

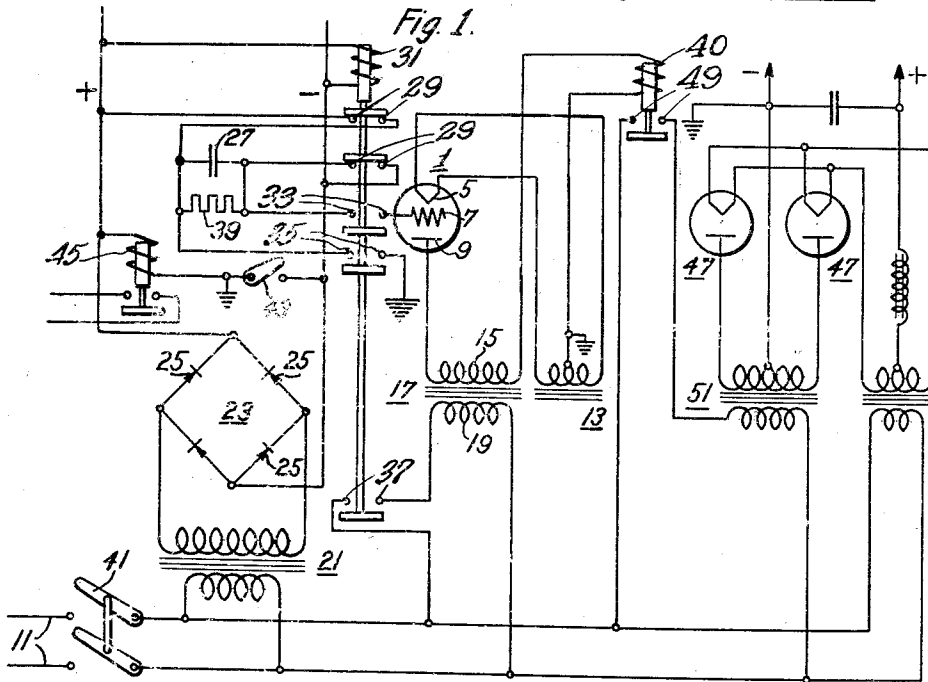
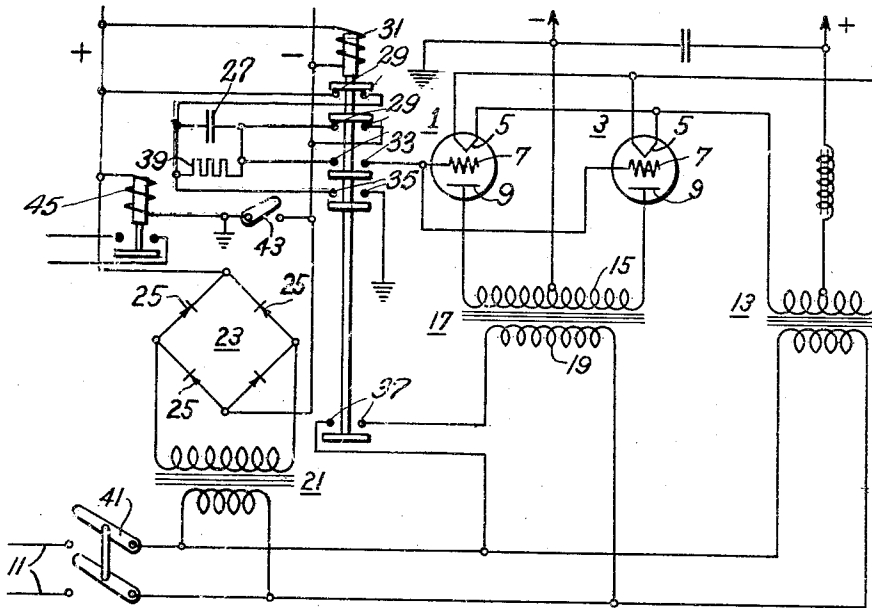
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TIME DELAY FOR RECTIFIER TUBES

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TIME DELAY FOR RECTIFIER TUBES

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My invention relates to radio circuits and more particularly to the rectifying portion thereof utilized in conjunction with an alternating-current source of supply to obtain plate power for the various electron discharge devices of the circuits.

Rectifying tubes are customarily employed in conjunction with radio circuits for the rectification of alternating current for power supply purposes. These tubes normally contain some gas, and in the operation thereof, more particularly when energizing these tubes in preparation for their operation in the system, it is quite essential that the cathodes thereof be brought up to their proper operating temperature before the application of full voltage to the anode of the tube. The reason for this resides in the fact that prior application of full anode voltage results in destructive bombardment of the cathode with positively charged gas ions, resulting in material reduction in the life of the rectifier, as well as possible destruction of the tube itself.

It is an object of my invention to provide a circuit for use in conjunction with electron discharge devices requiring a delayed application of plate voltage to the anodes in the preparation of such tubes for operation, which circuit shall withhold the application of the plate voltage until the cathodes have had an opportunity to arrive at the proper operating temperature.

A further object of my invention is to provide such a circuit which shall require no manual control in order to obtain this delayed action, but which shall be entirely automatic in operation.

My invention is disclosed in the figures of the accompanying drawing, wherein;

Figure 1 is a circuit diagram illustrating its application to gaseous discharge devices having a control electrode; and

Fig. 2 is a circuit diagram illustrating its application to gaseous discharge devices having no control electrodes.

A clearer understanding of the invention may be had by reference to the following description in conjunction with the circuits of the drawing.

My invention broadly embodies the idea of first energizing the cathode of the tube and subsequently applying plate voltage to the anode simultaneously with the connection of a discharging condenser in circuit with the grid and anode, the negative end of the condenser being electrically closer to the control or grid electrode. The condenser may be charged during the energization of the cathode, but independently thereof, and this charging condenser may be utilized to energize a relay which will automatically disconnect it from the charging circuit and connect it in circuit with the grid and anode at the proper time.

The rectifying circuit of the drawing (Fig. 1) comprises a pair of electron discharge devices 1 and 3, each having cathode grid and anode electrodes, 5, 7 and 9 respectively, these being connected to a single-phase source of power supply 11 in a conventional circuit hook-up, that is, the cathodes 5 are energized by means of a transformer 12 coupling them to the alternating-current source 11, and the anodes 9 are connected at the extremities of a secondary winding 15 of a transformer 17, the primary winding 19 of which is also connected to the same alternating-current source. The load to be fed from the rectifying circuit is connected by leads from the electrical midpoints of the plate and cathode transformers, the lead to the plate transformer being grounded.

The control circuit for assuring application of plate voltage to the anodes 9 of these electron discharge devices also receives its energy from the same alternating-current source. This is supplied to the control circuit by means of a coupling transformer 21, the secondary of which is connected across a rectifying bridge network 23, for example, consisting of copper-oxide rectifying elements 25. The output energy from this network, which now comprises direct-current energy, is fed to a condenser 27, shunted by a resistance 39, through a pair of closed relay contacts 29, one on each side of the condenser. In parallel with this condenser and connected across the direct-current lines is the winding 31 of a relay, with which are associated the closed contacts 29 through which the condenser is charged. The leads extending from the resistance shunted condenser terminate in normally opened contacts 33 and 35 which are also associated with the aforementioned relay coil 31, the opposite sides of the open contacts 33 and 35 being connected, one to the grids or control electrodes 7 of the rectifying devices 1 and 3, which control electrodes are connected in parallel; whereas the other is grounded, thereby completing a circuit through the grounded side of the rectifying circuit to the anodes 9 of the rectifying devices.

In one of the leads to the primary winding of the anode supply transformer is another normally opened contact 37 also associated with the relay winding 31 referred to previously.

Across the output leads of the rectifier circuit 23, one might connect suitable apparatus such as, for example, a key 43 in series with a keying relay winding 45, adapted to control the operation of a pair of keying contacts anywhere in a transmitter associated with the power supply circuit. The key will most likely be grounded at its connection to the keying relay winding.

Prior to placing the rectifier tubes in operation, the contacts described as being normally opened

are in their open condition. By closing a switch or breaker 41 in the main lines of the alternating-current supply, the primary windings of the control circuit transformer and the cathode heating transformer are energized, the primary winding of the anode supply transformer remaining unenergized due to the presence of the open contact 37 in one of the leads extending to this transformer winding.

At this stage, the cathodes of the electron discharge devices begin heating up, and simultaneously the energy supplied to the control circuit is rectified for charging up the condenser thereacross. When the potential across the condenser reaches a certain predetermined value, it energizes the relay winding 31 to the point of operation, at which moment the charging condenser will be disconnected from the charging circuit through the opening of the relay contacts 29 through which it was charged, and will be connected in circuit with the anode and control electrodes of the rectifying devices through the closing of the relay contacts 33 and 35. Simultaneously with the switching of the condenser 27 in circuit with the anode and control electrodes, the normally opened contacts 37 in the primary circuit of the anode supply transformer will be closed, thereby applying plate potential to the anodes of these tubes.

The condenser is so connected in circuit with the anodes and the control electrodes that its negative end will be electrically closer to the control electrodes than to the anodes, thus prohibiting the flow of current between the cathodes and anodes of the tubes, this effect decreasing as the condenser loses its charge through the resistor 39 in shunt therewith, until at the point where the condenser is completely discharged, the control electrode exerts practically no influence in the operation of the rectifiers, and the tube will draw full current. The change from the no-current to full-current condition of the rectifiers is not an abrupt change, but is of a gradual characteristic, conforming in general to the discharge characteristic of the condenser, except in an inverse manner.

The resistor 39 may be made variable to enable proper time adjustment of the discharge of the condenser 27.

An inductance placed in series with the resistor 39, will further enable one to alter the discharge characteristic of the condenser 27, and this could be utilized to advantage in a system of the character described.

The values of the capacity 27 and resistor 39 are so determined as to have the correct time constant necessary for the proper operation of the control circuit and this will depend in part upon the time necessary to energize the cathodes to their proper operating temperature. The condenser and resistor can be very small physically, because the grids consume no power in the operation of their controlling function.

Were no keying circuit or equivalent circuit employed, having an intermediate point grounded as shown in the drawing, the above described circuit of Fig. 1 may be somewhat simplified by grounding the positive side of the charging circuit instead of the contacts 35. This change will permit of the elimination of the contacts 33, 35 and the normally closed contacts 29 at the

negative side of the charging circuit. The ground connections disclosed in the drawing between relay contacts 35 and center tap of the plate winding 15 would be removed and a direct connection substituted therefor.

In the circuit of Fig. 2 wherein delayed application of plate voltage is shown in combination with rectifiers 47 of the two-element type, the delayed application circuits are substantially the same as those of Fig. 1. However, to adapt the circuit to tubes of the two-element type, a discharge device of the three-element type such as 1 of Fig. 1 is employed in conjunction with the delayed application circuit and in the plate circuit of this device is connected to relay 40 whose contacts 49 control the making or breaking of the primary circuit of the plate transformer 51 from which the rectifier tubes derive plate potential from the supply lines.

Thus in the operation of this circuit the flow of plate current through the anode circuit of the discharge device 1 is delayed through the application of the negatively charged condenser 27 to the control electrode of this tube. Since the closing of the contacts 49 is dependent upon the operation of its associated relay winding 40 which is connected in the plate circuit of the tube 1, it will be apparent that the application of plate potential to the rectifier devices 47 will be delayed for a time which can be made of sufficient duration to permit the filaments or cathodes of the rectifiers to reach proper temperature.

While I have disclosed my invention in great detail, various modifications may become apparent to those skilled in the art, and I do not propose that my invention be limited to these specific details disclosed by me except as may be necessitated by the prior art and the appended claims.

I claim as my invention:

1. In a starting system for an electron discharge device, a condenser, a charging circuit therefor, relay contacts in said charging circuit which, upon actuation, disconnect said condenser from said charging circuit and cause said condenser to discharge through an impedance paralleling the input electrodes of a discharge device and relay-means effecting actuation of said relay-contacts when the charge on said condenser approaches a predetermined value.

2. In a starting system for electron discharge devices, a condenser, a charging circuit therefor, a relay connected in said circuit, said relay being energized when the charge on said condenser approaches a predetermined value, a plurality of contacts actuated by said relay certain of which disconnect said condenser from said charging circuit upon energization of said relay, and others of which connect said condenser in the input circuit of an electron discharge device.

3. In a starting system for an electron discharge device having a cathode, a grid and an anode electrode, a condenser, a charging circuit therefor, and means, operative upon the building up of a predetermined charge in said condenser, for disconnecting said condenser from said charging circuit and causing it to discharge through an impedance between said grid and cathode with the negative terminal of said condenser toward said grid electrode.

REUBEN LEE.