

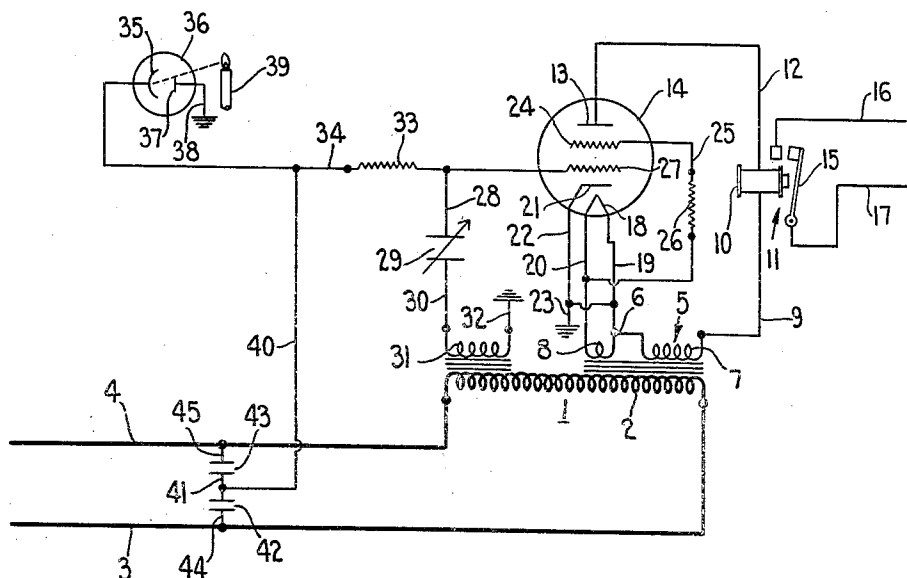
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ELECTRON TUBE CIRCUIT

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## ELECTRON TUBE CIRCUIT

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4 Claims. (Cl. 250—41.5)

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This invention relates to electron control circuits and more particularly to the control of electric loading means, such as a relay by electronic means.

An object of the invention is to provide an electron tube circuit which will be sensitive and certain in operation.

Another object is to provide an electron tube circuit controllable by light sensitive means.

Another object is to provide an electron tube circuit controlled by a photo-electric tube in which a minimum of light ray impingement on the cell is required to render the tube conductive.

Another object is to provide a photocell control for an electron tube circuit such that the tube circuit will be blocked upon shorting of the cell circuit or opening of the cell circuit.

The invention consists in the novel arrangement and cooperative relation of parts to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing, to be taken as a part of this specification, there is fully and clearly illustrated a preferred embodiment of the invention, in which drawing the figure is a schematic view showing the wiring diagram for the electron control means.

Referring to the drawing by characters of reference, 1 designates generally a transformer having its primary coil 2 supplied with alternating current via lead wires 3, 4 from a 110 v. source of potential. The transformer 1 has a secondary coil 5 provided with an intermediate tap 6 such that the end turns or coil 7 will provide 142 v. for the plate potential and such that the turns or coil 8 will provide a 6 v. potential for heating the tube filament. The positive terminal of the coil 7 is connected by a lead wire 9 to one terminal of a coil 10 of a relay or loading means 11 which has its other coil terminal connected by a lead wire 12 to the plate or anode 13 of an electron tube 14 preferably of the pentode gas charged type, such for example as an RCA #2051. The relay 11 has an armature 15 controlling a circuit having lead wires 16, 17 which may be connected to an electric valve, for example, or any other electrically energizable means. The tube 14 has a cathode heating filament 18 connected by lead wires 19, 20 respectively to the coil tap 6 and the negative terminal of the coil 8. The tube cathode 21 to be heated by the filament 18 is connected by a lead wire 22 to the filament lead wire 19 and is connected to ground by a lead wire 23 connected to the

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lead wire 22. The screen grid 24 of the tube 14 is connected to the filament lead wire by a lead wire 25 having inserted in series therein a resistor 26, preferably having a resistance of say 5 megohms. The control grid or electrode 27 is connected by a lead wire 28 to one terminal of a variable condenser 29 which may have a range of say ten to 60 mmf. and which has its other terminal connected by a lead wire 30 to the negative terminal of a secondary coil 31 of the transformer 1, having its positive terminal connected to ground by a lead wire 32, and of say 24 v. potential. The electrode 27 is connected at the lead wire 28 to a resistor 33 having a resistance of say 5 megohms. The other terminal of the resistor 33 is connected by a lead wire 34 to the cathode 35 of a photo-electric cell 36 having its anode 37 connected to ground by a lead wire 38. The cell 36 is energized by the impingement upon the cathode of light rays from a light source 39 such as a pilot burner which may serve to ignite a main burner having its fuel supply controlled by the relay 11. The photocell lead wire 34 is connected by a lead wire 40 to a lead wire 41 interconnecting one of each of the terminals of balancing condensers 42, 43 having their other terminals connected by lead wires 44, 45 respectively to the line wires 3 and 4 respectively. The condensers 42 and 43 may have capacities of say 50 mmf. and 200 mmf. respectively.

The operation of this control circuit is as follows. With the source of potential connected to the lead wires 3, 4 and the light source 39 extinguished, the tube 14 will be deenergized with the screen and control grids 24 and 27 respectively blocking current flow, and therefore holding the relay 11 deenergized. The negative bias on the screen grid 24 controls the extent to which the electrode 27 must become more positive or less negative in order for the tube 14 to fire or become conductive. The variable condenser 29 determines the negative bias on the electrode 27 which will render the tube 14 non-conductive at the potential of 142 v. on the plate 13. By employing the balancing condensers 42, 43, a negative bias is placed on the electrode 27 in opposite phase to the bias of the transformer coil 31. The extent of the negative bias by the balancing condensers 42, 43 is such as to reduce the amplitude of the biasing potential of the coil 31 so that the negative swing of the electrode 27 is held at the minimum or cut-off at the plate potential. When the pilot burner 39 is ignited, so that the light rays impinging on the cathode 35 render the cell 36 conductive, then there will be a nega-

tive drain of electrons from the balancing condensers 42, 43, thereby rendering the electrode 27 less negative and sufficiently positive for energization of the tube 14. Accordingly, current will flow from the anode 13 to the cathode 21 and through the relay coil 10, thereby closing the control circuit 16, 17. The resistor 33 is a safety means which renders the tube 14 non-conductive in the event of a short circuit of the photocell circuit which includes the lead wire 40 and condensers 42, 43. If a short circuit of the photocell circuit occurs, then the positive potential of the condensers 42, 43 will be shorted to ground with the result that the negative bias of the variable condenser 29 on the electrode 27 will block current flow through the tube 14.

Since the negative bias of the electrode 27 is at the minimum safe value and the amplitude of the swing of the negative potential is reduced by the out of phase negative bias, the extent to which the photocell 36 must be rendered conductive is held at a very low level, thereby conserving and materially extending the life of the cell 36.

What is claimed and is desired to be secured by Letters Patent of the United States is:

1. A control apparatus comprising an electron tube having an anode, a cathode and a control electrode, a circuit connecting said anode and said cathode, means to supply alternating current to said circuit, load means in and to be energized by current flow in said circuit, means to bias said control electrode negatively in phase with said alternating current to block current flow in said circuit, unidirectional light sensitive means connected to said control electrode and operable when energized to render said control electrode less negative for current flow in said circuit, and means to bias said control electrode negatively in opposite phase to said first-named bias thereby to reduce the amplitude of the biasing potential so that the sensitivity of said light sensitive means is increased, said last-named biasing means comprising a pair of balancing condensers connected across said current supply means, and a balancing circuit from the center tap of said condensers to said electrode.

2. A control apparatus comprising an electron tube having an anode, a cathode and a control electrode, a circuit connecting said anode and said cathode, means to supply alternating current to said circuit, load means in and to be energized by current flow in said circuit, means to bias said control electrode negatively in phase with said alternating current to block current flow in said circuit, unidirectional light sensitive means connected to said control electrode and operable when energized to render said control electrode less negative for current flow in said circuit, balancing condensers connected across said current supply means, a balancing circuit connecting the center tap of said condensers to said control electrode so as to apply to said electrode a negative bias in opposite phase to said first-named bias thereby to reduce the amplitude of the biasing potential so that the sensitivity of said light sensitive means is increased, and a resistance interposed between said first-named and said second-named biasing means so that a short circuit on the light sensitive means side and sec-

ond-named biasing means side of said resistance will render said control electrode sufficiently negative to block current flow in said tube.

3. A control apparatus comprising a pentode type gas filled electron tube having an anode, a cathode, a screen grid, a control grid and a filament for heating said cathode, a transformer, a main circuit for supplying alternating current to the primary of said transformer, a secondary coil having end terminals and an intermediate tap, a tube circuit connecting said tap to said cathode and connecting one of said terminals to said anode, load means in and to be energized by current flow in said tube circuit, a circuit for said filament connected to said tap and to the other of said terminals, a circuit having a resistor therein and connecting said screen grid to said other terminal, a photo-electric cell having an anode and a cathode and having its anode connected to ground, a control circuit connecting said cell cathode to said control grid, a resistor in said control circuit, a secondary below ground coil for said transformer and having one terminal connected to ground and having a biasing circuit connecting its other terminal to said control circuit on the control grid side of said control circuit resistance, said other terminal of said below ground coil being negative when said anode is positive so as to bias said control grid negatively in phase with current flow to said tube anode, balancing condensers connected across said main circuit and having a balancing circuit connected to said control circuit on the cell side of said control circuit resistance thereby to bias said control grid in opposite phase to said biasing circuit, and a condenser in said biasing circuit determining the amplitude of the negative potential on said control grid.

4. A control apparatus comprising an electron tube having an anode, a cathode and a control electrode, a transformer having a secondary coil, load means, a circuit connecting said coil and said load means to said anode and said cathode, a control circuit connecting said control electrode to ground, a unidirectional light sensitive resistance means in said control circuit, a resistor in said control circuit between said resistance means and said electrode, said transformer having a secondary below ground coil with one terminal connected to ground, a biasing circuit connecting the other terminal of said below ground coil to said control circuit between said resistor and said electrode, said other terminal being negative when said anode is positive so as to bias said control electrode negatively when said anode is positive, a main circuit for supplying alternating current to the transformer primary coil, balancing condensers connected across said main circuit, a balancing circuit connecting the center tap of said balancing condensers to said control circuit between said resistance means and said resistor so as to apply a negative potential to said control circuit when said anode is negative, and a condenser in said biasing circuit determining the amplitude of the negative potential on said control electrode when said anode is positive.

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