Dec. 15, 1931. J. C. BENJAMIN 1,836,569

ELECTRIC TRANSLATING DEVICE

Filed Dec. 21, 1927

FIG. 1.

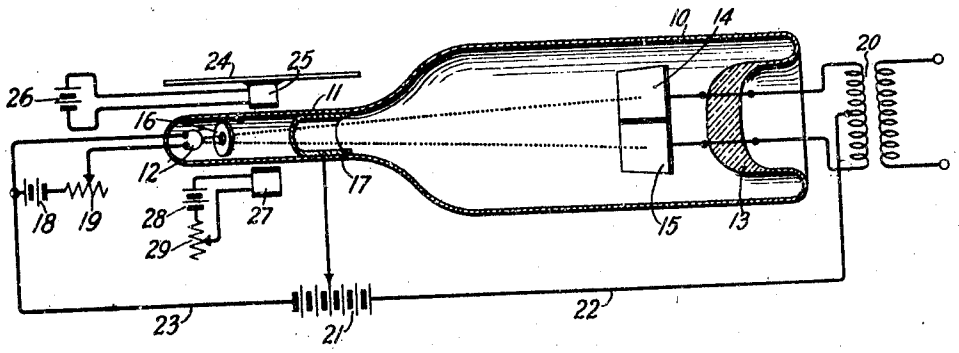
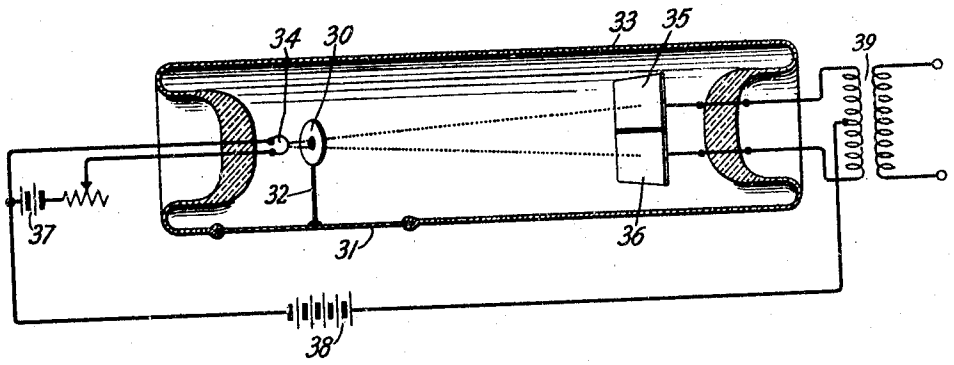


FIG. 2.



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ELECTRIC TRANSLATING DEVICE

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This invention relates to electric translating devices and more particularly to devices of the electric discharge type for changing mechanical vibrations into varying electric current.

An object of the invention is to produce varying electric current by a directional change in an electronic stream without appreciable change in the space current thereof.

A particular arrangement, illustrative of the invention, comprises an evacuated vessel in which an electronic stream emitted from a hot cathode impinges equally upon a pair of plate electrodes which are located in a plane perpendicular to the axis of the stream. Each electrode of the pair of plate electrodes is connected respectively to a terminal of the primary winding of a transformer, the mid-point of which is connected through a source of potential to the cathode. By suitable means for shifting the direction of the stream in accordance with sound waves impinging upon a diaphragm the portion of the stream impinging upon each plate electrode is varied, thereby producing a varying current in the secondary winding of the transformer corresponding to the exciting sound waves.

The invention will now be described more in detail having reference to the accompanying drawings.

Fig. 1 is a diagrammatic view of the discharge type of translating device made in accordance with this invention showing the arrangement of the elements in the device and the speech actuated diaphragm for controlling the direction of the electronic stream.

Fig. 2 is a modified form of the invention in which the electronic stream is mechanically controlled in accordance with speech vibrations.

Referring to Fig. 1, the electric translating device comprises a cylindrical glass enclosing vessel 10 having an elongated narrow portion 11 coaxial therewith. A filament or cathode 12 is sealed in the closed end of the elongated portion 11 and an inwardly projecting stem 13 is sealed into the other end of the vessel and is provided to support a pair of plate electrodes or collector elements 14 and 15 in a plane perpendicular to the axis of the vessel. These plates are arranged with their inner edges close together but insulated from each other so that there is no electrical connection between them and are supported in the vessel at a considerable distance from the cathode 12. An apertured disc 16, preferably of metal, is arranged close to the cathode 12 to focus the beam of cathode rays or electronic stream emitted from the cathode so that the rays normally impinge on equal portions of the plate electrodes 14 and 15. A cylindrical auxiliary plate electrode 17 is positioned in the elongated portion of the vessel intermediate the focusing disc 16 and the plate electrodes 14 and 15. The enclosing vessel may be highly evacuated, in a well-known manner, in order that a pure electron discharge may pass between the main electrodes, or the vessel may be filled with an easily ionized gas, such as argon, to facilitate the passage of the gaseous discharge between the main electrodes. The cathode is connected to a battery 18 and an adjustable resistance 19, to heat the cathode whereby electrons are emitted. The plate electrode 14 is connected to one side of the primary winding of transformer 20 while the other plate electrode 15 is connected to the other side of the primary winding of transformer 20. A positive potential is applied to the plate electrodes by connecting the positive side of battery 21 to the mid-point of the primary winding of transformer 20 over conductor 22, and the negative side of battery 21 is connected to the cathode 12 over conductor 23. A positive potential is also applied to the auxiliary plate electrode 17 from battery 21, to draw the electrons from the cathode through the perforated disc 16. Since the main plate electrodes are at a higher positive potential than the auxiliary electrode 17, the electronic stream will be drawn toward these plate electrodes. The electronic stream is normally directed to equal portions of the plate electrodes 14 and 15 and causes current to flow equally in both halves of the primary winding of transformer 20 which results in no potential being generated in the secondary winding.

The device may be employed in the translation of mechanical energy into electrical energy by controlling the direction of the electronic stream to various portions of the main plate electrodes. As shown in Fig. 1, a diaphragm 24 associated with an electro-magnetic winding or coil 25, connected to a battery 26, is arranged on one side of the elongated portion 11 of the vessel. The winding 25 is preferably located intermediate the apertured focusing disc 16 and the auxiliary plate electrode 17 and in a plane perpendicular to the center of the plate electrode 14. A balancing coil or winding 27 energized by battery 28 and adjusted by a variable resistance 29 is positioned on the other side of the elongated portion 11 of the vessel diametrically opposite the winding 25 and the diaphragm 24. The controlling winding 25 and the balancing winding 27 produce a magnetic field which maintains the electronic stream emitted from the cathode in its path along the axis of the vessel whereby the electrons impinge on equal portions of the plate electrodes 14 and 15 and produce a constant flow of current in equal branches of the primary winding of transformer 20. When speech or other sound waves impinge on the diaphragm 24 the magnetic field controlling the electronic stream is altered due to the change in position of the winding 25 and causes the electronic stream within the vessel to be deflected in its path from one plate electrode to the other. This deflection of the stream in the vicinity of the apertured disc 16 causes a large displacement of the stream at the surfaces of the plate electrodes 14 and 15. Consequently, a larger portion of the beam is shifted to either surface of the plate electrodes, thereby varying the current flow in the primary winding of transformer 20 and producing correspondingly potential variations at the output terminals of the secondary winding. For instance, if the electronic stream is deflected toward the collector element or plate electrode 15, the current flowing in the upper half of the primary winding of transformer 20 connected to the plate electrode 14 will be decreased, due to the small portion of the beam impinging on this electrode. The current in the lower half of the transformer 20 will be increased by a corresponding amount, due to the greater portion of the beam impinging on the plate electrode 15. The variations in current in the primary winding cause corresponding potentials to be generated in the secondary winding. The potential variations in the output circuit of the device bear a direct relation to the mechanical variations impressed on the external diaphragm adjacent the cathode, and may be amplified or reproduced by connecting an amplifier, receiver, recorder or measuring instrument (not shown) to the output terminals of the secondary winding of transformer 20. It will be seen from the above description that the changes in output potential are not accomplished by changes in space current between the electrodes since the space current remains substantially constant, but the amount of electrons impinging on the areas of the plate electrode is controlled to produce the changes in output potential. Furthermore, the small deflection of the electronic stream adjacent the cathode causes a large displacement of the stream at the surfaces of the plate electrodes thus producing a more sensitive device for transforming mechanical vibrations into electrical vibrations.

In the modified form of the invention shown in Fig. 2 the electronic stream is mechanically deflected by directly coupling the apertured focusing disc 30 to a diaphragm 31 by a rigid connecting member 32. The diaphragm is sealed into the wall of the vessel 33 which contains the cathode 34 at one end and the collector elements or plate electrodes 35 and 36 at the other end of the vessel. The cathode, focusing disc and plate electrodes are arranged in the vessel in a manner similar to that described in connection with Fig. 1. The cathode is heated by a battery 37 while a positive potential is applied to the plate electrodes 35 and 36 by a battery 38 connected to the cathode and the mid-point of the primary winding of transformer 39. The ends of the primary winding are connected to the plate electrodes 35 and 36 respectively, the same as described in Fig. 1. In this arrangement the vibration of the diaphragm 31, due to the speech or other sound waves impinging thereon, causes the focusing disc 30 to be vibrated accordingly. Since only the portion of the electronic stream which passes through the perforated disc 30 is directed to the plate electrodes 35 and 36 which in normal position allows the stream to impinge equally upon both electrodes, it follows that if the disc is vibrated by the diaphragm a portion of the beam is cut off from one plate electrode. The other plate electrode will therefore receive a greater portion of the cathode beam and thereby change the flow of current in the primary winding of transformer 39. The current variations in the transformer 39 will be similar to the current variations in transformer 20 described in connection with Fig. 1 and the mechanical energy imparted to the diaphragm 31 by speech waves will cause corresponding electrical variations in the output circuit of the device.

While the specific structures above described represent several embodiments of the invention, it is understood that various changes may be made without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A translating device comprising an en-

closing vessel, a cathode at one end of said vessel, a pair of collector elements at the other end of said vessel, said elements being in a plane at right angles to the axis of said cathode, means to focus an electronic stream from said cathode toward said collector elements, and sound responsive means including a diaphragm for controlling said stream to shift said stream to variable portions of said collector elements.

2. A translating device for converting mechanical vibrations into electrical impulses comprising an evacuated enclosing vessel having a cathode positioned in one end thereof, a pair of planary plate elements positioned at the other end of said vessel, the adjacent edges of said elements being on either side of the axis of said cathode, an apertured disc located between said cathode and plate elements, said disc being relatively close to said cathode and parallel with said plate elements, and sound responsive means adjacent said cathode and disc for modulating the electron stream between said cathode and said plate elements.

3. A device for converting mechanical vibrations into electrical impulses comprising an evacuated enclosing vessel having a cathode positioned in one end thereof, a pair of planary plate elements positioned within and at the other end of said vessel, the adjacent edges of said elements being on either side of the common axis of said cathode and vessel, an apertured disc located between said cathode and plate elements, said disc being relatively close to said cathode, an auxiliary cylindrical plate element located between said apertured disc and planary plate elements, and a diaphragm exterior to said vessel and adjacent said cathode for modulating the electron stream between said cathode and said planary plate elements.

4. An electronic microphone comprising an enclosing vessel containing a pair of collector plates, a cathode, and an apertured element coaxial with said cathode and a vibratile diaphragm adjacent said cathode and apertured element for acting upon the cathode ray beam.

5. An electronic microphone comprising an enclosing vessel, a cathode positioned at one end of said vessel, a pair of planary plate elements positioned at the other end of said vessel, and an apertured disc located adjacent said cathode and between said cathode and plate elements, said apertured disc normally directing said stream to equal portions of said plate elements, and means including a diaphragm located external to said vessel adjacent said cathode and apertured disc, said diaphragm being responsive to sound waves.

In witness whereof, I hereunto subscribe my name this 19th day of December, A. D. 1927.

JOHN C. BENJAMIN.