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CONTROL DEVICE FOR VACUUM TUBES

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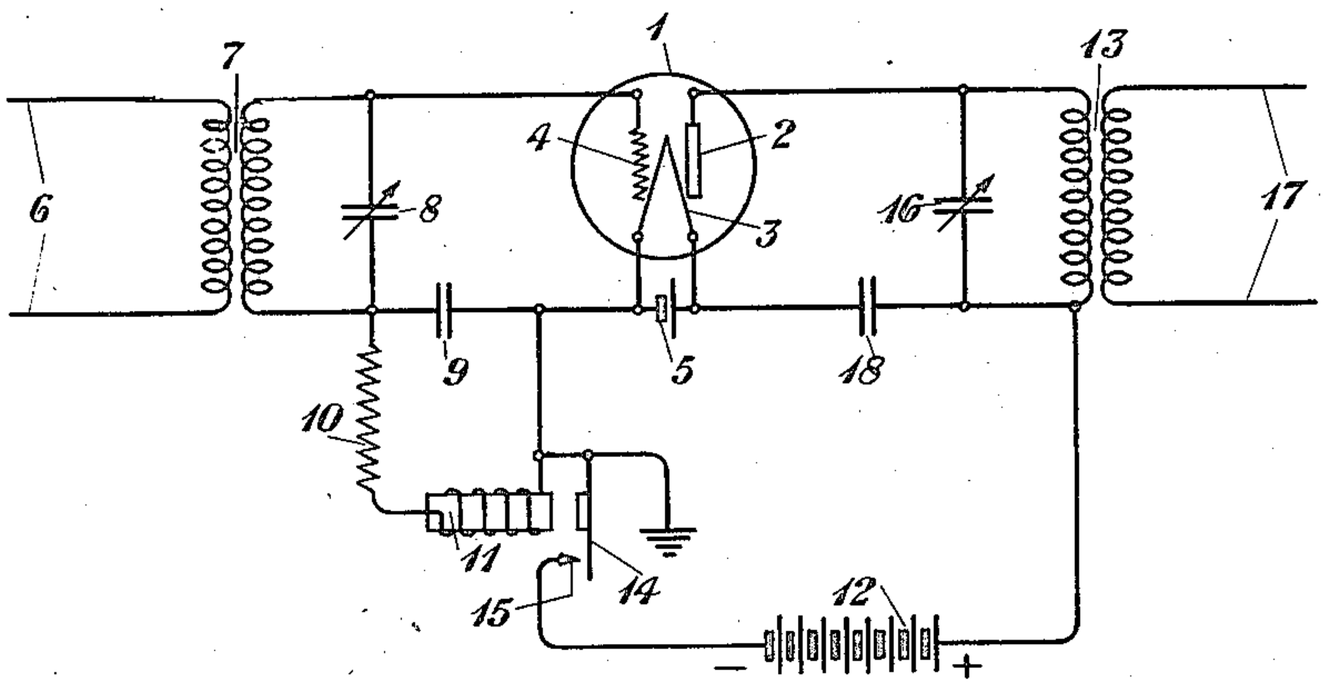

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CONTROL DEVICE FOR VACUUM TUBES.

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This invention relates to control devices for vacuum tubes, and particularly to devices for preventing excessive direct current from flowing in the output circuits of vacuum tubes.

A vacuum tube consists essentially of an evacuated vessel containing a thermionic cathode usually in the form of a filament which can be heated by passing a current through it, an anode and a discharge control electrode which may take the form of a wire mesh or grid, and is usually placed between the cathode and the anode. This third electrode may be of any form, since a controlling effect on the thermionic discharge from the cathode to the anode may be obtained by positioning any conductor with respect to the path of the discharge so that potential variations applied thereto will cause variations in the thermionic emission from the cathode to the anode.

When the discharge control electrode is negative, as is generally the case, all of the electrons are drawn from the cathode to the anode, none going to the control electrode. A variation in the potential that is applied to the control electrode changes the intensity of the electrostatic field between the cathode and the control electrode, resulting in the corresponding change in the number of electrons moving from the cathode to the anode. Therefore, the potential variations set up between the cathode and the control electrode cause corresponding variations in the current flowing from the cathode to the anode.

In this invention there is connected in the input circuit of a discharge tube a blocking condenser shunted by means of a leak resistance. Incoming oscillations make the control electrode alternately positive and negative with respect to the cathode. During the part of the cycle that the control electrode becomes positive with respect to the cathode, electrons are attracted by the control electrode and are trapped thereupon. During the other part of the cycle the control electrode becomes negative with respect to the cathode and no electrons are attracted by the control electrode. When the part of the incoming wave that is positive again strikes the control electrode, more electrons are attracted by the control electrode and are again trapped on the control electrode. When the part of this incoming wave that is negative strikes the control electrode no electrons will be attracted by the control electrode. This process continues and the control electrode builds up a negative potential. The leak resistance is so proportioned in the input circuit that these negative charges on the control electrode gradually leak back to the cathode.

But when no waves are impressed on the input circuit of such a discharge tube, then the control electrode does not impede the electronic emission from the cathode to the anode, and in such a case there is danger to the tube from the excessive heating that may occur to the anode.

It is therefore an object of this invention to provide means for preventing the electronic flow between the cathode and the anode of a discharge tube when there are no waves impressed on the input circuit thereof. It is a further object of the invention to associate a relay with the input circuit of a discharge tube so that when no current flows in the input circuit the flow of current in the output circuit will be substantially decreased.

A good understanding of this invention may be had from the description hereinafter following, when read in connection with the accompanying drawing showing one embodiment of the invention.

The reference character 1 represents an electrical discharge tube having an anode 2, a cathode 3, and a discharge control electrode 4. A battery 5 is connected to the cathode 3 to heat the cathode to incandescence. The reference character 6 represents a line connected to a source of current (not shown) which supplies the input circuit of the discharge tube 1 with current by means of a transformer 7. A variable condenser 8 is connected across the terminals of the secondary of the transformer 7 in order to select the particular wave train that is to be impressed on the input circuit of the tube. A blocking condenser 9 is connected in the input circuit of the discharge tube and is shunted by means of the leak resistance 10 which is connected in series relationship with the winding of a relay 11. The plate battery 12 has its positive terminal connected to the anode 2 of the discharge tube 1 through the primary winding of the transformer 13. The armature 14 of the relay 11 closes and opens contact 15 to connect and disconnect, respectively, the plate battery 12 in the output circuit of the discharge tube 1. The variable condenser 16 is connected across the termi-

nals of the primary winding of the transformer 13 in order to tune the output circuit of the discharge tube 1 to the particular frequency that is to be impressed through the transformer 13 upon the power output circuit 17. A condenser 18 shunts the plate battery 12 for alternating currents.

The input circuit may, if desired, be considered to be composed of the discharge control electrode 4, the cathode 3, the winding of the relay 11, the leak resistance 10 and the secondary winding of the transformer 7. The output circuit may be considered to be composed of the cathode 3, the anode 2, the primary winding of the transformer 13, the plate battery 12, contact 15 and armature 14.

The arrangement operates as follows:

Currents flowing from the source connected to the leads 6 are impressed on the input circuit of the discharge tube 1 through the transformer 7. The condenser 8 is employed for tuning the input circuit to any desired frequency. When direct current flows in the input circuit the winding of the relay 11 will become energized and will attract the armature 14. Contact 15 will therefore be closed and the plate battery 12 will be connected in the output circuit to supply space current to the anode 2. The output circuit of the discharge tube may be tuned to any frequency, preferably the frequency in the input circuit of the discharge tube, or to its second harmonic. The current in the output circuit of the discharge tube is then transmitted to the power output circuit 17 through the transformer 13.

When no alternating current is impressed on the input circuit of the discharge tube 1 there may be an excessive current flowing in the output circuit of the discharge tube 1 if the plate battery remains connected to the output circuit of the discharge tube 1. Under this condition the winding of the relay 11 will be deenergized and the armature 14 will be released. The contact 15 will be opened and the plate battery 12 will be disconnected from the output circuit of the discharge tube 1.

While this invention has been disclosed in one particular embodiment which is deemed desirable, it will be understood that it is capable of embodiment in other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In combination, a discharge tube having a grid, filament and plate, a source of electromotive force, and circuit means associated with the grid circuit of said tube and operated by the current in the grid circuit to connect said source of electromotive force to the plate circuit of said tube when incoming waves are impressed on said grid circuit and to disconnect said source of electromotive force from the plate circuit when incoming waves are not impressed on said grid circuit.

2. In combination, an electrical discharge tube, input and output circuits for said tube, a source of potential, and a relay the winding of which is connected to said input circuit and which is operated by the flow of current in said input circuit in order to connect said source of potential to the plate of said output circuit when energy is being received by said input circuit and to disconnect said source of potential from the plate of said output circuit when energy is not being received by said input circuit.

3. In combination, an amplifier of the three-electrode type, input and output circuits for said tube, a source of potential, and a relay the winding of which is connected to the input circuit of said tube in series with its two input electrodes so as to connect said source of potential to the output circuit when direct current flows in said input circuit and to disconnect said source of potential from said output circuit when no direct current flows in said input circuit.

4. In combination, an electron discharge tube having a cathode, an anode and a discharge control electrode, input and output circuits for said tube, and means in the input circuit of said tube to prevent the flow of current in the output circuit when the discharge control electrode is not negative with respect to the cathode.

5. In combination, a discharge tube of the three-electrode type, an input circuit for said tube, an output circuit for said tube, and a relay, the winding of which is connected in series relationship in said input circuit, the armature of said relay closing said output circuit when currents are impressed on the input circuit and opening said output circuit when no currents are impressed on the input circuit to prevent excessive current from flowing through said output circuit.

6. In combination, a vacuum tube having a grid, a filament and a plate, an input circuit for said tube, an output circuit for said tube, and means controlled by the flow of current in the input circuit of said tube for breaking the output circuit of said tube when the electron emission from the filament to the plate is greater than normal.

7. In combination, an electron discharge tube having a grid electrode, a filament and a plate electrode, an input circuit for said tube connected between the grid electrode and the filament, an output circuit connected between the plate electrode and the filament, and a relay, the winding of which is in series between said grid and filament electrodes for preventing the normal electronic emission from the filament to the plate electrode when substantially no current is impressed on said input circuit.

8. In combination, an electron discharge

tube having a cathode, an anode and a discharge control electrode, an input circuit for said tube connected between the discharge control electrode and the cathode, an output circuit for said tube connected between the anode and the cathode, and means included in the input circuit for substantially decreasing the flow of current in the output circuit of said tube when no current flows in the input circuit.

In testimony whereof, I have signed my name to this specification this 13th day of August, 1925.

RUSSELL S. OHL.