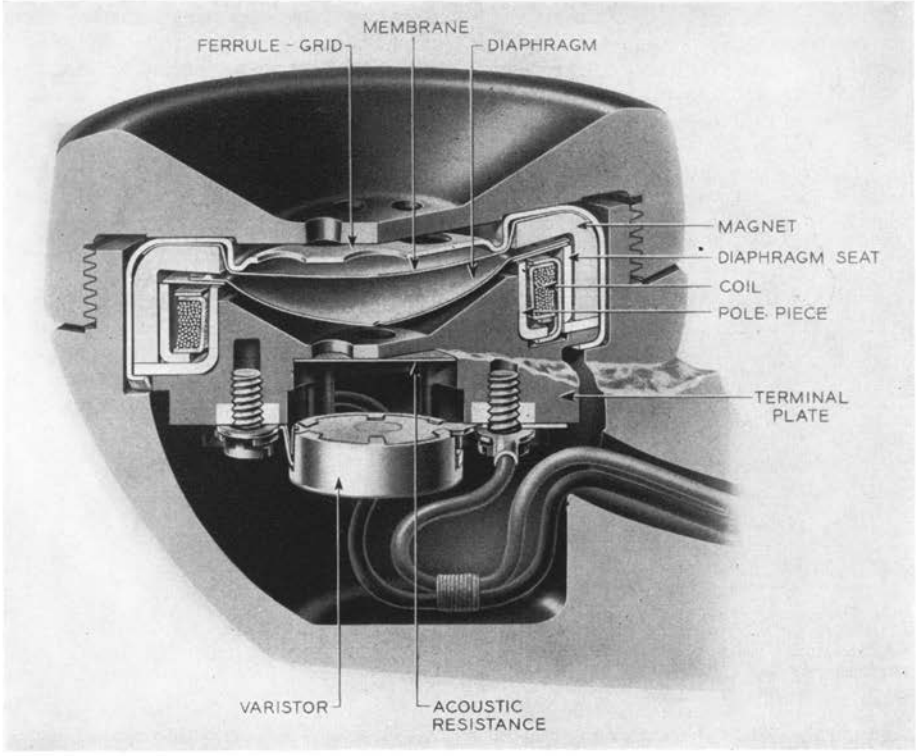

Fig. 4—U1 receiver.

it is a better acoustic radiator, with the result that when the receiver is held off the ear, the intelligibility is much better than that obtained from earlier receivers.

Acoustic controls on the response of the receiver are provided in the same manner as in the HA1 receiver of the F-type handset which forms a part of the present 302-type telephone set. Chambers on each side of the diaphragm connect to constricted passageways having the proper acoustic mass and resistance. The chamber under the diaphragm exhausts into the handset handle cavity through four holes covered with acoustic resistance fabric, while the chamber above the diaphragm exhausts into the listener's ear cavity through the acoustic mass and resistance of the holes in the receiver cap. The desired response-frequency characteristic of the new receiver in the G type handset is obtained by establishing the proper relationship between the acoustic and mechanical elements involved.

Because of the increased efficiency of the new receiver its diaphragm is pierced to introduce a low frequency cut-off to discriminate against disturbances due to the introduction of power frequency and its principal harmonics into telephone circuits. The diameter of the diaphragm hole is selected to obtain a response at 180 cps which is approximately 10 db below that obtained at 1000 cps. The receiver response-frequency characteristic is virtually flat from 400 up to 3500 cps as compared with the 3000 cps cut-off for the earlier receiver (Figure 3). The irregularities in the response characteristic of the new receiver at 450 and 1200 cps are not inherent in the receiver but are acoustical effects of the conduit in the handset handle. No adverse effects from these have been discerned.

To protect the user from uncomfortably high acoustic levels caused by transient electrical disturbances in the telephone circuit – a problem accentuated by the higher efficiency of the new receiver – a peak-limiting varistor is shunted across the new instrument. This copper oxide varistor also protects the receiver magnet from the demagnetizing hazards of such disturbances; consequently the magnet can be made less massive, thereby reducing the weight of the receiver, and economizing in the use of strategic magnet material.

Numerous simplifications make for economical manufacture. For example, there are no inserts in the molded handle as compared with six in the F type handle. Connections are made directly to screw terminals on the back of the receiver unit by running two of the four conductors in the cord through the cored handle. The other two conductors are attached to screw terminals on the back of the molded plastic cup at the transmitter end of the handset. The tinsel conductor cord is of lightweight neoprene-jacketed construction, and has a grommet molded on it at the handset end which serves to reduce destructively sharp bending at the point of entry and also seals the handset against room noises. A notch in this grommet engages projections molded inside the transmitter bowl of the handle, thereby eliminating the necessity for a conventional stay hook and attachment screw.

During the development, close cooperation with Western Electric engineers did much to insure a design suitable for large quantity and economical manufacture.

THE AUTHOR: LEONARD J. COBB is in charge of a group developing telephone instruments. When he joined the Laboratories in 1922 he was assigned the job of developing testing procedures for shop inspection of telephone transmitters and receivers. Later he designed and built specialized measuring facilities for laboratory use in this connection. In 1949 he took over his present responsibilities. Mr. Cobb was awarded an E.E. degree, cum laude, from Polytechnic Institute of Brooklyn in 1933.