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CONTROL SYSTEM

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Fig. 1.

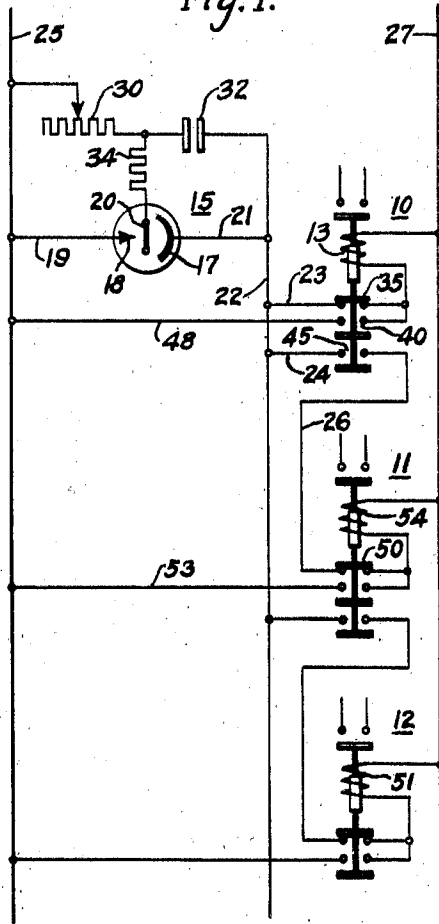
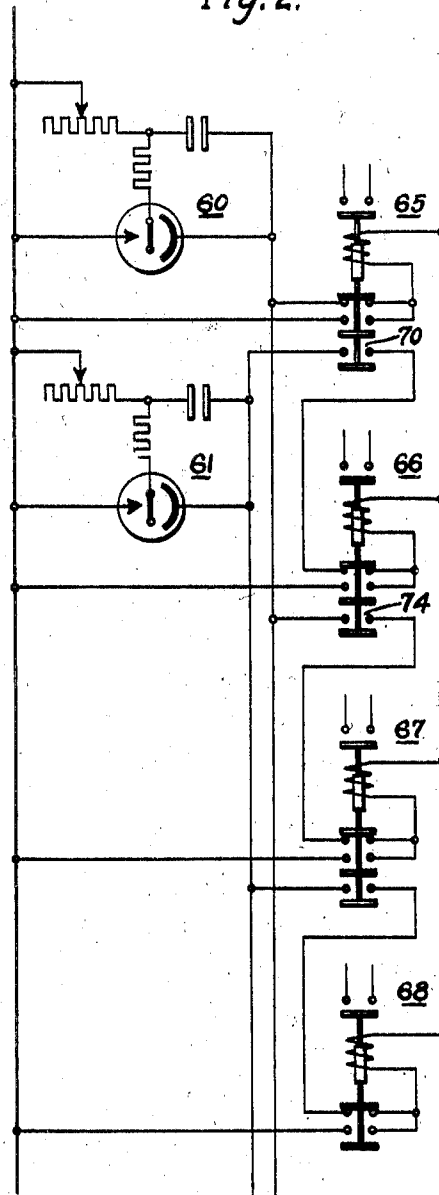


Fig. 2.



WITNESSES:

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CONTROL SYSTEM

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My invention relates to control systems and, more particularly, to control systems which may be utilized to operate a plurality of current-responsive devices.

5 An object of my invention is to provide a simple, reliable and inexpensive electrical control system for actuating a plurality of current-responsive devices in timed sequence.

10 It is also an object of my invention to provide for actuating a plurality of current-responsive devices, in timed sequence, by electronic means.

15 A more specific object of my invention is to provide for utilizing a discharge device and a timing circuit to operate a plurality of current-responsive devices which function to connect, successively, the discharge device and its associated timing circuit with each current-responsive device.

20 Other objects of the invention will hereinafter become apparent.

25 This invention, accordingly, is disclosed in the accompanying drawing and comprises the features of construction, the combination of elements and the arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

30 For a fuller understanding of the nature and the objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawing, in which,

35 Figure 1 is a diagrammatic view of a control system constructed in accordance with my invention, and

Fig. 2 is a diagrammatic view of a modified form of the control system.

40 In general, my control system provides for operating a plurality of current-responsive devices, in timed sequence, by utilizing an electric-discharge device and a timing circuit connected in circuit relation thereto. The

45 timing circuit provides for controlling the electric-discharge device, whereby the plurality of current-responsive devices may be successively actuated at definite intervals of time which depend, for their duration, upon the time constant of the timing circuit.

In order that the plurality of current-responsive devices may be operated with one discharge device, a plurality of contact fingers and contact segments are disposed to be actuated by each of the current-responsive devices. These contact fingers and segments are arranged to establish circuits whereby the discharge device and the timing circuit are successively connected in circuit with each of the current-responsive devices.

55 In other words, a definite time interval after the establishment of an energizing circuit for the timing circuit and the discharge device, depending on the time constant of the timing circuit, operation of the first of a series of current-responsive devices is effected. Operation of the first current-responsive device interrupts the circuit for the discharge device and establishes circuits whereby the second current-responsive device of the series is connected in circuit with the discharge device. After a predetermined interval of time, as determined by the time constant of the timing circuit, the discharge device functions to energize, and thus actuate, the second current-responsive device which thereupon causes the deenergization of the discharge device, and the connection of the discharge device in circuit with a third current-responsive device. According to my invention, as just broadly outlined, any number of current-responsive devices may thus be operated in timed sequence.

60 Referring to Fig. 1 of the drawing, the reference characters 10, 11 and 12 designate, generally, a plurality of current-responsive devices, such, for example, as relays which may be utilized to operate electric motors or any other electric devices. Although only three relays are shown in Fig. 1, it will be readily understood that any number of relays may be associated with the discharge device, designated generally by reference character 15.

65 The electrical-discharge device 15 is provided to actuate the relays in timed sequence. As shown, this device comprises a control electrode 20, a cathode 17 and an anode 18, which elements will be designated as the principal electrodes whenever the control

electrode 20 is subjected to potential of the proper value and sign relative to the principal electrodes, the discharge device becomes conducting, thereby permitting direct current to flow between the principal electrodes.

The timing circuit comprises a capacitor 32 and a variable resistor 30 connected in circuit with the control electrode through a current-limiting resistor 34. A source of direct-current power of appropriate voltage is connected across the anode and cathode. By appropriate adjustment of the timing circuit, the potential of the control electrode, relative to the principal electrodes, when the timing circuit is fully charged may be predetermined whereby the discharge device may be caused to function a predetermined interval of time after being connected to the source of supply.

The discharge device and its associated timing circuit and the relays are disposed to be energized from the supply conductors 25 and 27 which may be connected to any suitable source of direct-current power (not shown).

To effect the operation of the relays in timed sequence, each relay is provided with a plurality of contact fingers and contact segments. As shown, the actuating coil 13 of the relay 10 is connected in circuit with the discharge device 15 through the upper or back contact members 35. When the timing circuit has been fully charged, the discharge device functions, whereupon current flows from the positive conductor 25, through conductor 19, the principal electrodes 18 and 17 of the discharge device 15, the conductors 21, 22 and 23, the contact members 35 and the actuating coil 13, of the relay 10 to the negative conductor 27.

As will be noted, when the armature of the relay is raised, the circuit above traced is broken at the contact members 35 and, in consequence, the discharge device is deenergized. However, the momentum, acquired by the upwardly moving armature will be sufficient to cause it to continue its movement, thereby establishing a holding circuit from positive conductor 25, through conductor 48, contact members 40, and actuating coil 13, to the negative conductor 27.

Operation of the relay 10 also effects the closing of the contact members 45, whereby a circuit is established from the positive conductor 25, through conductor 19, anode 18, cathode 17, conductors 21, 22 and 24, contact members 45 of the relay 10, conductor 26, upper or back contact members 50 and the actuating coil 54 of the relay 11, to the negative conductor. Since the opening of the contact members 35 deenergizes the discharge device 15, the timing circuit is subjected to a charging action from the direct-current source of power the instant the discharge through the device 15 ceases. A predeter-

mined interval of time after this action takes effect, depending on the adjustment of the timing circuit, the discharge device again functions, thereby permitting current to flow through the actuating coil 54 by the circuit above traced. Operation of the relay 10 interrupts the circuit for the discharge device at contact members 35; establishes its own holding circuit through contact members 40; and connects the principal electrodes of the discharge device in circuit with the actuating coil 51 of the relay 12. The cycle of operation just explained may be repeated again and again, thus controlling an indefinite number of relays.

In explaining the operation of the control system, more in detail, it may be assumed that the supply conductors 25 and 27 are energized. Immediately upon the energization of the timing circuit, the capacitor 32 will begin to charge through the variable resistor 30. As will be readily understood, the rate at which the capacitor is charged depends upon the setting of the variable resistor 30. When the capacitor is charged to a predetermined extent, the control electrode 20 attains such potential, relative to the principal electrodes 17 and 18, that the discharge device becomes conducting, thereby causing the operation of relay 10, as heretofore explained.

Operation of the relay 10 causes interruption of the circuit from conductor 19 through anode 18, cathode 17 and coil 13, but, at the same instant or a trifle later, (depending upon the design of the relay) a holding circuit is established for coil 13 through contact members 40. It is, of course, apparent that the disposition of contact members 40 with reference to contact members 35 may be such that the holding circuit is established an instant before the circuit is interrupted at contact members 35. In any case, the discharge device is deenergized when the contact members of relay 10 move to their operative positions.

Operation of the contact members to circuit-closing position connects the discharge device and its timing circuit in circuit with the relay 11. Upon the establishment of this circuit, the capacitor 32 will again begin to charge through the variable resistor 30. When the capacitor is charged to a predetermined extent, the discharge device again becomes conducting, and current flows through the principal electrodes to energize the actuating coil 54 of the relay 11.

Relay 11 is, in every particular, like relay 10 and, when caused to operate, as just explained, repeats the cycle of operation effected by relay 10. It is thus apparent that the repeated functioning of the discharge device may cause the operation of any number of relays 10, 11, 12, etc., in timed sequence.

A modification of the control system shown in Fig. 1 is illustrated in Fig. 2, wherein two discharge devices 60 and 61 are utilized in-

stead of one. The functioning of these discharge devices is the same as that described for the discharge device in Fig. 1, with the exception that the relays which are to be actuated are alternately connected in circuit with the discharge device. In other words, the functioning of the discharge device 60 actuates the relay 65. Operation of the relay 65 connects the discharge device 61 and its associated timing circuit in circuit with the relay 66 through the contact members 70, of the relay 65, whereupon relay 66 is caused to operate by discharge device 61. Operation of relay 66 connects the discharge device 60 and its controlling timing circuit in circuit with the relay 67 through the contact members 74 of the relay 66. In a similar fashion, the operation of the relay 67 connects the discharge device 61 and its controlling timing circuit in circuit with the relay 68. It is evident, therefore, that any number of relays may be alternately connected to a plurality of discharge devices having equal or unequal time constants.

While the illustrated example constitutes one practical embodiment of my invention, I do not limit myself strictly to the exact details herein illustrated, since the structure may be considerably varied without departing from the spirit of the invention, as defined in the appended claims.

I claim as my invention:

1. A control system, in combination, a supply of electrical energy for the control system, an electric-discharge device having a plurality of electrodes connected in circuit relation with the supply of electrical energy, a timing circuit associated with the electrodes to control the operation of the discharge device, a current-responsive means connected in circuit with the discharge device and controlled thereby, means operated by the current-responsive means to disconnect it from the discharge device, and a holding circuit, whereby the current-responsive means is energized independently of the discharge device.

2. A control system, in combination, a plurality of current-responsive devices, a supply of electrical energy for the control system, an electrical-discharge device for controlling the current-responsive devices, the said electric-discharge device and the said current-responsive devices being connected in circuit relation with the supply of electrical energy, a timing circuit for controlling the operation of the discharge device, means for connecting the timing circuit and discharge device in circuit with one current-responsive device, and means actuated by said current-responsive device for connecting the timing circuit and the discharge device in circuit with another current-responsive device.

3. A control system, in combination, a plurality of current-responsive devices, a supply

of electrical energy for the control system, an electrical-discharge device for controlling the current-responsive devices, a timing circuit for controlling the operation of the discharge device, and means actuating by the current-responsive devices for connecting the timing circuit and the discharge device in circuit relation with the supply of electrical energy.

4. A control system, in combination, a plurality of current-responsive devices, a supply of electrical energy for the control system, an electric discharge device for controlling the current-responsive devices, means actuated by the current-responsive devices for connecting the current-responsive devices in timed sequence with the discharge device and the supply of electrical energy, and holding circuits, whereby the current-responsive devices are energized independently of the discharge device.

5. In a control system, in combination, a plurality of current-responsive devices, a supply of electrical energy for the control system, a plurality of electric-discharge devices for controlling the current-responsive devices, said electric-discharge devices and current-responsive devices being connected in circuit relation with the supply of electrical energy, means for alternately connecting the current-responsive devices in timed sequence with the discharge devices, and holding circuits, whereby the current-responsive devices are energized independently of the discharge devices.

6. A control system comprising, in combination, a plurality of current-responsive devices disposed to be operated in timed sequence, an electric-discharge device for controlling the sequential operations of the current-responsive devices, a timing circuit for controlling the operation of the electric-discharge device, circuit connections between the current-responsive devices themselves and between each of the current-responsive devices and the electric-discharge device, and means responsive to the operation of the first and each of the succeeding current-responsive devices for so establishing the circuit connections that the electric-discharge device is successively connected in circuit relation with each of the current-responsive devices.

7. A control system comprising, in combination, a plurality of current-responsive devices disposed to be operated in timed sequence, an electric-discharge device for controlling the sequential operations of the current-responsive devices, a timing circuit for controlling the operation of the electric-discharge device, circuit connections between the current-responsive devices themselves and between each of the current-responsive devices and the electric-discharge device, means responsive to the operation of the first and

each of the succeeding current-responsive devices for so establishing the circuit connections that the electric-discharge device is successively connected in circuit relation with each of the current-responsive devices, and a self-energizing circuit for each current-responsive device, so that, when each current-responsive device is operated, it remains energized independently of the electric-discharge device.

8. A control system comprising, in combination, a plurality of relays disposed to be operated in timed sequence, each of said relays having a plurality of contact members, an electric-discharge device for controlling the sequential operations of the relays, a timing circuit for controlling the operation of the electric-discharge device, circuit connections between each relay and the electric-discharge device, the circuit connections for the second and each succeeding relay being so connected in circuit relation with the contact members of the preceding relay that, when the preceding relay operates, the subsequent relay is connected in circuit relation with the electric-discharge device.

9. A control system comprising, in combination, a plurality of current-responsive devices disposed to be operated in timed sequence, an electric-discharge device for controlling the sequential operations of the current-responsive devices, means for effecting the periodic operation of the electric-discharge device, circuit connections between each of the current-responsive devices and the electric-discharge device, and means governed by the operation of the first and each succeeding current-responsive device for establishing a circuit connection between the electric-discharge device and the next current-responsive device to be operated.

10. A control system comprising, in combination, a plurality of relays disposed to be operated in timed sequence, a source of electrical energy, means for successively connecting the relays in circuit relation with the source of energy, said means including an electric-discharge device, a timing circuit associated with the electric-discharge device, and circuit connections between each relay and the electric-discharge device and between the relays themselves.

11. A control system comprising, in combination, a plurality of relays disposed to be operated in timed sequence, contact members for each relay, a source of electrical energy, means for successively connecting the relays in circuit relation with the source of energy in timed sequence, said means including an electric-discharge device, a timing circuit associated with the electric-discharge device, and circuit connections between each relay and the electric-discharge device and between the contact members of the relays, the said connections being so governed by the contact

members of each relay that, when the contact members are in one position, the relay itself is connected in circuit relation with the electric-discharge device, and when the contact members are in another position, the subsequent relay is connected in circuit relation with the electric-discharge device.

12. A control system comprising, in combination, a plurality of relays disposed to be operated in timed sequence, contact members for each relay, a source of electrical energy, means for successively connecting the relays in circuit relation with the source of energy in timed sequence, said means including a pair of electric-discharge devices, a timing circuit for each electric-discharge device, and circuit connections between the relays and the electric-discharge devices and between the contact members of the relays, the said connections being so governed by the contact members of each relay that, when the contact members are in one position, the relay itself is connected in circuit relation with one of the electric-discharge devices, and when the contact members are in another position, the subsequent relay is connected in circuit relation with the other electric-discharge device.

13. A control system comprising, in combination, a plurality of relays disposed to be operated in timed sequence, contact members for each relay, a pair of electric-discharge devices for controlling the sequential operations of the relays, a timing circuit associated with each electric-discharge device, circuit connections between the relays and the electric-discharge devices and between the contact members of the relays, the circuit connection for the odd-numbered relay being such that the said odd-numbered relays are connected in circuit relation with one of the electric-discharge devices, and the circuit connection for the even-numbered relay being such that, when the preceding odd-numbered relay operates the subsequent even-numbered relay is connected in circuit relation with the other electric-discharge device.

14. In an electric system of control for controlling the operation of electric devices, in combination, a plurality of current responsive means, an electric discharge device controlling the operation of said current responsive means, timing circuits associated with said device for controlling the successive operations of said discharge device, circuit connections for connecting one current responsive means to the discharge device and disconnecting it from the discharge device and means controlled by the said one current responsive means to successively interconnect said other current responsive means with said discharge device.

15. In an electric system of control for controlling the operation of electric devices, in combination, a plurality of current-responsive means arranged in a given order, an elec-

tric discharge device, and a plurality of circuit connecting devices associated with said current-responsive means and discharge device to effect alternate operation of said discharge device and successive current-responsive means.

16. In an electric system of control for controlling the operation of electric devices, in combination, a plurality of current-responsive means arranged in a given order, a pair of discharge devices, and a plurality of circuit connecting devices associated with said current-responsive means and discharge devices for alternately operating one of the discharge devices and successive odd-numbered current responsive devices and for alternately operating the other of said discharge device and successively even-numbered current-responsive device.

17. A control system, in combination, a plurality of current-responsive devices, a supply of electrical energy for the control system, a pair of electric-discharge devices for controlling the current-responsive devices, means governed by the current-responsive devices for connecting the odd-numbered current-responsive devices in timed sequence with one of the discharge devices and the supply of electrical energy, and means governed by the current-responsive devices for connecting the even-numbered current-responsive devices in timed sequence with the other electric-discharge device and the supply of electrical energy.

In testimony whereof, I have hereunto subscribed my name this 6th day of April 1931.

WILLIAM A. MINKLER.