

W. WILSON.
 REPEATER FOR UNDULATORY CURRENTS.
 APPLICATION FILED MAR. 21, 1917.

1,426,801.

Patented Aug. 22, 1922.

Fig. 1.

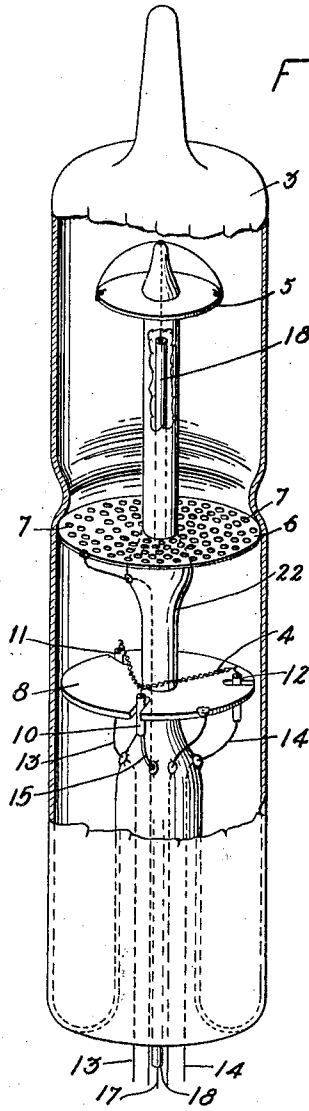
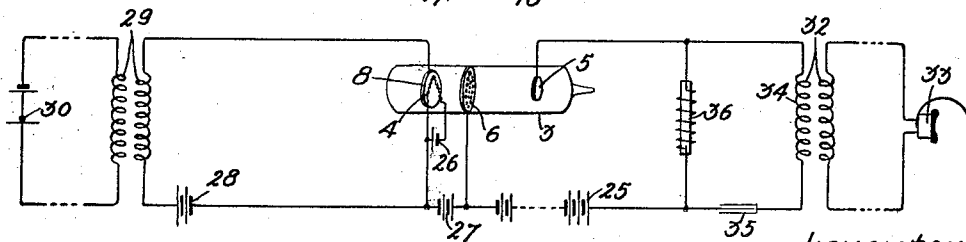


Fig. 2.



Inventor:

William Wilson.

by *L. T. Munnel*, Att'y.

UNITED STATES PATENT OFFICE.

WILLIAM WILSON, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REPEATER FOR UNDULATORY CURRENTS.

1,426,801

Specification of Letters Patent. Patented Aug. 22, 1922.

Application filed March 21, 1917. Serial No. 156,276.

To all whom it may concern:

Be it known that I, WILLIAM WILSON, a subject of the King of Great Britain, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Repeaters for Undulatory Currents, of which the following is a full, clear, concise, and exact description.

10 This invention relates to improvements in repeaters for undulatory currents, and the primary object is to reinforce current waves of any given frequency or form.

The present invention consists of an evacuated vessel containing an anode, a cathode and a perforated electrode which completely divides the space between the anode and the cathode. This auxiliary electrode is inserted to prevent the formation between said anode and cathode of an arc or glowing discharge characteristic of positive ionization, as the formation of such an arc or glow discharge renders the device inoperative on account of the inability to control it by the currents to be reinforced. However, if this auxiliary electrode is included in the tube the luminous arc forms between the auxiliary electrode and the anode, but not between the cathode and the auxiliary electrode. The currents to be reinforced are, in the usual tubes of this type, such as that in the reissue to Von Lieben and Reisz, 13779, July 21, 1914, impressed directly upon said auxiliary electrode, thereby giving rise to corresponding variations in the arc current, due to the changes produced by said electrode upon the effective resistance of the arc.

It is known that the sensitivity and amplifying power of such a device is greatly increased by decreasing the distance between said auxiliary electrode and the cathode, but experiment has shown that for a given voltage for the arc current this distance cannot be decreased beyond a certain minimum value without causing the arc to "strike through" the auxiliary electrode to the cathode, thereby destroying the action of the tube as heretofore explained.

50 This invention therefore provides a more sensitive and efficient means for controlling the arc current in accordance with the cur-

rents to be amplified by providing in close proximity to the cathode an additional control electrode upon which the feeble currents may be impressed. The variations in the potential of said control electrode, due to its close proximity to the cathode, will vary the thermionic discharge from said cathode; and, as the conductivity or effective resistance between the anode and auxiliary electrode is dependent upon, and controlled by, said thermionic discharge, the arc current will then undergo corresponding high power variations, which may be impressed upon an outgoing line or upon transmitting terminals to be amplified further, or they may be transmitted to any suitable receiving apparatus.

Furthermore, as this additional electrode does not function to divide the space between the anode and the cathode into a luminous and a non-luminous portion, it may be brought into any desired proximity to the cathode without producing the deleterious effect noted above when the auxiliary electrode is similarly moved.

For the better understanding of this invention reference is made to the accompanying drawings, in which Fig. 1 represents one embodiment of this invention; and Fig. 2 illustrates how this invention may be employed to amplify low frequency currents.

In Fig. 1, 3 is a glass vessel containing a vapor or gas at a fairly low pressure. 4 is a cathode filament and 5 is an anode plate. 6 is an auxiliary electrode which completely divides the space between said anode and cathode. In this plate are small perforations or apertures 7 of suitable size, the function of which will be hereinafter described. 8 is a plate electrode in close proximity to the filament 4 and serves to control the action of said filament.

The filament 4 is shown supported by the two lead wires 13 and 14 and the additional supporting wire 15. These wires are insulated from the plate 8 by the insulation members 10, 11 and 12. The auxiliary electrode 6 is shown supported by a protuberance in the glass stem 22 which projects into the interior of the vessel. The anode 5 is fastened near the upper end of said stem. The lead wire 17 to the anode 5 is shown to

be encased in an insulating tube 18 in order to insure the complete insulation of the wire from the other lead wires. These above mentioned electrodes, however, may be supported in any suitable manner and may be of any suitable form.

The apertures 7 of the electrode 6 are of such a character that the "striking through" of the arc to the cathode is prevented, but at the same time are such as to afford a passageway to the thermionic discharge from the cathode, so that the gas between electrodes 5 and 6 may be ionized to the desired degree.

In the application of this invention, as illustrated in Fig. 2, 25 is a source of current for the anode 5 and the auxiliary electrode 6, between which electrodes a luminous discharge of an arc may be formed. 26 is a battery for heating the filament 4 to such a degree that there will be sufficient ionization between the auxiliary electrode and the anode to provide for the desired luminous discharge. The amount of this discharge, and, consequently, the conductivity between the auxiliary electrode and the anode is dependent upon the ionization produced by said cathode. For a given value of the battery 26 the thermionic emission of the cathode also depends upon the potential of the control electrode 8, the steady value of which is determined by the source of voltage 28. 29 is a transformer by means of which oscillations from the source 30 may be impressed upon the electrode 8, thereby varying its potential. This will cause corresponding changes in the electron emission from said cathode, thereby providing means for controlling the arc current between electrodes 5 and 6 in accordance with the oscillations from source 30 resulting in the production of amplified oscillations. These amplified oscillations, by means of the transformer 32, may be impressed upon a suitable receiver 33 or upon any suitable apparatus desired.

In order to increase the thermionic discharge of said cathode, a battery 27 is provided between the filament 4 and the auxiliary electrode 6, the negative terminal of which is connected to said filament.

As the battery 25 is generally large in value, say, in the neighborhood of two hundred volts, it is preferable that the direct current from the battery 25 shall not pass through primary winding 34 of the transformer 32, as the current may be large enough to magnetize this winding to a considerable extent, thereby preventing it from performing its proper function. A large condenser 35 is, therefore, inserted to prevent the direct current from passing through said winding, but offering a negligible impedance to the oscillations in said current. 36 is a choke coil for affording

an easy path for the direct current component between electrodes 5 and 6. The alternating current, however, cannot pass through said choke coil on account of its high impedance.

It is obvious that this invention is not limited to the application illustrated in Fig. 2, but may be used in any suitable manner in any electric system in which it is desired to reinforce oscillations of any frequency or form.

What is claimed is:

1. A discharge device comprising a tube operating with a luminous discharge and having an anode, a cathode, a control electrode, and an apertured screen, said screen dividing the space between said anode and cathode into separate parts and having a size substantially the same as a cross-section of the tube at the point where the screen is located.
2. In an electrical system a discharge device comprising a tube having an anode, a cathode, a control electrode in close proximity to said cathode, and a perforated electrode dividing the space between said anode and cathode, said perforated electrode being substantially of the same size as a cross section of said tube taken at a point where said perforated electrode is located.
3. In an electric system a vacuum tube comprising two electrodes, means for producing a luminous discharge between said electrodes, a cathode adapted to control said luminous discharge, and a control electrode for said cathode whereby said luminous discharge may be varied in accordance with the potential of said control electrode, and means for supplying a variable potential between said cathode and said control electrode.
4. A thermionic discharge tube comprising an evacuated vessel, said vessel containing an anode, an auxiliary cold electrode, a thermionic cathode adapted to alter the conductivity between said anode and auxiliary electrode, and a control electrode adapted to regulate the thermionic discharge of said cathode in a predetermined manner, said auxiliary electrode being of substantially the same size as a cross section of said tube taken at the point where said auxiliary electrode is located.
5. In an electric system a discharge device comprising a tube, said tube containing a gaseous medium, an anode, a thermionic cathode and an auxiliary electrode, said auxiliary electrode containing perforations and intersecting the space between said cathode and anode, electrical connections between said auxiliary electrode and said cathode and means within said tube and external to said auxiliary electrode for controlling the thermionic discharge from said cathode in accordance with signals to be re-

peated, the distance between said external means and said cathode being less than the distance between said auxiliary electrode and said cathode.

5 6. A discharge device comprising an evacuated vessel, said vessel containing a gaseous material at a low pressure, an anode, a thermionic cathode, an auxiliary cold electrode adapted to divide the space between said
10 cathode and anode into a luminous and a non-luminous part, and a control electrode adapted to control the thermionic discharge from said cathode in accordance with signals to be repeated.

15 7. In an electric system a discharge device comprising an evacuated vessel, said vessel containing an anode, a cathode, a perforated electrode adapted to divide completely the space between said anode and cathode into
20 two parts, and a control electrode on the opposite side of said cathode from said perforated electrode and adapted to control the ionization stream between said cathode and anode, means for supplying a variable po-
25 tential between said cathode and said control electrode and means for maintaining said control electrode and said perforated electrode at normally different direct current potentials with respect to said cathode.

30 8. A vacuum tube comprising an anode, a cathode, a control electrode, and a perforated electrode between said cathode and anode, a source of voltage between said anode and cathode, and means for maintaining said
35 perforated electrode at a potential intermediate the potentials of said anode and said cathode, the distance between said perforated electrode and said cathode being greater than the distance between said control electrode and said cathode.

40 9. A vacuum tube comprising an anode, a filamentary cathode, a control electrode and a screen electrode, a source of voltage between said anode and cathode, said screen electrode being adapted to divide the space
45 between said anode and cathode into a luminous and non-luminous portion, and means for maintaining said screen electrode at a potential intermediate the potentials of said anode and said cathode.

50 10. In an electrical system, a vacuum tube comprising an anode, a filamentary cathode, a third electrode for controlling the electron emission from said cathode in accordance
55 with signals to be repeated and means for dividing the space between said cathode and said anode into a luminous and non-luminous portion.

60 11. In an electric system a vacuum tube comprising an anode, an electron emitting electrode, means comprising a third electrode for controlling the emission of said electrode, and means comprising a screen electrode for preventing substantial ioniza-
65 tion in the space near said cathode,

12. In an electric system a vacuum tube comprising an anode, a cathode, means comprising a third electrode for controlling said cathode, a source of voltage between said anode and cathode, a portion of the space
70 between said anode and cathode being luminous, and means for preventing said luminescence from appearing in the region of said cathode.

13. A vacuum tube having an anode, a
75 cathode, an auxiliary plate electrode, a source of voltage for said tube, and means whereby the space between said anode and said cathode is divided into two portions in which occur dissimilar discharges.

80 14. A vacuum tube having an anode, a cathode, a control electrode for said cathode, a screen electrode between said cathode and said anode, means for heating said cathode, an external circuit between said anode and
85 cathode comprising a source of voltage and an impedance device, said screen electrode being connected to an intermediate point in said circuit in such a manner that said source is also included between said screen
90 and said cathode, and a circuit between said cathode and said control electrode containing a source of steady voltage and a source of variable voltage.

95 15. A vacuum tube having an anode, a cathode, a control electrode for said cathode, a fourth electrode located between said cathode and anode, a source of voltage between said anode and cathode, and means
100 for maintaining said control electrode and said fourth electrode at a positive potential with respect to said cathode.

16. A vacuum tube comprising an anode, a cathode, a control electrode and a screen electrode, an external circuit between said
105 anode and cathode containing a source of voltage and a winding of a transformer, said screen electrode being connected to an intermediate point in said circuit, an external circuit between said control electrode and
110 said cathode containing a winding of a transformer, and means for maintaining said control electrode at a positive potential with respect to said cathode, the distance between said control electrode and said
115 cathode being less than the distance between said screen and said cathode.

17. A vacuum tube containing a stem projecting into the interior of said tube, and a plurality of discs of conducting material
120 symmetrically supported by said stem as an axis.

18. A vacuum tube containing a stem projecting into the interior of said tube, a plurality of parallel disc electrodes in said tube,
125 each of said discs lying in a plane at right angles to said stem, and each of said discs being symmetrically supported by said stem.

19. A vacuum tube containing a plurality of disc electrodes and a glass stem attached
130

to the base of said tube and projecting through the center of each of said discs, whereby said discs may be supported.

20. In an electric system, a vacuum tube comprising an anode, an electron emitting electrode, a third electrode for controlling the electron emission in accordance with signals to be repeated and means for dividing the space between said electron emitting

electrode and said anode into a luminous 10 and non-luminous portion, the distance between said means and said electron emitting electrode being greater than the distance between said third electrode and said cathode.

In witness whereof, I hereunto subscribe 15 my name this 20th day of March A. D., 1917.

WILLIAM WILSON.