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AUDIPHONE

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FIG. 1

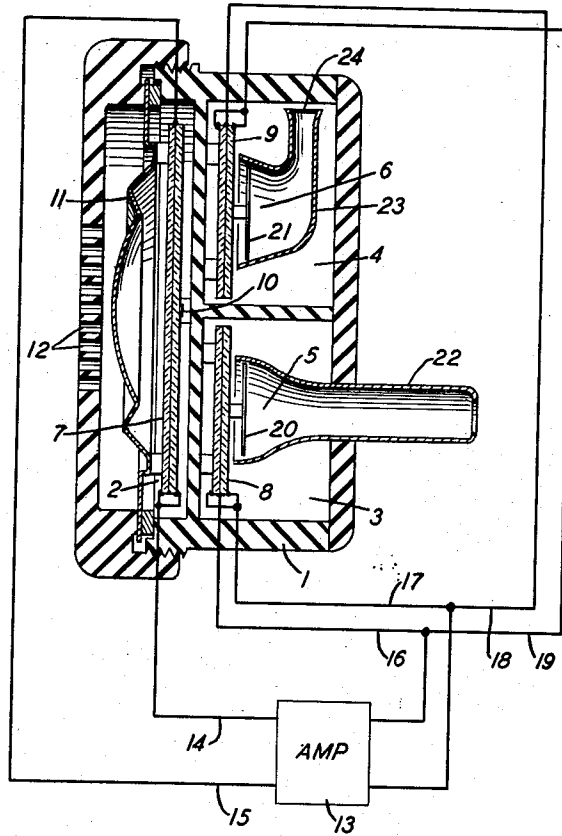
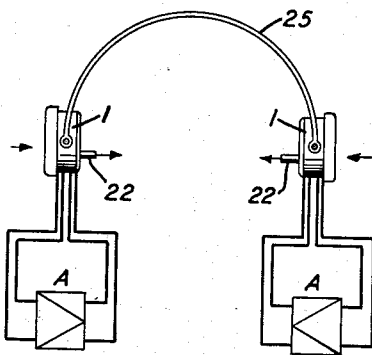


FIG. 2



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AUDIPHONE

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3 Claims. (Cl. 179-107)

This invention relates to audiphones and the object of the invention is to prevent an audiphone from singing when operating at high gain with the pick-up transmitter close to the receiver.

It has been suggested heretofore that for a very compact audiphone the pick-up transmitter should be mounted together with a receiver in a single casing which is held in position against the ear of the user. For binaural systems this arrangement would have the further distinct advantage that the microphones turn with the head of the user and thereby assist him in locating the direction of a sound source in somewhat the same manner as normal ears.

In modern audiphone practice, however, an amplifier of either the microphone or vacuum tube type is ordinarily used between the transmitter and receiver and since the gain used at times may be as much as 50 decibels special precautions must be taken to avoid singing due to acoustic or other coupling between the output and input circuits even when the pick-up transmitter is mounted on the lapel or at some other place relatively remote from the receiver. Due to the tendency of these high gain systems to sing, it has been necessary heretofore to forego the advantages of mounting the pick-up transmitter at the ear and to place it in some more stable operating position, such as on the coat lapel.

According to this invention the acoustic feedback from the receiver to the pick-up transmitter is neutralized by the feedback from a second or dummy receiver having an acoustic terminating network simulating the impedance of the user's ear. In the preferred structure two basically similar receivers are symmetrically disposed with respect to the pick-up transmitter in a common case. One of these receivers is adapted to be connected to the ear by a direct acoustic path in the usual manner and the other receiver having the artificial termination is connected to the amplifier output with opposite polarity as compared with the receiver working into the real ear.

The considerations involved in the design of an artificial ear are well known, as shown for example by the article "A voice and ear for telephone instruments," by Inglis, Gray and Jenkins in the Bell System Technical Journal for April, 1932. Those skilled in the art can, therefore, make the acoustic network simulate the ear impedance to any degree of accuracy required but in most cases it will be sufficient to load the sec-

ond receiver by a simple structure such as an acoustic path of the same cross section as the ear canal terminated by a diaphragm simulating the ear drum.

In the drawing,

Fig. 1 is an audiphone unit according to the invention and Fig. 2 shows a binaural audiphone using units of the type shown in Fig. 1.

In Fig. 1 the casing 1 has a chamber 2 housing a pick-up transmitter and two other chambers 3 and 4 for the receivers 5 and 6, respectively. The vibratory elements 7, 8 and 9 of the transmitter and receivers may be of any known type but the well-known bi-morph crystal elements of Rochelle salt are particularly well suited to the purposes of this invention since they may be very light in weight and, unlike magnetic types, they do not give rise to undesirable coupling effects. The crystal elements 8 and 9 of the receivers are connected to suitable diaphragms 20, 21 in the usual manner and in the case of the receiver 5 the sound waves generated by the diaphragm 20 are transmitted through a suitable ear-piece 22 to the user's ear. In the case of the dummy receiver 6, however, the sound waves are transmitted through the acoustic chamber 23 to the diaphragm 24.

The transmitter crystal unit 7 may, for example, be secured to the casing at its center 10 and to the diaphragm 11 at its ends as shown. Sound waves impinging on the diaphragm through the holes 12 in the casing will stress the crystal unit so as to generate between the crystal electrodes potentials varying with the sounds in the well-known manner and these potentials will be impressed on the input of the amplifier 13 over the conductors 14, 15.

The crystal elements 8 and 9 of the receivers may be connected to the output of the amplifier in series or in parallel by means of conductors 16, 17 and 18, 19 as shown, but in either case care must be taken to pole the receivers in opposite senses with respect to the amplifier output. With the receiver 5 in place against the ear of the user the receivers 5 and 6 will both radiate vibrations, but due to the connections of opposite polarity the sound waves from the two receivers will be of opposite phase and hence will substantially cancel each other in their effects on the crystal unit 7 of the transmitter.

A single unit of the type shown in Fig. 1 may be used as an ordinary audiphone but for best results a duplicate unit should be provided for the other ear so as to take full advantage of the improved binaural effect obtained with transmit-

ters at the ear positions. In such a binaural set the units would ordinarily be mounted on a suitable head-band or other support 25 as shown in Fig. 2. In cases where the gain requirements are met by small amplifiers of the microphone type these amplifiers may also be mounted in the unit housings 1.

It is, of course, desirable to keep the wiring of the two units of a binaural set separated as far as possible on the person to minimize the transfer of energy between the channels since this type of cross-talk impairs the binaural effect. It will also be understood that with any given structure according to the invention it may often be possible to improve the acoustic balance empirically by modifying the acoustic terminating impedance as the case requires, or by shifting the positions of the receivers in their respective chambers.

While the invention has been described with reference to an audiphone with air conduction receivers it is, of course, equally applicable to audiphones using bone conduction receivers. When bone conduction receivers are used a better acoustic balance will be obtained by using dummy receivers of the same type suitably terminated by a simple form of loading which approximates the mastoid impedance in accordance with the general theory as explained, for example, in the article "An artificial mastoid for audiphone measurements," by M. S. Hawley in the Bell Laboratories Record for November, 1939.

What is claimed is:

1. In an audiphone, a sound pick-up transmitter, a first receiver, an amplifier connecting the transmitter to the receiver, a second receiver having an acoustic termination simulating the impedance of a human ear connected to the amplifier in opposite polarity with respect to the first receiver and a casing housing the transmitter and both of the receivers.

2. In an audiphone, an amplifier having input and output circuits, a sound pick-up transmitter connected to the input circuit, two receivers symmetrically disposed with respect to the transmitter and connected in acoustically opposing relationship to the output circuit, and means for loading one of the receivers to simulate the loading on the other receiver when in contact with a human ear.

3. In a binaural audiphone including two sound amplifying channels each comprising a sound pick-up transmitter, a receiver, an amplifier connecting the transmitter to the receiver and a housing for each transmitter and its associated receiver, and means for mounting the housing on the head of a user with the receivers in operative relation with the user's ears, other receiving means for each channel disposed within the housing and connected to the associated amplifier for producing at the transmitter a sound field in phase opposition to the sound field produced by the receiver.

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