

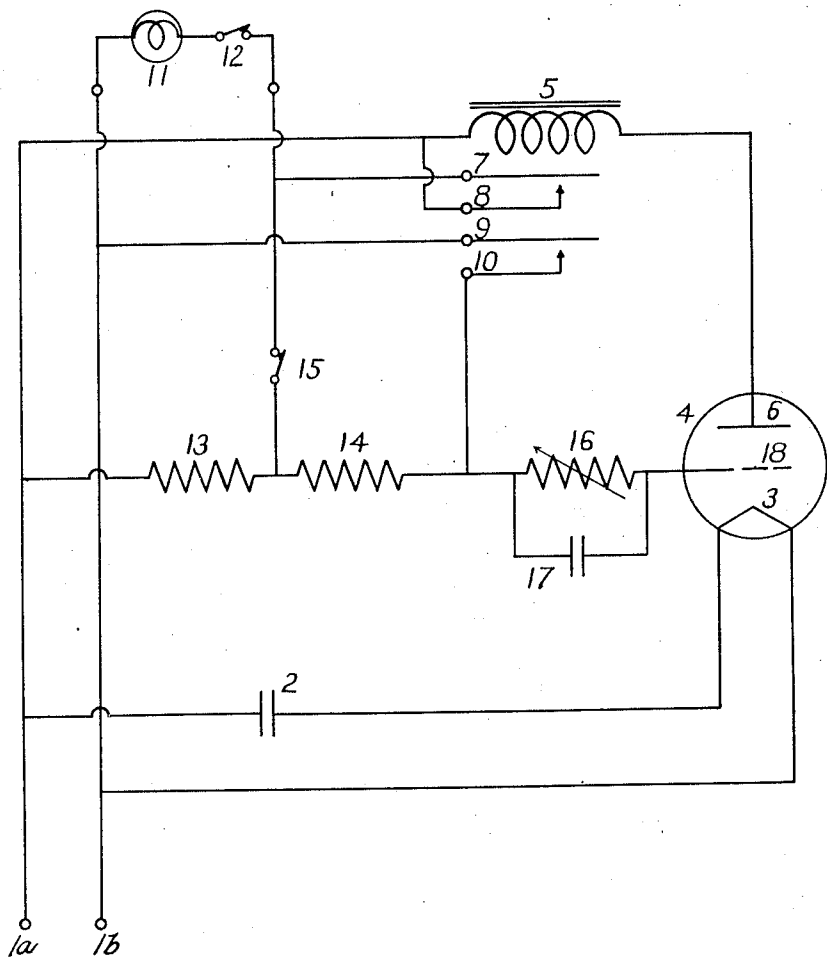
Sept. 20, 1949.

W. H. BLANKMEYER

2,482,397

TIME DELAY ELECTRICAL RELAY SYSTEM

Filed June 21, 1945



INVENTOR.

Wallace H. Blankmeyer
BY

ATTORNEYS.

UNITED STATES PATENT OFFICE

2,482,397

TIME DELAY ELECTRICAL RELAY SYSTEM

Wallace H. Blankmeyer, Butte, Mont.

Application June 21, 1945, Serial No. 600,738

1 Claim. (Cl. 175—320)

1

My invention relates to timing devices and relates more particularly to timing devices which control an electrical circuit. A general object of this invention is to provide a timing device which does not require a separate controlling or time-interval initiating circuit. More specifically then, the objects of this invention are; first, to provide an interval initiating method which is an integral part of the electrical load circuit, thereby eliminating the necessity of a separately wired and actuated initiating circuit; second, to promote simplicity of installation and operation of interval timers; and third, to provide a timing circuit which in the manufactured article will be particularly adaptable for controlling existing equipment and at the same time will be more easily adapted to new equipment requiring a timing control.

Among many applications for this invention is that of timing photographic printing operations. In this field, the timing device when attached to photographic printers requires no additional wiring of control circuits because the switch normally used to operate printer lights is now capable of initiating timing intervals in the timing device. The timing device in turn controls the printer lights according to previously established time-interval settings.

The drawing is a diagram of an electronic circuit, which is one method among several possible methods of accomplishing the desired timing control function.

In the drawing and following description, the timing device as applied electronically, comprises these parts and operations.

An electrical power source of alternating current is applied across the points designated as 1a and 1b on the drawing. 2 is a capacitor which is in series with the filament-cathode 3 of electron tube 4. Capacitor 2 provides the reactance necessary to limit filament current to rated values for the specific tube used. The capacitor and tube chosen are selected so that the largest portion of applied alternating voltage appears across the capacitor and the smallest portion appears across the tube filament. Thus the filament (hereafter called the cathode) has a comparatively low voltage difference across the two terminals and can be considered as a unit with reference to the anode 6 of the tube. Cathode 3 then is considered for purposes of explanation and from the practical operating condition to have, throughout, the same potential as point 1b to which the cathode is directly connected. The cathode is considered solely as a source of emitted

2

electrons which will be collected by the anode 6 and in some conditions by control grid 18.

Relay 5 is energized by current flowing through it as a result of electron emission from cathode 3 to anode 6 during power half-cycles when 1a is positive and 1b is negative. This current can flow only when conditions within tube 4 permit. The reverse power half-cycles are unused with respect to relay energization. Assuming relay 5 to be energized as shown, then the current through the relay coils will hold the relay contact 7 away from contact 8 and contact 9 away from contact 10. Lamp 11 represents the electrical load circuit of the equipment to be controlled by the timer. Lamp 11 can be energized for operation only during portions of the timing cycle when relay 5 allows contacts 7 and 8 to touch. Contacts 9 and 10 also touch at the same moment 7 and 8 touch.

13 is a resistance having an ohmic value several times greater than any load lamp which will be used at 11. With conditions as shown, resistance 13 is in series with load 11 when relay 5 is energized. This latter condition exists after the completion of a timing cycle and a quiescent state remains until another cycle is started. Tracing through the series connection of resistor 13 and load 11, start at 1b (one A. C. power connection) go through load 11 and load switch 12 (which is closed), through push button switch 15 (which is held closed by spring pressure) to the junction point of resistors 13 and 14, through resistor 13 and back to the other A. C. power terminal 1a. In this condition, the greater portion of the applied A. C. voltage appears across resistor 13 and the lesser portion of the voltage appears across load 11, because 13 resistor has a much higher resistance than the load 11. As established by design, the value of resistor 13 is very high compared with load 11 so that the magnitude of current flowing through those circuit elements is so low that there is no apparent effect upon the load equipment 11.

Now, since load 11 connects on one side directly to 1b and since the voltage drop across load 11 is low compared to the voltage appearing across resistor 13, this places junction of resistors 13 and 14 nearer the potential of 1b. Junction of resistors 13 and 14 connects through 14, variable resistance 16 (across which is condenser 17), to control grid 18 of tube 4. Because grid 18 connects back to junction of resistors 13 and 14, the grid is held at low potential with respect to cathode 3 since 3 ties directly to 1b and only a comparatively low potential exists across load 11

which ties junction of resistors 13 and 14 back to point 1b.

So far, conditions have been as shown in the drawing with power on the half cycles when 1b is negative, entering at 1b, flowing through to cathode 3 into the electron stream emitted from cathode 3 (assuming current flow to be in the direction of electron flow) to anode 6, through relay coil 5 and back to the positive side of power 1a.

As established earlier, the potential difference between grid 18 and cathode 3 is held low by the low potential drop across load 11. Under this condition, tube 4 conducts on all half cycles when cathode 3 is negative and anode 6 is positive. This rectified A. C. maintains relay coil 5 in the energized position.

To prepare for a timing interval, switch 12 is opened. With switch 12 open, junction of resistors 13 and 14 is no longer held near the potential of point 1b. Junction of resistors 13 and 14 now has no tie to 1b but it is tied to 1a through resistor 13. This now places resistors 14, 16, condenser 17 and grid 18 at a potential approaching that of 1a while cathode 3 is connected to 1b. Consequently, when 1b is negative and 1a is positive, current will flow through the circuit starting at 1b, to cathode 3 through the electron stream to grid 18 through resistor 16, resistor 14 and resistor 13 to point 1a. After a few half cycles of this grid rectification, condenser 17 will become charged to nearly the peak A. C. voltage from the power source. The charge across condenser 17 is developed by the drop across resistor 16 as a result of the rectified current passing through it from grid 18. Current magnitudes in this circuit are of very low order so that proper action can take place through resistor 13 which has a resistance high compared to load 11 but low compared to grid circuit values.

With the entire circuit in this present condition where switch 12 is open, both grid and anode rectification takes place and relay coil 5 remains energized by current from the anode rectification. Condenser 17 is charged with the negative side toward grid 18 and positive toward resistor 14 which connects back through resistor 13 to point 1a. Thus, since the grid network connects back to 1a which is also the anode side of the circuit, grid 18 has no ability in this condition, to prevent the passage of electrons from cathode 3 to anode 6.

Now to start a timing cycle, switch 12 will be closed. This brings the junction of resistors 13 and 14 closer to the potential of 1b because of the comparatively low resistance of load 11 which ties back to 1b. This new condition places the positive side of condenser 17 through resistor 14 and load 11 back to cathode 3 while the negative side of condenser 17 remains on grid 18. Grid 18 is now highly negative with respect to cathode 3 so that electrons can not pass from cathode 3 to anode 6 and relay 5 deenergizes. With relay 5 deenergized, relay contact 7 closes to contact 8 and relay contact 9 closes to contact 10. When relay contacts 7 and 8 touch, current can flow from 1a through contacts 7 and 8 through closed switch 12, through load 11 back to 1b on both half cycles of power. This places the load 11 in an operating condition. With relay contacts 9 and 10 closed, the junction of 14 and 16 resistors is connected to 1b and to the cathode 3 bringing the positive side of condenser 17 to cathode 3. The negative side of condenser 17 is on the grid 18.

Resistor 16 which is variable to adjust the tim-

ing device to the desired time interval, is of a very high ohmic value so that the discharge time of condenser 17 through resistor 16 is sufficiently slow to accomplish the timing function. Actually the current discharging through resistor 16 from condenser 17 will be down to a few micro-amperes before the voltage across resistor 16 becomes low enough to allow electrons to pass from cathode 3 to anode 6. When electrons resume passing from cathode 3 to anode 6, rectified current again energizes relay 5 which opens contacts 7 and 8 and load 11 becomes deenergized in the active state. Relay contacts 9 and 10 also open which places load 11 in series with resistor 13. A complete timing interval has transpired and the circuit is now again in the quiescent state which holds until another timing interval is started by opening and closing switch 12. Timing intervals can also be started by momentarily opening push-button switch 15 which has the same function electrically as load switch 12 except that 15 is located on the timer for convenience when load switch 12 might be at a distance from the timer or for some other reason might be inaccessible.

Resistor 14 is an isolating element which prevents placing a direct short circuit across points 1a and 1b when relay contact 7 closes to contact 8 and contact 9 closes to contact 10. Full power voltage is applied to resistor 14 when a timing interval is proceeding. Tracing this circuit through, start at 1a, through contacts 7 and 8 through switch 15 and resistor 14, through contacts 10 and 9 to point 1b (relay contacts are closed during a timing interval). As chosen by design requirements, resistor 14 has an ohmic value capable of limiting the current through it to a low amount of heat dissipation but still does not interfere with the final voltage across condenser 17 as a result of grid rectification during the time that switch 12 is open for preparing the circuit for a timing interval.

This timing device allows full and normal use of the switch originally installed for controlling the connected load, and in addition provides an adjustable timing function.

I do not limit myself to the specific circuit design shown and described because there are several ways of causing a load circuit to also act as the starting or initiating circuit of a timing device.

I am aware of the various existing forms of timing arrangements. These arrangements accomplish the timing cycle initiation through a separate action or switch, this switch requiring a separate circuit devoted partially or entirely to the initiating function.

I claim:

In an electrical timing device using an electron tube having a cathode grid and anode with the cathode energized through a series voltage dropping capacitor, said capacitor connected in series with the cathode and from the anode side of an external alternating current source with the cathode returned to the other side of the A. C. source, said tube having an input circuit connected between cathode and grid, and an output circuit connected cathode and anode, a relay energized from said output circuit, said relay having two pairs of contacts arranged to be open when relay is energized, first pair of said contacts being in series with any external load to be energized for a time interval, said A. C. source to timing device to supply said external load through said first contact pair, second contact pair being connected in series from cathode

5

side of A. C. source to a capacitor shunted by an adjustable resistor, said capacitor and resistor combination hereafter referred to as the discharge circuit, said discharge circuit being in series with the connection to tube grid, junction point of second contact pair and discharge circuit being returned through two high value series resistances to anode side of A. C. source, said discharge circuit is thereby effectively connected to anode side of A. C. source except when second contact pair closes to return discharge circuit to cathode side of A. C. source, junction of said two series resistances connects with load side of first contact pair with other side of said load returning to cathode side of A. C. source, thus said load becomes part of the tube input circuit as long as relay contacts remain open, said load circuit being of comparatively low impedance in reference to said two high value resistances maintains the input circuit effectively near cathode potential as long as load circuit continuity exists, opening said load circuit at any point then permits the input circuit to assume potential of anode side of A. C. source through said series resistances, said potential difference existing across grid and cathode results in grid rectification and storing of a potential in said discharge circuit capacitor, said potential across discharge circuit having negative polarity toward the tube grid, said potential being more than sufficient to reduce or block the tube anode current in the output circuit when positive side of discharge circuit is returned to tube cathode, said return to cathode being accomplished by closing

6

external load circuit, said potential across discharge circuit now blocks anode current in output circuit, releasing relay contacts to closed position, said first contact pair energizes external load circuit, said second contact pair connects cathode side of A. C. source to junction of discharge circuit and the two series resistances, said energization of external load continues until potential in discharge circuit capacitor discharges through said adjustable resistance until discharge circuit potential is no longer sufficient to block the anode current, relay is then energized thus opening contacts to deenergize external load at end of timing interval, said timing interval can initiate at any time by opening and closing external load circuit at any point, length of said timing interval to be predetermined by the rate of discharge from discharge circuit capacitor as set on adjustable resistance across said capacitor.

WALLACE H. BLANKMEYER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,238,987	Albin	Apr. 22, 1941
2,249,488	Nickle	July 15, 1941
2,339,750	Bartholy	Jan. 25, 1944
2,368,477	Kinsman	Jan. 30, 1945
2,396,497	Eisenberg	Mar. 12, 1946
2,433,845	Hayes	Jan. 6, 1948