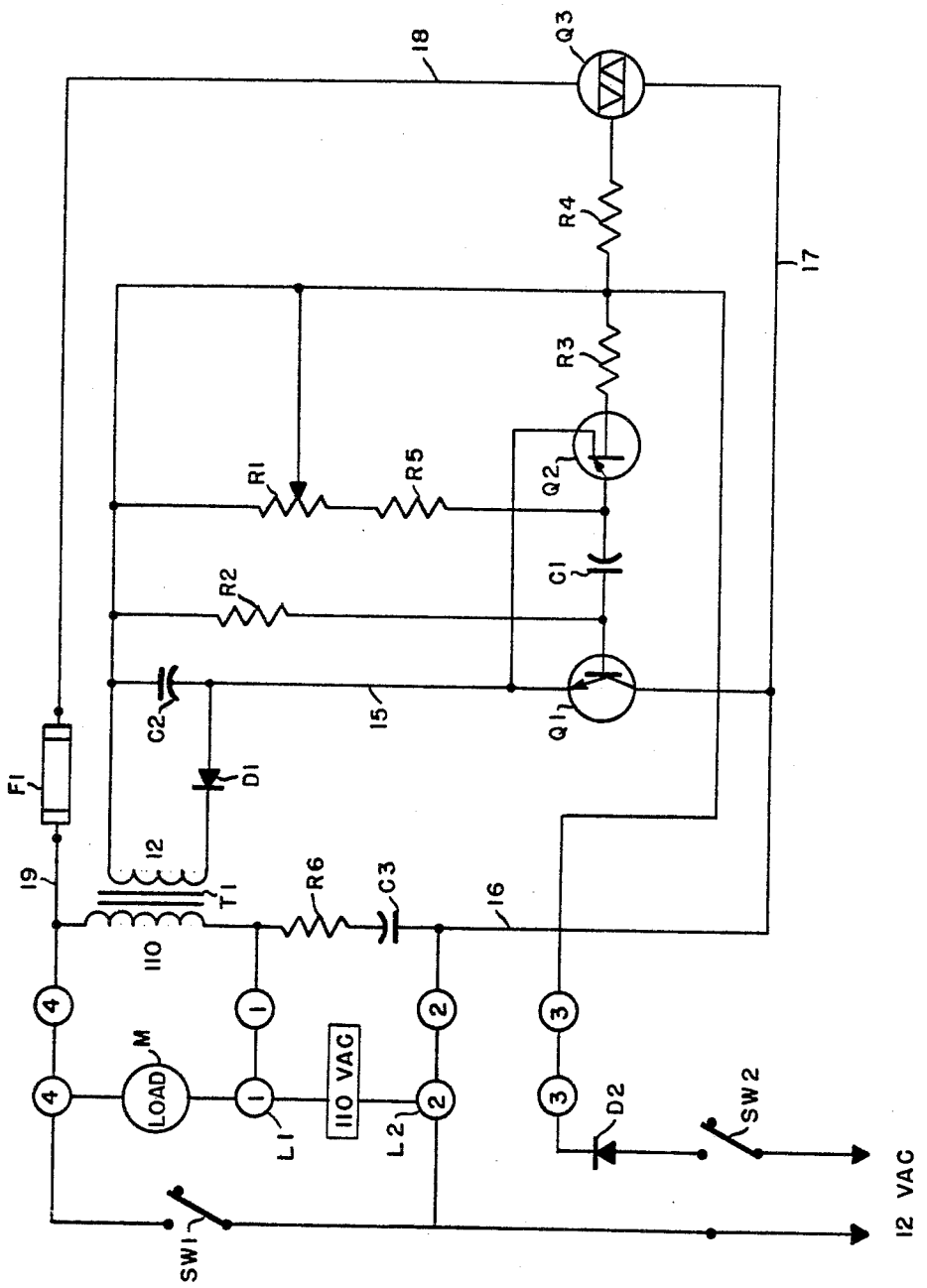
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ADJUSTABLE SOLID-STATE ELECTRONIC TIMING SWITCH

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ADJUSTABLE SOLID-STATE ELECTRONIC TIMING SWITCH

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ABSTRACT OF THE DISCLOSURE

A gate controlled A.C. switch for supplying alternating current to a load for adjustable time periods. The gate is turned on by operation of a trigger switch in a high or low voltage circuit and is held activated by the flow of current through the A.C. switch. The discharge of a timing capacitor turns off the gate to open the switch.

This invention pertains to timing devices and more particularly to electronic timers involving solid-state circuitry operable at different voltages, current phases and cycle frequencies.

There are many applications in industry requiring a timer in a control circuit to close contacts to send an electric current through a working load for a predetermined interval of time. Any such timer should desirably be capable of automatic instant resetting to go through repeated incremental operations at various intervals in a predetermined sequence until a desired result is achieved, such as feeding materials in increments to predetermined stations.

Heretofore, various types of complicated mechanical timing devices combined with electric circuits have been tried out and discarded because they were not dependable, and were entirely too bulky, and could not be remotely located from the device or apparatus under control.

Timing circuits using hot vacuum or gas tubes have been used in combinations with many variations of impedances, capacitors, relay switches, rectifying tubes, etc., which were unsatisfactory because of unpredictable breakdown and heat damage from the tubes to other interconnected electrical components.

Therefore, an object of the present invention is to provide a compact, simplified dependable electronic timer that can be used in any desired position remote from the apparatus to be controlled and without having to use a mechanical relay or switch.

Another object is to provide a solid-state timer that, when triggered, will proceed through a predetermined cycle and then return to a normal inoperative position, ready for another operative cycle.

Another object is to provide a completely transistorized timer that can be quickly and easily adjusted to vary the timed interval to any desired value within predetermined limits.

Another object is to provide a timing circuit which is completely under alternating current control at any desired voltage, phase and frequency.

Still another object is to provide a plurality of means or ways in the circuitry of this invention for momentarily triggering the timer into operation at different voltages, such as high voltage-high current or low voltage-low current.

According to the exemplification of this invention, one of many embodiments is disclosed for illustrative purposes only and not as a restriction to the broad aspects of the invention, wherein a potentiometer, removed from a load to be worked on, is adjusted to any desired time delay, and a trigger switch of either low or high voltage

is momentarily closed to energize a transformer for just sufficient time to pass current through a silicon rectifier (rectifies A.C. to half wave D.C.) and through a filter capacitor used for filtering purposes only. A gate switch connects A.C. current at a desired voltage to a working load to run it for the length of time adjusted to by the time control potentiometer while a timing capacitor connected to the control potentiometer continues charging until it reaches a predetermined potential whereup a unijunction transistor fires to discharge the timing capacitor, which thus opens the switching transistor and causes the gate controlled A.C. switch to stop conducting thereby shutting off the operating power to the working load at the end of the timing cycle as determined by the time setting of the timing potentiometer and the values of the above various solid-state components and resistances and the voltages used in the solid-state circuitry.

The above circuit in many variations may use any desired A.C. voltage, and current of any amperage at any desired phase, and at any desired cycle frequency.

Other objects and advantages of the invention will become apparent from the following description when taken in conjunction with the drawing which shows a schematic circuit diagram of one illustrative embodiment of a solid-state electronic timing device embodying the features of the present invention for applying an A.C. operating current to any desired load in the electrical system for a predetermined interval of time.

The components of this solid-state timing device of the present invention may be removably mounted in a portable housing with a removable cover and controls extending therethrough. The housing with timer therein may be placed in any place remote to or near the working load to be timed.

The drawing discloses diagrammatically an efficient method of controlling the actual operating time of an A.C. load such as the "Feed-O-Meter" motor M in Jaquith Patent No. 3,111,113 for the incremental feeding of a flowable material. Obviously, any A.C. switching load within the capacity limitations would be applicable for use with the present solid-state timing device as shown in the drawing. In this instance, the "Feed-O-Meter" motor M operates from 110 volts A.C. source when connected to terminals 1 and 4 of this source.

If the time delay solid-state timer is to be placed in a remote location from the load M, then two wires from the 110 volt A.C. source terminals 1 and 4 may be connected to the terminals of load motor M.

It is to be understood that the solid-state timer of the present invention can be constructed to operate within any desired low range such as .01 to 1 second or more, and within any higher range of a few minutes or hours as required.

Two methods may be used to operate the solid-state timer for any preselected period of time such as, for example, from 5 seconds to 4 minutes or more. One method is by momentarily closing switch SW1 across terminals 2 and 4 to start the time delay circuit in a high voltage and high current mode of switching. The second method is by momentarily closing switch SW2 to send a single impulse of low current and low voltage through terminals 2 and 3.

Thus the time delay control of this invention is a method of switching on AC loads of any desired nature from O: position or quiescent state to On or operative position by employing solid-state circuitry using switching transistors and a gate controlled A.C. switch and maintaining the A.C. load in operation for any selected predetermined period of time ranging from fractions of a second to seconds or to minutes and even to hours, as desired, and then automatically terminating the operation at the end of the timing cycle.

As shown in the drawing, power terminals 1 and 2 are connected to 110 volts A.C., and terminals 1 and 4 are connected to a load or motor M. A push button switch SW1 is connected across terminals 2 and 4 and when this button switch is actuated momentarily, transformer T1 is energized just long enough to pass current through rectifier diode D1 and power supply filter capacitor C2. Current then passes through conductor 15 to operate switching transistor Q1 which biases and turns on gate Q3.

The activation of gate Q3 causes 110 volt A.C. current to pass through the load or motor M from terminal 2 through conductors 16–17, gate controlled A.C. switch Q3, conductor 18, overload fuse F1, and conductor 19 to load terminal 4 to complete the circuit which also supplies current to the transformer T1.

For example, assume that it is determined to operate the load or motor M for 3 minutes, then potentiometer R1 is adjusted to that position and switch SW1 across power terminals 2 and 4 is momentarily closed thereby turning on transistor Q1 and gate Q3 to apply 110 volt A.C. current to operate load M for the length of time of three minutes. During this operation of load or motor M, a capacitor C1 (connected in series with a unijunction transistor Q2, resistors R3–R4 and gate Q3) is continually charging until it reaches a predetermined charge whereupon it triggers unijunction Q2 to discharge capacitor C1 thus turning off transistor switch Q1 which causes gate Q3 to stop conducting thereby disconnecting the 110 volt A.C. across terminals 1 and 4 to stop operation of load or motor M at the end of three minutes.

Manifestly, the timer may be designed and varied to operate a load for just a few seconds or for many hours. Also, the gate switch may be designed to carry any practical amperage.

Although the drawing discloses a load operated at 110 volts A.C. with 12 volts A.C. in the pilot circuit, it is to be understood that the circuit is adapted to be used with any of the standard voltages such as 220, 380, 440 volts A.C. and at any desired cycle frequency such as 25, 50 or 60 cycles per second by varying the values of the transformer T1. The current used may be single phase, two phase, or three phase as desired through modifications in the circuit.

The gate controlled A.C. switch Q3 is an active circuit which can be opened (turned on) or closed (turned off) by a voltage signal. Conduction of current to the load or motor M is controlled by this gate Q3 which can function over a broad range of amperage.

The charging of timing capacitor C1 is regulated or adjusted by potentiometer R1 with a timing range of 5 seconds to 4 minutes or more—the greater the resistance of R1, the longer the timing period. The discharge of the timing capacitor C1 is caused by the firing of unijunction transistor Q2 which turns off transistor switch Q1 to close the gate Q3 to open the operating circuit through motor or load M and stop its operation.

The silicon rectifier diode D1 is used to rectify the A.C. voltage to half wave D.C. voltage. Power supply filter capacitor C2 is used for filtering purposes only. Capacitor C3 and resistor R6 are used for transient voltage suppression. Capacitor C1 and adjustable potentiometer R1 are used together for desired time delays ranging from 5 seconds to 4 minutes or more.

Resistor R2 controls and provides sufficient base current to transistor Q1 relative to the resistance of gate Q3 and the minimum specified current gain of the transistor Q1.

Resistor R3 is primarily used for temperature compensating purposes.

Resistor R4 is used to accentuate the voltage drop in the gate circuit of the gate controlled A.C. switch Q3.

Resistor R5 is used as a standard for a time period of 5 seconds when the potentiometer R1 is set at zero or minimum value.

Diode D2 in series with switch SW2 is employed to rectify any 12 volt A.C. impulse from terminals 2 and 3 when 12 volt A.C. is used instead of 12 volt D.C. impulses.

F1 is a 5 ampere 125 volt fast action fuse to protect the gate controlled A.C. switch Q3 from an overload current or from a short circuit occurring in the load.

By varying the values of the resistors R1 and R5 the timing can be varied from zero to any number of minutes or hours.

The time delay device embodying the present invention is a compact, self-contained unit which makes it very desirable for remote switching applications for use with any voltage and current at any phase and any desired cycle frequency.

The values of the components disclosed in the drawing are as follows:

F1 5 ampere 125 volt fuse—instrument type
T1 Transformer PRI–110 sec. 12 volt
D1 Silicon rectifier ¾ amp @ 50 volt
D2 Silicon rectifier ¾ amp @ 50 volt
Q1 GE 2N2195 transistor switch
Q2 GE 2N 2646 unijunction transistor
Q3 GE gate controlled A.C. switch SC41B
C1 Timing capacitor 100 mfd. @ 25 volt
C2 Power supply filter capacitor 100 mfd. @ 25 volt
C3 Transient suppression metallized paper or film type capacitor .47 mfd. @ 200 volt
R1 2.0 meg. ohm 1-watt potentiometer 20% variable
R2 3000 ohm ½ watt resistor 10%
R3 100 ohm ½ watt resistor 10%
R4 180 ohm 2 watt resistor 10%
R5 10,000 ohm ½ watt resistor 10%
R6 100 ohm ½ watt resistor 10%.

Manifestly, components with values other than those above could be substituted, in a modified circuit, and used with different voltages and currents of different phases and different cycle frequencies.

Although the embodiment disclosed and described is based on single phase actuation, it will be understood the present invention covers and includes a three (3) phase operation through the use of three (3) gating switches Q3 with the common pilot control for time and with appropriate means of isolation between the three power phases.

While several embodiments of the invention have been described, it is to be understood that various changes may be made in the circuitry by those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A solid state timer for supplying alternating current from a first A.C. source to a load comprising a gate controlled alternating current switch and an isolated timing means for turning said gate controlled current switch off after a preselected time interval, said timing means comprising first and second storage means, said first storage means including means for rectifying a momentary presence of A.C. signal from said first A.C. source to initiate the triggering of said gate controlled current switch and also to initiate a timing function determined by said second storage means, a second A.C. source and a further switch including means for rectifying a momentary presence of A.C. signal from said second A.C. source to directly trigger said gate controlled current switch to supply said first A.C. source to said load and to said timing means to initiate a said timing function as determined by said second storage means, the triggering of said gate controlled current switch being selectively provided from said first A.C. source or from said second A.C. source.

2. A device as defined in claim 1 wherein said second storage means comprises a capacitor in circuit with the gate.

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5

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