

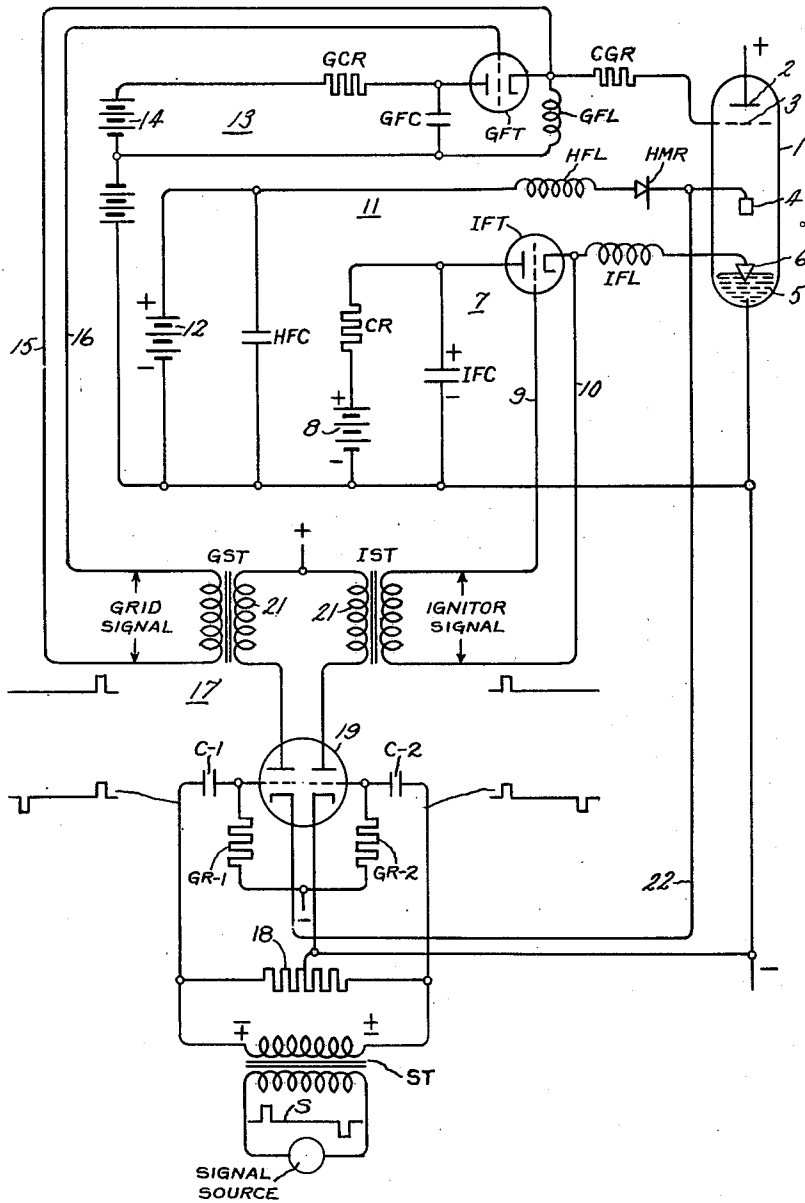
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EXCITATION AND CONTROL SYSTEM FOR ELECTRONIC DEVICES

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EXCITATION AND CONTROL SYSTEM FOR
ELECTRONIC DEVICES

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This invention relates to excitation and control systems for electronic devices and more particularly to an arrangement for controlling the ignitor and control grid circuits of an electronic valve such as an ignitron.

Electric valves of the ignitron type are provided with a main anode, a control grid, a mercury pool cathode, an ignitor element immersed in the mercury pool for causing ionization thereof, and an excitation or holding anode, the function of which is to maintain for a short time the cathode spot established by the flow of current through the ignitor element and the mercury pool. Thus the excitation and control circuits for ignitron tubes must establish a cathode spot by passing a pulse of current through the ignitor circuit. This cathode spot is maintained by the holding or excitation anode for a period of time after flow of current through the ignitor has ceased. Subsequently, the control grid is energized with a positive voltage and conduction through the cathode and main anode circuit is established. The control grid must be maintained negative until after the cathode spot has been established since damage to the tube will result if a positive potential is applied to the control grid before the cathode spot has been established. Of course, the control grid must be made negative after the conducting period in order to maintain proper control of the tube.

From the above it is clear that precise timing of the instant at which the control grid is rendered positive is a prerequisite to precise timing in the initiation of conduction through the cathode-anode circuit of the tube and also that the application of a negative voltage to the control grid following the conduction period is vital in order to maintain proper control of the tube.

In known arrangements for controlling ignitron type tubes it has been the practice to derive an electrical quantity from the holding anode circuit and to use such quantity for purposes of rendering the control grid of the ignitron effective to cause conduction through the tube. With such an arrangement, however, it is not always possible to obtain the desired degree of precision in the timing of the instant at which operative energization of the control grid is accomplished.

An object of the invention is to provide an improved excitation and control system for electronic valves of the ignitron type which is characterized by greater precision in the timing of the energization of the excitation and control elements of the tube.

Another object of the invention is to provide an improved control arrangement for use in conjunction with ignitron tubes which prevents the application of a firing signal to the ignitron control grid unless a suitable cathode spot has already been properly established.

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According to the invention, a control grid of an ignitron is energized after the energization of the ignitor firing circuit by means of a suitable signal supplied from a signal source through tube means arranged in push-pull relationship.

In accordance with one feature of the invention, the potential of a control electrode in the ignitron tube envelope is dependent upon the condition of ionization of the ignitron and is used to provide a control signal for controlling the ignitron control grid.

The single figure of the drawing schematically shows an ignitron control and excitation arrangement embodying a specific form of the invention.

In the drawing the numeral 1 designates the enclosing envelope for an ignitron tube having an anode 2, a control grid 3, a holding or excitation anode 4, a mercury pool cathode 5, and an ignitor element 6.

Ignitor element 6 effectively initiates ionization within the envelope 1 when properly energized by the ignitor firing circuit generally designated by the numeral 7. Firing circuit 7 includes an ignitor firing reactor IFL, an ignitor firing tube IFT, an ignitor firing capacitor IFC, a resistor CR and a bias indicated by the battery 8. Firing circuit 7 is controlled by means of a signal supplied through conductors 9 and 10 to the grid of tube IFT. Thus a charge accumulated on capacitor IFC from the source of potential 8 is allowed to discharge through ignitor 6 and reactor IFL when a suitable signal is supplied to the grid of tube IFT.

Auxiliary electrode or holding anode 4 is energized by the excitation circuit generally indicated by the numeral 11. Excitation circuit 11 includes a source of potential indicated by the battery 12, capacitor HFC, reactor HFL, and unidirectional conducting device HMR. Since the potential of holding anode 4 is positive with respect to the cathode 5, a cathode spot will be maintained and ionization extended due to the action of holding anode 4 and its excitation circuit 11.

The control grid 3 is controlled by means of the control circuit generally designated by the numeral 13. Control grid 3 is normally at negative potential. Capacitor GFC is charged through resistor GCR from source 14. When a suitable signal is supplied to the control grid of grid firing tube GFT, the grid firing capacitor GFC is allowed to discharge through tube GFT and grid firing reactor GFL. In this way control grid 3 is driven positive and conduction through the ignitron is initiated. The control signal for grid firing tube GFT is supplied through conductors 15 and 16.

The precise timing of the instant of operative energization of control grid 3 with respect to the initiation of ionization within the envelope 1 by means of the ignitor 6 is accomplished in accord-

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ance with the invention by means of the timing circuit generally indicated by the numeral 17. This circuit includes a signal transformer ST, the primary winding of which is energized from a suitable signal source which produces a signal such as is represented at S. Resistor 18 is connected across the terminals of the secondary winding of signal transformer ST and the midpoint of resistor 18 is interconnected with the cathode of the ignitron. The grids of double triode 19 are connected through suitable capacitors such as C-1 and C-2 to the terminals of resistor 18 and the secondary winding of transformer ST. The grids of double triode 19 are also connected through resistors GR-1 and GR-2 respectively to a source of negative bias. One cathode of double triode 19 is connected to the cathode of the ignitron and the other cathode of double triode 19 is connected to holding or excitation anode 4. The anodes of double triode 19 are connected to a positive potential through the primary windings of transformers GST and IST as indicated. Thus when transformer winding 20 is energized a signal will be supplied to ignitor firing tube IPT and will cause the ignitor firing circuit 7 to conduct and establish a cathode spot within the ignitron. When winding 21 is conductive a signal will be supplied to the grid of grid firing tube GFT and that tube in turn will cause the control grid 3 of the ignitron to become positive thereby to allow conduction through the ignitron.

When a signal such as the positive portion of the signal S is supplied to signal transformer ST so that the right-hand terminal thereof is positive and the left-hand terminal is negative, the right-hand portion of double triode 19 will be rendered conductive and the left-hand portion, being supplied with negative bias, will be held off. In this way, the transformer IST is energized and the ignitor 6 in turn is effective to establish a cathode spot within the tube. Subsequently at a predetermined time after the establishment of the cathode spot a signal such as the negative portion of signal S will cause the left-hand terminal of transformer ST and impedance 18 to become positive and the right-hand terminal thereof to become negative. This causes the left-hand portion of double triode 19 to conduct and through the action of transformer GST and control circuit 13 the control grid 3 of the ignitron is driven positive so that conduction through the ignitron is initiated. It will be observed that the time of energization of control grid 3 is dependent upon the time interval between the positive and negative portions of the signal S.

As already pointed out the control grid 3 should not become positive unless the cathode spot has been properly established. In accordance with another feature of the invention, the left-hand portion of the double triode 19 is arranged to conduct current only if the holding anode 4 has been properly energized. In order to achieve this purpose, the left-hand cathode of double triode 19 is connected through conductor 22 with the holding anode 4. If the holding anode 4 is not conducting current and hence is at such a potential as to indicate that a cathode spot has not been established within the ignitron, the potential of the left-hand cathode of double triode 19 will be such that the signal supplied to the left-hand grid element of double triode 19 will be incapable of causing the left-hand portion of double triode 19 to conduct. Thus, if the cathode spot has not been established it is not possible

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to energize control grid 3 with positive potential. Of course, if the cathode spot has been established, then the potential of the left-hand cathode of double triode 19 will be such with respect to the left-hand grid thereof as to allow conduction when a suitable control signal is supplied thereto. Obviously two separate triodes could be used instead of double triode 19 if desired.

Thus, it will be seen that by the invention an improved precisely timed operation of the control grid of a tube such as an ignitron is achieved with such operation being independent of small variations in the instant of cathode spot initiation by the ignitor element. Furthermore, by means of the holding or excitation anode potential, the energization of the ignitron control grid is rendered impossible unless the cathode spot has been established.

While I have shown and described particular embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention in its broader aspects and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, electric valve means of the ionizable medium type having a cathode, an ignitor, and a control grid, a firing circuit for energizing said ignitor, a control circuit for said grid, first electric valve control means for controlling the energization of said firing circuit, second electric valve control means for controlling the energization of said control circuit, a signal source for producing a first signal and a second signal, the time between said signals being predetermined, circuit means interconnecting said source and both said valve control means for supplying each of said signals to each of said valve control means, each of said signals being effective to render one of said valve control means conductive and being ineffective to cause the other of said valve control means to conduct current.

2. In combination, electric valve means of the ionizable medium type having a cathode, an ignitor, and a control grid, a firing circuit for energizing said ignitor, a control circuit for said grid, first electric valve control means for controlling the energization of said firing circuit, second electric valve control means for controlling the energization of said control circuit, a signal source for producing a first signal and a second signal, the time between said signals being predetermined, circuit means interconnecting said source and both said valve control means for supplying each of said signals to each of said valve control means, said first signal being effective to operate said first valve control means and said second signal being effective to operate said second valve control means.

3. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising first control means interconnected with said ignitor for controlling the energization thereof, second control means interconnected with said control grid for controlling the energization thereof, a signal source, circuit means interconnecting said source and said first and second

control means so that a control signal is simultaneously supplied to both said control means to cause one of said control means to be operatively energized.

4. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising first control means interconnected with said ignitor for controlling the energization thereof, second control means interconnected with said control grid for controlling the energization thereof, a signal source for producing a first signal and a second signal, the time between said signals being predetermined, circuit means interconnecting said source and both said control means for supplying each of said signals to each of said control means, each of said signals being effective to render one of said control means operable.

5. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising first control means interconnected with said ignitor for controlling the energization thereof, second control means interconnected with said control grid for controlling the energization thereof, a signal source for producing a first signal and a second signal, the time between said signals being predetermined, circuit means interconnecting said source and both said control means for supplying each of said signals to each of said control means, said first signal being effective to operate said first control means and said second signal being effective to operate said second control means.

6. In combination, electric valve means of the ionizable medium type having a cathode, an ignitor, and a control grid, a firing circuit for energizing said ignitor, a control circuit for said grid, first electric valve control means for controlling the energization of said firing circuit, second electric valve control means for controlling the energization of said control circuit, a signal source, circuit means interconnecting said signal source and both said valve means in push-pull relationship so that a control signal of one polarity is supplied to one of said valve control means and a control signal of opposite polarity is simultaneously supplied to the other of said valve control means.

7. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising first valve control means for controlling the energization of said ignitor, second valve control means for controlling the energization of said control grid, a signal source connected with both said valve control means in push pull relationship so that a control signal of one polarity is supplied to one of said valve control means and a control signal of opposite polarity is simultaneously supplied to the other of said valve control means.

8. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising first valve control means for controlling the energization of said ignitor, second valve control means for controlling the energization

of said control grid, a signal source for producing a first signal and a second signal of opposite polarity from said first signal, the time between said signals being predetermined, circuit means interconnecting said signal source and said first and second valve control means in push pull relationship so that said first signal is effective operably to energize said first valve control means and so that said second signal is effective operably to energize said second valve control means.

9. A control arrangement for an electric valve device having a control grid, a cathode of the ionizable medium type, and an auxiliary electrode, said arrangement comprising, means including a signal source for initiating electron emission at said cathode, a control valve having a control element and a cathode and being interconnected with said control grid for controlling the energization thereof, means interconnecting said source and the control element of said control valve for rendering said control valve conductive a predetermined time after the initiation of electron emission at the cathode of said device, and circuit means interconnecting said auxiliary electrode and the cathode of said control valve so that operative energization of said control valve from said signal source is dependent upon the flow of current through said excitation anode.

10. A control arrangement for an electric valve having a control grid, a cathode of the ionizable medium type, and an excitation anode, said arrangement comprising, means for initiating electron emission at said cathode, an excitation circuit for said anode, a control valve interconnected with said control grid for controlling the energization thereof, said control valve having a control grid and a cathode, circuit means interconnecting said excitation anode and the cathode of said control valve, and means for supplying a control signal to the grid of said control valve, said signal being effective to render said control valve conductive only if said excitation anode is conducting current.

11. A control arrangement for an electric valve having a control grid, an excitation anode, a cathode of the ionizable medium type, and an ignitor for causing ionization of said medium, said arrangement comprising an excitation circuit for said excitation anode, first valve control means for controlling the energization of said ignitor, second valve control means having a cathode and a grid for controlling the energization of said control grid, a signal source connected with both said valve control means in push pull relationship so that a control signal of one polarity is supplied to one of said valve control means and a control signal of opposite polarity is simultaneously supplied to the other of said valve control means, and circuit means interconnecting the cathode of said second control valve and said excitation circuit for preventing operation of said second valve unless said excitation anode is conducting current.

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The following references are of record in the file of this patent:

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