

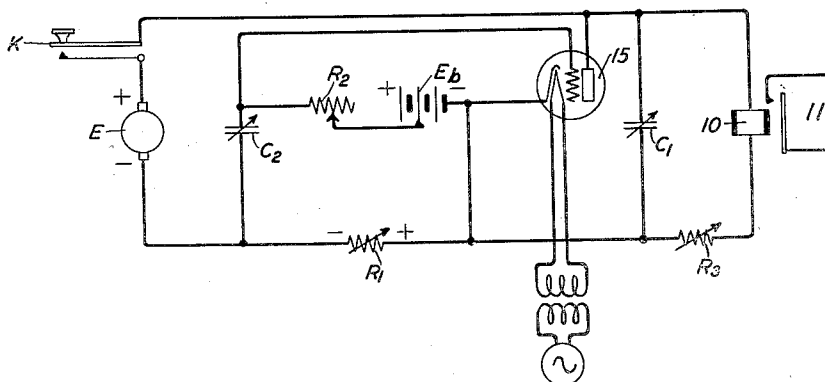
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CIRCUIT CONTROL ARRANGEMENTS

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CIRCUIT CONTROL ARRANGEMENTS

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8 Claims. (Cl. 250—27)

This invention relates to time delay circuits and interval selecting means of the kind having no moving parts.

A general object of the present invention is to provide a novel method and means adapted to produce a definite time interval of open and/or closed circuit conditions by static electric means.

A further object of the invention is to produce successive time intervals, any or all of which may be precisely determined as to extent.

A still further object of the invention is to utilize with such time controlling or measuring apparatus the characteristics of a gas-filled tube and a shunting condenser with other electrical elements which precisely control the interval required for obtaining the potential difference between the elements of the tube necessary to cause a discharge.

A feature of the invention involves a condenser in parallel with the magnetic windings of a relay to delay the operation of the relay and aid in the control of the gas-filled discharge tube.

A further feature of the invention involves a gas-filled tube in shunt to the magnetic relay, a condenser in shunt with the grid-cathode circuit of the gas-filled tube and a controlled source of potential adapted to selectively delay the time of full charging of the condenser which delays the shunting of the relay by the firing of the gas-filled tube. Other and further objects and features of the present invention will be apparent to those skilled in this particular art on consideration of the drawing in view of the accompanying specification disclosing a proposed embodiment of the invention.

In the embodiment on the drawing, the single figure is a schematic diagram of circuit suited for the precise time delay or time interval selecting device of the invention.

While the invention is of general application, it will be described, by way of example, as embodied in an electric welding control circuit, in which relay 10 at its armature and contact control application of welding current to welding circuit 11, of maximum duration predetermined by tube 15 and associated elements. Current for operating relay 10 is derived from source E through closure of key K. Tube 15 is preferably a gas-filled tube. When a discharge is started in this tube it deprives the winding of relay 10 of current and allows it to open circuit 11. If key K is released before tube 15 fires, the welding circuit is immediately opened.

It is thought that the circuit structure will be best understood from considering its operation.

The closure of the key K applies sufficient voltage almost immediately to the relay 10 to cause it to operate, closing the welding circuit 11 which can remain closed only while the key or switch K is closed. The adjustable time delay circuit in the grid of the gas-filled tube 15 causes this tube to operate or fire after a controlled length of time, shunting the relay so that it releases and opens the welding circuit. The opening of the key K restores the circuits to initial condition. The release of the key K at any time before the timing circuit operates, immediately opens the welding circuit so that light welds may be made at any time. The timing circuit simply limits the maximum length of welding time. The desired time is set by the adjustment of the resistor R₂, which may be in the form of a tapped resistor or bank of resistors, the leads being brought to a multicontact switch.

The time control features in the operation of the circuit are as follows: On the application of voltage to the control circuit by the closing of the key K, an initial current results to charge condenser C₁ through the resistance R₁. The presence of C₁ prevents any difference of potential due to voltage E from appearing immediately between the anode and cathode of the gas-filled tube, substantially the entire impressed voltage appearing across the resistance R₁, the initial current through R₁ being, therefore, approximately E/R₁. This voltage appears across the condenser C₂ and the grid filament path of the tube. The common junction of the condenser C₂ and the grid was originally at approximately E_b volts positive with respect to the filament, so that the application of the voltage developed across C₂ will reverse the original bias on the grid to E_b—E or in the case shown to (22½–110) volts. This is by virtue of the fact that the grid filament capacitance of the tube is negligibly small compared to the value of C₂. As the time required to charge C₁ is very small (time constant R₁C₁=2.5×10⁻⁴ second) the relay will soon operate and a constant potential of

$$E \left(\frac{R_3 + R_{\text{relay}}}{R_1 + R_3 + R_{\text{relay}}} \right)$$

will appear between the anode and cathode of the tube. With the constants shown this is approximately 75 volts. In the meantime the condenser C₂ will be charging up. The time constant of this circuit R₂C₂ is, however, rather large. The potential difference between the grid and cathode of the tube will then vary as follows: The initial potential is approximately 22.5 volts. The ap-

plication of the supply voltage E by the key K carries this to -87.5 volts, but the charging of C₁ causes this to change very rapidly to -12.5 volts. From this value it starts to go positive at a rate governed by the time constant R₂C₂, the apparent ultimate value being +22.5 volts. However, when the grid potential (with respect to the filament) has reached about -1 volt, the exact value depending on the tube characteristic, a discharge will occur between cathode and anode, the potential between cathode and anode will fall to around 20 volts and the work control relay will release, opening the welding circuit 11. The discharge of condenser C₁ through the tube will produce sufficient ionization to reduce the effective grid-cathode impedance to a very low value so that C₂ will almost immediately assume a constant charge. The release of the key K will restore everything to the original condition. The excess charge on the condenser C₂ will be carried off rapidly by the now conducting grid-cathode path in the tube (the grid being positive) so that the circuit will be ready for the next operation with no perceptible delay.

The invention is not to be construed as limited to the magnitude or other details given, but by the scope of the claims.

What is claimed is:

1. Apparatus for the control of work or of electrical circuits comprising a source of unidirectional electromotive force, a work control means in series with the source, a switching means for initiating operation of the work control means, a gas-filled tube in shunt relation to said work control means, and means permitting breakdown of said gas-filled tube only after a predetermined interval of time following actuation of said switching means, said tube, upon breaking down, shunting current from said work control means and causing the latter to release.

2. In combination, a source of direct current, a switch therefor, means in series therewith and actuated by closure of said switch for controlling a work circuit, a gas-filled tube shunted across the circuit between said switch and said means, a control circuit for said tube, and means connected in the control circuit of said tube for delaying the firing of the tube a predetermined time interval after closure of said switch, whereby said tube after such time interval shunts out said first-mentioned means and allows it to restore to unactuated condition.

3. Time control apparatus for an electrical circuit having a source of unidirectional electromotive force and a work control means, said time control apparatus including a circuit in shunt to said first circuit with a three-element gas-filled tube in said shunting circuit, and means in the grid-cathode circuit of the tube to operate the tube after a predetermined time to shunt the first mentioned circuit by the circuit through the gas-filled tube said shunt circuit, when said tube is operated, causing the release of the work control means at the end of the predetermined interval of time.

4. In a time control circuit, a current actuated device, a gas-filled tube having an output circuit in shunt relation thereto, means to apply a unidirectional voltage to said circuit, a condenser in shunt relation to said tube output circuit whereby upon initial application of said voltage to said circuit said condenser prevents immediate rise of voltage across said tube, a control circuit

for said tube, means to apply a blocking potential to said control circuit immediately upon application of said voltage to said circuit, timing elements for reducing said blocking voltage gradually to the firing value whereby said tube shunts out said current actuated device, said condenser discharging through said tube.

5. Apparatus for controlling the time of operation of work means including a circuit for said work means, a main source of electromotive force, means for applying to said circuit a unidirectional voltage from said source to control said means, a circuit in shunt to said work means having means for terminating the control exercised by said source of electromotive force, a three-element tube in said shunting circuit, a condenser with one electrode connected to the grid of said tube and the other electrode connected to said main source of electromotive force, a variable resistance connected to said first electrode, a variable battery connecting the variable resistance to the cathode of said tube with the positive pole of the battery connected to the grid and a variable resistance connecting the other electrode of the condenser to the negative pole of the battery, the variable circuit elements being adjusted to give the desired delay in the firing of the tube to terminate control of the work control means after a definite interval of time, and a condenser in said shunting circuit preventing the firing of said tube upon initial application of said voltage to the circuit.

6. Apparatus for timing the operation of a current responsive device including a source of electromotive force, means to apply a unidirectional voltage to said device from said source, a circuit including a gas-filled tube in shunt to said device for timing the control exercised by the said source of electromotive force, and a battery furnishing a positive grid bias for the tube to make the grid of the shunt control tube conducting after disconnection of the said source of electromotive force to insure rapid resetting of the apparatus.

7. Apparatus for controlling the interval of operation of a device, including a source of unidirectional electromotive force, control means for the source, means for terminating the control exercised by said source of electromotive force of the device, including a three-element gas-filled tube having its space path connected in shunt relation to said device, and a battery providing a controllable positive bias on the tube to vary the delay in its control of the shunting of the device.

8. In combination, a source of electromotive force, a work circuit, a control means for the work circuit energized by a unidirectional voltage from said source through a switch, a tube in shunt to said control means for causing release of said control means, means to time the operation and release of said control means comprising a condenser in shunt to both the control means and the tube to delay operation of the control means after closure of said switch, and comprising also delay means in circuit with said tube to delay operation of the tube for a time after the operation of said control means, said condenser upon operation of said tube acting to produce large discharge current through the tube, such large discharge current conditioning said delay means to accelerate the restoration of the circuit to normal after opening of said switch.

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