United States Patent [19]

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[11] **3,906,292**

[45] **Sept. 16, 1975**

[54] **DEVICE FOR CONTROLLING LIGHTING TIME OF LAMP**

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[22] Filed: **Nov. 2, 1973**

[21] Appl. No.: **412,097**

[30] **Foreign Application Priority Data**

Nov. 6, 1972 Japan 47-110250

[52] **U.S. Cl.** ..... **315/208;** 315/209 CD; 315/241 P

[51] **Int. Cl.** **H05b 37/00**

[58] **Field of Search** ..... 315/200 A, 208, 209 CD, 315/238, 240, 241 P, 241 S; 331/75, 111, 150; 307/293

[56] **References Cited**

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Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

A series circuit consiting of a device for obtaining a constant voltage and a resistor, a series circuit consisting of a resistor and a charging-discharging circuit adapted to be charged to a predetermined level when a trigger switch is closed and then gradually discharged, and a circuit consisting of a lamp, a switching circuit and its output circuit, are connected in parallel to each other and to a DC power source. The control voltage and the reference voltage of the switching circuit are derived from the junction between the charging-discharging circuit and the resistor connected in series thereto and the junction between the device for obtaining a constant voltage and the resistor connected in series thereto, respectively. When the voltage of the DC power source drops below the rated voltage, the voltage difference between said two junctions is increased so that the "on" time of the switching circuit is increased, thereby increasing the lighting time of the lamp.

5 Claims, 3 Drawing Figures

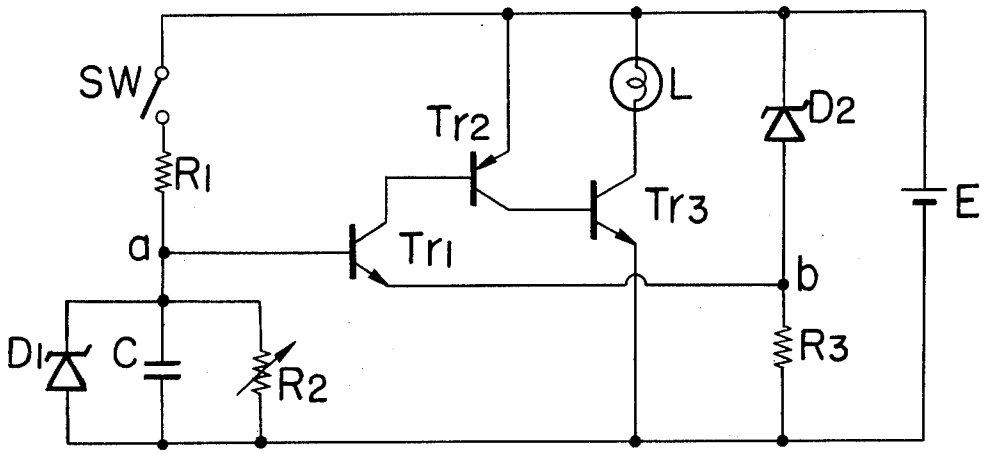


FIG. 1

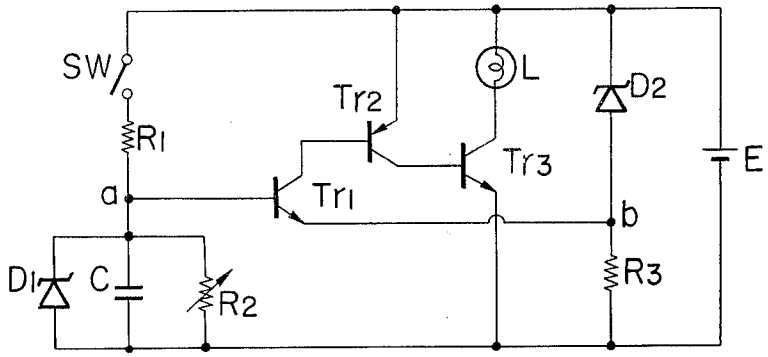


FIG. 2

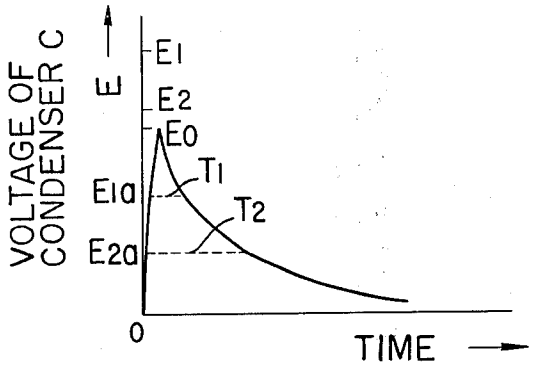
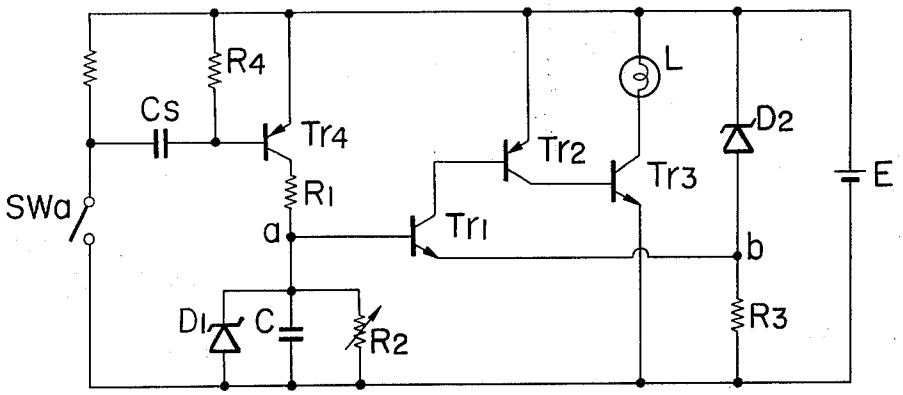


FIG. 3



DEVICE FOR CONTROLLING LIGHTING TIME OF LAMP

BACKGROUND OF THE INVENTION

The present invention relates to a device for controlling a lighting time of a lamp.

An illumination device incorporating the so-called CR discharge type timer consisting of a capacitor and a resistor connected in parallel thereto is used in a camera of the type capable of superimposing desired data such as dates upon a film together with a subject. A trigger switch is actuated in response to the shutter release operation or by a suitable actuating member to energize the illumination device to turn on a lamp, thereby illuminating desired data to be superimposed upon a film. However, when the voltage of the power source for the illumination device drops, the quantity of light emitted from the lamp is reduced and the lighting or "on" time of the lamp, which is determined by the CR timer, is also decreased, resulting in the underexposure of the data to be superimposed. It is economically disadvantageous to replace a power source such as a dry cell too frequently, but when the power source whose voltage drops below a certain level is not replaced, the failure in data superimposition occurs.

SUMMARY OF THE INVENTION

In view of the above, the present invention provides an improved device for controlling a lighting time of a lamp, in which a device for obtaining a constant voltage is inserted into a CR timer so that the on time interval of the timer may be increased as the voltage drop of the power source is increased, thereby preventing the drop in quantity of light emitted from the lamp.

Briefly stated, according to the present invention, a charging-discharging circuit adapted to be charged to a predetermined constant voltage when a trigger switch is closed and to start the discharge as soon as the trigger switch is opened, a switching circuit for controlling the current flowing through a lamp, and a series circuit consisting of a resistor and a device such as a zener diode for obtaining a constant voltage, are connected to parallel to each other and to a DC power source. The base of a switching element in the first stage of the switching circuit is connected to the charging-discharging terminal to be referred to as the point *a* hereinafter of the charging-discharging circuit, and the emitter is connected to the junction of the device such as a zener diode for obtaining a constant voltage and the resistor in said series circuit. (the latter junction will be referred to as the point *b* hereinafter.) The switching element is turned on when the voltage difference between the points *a* and *b* is within a predetermined range, so that a lamp is turned on. The voltage at the point *b* varies as the voltage of the DC power source varies. The charging-discharging circuit is always charged to a predetermined constant voltage so that the larger the voltage drop of the DC power source, the longer the time when the voltage at the points *a* and *b* are equal becomes. As a result, the lighting time of the lamp is increased accordingly.

The present invention will become more apparent from the following description of preferred embodiments thereof taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a circuit diagram of a first embodiment of the present invention;

FIG. 2 is a graph used for the explanation of the mode of operation thereof; and

FIG. 3 is a circuit diagram of a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

First Embodiment, FIGS. 1 and 2

FIG. 1 is a diagram of a circuit for turning on a lamp L in order to superimpose the data such as date upon a film loaded in a camera. SW is a trigger switch which is closed for a very short time and then opened in response to a shutter release operation or by a suitable actuating member. R_1 is a resistor; R_2, a variable resistor; R_3, a resistor; C, a capacitor connected in parallel with the variable resistor R_2; D_1, a device such as a zener diode for obtaining a predetermined constant voltage connected in parallel with the variable resistor R_2 and the capacitor C; Tr_1 and Tr_3, NPN transistors; and Tr_2 a PNP transistor. These transistors Tr_1, Tr_2 and Tr_3 make up a switching and amplifier circuit. E is a power source; and D_2, a device, such as a zener diode for obtaining a predetermined constant voltage, connected in parallel with the lamp L and the transistor Tr_3 and connected in series to the resistor R_3 and the power source E.

Next the mode of operation will be described. When the trigger switch SW is closed for a very short time, the capacitor C is charged. The voltage across the capacitor C has a predetermined level because the zener diode D_1 is connected in parallel with the capacitor C. Therefore whether the voltage of the power source E is E_1 or E_2 in FIG. 2, the voltage charged across the capacitor C is always E_0. The voltage at the junction *a* at the base of the transistor Tr_1, the resistor R_1 and the capacitor C_1 is higher than the voltage at the junction *b* at the zener diode D_2, the emitter of the transistor Tr_1 and the resistor R_3. The voltage at the junction *b* is lower than the voltage of the power source E by a voltage drop across the zener diode D_2. As a result the base voltage of the NPN transistor Tr_1 is higher than the emitter voltage so that the transistors Tr_1 Tr_2 and Tr_3 are turned on. The lamp L is thus turned on. Then the discharge of the capacitor C through the resistor R_2 is started so that when the voltage at the junction *a* and hence the base potential of the transistor Tr_1 becomes lower than the voltage at the junction *b* and hence the emitter potential, the transistor Tr_1 is turned off Tr_2, Tr_3 and, thereby turning off the lamp L.

When the voltage of the power source E drops below its rated voltage, the voltage charged across the capacitor C remains unchanged while the voltage at the junction *b* drops below the voltage obtained when the voltage of the power source does not drop. Therefore, the on time of the transistor Tr_1 becomes longer so that the exposure or on time of the lamp L is also increased. This will be described with reference to FIG. 2 illustrating the charging-discharging characteristic curve of the capacitor C. When the trigger switch SW is closed, the voltage across the capacitor C increases from zero to E_0 (which is constant because of the zener diode D_1). When the lamp L is turned on, the voltage across the capacitor C gradually drops. (The switch SW remains

"off"). When the voltage of the power source E is E_1, the voltage at the junction *b* is E_{1a} and the lamp L is turned on for a time interval T_1. When the voltage of the power source E drops to E_2, the voltage at the junction *b* becomes E_{2a} and the lamp L is turned on for a time interval T_2 which is longer than the time interval T_1.

Second Embodiment, FIG. 3

The second embodiment whose circuit diagram is shown in FIG. 3 is substantially similar in arrangement to the first embodiment except that a transistor Tr_4 with a differentiating circuit consisting of a capacitor C_s and a resistor R_4 is inserted in place of the switch SW. Therefore when the trigger switch SW_a is closed, the differentiated voltage is applied to the base of the transistor Tr_4 so that even when the trigger switch SW_a is closed for a relatively long time, the lamp L is turned on for a time interval corresponding to the voltage of the power source.

In the first and second embodiments of the present invention, the decrease in quantity of light emitted from the lamp L due to the voltage drop of the power source may be compensated by varying the resistance of the variable resistor R_2 and by selecting suitable zener diodes D_1 and D_2. When the device of the present invention is incorporated in a camera capable of superimposing the data, the service life may be increased and the failure in data superimposition may be prevented.

It is to be understood that instead of the NPN transistors Tr_1 and Tr_3 and the PNP transistors Tr_2 and Tr_3, the PNP and NPN transistors may be used with the polarities of the power source and zener diodes reversed.

What is claimed is:

1. A Device for controlling a lighting time interval of a lamp, comprising;

a. a DC power source having a nonconstant voltage output;

b. a charging-discharging circuit and a trigger switch connected in series, the series combination being connected in parallel with said DC power source and charged to a constant predetermined voltage when the trigger switch is closed, and then discharged when the trigger switch is opened;

c. a switching circuit having two states connected to said charging-discharging circuit;

d. a lamp connected to said switching circuit so as to be turned on and off in response to the state of said switching circuit;

e. a series circuit comprising a resistor and means for obtaining a constant voltage, said series circuit being connected in parallel with said DC power source to obtain a voltage at the junction of the resistor and the constant voltage means which is the voltage of the DC power source less the constant voltage drop of said constant voltage means; and

f. a switching element having a control terminal and a reference terminal in said switching circuit, said control terminal being connected to said charging-discharging circuit and said reference terminal being connected to the junction between said means for obtaining a constant voltage and said resistor, the difference between the voltage at the control terminal and the voltage at the reference terminal being an inverse function of said DC power source voltage output and the voltage difference controlling the state of said switching circuit such that said switching circuit turns on said lamp for a longer time interval as said DC power source voltage output decreases.

2. A device as defined in claim **1** wherein said charging-discharging circuit comprises:

a capacitor;

a variable resistor; and

a second means for obtaining a constant voltage, said capacitor, said resistor and said means for obtaining a constant voltage being connected in parallel with each other.

3. A device as defined in claim **1** wherein said trigger switch comprises a switch and circuit means for providing a differentiated output pulse, the duration of said pulse being substantially independent of the duration of activation of said trigger switch.

4. A device as defined in claim **3** wherein said circuit means comprises:

a transistor; and

a differentiating circuit activated by said switch and connected to the base of said transistor.

5. A device as in claim **2** wherein said means for obtaining a constant voltage is a zener diode.

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