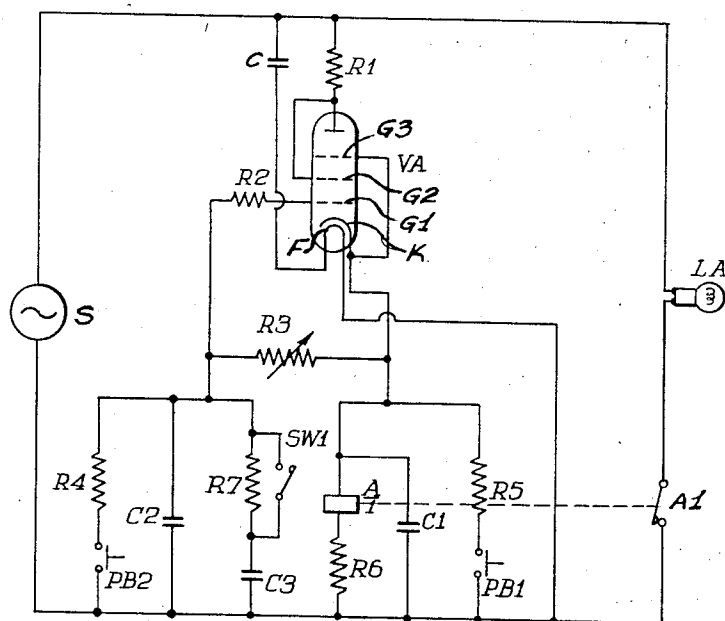


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ELECTRONIC TIMING DEVICE

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ELECTRONIC TIMING DEVICE

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This invention concerns electronic timing devices. More particularly it concerns such timing devices as are suitable for controlling a lamp circuit for photographic processes where it is essential to provide illuminating means which may be actuated repeatedly for extremely accurately defined intervals, the length of the interval being adjustable.

One object of the invention is to provide such a device which will give consistent results over a wide range of time-intervals, such consistency being an essential consideration in many photographic processes, especially those concerning the art of colour photography. Further objects of the invention are to provide a simple, robust and compact unit, with a minimum of controls, and one which is not affected by momentary variations of the electrical supply to which it is connected. An essential feature of the device is that it is suitable for use with existing photographic apparatus without modification of such apparatus or the device. Its construction is such that moving parts are eliminated, making the assembly more reliable, and continual use not affecting its accuracy.

According to the present invention there is provided an electronic timing device including a control circuit fed by a source of alternating current, said control circuit comprising a vacuum tube having an anode, a cathode and at least one grid, a relay and a condenser in parallel therewith, the winding of said relay being connected directly to said cathode, contacts carried by said relay and operable by said relay on energisation thereof to open to break a circuit to a load device, a capacitance-resistance circuit comprising a series-connected condenser and resistance and a further condenser connected in parallel with said series-connected condenser and resistance, a variable resistance connecting said capacitance-resistance circuit to said cathode and in parallel with said relay, a grid resistance connecting said variable resistance, on the capacitance-resistance circuit side thereof, to the control grid, and means for momentarily short-circuiting said relay together with its associated condenser and said capacitance-resistance circuit.

The means for momentarily short-circuiting said relay with its associated condenser and said capacitance-resistance are common and may advantageously be constituted by a single spring loaded push button switch, normally open circuited but completed on depression of the button.

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A further feature of the invention is that in order to extend the time range of the device, a further resistance and condenser in series are connected in parallel across the first-mentioned capacitance-resistance circuit. By provision of a switch whereby this further resistance can be short-circuited or included in the circuit at will, the effective capacitance of the circuit may be altered, so permitting a double range scale to be associated with the manual control of the variable resistance, and increasing the time range of the device.

The invention will be described further, by way of example, with reference to the accompanying drawing which is a circuit diagram of an electronic timing device according to the invention.

In the circuit diagram VA a suitable vacuum tube, for instance a high frequency pentode of the type known under the designation 6SH7; LA is a lamp; R1, R2, R3, R4, R5, R6 and R7 are resistances having respectively ohmic values of 10,000 100,000, variable magnitude with maximum 500,000, 100,000, 10,000, 10,000 and 500,000; C1, C2 and C3 are condensers having capacities of 10, 2 and 2 micro-farads respectively; SW1 is a switch PB1—PB2 are the poles of a spring loaded finger-operated double pole push button switch and A is a relay having spring restored break contacts A1, i. e. contacts which normally are closed, but which open on energisation of the relay A. The circuit is fed by a source S of alternating current, at 240 volts and 50 cycles per second, for which voltage and frequency all the above-mentioned values of resistance and capacitance are calculated in operation, when the source of supply S is switched on, as by the usual type of toggle switch (not shown in the drawing) the lamp LA, which is connected across the source S through the relay contacts A1 is supplied directly with current since the relay A is not operated and contacts A1 are normally closed. The heater circuit of the vacuum tube VA, containing a suitable series condenser C, is also connected directly across the supply S, the condenser C presenting an impedance such as to provide for the correct operating voltage across the tube filament F, and the tube filament F will warm up. As the cathode K is heated by the filament F, the tube VA commences to conduct current through the series-connected combination comprising the relay A and the resistance R6 (the latter being provided to limit the current flowing through relay A to the correct value), which combination is itself connected in series

with the cathode K. The potential drop developed across the combination A and R6 will cause the condenser C1 to charge until eventually a steady state is reached when the tube VA passes sufficient current to maintain condenser C1 charged at a voltage adequate to cause relay A to operate. The desired steady state, however, will not be achieved until the condensers C2 and C3 have also been charged, via the variable resistance R3, and again by the potential developed across relay A and resistance R6. On operation of relay A, contacts A1 will open to interrupt the supply S, and the lamp LA will be extinguished.

The device is now ready for use and the manual control of variable resistance R3 is adjusted by reference to a previously calibrated scale associated with such control, thus adjusting the time constant of the circuit including condensers C2, C3 and resistances R3, R7 (if not in short circuit by switch SW1), and hence setting the desired time interval for which the lamp subsequently is to remain alight. The scale may be calibrated in the required time units by predetermining the values of condensers C2 and C3 at the minimum value of resistance R3 and with resistance R7 short circuited. These values of C2 and C3 will then determine the minimum time constant of the circuit including C1, C2, C3, R3, A and R6 to determine the minimum time delay required for recharging the said condensers and hence re-operating relay A to extinguish the lamp LA. This time constant may be increased, and lamp LA lit for a longer period by increasing the value of variable resistance R3 as required.

To operate the device, the push button of switch PB1—PB2 is depressed, thus causing condensers C1, C2 and C3 simultaneously to be short-circuited through limiting or spark quenching resistances R4 and R5 and the said condensers thus become fully discharged. The relay A will consequently release since the holding potential previously supplied by condenser C1 is removed, as also is the potential similarly applied across relay A by condensers C2 and C3 (which potential is in any case insufficient, due to the small capacities of C2 and C3, to maintain the relay in an operated condition). Relay contacts A1 will therefore close and reconnect the supply S across the lamp LA, which will light. The push button of switch PB1—PB2 is immediately released and the lamp LA will remain illuminated for a set interval during recharging of the condensers C1, C2, C3, before being extinguished on re-operation of relay A. This cycle is repeated on each depression of the push button of switch PB1, PB2.

As previously indicated, control of the time interval is obtained by adjustment of variable resistance R3. If variable resistance R3 is adjusted to a low value, the control grid G1 of the tube VA will have nearly the same potential as the cathode K, the tube VA will pass a relatively high current and therefore C1 charges rapidly and the relay is operated after a very short period of time.

If, however, the variable resistance R3 is adjusted to a large value, the condenser C1 will not charge quickly for two reasons:

(a) The control grid G1 of the tube will be negatively biased relative to the cathode due to the grid-leak resistance presented by R2 and R3. This results in a reduced tube current and consequently a longer charging time for condenser C1. In this connection it may be noted that when the push button of switch PB1—PB2 is

closed to discharge the condensers C1, C2 and C3, the provision of grid resistance R2 will prevent the tube VA from drawing an excessive current.

(b) If variable resistance R3 has any substantial value and/or if the resistance R7 is not short-circuited by switch SW1, the time constant of the circuit including condensers C2, C3 and resistance R7 is increased so that a longer period is required to charge this circuit and consequently a longer period is required before the voltage developed thereacross becomes effective to assist condenser C1 to hold the relay A in an operated condition.

Resistance R7 may be included or not, as desired, and in increasing the time constant of the circuit including C2, C3, R7, enables the time range of the device to be rendered more extensive by the use of a further calibrated scale associated with the manual control of variable resistance R3. Preferably the value of R7 is chosen such that the minimum time constant of the circuit including C1, C2, C3, R3, R6, R7 and relay A is equal to or just less than the maximum time constant of said circuit when R7 is short-circuited.

A timing device constructed as described is capable of operating consistently at time intervals of from one-fifth of a second up to as much as thirty or forty seconds.

The vacuum tube used, may in addition to the control grid G1 described have, in known manner, a screen grid G2 externally directly connected to the anode A and a suppressor grid G3 directly connected to the cathode K. The normal anode load and other resistance such as anode load resistance R4, may be provided to ensure that the vacuum tube operates under the conditions recommended by the manufacturers thereof.

I claim:

1. An electronic timing device including a control circuit fed by a source of alternating current, said control circuit comprising a vacuum tube having an anode, a cathode and at least one grid, a relay and a condenser in parallel therewith, the winding of said relay being connected directly to said cathode, contacts carried by said relay and operable by said relay on energisation thereof to open to break a circuit to a load device, a capacitance-resistance circuit comprising a series-connected condenser and resistance and a further condenser connected in parallel with said series-connected condenser and resistance, a variable resistance connecting said capacitance-resistance circuit to said cathode and in parallel with said relay, a grid resistance connecting said variable resistance, on the capacitance-resistance circuit side thereof, to the control grid, and means for momentarily short-circuiting said relay together with its associated condenser and said capacitance-resistance circuit.

2. An electronic timing device including a control circuit fed by a source of alternating current, said control circuit comprising a vacuum tube having an anode, a cathode and at least one grid, a relay and a condenser in parallel therewith, the winding of said relay being connected directly to said cathode, contacts carried by said relay and operable by said relay on energisation thereof to open to break a circuit to a load device, a capacitance-resistance circuit comprising a series-connected condenser and resistance and a further condenser connected in parallel with said series-connected condenser and resistance, a variable

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resistance connecting said capacitance-resistance circuit to said cathode and in parallel with said relay, a grid resistance connecting said variable resistance, on the capacitance-resistance circuit side thereof, to the control grid, and means for momentarily short circuiting said relay, common to both the said relay with its condenser and to said capacitance-resistance circuit, said means comprising a single spring loaded double pole push button switch, connected so as on operation of said switch to short circuit said relay together with its associated condenser and said capacitance-resistance circuit.

3. An electronic timing device including a control circuit fed by a source of alternating current, said control circuit comprising a vacuum tube having an anode, a cathode and at least one grid, a relay and a condenser in parallel therewith, the winding of said relay being connected directly to said cathode, contacts carried by said relay and operable by said relay on energization thereof to open to break a circuit to a load device, a capacitance-resistance circuit comprising a series-connected condenser and resistance and a further condenser connected in parallel with said series-connected condenser and resistance, a variable resistance connecting said capacitance-resistance circuit to said cathode and in parallel with said relay, a grid resistance connecting said variable resistance, on the capacitance-resistance circuit side thereof, to the control grid, means for momentarily short-circuiting said relay together with its associated condenser and capacitance-resistance circuit, and a switch to short-circuit the resistance of said capacitance-resistance circuit so that it can be included in or removed from said capacitance-resistance circuit at will.

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4. An electronic timing device including a control circuit fed by a source of alternating current, said control circuit comprising a vacuum tube having an anode, a cathode and at least one grid, a relay and a condenser in parallel therewith, the winding of said relay being connected directly to said cathode, contacts carried by said relay and operable by said relay on energization thereof to open to break a circuit to a load device, a capacitance-resistance circuit comprising a series-connected condenser and resistance and a further condenser connected in parallel with said series-connected condenser and resistance, a variable resistance connecting said capacitance-resistance circuit to said cathode and in parallel with said relay, a double range suitably graduated scale associated with said variable resistance for indicating the various settings thereof, a grid resistance connecting said variable resistance, on the capacitance-resistance circuit side thereof, to the control grid, and means for momentarily short-circuiting said relay together with its associated condenser and said capacitance-resistance circuit.

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