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TIMING SYSTEM

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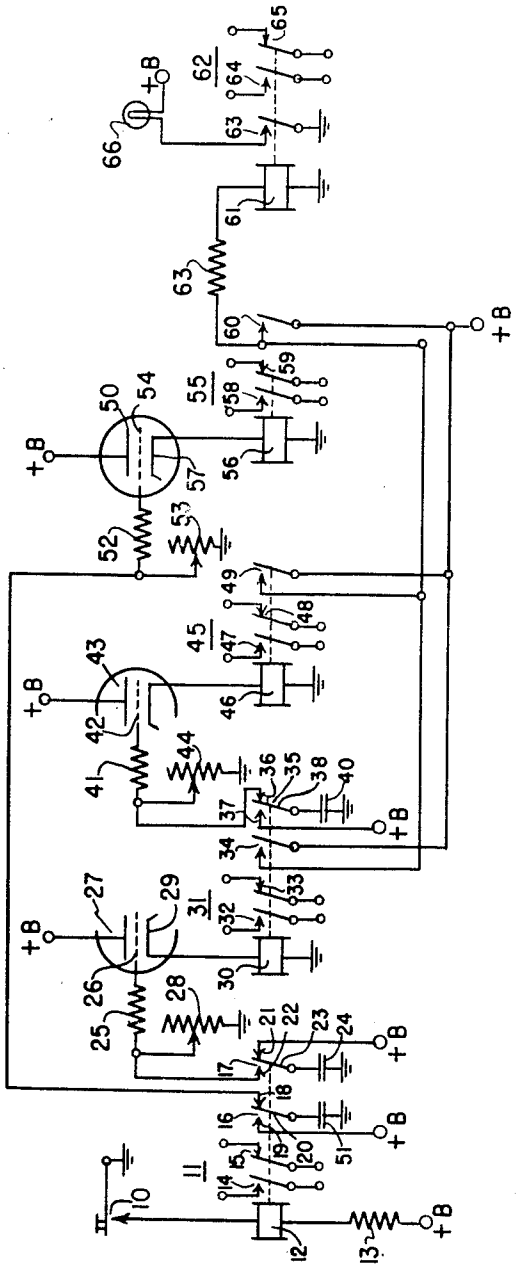

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TIMING SYSTEM

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This invention relates generally to timing systems and more particularly to an electronic timing system in which the interval between operations can be adjusted.

Timing systems have come into very common usage due to the great demand for automatically controlled equipment. Various types of timing systems have been used including mechanical systems, clock operated systems and electronic timing systems. Electronic timing systems, while being adaptable to many uses and being generally flexible in their nature, have been relatively complicated and expensive. In many cases thyratron or other expensive tubes are used resulting in a system which is relatively expensive.

It is, therefore, an object of the present invention to provide a simple and inexpensive electronic timing system.

Another object of this invention is to provide a timing system for providing a plurality of controls in sequence in which the interval between controls may be easily adjusted.

A feature of this invention is the provision of a timing system including a plurality of sections each of which includes a relay for connecting a condenser to a source of potential and then connecting the condenser to a vacuum tube for causing the tube to conduct to energize the next section.

A further feature is the provision of such a system in which the time required for discharge of the condenser can be controlled to thereby control the timing interval between the various controls.

A still further feature of this invention is the provision of a timing system including a plurality of relays for producing any desired control operations in sequence, in which contacts of the relays provide connections for charging a condenser and for applying the potential across the condenser to another section of the system.

Still another feature of this invention is the provision of a timing system for operating a plurality of controls in sequence and including an auxiliary circuit which is energized during the entire timing operation.

Further objects, features and advantages will be apparent from a consideration of the following description when taken in connection with the accompanying drawing which illustrates one embodiment of the timing system.

In practicing the invention there is provided a timing system including a plurality of sections each of which includes a relay having contacts for producing any desired control function and

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other contacts for operating another section of the system. These other contacts are arranged to connect a condenser to a source of potential and then, in response to operation of the relay, connect the charged condenser to the control grid of a vacuum tube so that the tube conducts. The output circuit of the tube is connected to the relay of another section to cause operation of such next section. The contacts of the relays may be arranged so that the condensers may normally be charged and, therefore, cause the tubes to conduct as soon as the preceding relay is operated. Alternatively, the condensers may be normally discharged and charged when the relay is actuated. In this system the vacuum tube of any section will not be rendered conducting until the relay in the preceding section has dropped out. Combination of circuits operating in the two ways may be combined in the same system if desired. The length of time the tube conducts will, of course, depend upon the time required to discharge the condenser and may be controlled by the use of a variable resistor across which the charge on the condenser leaks off. An auxiliary circuit is provided which is connected to a set of contacts on each of the main relays for operating an additional relay to produce some control function as long as any one of the main relays are actuated.

With reference to the drawing, the figure is a schematic representation of applicant's invention.

Referring now to the drawings, the main operating switch is indicated at 10. This switch is connected to relay 11, the operating coil 12 of which is connected through resistor 13 to +B. The relay 11 includes single-throw contacts 14 and 15 and double-throw contacts 16 and 17. The relay is shown in an un-energized position with the contacts 14 open and the contacts 15 closed. The contact set 16 includes stationary contacts 18 and 19 and movable contact 20, and contact set 17 similarly includes fixed contacts 21 and 22 and movable contact 23. A condenser 24 is connected to movable contact 23 and when the switch is in the normal position, as illustrated, the condenser is connected through contacts 21 and 23 to +B. This will, of course, charge the condenser to the +B potential. Now when the relay 12 is actuated, the movable contact 23 will engage fixed contact 22 so that the potential of the condenser is applied to the contact 22.

As illustrated, the contact 22 is connected through resistor 25 to the grid 26 of triode section 27. A variable resistor 28 is also connected

to the fixed contact 22 and is effective to discharge the condenser 24 when the condenser is connected to the variable resistor through contacts 22 and 23. The plate potential on the triode 27 is such that when the charged condenser 23 is connected to the grid 26, the tube 27 will conduct. This will cause current from the cathode 29 to flow to the energizing winding 30 of relay 31. This, of course, causes this relay to be operated. When the voltage on condenser 24 drops to a predetermined value, the voltage on grid 26 will not be sufficient to render the tube conducting and the relay 31 will drop out.

Relay 31 may be generally similar to relay 11 and includes single-throw contacts 32, 33 and 34 and double-throw contact set 35. As is apparent, contacts 32 and 34 are normally open and are closed by the actuation of the relay 31. Contacts 33 are normally closed and are opened by operation of relay 31. It is obvious that these relays may have different contact arrangements than those shown, and the arrangements shown merely illustrate one embodiment of the structure. Contacts 32 and 33 can be used to operate any desired controls. The contact set 35 of relay 31 includes fixed contacts 36 and 37 and movable contact 38 with the contact 38 being normally in engagement with the contact 36. A condenser 40 is connected to contact 38. When the relay 31 is actuated the movable contact 38 engages contact 37 to charge condenser 40 from +B potential. When relay 31 then is de-energized or falls out, the potential across condenser 40 is applied through resistor 41 to the grid 42 of triode 43 and causes the triode 43 to conduct. Variable resistor 44 is thereby connected across the condenser 40 through contacts 36 and 38 and is effective to discharge the condenser at a rate depending upon the adjustment of the variable resistor 44. Contacts 34 are included in the auxiliary circuit as will be further explained.

A relay 45 is connected to the tube 43 with the winding 46 thereof being connected in series with the cathode. The relay includes single-throw contacts 47, 48 and 49. The contacts 47 and 48 can be used to provide any desired control function and the contact 49 is used in the auxiliary circuit. It is obvious that additional stages can be added which may be arranged so that they will operate after the tube 43 conducts. This can be accomplished by providing additional contacts on relay 45 such as contacts 35 on the relay 31

The contacts 16 of relay 11 are used to control the tube 50. When the relay 11 is closed contact 20 engages contact 19 to charge condenser 51. Then when the relay 11 is de-energized so that the contacts fall back, the contact 20 engages contact 18 and connects the voltage across condenser 51 to the grid 54 of tube 50 through resistor 52. Variable resistor 53 again provides a discharging path for the condenser. Tube 50 is rendered conducting by the voltage from condenser 51 when this condenser is charged. A relay 55 is connected to the tube 50 with the winding 56 thereof being connected in series with the cathode 57 of the tube. This relay includes single-throw contacts 58, 59 and 60. Contacts 58 and 59 may be used for any desired control function and contacts 60 are in the auxiliary circuit.

As long as any one of the sets of contacts 34, 49 and 60 are closed, an auxiliary circuit is completed through the winding 61 of relay 62 and resistor 63 to +B. This causes actuation of the relay 62 which includes contacts 63, 64 and 65. Contacts 63 may be used to energize a light as indicated at 66 so that it will be apparent to an operator that the controls are being operated. Such a light is of particular value in a system in which one control operation may not be started until the previous control operation has been completed. Contacts 64 and 65 may be used for any desired control functions.

It will be apparent that various types of switching operations may be produced by the above system. When the main switch 10 is operated relay 11 will be operated and contacts 17 thereof are effective to cause operation of relay 31. Therefore, the control circuits connected to contacts 14 and 15 will first be operated and then control circuits connected to contacts 32 and 33 will very shortly thereafter be operated. Contacts 14 and 15 will remain in operated position as long as switch 10 remains closed but contacts 32 and 33 will drop out as soon as the condenser 24 discharges through resistor 28 to such a value that the tube 27 no longer conducts. By reversing the fixed contacts on the contact set 35, tube 43 can be made to conduct almost immediately after tube 27 so that control circuits operated by contacts 47 and 48 would be operated after a very short interval. However, as illustrated, the tube 43 is not rendered conducting until tube 27 ceases to conduct and, therefore, a considerable interval of time elapses before control circuits connected to contacts 47 and 48 are operated with this time depending upon the value of resistor 28 Likewise, the length of time that the contacts 47 and 48 are operated will depend upon the value of resistor 44 which controls the discharging of condenser 40.

When the main switch 10 is open the tube 59 will conduct so that control circuits connected to contacts 58 and 59 will be operated. These contacts will remain operative until condenser 51 is discharged by resistor 53 to such an extent that the tube 50 no longer conducts. The auxiliary circuit, in addition to indicating when controlling operations are taking place, may also be used to provide such other controls as are desired.

It is obvious that many changes can be made in this system without departing from the intent of the invention. For example, a much larger number of sections can be used. Various sections can be made to operate after different intervals and these succeeding sections can be made to operate immediately adjacent the preceding section or after the preceding section has operated and then dropped out. The embodiment of the invention illustrated is, therefore, to be considered as illustrative only, and the invention is to be limited only to the extent defined in the appended claims.

I claim:

1. A timing system for operating a plurality of controls in sequence including in combination, a source of positive potential, a first electrically operable control including relay means, first condenser means, resistor means, an electron discharge valve having a cathode, an anode and a grid, main operating switch means having a movable contact and first and second fixed contacts, circuit means connecting said first condenser means between said movable contact and ground, said source of potential to said first fixed contact, said grid of said valve to said second fixed contact, and said resistor

means between said grid of said valve and ground, means connecting said source of potential to said anode of said valve and connecting said relay means between said cathode of said valve and ground so that said cathode of said valve is held at a positive potential and said valve is normally non-conducting, said movable contact of said switch means normally engaging said first fixed contact to charge said condenser means from said source of positive potential and moving upon actuation of said switch means to a position engaging said second fixed contact to apply the charge across said condenser means to said grid for rendering said discharge valve conducting, said resistor means constituting a discharge path for said condenser when said switch is actuated to reduce the charge thereof and thus control the interval during which said valve conducts, second condenser means, and a second electrically operated control, said relay means having a movable contact and first and second fixed contacts positioned to be selectively engaged by said movable contact, said circuit means connecting said second condenser means to said movable relay contact, said source of potential to said first fixed relay contact, and said second electrically operable control to said second fixed relay contact, with said relay means holding said movable contact thereof in engagement with said first fixed contact thereof for charging said second condenser means when said discharge valve is conducting, and holding said movable contact thereof in engagement with said second fixed contact thereof when said discharge valve is non-conducting, so that said charged condenser means actuates said second electrically operated control.

2. A timing system for operating a plurality of controls including in combination, a source of positive potential, main operating switch means, main relay means connected to said source of potential through said main switch means, said main relay means including first and second contact means each including a movable contact and normally closed and normally open fixed contacts selectively engaged thereby, first and second condenser means individually connected to said movable contacts of said first and second contact means, first and second electron discharge valves each having a cathode, an anode, and a grid, said anodes of said valves being connected to said positive potential, first and second relay means having operating portions individually connected between ground and said cathodes of said valves, first and second resistor means individually connected between ground and said grids of said valves, said normally closed fixed contact of said first contact means of said main relay means being connected to said source of positive potential whereby said first condenser means is normally charged thereby, said normally open fixed contact of said first contact means being connected to said grid of said first valve so that the potential across said first condenser means is applied to said grid of said first valve when said main relay means operates to render said first valve conducting and actuate said first relay means, said normally open fixed contact of said second contact means being connected to said source of potential to charge said second condenser means when said main relay means is operated, said normally closed fixed contact of said second contact means being connected to said grid of said second valve so that the potential across said second condenser means if applied to said grid of said second valve when said main relay means is released to render said second valve conducting and actuate said second relay means, said first and second resistor means individually operating to discharge the connected condenser means and thereby controlling the period of conduction of said first and second valves.

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