Telephone Sets for Noisy Locations

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BOTH the intensity and the frequency composition of surrounding noise affects one's ability to hear through the telephone, but these factors alone do not permit the influence of noise to be evaluated. Noise disturbs the understanding of speech both by a distracting effect and by actually "masking" the speech; and the situation is further complicated by there being several paths over which the noise may travel. The distracting effect is predominantly psychological, but the masking is physical. A person who habitually uses the telephone in noisy locations usually becomes able to overcome the distracting effect, but masking must be reduced by physical means.

The three main paths over which noise acts are known as the "side-tone" path, the leakage path, and the other-ear path. Noise following the side-tone path is that which falls on the telephone transmitter, and is transmitted to the receiver through the local telephone circuit. The anti-side-tone telephone set,* now in common use, introduces a considerable loss in this path, and has thus greatly reduced the effect of noise on the telephone user. With the present instruments, the complete elimination of the remaining side-tone would improve reception by only a few db. Noise following the other-ear path reaches the consciousness by way of the ear not covered by the telephone receiver. It can be reduced only by blocking that ear. Noise acting over this path, however, produces much less disturbing effect than noise at the ear receiving speech, and ordinarily is not serious. Leakage-path noise is that reaching the ear to which the receiver is held by passing between the receiver and the ear. It can be appreciably reduced by holding the receiver tightly to the ear, or by employing a specially designed, tightly fitting receiver cap.

In designing a telephone set for noisy locations, therefore, neither the other-ear or leakage-path noise can be reduced by changes in the telephone circuit itself. Noise passing over the side-tone path, however, can be reduced, and its total disturbing effect can be decreased in either or both of two ways: by increasing the loss in the side-tone path itself, or by increasing the speech level relative to the noise. Which of these two methods is most desirable will depend to a large extent on the loudness and frequency composition of the noise. If the frequencies are predominantly those readily passed through the side-tone path, and the noise level is not too high, a reduction in side-tone is generally effective. If the major noise components, on the other hand, are those that readily pass through the leakage path, or if the noise is so great that the other-ear and leakage paths become important, additional gain in the speech path

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will be the more effective way of handling.

In view of this situation, a new telephone set for noisy locations has been made available. It has two forms: one employs an amplifying arrangement, which raises the receiving level without materially changing

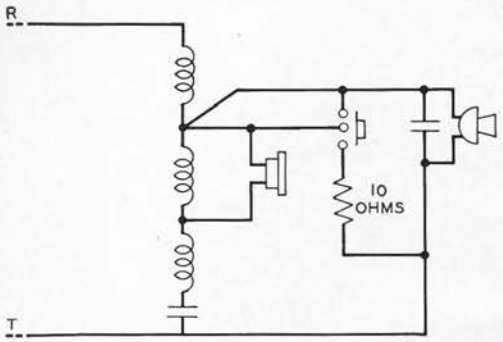

Fig. 1—Simplified circuit for the non-amplifying arrangement

the level of the noise; the other is a non-amplifying arrangement, which reduces the noise passing through the side-tone path, but does not increase the received speech. Both employ a low resistance that is shunted across the transmitter during the listening periods, but the former also provides an amplifier to increase the level of the received speech. With either arrangement the handset is replaced by a D-173198 handset. This is similar to the commonly used F1 handset except that it incorporates a push-button in the handle which is pressed for listening. With the non-amplifying arrangement, this handset is the only addition made, but with the amplifying arrangement, a D-165582 key and one No. 6 dry cell are also required. The key unit includes a 111B amplifier, which is the amplifier used with the telephone set for the hard of hearing* and also a 1500-ohm resistance, which is in series with the amplifier input, but is short-circuited when the push-button on the handset is pressed. The dry cell may be mounted in any convenient place and is wired to the key unit. The drain on the battery while in use is only 10 or 15 milliamperes.

A simplified circuit diagram for the non-amplifying arrangement is shown in Figure 1. This is the regular anti-side-tone handset circuit except for the push-button and the 10-ohm resistance. A resistance to this value produces the reduction in side-tone desired, while a short-circuit would make the circuit sound dead, and the distant subscriber might think he had been disconnected. During listening periods the push-button is pressed, connecting the resistance across the transmitter, thus reducing the side-tone by about 12 db. The result is an increase in the effective receiving gain by 2 to 4 db, depending on the existing side-tone and on the noise level.

Where the noise conditions are such that satisfactory hearing cannot be secured with the non-amplifying arrangement, the D-165582 key is added, and the circuit is arranged as shown in Figure 2. In this diagram s1, s2, and s3 are three springs of the key, which are all operated at the same time when the lever is moved. With the lever in the "down" position as indicated, the amplifier is disconnected, and the circuit is effectively the same as in Figure 1. With the

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The Author: Upon receiving the degree of B.S. in E.E. from the University of Illinois in 1911, J. W. Foley immediately joined the Western Electric Company at Hawthorne. Upon the completion of the student course, he entered the Transmission Laboratory at New York, where he was concerned with general transmission studies. His work soon became centered upon telephone sets and their associated circuits. He has been intimately associated with the development of the anti-side-tone telephone sets now standard for both subscribers and operators as well as many sets for special purposes such as train dispatching, amplifier sets for the hard of hearing, and loudspeaker systems for both intercommunicating and regular telephones. More recently he has participated in the development of closed-core induction coils for operator and subscriber sets, of acoustic shock prevention devices, and in further studies for the improvement of subscriber telephone sets and their associated apparatus.

key "up," the input of the amplifier, in series with the 1500-ohm resistance, is substituted for the receiver of Figure 1, while the receiver is connected to the output of the amplifier. Under these conditions the 12 db gain of the amplifier is practically offset by the loss through the 1500-ohm resistance, and thus listening conditions are the same as those encountered with the standard telephone set.

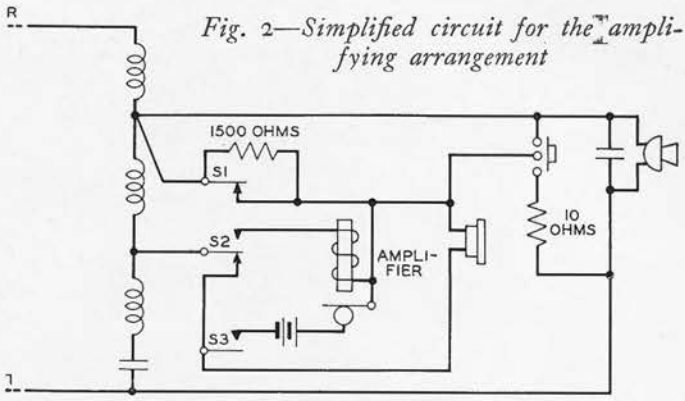
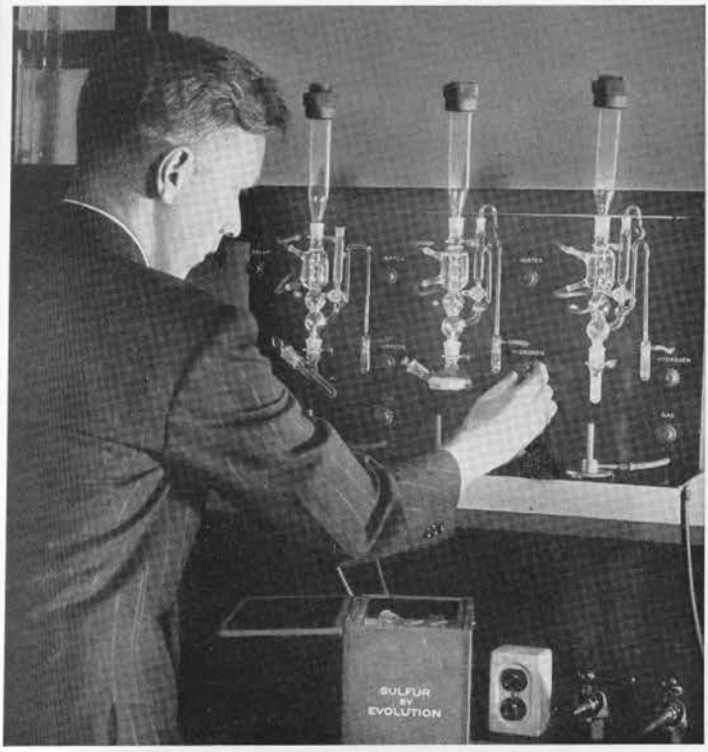


Fig. 2—Simplified circuit for the amplifying arrangement

When the push-button in the handset is pressed, however, the 1500-ohm resistance is short-circuited, and the 10-ohm resistance is shunted across the transmitter. As a result, the 12-db gain of the amplifier is effective in both the receiving and side-tone paths, but the side-tone is decreased 12 db by the resistance shunting the transmitter. The net result is to leave the side-tone at about the original level, but to increase the incoming speech 12 db, thus improving the receiving efficiency by this amount.

With these two arrangements available, it is felt that satisfactory transmission can be furnished even in very noisy locations where the improvement that is made possible by the anti-side-tone telephone set alone does not prove adequate.



C. W. Mattson of the Microchemical Laboratory employing apparatus recently developed to detect sulfide sulfur in unusually low concentrations. Minute amounts of sulfur can exert a marked influence on many materials, and when present as sulfides on surfaces can profoundly affect the mechanism of interfacial reactions. This is particularly true of communication equipment, where delicate contacts and vacuum tubes are both subjected to sulfur "poisoning." With this apparatus as little as one millionth of a gram of sulfur can be determined.