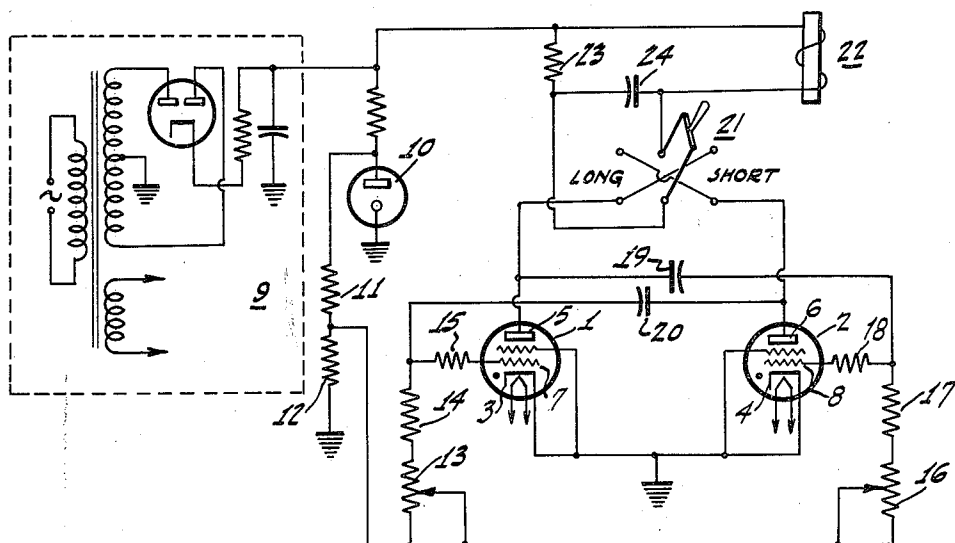


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ELECTRONIC INTERVAL TIMER

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ELECTRONIC INTERVAL TIMER

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My invention relates to a control circuit and more particularly to a control circuit in which the control is provided by the periodic conduction of a pair of gas discharge tubes.

For many uses, it has been found desirable to provide apparatus for controlling any suitable load device which will be alternately energized and de-energized at definite, predetermined intervals. Many such devices have heretofore been proposed, but not any of them, insofar as I am aware, has been entirely satisfactory because they were more or less uncertain in their operation and complicated in construction.

It is an object of my invention to provide a simple control circuit in which both the periodicity of energization of the load device and the duration of the period of energization of such device may be accurately predetermined.

A further object of my invention is the provision of a circuit arrangement whereby selection is provided for the duration of the period of energization of the load device for each chosen frequency of cyclic operation.

In general, I have provided a pair of gas discharge tubes connected in an oscillatory circuit, said circuit utilizing grid potential storage means wherein the time constants of the said grid potential storage means may be independently varied. Selective means is provided in the anode output circuits of the gas discharge tubes for the purpose of permitting the energization of a load device by the output of either of the tubes.

A better understanding of my invention may be had from the following description of a particular embodiment of my invention taken in conjunction with the accompanying drawing in which the single figure represents schematically one method of utilizing my invention.

Referring to the drawing, it will be seen that there has been provided a pair of gas discharge tubes, 1 and 2, having cathodes, 3 and 4, respectively, anodes, 5 and 6, respectively, and control grids, 7 and 8, respectively. A direct current source of potential 9 is supplied to the system, a portion of which is utilized for grid bias on the gas discharge tubes. This biasing potential is controlled and regulated by means of a voltage regulator 10 and a potential divider, the latter comprising two resistors, 11 and 12. It will be obvious that the ratio of the values of the resistors forming the potential divider may be chosen to bias the gas discharge tubes to any desired level. The anode 5 of the gas discharge tube 1 is connected to one side of a reversing switch 21 and also to a capacitor 19. In the

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charging circuit of capacitor 19, there is provided a fixed resistor 17 and a variable resistor 16. Similarly, the anode 6 of the gas discharge tube 2 is connected to the other side of the reversing switch and to a capacitor 20. In the charging circuit of this capacitor, there is likewise provided a fixed resistor 14 and a variable resistor 13. The gas discharge tubes are provided with grid resistors, 15 and 18, respectively, the grid resistor of the gas discharge tube 1 being connected to the charging circuit of the capacitor 20 between it and the fixed resistor 14, the grid resistor 18 of the gas discharge tube 2 being connected between the capacitor 19 and the fixed resistor 17.

One of the center taps of the reversing switch 21 is connected through the coil of a relay 22 to the supply line; while the other center tap of such switch is connected through a resistor 23 to the supply line. Between the two center taps of the reversing switch there is connected a capacitor 24.

To initiate the operation of the system, the reversing switch is put in an open position and electrical energy is applied to permit the elements of the gas discharge tubes to sufficiently warm up to insure proper operation. After the tubes are sufficiently warmed, the switch may be closed to either side. For example, it is assumed that the switch is closed on the side marked "Long." When the switch is thus closed, a path of current flow will be completed through the resistor 23, the capacitor 19, and the resistors 17 and 16. A path will also be completed through the coil of the relay 22, the capacitor 20, and the resistors 13 and 14. As a result, the capacitors 19 and 20 start to charge. However, since the time constant of the circuit through capacitor 19 is less than the time constant of the circuit through capacitor 20, the anode 5 of the gas discharge tube 1 will reach firing potential before the anode 6 of the gas discharge tube 2. When the gas discharge tube 1 conducts, current flows through resistor 23, and the potential difference across the tube 1 is greatly reduced causing, in effect, a negative pulse to be transmitted across capacitors 19 and 24. The pulse across the capacitor 24 will be reflected at the anode 6 of the gas discharge tube 2 preventing its firing. This pulse is quickly dissipated, however, since the time constant of the circuit including capacitor 24 is short. At the same time the pulse across capacitor 19 is reflected on the control grid 8 of the gas discharge tube 2, further preventing the firing of such tube. Since the time constant of the circuit including

capacitor 19 is longer than that including capacitor 24, the effect of the negative pulse will exist on the control grid 8 of the gas discharge tube 2 much longer than on its anode. Therefore, although the anode 6 may reach firing potential, the control grid 8 will prevent conduction until the capacitor 19 has discharged, and when such capacitor discharges sufficiently the gas discharge tube 2 will fire, causing current to flow through the coil of relay 22, thus closing it and keeping it closed for as long as such tube 2 is conducting.

This flow of current greatly reduces the potential drop across the gas discharge tube 2 which, in effect, causes a negative pulse to be transmitted across the capacitors 20 and 24. The negative pulse across capacitor 24 is reflected at the anode 5 of the gas discharge tube 1 causing it to be extinguished. At the same time the negative pulse across capacitor 20 is reflected at the control grid 7 preventing the refiring of the gas discharge tube 1. The pulse across capacitor 24 is quickly dissipated and the anode 5 of the gas discharge tube 1 is restored to firing potential. However, because of the length of the time constant of the circuit including capacitor 20, the control grid 7 will prevent the firing of tube 1 until capacitor 20 has sufficiently discharged. When the gas discharge tube 1 fires, the operation is reversed, extinguishing the gas discharge tube 2 which allows the relay to return to its former position. The action described above is then repeated causing the continuous on and off operation of the relay.

It may be seen from the foregoing description that, because of the difference in the time constants of the circuits, the gas discharge tube 1 will conduct for a shorter time each cycle than the gas discharge tube 2. If the switch 21 had been closed to the side marked "Short," the only difference in the circuit would have been that the relay 22 would have been in the anode circuit of the gas discharge tube 1 and the resistance 23 would have been in the anode circuit of the gas discharge tube 2. This would mean that the relay would have been closed for a shorter time each cycle.

Further, it may be seen that by varying either or both of the resistors 13 and 16, any desired periodicity of operation, and any relay closed-time duration may be obtained, within the limits of the particular elements of the circuit.

The positive grid bias is utilized and so chosen to cause the firing of the gas discharge tubes 1 and 2 before the grid charging curve deviates from its linear slope.

While I have described my invention in a particular arrangement for the purpose of illustration, it will be understood that the general principles of my invention may be applied to other and widely varied organizations without departing from the spirit of my invention and the scope of the appended claims.

What I claim is:

1. In a control circuit, a source of direct current potential, a first gas discharge tube, having a cathode, an anode and a control grid, a second gas discharge tube having a cathode, an anode and a control grid, a point of fixed reference potential, said cathodes being connected to said point, a source of positive biasing potential connected to both of said control grids, a first ca-

pacitor-resistor network constituting a potential storage means connecting the output of said first tube to the control grid of said second tube, the potential stored in said first network being applied between the cathode and control grid of said second tube, a second capacitor-resistor network constituting a second potential storage means connecting the output of said second tube to the control grid of said first tube, the potential stored in said second capacitor-resistor network being applied between the cathode and control grid of said first tube, a capacitance connecting the outputs of both of said tubes, a load device, an impedance, a switching device connecting said load device in series with the space discharge path of either of said tubes and said source of direct current potential and simultaneously connecting said impedance in series with the space discharge path of the other of said tubes and said source of direct current potential.

2. In a control circuit, a source of direct current potential, a first gas discharge tube, having a cathode, an anode and a control grid, a second gas discharge tube having a cathode, an anode and a control grid, a point of fixed reference potential, said cathodes being connected to said point, means providing a source of positive biasing potential connected to both of said grids, a first capacitor-resistor network connecting the output of said first gas discharge tube to the control grid of said second gas discharge tube, the potential stored in said first capacitor-resistor network being applied between the cathode and control grid of said second gas discharge tube, a second capacitor-resistor network connecting the output of said second gas discharge tube to the control grid of said first gas discharge tube, the potential stored in said second capacitor-resistor network being applied between the cathode and control grid of said first gas discharge tube, the time constants of said capacitor-resistor networks being independently variable, a load device, an impedance, a switching device connecting said load device in series with the space discharge path of either of said gas discharge tubes and said source of direct current potential, said switching device simultaneously connecting said impedance in series with the space discharge path of the other of said gas discharge tubes and said source of direct current potential.

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