Dec. 12, 1944. W. F. WOLFNER, 2D 2,364,680

TIMER

Filed Jan. 19, 1942

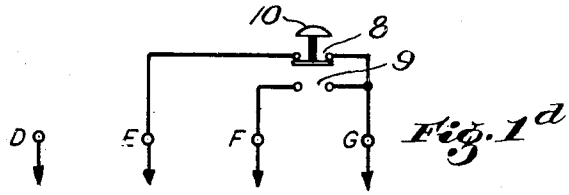


Fig. 1d

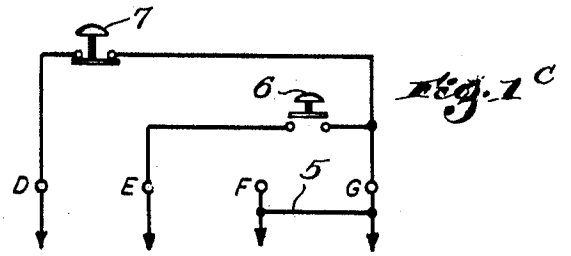


Fig. 1c

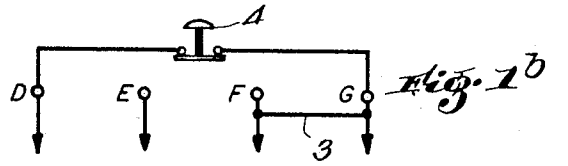


Fig. 1b

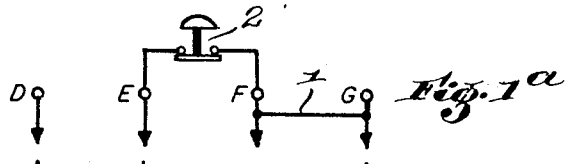


Fig. 1a

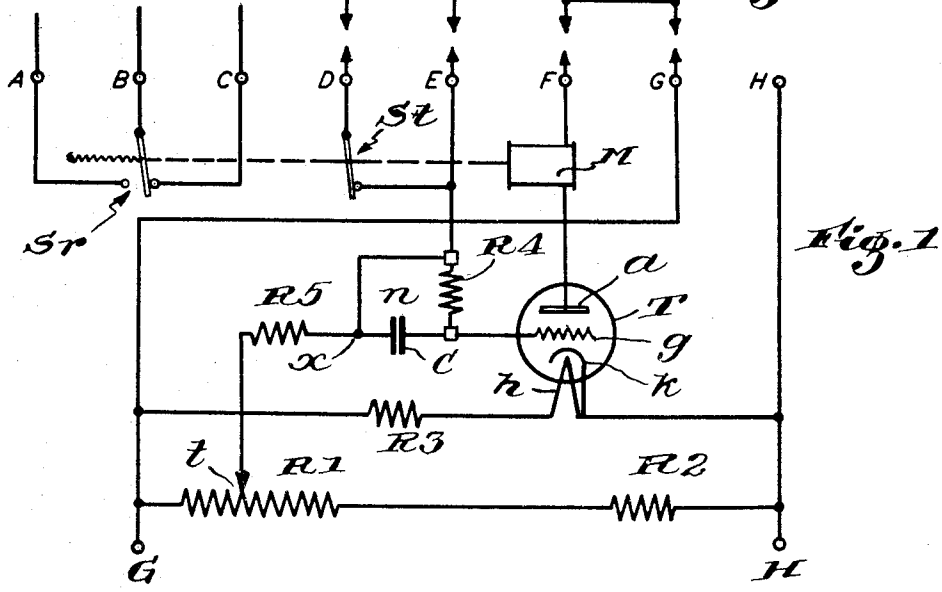


Fig. 1

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TIMER

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10 Claims. (Cl. 250—27)

This invention relates to electronic control circuits and particularly to timing devices.

It is one of the main objects of my invention to provide a simple, inexpensive, rugged and reliable electronic timing device which uses a standard vacuum tube, is adaptable for operation with alternating or direct current and for interval or delay timing as the application may require, and provides for both operation upon momentary actuation of controlling elements and during actuation of a control element.

In one aspect, the invention provides a universally adaptable electronic timer, as for use in controlling the duration of certain operations as for example the flow of paint in automatic spraying machines, or causing an initial delay before a certain function occurs, as for example allowing the cathodes of an electronic circuit to heat up before the high voltage is applied.

In another aspect, my invention provides a timer which has a basic universally applicable circuit with peculiarly arranged terminals which permit its application to diversified uses, avoiding the previous practice of designing a timer for every particular type of operation.

These and other objects, aspects and advantages will be apparent from the following description of a practical embodiment of my invention characterizing its nature by way of example. This description refers to a drawing in which

Fig. 1 is the circuit diagram of a timer unit according to the invention; and

Figs. 1^a, 1^b 1^c and 1^d are diagrams of circuit arrangements which may be connected to the terminals of the unit according to Fig. 1.

In the practical embodiment herein to be described, the timing unit is supplied from conductors G, H which are to be connected to a current source, for example a standard direct or alternating current line. Connected between conductors G and H is a potentiometer R1 which has a tap *t* and may be in series with a fixed resistance R2.

A triode T with anode *a*, cathode *k*, heater *h* and grid *g* is connected as follows. Heater *h* and cathode *k* are directly on conductor H; a resistor R3 is connected between heater *h* and conductor G; anode *a* is connected to one side of a relay magnet or analogous device M; and grid *g* is connected to tap *t* through a timing network *n* consisting of a condenser C and a resistor R4 connected in parallel thereto. A resistor R5 may be inserted between network *n* and tap *t*. Resistor R4 may be of the easily interchangeable plug-in type as indicated in Fig. 1, in order to permit adjustment of the rate of discharge of condenser C.

Magnet M, while energized, retains closed an auxiliary switch *St* and keeps relay switch *Sr* in a desired position, for example connecting relay terminals B and C. Upon deenergization of M, switch *St* opens and relay switch *Sr*, for example transfers terminal B from C to A.

For purposes of the present invention, certain points of this circuit are brought out as follows.

In addition to relay terminals A, B, C or analogous elements suited for connection to the apparatus to be controlled, the following modification terminals are provided. Auxiliary switch *St* leads to switch terminal D; tap *t* or a point *x* between *n* and R5 is connected to tap terminal E; actuator magnet M leads to actuator terminal F; and the supply conductors may be connected to supply terminals G, H.

As pointed out above, this arrangement lends itself very well to different forms of operation, four of which are herein illustrated with reference to Figs. 1^a, 1^b, 1^c and 1^d.

Referring first to Fig. 1^a, terminals F and G may be permanently connected by a jumper 1, and terminals E and F, G through a normally closed push button switch 2.

According to Fig. 1^b, terminals F and G are permanently connected at 3, and terminals D and F, G through a normally closed push button switch 4.

According to Fig. 1^c, terminals F and G are permanently connected at 5, terminals E and F, G can be connected through a normally open push button switch 6 and terminals D and F, G are connected through a normally closed push button switch 7.

According to Fig. 1^d, terminals E and G are connected through contacts 8 and terminals F and G can be connected through contacts 9; push button 10 common for both switches, normally closes contacts 8 but on being depressed opens contacts 8 and closes contacts 9.

It will be evident that instead of manually operated push button switches other circuit makers can be used, as for example relay switches.

If the modification terminals are connected according to Fig. 1^a, tube T will be normally conductive; if the device is supplied with alternating current, it will conduct when terminal G is positive and terminal H negative. Switch 2 being in its normal closed position, magnet M is energized and condenser C will accumulate a

charge through the grid to cathode path G—F—E—*x*—C—*g*—*k*—H so that its peak voltage is approximately equal to the peak value of the supply source connected to terminals G, H.

If the switch 2 is now opened, for example by depressing its push button, the potential at point *x* is depressed with respect to cathode *k* and the grid *g* is driven negative by an amount determined by the setting of tap *t*. The negative grid voltage causes the current in tube T to drop below the operating point of relay M which moves relay switch *Sr*.

The push button being still depressed, relay M remains deenergized until the charge on condenser C has dissipated through resistance R4 which determines the timing interval. As mentioned above, resistance R4 is preferably of the plug-in type so that by changing its value the maximum timing interval can be altered.

The timing cycle can be ended before it has terminated by sufficient discharge of condenser C, if the push button is released, closing switch 2, increasing the potential at *x*, and causing tube T again to conduct and to energize magnet M.

It will be noted that with this terminal connection the switch 2 must be closed and again opened in order to start another timing cycle, that the predetermined timing interval is applied by retaining switch 2 open, and that the timing interval can be prematurely terminated by closing switch 2, as by releasing the push button.

If the terminals are connected according to Fig. 1[b], normally closed switches 4 and *St* will cause normal energization of device M and charging of condenser C. Opening of switch 4, as by depressing a push button, will deenergize M, operate relay switch *Sr* and open switch *St* so that switch 4 can be immediately reclosed as by releasing its push button, without interfering with the timing interval as determined by the discharge of condenser C. Upon discharge of C, M will be again energized closing switch *St* and resetting switch *Sr*.

It will be noted that with this terminal connection a predetermined timing cycle is initiated by momentarily closing switch 4 and that this cycle can not be interfered with.

If the terminals are connected according to Fig. 1[c], the tube T is again normally conductive and condenser C maintained charged in a circuit through normally closed switches *St* and 7. If switch 7 is opened, the tube becomes non-conductive, magnet M will be deenergized, switch *Sr* moved and switch *St* opened, the circuit operating as described above with reference to Fig. 1[b].

If, however, stop switch 6 is closed, as by momentarily depressing a button, before the timing interval has elapsed, the grid will become immediately sufficiently positive to restore the device to normal condition and to end the timing cycle.

It will be noted that with this terminal connection it is possible to initiate a timing cycle by momentarily operating a switch, and prematurely to terminate the cycle by momentarily operating another switch.

If the terminals are connected as shown in Fig. 1[d], tube T is normally non-conductive since the anode circuit is interrupted at 9; hence, magnet M is normally deenergized. A circuit H—*k*—*g*—*n*—E—8—G is, however, normally maintained through normally closed contacts 8, maintaining condenser C normally charged as above described.

If now contacts 9 are closed and contacts 8 opened, as by depressing push button 10 common to both switches, the anode circuit is closed through F, 9 and G, but the connection to G of the network *n* is opened at 8, which drives grid *g* negative and cuts off any current flow in tube T so that, even though the anode circuit is completed, device M will remain deenergized until condenser C is discharged. If the button is released at any time before the timing cycle has been completed, the device is reset and ready to start a new timing cycle.

It will be noted that in the normal condition of an arrangement according to Fig. 1[d] magnet M is deenergized and, with the start button depressed, remains deenergized until the end of the timing cycle, at which time it pulls in and remains pulled in until the push button is released. If, however, the start button is released before the end of the timing cycle, relay M will never pull in; if the start button is released and depressed in intervals shorter than the timing cycle, relay M will also never pull in.

This type of operation may be particularly useful in situations as the following one. Suppose, for example, that a machine were to produce one article every 56 seconds and that the operation of ejecting the finished piece might, for example by photoelectric means, release and redepress the starting switch 10. If the timer is now adjusted to 60 seconds timing delay, relay M will not operate so long as the switch is actuated every 56 seconds. If, however, the machine should fail to eject a piece in 60 seconds, relay M will become energized and might indicate by a signal that the machine was not functioning properly, or it might be adapted to shut the machine off.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. An electric control circuit comprising a current source having two terminals supplying a potential difference, an electron discharge device having anode, cathode, and control electrode, connections including a current responsive device from said anode and said cathode to respective ones of said terminals, potential supply means having a point of potential intermediate those of said cathode and said anode, a timing circuit for storing and gradually dissipating an electric charge permanently connected between said control electrode and said point, and a switch adapted to establish an independent path, apart from said potential supply means and said timing circuit, connecting said intermediate point with said anode connection while said circuit remains connected to said point.

2. An electric control circuit comprising a current source having two terminals supplying a potential difference, an electron discharge device having anode, cathode, and control electrode, connections including a current responsive device from said anode and said cathode to respective ones of said terminals, potential supply means having a point of potential intermediate those of said cathode and said anode, a timing circuit for storing and gradually dissipating an electric charge permanently connected between said control electrode and said point, a switch adapted to establish an independent path, apart from said potential supply means and said timing circuit, connecting said point with said anode connection while said circuit remains connected to said

point, and switching means connected in series with said switch and controlled by said current responsive device.

3. An electric control circuit comprising a current source having two terminals supplying a potential difference, an electron discharge device having anode, cathode, and control electrode, connections including a current responsive device from said anode and said cathode to respective ones of said terminals, potential supply means having a point of potential intermediate those of said cathode and said anode, a timing circuit for storing and gradually dissipating an electric charge permanently connected between said control electrode and said point, a switch normally connecting said point with said anode connection, a second switch, operated and normally retained in closed position by said current responsive device, in series with said switch, and a third normally open switch in parallel with said switches adapted to establish an independent path, apart from said potential supply means and said timing circuit, connecting said point with said anode connection while said circuit remains connected to said point.

4. An electric control circuit comprising a current source having two terminals supplying a potential difference, an electron discharge device having anode, cathode, and control electrode, means including a current responsive device adapted to connect said anode and said cathode to respective ones of said terminals, a timing circuit for storing and gradually dissipating an electric charge permanently connected between said control electrode and said point, a switch normally connecting said point with the anode source terminal through an independent path apart from said timing circuit, and a switch normally disconnecting said anode from its source terminal.

5. An electric control circuit comprising a current source with two terminals, a potentiometer connected between said terminals and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source terminals, a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, and modification terminals permanently connected to the other source terminal, to said actuator and to said tap, said modification terminals being arranged for the interchangeable connection thereto of control switches and bridging connectors, permitting selectively variable operation of the circuit.

6. An electric control circuit comprising a current source with two terminals, a potentiometer connected between said terminals and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source terminals, a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, a switch controlled by said actuator and connected with one side to said tap, and modification terminals permanently connected to the other source terminal, to said actuator, to said tap and to the other side of said switch, said modification terminals being arranged for the interchangeable connection thereto of control switches and bridging connectors, permitting selectively variable operation of the circuit.

7. An electric control circuit comprising a current source with two supply conductors, a potentiometer connected between said supply conductors and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source conductors, a timing circuit including a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, modification terminals permanently connected to the other supply conductor, to said actuator, and to said tap, a connection between said supply conductor terminal and said actuator terminal, and a normally closed switch adapted to establish an independent path apart from said tap and said timing circuit between said actuator terminal and said tap terminal.

8. An electric control circuit comprising a current source with two supply conductors, a potentiometer connected between said terminals and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source conductors, a timing circuit including a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, a switch controlled by said actuator and connected with one side to said tap, modification terminals permanently connected to the other supply conductor, to said actuator, and to the other side of said switch, a connection between said supply conductor terminal and said actuator terminal, and a normally closed switch adapted to establish an independent path apart from said tap and said timing circuit between said actuator terminal and said switch terminal.

9. An electric control circuit comprising a current source with two supply conductors, a potentiometer connected between said terminals and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source conductors, a timing circuit including a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, a switch controlled by said actuator and connected with one side to said tap, modification terminals permanently connected to the other supply conductor, to said actuator, to said tap, and to the other side of said switch, a connection between said supply conductor terminal and said actuator terminal, a normally open switch connected between said actuator terminal and said tap terminal, and a normally closed switch connected between said actuator terminal and said switch terminal.

10. An electric control circuit comprising a current source with two supply conductors, a potentiometer connected between said terminals and having an intermediate tap, an electron tube having a grid, an anode, and a cathode connected to one of said source conductors, a timing circuit including a condenser and an impedance permanently connected in parallel between said tap and said grid, a relay actuator connected to said anode, modification terminals permanently connected to the other supply conductor, to said actuator, and to said tap, and switching means normally connecting said supply conductor terminal with said tap terminal and upon opening connecting said supply conductor terminal with said actuator terminal.

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