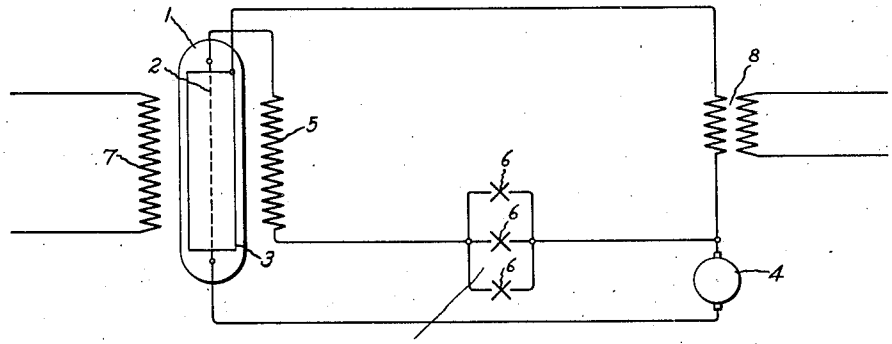
June 8, 1926. 1,588,231

A. W. HULL

ELECTRON DISCHARGE APPARATUS

Filed March 6, 1923



RESISTANCE THROUGH WHICH CURRENT VARIES IN PROPORTION TO THE SQUARE ROOT OF THE APPLIED VOLTAGE.

Inventor:
Albert W. Hull,
by Alexander S. Lent
His Attorney.

Patented June 8, 1926. 1,588,231

UNITED STATES PATENT OFFICE.

ALBERT W. HULL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE APPARATUS.

Application filed March 6, 1923. Serial No. 623,268.

My present invention relates to electron discharge apparatus of the magnetron type as described in a paper which was published in the Journal of the American Institute of Electrical Engineers, September 1921, page 715.

In the operation of such devices for certain purposes it is customary to provide a polarizing magnetic field in order that the normal current flowing through the device may be adjusted to a value at which small changes in the magnetizing field will produce large changes in the value of the current. If the source of potential employed for producing a flow of current through the device is a variable source the value of field strength at which the current will be reduced to substantially zero varies with the square root of the voltage and the strength of the magnetizing field required for maintaining a desired value of current will vary accordingly.

The object of my invention is to provide a means for automatically varying the strength of the polarizing magnetic field to compensate for variations in the value of the potential applied between the electrodes.

My invention may conveniently be carried out by producing the polarizing magnetic field by means of the same source of potential which produces a flow of current between the electrodes. If a resistance is included in the circuit, whereby the polarizing field is produced, having the characteristic that the current flow therethrough is proportional to the square root of the voltage at its terminals and the value of this resistance is made large in proportion to the other resistance of the circuit, the correct value of the polarizing magnetic field may be maintained over a wide range of potential. One form of resistance which I have found particularly suitable for this purpose is a gas-filled tungsten lamp.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself however both as to its organization and method of operation will best be understood by reference to the following description taken in connection with the accompanying drawing in which I have indicated diagrammatically one circuit connection whereby my invention may be carried into effect.

I have indicated in the drawing an electron discharge device of the magnetron type comprising a tubular receptacle 1 enclosing a linear cathode 2 and a surrounding cylindrical anode 3. A source of potential 4 is connected in a circuit between cathode and anode and current for heating the cathode is also supplied by source 4 through a circuit which includes a coil 5 which surrounds the receptacle 1. This coil is so proportioned that the magnetic field produced by the current required to heat the cathode to a desired operating value will be of such strength that the normal value of current flowing through the device will fall on a portion of the characteristic curve where small changes in the value of the magnetic field will produce large changes in current.

The circuit for supplying heating current to the cathode also includes resistance 6 having the characteristic that the current flow therethrough varies in proportion to the square root of the voltage at their terminals. These resistances may be gas-filled tungsten lamps or other devices having the desired characteristic. The value of these resistances should be large in proportion to the other resistance of the circuit.

The device which I have described may be employed as an amplifier by causing the currents to be amplified to flow through a magnetizing coil 7 surrounding the receptacle 1. Amplified currents may then be supplied directly to indicating devices in the circuit between the electrodes or by means of a transformer 8, the primary of which is included in the circuit between the electrodes, to other devices for utilizing the amplified currents or producing further amplification thereof.

While I have shown and described the preferred embodiment of my invention it will be apparent that my invention is by no means limited to the precise embodiment indicated as many modifications in the form of the instrumentalities employed for carrying my invention into effect as well as in the circuit arrangements used may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode, of a source

of potential for producing a flow of current between said electrodes, means for producing a magnetizing field in the space between said electrodes for maintaining a desired value of current between said electrodes, including a circuit to which said source of potential is connected and a resistance in said circuit having the characteristic that the current therethrough is proportional to the square root of the voltage at its terminals.

2. The combination with an electron discharge device having an electron emitting cathode and a co-operating anode of a source of potential for producing a flow of current between said electrodes, means for producing from said source of potential a magnetizing field between said electrodes and means for causing said magnetizing field to vary in strength in such a manner as to compensate for variations in the potential applied between said electrodes and maintain a desired value of current flow between said electrodes.

3. The combination with an electron discharge device having an electron emitting cathode and a co-operating anode of a circuit between said electrodes, a second circuit for producing a magnetizing field in the space between said electrodes, a common source of potential for supplying current to both circuits, and means in said second circuit for causing said magnetizing field to vary in strength in such a manner as to compensate for variations in the potential of said source and maintain a desired value of current flow between said electrodes.

4. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for producing a magnetizing field in the space between said electrodes, a common source of potential for supplying current to both circuits and a resistance in said second circuit having the characteristic that the current flow therethrough is proportional to the square root of the voltage at its terminals.

5. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit which includes means for producing a magnetizing field between said electrodes and a resistance in said circuit having the characteristic that the current flow therethrough is proportional to the square root of the voltage at its terminals.

6. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for supplying heating current to said cathode, a common source of potential for supplying current to both circuits and a resistance in said second circuit having the characteristic that the current flow therethrough is proportional to the square root of the voltage at its terminals.

7. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for supplying heating current to said cathode and for producing a magnetic field in the space between said electrodes, a common source of potential for supplying current to both circuits and a resistance in said second circuit having the characteristic that the current flow therethrough is proportional to the square root of the voltage at its terminals.

8. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for producing a magnetizing field in the space between said electrodes, a common source of potential for supplying current to both circuits and a gas filled tungsten lamp in said second circuit.

9. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for supplying heating current to said cathode and for producing a magnetic field in the space between said electrodes, a common source of potential for supplying current to both circuits and a gas filled tungsten lamp in said second circuit.

10. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit between said electrodes, a second circuit for supplying heating current to said cathode, a common source of potential for supplying current to both circuits and a gas filled tungsten lamp in said second circuit.

11. The combination with an electron discharge device having an electron emitting cathode and a cooperating anode of a circuit which includes means for producing a magnetizing field between said electrodes and a gas filled tungsten lamp in said second circuit.

12. The method of operating an electron discharge device having an electron emitting cathode and a cooperating anode from a variable source of potential which consists in producing in the space between the electrodes a magnetizing field, the strength of which varies in proportion to the square root of the potential of the variable source.

In witness whereof, I have hereunto set my hand this 5th day of March, 1923.

ALBERT W. HULL.