April 23, 1957 W. H. ELLIOT 2,790,115

ELECTRONIC TIMER

Filed Aug. 24, 1953

Fig. 1

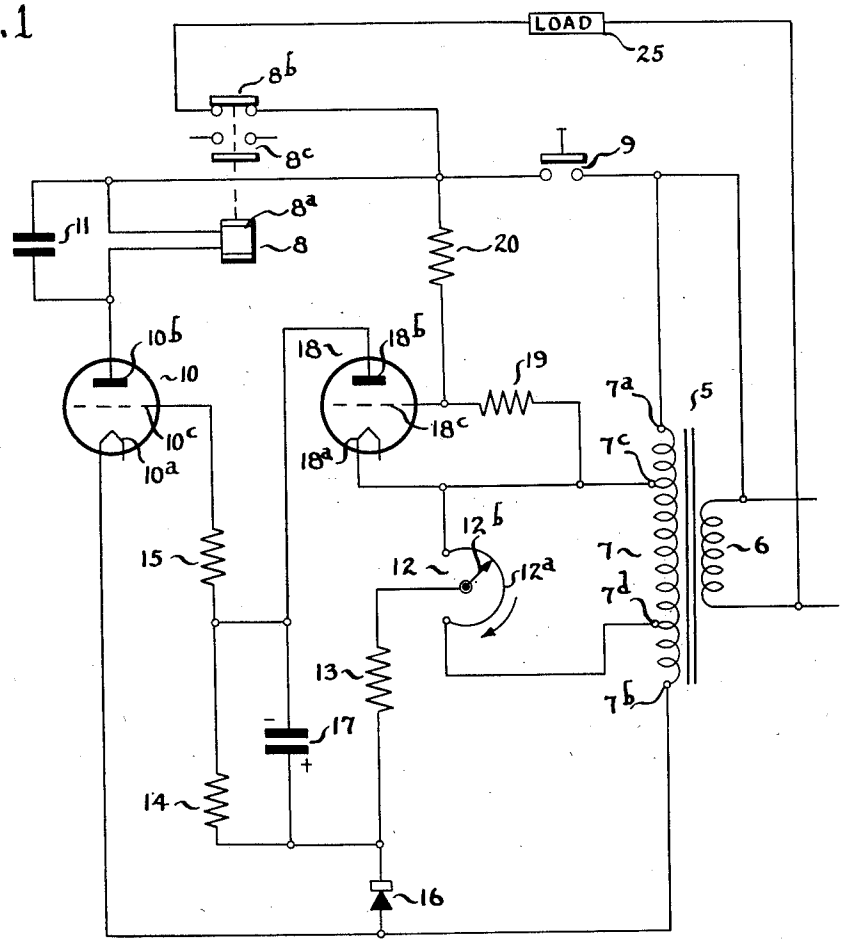
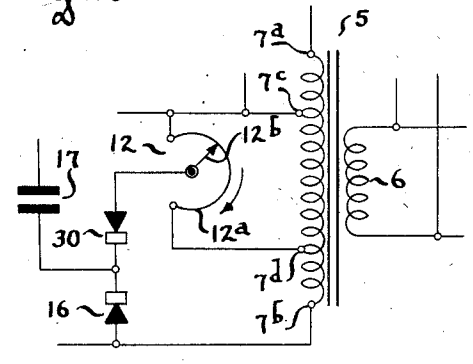


Fig. 2



Inventor
William H. Elliot
By W. E. Lyon
Attorney

United States Patent Office 2,790,115 Patented Apr. 23, 1957

2,790,115

ELECTRONIC TIMER

William H. Elliot, Whitefish Bay, Wis., assignor to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

Application August 24, 1953, Serial No. 376,004

5 Claims. (Cl. 317—142)

This invention pertains to an electronic timer of the resistor-capacitor type.

In certain respects the invention of this application is similar to that disclosed in my application Serial No. 340,639, filed March 5, 1953, and constitutes an improvement.

A primary object of the present invention is to provide an improved form of general purpose electronic timer of the aforementioned type which is relatively simple and inexpensive to manufacture, and

Another object is to provide a timer of the aforementioned character affording fast reset, relative insensitivity to line voltage fluctuations, and ability of timer's single pole pilot switch to simultaneously initiate timer action and closure of load circuit.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates preferred embodiments of the invention which will now be described, it being understood that the embodiments illustrated are susceptible of various modifications in respect of details without departing from the scope of the appended claims.

In the drawings:

Figure 1 is a diagrammatic showing of an electronic timer incorporating the invention, together with a load circuit controlled thereby, and

Fig. 2 depicts a modification to a portion of the timer of Fig. 1.

In the drawing the numeral 5 designates a transformer having a primary winding 6 for connection to a source of alternating voltage supply and a secondary winding 7 provided with end terminals 7^a and 7^b and intermediate tap terminals 7^c and 7^d. An electromagnetic relay 8 having an operating winding 8^a, normally closed contacts 8^b, and normally open contacts 8^c, has one end of its operating winding connected in series with a normally open switch 9 to end terminal 7^a of winding 7, and the other end of its operating winding connected to anode 10^b of an electron tube 10. Tube 10 is provided with a cathode 10^a which is connected to end terminal 7^b of winding 7, and is also provided with a control grid 10^c. A capacitor 11 is connected in shunt with winding 8^a of relay 8 and affords well known smoothing action. Tube 10 will of course only be conductive when the alternating potential to which its anode 10^b is subjected is positive with respect to the potential of cathode 10^a, which occurs during alternate half cycles of the alternating potential between terminals 7^a and 7^b of winding 7.

A potentiometer 12 has its resistance element 12^a connected across terminals 7^c and 7^d of winding 7 and has its adjusting element 12^b connected in series with resistors 13, 14 and 15 to control grid 10^c of tube 10 for subjecting such grid to an alternating potential. End terminal 7^b of winding 7 is connected in series with a half-wave rectifier 16, a capacitor 17 and resistor 15 to control grid 10^c of tube 10, and is also connected in series with rectifier 16 and capacitor 17 to the anode 18^b of an electron tube 18 which has its cathode 18^a connected to terminal 7^c of

winding 7. Tube 18 is also provided with a control grid 18^c which is connected in series with a resistor 19 to cathode 18^a, and to terminal 7^c of winding 7. Grid 18^c is also connected in series with a resistor 20 to the point common between operating winding 8^a of relay 8 and switch 9.

With switch 9 open, grid 18^c is connected to its cathode 18^a so that tube 18 will be fully conducting whenever its anode 18^b is positive with respect to its cathode 18^a. Capacitor 17 will then be charged with the polarities depicted when switch 9 is open and terminal 7^b is positive with respect to terminal 7^a of winding 7; the charging circuit being from terminal 7^b through rectifier 16, capacitor 17, and tube 18 to terminal 7^c.

Control grid 10^c of tube 10 is subjected through the medium of its aforedescribed connections to adjusting element 12^b of potentiometer 12 to an alternating potential relative to its cathode which is of the magnitude obtaining between adjusting element 12^b and terminal 7^d of winding 7. Such alternating potential to which control grid 10^c is subjected is sufficient, alone, to render tube 10 conductive during its conducting half-cycles, but such alternating potential is normally superimposed on a unidirectional potential, which is a function of the voltage to which capacitor 17 is charged, and which is sufficiently negative with respect to the potential of cathode 10^a when switch 9 is open as to prevent such alternating potential from rendering tube 10 sufficiently conductive to operate relay 8.

To start the timing cycle, switch 9 is closed and held closed. Now control grid 18^c of tube 18 will be biased sufficiently negative with respect to cathode 18^a, by virtue of the potential drop across resistor 19, which in series acts as a potential divider across terminals 7^a and 7^c of winding 7, so that conduction of tube 18 will be blocked. Consequently capacitor 17 will then discharge through resistor 14. After a given period of time as determined by the setting of adjusting element 12^b of potentiometer 12, the value of current conducted by tube 10 will increase to a value sufficient to energize winding 8^a of relay 8 and cause the latter to open its contacts 8^b and close its contacts 8^c. Winding 8^a of relay 8 will thereafter be maintained energized so long as switch 9 remains closed. Opening of switch 9 "resets" the timer by permitting tube 18 to again conduct to effect charging of capacitor 17.

The timing period may be varied, within limits by changing the position of adjusting element 12^b of potentiometer 12, and the range of time may be changed by changing the ohmic value of resistor 14 in the discharge path of capacitor 17, or by changing the capacitance value of the latter.

Charging of capacitor 17 through the plate circuit of tube 18 permits higher charging currents than is permissible through the grid-cathode circuits in other timer arrangements known in the prior art, thus permitting appreciably faster reset. The unidirectional voltage to which capacitor 17 is charged is always the same thus making for better repetitive accuracy during timing operations.

The timer is relatively insensitive to line voltage fluctuations, as any such fluctuations cause corresponding changes in the potential to which capacitor 17 is charged and in the peak value of the A. C. to which the grid 10^c of tube 10 is subjected. These changes offset one another thereby minimizing the change in time delay that might otherwise occur because of a line voltage fluctuation.

It is a feature of the timer that closure of the single pole switch 9 can be utilized for simultaneous energization of a load circuit and energization of the time delay current. As depicted in Fig. 1, a load 25 is connected at

one end to one end terminal of winding **6** and at its other end in series with normally closed contacts **8**^{b} of relay **8** to the left-hand stationary contact whose right-hand stationary contact is connected to the other end terminal of winding **6**. It is apparent that when switch **9** is closed circuit is completed through load **25**, and that the latter will be energized so long as both contacts **8**^{b} and switch **9** remain closed.

While tubes **10** and **18** have been shown as separate tubes, in a commercial form of the timer these preferably could be combined in a single envelope, such as the so-called "Twin-Triode" tube.

As shown in Fig. 2, a half-wave rectifier **30** may be used in place of resistor **13**. Use of rectifier **30** in place of resistor **13** affords a low forward resistance and high back resistance which eliminates the half-wave load on rectifier **16** and on transformer **5**, which obtains with the use of resistor **13**, without altering appreciably the A. C. voltage applied to grid **10**^{c} of tube **10**.

I claim:

1. In combination, a source of alternating potential, a translating device, an electron tube having a control electrode, means including a switch operable to connect said translating device and the conducting path of said tube in series circuit with said source, means in circuit with said source and said control electrode for subjecting the latter to an alternating potential tending to render said tube conducting, a capacitor in circuit with said control electrode, a second electron tube having a control electrode in circuit with said source and subjected to a potential normally rendering said second tube conductive during non-conducting half-cycles of the first mentioned tube, means including the conducting path of said second tube in circuit with said source and said capacitor for charging the latter to a potential blocking conduction

of said first mentioned tube, a discharge circuit for said capacitor, and means in circuit with said switch and said control electrode of said second tube responsive to the aforementioned operation of said switch to block conduction of said second tube.

2. The combination according to claim 1 wherein said means for subjecting the control electrode of the first mentioned tube to an alternating potential comprises a potentiometer for adjusting the amplitude of such potential.

3. The combination according to claim 2 wherein said means for charging said capacitor with a potential blocking conduction of the first mentioned tube includes a half-wave rectifier connected between said source and the positive potential terminal of said capacitor and has the conducting path of said second tube connected between the negative potential terminal of said capacitor and said source.

4. The combination according to claim 3 wherein said potentiometer has its adjusting element connected in circuit with the control element of first mentioned tube and the positive terminal of said capacitor in series with a second half-wave rectifier.

5. The combination according to claim 4 wherein said translating device is an electromagnetic relay.

References Cited in the file of this patent

UNITED STATES PATENTS

2,003,992	Cockrell	June 4, 1934
2,126,895	Knott	Aug. 16, 1935
2,433,845	Hayes et al.	Jan. 6, 1948
2,471,834	McDowell et al.	May 31, 1949
2,497,681	Mayer	Feb. 14, 1950
2,538,881	Schommer	Jan. 23, 1951