Oct. 30, 1928. 1,689,692

H. SELL

AURAL TELEPHONE SYSTEM

Filed April 22, 1925

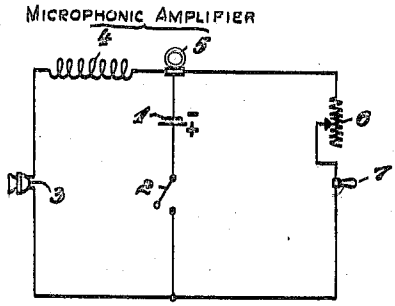


Fig. 1

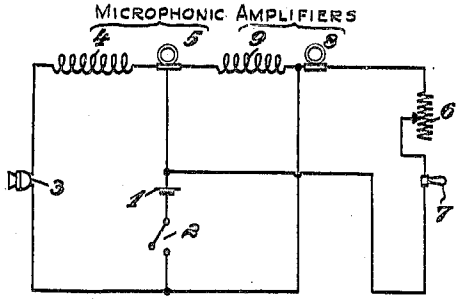


Fig. 2

Fig. 3

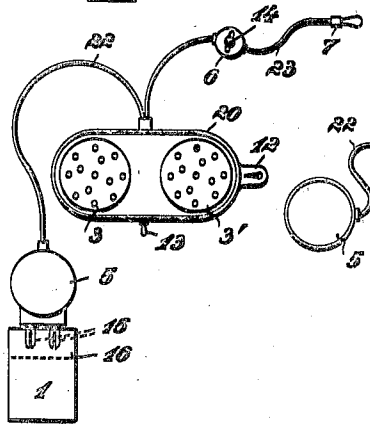


Fig. 4

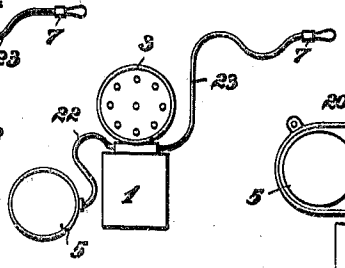


Fig. 5

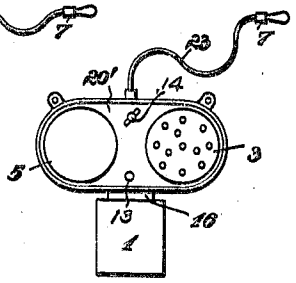


Fig. 7

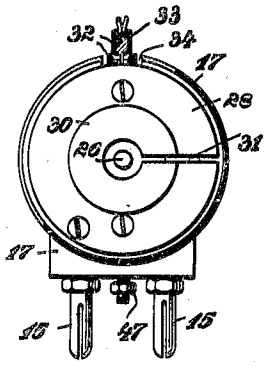


Fig. 6

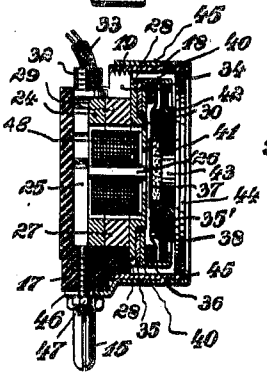
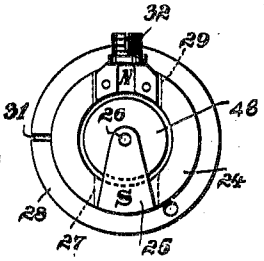


Fig. 8



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UNITED STATES PATENT OFFICE.

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AURAL TELEPHONE SYSTEM.

Application filed April 22, 1925, Serial No. 24,986, and in Germany August 20, 1924.

The present invention relates to improvements in aural telephone systems for the deaf and for persons hard of hearing and the object of the invention is to produce an outfit of light weight, great sound-intensity, low current consumption and of such form and dimensions that the greater part of it may be hidden in the garments of the user.

The usual hearing devices for the deaf and for persons hard of hearing comprise one or more microphones which are fed from a dry battery and in the circuit of which an ear phone is placed. All such devices have the advantage that the fluctuations of current which are created in the microphones when the sound waves are impressed upon the microphone diaphragms only form a very small part of the constant working current which passes through the microphones. In other words the deflections caused by the sounds are minimal and insufficient for the purpose intended the greater part of the current being lost. Partly improved results may be obtained by using a relatively coarse contact material, for instance granulated carbon or carbon balls. By this measure the sound intensity is increased but the clearness of articulation becomes impaired. In order to intensify the sound it is necessary to arrange a great number of contacts so that a good sound is secured as an average value of the several contacts. Without this measure it is impossible to obtain a satisfactory result.

These disadvantages are removed by the present invention. In accordance with the same a microphone of any desired kind may be used for the reception of the sound oscillations, provided that it gives a clear articulation. This is of more importance than its amplifying qualities. The current fluctuations created in this microphone are used to control electromagnetically a second microphone in the circuit of which the ear phone is located. It is advantageous also for the second microphone which is of extremely small dimensions, to use a non-sensitive but good-working contact arrangement and a sufficiently damped diaphragm. The current fluctuations or amplitudes of the second microphone are vastly greater than those of the first one.

The advantages of this amplification manifest themselves in different ways. It becomes for instance possible to work with microphones and ear phones of rather moderate sensitiveness giving the user the same sound intensity but at a very small consumption of current. As is known the life of the battery is by this measure increased to a much higher degree than in proportion to the lower consumption of current. It is also possible at the same or a somewhat increased current consumption to increase the sound intensity immensely. It is for instance easy to reach a physical sound intensity which is a thousand times greater than the original physical sound intensity.

When using two amplifier microphones the first of which is controlled by the pick-up microphone and the second by the first amplifier microphone a type is preferably used for the first amplifier microphone which is very sensitive to the lowest intensities of current, but for the second amplifier microphone a type is chosen which gives a large amount of amplification.

Finally it is possible to decrease the dimensions of the apparatus elements at the same consumption of current. A receiving microphone may be used which is of the size of a coat button and preferably an ear phone is used of the type which is in known manner introduced in to the meatus such as is disclosed for instance in the U. S. Patent No. 1,406,510 to Weber. Notwithstanding the small dimension of these foregoing elements, also the amplifier microphone may be of extremely small dimensions so that all parts of the apparatus except the ear phone may be hidden in the garments.

The invention is shown by way of examples in the accompanying drawings.

Fig. 1 shows a general diagram of connections.

Fig. 2 is a diagram of connections of an apparatus in which two amplifying microphones are used.

The Figs. 3, 4 and 5 show some preferred embodiments of all the apparatus.

Fig. 6 is a vertical section through an amplifier-microphone of the kind which is preferably used in this apparatus, and

Figs. 7 and 8 show a front and a rear view of the inner parts of the amplifier according to Fig. 6.

According to Fig. 1, 1 is a battery (usually of 3 to 4 volts) and 2 is a cut-out switch. 3 is the pick-up microphone which picks up and is actuated by the sound waves and 4 is the exciting winding of the controlled amplifier microphone 5, 6 denotes an adjustable series resistance and 7 the ear telephone.

In the example shown in Fig. 2 the pick-up microphone 3 controls two amplifier microphones 5 and 8. The current from the battery 1 passes over the pick up microphone 3 through the control winding 4 of the amplifier microphone 5, whereas the current which the last named microphone receives from the battery 1 passes through the control windings 9 of the second amplifier microphone 8, over which the battery current of the telephone 7 adjustable by the resistance 6 is conducted. In other words the system represents a plurality of microphonic amplifying devices in cascade connection. An amplification will therefore take place in two successive stages in the microphones 5 and 8.

The amplifier microphone 5 as well as the pick up microphone 3 are of such a type that they are as sensitive as possible and that their contact resistances change in response to the smallest variations of sound waves respectively of the current. On the other hand the amplifier microphone 8 is constructed in such a manner that it will give a large amount of amplification.

The arrangement of the elements of the outfit may be varied in many ways in accordance with the special use for which the apparatus is designed, as shown in the Figs. 4, 5 and 6.

According to Fig. 3 two pick up microphones 3 and 3′ are connected together by a frame 20. Each of them as well as the amplifier microphone 5 have an extremely small diameter, amounting only to about 30 mm. The frame 20 can be fastened to a button in the garments by means of a strap 12. It may advantageously be placed as high as possible (for instance at the height of the shoulders of the bearer) in order to be near the same level as the mouth of the person speaking into it. By means of double strands 22 the pick-up microphones 3, 3′ are connected in parallel to a dry battery 1 of such dimensions that it may be easily put into a pocket of the garments, these microphones being also connected to the amplifier microphone 5 arranged at the top of the battery and by strand 23 to the earphone 7. The earphone is of such a form and of such dimensions that it may be placed into the auditory passage of the ear. The amplifier microphone 5 is provided with plugs 15 which may be inserted into a socket 16 arranged at the top of the battery 1.

In the frame 20 the cut-out switch for the battery 1 is arranged of which only the moving lever 13 is seen in the drawings. The adjustable resistance 6 is arranged in the strand 23 and a small pin 14 is provided for to make the adjustments.

According to the embodiment of the invention shown in Fig. 4 the pick-up microphone 3 is arranged on the top of the battery 1 and, when the latter is put into a pocket of the waist-coat, the microphone will project from the pocket. The same will nevertheless hardly be observed on account of its small dimensions. Generally however the sound effect of the new device is so great that it almost always will be possible to hide also the pick-up microphone in the garments, as the sound effect even through the garments will be sufficient.

In Fig. 5 the pick-up microphone 3 is connected with the amplifier microphone 5 by a frame 20′ placed directly upon the socket 16 of the battery 1. In this modification only one line for the ear telephone 7 is necessary and the rest of the apparatus may be placed in a pocket or in a lady's hand-bag. The cut-out switch and the adjustable resistance, the adjusting buttons or levers 13, 14 of which alone are visible in that figure, are arranged at a suitable place inside of the frame 21.

Other combinations of the apparatus elements are of course possible.

Figs. 6–8 show an embodiment of an amplifier microphone of a kind which on account of the small dimensions of its different elements and its other good properties is very well suited for use in the above described devices.

This apparatus consists of a casing 17 of hard rubber and a metallic cover 18 connected to it by a thread 19 in which a magnet system and a microphone controlled by that system are located. This magnet system may have a soft iron core or a permanent magnet core. The system shown is of the latter type. It consists of a ring of steel 24 magnetized in diametral direction as indicated by the letters N and S in Fig. 8. To the south-pole S is rigidly connected a sector-shaped piece 25 of iron at the end of which an iron pin 26 is arranged coaxially with the ring 24. To the lower part S of the ring magnet 24 a disc 28 of soft iron is fixed by a piece 27 of non-magnetic material which disc is fixed to the upper part N of the ring by an iron piece 29. The disc 28 is provided with a projecting part 30 and with a radial slot 31 which prevents the occurrence of short-circuit currents. In the plane of the projecting part 30 this part forms a north-pole and the end of the pin 26 a south pole. On the pin 26 is arranged the winding 48 controlling the microphone. The

magnet system is inserted into the casing 17 and a sleeve 32, adapted to lead the communication strands 33 out of the casing, is guided in a slot 34 of the casing 17.

On the rim of the disc 28 a distance ring 35 of non-magnetic metal is laid and upon this ring the microphone is arranged. The microphone comprises a diaphragm 35′ which is of a high grade elastical material preferably phosphor-bronze and of a thickness amounting only to a few hundred parts of a millimeter or less. The edge of this foil is soldered to a supporting ring 36 the edge of which rests on the distance ring 35. To the central part of this foil a disc shaped iron armature 37 is soldered, which has a thickness of only some tenth part of a millimetre and a diameter of about 10 millimetres so that it just will cover the air gap between the poles 26 and 30 of the magnet system. The foil or diaphragm 35′ is kept permanently tensioned or stretched by means of a body 38 forming the microphone cell supplied with a ring-shaped edge 39 pressed against the foil 35′ by means of a ring 40 clamping together the support ring 36 and the edge of the microphone cell 38. In the microphone cell a filling 41 preferably of granulated carbon is used as resistance material and the peripheral parts of the diaphragm are preferably damped by means of a felt ring 42, so that only the central part of the diaphragm, which gives the strongest oscillations, comes into action.

In the bottom of the microphone cell 38 an opening is formed into which a cylindrical projection 43 of a metal plate 44 projects in such manner that with its front side it presses against the carbon filling 41. This plate and also the entire microphone cell are held in place by the cover 18 of the casing 17.

The electrical connection of the projection 43 is formed by a metal cap 45 put over the cover 18 at the edge of which a bifurcated tongue 46 is arranged. This tongue is pushed over a screw 47 on the casing 17. The strands of the cable 33 are connected to the plug pins 15, the screw 47 and diaphragm 35′ respectively.

If according to Fig. 2 two amplifier microphones are made use of the ring of felt 42 in the first microphone is broad so that the cell has a diameter of only a few millimetres, and the carbon filling 41 is very finely granulated. The second microphone 9, 8 contains a narrower felt ring so that the cell is proportionally large and the contact pressure is caused by the weight of the carbon filling.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an aural telephone system of the character described a sound pick-up microphone, at least one microphonic amplifier device electrically connected in cascade with said pick-up microphone, an ear phone, suitable conductors for connecting said ear phone with said microphones and a battery connected in parallel with said microphones and with said ear phone.

2. In an aural telephone system of the character described a sound pick-up microphone, at least one microphonic amplifier device electrically connected in cascade with said pick-up microphone, an ear phone, suitable conductors for connecting said ear phone with said microphones and a battery connected in parallel with said mircrophones and with said ear phone, an adjustable resistance in circuit with said ear phone and a common cut-out switch between said battery and said microphones and ear phone.

3. In an aural telephone system of the character described a sound pick-up microphone, at least one microphonic amplifier device electrically connected in cascade with said pick-up microphone, an ear phone, suitable conductors for connecting said ear phone with said microphones, all of said microphones being mounted on a common base, a battery and a plug and socket connection between said base and said battery to make a rigid but separable unit of said two elements, said plug connecting the battery in parallel to said microphones and said ear phone, an adjustable resistance in circuit with said ear phone and a common cut-out switch between said battery and said microphones and ear phone.

4. In an aural telephone system of the character described a sound pick-up microphone, a microphonic amplifier device of small amplifying power electrically connected in cascade with said pick-up microphone, a microphonic amplifier device of large amplifying power electrically connected in cascade with said first amplifier device, an ear phone electrically connected with said second amplifier device and a battery connected in parallel with said pick-up microphone, said amplifiers and said ear phone.

5. In an aural telephone system of the character described a sound pick-up microphone, a microphonic amplifier device of small amplifying power electrically connected in cascade with said pick-up microphone, a microphonic amplifier device of large amplifying power electrically connected in cascade with said first amplifier device, an ear phone electrically connected with said second amplifier device and a battery connected in parallel with said pick-up microphone, said amplifiers and said ear phone, an adjustable resistance in circuit with said ear phone and a common cutout switch between said battery and all of the aforesaid devices connected to it.

6. In an aural telephone system of the character described a sound pick-up microphone, a microphonic amplifier device having a relatively small microphone cell containing finely granulated carbon, said amplifier device being electrically connected in cascade with

said pick-up microphone, a second microphonic amplifier device having a relatively large microphone cell containing coarsely granulated carbon whose contact pressure is effected through its weight, said second device being electrically connected in cascade with said first amplifier device to effect first small amplification but great sensitiveness and then great amplication through said cascade connections, an ear phone electrically connected with said second amplifier device and a battery connected in parallel with said pick-up microphone, said amplifier devices and said ear phones.

In testimony whereof I affix my signature.

HELMUT SELL.