

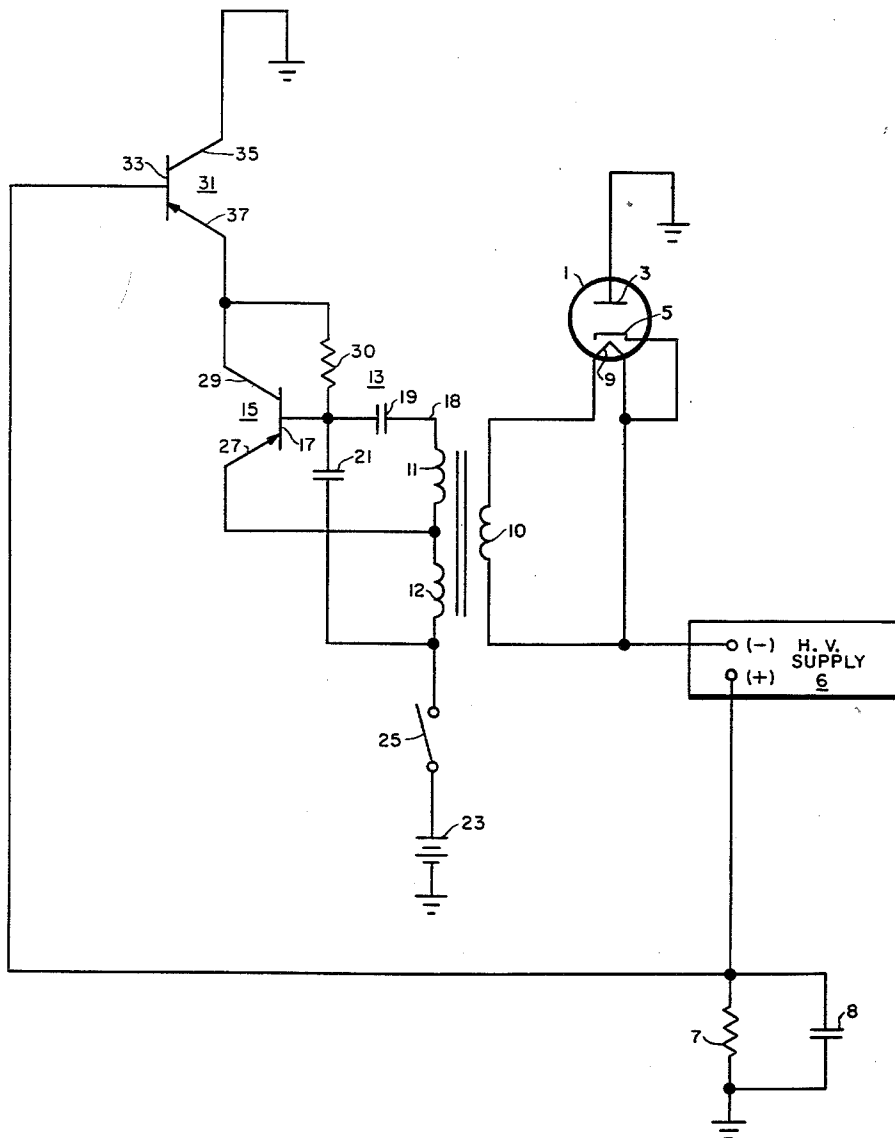
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AUTOMATIC CONTROL CIRCUIT

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AUTOMATIC CONTROL CIRCUIT

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4 Claims. (Cl. 315-107)

This invention relates to automatic control circuits and more particularly to automatic control circuits which regulate the voltage applied to the vacuum tube element which supplies the free electrons for the vacuum tube, as a function of the vacuum tube output.

Certain vacuum tubes, especially magnetrons, require different heater voltages for different operating conditions. In order to achieve this, prior devices utilize multiple transformer windings and switching mechanisms for applying different voltages to the heater element for different operating conditions. The switching mechanisms are operated either manually or automatically at preset time intervals. In both cases, this is not entirely satisfactory since the voltage changes are step functions which are not automatically determined by the tube output and are not automatically reversible.

One object of this invention is to provide an automatic control system for use in vacuum tube circuits which continuously regulates the voltage applied to the vacuum tube element which supplies the free electrons as a function of the vacuum tube output.

Another object of the invention is to provide an automatic control system for use in vacuum tubes which have no moving parts and is reliable in operation.

A further object is to provide an automatic control system, as set forth above, which is bidirectional in operation.

The invention contemplates an automatic control system for use in vacuum tube circuits comprising, a vacuum tube device having an element for providing free electrons, a sensing device connected to the tube output for detecting changes in the output and for providing electric signals corresponding thereto, adjustable means connected to said element for supplying an alternating operating voltage thereto, and voltage control means responsive to said sensing device for regulating the magnitude of the output of said adjustable means as a function of the tube output.

The foregoing and other objects and advantages of the invention will appear more clearly from a consideration of the specification and drawing wherein one embodiment of the invention is described and shown in detail for illustration purposes only.

The single figure is a schematic diagram of a novel control circuit constructed in accordance with the invention.

A magnetron 1 has its anode 3 connected to ground and its cathode 5 connected to the negative terminal of a high voltage source 6. The positive terminal of source 6 is connected to ground by a resistor 7 and a parallel connected condenser 8.

The heater element 9 of the magnetron tube 1 is connected across a winding 10 which is inductively coupled to a pair of windings 11 and 12 and a tank circuit 18 of an oscillator 13. One point of the heater circuit is also connected to the negative terminal of the high voltage source 6.

Oscillator 13 is a Hartley type oscillator and comprises a transistor 15 having a base 17 connected to one

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side of tank circuit 18 which includes series connected windings 11 and 12, a condenser 19 connected in series therewith, and a condenser 21 connected in parallel with the series connected windings and condenser 19. The other side of tank circuit 18 is connected to the positive terminal of a battery 23 by a manually operated switch 25 and the negative terminal of the battery is connected to ground. The emitter 27 of transistor 15 is connected to the common junction of windings 11 and 12 and the collector 29 is connected to the base 17 by a biasing resistor 30.

A voltage control transistor 31 has its base 33 connected to the positive terminal side of resistor 7 and its collector 35 connected to ground. The emitter 37 of transistor 31 is connected to the collector 29 of transistor 15.

In order to institute operation of the circuit, manually operated switch 25 is closed. This connects battery 23 to oscillator 13 which starts oscillating. The frequency of oscillation is determined by the values of inductive windings 11 and 12 and capacitors 19 and 21 which comprise the tank circuit 18. Oscillator 13 is a conventional Hartley oscillator wherein transistor 15 acts as an amplifier feeding a tank circuit 18. A portion of the energy in circuit 18 is fed back from the winding 11 through the capacitor 19 to the base 17 of transistor 15 to sustain the oscillations.

The remainder of the energy in tank circuit 18 is inductively coupled into winding 10 which is connected across heater element 9 which supplies free electrons for operation of magnetron 1. As the electrons are provided, a plate current flows in the plate circuit of the magnetron which includes resistor 7. The plate current increases since it is not limited by the indirectly heated cathode temperature, but by the load resistance. Thus, it is necessary to hold the incandescent cathode temperature within very narrow limits. This is also necessary to prevent deterioration of the magnetron.

This is accomplished by varying the heater voltage as an inverse function of the magnetron output. The voltage drop across resistor 7 is applied to the base of voltage control transistor 31 and as the magnitude of this voltage increases the effective impedance of transistor 31 increases and the voltage at the emitter 37 of transistor 31 becomes more positive. This reduces the potential difference between the collector 29 and emitter 27 of transistor 15 which in turn reduces the amplitude of the oscillations in tank circuit 18. Since tank circuit 18 supplies the operating voltage to heater 9 the heater voltage is reduced as an inverse function of the tube output.

The frequency of oscillator 13 is arbitrarily selected and may be varied by changing the values of the circuit elements of tank circuit 18. If a high frequency is chosen, considerable savings in the size and weight of the components is possible. Furthermore, if a high frequency is chosen, the capacity of the cathode circuit of the magnetron may be reduced considerably thus improving operation of the magnetron.

This invention is also applicable to other vacuum tube applications where a constant emission current is required, since regulation of the heater or cathode temperature as a function of the emission current is possible.

While one embodiment only of the invention has been shown and described in detail it is to be expressly understood that the invention is not to be limited thereto.

What is claimed is:

1. An automatic control system for use in magnetron tube circuits comprising: a magnetron tube having a heater element for providing free electrons, an anode, and a cathode; a high voltage source having a negative and a positive terminal, said negative terminal being connected to said heater and cathode elements; means con-

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nected between the anode and the positive terminal of the high voltage source for detecting changes in the anode output and for providing an electric output corresponding thereto; an adjustable oscillator connected to the heater element for supplying an alternating operating voltage of predetermined frequency thereto; and voltage control means responsive to the output from said detecting means and connected to said oscillator for regulating the magnitude of the alternating voltage supplied to the heater element as an inverse function of the anode output.

2. An automatic control system as defined in claim 1 wherein said voltage control means includes a transistor having one control electrode connected to the detecting means and arranged to vary in impedance as a function of the output from the detecting means.

3. An automatic control system for use in magnetron tube circuits comprising, a magnetron tube having a heater element, a cathode, and an anode, a high voltage

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supply connected in the cathode anode circuit, an oscillator including a first transistor for supplying alternating current to the heater element, a second transistor connected to said oscillator for controlling the amplitude of its output according to the conductivity of said second transistor, and means responsive to the current through the magnetron for adjusting the conductivity of said second transistor to regulate the alternating current supplied to the heater element as an inverse function of the current through the magnetron.

4. An automatic control system as set forth in claim 3 in which the means responsive to the current through the magnetron includes a resistor connected in series with the magnetron anode.

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