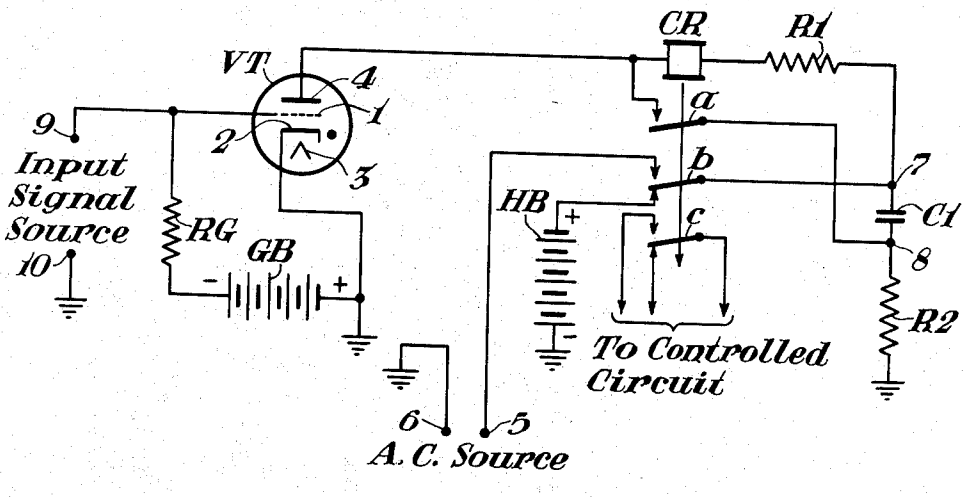
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ELECTRON TUBE CIRCUIT MEANS RESPONSIVE
TO A SIGNAL PULSE OF SHORT DURATION
Filed April 11, 1950



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ELECTRON TUBE CIRCUIT MEANS RESPONSIVE TO A SIGNAL PULSE OF SHORT DURATION

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My invention relates to electron tube circuit means responsive to a signal pulse of short duration, and more particularly to electron tube circuit means for operating a signaling circuit for a predetermined minimum time interval in response to an input signal which may be a pulse of very short duration.

The present invention is an improvement upon the electron tube circuit means described and claimed in the copending application for Letters Patent of the United States, Serial No. 155,248, filed April 11, 1950, by William Bruce Coughlin for Electron Tube Circuits Responsive to a Signal Pulse of Short Duration, the two applications being of common ownership.

It is well known that electron discharge devices of the gas filled variety have the inherent property of becoming conductive or of being fired due to the ionization of the gas. In order to deionize the gas so as to stop the conduction of the device, it is necessary to reduce the positive anode potential of the device below a certain value for a short period of time. For example, in grid-controlled gas tubes such as thyratrons the control grid is capable of preventing the tube from firing; however, after the tube has fired it is necessary to reduce the positive anode potential in order to stop the conduction of the tube.

When the anode of an electron discharge device of the gas filled variety is supplied with direct current energy the usual manner of deionizing the gas and stopping the conduction of the device is to remove the energy supplied to the anode.

It is a well known expedient to supply the anode of electron discharge devices of the gas filled variety with alternating current. When this is done the device can fire only on the alternate half cycles during which the anode potential is positive, and during the half cycles when the anode is negative the gas deionizes thereby stopping the conduction of the device.

In certain applications it is desirable that a circuit means be provided for operating a signaling circuit for a predetermined minimum time interval in response to an input signal which may be a pulse of very short duration. Also, it is desirable that a circuit means be arranged to operate a signaling circuit in response to and during an input signal of an extended duration. Furthermore, the circuit means should be capable of recurrently responding to successive input signals. A use for such a circuit means is shown in the copending application for Letters Patent of the United States, Serial No. 105,144,

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for Vehicle Reporting Systems, filed July 16, 1949, by Richard W. Treharne, Jr. In the above referred to application there is shown the apparatus for detecting the passage of a vehicle such as a train by a certain point. The passing train causes the apparatus to produce a signal or pulse of very short duration such as approximately one millisecond if the train is traveling at a high rate of speed. However, if the train should stop at or be moving very slowly by the detection point, the apparatus produces a signal of extended duration.

It is an object of my invention to provide an improved circuit means which includes an electron discharge device of the gas filled variety and wherewith a signal of a predetermined duration is effected in response to a signaling impulse of very short duration.

It is a further object of my invention to provide novel and improved circuits for deionizing an electron discharge device of the gas filled variety.

Another object of my invention is the provision of circuit means for an electron discharge device of the gas filled variety incorporating novel means to maintain a signal circuit operated when the tube is recurrently ionized and deionized in response to an input signal of some duration.

It is another object of my invention to provide an improved circuit means for operating a signaling circuit for a predetermined minimum time interval in response to an input signal produced by the apparatus used in the above referred to Vehicle Reporting System.

Other objects of my invention and features of novelty therein will be apparent from the following description taken in connection with the accompanying drawing.

In practicing my invention I provide an electron discharge device of the gas filled variety such as a thyratron tube having an anode, a cathode, and a control electrode. The tube is provided with an anode circuit which includes in series a timing resistor and the winding of a control relay. The anode circuit is normally supplied with energy from a direct current source by a circuit including a back contact of the relay, and when the control relay is picked up, the anode circuit is supplied with energy from an alternating current source by a circuit including a front contact of the relay. The voltage of both the direct current source and the alternating current source are preferably high enough to render the tube conductive; however, the control electrode is normally biased in a negative

direction to thereby render the anode circuit ineffective to fire the tube. The circuit operation is such that when the signal applied to the control electrode overcomes the bias of the control electrode, the tube is rendered conductive and the control relay picks up its contacts. A capacitor in series with a resistor is connected across the anode circuit, and the capacitor is normally charged to the potential of the direct current source. Thus, when the control relay in picking up opens its back contacts, a current flows through the anode circuit due to the partial discharging of the capacitor and thereby causes the relay to continue to pick up and close its front contacts. When the control relay closes its front contacts, the alternating current source supplies energy to the anode circuit so that during the negative half cycles of the alternating current the tube becomes deionized and thereby permits the control electrode to regain control of the conduction through the tube. Also when the control relay closes its front contacts, the partially discharged capacitor is connected in multiple with the control relay and timing resistor by a circuit which includes one of the front contacts of the control relay. The capacitor then discharges causing a current to flow through the relay and the timing resistor so that the relay remains in the picked up position for a short period of time, for example, one second. Thus, if the signal applied to the control electrode is a pulse of short duration, the relay is picked up for approximately one second, and if the signal is of extended duration the pulsating current through the control relay will cause the relay to remain picked up. Under either condition, the relay is picked up for at least approximately one second after which time the relay returns to its normal position and may be operated again in a similar manner. It can readily be seen that the device which is to be operated by this circuit means can be governed over the contacts of the control relay.

I shall describe one form of circuit means for operating a signaling circuit for a predetermined minimum time interval in response to an input signal which may be a pulse of very short duration, which circuit means comprises a preferred embodiment of my invention and is adapted for use with a vehicle detection system. I shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing a preferred embodiment of my invention.

Referring to the drawing, the apparatus here shown comprises a thyratron tube VT having a control electrode or grid 1, a cathode 2, a heater 3 and an anode 4. The apparatus also includes a control relay CR, a first resistor R1; a second resistor R2; a capacitor C1; a high voltage direct current source HB; a suitable source of alternating current energy not shown connected to terminals 5 and 6, which provides the proper voltage for operating the apparatus; a resistor RG and a battery GB for applying a direct current bias voltage between the grid 1 and the cathode 2 of tube VT; and an input signal source, not shown, connected to terminals 9 and 10 for producing the input signal which causes the circuit to operate.

The apparatus is shown in its normal condition; that is, the input signal source is inactive, thyratron tube VT is non-conducting, and the control relay CR is in its deenergized position. The anode 4 of tube VT is connected to the positive terminal of the source of direct current HB by a circuit that may be traced from the anode, through the winding of relay CR, through the timing resistor R1, and over back contact *b* of relay CR to the positive terminal of battery HB. The cathode 2 of tube VT is connected to the negative terminal of battery HB by a common ground connection as indicated on the drawing. Capacitor C1 is charged to a potential equal to that of the direct current source HB by a circuit that may be traced from terminal 7 of capacitor C1, over back contact *b* of relay CR to the positive terminal of battery HB and from the negative terminal of battery HB by means of the common ground connections through resistor R2 to terminal 8 of capacitor C1. The resistance of resistor R2 is proportioned and arranged so as to limit the value of the initial surge of current charging capacitor C1 to a suitable value. In order to simplify the drawing, the circuit for supplying energy to the heater 3 of tube VT is not shown. The control electrode or grid 1 of tube VT is biased negatively by a source of direct current that is applied over a circuit that may be traced from the grid 1, through resistor RG to the negative terminal of battery GB, and from the positive terminal of battery GB to the cathode 2 of tube VT. The parts are arranged and proportioned so that the negative potential applied to the grid 1 with respect to the cathode 2 sufficiently biases tube VT to thereby prevent the firing of, or conduction through tube VT even though the proper positive operating potential is applied to the anode 4 with respect to the cathode 2. It is to be understood that other well known means for biasing thyratron tubes may be used and that my invention is not limited to the method herein shown.

The input signal source, not shown, which produces the input signal that causes the circuit to operate is connected to terminals 9 and 10 which are respectively shown connected to the grid 1 of tube VT and to the cathode 2 by means of the common ground connections as indicated.

It is well known in the art that with a thyratron tube, even though a large positive potential is applied to the anode with respect to the cathode if the potential with respect to the cathode applied to the control electrode or grid is more negative than a certain value, depending upon the magnitude of the anode potential, the tube is considered to be non-conductive by virtue of the fact that the gas therein is not ionized. However, when the potential applied to the grid is less negative than this certain value, the tube is said to be fired or rendered conductive in that ionization of the gas therein takes place.

From the foregoing, it will be seen that when the input signal source is made active and the input signal supplied from the input signal source overcomes the negative grid bias voltage applied to tube VT, the tube will be fired or become conductive. As a result of tube VT becoming conductive a current, hereinafter referred to as the anode current, flows through a circuit that may be traced from the positive terminal of battery HB, over back contact *b* of relay CR, through resistor R1, through the winding of relay CR, through the tube VT from the anode 4 to the cathode 2, and thence to the negative terminal of battery HB by means of the common ground connections. The parts are arranged and proportioned so that the anode current which flows through the winding of relay CR energizes the relay causing it to pick up its contacts.

When relay CR picks up its contacts, the previously traced circuit established over its back contact *b* is opened and thus the anode current supplied by battery HB is interrupted. However, anode current will flow through a circuit that may be traced from terminal 7 of capacitor C1, resistor R1, relay CR, the tube space from the anode 4 to the cathode 2 of tube VT, the common ground connections, and resistor R2 to terminal 8 of capacitor C1. The capacitance of capacitor C1 and the value of the circuit resistance comprising the sum of the resistances of resistors R1 and R2, relay CR and the anode to cathode resistance of tube VT are proportioned so that the current that flows through the winding of relay CR due to the discharging of capacitor C1 causes relay CR to continue to pick up and close its front contacts.

When relay CR picks up its contacts and front contact *b* is closed, a circuit is completed that may be traced from terminal 5 of the alternating current source, over front contact *b* of relay CR, through resistor R1, the winding of relay CR to the anode 4 of tube VT and from the cathode 2 to terminal 6 of the alternating current source by means of their common ground connections. Also when relay CR picks up its contacts and front contact *a* is closed, a capacitor discharging circuit is completed which may be traced from terminal 7 of capacitor C1, through resistor R1, through the winding of relay CR, and over front contact *a* of relay CR to terminal 8 of capacitor C1. It will also be noted that resistor R2 is connected in multiple with the anode 4 and cathode 2 of tube VT by a circuit that may be traced from the anode 4, over front contact *a* of relay CR, through resistor R2 and by means of their common ground connections to the cathode 2 of tube VT. Thus, when the contacts of relay CR are in their picked up positions, the alternating current source connected between terminals 5 and 6, is connected in series with the charged capacitor C1, which is connected in multiple with the control relay CR and resistor R1, and the anode-cathode circuit of tube VT which is connected in multiple with resistor R2.

It is obvious that the potential applied to the anode 4 with respect to the cathode 2 of tube VT by the previously traced circuit will be at any instant the algebraic sum of the voltage across the capacitor C1 and the voltage of the alternating current source and obviously the potential applied to the anode 4 with respect to the cathode 2 may be at times either positive or negative. Therefore, it can be seen that during the time that the potential applied to the anode 4 with respect to the cathode 2, is negative, the gas within the tube VT becomes deionized and there is no conduction through the tube. Also, during the time that the potential applied to the anode 4 with respect to the cathode 2, is positive and greater than the ionizing potential of the tube, the gas within the tube VT becomes ionized and there is conduction through the tube provided that the input signal supplied from the input signal source overcomes the negative grid bias voltage applied to the tube VT. The current that flows through the previously traced circuit when there is conduction through the tube VT charges capacitor C1 to a voltage that is somewhat less than the peak voltage of the alternating current source.

Since the charged capacitor C1 is connected by the previously traced circuit across the series combination of resistor R1 and the winding of relay CR, the capacitor discharges through the series combination. The values of the capacitance of capacitor C1 and the resistance of the winding of relay CR and resistor R1 are so proportioned that the current that flows during the discharging of capacitor C1 sufficiently energizes relay CR to cause it to continue to retain its contacts in their picked up position for a desired minimum time interval which may be approximately one second before the current decays to such a low value that the relay releases its contacts. It is obvious that the values of these circuit components may be chosen to provide greater or less time delay before the relay CR releases its contacts and that my invention is not limited to the approximately one second time delay as shown in this embodiment.

Thus, if the input signal which initiated the circuit operation described above is of extended duration, the control relay CR picks up its contacts and they remain picked up during the time the input signal is applied in addition to approximately one second immediately following the removal of the input signal depending upon the values of the circuit components in the capacitor discharging circuit.

When the control relay CR releases its contacts, the apparatus is returned to its normal condition ready to be reactuated.

When the input signal which initiates the circuit operation is a pulse of very short duration, the circuit operation is as described above except that when the control relay CR picks up its contacts thereby closing the circuit over its front contact *a*, the gas within tube VT becomes deionized and the tube will not become conductive because the negative grid bias potential applied to its control electrode on grid 1 in the absence of a suitable input signal prevents the tube from firing or becoming conductive. Thus, the contacts of the control relay having picked up remain picked up for approximately one second depending upon the values of the circuit components in the capacitor discharging circuit. When the control relay CR releases its contacts, the apparatus is again returned to its normal condition ready to be reactuated.

From the foregoing it will be seen that I have provided circuit means for operating the contacts of the control relay CR for a period of at least approximately one second from an input signal which may be a pulse of very short duration. Circuits which are to be governed by the presence or absence of an input signal may be controlled by contact *c* of relay CR as shown on the drawing. It is to be understood, however, that the arrangement of the contacts of relay CR for controlling particular circuits is not limited to that shown on the drawing but that other contact arrangements may be provided if desired.

Although my invention is especially suited for use in connection with vehicle detection systems, it should be pointed out that my invention is not limited to such use, but that it may be used in other applications where a short input signal or pulse is to be used for operating another circuit for a considerable longer period of time.

Although I have herein shown and described only one form of apparatus embodying my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a source of direct current, a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, means for supplying direct current to said circuit from said direct current source when said relay is in its deenergized position, means for supplying alternating current to said circuit from said alternating current source when said relay is in its energized position, a capacitor, means governed by said relay in its deenergized position for charging said capacitor from said direct current source, means including said charged capacitor for supplying current to said circuit from said charged capacitor during the time that said relay is operated from its deenergized to its energized position, and means governed by said relay in its energized position for discharging said capacitor through said winding of the control relay, the parts being so proportioned that said relay will be operated to its energized position in response to a predetermined condition of said control electrode.

2. In combination, a source of direct current, a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, means governed by said relay in its deenergized position for supplying direct current to said circuit from said direct current source, means governed by said relay in its energized position for supplying alternating current to said circuit from said alternating current source, a capacitor, means governed by said relay in its deenergized position for charging said capacitor from said direct current source, means including said charged capacitor for supplying current to said circuit from said charged capacitor during the time that said relay is operated from its deenergized to its energized position, means governed by said relay in its energized position for discharging said capacitor through said winding of the control relay, a source of input signal voltage, and means to connect said input signal voltage source across said control electrode and cathode, said source of input signal voltage being effective at times to render said direct current source and said alternating current source effective to fire said discharge device.

3. In combination, a source of direct current, a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and a cathode and including a winding of said relay, means governed by said relay in its deenergized position for supplying direct current to said circuit from said direct current source, means governed by said relay in its energized position for supplying alternating current to said circuit from said alternating current source, a capacitor, means governed by said relay in its deenergized position for charging said capacitor from said direct current source, means including said charged capacitor for supplying current to said circuit from said charged capacitor during the time that said relay is operated from its deenergized to its energized position, means governed by said relay in its energized position for discharging said capacitor through said winding of the control relay, and a source of bias voltage connected across said control electrode and cathode and so proportioned to normally render said direct current source and said alternating current source ineffective to fire said discharge device, a source of input signal voltage connected across said control electrode and cathode, and said source of input signal voltage being effective at times to render said direct current source and said alternating current source effective to fire said discharge device.

4. In combination, a source of direct current, a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, said relay having contacts operable from a first to a second position when its winding is energized, means including one of said contacts of the control relay in its first position for supplying direct current to said circuit from said direct current source, means including one of said contacts of the control relay in its second position for supplying alternating current to said circuit from said alternating current source, a capacitor, means including one of said contacts of the control relay in its first position for charging said capacitor from said direct current source, means including said charged capacitor for supplying current to said anode circuit from said charged capacitor during the time that said contacts of the control relay are moving between their first and second positions, and means including one of said contacts of the control relay in its second position for discharging said capacitor through said winding of the control relay, the parts being so proportioned that said relay will be operated to its energized position in response to a predetermined condition of said control electrode.

5. In combination, a source of direct current, a source of alternating current, a thyratron tube having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, said relay having contacts operable from a first to a second position when its winding is energized, means including one of said contacts of the control relay in its first position for supplying direct current to said circuit from said direct current source, means including one of said contacts of the control relay in its second position for supplying alternating current to said circuit from said alternating current source, a capacitor, means including one of said contacts of the control relay in its first position for charging said capacitor from said direct current source, means including said charged capacitor for supplying current to said anode circuit from said charged capacitor during the time that said contacts of the control relay are moving between their first and second positions, means including one of said contacts of the control relay in its second position for discharging said capacitor through said winding of the control relay, and a source of bias voltage connected across said control electrode and cathode and so proportioned to normally render said direct current source and said alternating current source ineffective to fire said discharge device.

6. In combination, a first pair of terminals adapted to be connected to a source of direct current, a second pair of terminals adapted to

be connected to a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, means for connecting said circuit to said first pair of terminals when said relay is in its deenergized position, means for connecting said circuit to said second pair of terminals when said relay is in its energized position, a capacitor, means governed by said relay in its deenergized position for connecting said capacitor to said first pair of terminals, circuit means for connecting said capacitor to said circuit during the time that said relay is operated from its deenergized to its energized position, and means governed by said relay in its energized position for connecting said capacitor across said winding of the control relay, the parts being so proportioned that when said terminals are connected to said sources of current said relay will be operated to its energized position in response to a predetermined condition of said control electrode.

7. In combination, a first pair of terminals adapted to be connected to a source of direct current, a second pair of terminals adapted to be connected to a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, means governed by said relay in its deenergized position for connecting said circuit to said first pair of terminals, means governed by said relay in its energized position for connecting said circuit to said second pair of terminals, a capacitor, means governed by said relay in its deenergized position for connecting said capacitor to said first pair of terminals, circuit means for connecting said capacitor to said circuit during the time that said relay is operated from its deenergized to its energized position, means governed by said relay in its energized position for connecting said capacitor across said winding of the control relay, and a third pair of terminals adapted to be connected to a source of input signal voltage and connected across said control electrode and cathode, the parts being so proportioned that when said terminals are connected to said sources of current and voltage, said source of input signal voltage will be effective at times to render said direct current source and said alternating current source effective to fire said discharge device.

8. In combination, a first pair of terminals adapted to be connected to a source of direct current, a second pair of terminals adapted to be connected to a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, means governed by said relay in its deenergized position for connecting said circuit to said first pair of terminals, means governed by said relay in its energized position for connecting said circuit to said second pair of terminals, a capacitor, means governed by said relay in its deenergized position for connecting said capacitor to said first pair of terminals, circuit means for connecting said capacitor to said circuit during the time that said relay is operated from its deenergized to its energized position, means governed by said relay in its energized position for connecting said capacitor across said winding of the control relay, a third pair of terminals adapted to be connected to a source of bias voltage and connected across said control electrode and cathode, and a fourth pair of terminals adapted to be connected to a source of input signal voltage and connected across said control electrode and cathode, the parts being so proportioned that when said terminals are connected to said sources of current and voltage, said source of bias voltage will normally render said direct current source and said alternating current source ineffective to fire said discharge device, and said source of input signal voltage will be effective at times to render said direct current source and said alternating current source effective to fire said discharge device.

9. In combination, a first pair of terminals adapted to be connected to a source of direct current, a second pair of terminals adapted to be connected to a source of alternating current, a gas-filled electron discharge device having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, said relay having contacts operable from a first to a second position when its winding is energized, means including one of said contacts of the control relay in its first position for connecting said first pair of terminals to said anode circuit, means including one of said contacts of the control relay in its second position for connecting said second pair of terminals to said anode circuit, a capacitor, means including one of said contacts of the control relay in its first position for connecting said capacitor to said first pair of terminals, circuit means for connecting said capacitor to said anode circuit during the time that said contacts of the control relay are moving between their first and second positions, and means including one of said contacts of the control relay in its second position for connecting said capacitor to said winding of the control relay, the parts being so proportioned that when said terminals are connected to said sources of current said relay will be operated to its energized position in response to a predetermined condition of said control electrode.

10. In combination, a first pair of terminals adapted to be connected to a source of direct current, a second pair of terminals adapted to be connected to a source of alternating current, a thyratron tube having an anode, a cathode and a control electrode, a control relay, a circuit connected across said anode and cathode and including a winding of said relay, said relay having contacts operable from a first to a second position when its winding is energized, means including one of said contacts of the control relay in its first position for connecting said first pair of terminals to said anode circuit, means including one of said contacts of the control relay in its second position for connecting said second pair of terminals to said anode circuit, a capacitor, means including one of said contacts of the control relay in its first position for connecting said capacitor to said first pair of terminals, circuit means for connecting said capacitor to said anode circuit during the time that said contacts of the control relay are moving between their first and second positions, and means including one of said contacts of the control relay in its second position for connecting said capacitor to said winding of the control relay, a third pair of terminals adapted to be

connected to a source of bias voltage and connected across said control electrode and cathode, a fourth pair of terminals adapted to be connected to a source of input signal voltage and connected across said control electrode and cathode, the parts being so proportioned that when said terminals are connected to said sources of current and voltage, said source of bias voltage will normally render said direct current source and said alternating current source ineffective to fire said tube, and said source of input signal voltage will be effective at times to render said direct current source and said alternating current source effective to fire said tube.

11. In combination, a source of direct current, a source of alternating current; a gas filled electron discharge device having an anode, a cathode and a control electrode; a control relay having a winding and front and back contacts, a first anode circuit connected across said anode and cathode and including said winding and a back contact of said relay and said direct current source, a second anode circuit connected across said anode and cathode and including said winding and a front contact of said relay and said alternating current source, a source of input signal voltage, an input circuit connected across said control electrode and cathode and including said source of signal voltage, said input signal voltage source poled to render said direct current source and said alternating current source effective to fire said discharge device, a capacitor, a first circuit means including a back contact of said relay connecting said capacitor to said direct current source to charge the capacitor, a second circuit means connecting said capacitor across said relay winding to energize the relay by the discharge of said capacitor when the back contacts of the relay are opened, said capacitor by its discharge effective to pick up the relay and retain the relay picked up for a selected time interval, whereby the relay is picked up and retained picked up for said selected time interval in response to a relatively short pulse of signal voltage, is retained picked up as long as the signal voltage continues and is released when the signal voltage ceases, and a signal control circuit including a contact of said control relay.

12. In combination, a first pair of terminals to which a source of direct current may be connected, a second pair of terminals to which a source of alternating current may be connected, a third pair of terminals to which a source of bias voltage may be connected, a fourth pair of terminals to which a source of input signal voltage may be connected; a gas filled electron discharge device having an anode, a cathode and a control electrode; a control relay having a winding and front and back contacts, a first anode circuit connected across said anode and cathode and including said winding and a back contact of said relay and said first pair of terminals, a second anode circuit connected across said anode and cathode and including said winding and a front contact of said relay and said second pair of terminals, a first input circuit connected across said control electrode and cathode and including said third pair of terminals, a second input circuit connected across said control electrode and cathode and including said fourth pair of terminals, said first and second input circuits poled for said discharge device to be normally nonconductive due to a bias voltage at said third pair of terminals and for the discharge device to be fired due to a signal voltage at said fourth pair of terminals, a capacitor, a first circuit means including a back contact of said relay connecting said capacitor across said first pair of terminals for charging the capacitor, a second circuit means connecting said capacitor across said winding of said relay for supplying current to the winding due to the discharge of the capacitor when the back contacts of said relay are opened, said capacitor by its discharge through said second circuit means effective to pick up said relay and to retain it picked up for a selected time interval in response to the firing of the discharge device due to a short pulse of signal voltage at said fourth pair of terminals, said second anode circuit effective to fire the discharge device and retain the relay picked up in response to a prolonged signal voltage at said fourth pair of terminals and to deionize said device when a signal voltage ceases, and a signal control circuit including a contact of said relay.

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