

April 7, 1931.

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1,799,345

ELECTRON TUBE

Filed July 2, 1924

Fig. 1

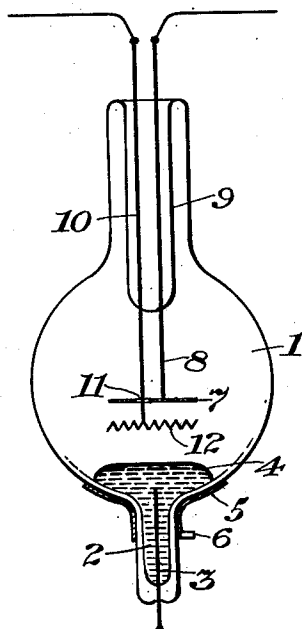
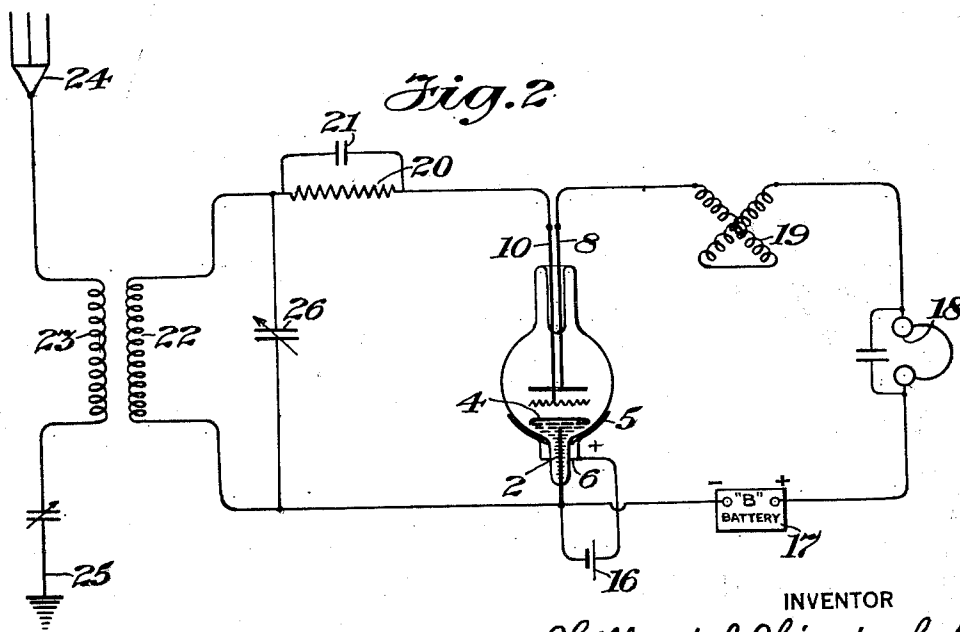


Fig. 2



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ELECTRON TUBE

Application filed July 2, 1924. Serial No. 723,694.

My present invention relates to electron emission methods and devices such as are used for radio communication and for use in the arts generally and particularly to such a device in which electron emission is caused by condenser effect between parts of the device one of which is capable of giving off electrons when under an electrostatic strain.

I have discovered that an effective electron flow suitable for use in devices of the kind and nature of audion tubes and the like can be obtained by creating a potential difference between a pool of electrically conducting liquid and another conducting body positioned in close proximity thereto but electrically insulated therefrom as by a thin sheet of glass used for the separation thereof. Electron discharge by this method I find is achieved with minimum energy consumption and is adapted to close control and regulation of the quantity of electrons caused to flow. And for example, this electron flow is achieved with less consumption of energy and greater adaptability of control than such a flow secured from a glowing filament which is heated by electric current flow because in the latter case the greater part of the energy consumed is used in the heating of the filament to incandescence and because close or flexible control of electron emissions is trammelled by the short range of filament temperatures between which maximum and minimum electron emission occurs.

An electron flow source of this kind is free from certain disadvantages of the Cooper Hewitt mercury arc rectifier such for example, as those attending critical vapor pressures, the heating of the mercury necessary for starting electron emission, and the comparatively great mass or inertia of the mercury molecule. These disadvantages are not met with here because electron emission is produced in the device of my invention by electrostatic difference of potential between the mercury and another electrode connected at a difference of potential in an electric circuit.

An object of my invention is therefore to provide an electron emission device suitable for the control and regulation of electrical and electro-magnetic circuits in which elec-

tron emission or flow is produced with a minimum of energy consumption.

Another object of my invention is to provide an electron emission device in which great flexibility of control of the quantity of electrons down to very small quantities is possible.

Other objects of my invention will appear from the specification and from the drawings in which:

Fig. 1 is an elevation view of an embodiment of my invention in the form of a three element electron tube suitable for use in radio communication, and

Fig. 2 is a diagram of a conventional radio receiving circuit of which the device of Fig. 1 is a part.

In the drawings the sealed envelope 1 has sealed through the bottom of the chamber 2 formed at the bottom thereof the electrode 3 which terminates below the surface of the body of mercury 4 contained in said envelope. About said envelope in the vicinity of said mercury body is formed the band 5 of conducting material having formed thereon a terminal 6.

Within the envelope and substantially parallel to the surface of the body 4 is mounted the plate electrode 7 which is supported by the lead 8 sealed into the envelope through the reentrant tube 9 which extends downwardly from the top of said envelope. Another lead 10 sealed through said reentrant tube 9 and extending parallel with said lead 8 and passing through an opening 11 in said plate 7 supports and acts as a lead for the grid electrode 12 positioned between said plate 7 and the body of mercury 4 and parallel therewith.

In Fig. 2 the electrode 2 is connected to the negative terminal of a source of electric current 16 and the band 5 is connected through the terminal 6 to the positive terminal of said source. Connection is also made from said electrode 2 to the negative terminal of a second source of electric current 17 the other terminal (positive) of which is connected through telephone receivers 18, variometer 19 to said lead 8. Connection is made from lead 10 through the grid leak and con-

denser 20 and 21 in parallel through the secondary coil 22 to the said electrode 2. The primary coil 23 cooperating with said coil 22 is connected to a suitable aerial 24 and to ground 25. The variable condenser 26 connected across coil 22 serves for tuning the secondary circuit.

In the operation of the device of my invention as applied to the circuit shown in Fig. 2 the electrostatic field produced between band 5 and mercury body 4 by the difference of potential therebetween in the circuit of direct current source 16 results in an electron emission from said body of mercury which completes the circuit between said body 4 and said plate electrode 7 whereby current flows through the telephones 18. The electron stream also serves as a conductive path between grid electrode 12 and mercury 4 whereby any potential difference induced in secondary 22 will cause current to flow between said body 4 and said grid whereby the current flow in the telephone circuit is varied with the resulting signal reproduction in said telephones.

The temperature electron emission characteristic of the liquid cathode may be varied for different uses as by using mercury with sodium, copper, calcium, cadmium, bismuth, boron, thorium, thoria, or other metal or metalloid or oxides thereof. In some cases solid sodium, potassium, or other metals or oxides thereof which are serviceable as electron emitters is used instead of the mercury electrode as described in the specification.

I claim:

The method of energizing a sealed tube having electrodes mounted therein and an exterior terminal insulated from said internal electrodes which consists in applying potential difference to the internal electrodes of said device and continually applying electrostatic force to the exterior terminal to cause one of said interior electrodes to emit electrons to establish and maintain current flow in the path between said internal electrodes and applying potential variations from another source of current to vary the current flow between the main electrodes.

Signed at Hoboken, in the county of Hudson and State of New Jersey, this first day of July, A. D. 1924.

WILFORD J. WINNINGHOFF.

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