United States Patent

Biber

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[54] LOW ENERGY LEVEL ELECTRONIC FLASH MODULATOR

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[51] **Int. Cl.** **G03b 9/70**

[58] **Field of Search**.....95/11.5 R; 315/241 P, 100 S, 315/232, 238

[56] **References Cited**

UNITED STATES PATENTS

2,756,365	7/1956	Germeshausen	315/238 X
2,901,671	8/1959	Most	95/11.5 X
3,296,947	1/1967	Engelsmann et al.	95/11.5 X
3,350,604	10/1967	Erickson	315/241 P
2,721,959	10/1955	Nessel	315/238 X
3,353,062	11/1967	Nuckolls	315/232 X
2,724,792	11/1955	Nessel	315/238 X

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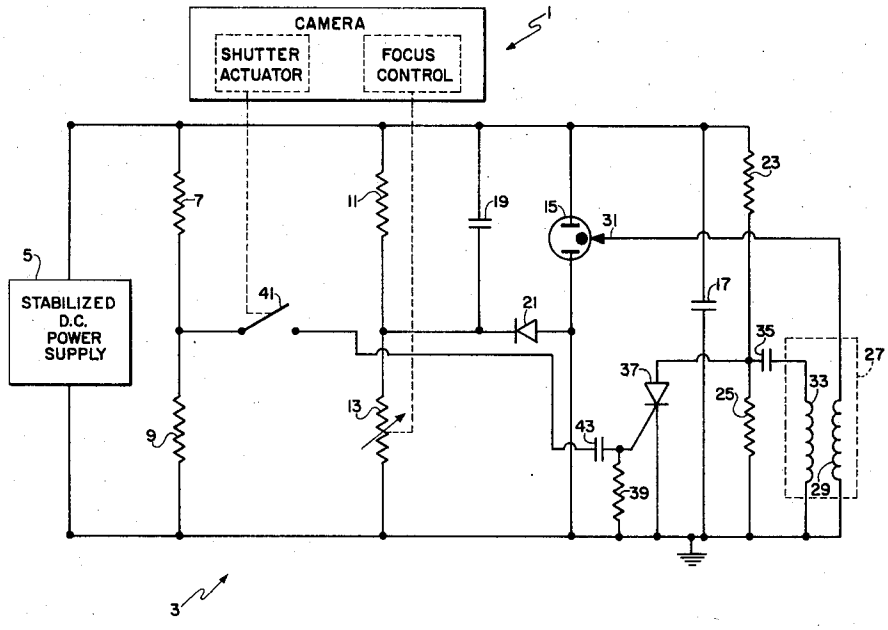
[57] **ABSTRACT**

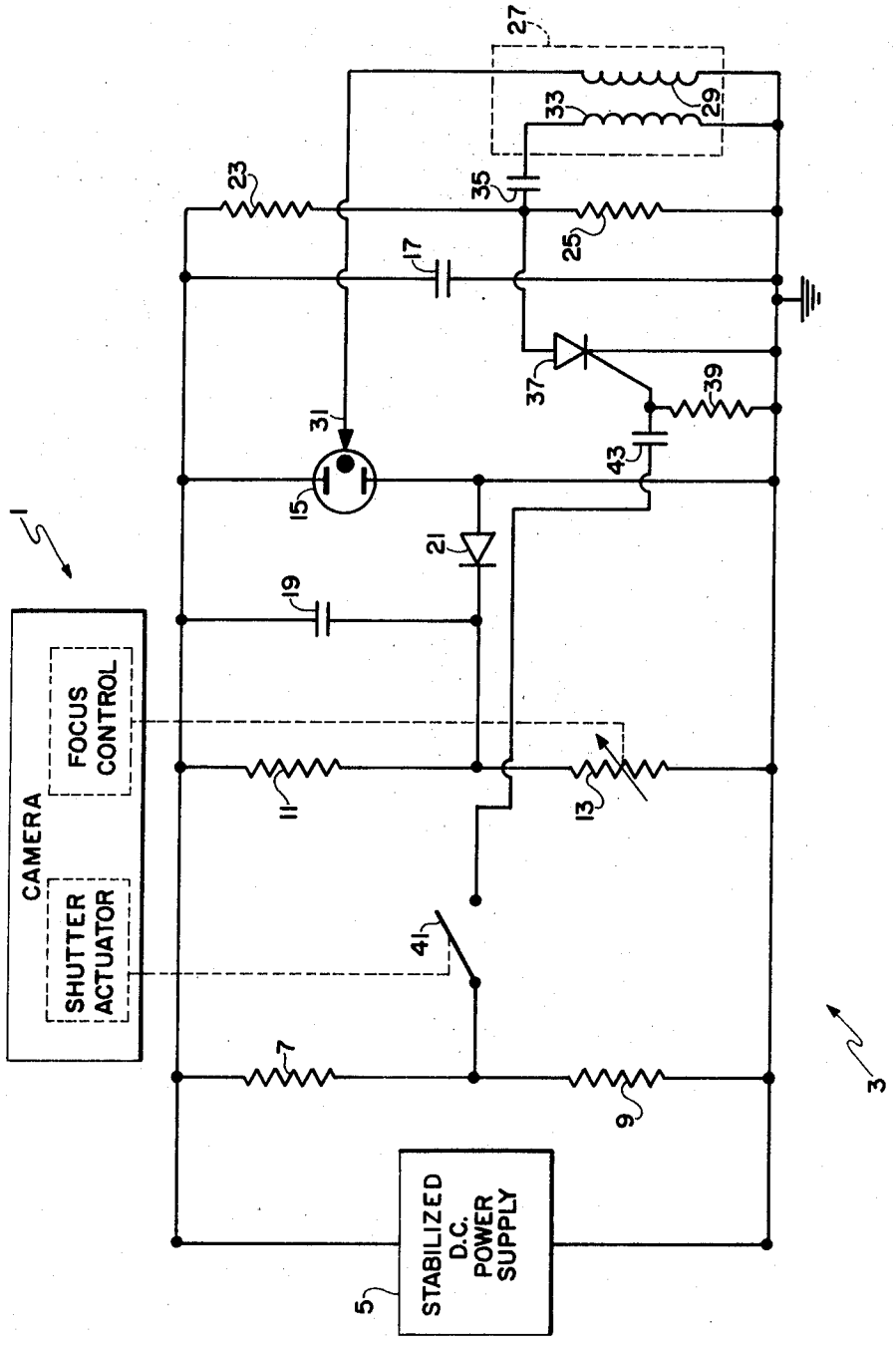
A device is provided for modulating actinic radiation emanating from a gas discharge lamp in response to the focus setting of a camera.

Plural energy storage sources are provided with one such source having relatively low storage capacity and storing energy of sufficiently high potential to fire the lamp in response to a trigger signal.

Another source, having a relatively high capacity for storing energy of a potential sufficient to maintain a discharge from said lamp, but insufficient for initiating such discharge with an acceptable frequency of success, is provided.

10 Claims, 1 Drawing Figure





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LOW ENERGY LEVEL ELECTRONIC FLASH MODULATOR

BACKGROUND OF THE INVENTION

This invention relates, generally, to gas discharge lamp control networks and, more particularly, to an improved means for modulating the actinic radiation emanating from such a lamp.

Many gas discharge lamp control circuits have been developed in recent years to produce flashes of different intensities, or durations, for different exposure situations. These circuits eliminate the problems inherent in adjusting camera controls to provide a proper exposure with a constant light source, such as is commonly provided by more conventional lamp systems.

In one prior art system, a capacitor is connected across the gas discharge lamp and serially connected to a power supply through a variable resistor controlled switch. The resistor is operably connected to the focus control of a camera so that changes in exposure setting will effect a change in the impedance of the resistor, the potential to which the capacitor may be charged and, consequently, the intensity of the lamp output.

In another type of prior art system, an electronic switching network shunts the lamp and receives activating signals from a conventional timing network. After a predetermined time, following the firing of the lamp, the timing network activates the switching network to short circuit the lamp and terminate its discharge.

Systems of the above-described prior art types are limited to providing actinic radiation of relatively high intensity because the capacitor connected across the gas discharge lamp, and providing the discharge energy thereto, must be charged to a potential sufficient to fire said lamp with a desired frequency of success.

SUMMARY OF THE INVENTION

The subject invention, unlike prior art systems, provides a means for modulating the actinic discharge from a gas discharge lamp while sustaining such discharge with an input potential generally insufficient for initiating said discharge with an acceptable frequency of success. Thus, modulation of a relatively low intensity actinic discharge may be effected.

The foregoing is accomplished by connecting a small capacitor across a gas discharge lamp and charging such capacitor to a potential sufficient to fire said lamp in response to a trigger signal.

A much larger capacitor is connected across the lamp through a diode, which prevents the potential across the small capacitor from being reflected across the larger one.

The signal to the larger capacitor is supplied from the same high potential source as the small capacitor, but is reduced in potential by a variable voltage divider network, the impedance ratio of which is controlled by the focus control of a camera.

A switch, activated by the shutter actuator of the camera, provides a triggering pulse to the lamp (via an electronic switching network) causing the lamp to fire and the small capacitor to discharge therethrough.

The discharge through the lamp is maintained by the larger capacitor at a relatively low intensity controlled by the variable voltage divider network and, hence, the setting of the camera focus control.

Accordingly, it is an object of this invention to provide a means for modulating a relatively low intensity actinic discharge from a gas discharge lamp.

Another object of the instant invention is to initiate an actinic discharge in a gas discharge lamp with a signal of high potential and sustain such discharge with a signal of lower potential.

Still another object of the present invention is to initiate an actinic discharge in a gas discharge lamp with a signal of high potential and sustain such discharge with a signal of lower potential while modulating the intensity of such discharge in response to the focus setting of a camera.

Other objects and many of the attendant advantages of the present invention will be better appreciated and said invention will become clearly understood by reference to the following detailed description when considered in conjunction with the accompanying drawing, illustrating one embodiment of the instant invention, wherein the FIGURE provides a simplified schematic of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing in more detail, a camera, having a shutter actuator and a focus control, is shown generally at **1**. The camera is operably associated with a gas discharge lamp control network **3**, in a manner to be more fully described hereinafter.

The control network **3** includes a stabilized DC power supply **5**, such as is common in the art, one side of the output of which is grounded. A pair of resistors **7** and **9**, respectively, are serially connected across the output of the power supply **5** to effect a voltage divider network.

Connected across the resistors **7** and **9** is a variable voltage divider network comprising a resistor **11** serially connected with a variable resistor **13**.

A gas discharge lamp **15** is connected across the output of the power supply **5** as is a capacitor **17**. Another capacitor **19**, of substantially greater capacity than said capacitor **17**, is connected across the resistor **11** and a diode **21** is connected between the grounded side of the lamp **15** and the common junction of the resistors **11** and **13** and the capacitor **19**, with the diodes forward direction being away from ground.

A pair of resistors **23** and **25**, respectively, are serially connected with each other so as to form a third voltage divider network which in turn is connected across the capacitor **17**.

A triggering transformer **27** is connected with its secondary winding **29** between the trigger electrode **31** (of the lamp **15**) and ground and its primary winding **33** serially connected with a capacitor **35** across the resistor **25**.

A silicon controlled rectifier **37** is connected at its anode to the junction of the resistors **23** and **25**, and with its cathode grounded, so as to shunt the resistor **25** in its conducting state. The gate of the silicon controlled rectifier is grounded through a resistor **39** to prevent inadvertant triggering of said rectifier **39** by circuit transients.

One side of a single pole-single throw switch **41** is connected to the junction of the resistors **7** and **9** and the other side of the switch **41** is connected through a capacitor **43** to the gate of the silicon controlled rectifier **37**.

The shutter actuator of the camera **1** is connected to the switch **41** so that the switch **41** will close when the camera shutter is actuated. The focus control of said camera **1** is connected to the variable resistor **13** in a well-known manner, whereby focusing the camera **1** will change the impedance of the resistor **13** (an amount sufficient to effect a predetermined potential across the capacitor **19**) so that the output of the lamp **15** will be made to suit the focus setting.

With the network **3** operably connected to the camera **1**, the switch **41** will remain open until the shutter of the camera **1** is actuated. Prior to such time, the capacitor **17** will be charged to the full output potential of the power supply **5** and the capacitor **19** will be charged to a lower potential which will be predetermined by the focus setting of the camera **1**. In a like manner, the capacitor **35** will be charged to a potential fixed by the ratio of the resistors **23** and **25** and the output of the power supply **5**.

When the shutter of the camera **1** is actuated the switch **41** will close, sending a signal through the capacitor **43**, to the gate of the silicon controlled rectifier **37**, to effectively turn on said rectifier **37**. The resistor **25** will effectively be short circuited by the silicon controlled rectifier **37**, permitting the capacitor **35** to discharge rapidly and send a signal through the triggering transformer **27**, via the primary winding **33** and the secondary winding **29**, to the trigger electrode **31** of the lamp **15**.

The signal to the electrode **31** will initiate an actinic discharge through the lamp **15**, quickly dissipating the charge stored in the small capacitor **17**.

Once the discharge has been started a lower potential will be able to maintain a discharge (of lower intensity) even though such lower potential would not have been sufficient to initiate such a discharge, at least with an acceptable frequency of success. The capacitor **19**, with its much greater storage capacity (though lower potential) than the capacitor **17**, will provide the necessary energy to maintain the actinic discharge.

It should be noted that the term"acceptable frequency of success" has been used herein because a discharge may be initiated over a wide range of potentials.

For example, a potential which is not normally sufficient to initiate a discharge in a gas discharge lamp may, nevertheless, occasionally initiate such a discharge. Thus, the question of frequency of success in effecting such a discharge becomes important. However, success 100 percent of the time is often what is desired.

Consider, now, the case where the parameters of the control network **3** are such that a potential of 500 volts across the lamp **15** will insure the initiation of a discharge therewithin. However, let us assume that the camera **1** is to be provided with three discrete focus settings and is to operate in an environment wherein the intensity of the actinic discharge from the lamp **15** is to be varied with focus setting.

Let us further assume that the potentials across the lamp **15** corresponding to the three focus settings are 360 **volts**, 180 volts, and 90 volts, respectively. For a particular gas discharge lamp, a potential thereacross of 360 volts may be sufficient to insure the initiation of a discharge therein 100 percent of the time. A potential of 180 volts may insure a discharge with a much lower frequency of success and a potential of 90 volts may be virtually insufficient to initiate a discharge.

Obviously, anything less than 100 percent success in effecting a discharge from the lamp **15** is undesirable for photographic purposes. However, in the example given, a firing potential of 500 volts will be applied across the lamp **15** by the capacitor **17** irrespective of the camera focus setting. Thus, a discharge will be initiated notwithstanding the focus setting and the potential across the capacitor **19** corresponding thereto.

Assuming the potential across the lamp **15** necessary to maintain a discharge therein is below 90 volts, we will be able to effect a discharge at any of the three discrete focus settings and maintain such discharge whether the potential across the capacitor **19** is 360 volts, 180 volts, or 90 volts.

In view of the foregoing, it can readily be seen that many variations and modifications of the present invention are possible and it will be apparent to those skilled in the art that various changes in form and arrangement of components may be made to suit requirements without departing from the spirit and scope of the invention.

It is therefore to be understood that, within the scope of the appended claims, the instant invention may be practised in a manner otherwise than is specifically described herein.

I claim:

1. In combination with a gas discharge lamp, a device for effecting and modulating actinic radiation therefrom including:

first energy storage means connected to said lamp for supplying energy thereto of sufficient potential to initiate an actinic discharge therein, with a desired frequency of success, in response to a control signal;

second energy storage means for supplying energy to said lamp at a potential insufficient to initiate an actinic discharge therein, with a desired frequency of success, but sufficient to maintain such a discharge once initiated; said first and second energy storage means being functionally independent; and

means for isolating said second energy storage means from said first energy storage means for preventing the transfer of energy therebetween.

2. The invention as cited in claim **1**, additionally including: means for variably predetermining the potential of the energy stored in said second energy storage means.

3. The invention as set forth in claim **2**, further including means for supplying control signals to said lamp for triggering an actinic discharge therein at a predetermined time.

4. The invention of claim **3**, further comprising a camera having a focus control and a shutter actuator, with said means for predetermining the potential of the energy in said second energy storage means operably connected to and controlled by said focus control, and said means for supplying triggering control signals to said lamp operably connected to and controlled by said shutter actuator.

5. The invention as recited in claim **4**, wherein said first energy storage means shunts said lamp and said second energy storage means is serially connected to said isolation means across said lamp, and wherein current may flow through said isolation means in only one direction.

6. The invention as related in claim **5**, wherein said first energy storage means comprises a capacitor and said second energy storage means comprises a capacitor having a higher capacity than that of said first energy storage means.

7. The invention of claim **6**, wherein said means for supplying triggering control signals includes:

a transformer having primary and secondary windings;

a capacitor serially connected to the primary of said transformer;

a resistor shunting said capacitor and said primary winding;

means for charging said capacitor; and

means for short circuiting said resistor and responsive to said shutter actuator for generating a triggering control signal in said secondary winding upon activation of said actuator.

8. The invention as related in claim **7**, wherein said resistor short circuiting means includes an electronic switching device connected in shunt with said resistor.

9. The invention of claim **8**, wherein said electronic switching device comprises a silicon controlled rectifier.

10. In combination with a camera having a shutter actuator and a focus control, an electronic flash modulator, including:

a gas discharge lamp having a trigger electrode;

means connected to said shutter actuator and said trigger electrode for supplying triggering control signals to said trigger electrode in response to activation of said shutter actuator;

first storage means connected across said lamp for supplying electrical energy thereto of sufficient potential to initiate a discharge therein;

second storage means having greater capacity for the storage of electrical energy than said first storage means for supplying electrical energy to said lamp to sustain said discharge for a time interval sufficient to record a photographic image;

means for supplying electrical energy to said first and second storage means, with that supplied to said first storage means having a higher potential than that supplied to said second storage means; and

diode means serially connected between said second storage means and said gas discharge lamp for preventing the transfer of energy between said second storage means and said first storage means.

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