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MICROPHONE

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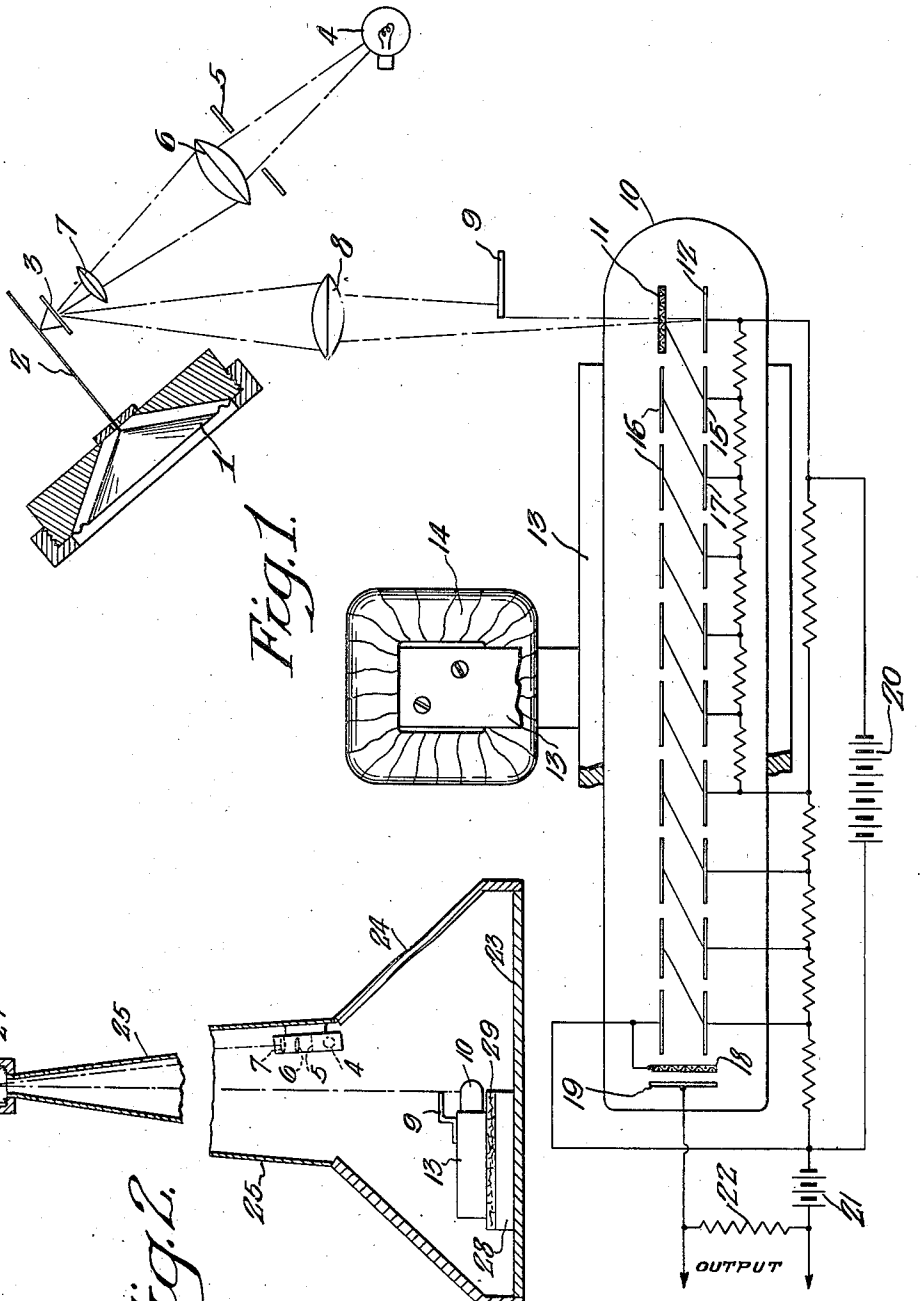


Fig. 1.

Fig. 2.

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MICROPHONE

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2 Claims. (Cl. 179—121)

This invention relates to microphones and more particularly to the type of microphones wherein an acoustically actuated element controls an optical element which, in turn, varies the light falling upon a photoelectric surface.

Microphones, in general, in the prior art have been divided into four types: the carbon microphone, the condenser microphone, the inductor microphone, and the photoelectric microphone; and each of these types has been subject to its own peculiar disadvantages. The carbon microphone, in which the resistance of carbon particles or buttons is varied in accordance with the vibration of the diaphragm, handles fairly large currents and provides a rather high current output, but it is entirely unsatisfactory for transmission of sound where high amplification or high fidelity is required, as, for example, in sound recording or in radio broadcasting, due to the large amount of hiss which it produces. The other three types of microphones are considerably better than the carbon microphone in this respect.

In the condenser microphone, a thin acoustically responsive diaphragm is separated by a very slight distance from a fixed diaphragm and the capacity between these two elements is varied in accordance with the sound waves; in the inductor microphone, a coil or ribbon is moved in a magnetic field in accordance with the sound waves; and in the photoelectric microphone a beam of light is deflected or varied in intensity acoustically and picked up on a photocell.

Each of these types has a very low level of output which requires a high degree of amplification in order to render the output useful. The high degree of amplification necessary with these low level devices is disadvantageous in that many extraneous noises are likely to appear.

In the first place, any conductors or transformers between the microphone and the amplifier must be very carefully shielded in order to prevent electrostatic or electromagnetic pickup of extraneous impulses because any such impulses picked up at this point are amplified in the same ratio as the desired impulses from the microphone. Further, due to the high amplification ratio necessary, additional noises are produced in the amplifier, such as those due to the shot effect in the electron tubes and those due to thermo-agitation in the microphone coil, as well as to the noises from obscure sources, the nature of which has not yet been determined.

In order to avoid the above disadvantages, I have devised a novel microphone which has high sensitivity and accurate frequency response, but which provides a relatively high output level and which, therefore, avoids the difficulties in amplification above referred to. In accordance with my invention, I provide an appropriate acoustically responsive member such as a diaphragm which is connected to an optical member such as a vibratable mirror, which serves to modulate a beam of light. This beam of modulated light is directed to the photosensitive electrode of a type of multi-electrode tube known as an "electron multiplier", which serves to provide a very high electrical output level at its output terminals without introducing the aforesaid extraneous noises, and thereby produces a much improved result.

One object of my invention is to provide a microphone having a high output level.

Another object of my invention is to provide a microphone which does not introduce hiss or other undesired noises.

Another object of my invention is to provide a microphone which has a high degree of fidelity over the audio range.

Another object of my invention is to provide a microphone which is relatively simple to construct.

Other and incidental objects of my invention will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawing in which

Figure 1 is a diagrammatic illustration, partly in section, of my improved microphone; and

Figure 2 is a vertical section through a microphone and stand made in accordance with my invention.

As shown in the drawing, the microphone includes an appropriate acoustically responsive element 1 which may be a diaphragm, as shown. Connected to this diaphragm is an appropriate driving connection 2 which serves to transmit impulses from the diaphragm to a mirror 3, which is pivoted so as to vibrate in accordance with the movements of the driving rod. An exciter lamp 4 is provided, from which light is directed upon an aperture 5, which is preferably rectangular in shape and from which the light is directed by the lenses 6 and 7 upon the galvanometer mirror 3. These lenses 6 and 7 are chosen of such focal length as to focus an image of the filament of the lamp 4 upon the mirror 3. From the mirror 3 the light passes through the lens 8 to the stop 9. The lens 8 is chosen of such focal length that, in conjunction with the lenses 6 and 7, it will focus an image of the aperture in the aperture plate 5 upon the stop 9. The portion of the light beam which passes the stop 9 is directed into the electron multiplier tube 10, which will be hereinafter described in greater detail. It will be apparent that when the mirror 3 is vibrated about its axis, the beam of light striking the stop 9 will be moved transversely of the stop in accordance with the sound waves and more or less of the beam will be permitted to pass the stop 9 and reach the tube 10.

The tube 10 is of the type described and claimed in Slepian Patent No. 1,450,265, and more specifically is of the type described and claimed in the Patent to Zworykin and Massa, No. 2,078,034, issued April 27, 1937, on application Serial No. 48,982, filed October 30, 1935 entitled "Electric discharge devices".

In this device light passes through the electrode 11, which is preferably formed of wire gauze or the like in order that it may not materially obstruct the light, and strikes the electrode 12. The electrode 12 is coated with a photosensitive material, such, for example, as caesium, which causes the emission of electrons in proportion to the amount of light incident thereon. The electrode 12 is a cathode, while the electrode 11 is an anode relative to the electrode 12, and the electrons emitted from the electrode 12 are therefore emitted in the direction of the electrode 11. However, the tube 10 is placed within a magnetic field defined by an appropriate pair of pole pieces 13 which are energized by a magnet winding 14, the nearer pole pieces 13 being shown partly broken away. The magnetic field between these pole pieces causes the electrons leaving the electrode 12 to travel in a curved path and to strike the electrode 15 which is connected to the electrode 11, which therefore serves as an anode in relation to the cathode 12. This electrode 15 is coated with an appropriate material, such, for example, as with caesium oxide, as is the electrode 12, and when the electrons impinge thereon they cause the secondary emission of electrons in much greater number, and these secondarily emitted electrons leave the electrode 15 and travel toward the electrode 16, which is an anode in relation to the electrode 15, just as the electrode 11 was in relation to the electrode 12. Here again under the influence of the magnetic field, the electrons leaving the electrode 15 travel in a curved path and strike the electrode 17, which is electrically connected within to the electrode 16 where the process is again repeated. The same process is repeated in each pair of electrodes travelling from right to left in the tube, as shown, until it reaches the tenth pair of electrodes, when the electrons deflected from the tenth anode-cathode travel in a curved path through the screen 18 to the plate 19, where the output of the device is taken off.

An appropriate external source of E. M. F. 20 is provided and the potential from this source is appropriately distributed between the electrodes of the electron multiplier by the voltage dividers shown. The additional source 21 is provided between the plate 19 and the last anode-cathode, as this last stage requires much higher voltage than the others. The output of the device is taken off across the resistor 22, whence it may be fed to any suitable utilization apparatus.

In the apparatus as described, the output is secured across the resistor 22 without the noises incident to the use of the ordinary thermionic amplifier and at a level which is very much higher than that produced by any former type of microphone.

A suitable constructional form of the invention shown in Fig. 2, wherein the reference numerals are the same as in Fig. 1, insofar as they apply to the same elements. This figure shows a form of the microphone adapted for use as a floor stand or pedestal. An appropriate base member 23, which is preferably relatively heavy, is provided. Upon this is supported an appropriate container 28, which houses the external resistors and magnet coil of the electron multiplier and from which there project the magnet pole pieces 13.

The electron multiplier tube itself 10 rests upon a shock absorbing layer 29 which may be of felt, for example, in order to prevent vibrations of the floor from affecting the tube. The stop 9 is supported either from the box 28 or from one of the pole pieces 13 in appropriate relation to the photosensitive electrode of the electron multiplier.

This entire portion of the apparatus is enclosed within a relatively heavy metallic casing 24, which serves to shield this portion of the apparatus electrostatically, magnetically and mechanically, and also assists in providing a stable support for the diaphragm portion of the apparatus. A thinner tubular member 25 extends upwardly from the member 24 and supports at its upper end the casing 26 which carries the diaphragm 1.

Supported near the bottom of the portion 25 is the optical system including the lamp 4, the diaphragm 5, and the lenses 6 and 7, which are so arranged that an image of the filament of the lamp 4 is projected on the mirror 3 while an image of the aperture 5 is focused at the stop 9. The casing 26 may be lined with felt or the like, as indicated at 27, in order to prevent internal reverberation in the device, an adequate quantity of felt being provided to absorb the waves from the back of the diaphragm and prevent resonance within the lower portion of the apparatus.

Since the normal height of the diaphragm 1 from the floor would be approximately four and one-half feet, it will be apparent that this arrangement provides an optical lever having each of its arms approximately four feet long, and which therefore has a very high sensitivity. Due to this high sensitivity, this construction makes it possible to use an extremely stiff diaphragm at 1, and to use such damping as I may desire on the movable optical system 2, 3, as well as such acoustic damping in the interior of the microphone casing 26 as may be desirable to prevent reverberation, and very satisfactory frequency response can be accordingly secured.

Having now described my invention, I claim:

1. A microphone comprising a hollow pedestal, an acoustically responsive member mounted at the top of said pedestal, light modulating means connected thereto, a light source mounted at the bottom of said pedestal, means for directing light from said source through said light modulating means, and light sensitive means mounted at the bottom of said pedestal and in cooperative relation with said light modulating means.

2. A microphone comprising a hollow pedestal, an acoustically responsive member mounted at the top of said pedestal, light modulating means connected thereto, a light source mounted at the bottom of said pedestal, means for directing light from said source through said light modulating means, and light sensitive means mounted at the bottom of said pedestal and in cooperative relation with said light modulating means, said light sensitive means including a photoelectrically sensitive electrode and a series of secondary emission electrodes in cascade relation within a single envelope.

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