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**Weinberg**

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## [54] TIMING CONTROL DEVICE


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[51] **Int. Cl.** ..... **H01h 7/00**

[58] **Field of Search**..... 307/141 R, 141.4; 315/360, 315/154; 317/142 R, 141 R



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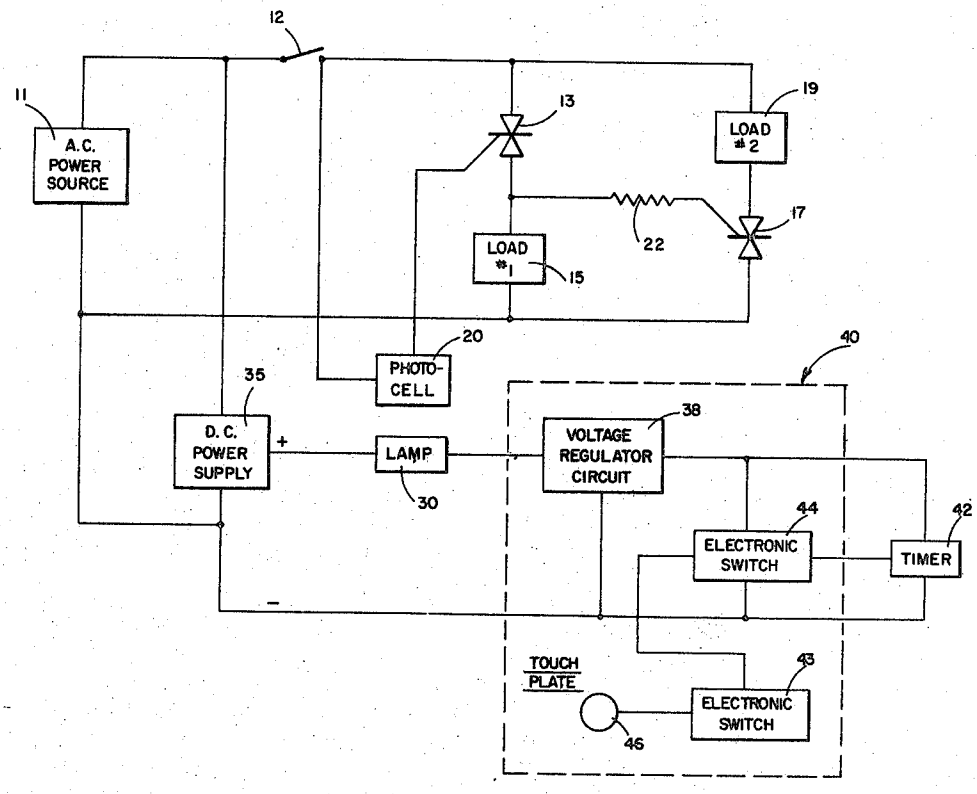
*Primary Examiner*—David Smith, Jr.
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[57] **ABSTRACT**

A timing control device which is suitable for use in controlling equipment in a photographic dark room, includes a pair of electronic switches for alternatively activating either of two loads. A timer is provided which utilizes a wire wound potentiometer for setting a precise timing period. The timing circuit, which includes a resistive-capacitive charging circuit, is utilized to generate a ramp voltage which is fed to the anode of a programmable unijunction transistor, the output of the timing control potentiometer being fed to the gate of this transistor to set the program therefor. The programmable unijunction transistor is utilized to provide a keying signal which actuates an electronic switch which in turn controls the switching circuits associated with the loads. Initiation of the timing action is controlled by means of a touch plate which actuates a switching circuit which in turn activates the timing circuit.


**9 Claims, 3 Drawing Figures**



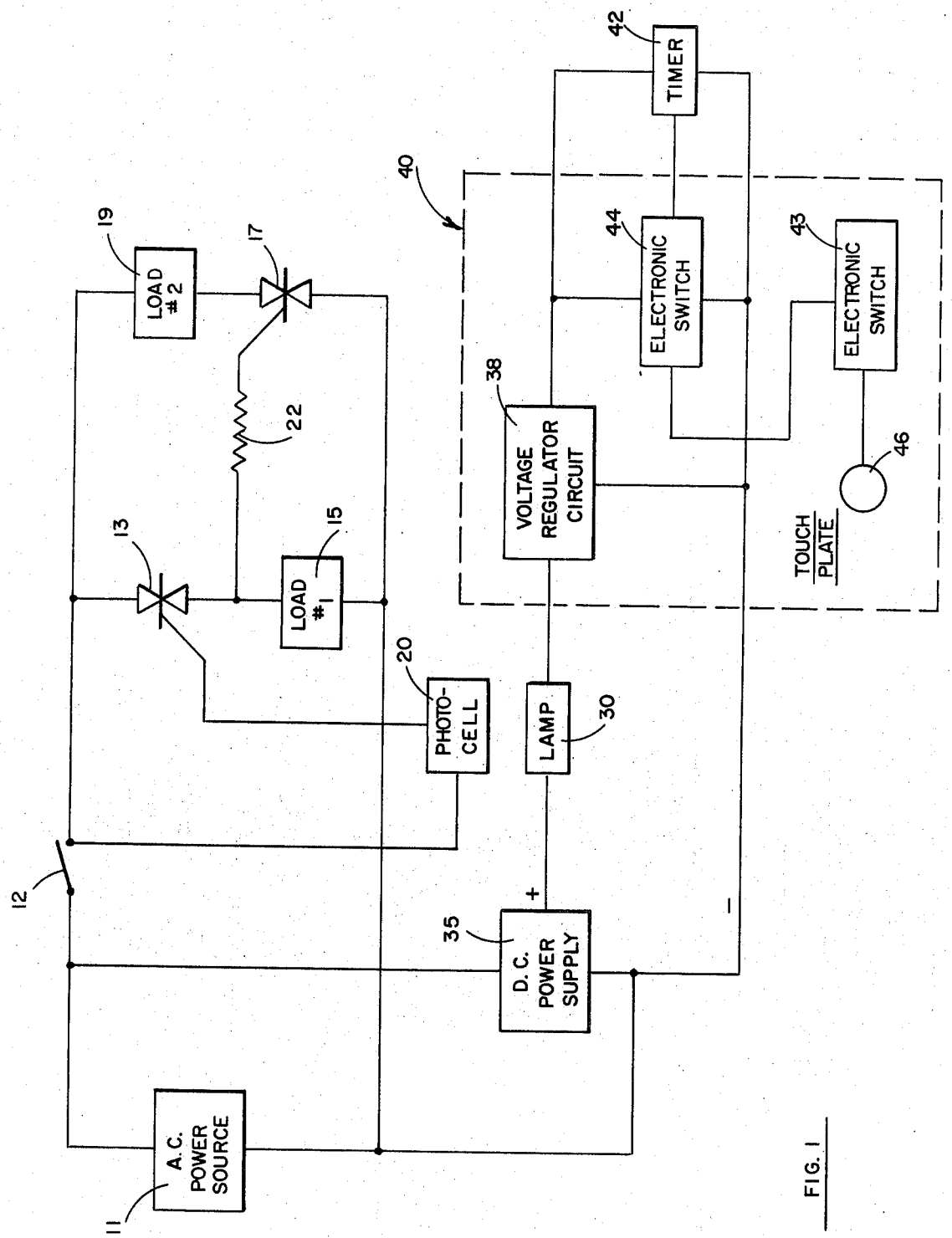

42
TIMER
40
44
ELECTRONIC SWITCH
43
ELECTRONIC SWITCH
19
LOAD #2
17
38
VOLTAGE REGULATOR CIRCUIT
22
46
TOUCH PLATE
13
15
LOAD #1
20
PHOTO-CELL
LAMP
30
12
+
35
D.C. POWER SUPPLY
−
A.C. POWER SOURCE
11

FIG. 1

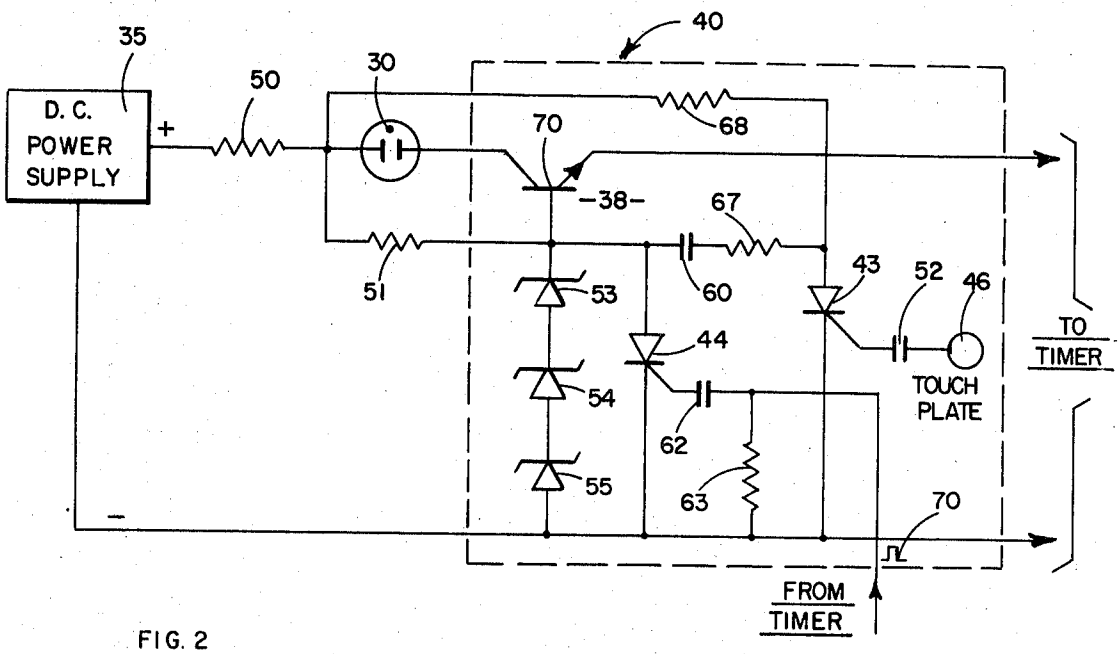

35
D. C.
POWER
SUPPLY
+
50
30
40
68
70
-38-
67
51
53
60
43
52
46
44
TO
TIMER
54
TOUCH
PLATE
62
55
63
70
FROM
TIMER

FIG. 2

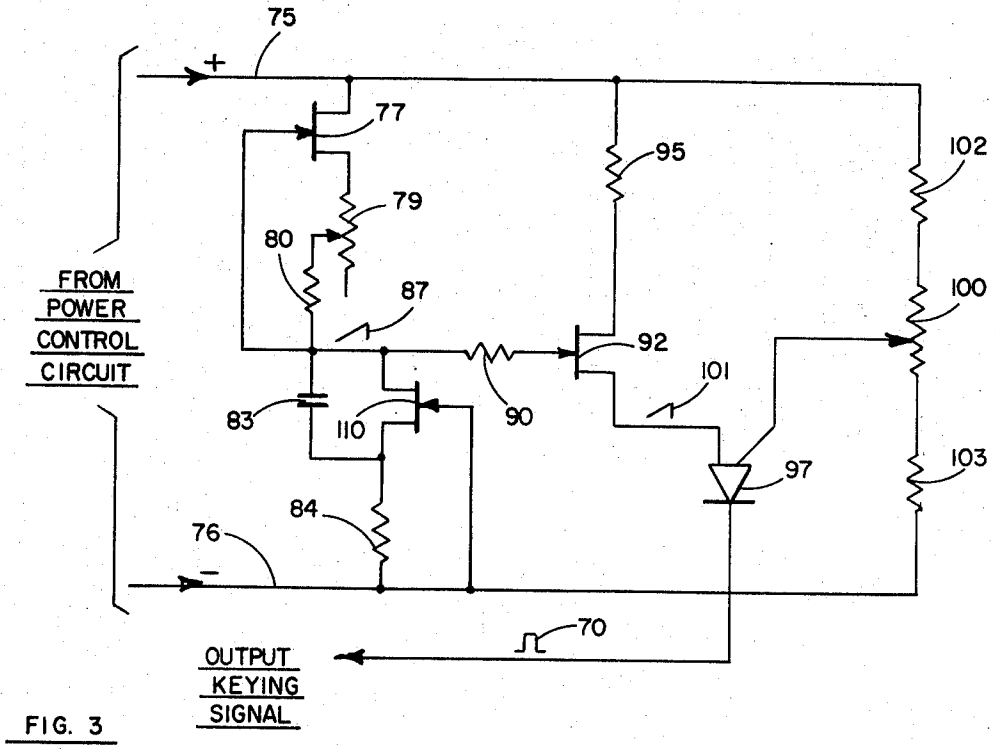

75
+
77
95
102
79
80
FROM
POWER
CONTROL
CIRCUIT
87
92
100
101
83
110
90
97
103
84
76
-
70
OUTPUT
KEYING
SIGNAL

FIG. 3

# TIMING CONTROL DEVICE

This invention relates to an electronic timing control device and more particularly to such a device suitable for controlling the operation of photographic dark room equipment.

In operating photographic dark room equipment, precise automatic timing of the exposure time of photographic papers is generally required. It is often desirable to simultaneously control the operation of the dark room safe light, i.e. to turn the safe light on whenever the enlarged exposure lamp is off and vice versa. Such timing control is generally achieved by means of a resistive-capacitive timing circuit utilizing a single capacitor and a plurality of fixed resistors which are selectively placed in the charging circuit by means of a multiposition selector switch. To obtain precision timing as is required by the expert photographer, precision resistors must be utilized which maintain their accuracy over long periods of use and under varying temperature conditions. Also to assure relability, a relatively good quality switch must be utilized. Such components are generally more costly than would be desired. Further, accuracy of operation, particularly under varying temperature conditions, is difficult to maintain as is repeatability of the timing operation of units produced on a production line basis. Further, the switch contacts often present reliability problems.

The device of this invention provides an improvement over prior art devices of the aforementioned type in eliminating the use of various resistors for selection in the timing circuit and thus the need for a selector switch for selecting such resistors. Rather, a single wire-wound potentiometer is utilized for selecting the timing over a continuous range. This potentiometer is not utilized in the resistive-capacitive charging circuit but rather is used to program a programmable unijunction transistor. This eliminates the need for a plurality of high-cost precision resistors as well as a selector switch, and thus cuts the cost of the device and improves its reliability. The device of this invention additionally includes a unique touch control for initiating the timing action with the touching of a touch plate by the operator without the need for actuating a mechanical switch. Further, stable and reliable electronic switching circuitry is utilized which can be fabricated with a minimal number of economical components which affords accurate and reliable operation.

It is therefore an object of this invention to provide an improved timing control device suitable for utilization in controlling photographic dark room equipment;

It is another object of this invention to provide a timing control device of more economical construction than similar prior art devices;

It is still another object of this invention to provide timing control having higher reliability than similar prior art devices;

It is still a further object of this invention to facilitate the timing control of photographic dark room equipment;

Other objects of this invention become apparent as the description proceeds in connection with the accompanying drawings of which:

FIG. 1 is a functional block diagram illustrating a preferred embodiment of the invention.



FIG. 2 is a functional block diagram of one embodiment of the power control circuit of the preferred embodiment, and

FIG. 3 is a schematic drawing illustrating one embodiment of the timer of the preferred embodiment.

Briefly described, the device of the invention is as follows:

A pair of electronic switches are provided to alternatively energize either of two loads which may comprise the exposure lamp of a photographic enlarger and a dark room safe light. Where one of the loads is a dark room safe light, the switch which controls this light is normally activated to keep this light on and the enlarger exposure lamp off. A timer is utilized which has a circuit including a programmable unijunction transistor. The programming gate of this transistor is controlled with a precision potentiometer by means of which the voltage fed to this gate can be set to a predesired value. A resistive-capacitive charging circuit is utilized to generate a ramp voltage which is fed to the anode of the programmable unijunction transistor. The timing action of the timer is initiated by the operators touching of a touch plate to operate a series of electronic switches; these switches both initiating the timing operation of the timer and activating the electronic switch for the enlarger exposure lamp. When the timing period has been completed, i.e. when the ramp voltage at the anode of the programmable unijunction transistor reaches the voltage set on the timing potentiometer, the transistor provides a keying output signal. This signal is used to actuate the aforementioned electronic switches to cause the switch for the enlarger exposure lamp to be deactivated and that for the safe light to be activated restoring the device to its original condition and placing it in a state for a new timing cycle.

Referring now to FIG. 1, a functional block diagram of a preferred embodiment of the invention is shown. AC power source **11** is connected by means of main power switch **12** across series connected electronic switch **13** and load No. **1,15** and series connected electronic switch **17** and load No. **2,19.** Electronic switches **13** and **17** may comprise Triacs. Where the equipment is used to control photographic dark room equipment, load No. **1, 15** may comprise the exposure lamp of a photographic enlarger while load No. **2, 19** may comprise a dark room safe light. During the equipment's timing cycle, which is to be explained further on in the specification, Triac **19** is normally activated to provide current to load No. **2, 19** with Triac **13** and load No. **1, 15** being deactivated. This is in view of the fact that the gate of Triac **13** is connected to AC power source **11** through photocell **20.** This photocell receives light input solely from lamp **30.** When lamp **30** is not on, the photocell has a high resistance. This high resistance in the gate circuit of the Triac keeps the Triac at cut-off. Lamp **30,** as to be explained further on in the specification, is actuated to the on condition only when the system timer is in one of its timing cycles. The Triac **17** is actuated to the on condition by virtue of the low resistance path between its gate and AC power source **11** provided by resistor **22** and load number **1,15.**

The output of AC power source **11** is rectified and filtered by means of DC power supply **35.** The output of DC power supply **35** is connected through lamp **30** to voltage regulator circuit **38** which forms part of power control circuit **40.** The output of voltage regulator circuit **38** is fed to timer **42.** Electronic switches **43**

and 44 operate, as now to be explained, in conjunction with touch plate 46 to control the operation of the timer and control circuits which respond thereto.

To initiate a timing cycle, the operator momentarily touches the touch plate 46 with his finger, this plate being a metallic plate which is connected in the gating circuit of electronic switch 43. Electronic switch 44 is normally (i.e. when timer 42 is not performing a timing cycle) activated and operates in this condition to shunt out the output of voltage regulator circuit 38 so that no power is being delivered to timer 42. When electronic switch 43 is activated by means of touch plate 46, it drives electronic switch 44 to cut off thereby supplying power to timer 42. When timer 42 is so energized it commences its timing cycle. With the shunt across voltage regulator circuit 38 removed so that current is being delivered to timer 42, lamp 30 is energized to in turn activate photocell 20. This provides a low resistance path between the gate of triac 13 and AC power source 11 to activate triac 13 and along with it load No. 1, 15 which as already noted, may comprise the exposure lamp of a photographic enlarger. With triac 13 activated, a shunt is applied between the gate and the low side of triac 17 driving this triac to cut off thereby de-energizing load No. 2, 19 which may comprise a safe light.

When the timing operation of timer 42 has been completed, a signal is provided from the timer to actuate electronic switch 44 to the "on" condition thereby restoring the shunt across voltage regulator circuit 38 and interrupting the supply of current to the timer. This causes the de-energization of lamp 30 which in turn effects the de-energization of load No. 1, 15, and the energization of load No. 2, 19.

Referring now to FIG. 2, a schematic drawing of a preferred embodiment of the power control circuit 40 of the invention is illustrated. The power is supplied from DC power supply 35 through resistors 50 and 51 to series connected Zener diodes 53–55. Connected in shunt across the series connected Zener diodes is silicon controlled rectifier 44. The gate of silicon controlled rectifier 60 is connected through capacitor 62 and resistor 63 to the negative terminal of DC power supply 35. Normally (i.e. except during the timing cycle of the timer), silicon controlled rectifier 60 is activiated by virtue of the forward bias supplied by the power supply and thus provides a shunt across the Zener diodes which connects the base of NPN transistor 70 to the negative terminal of DC power supply 35. This maintains transistor 70 at cut off and thus interrupts the current path to the timer.

Silicon controlled rectifier 43 is also maintained at cut off in view of the fact that its gate, which is connected through capacitor 50 to touch plate 46, is effectively "floating" at this time. Capacitor 60 charges through the path provided by resistors 67 and 68 and silicon controlled rectifier 44. Silicon controlled rectifier 43 is of a type having a sensitive gate, (i.e., one that will trigger with less than 10 microamps of gate current). When the operator touches touch plate 46 this provides a sufficient current to the gate of silicon controlled rectifier 43 through capacitor 50 to activate the silicon control and rectifier, momentarily. The momentary activation of silicon controlled rectifier 43 permits the discharge of capacitor 60 through resistor 67 and silicon controlled rectifier 43. This momentarily reverse biases silicon controlled rectifier 44 driving it to cut off. In view of the fact that resistor 68 is of a very high magnitude (of the order of 22 megohms) the silicon controlled rectifier is current starved so that it immediately returns to the deactivated state after its momentary actuation, its only function being to "dump" commutating capacitor 60. With silicon controlled rectifier 44 at cut off, the shunt is removed from across the zener diode network formed by Zener diodes 53–55 and a positive voltage is applied to the base of transistor 70 to drive this transistor to conduction. This causes the activation from neon lamp 30 and provides a current path from the DC power supply to the timer.

When the timing cycle of the timer has been completed, a pulse 70 is generated by the timing circuit. This pulse is fed through capacitor 62 to the gate of silicon controlled rectifier 44 to drive this silicon controlled rectifier back to the conductive state, thus interrupting the supply of the current to the timer and deactivating neon lamp 30.

Referring now to FIG. 3, a preferred embodiment of the timer utilized in the device of the invention is schematically illustrated. The positive voltage line 75 from the power control circuit is connected to the drain of field effect transistor 77. The source of this transistor is connected through potentiometer 79, resistor 80, capacitor 83, and resistor 84 to the negative line 76 of the power control circuit. Transistor 77 acts as a linear current source for the resistive-capacitor charging circuit formed by resistors 79 and 84, potentiometer 80 and capacitor 83. A ramp voltage 87 is thus developed in the charging circuit. Potentiometer 79 is used as a trimmer to adjust the charging current for optimum characteristics.

The ramp voltage 87 is fed through resistor 90 to the gate of field effect transistor 92. The drain of this transistor is connected through resistor 95 to power line 75 while the source of this transistor is connected to the anode of programmable unijunction transistor 97. Transistor 92 functions as a current amplifier and overcomes the offset as is necessary to fire programmable unijunction transistor 97 with short timing cycles. A fixed DC voltage is applied to the program gate of programmable unijunction transistor 97 from the arm of timing potentiometer 100. This timing potentiometer is connected in a voltage divider circuit formed by itself and resistors 102 and 103 which are connected between lines 75 and 76. Timing potentiometer 100 is preferably a precision wire wound potentiometer and is calibrated so that it can be set to provide the various desired timing outputs. When the ramp voltage output 102 of transistor 92 exceeds the voltage applied to the gate of programmable unijunction transistor 97, the programmable unijunction transistor fires to produce an output pulse 70 at its cathode which signals the end of a timing cycle. This pulse as explained in connection with FIG. 2, is utilized as a keying signal which fires the power control circuits to cut off the supply of power to the timer.

Field effect transistor 110 is connected across capacitor 83 and operates to discharge this capacitor at the termination of each timing cycle. During the timing cycle, transistor 110 is maintained at cut off by virtue of the negative bias applied to its gate. With the removal, however, of the potential between lines 75 and 76, this bias disappears and an effective discharge path is provided for capacitor 83 through the transistor.

The timing control device of this invention thus provides a simple and economical control which is capable of accurate and reliable operation.

While the invention has been described and illustrated in detail, it is to be clearly understood that this is intended by way of illustration and example only, and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the following claims.

I claim:

1. A timing control device for controlling the application of power from a power source through load means for predetermined periods of time comprising:

a timer for generating a timing signal corresponding to the end of each of said predetermined periods of time,

means for switching power from said power source to said load means, and

a power control circuit for controlling the application of power to said timer and actuating said means for switching power, the timing operation of said timer being initiated when power is supplied thereto from said power control circuit,

said timer including a resistive-capacitive charge circuit for generating a ramp voltage, a precision potentiometer connected to the output of said power control circuit to provide a selectable voltage and electronic switch means having cathode and anode electrodes and a control gate, said control gate receiving the output of said potentiometer, one of said electrodes receiving said ramp voltage, the timing signal appearing at the other of said electrodes when the ramp voltage goes above the voltage on said control gate,

said power control circuit receiving the output of said power source and including voltage regulator circuit means for regulating said power source output and electronic switch means for effectively shunting said regulator circuit at all times except during the timing cycles of said timer,

said power control circuit further including manually operable switch means for providing an actuating signal for said electronic switch means to initiate the supply of current from said power control circuit to said timer, the timing signal from said timer being fed to said electronic switch means to actuate said electronic switch means to remove the supply of power to said timer to terminate each timing cycle.

2. The device of claim 1 wherein said electronic switch means comprises a semiconductor switching device having a sensitive gate, said manually operable switch means comprising a touch plate connected to the gate of said switching device whereby the touching of said touch plate provides current to said gate to fire said switching device.

3. The device of claim 1 wherein said load means comprises first and second loads and switch means responsive to said power control circuit for alternatively activating one or the other of said loads.

4. The device of claim 1 wherein said voltage regulator circuit means comprises a plurality of series connected zener diodes, said electronic switch means comprising a silicon controlled rectifier connected in shunt across the series connected zener diodes.

5. The device of claim 1 wherein said means for switching power to said load comprises an electronic switch having a gate control circuit, a photoelective cell in said gate control circuit, lamp means connected in said power control circuit, said lamp means being driven to the illuminated state by said power control circuit to excite said photoelectric cell thereby causing said electronic switch to be actuated.

6. The device of claim 1 and additionally including electronic switch means connected across the capacitive portion of said charge circuit for discharging said capacitive portion on the completion of each timing cycle, said switch means being activated in response to said timing signal, and means for providing bias to said last mentioned switch means to maintain said switch means in a deactivated state except when actuated by said timing signal.

7. A timing control device for controlling the application of power from a power source to a load during predetermined time intervals comprising:

electronic switch means for interconnecting said power source and said load,

power control circuit means for controlling the operation of said electronic switch means, said power control circuit means including manually operable switch means, and

timer means for providing a timing control signal for controlling the operation of said power control circuit means, said timer means including a resistive-capacitive charge circuit for generating a ramp voltage, said charge circuit receiver a voltage from said power control circuit means to initiate the charging thereof in response to an actuation of said manually operable switch means, a potentiometer connected to receive voltage from said power control circuit for selecting a desired voltage and a programmable unijunction transistor, the program gate of said unijunction transistor receiving the output of said potentiometer, the anode of said unijunction transistor receiving said ramp voltage, said timing control signal appearing at the cathode of said unijunction transistor when the ramp voltage at the anode thereof exceeds the voltage at the gate thereof.

8. The device of claim 7 wherein said manually operable switch means includes a silicon controlled rectifier having a sensitive gate and a touch plate for providing an actuation signal to said gate when touched by an operator.

9. The device of claim 7 wherein said power control circuit means includes voltage regulator circuit means comprising a plurality of series connected zener diodes, a silicon controlled rectifier connected in shunt across said zener diodes, said silicon controlled rectifier being activated to effectively shunt out the current supply to said charge circuit and said potentiometer in response to said timing control signal, said silicon controlled rectifier being deactivated in response to said manually operable switch means to remove said shunt and permit the supply of current to said charge circuit and said potentiometer.

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