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REVERSELY-CONNECTED ELECTRIC DISCHARGE DEVICE SYSTEM

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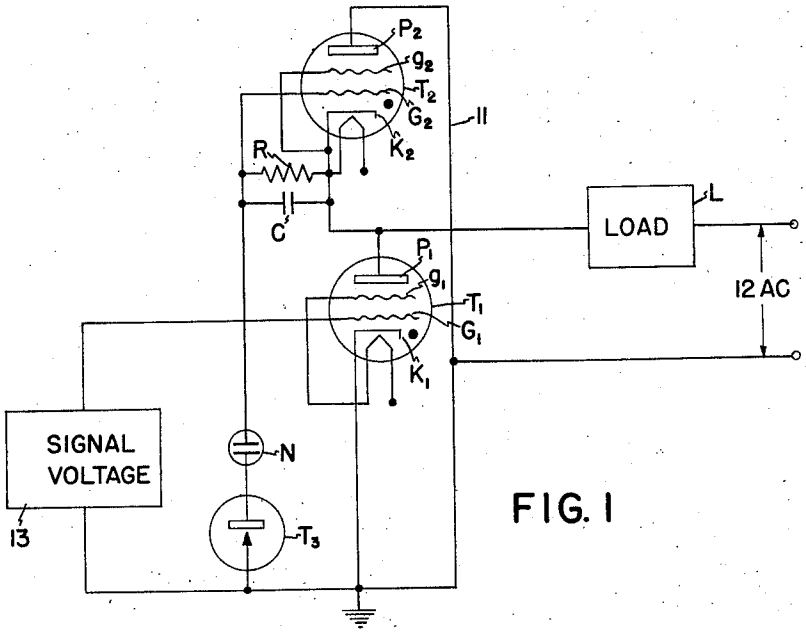


FIG. 1

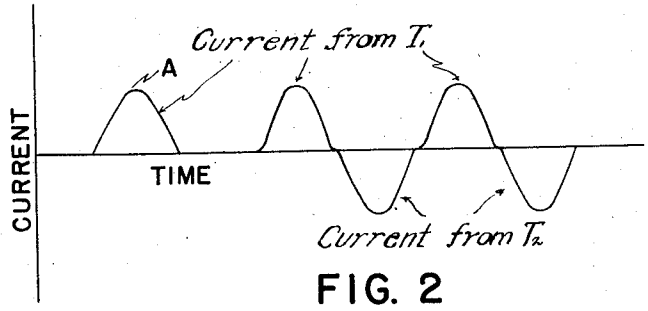


FIG. 2

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REVERSELY-CONNECTED ELECTRIC DISCHARGE DEVICE SYSTEM

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2 Claims. (Cl. 250—27)

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The present invention relates to electric circuits preferably employing grid controlled gaseous tubes and is more particularly concerned with a circuit in which a load is supplied with alternating current through a circuit controlled from an independent electrical controlled source.

The object of the present invention is to supply to a load circuit alternating current and alternating current power greater than that which may be supplied by one gaseous grid controlled electronic tube.

A further object of the present invention is to employ two gaseous grid controlled electronic tubes with the anode of one tube connected to the cathode of a second tube and with the cathode of the second tube connected to the anode of the first tube in such a manner as to obtain the sum of the power which may be delivered by each of the tubes.

A further object of the present invention is to fire the second gaseous tube from the first gaseous tube when the first gaseous tube has been fired by some outside control source as, for instance, a signal voltage.

A further object is to secure alternating current through a load circuit by means of two gaseous grid controlled tubes. Such gaseous controlled tubes as are herein described may comprise a cathode, an anode enclosed in a gaseous vessel with one or more controlled electrodes positioned between the cathode and anode. The so-called "Thyratron" of the General Electric Company is suitable for this purpose as well as Radio Corporation of America Type 2050 tube and 2051 tube. These tubes are so called hot cathode tubes in which a heating current may be supplied to provide the electron emission from the cathode rather than relying upon the action of the tube to provide the cathode electron emission.

In the operation of tubes of this type, the grid control electrode controls the point of breakdown or passage of current through the tube with reference to the potential applied between the cathode and the anode. After the passage of current through such a tube occurs, the grid no longer has control until the current in the tube has been cut off by decreasing the potential between the cathode and the anode to such a low point that current through the tube will no longer be sustained. Due to these properties of the tubes it is difficult to operate two such tubes together particularly if the cathode-anode circuits are parallelly connected for then the breakdown of one tube will simultaneously reduce the potential across the second tube so that there will be no power to operate it.

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In the present invention two such tubes of the "Thyratron" or other similar type are operated substantially in parallel in such a manner as to provide a substantially continuous flow of alternating current from the alternating current source to the load to be supplied.

Other objects and merits of the present invention will be more clearly understood with reference to the drawings illustrating the embodiment of the invention in which Figure 1 shows a diagram of the circuit of the invention and Figure 2 shows a curve of current as applied to the load circuit.

As indicated in Figure 1, there is provided two similar gaseous controlled tubes, T_1 and T_2, each of which is provided with cathodes and anodes respectively K_1, K_2 and P_1, P_2. G_1 and G_2 are the control grids of the tubes T_1 and T_2 respectively, the second grid g_1 and g_2, respectively being connected to the cathode as indicated in Figure 1. In the circuit as shown in Figure 1, it will be noted that the cathode K_2 and the anode P_1 are connected together by means of the lead 10 and that the cathode K_1 and the anode P_2 are also connected together by means of the lead 11. The alternating current supply 12 is applied through load L between the cathode K_1 and the anode P_1 and since the two tubes T_1 and T_2 are connected in reverse, these same leads also apply the alternating current supply voltage between the cathode K_2 and the anode P_2 of the "Thyratron" tube T_2. The rest of the circuit comprises a signal or bias voltage source 13 connected between the cathode K_1 and the grid G_1 to apply a grid control potential to the grid G_1 for controlled operation of the circuit. The grid G_2 of the tube T_2 is connected to the cathode K_2 of the same tube through a shunt condenser resistance circuit comprising the resistance R and the condenser C while the terminal of the grid G_2 is also connected through a neon tube N and the rectifier T_3 in series with one another to the cathode K_1 of the tube T_1.

In the operation of the system before any signal bias voltage is applied to the grid G_1 of the tube T_1, the neon tube N continues to fire through the rectifier T_3 since this circuit in series with the condenser resistance circuit is always across the A. C. supply line. The condenser C, therefore, becomes charged and maintains a negative bias on the control grid G_2 preventing the tube T_2 from discharging. When a signal voltage acts through the control apparatus 13, a negative grid

bias which normally is maintained on G_1 of the tube T_1 is altered so that when the positive half-cycle from the alternating current source is applied to P_1 of tube T_1 a discharge across the tube T_1 is started which in turn reduces the cathode-anode voltage across this tube to a low value which may be approximately 15 volts and is lower than that for sustaining the operation of the neon tube N.

Since the voltage across the condenser C is no longer maintained, it begins to discharge, during the positive half-cycle applied to the tube T_1, across the resistance R so that the bias on the grid G_2 of the tube T_2 gradually reduces from that point onward. The time constant, however, of this circuit is sufficiently long so that a negative bias is still maintained on the grid G_2 when the next positive half-cycle is applied across the tube T_1. However, if the grid G_1 is still not sufficiently negative, the tube T_1 will again discharge so that the voltage supply source will not be applied across the condenser C. By the time this second positive half-cycle has gone by, the bias on the grid G_2 has disappeared sufficiently to permit the discharge of the tube T_2 when the anode becomes positive with respect to the cathode. This, therefore, permits the flow of current through the lower half of the alternating current cycle therefore completing the flow of current through the full cycle. This will continue as long as the signal voltage is applied and both tubes will fire, one for the positive half-cycle and the other for the negative half-cycle.

The circuit including the rectifier T_3 and the condenser resistance circuit is necessary for the operation of the system. When the anode of T_1 is positive, it will be noted that the rectified current flows through R. During the next half-cycle the anode of T_1 is negative and no current flows through R except that current which has been stored up in the capacitor C but during this half-cycle the anode of T_2 is positive and thus T_2 would fire if the grid did not have a negative bias which is supplied during this half-cycle by the discharge of the capacitor C through R. The rectifier T_3 is necessary as otherwise alternating current would pass through R and the average bias of the tube T_2 would be zero instead of being maintained normally at a negative value.

It is possible to eliminate the neon tube if the value of the resistor R and the capacitor C are chosen very accurately to provide the proper bias values. The advantage of the neon tube shows itself when the voltage drops below the ignition point, which takes place immediately T_1 is fired, thus giving a positive shut-off of current through R. By using the neon tube, as high a variation as 20% in values of R and C may be permitted with successful operation of the system.

In the curve shown in Figure 2, the first hump A is the current flow through the tube T_1 when the negative bias is reduced. During the negative half of the alternating current cycle, the voltage

on the tube T_1 is in the wrong direction to sustain a discharge through this tube while the bias on the tube T_2 still exists so that no current flows through this half of the cycle. When the next positive half-cycle comes around, however, if the bias on the tube T_1 is still below the firing point, current will again flow in this tube, and since in the negative half of the cycle the bias on the grid of the tube T_2 has reduced sufficiently so that the tube T_2 will fire as in this half-cycle the positive potential is applied to the anode of the tube and the negative potential to the cathode.

Having now described my invention, I claim:

1. In combination with an alternating current power source and a load, an electrical control circuit for controlling the power applied to the load comprising two gaseous discharge control tubes reversely connected between the power source through the load, each of said control tubes having a cathode and a control grid, signal means connected to one of said control grids for controlling the discharge of the one tube, a rectifier circuit connected between the cathodes of the tubes and means included in said rectifier circuit for applying periodically a gradually decaying potential to the grid of the other tube for controlling the initiation of the discharge across said tube and a neon tube in series in said rectifier circuit for opening the circuit when the potential has dropped below a given desired value.

2. In combination with an alternating current power source and a load, an electrical control circuit for controlling the power applied to the load comprising two gaseous discharge control tubes reversely connected between the power source through the load, each of said control tubes having a cathode and a control grid, signal means connected to one of said control grids for controlling the discharge of the one tube, a rectifier circuit connected between the cathode of the tubes having a parallelly connected resistor and condenser serially connected in said rectifier circuit and in the circuit of said second control grid, and a discharge neon tube in series with said rectifier.

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