

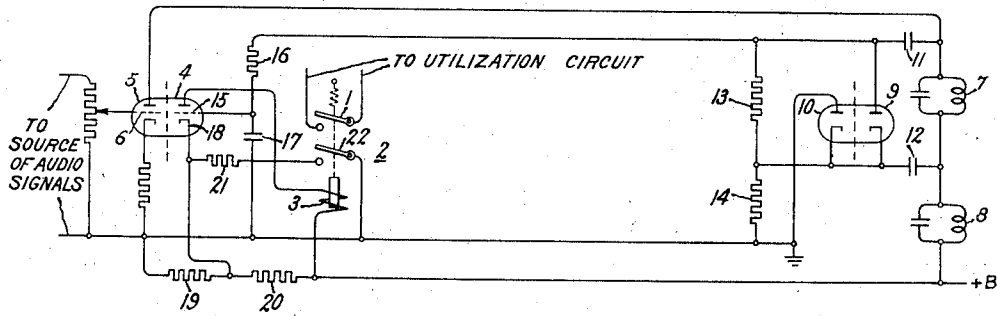
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CONTROL SYSTEM

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CONTROL SYSTEM

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Our invention relates to systems for actuating movable elements such as switch or like elements adapted to be operated to different positions for the control of load or utilization circuits or like uses, particularly to systems for operating movable elements or switch means adapted for the remote control of circuits in response to signal frequencies, and its object is the provision of an improved and simplified system of this character.

In accordance with our present invention this object is attained by actuating a movable control element by a single electron discharge device, control electrode bias potentials of which are controlled, for example, in response to the resultant of potentials derived from signals, and cathode bias potentials of which are controlled in response to change in the condition of the switch means, the control electrode bias means and the cathode bias means cooperating to cause the electron discharge device to open or to close the switch element or to maintain this element in the position to which it has been moved.

The novel features which are considered to be characteristic of our invention are set forth with particularity in the appended claims. Our invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing wherein the single figure thereof is a diagrammatic representation of an audio-signal remote control system in which our invention has been embodied.

In the drawing, a utilization circuit (not shown) is arranged to be controlled by contacts 1 of a movable element which may be a switch means or relay 2 the actuating winding 3 of which is adapted to be energized from the output circuit of a suitable electron discharge device 4, shown herein as having the same envelope as that of an electron discharge device 5.

The control electrode 6 of discharge device 5 is adapted to have signal potentials impressed thereon from a distant source (not shown) of preferably audio signals, and in series in the output circuit of device 5 are connected two parallel-resonant circuits 7 and 8 tuned respectively to two different frequencies of the audio signals. Two rectifiers 9 and 10, in back-to-back or opposed relation, are connected respectively, through condensers 11 and 12, across the resonant circuits 7 and 8. Across the rectifiers 9 and

10 respectively are connected in series two resistances 13 and 14. The rectifiers are shown herein as constituting a unitary rectifier device in a single envelope but may be separate devices each having its own envelope.

The resistances 13 and 14 in series are connected across the input circuit of electron discharge device 4 to provide the biasing potential for the control electrode 15 of the latter device, the electrode 15 being connected, in the present instance, through a filter resistor 16 to the outer terminal of the resistance 13. The control electrode 15 is connected to ground or other suitable point of reference potential of the system through a filter condenser 17. An initial positive bias is provided for the cathode 18 of discharge device 4 by connection of this cathode to a potentiometer comprising resistors 19 and 20 connected across the anode potential source. To change the cathode potential from its initial value, for a purpose to be described hereinafter, the cathode 18 is adapted to be connected to ground, or to a predetermined point of reference potential of the system which may or may not necessarily be at ground, through a resistor 21 and contacts 22 of the switch means 2.

In operation of the system illustrated in the drawing, let it be assumed initially that operating potential is being supplied to the anodes of the electron discharge devices 4 and 5 but that no signal is being impressed upon the input circuit of the latter. Therefore no bias potential is being impressed from the resistances 13 and 14 upon the control electrode 15 of the electron discharge device 4 and the potential of control electrode 15 is at ground potential or at the reference potential above-mentioned. The adjustment of the potentiometer 19, 20 is next made such that the initial potential of the cathode 18 is somewhat positive with respect to ground or reference potential and the anode current of the discharge device 4 is approximately at cut-off. Under these conditions little if any current flows through the actuating winding 3 of switch 2 and the latter is in its normal initial or open position, as illustrated.

If it be now desired to actuate the movable element or switch 2 to a second position, in the present instance to close the switch, for example, to initiate operation of the utilization circuit, an audio or tone signal at the resonant frequency of tuned circuit 8 is impressed on the control electrode 6 of discharge device 5. The potential appearing across circuit 8 is then greater than that appearing across circuit 7 since the imped-

ance of circuit 8, under this condition of signal frequency, is greater than the impedance of circuit 7. Rectification now occurs in rectifiers 9 and 10, producing direct potentials across resistances 13 and 14 in proportion to the alternating voltages across circuits 7 and 8. The rectifiers are so connected that the direct potentials are in opposition. The resultant potential between the control electrode 15 of device 4 and ground or point of reference potential is thus the algebraic sum of the potentials across resistances 13 and 14. Any alternating component in the potential impressed upon control electrode 15 is removed by the filter constituted by resistance 16 and condenser 17.

When the potential across resistance 14 is thus caused to exceed that across resistance 13 the resultant potential on the control electrode 15 of discharge device 4 becomes positive with respect to ground or point of reference potential and discharge device 4 becomes conductive. Anode current then flows in energizing winding 3 of switch 2 causing the latter to move from the open to the closed position, thereby closing contacts 1 to initiate operation of any utilization circuit connected thereto.

When switch 2 moves to the closed position as described, contacts 22 close, thereby connecting cathode 18 of discharge device 4 to ground or point of reference potential through resistor 21. The positive voltage on cathode 18 is thus reduced to such a value that upon termination of the signal of the frequency of circuit 8, and therefore of the positive voltage impressed upon the control electrode 15, the discharge device 4 remains conductive. The discharge device 4 thus continues to draw sufficient anode current to maintain switch 2 closed even though the input signal to discharge device 5 be removed.

Therefore as the result of operation of the system thus far, a short pulse of audio signal of a suitable predetermined frequency impressed upon the input of the discharge device 5 causes the switch 2 to close and to remain closed.

When desired, the switch 2 may be reopened by applying to discharge device 5 an audio signal at the resonant frequency of tuned circuit 7. The potential appearing across circuit 7 is now greater than that appearing across circuit 8 since the impedance of circuit 7, under this latter condition of signal frequency, is greater than the impedance of circuit 8. The resultant potential, produced after rectification as hereinbefore described, across resistances 13 and 14 in series is now negative with respect to ground or reference potential and the negative resultant potential impressed upon the control electrode 15 of discharge device 4 causes the latter to become non-conductive. Anode current then ceases to flow in energizing winding 3 of switch 2 permitting the latter to move from the closed position back to the open position, thereby opening contacts 1 to terminate operation of the utilization circuit connected thereto and also opening contacts 22 to permit subsequent reclosing of the switch.

Therefore, a short pulse of audio signal at a suitable predetermined frequency different from that of the first-named signal causes the switch 2 to reopen and causes the system to remain in condition for reclosing of the switch means.

In a practical example of an audio frequency control system in accordance with our invention, a relatively low signal potential, of the order of 0.5 volt, at 1000 cycles per second was found to close the switch means reliably and a like poten-

tial at 235 cycles was similarly capable of reliably opening the circuit. In the practical system above mentioned, it was found that false operation by random frequency signals, such as voice signals, was virtually impossible.

Our invention has been described herein in a particular embodiment for purposes of illustration. It is to be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims we intend to cover any such modifications as fall within the true spirit and scope of our invention.

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

1. In combination, a movable element having an actuating winding, an electron discharge device for energizing said winding, means for biasing the cathode of said device positively to maintain said winding deenergized, means for biasing the control electrode of said device positively to energize said winding, means controlled by said movable element and operating simultaneously with said last-named means for reducing said positive cathode bias to maintain said winding energized after said positive control electrode bias is removed, and means for biasing said control electrode negatively to deenergize said winding.

2. In combination, a movable element, an electron discharge device for operation thereof having a cathode and a control electrode, means for maintaining said element in one position including means for causing the potential of said cathode to become positive with respect to a predetermined initial potential of said control electrode, means for operating said element to a second position including means for causing the potential of said control electrode to become positive with respect to said predetermined initial potential, and means for maintaining said element in said second position after the potential of said control electrode returns to said initial potential, said last-named means including means for causing the potential of said cathode to become less positive with respect to the potential of said control electrode.

3. In combination, a movable element, an electron discharge device for operation thereof having a cathode and a control electrode, means for maintaining said element in one position including means for biasing said cathode positively with respect to a predetermined reference potential and means for maintaining the potential of said control electrode at said reference potential, means for operating said element to a second position including means for biasing said control electrode positively with respect to said reference potential, and means for maintaining said element in said second position after the potential of said control electrode is returned to said reference potential, said last-named means including means for causing the biasing potential of said cathode to become less positive with respect to said reference potential.

4. In combination, a movable element, an electron discharge device for operation thereof to a plurality of positions corresponding to prearranged signals and having a cathode and a control electrode, means for maintaining said element in an initial position including means for biasing said cathode positively with respect to a predetermined reference potential and means for maintaining said control electrode at said

reference potential in the absence of said signals, means for operating said element to a second position including means responsive to one of said signals for biasing said control electrode positively with respect to said reference potential, means for maintaining said element in said second position after said one of said signals is discontinued and the potential of said control electrode is returned to said reference potential

including means to cause the potential of said cathode to become less positive with respect to said reference potential, and means to return said element to said initial position including means responsive to another of said signals for biasing said control electrode negatively with respect to said reference potential.

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