July 27, 1926. 1,593,636

B. F. MIESSNER

ELECTRONIC TELEPHONE

Filed Dec. 18, 1924

Fig. 1,

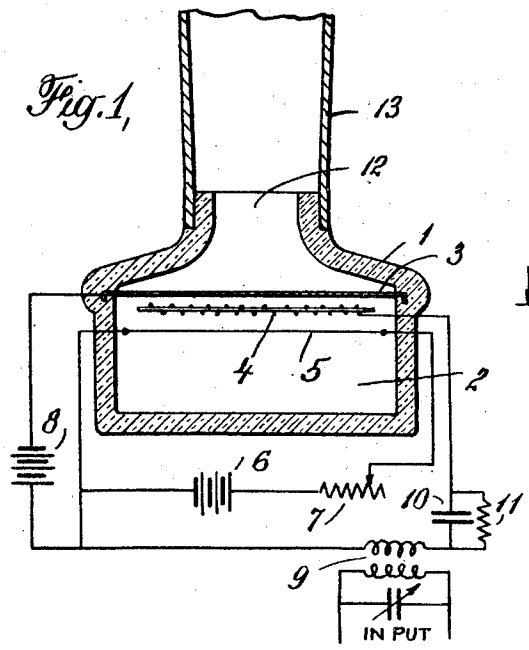


Fig. 2,

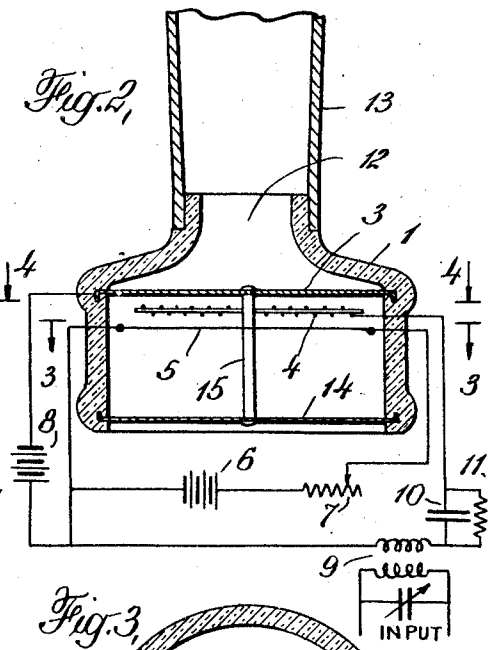


Fig. 3,

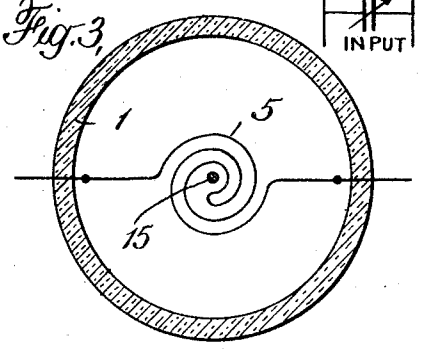


Fig. 5,

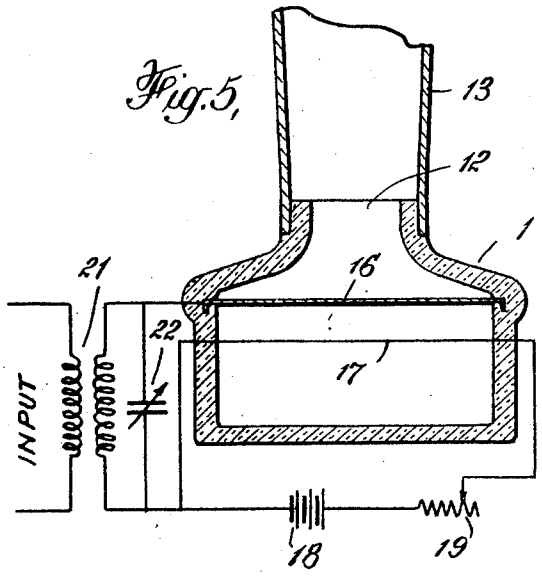
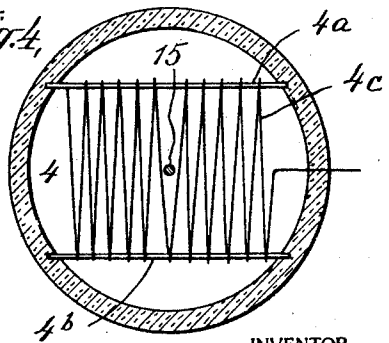


Fig. 4,



INVENTOR

Benjamin F. Miessner

BY Marvin & Edmond

his ATTORNEYS

Pennie Davis

Patented July 27, 1926. 1,593,636

UNITED STATES PATENT OFFICE.

BENJAMIN F. MIESSNER, OF SOUTH ORANGE, NEW JERSEY.

ELECTRONIC TELEPHONE.

Application filed December 18, 1924. Serial No. 756,657.

This invention relates to telephone receivers, especially, loud speaking telephones and has to do with a telephone receiver wherein the reproducing diaphragm is actuated by electronic bombardment instead of by magnetic forces as is the case in telephone receivers heretofore employed.

It is a matter of common knowledge that telephone receivers of the usual kind employing electromagnets are incapable of even approximately uniform reproduction of sound waves of widely different frequencies—that is assuming equal energy at all frequencies. This is due, in part to the inertia or impedance of the magnet windings and, in part, to the natural tendency of the diaphragm to operate most vigorously at a definite natural period and less vigorously at all frequencies other than the natural frequencies. These seemingly unavoidable characteristics of magnet coils and diaphragms have necessitated certain compromises in order to avoid, as far as possible, the results thereof.

It is further known that the operation of thermionic vacuum tubes is substantially, if not wholly, without inertia. In other words the resistance or impedance of the space between the plate and cathode of such a device does not vary to any practical extent with changing frequencies or at least the variation in this character of device is so slight as to be negligible.

The present invention arises from the discovery that electronic discharge in a thermionic vacuum tube can be caused to mechanically actuate the plate element in accordance with variations of discharge intensity. This phenomenon, which is believed to be due to electronic bombardment of the plate element by electrons discharged from the hot cathode is not ordinarily noticeable in the usual three-electrode vacuum tubes—although it has been observed in them—due largely to the fact that the plate element is not well adapted in its design to be vibrated sufficiently to produce sound waves detectable by the ear. Furthermore, the glass bulb and surrounding vacuum both tend strongly to impede transmission of the weak sound waves produced by the plate.

In a telephone receiver of the type hereinafter described the plate element is exposed to the air on one side and is designed with a view to maximum response. In this way sound waves are communicated directly to the air without any intervening vacuous space—which, if perfect would not transmit sound waves to any extent.

In the devices according to this invention one of the inherent difficulties characteristic of ordinary telephone receivers, namely, that arising from the varying impedance of the magnet coils, has been eliminated. This is due to the fact previously stated that the variation in impedance of the discharge space with changing frequencies is substantially negligible for all practical purposes. The elimination of this one source of difficulty leaves only that of the natural period of the diaphragm which can be very largely offset by careful design and particularly by the utilization of a diaphragm having a natural period higher than the voice range or musical scale. It becomes evident then that quality of reproduction may be materially improved by this invention.

In the drawings,

Fig. 1 is a cross-sectional view of a loud speaking telephone instrument in accordance with this invention, together with the circuit connections therefor,

Fig. 2 is a cross-sectional view of a loud speaking telephone instrument and represents a modification of the embodiment illustrated in Fig. 1,

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 2 and shows the filament or cathode,

Fig. 4 is a cross-sectional view taken along the line 4—4 of Fig. 2 and shows the grid element, and

Fig. 5 is a cross-sectional view illustrating an alternative embodiment of the invention in which only two electrode elements are employed.

The device of Fig. 1 comprises a glass receptacle 1, having an evacuated chamber 2, which is enclosed by the metal diaphragm 3, the peripheral portion of which is embedded in the glass receptacle. The diaphragm 3 functions as the plate or anode of a three-electrode thermionic device. The other two electrodes comprise a grid 4 which is indicated by dotted lines and is shown in plan view in Fig. 4, and a filamentary cathode 5 is shown in plan view in Fig. 3. The terminals of the filament, grid and plate are brought through the walls of the glass receptacle and are connected in circuit as

shown. The battery 6 serves as the filament heating battery while the rheostat 7 functions to control the filament current, in the usual manner. The plate battery 8 is shown connected in circuit with its positive terminal connected to the plate or diaphragm 3 and its negative terminal connected to the filament. The device is shown connected to the output side of a radio frequency amplifier, through a radio frequency transformer 9, the secondary winding of which has its terminals connected to the grid and filament of the device respectively.

In operation the filament 5 is heated to incandescence whereupon an electron stream flows through the evacuated space between the filament and diaphragm 3. This electron stream is supplied by the plate battery 8. The electrons discharged from the filament, although of infinitesimal dimensions are nevertheless possessed of mass and they move at a very great speed. These electrons therefore bombard the diaphragm 3 and actually impart motion to it. In ordinary vacuum tubes this bombardment of the plate is more generally manifested in the generation of heat, rather than in any perceptible physical motion. In the devices of this invention the energy applied to the plate or diaphragm in the form of electronic bombardment is converted into motion, rather than heat. Of course, part of this energy is converted into heat. It cannot very well be avoided, but nevertheless a large part of it is converted into motion.

A grid condenser 10 and grid leak resistance 11 may be inserted in the grid conductor. These function to cause the grid potential to vary at audio frequency as in the case of the usual vacuum tube detector. With each variation of potential on the grid 4 the electronic bombardment of the diaphragm is correspondingly increased or decreased, depending upon whether the grid is rendered more positive or more negative. It is evident that the device functions as both a detector and amplifier, as well as a loud-speaking instrument and it is further evident that it can be made to operate regeneratively thereby increasing its amplification by providing for a feedback action between the output and input circuits. This may be accomplished by tuning the output and input circuits of the device or by any of the known methods for producing regenerative effects.

The receptacle 1 is provided with a sound wave discharge orifice 12 and a horn 13 is ordinarily employed.

In constructing a device of the kind here dealt with it is necessary to take into consideration the effects of atmospheric pressure. This is a factor of very considerable importance, when it is desired to use an extremely thin diaphragm and particularly a thin diaphragm of relatively large diameter. In cases where it is desired to use diaphragms of thin, fragile material such as glass, the atmospheric pressure becomes a most important factor. The structure of Fig. 2 is calculated to meet this problem.

The device of Fig. 2 operates in the same manner as that of Fig. 1 and contains the same elements. But in addition thereto this device has a supplementary diaphragm 14, which is secured to the main diaphragm 3, through the medium of a separator 15 which is attached to the centers of both diaphragms. The atmospheric pressure applied to the outside surfaces of the diaphragms 3 and 14 are opposed. This provides support for the center of diaphragm 3, while at the same time, not interfering materially with its actuation, since the diaphragm 14 is likewise free to vibrate.

A convenient form of filament for devices of this character is illustrated in Fig. 3. Of course, the filament may be of any convenient form and may be of any material which is suitable for use in vacuum tubes.

The grid 4 shown in Fig. 4 represents one of many different forms which the grid element may take. The grid shown is one of the well known types of grid structure comprising two parallel members 4_a and 4_b about which is wound a fine wire 4_c forming the grid mesh.

Bearing the same relation to the devices of Figs. 1 and 2 as the two element vacuum tube or Fleming valve bears to the three-electrode vacuum tube, is a two-electrode device illustrated in Fig. 5. In this device the grid element is omitted. Here there is a diaphragm 16 which functions as a plate element and a filamentary cathode 17. The cathode is heated by the battery 18 and controlled by the rheostat 19. As in the previously described devices, there is an evacuated glass receptacle 20, through the walls of which the leads from the diaphragm and filament are passed. It will be noted that the connections for this device are analogous to the connection ordinarily used with a two element valve. The diaphragm and filament terminals are connected respectively to the terminals of the secondary winding of a radio frequency transformer 21, the primary winding of which is in the output circuit of a radio frequency amplifier. A variable condenser 22 is preferably employed for tuning the secondary circuit. This device depends for its operation upon signal potential variation between the diaphragm 16 and filament 17. Each increase of potential between these elements increases the electronic bombardment. As might be expected, the device of Fig. 5 is not as sensitive as those shown in Figs. 1 and 2.

It is evident that the present invention

may be embodied in many forms and modifications, other than those herein disclosed in detail.

I claim:

1. The method of producing sound waves which consists in bombarding a vibratory body with an electron stream, and in varying the intensity of said stream, in accordance with the sound waves to be produced.

2. The method of producing sound waves, which comprises bombarding a vibratory diaphragm with an electron stream, and variably interfering with the electron stream in accordance with the sound waves to be produced.

3. A sound producing device comprising a diaphragm adapted to function as an anode, an electron emitting element disposed in operative relation to said diaphragm, a medium between said diaphragm and said electron emitting element, said medium being capable of conducting an electron stream, circuit connections and a source of current for providing an electron stream between said element and said diaphragm and means whereby the intensity of said electron stream may be varied in accordance with sound waves to be produced.

4. A sound producing device comprising a diaphragm which is adapted to function as an anode, an electron emitting element disposed in operative relation with said diaphragm, and a control electrode disposed in operative relation to said diaphragm and said element, circuit connections for said diaphragm, element and control electrode and a source of current included in said circuit connections capable of producing an electron stream between said diaphragm and said element and means whereby the potential of said control electrode may be varied in accordance with sound waves to be produced, said electron stream being operable to vibrate said diaphragm, the potential variations of said control electrode being effective to vary the electron stream in accordance therewith.

5. A sound producing device comprising a diaphragm, an electron emitting element disposed in operative relation to said diaphragm, a control electrode interposed between said diaphragm and said element, means for heating said element, a circuit including a source of current interconnecting said diaphragm and said element and means for varying the potential of said control electrode in accordance with sound waves to be produced by the diaphragm.

6. A sound producing device comprising an evacuated receptacle, a diaphragm in said receptacle, one side of said diaphragm being exposed to the air, a cathode and a control electrode enclosed within the evacuated space in said receptacle, said cathode being disposed in such relation to said diaphragm that an electron stream discharged from said cathode is impressed upon said diaphragm, said control electrode being operative in response to potential variations thereon to effect corresponding variations of the electron stream, circuit connections and a source of current for heating said cathode, a circuit interconnecting said diaphragm and said cathode, said last mentioned circuit including a source of current for supplying the electron stream and means for impressing potential variations corresponding with sound waves between said control electrode and said cathode.

7. A sound producing device comprising a pair of substantially parallel spaced diaphragms, a receptacle combined with said diaphragms to form a chamber, said chamber being evacuated, an electron emitting element disposed within said chamber in operative relation to one of said diaphragms, a control electrode interposed between said last-mentioned diaphragm and said element, means for heating said element, a circuit including a source of current interconnecting said last-mentioned diaphragm and said element, means for varying the potential of said control electrode in accordance with sound waves to be produced by the diaphragm and a separator interconnecting the midportions of said diaphragms.

In testimony whereof I affix my signature.

BENJAMIN F. MIESSNER.