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MECHANICAL AMPLIFIER
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FIG. 1

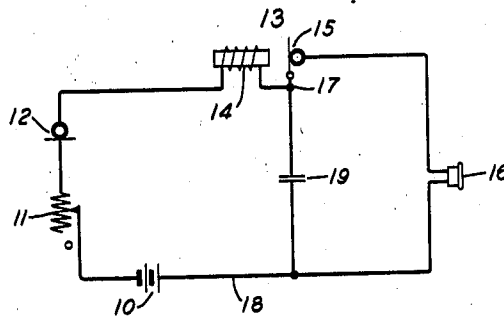


FIG. 2

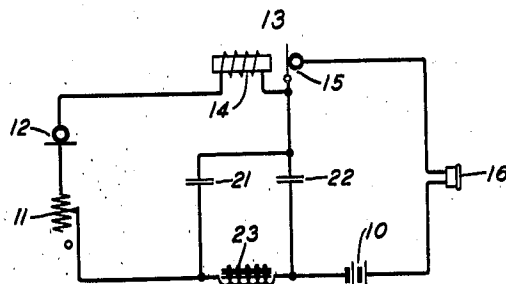
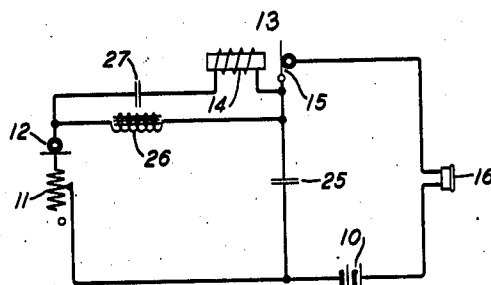


FIG. 3



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MECHANICAL AMPLIFIER

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5 Claims. (Cl. 179-107)

This invention relates to amplifying systems and particularly to mechanical or microphone amplifier systems as commonly used in audiphones.

These systems usually consist essentially of a pick-up microphone, a microphone amplifier, a receiver and suitable batteries for energizing these devices. In one well-known system of this type two separate batteries are used for energizing the pick-up microphone and the microphone unit of the amplifier, respectively. While such a system may be made to operate satisfactorily, the use of two batteries in an audiphone usually makes the audiphone rather heavy and bulky and complicates the wiring necessary to connect the parts together when they are conveniently disposed about the person of the user.

In order to keep the audiphone small and light in weight, it is common practice to use a single battery for energizing both the input and output networks. In circuits of this type, however, the impedance of the battery is common to the input and output circuits of the amplifier and special precautions are necessary to prevent the resulting feedback from making the system unstable in operation.

The object of this invention is to energize such a system from a single battery in such a manner that the system is inherently stable and capable of being controlled from any desired position on the person of the user without complicating the necessary wiring.

According to the general features of the invention, the pick-up microphone, the receiver and microphone units of the amplifier and the receiver are all connected in series with the single battery and a low impedance path for the signal current variations in the amplifier input and output networks is provided by connecting a condenser of large capacity from the common connection between the amplifier units to an electrically remote point on the other side of the series network between the microphone and receiver. A system of this kind also has the important advantage that it may be controlled by a switch and volume control connected in the series loop at any position convenient for the user.

These and other features of the invention will be more clearly understood from the following detailed description and the accompanying drawing in which:

Fig. 1 shows an amplifying system according to the invention; and

Figs. 2 and 3 show alternate circuits which further increase the stability of the system.

Referring to Fig. 1, the battery 10 is connected in series with a combination switch and volume control 11, a pick-up microphone 12, a microphone amplifier 13 comprising a receiver unit 14 and a microphone unit 15, and a receiver 16. Connected between the common point 17 between the receiver and microphone units of the amplifier and the conductor 18 between the battery and receiver is a condenser 19 of such large capacity that its impedance is small for all frequencies transmitted. While this requires a condenser of the order of 16 microfarads capacity or larger, such condensers for low voltage applications are now available in such small sizes that they add very little to the weight or bulk of an audiphone.

The variations produced in the battery current flowing in the series circuit traced above when sound waves actuate the microphone 12, energize the receiver unit 14 of the amplifier which, in turn, drives the microphone unit 15 and the amplified output of the unit 15 energizes the receiver 16 as in many prior designs. The signal current variations produced in the microphone unit 15 and flowing in the receiver 16, however, have a low impedance return path through the condenser 19 and, hence, are not transmitted to any appreciable extent through the amplifier input network. In other words, though this condenser is common to both the amplifier input and output circuits, its impedance is so low that the signal voltage developed across it is not sufficient to produce feedback difficulties.

It will be readily seen that the capacity required in the condenser 19 to produce stable operation will depend, to some extent at least, on the frequency transmission characteristic of the amplifier. For any given signal current amplitude, the voltage developed across the condenser and tending to produce feedback will vary inversely with frequency and, hence, will be greatest at low frequencies. Some audiphone amplifiers are designed to transmit efficiently only down to about 300 cycles per second since frequencies lower than this are not very important for intelligibility of speech. Other types of amplifiers, however, have practically uniform response down to the lowest sound frequencies. If an amplifier of the latter type is used in the circuit of Fig. 1, the condenser 19 must be of larger capacity than is required for stable operation with an amplifier which is inefficient at low frequencies.

If in any case satisfactory operation requires a

condenser of excessively large capacity in the circuit of Fig. 1, it may be preferable to provide separate shunt paths for the current variations in the input and output networks as shown in Fig. 2. In this circuit condensers 21 and 22 are both of the large capacity low impedance type. Condenser 21 provides a shunt path for the current variations produced in microphone 12 and condenser 22 performs a similar function for the variations produced in the microphone unit 15 of the amplifier. In order to prevent the potential set up across condenser 22 by these latter variations from producing excessive feedback to the input of the amplifier, a small retard coil 23 of about 0.2 henry inductance is connected in the series loop on the input side of the point of connection of condenser 22. Since the retard coil and the condenser will ordinarily be mounted in the same casing as the amplifier and battery, it usually will be convenient to connect them into the circuit as shown, but, if desired, as when some other mechanical arrangement is employed, the various elements may be transposed in various ways, keeping in mind that the condenser 21 must provide a return path for the input variations independently of the retard coil and that the coil must be in some portion of the input network other than the portion common to both input and output networks. In both this circuit and that of Fig. 1 the location of the battery in the series loop is immaterial but it is found that greater stability at high frequencies is sometimes obtained by a proper choice of polarity in connecting the battery in the circuit.

Since the steady component of the battery current flows through the receiver unit 14 of the amplifier in the circuits of both Figures 1 and 2, these circuits are applicable to systems using amplifiers with either electromagnetic or permanent magnet type receiver units. In cases where the circuit of Fig. 1 is not entirely satisfactory because of instability at low frequencies and the receiver unit of the amplifier is of the permanent magnet type, the modification shown in Fig. 3 may be used.

In Fig. 3 condenser 25 is similar to condenser 19 and provides a common return for the input and output variations as in Fig. 1. In this case, however, the steady component of the current from the battery 10 is by-passed around the receiver unit 14 by means of a small retard coil 26 and the output variations of the microphone 12 are impressed on the receiver unit 14 of the amplifier through a small condenser 27. The values of the retard coil 26 and the condenser 27 will, of course, depend on the low frequency cut-off required to give stable operation but in most cases a coil of 0.2 henry inductance and a condenser of 1.0 microfarad capacity will so reduce the low frequency response that the feedback voltage developed across the condenser 25 will not adversely affect the operation of the system.

While in audiphone applications of these am-

plifying systems it is usually most convenient to mount the switch and volume control on or adjacent the pick-up transmitter, such a disposition in prior systems required that a lead from the output network be brought back to the control point. This extra lead not only complicated the wiring system but, being disposed in close relation to the input circuit wiring, it made further precautions necessary to avoid feedback difficulties.

It will be noted, however, that in all of the above circuits the steady component of the current flows in the external series loop so that the control 11 may be connected into the loop at any point depending upon the desired physical disposition of the several component parts about the person of the user.

What is claimed is:

1. In an amplifying system, a pick-up microphone, an amplifier comprising receiver and microphone units, a receiver and a source of current all connected in a closed series loop and a condenser of large capacity connected from the common connection between the units of the amplifier to the electrically remote connection between the pick-up microphone and the receiver.

2. In an amplifying system, a pick-up microphone, an amplifier comprising receiver and microphone units, a receiver and a source of current all connected in a closed series loop and a condenser of large capacity dividing the series loop into input and output amplifier networks.

3. In an amplifying system, a pick-up microphone, a mechanical amplifier having receiver and microphone elements and a receiver all connected in series, a return path connecting the receiver to the microphone to form a loop circuit, a source of current serially connected in the circuit, two condensers of large capacity connected across the circuit from the connection between the elements of the amplifier to different points in the return path and an inductance serially connected in the path between the points of connection of the two condensers.

4. In an amplifying system according to claim 2 in which the receiver unit of the amplifier is of the permanent magnet type, a small capacitance serially connected between the pick-up microphone and the receiver unit and an inductance shunting the capacitance and the receiver unit for reducing the efficiency of transmission of the input network for currents of low frequencies.

5. In an amplifying system comprising a pick-up microphone, a telephone receiver, and a microphone amplifier having a permanent magnet type receiver unit connected to the pick-up microphone and a microphone unit connected to the telephone receiver, means for supplying direct current to the microphone and the microphone unit and means of relatively high impedance for low frequencies connected between the pick-up microphone and the receiver unit.

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