



A New Telephone Set for the Hard of Hearing

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FOR a number of years the Bell System has had apparatus for association with the regular telephone set to assist the hard of hearing. Known as the 10A key equipment, it consists of a vacuum tube amplifier, a box for the filament and plate battery, and a third unit containing a volume control key and switch. This apparatus has given satisfactory service in many installations. Recently a new amplifying set has been developed which permits all the added equipment except a small $4\frac{1}{2}$ -volt battery to be incorporated in the base of the telephone. The gain

of the amplifier is adjusted by turning one of the switchhook plungers, and the amplifier can be disconnected by a second switch controlled by this same plunger. The new set is available in two forms, coded the 332-type and 334-type telephone sets, whose differences pertain only to the type of lines on which they will be used.

In appearance the new amplifier set is like any other of the combined type hand telephone sets, as may be seen from the photograph at the head of this article. The switchhook plunger at the right, which the girl is adjusting, gives gain control. This may

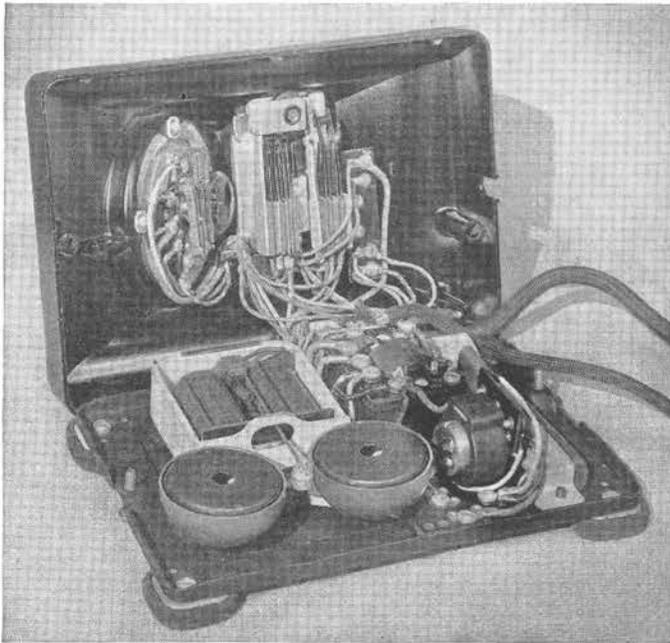


Fig. 1—In the new subset, the amplifier occupies a space less than one of the bells

be turned to any one of three positions, marked L, M and H, to give low, medium or high gain. Vertical motion of this plunger removes the amplifier from the circuit entirely. The contacts controlled by this vertical motion may be wired in either of two ways. If the set is to be used chiefly by one who is hard of hearing, the wiring is arranged so that the amplifier is normally in the circuit and is removed by pulling the plunger up. When the set is to be used by a number of persons, some of whom are not hard of hearing, the wiring is arranged so that the plunger has to be pulled up to connect the amplifier into the circuit. When the handset is replaced after using, the plunger is returned to its normal position.

Two elements have contributed to the small size of the new set. One is the compact design of the volume and control spring assemblies operated by

the switchhook plunger. The other is the very small amplifier unit employed. This is a modification of the amplifier used with the ortho-technic audiophone, and has already been described in the RECORD.* It consists of a granular-carbon microphone whose diaphragm is actuated by a bipolar receiver element using permanent magnets. Its appearance and location in the set may be seen in the front right hand corner of Figure 1. A soft rubber mounting prevents it from picking up vibrations from the surface on which

the set is resting. When the amplifier is in use its receiver element is connected in place of the regular handset receiver, while its transmitter element is connected to the handset receiver in series with a $4\frac{1}{2}$ -volt battery which may be placed in any convenient location and connected to the set by two wires. With this arrangement, the handset receiver is operated by the amplified speech from the transmitter element of the amplifier.

The major circuit elements of the amplifier set are indicated in Figure 2. The key marked K1 is operated by the vertical motion of the switchhook plunger above its position when the handset is lifted. In one position, the receiver of the handset is connected to the induction coil in the usual manner, and the amplifier is disconnected. In the other, the one indicated, the handset receiver is connected to the

*RECORD, September, 1939, page 8.

output of the transmitter part of the amplifier and the receiver part of the amplifier is connected through a τ resistance network to the terminals of the induction coil normally connected to the handset receiver. The τ network in the connection to the amplifier receiver gives the gain control. As arranged on the schematic, the network gives maximum loss, and thus the lowest net amplifier gain. When the plunger is turned to the M position, the resistance c is connected in parallel with B instead of with D . When the plunger is turned to the H position, c remains in parallel with B , but a short circuit is placed from the input of B to the output of A , and D is disconnected at its lower end. This entirely cuts out the resistance pad and gives maximum gain. Since only a small amount of power is dissipated by these resistances, they are very small and require very little space.

Since to prevent "singing" the amount of gain around the closed path from the receiver to the transmitter through the air path and then back to the receiver through the induction coil must be less than the total loss,

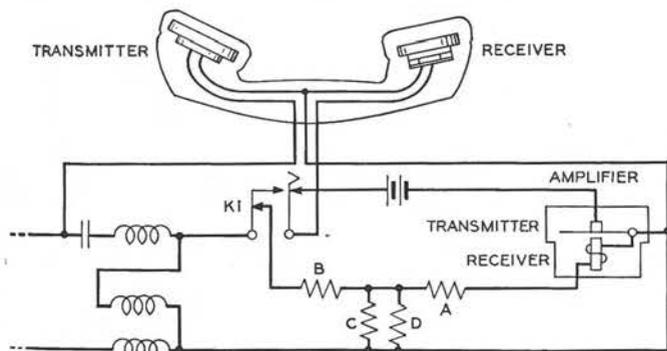


Fig. 2—Simplified schematic of amplifier set

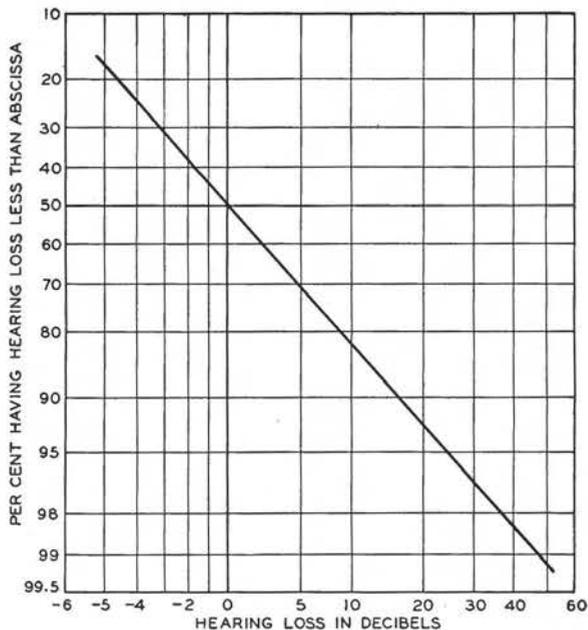


Fig. 3—Distribution of hearing loss at 1760 cycles

the amount of gain that can safely be introduced into the receiver path of a telephone set is limited. A maximum of 25 db gain is provided by the amplifier used, and while this is great enough to cause singing if the handset is held away from the ear and facing a reflecting surface such as the top of a desk, singing will not occur in normal use.

Interesting information regarding the field of use of such a hearing aid may be derived from the hearing tests made in the Bell System Exhibit at the New York World's Fair in 1939. The extent of hearing loss of a cross-section of the public from 10 to 59 years of age is given in Figure 3. The loss will be different at different frequencies, of course, but that shown, which is at 1760 cycles, may

be taken as typical. The reference loss of 0 db is that of the group from 20 to 29 years of age. A person is not conscious of hearing impairment for ordinary room conversations until his loss is about 25 db, and thus as is shown by the curve only about 5 per cent of the population would be conscious of the need for a hearing aid. This percentage would be smaller for telephone conversations because the average speech level received is approximately 10 db higher than that of

normal direct conversation. In other words, the ordinary telephone set acts as a hearing aid. With the additional 25 db provided by the new set, persons with as much as 60 db loss will receive adequate volume. Since only 0.5 per cent have a loss greater than this, the new set provides the help needed for about 90 per cent of those conscious of hearing impairment, and would undoubtedly give worthwhile assistance to many with losses in excess of this.



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From a world-wide broadcast by Dr. Buckley for the American Philosophical Society over WRUL, July 10, 1942.