United States Patent [19]

Mason

[11] **3,828,222**

[45] **Aug. 6, 1974**

[54] **FLASH LAMP CIRCUIT**

[75] Inventor: **Lawrence J. Mason,** Webster, N.Y.

[73] Assignee: **Xerox Corporation,** Stanford, Conn.

[22] Filed: **Feb. 20, 1973**

[21] Appl. No.: **333,826**

[52] **U.S. Cl.** ..... **315/241 P,** 315/240, 315/241 R

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

[58] **Field of Search** ..... 315/240, 241 P, 241 R; 320/1

[56] **References Cited**

UNITED STATES PATENTS

3,248,605 4/1966 Tomkinson ..... 315/241 R

3,569,779 3/1971 Luursema ..... 315/241 R X

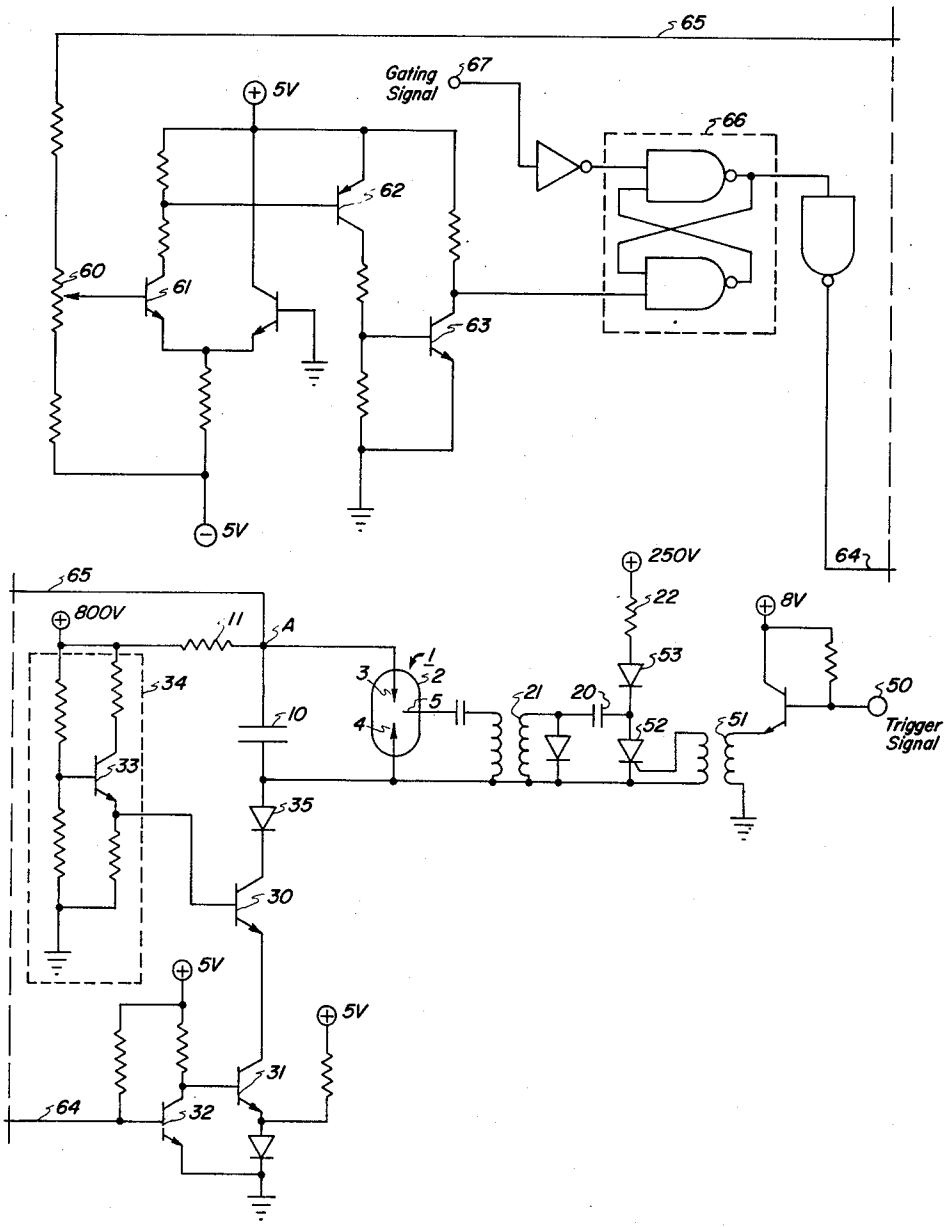
Primary Examiner—Herman Karl Saalbach

Assistant Examiner—Lawrence J. Dahl

[57] **ABSTRACT**

Circuitry for firing a flash lamp. Gating means in the charging path of the storage and trigger capacitors is selectively enabled only when these capacitors are to be charged. The gating means is disabled upon the terminating of charging. The disablement of the gating means before flashing allows the lamp to deionize before the re-application of power thereto.

3 Claims, 2 Drawing Figures



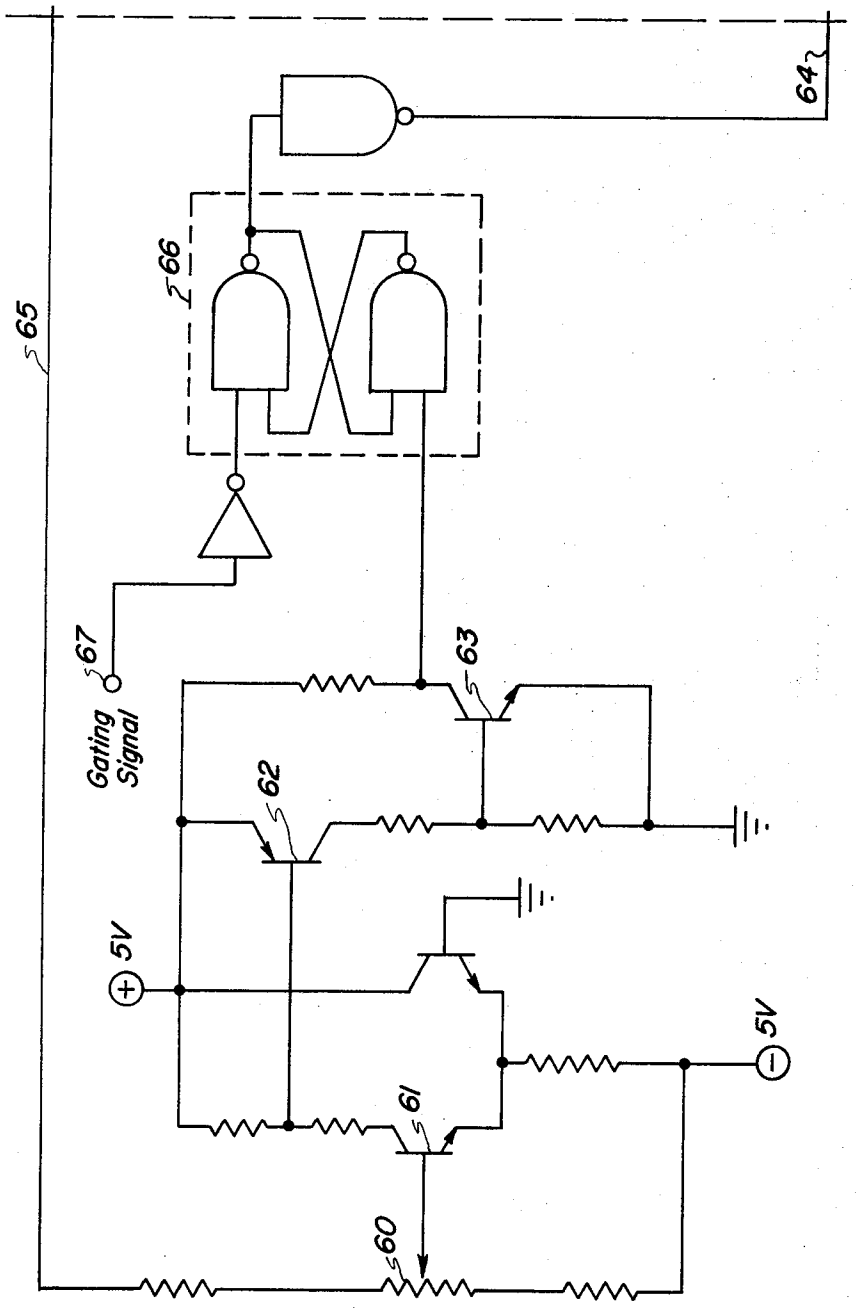


FIG. 1a

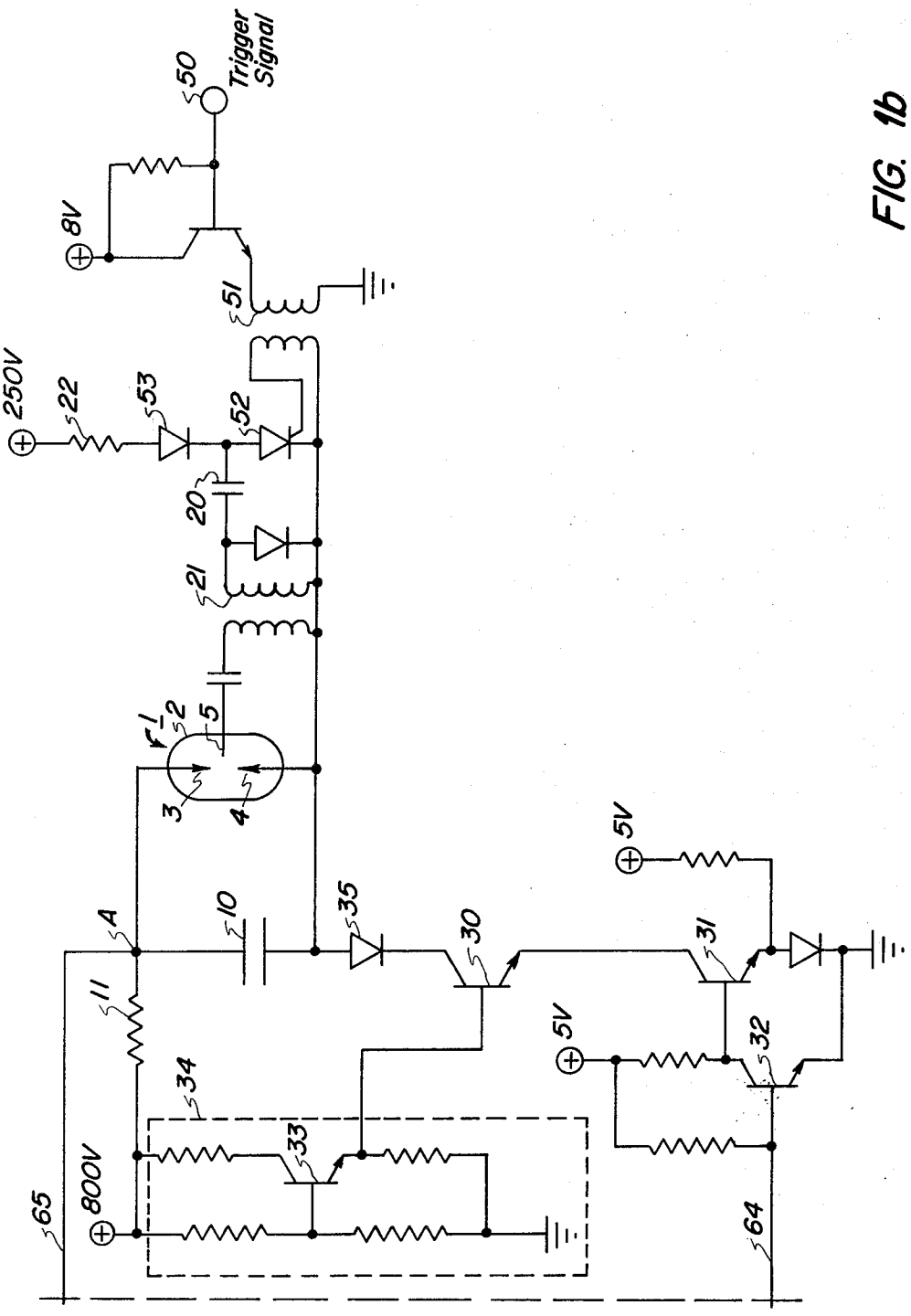

50
Trigger Signal
8V
51
250V
22
53
52
20
21
F1
2
5
3
4
5V
10
35
30
31
4
11
34
33
32
800V
65
64

FIG. 1b

FLASH LAMP CIRCUIT

BACKGROUND OF THE INVENTION

This invention relates to circuitry for firing a flash lamp and, more particularly, to circuitry for providing a minimum time between successive firings of the same flash lamp.

In the prior art, flash lamps have been utilized for various purposes, including optical character recording. Apparatus for optically recording characters may include a plurality of flash lamps positioned within a rotating drum, the drum being rotated about the flash lamps to enable illumination of transparent characters carried upon the surface of the drum. The illumination transmitted by the transparent characters is projected onto a photosensitive recording medium.

A typical flash lamp comprises a quartz envelope filled with an inert gas such as xenon. When a high voltage is applied to primary electrodes within the envelope, the gas ionizes, thereby producing a high intensity light flash. Conventionally, the high voltage triggering of flash lamps into a conductive ionized state is implemented by utilizing a trigger electrode comprising a strand of wire wrapped around the lamp between the primary electrodes or by a conductive strip positioned longitudinally along the side of the lamp or by electrodes extending into the envelope within the primary electrode gap. A high voltage is applied to the primary electrodes and then a triggering pulse is applied to the trigger electrode. The triggering pulse creates an electromagnetic field which causes the gas within the envelope to partially ionize. The high voltage across the primary electrodes completes the ionization process. The ionized gas then conducts current between the primary electrodes.

It is usual to use capacitors to store the high voltage energy for the primary electrodes and the triggering pulse. The capacitor used for the triggering pulse voltage is called the trigger capacitor and the capacitor for the high voltage placed across the primary electrodes is called the storage capacitor. Typically, the circuitry for firing the flash lamp includes a transformer, the primary of which is connected across the trigger capacitor and the secondary of which is connected to the trigger electrodes. The storage capacitor is connected directly across the primary electrodes of the lamp. When it is desired to flash the lamp, the trigger capacitor is caused to quickly discharge through the primary of the transformer, thereby producing a triggering pulse across the triggering electrodes. This causes the xenon gas within the flash lamp envelope to partially ionize, thereby allowing the voltage on the storage capacitor to cause the complete ionization of the gas within the flash lamp, this ionized gas providing a discharge path for the storage capacitor.

In many applications of flash lamps, for example the aforementioned optical recording of characters, it is desired to have a very short time, on the order of hundreds of microseconds, between successive flashings of a flash lamp. In order to accomplish this, it is necessary to quickly charge the storage and trigger capacitors after they have been discharged. However, a flash lamp is a device that once ionized will remain ionized unless power is removed from the primary electrodes for a minimum time termed the deionization time. Therefore, if a voltage is applied to the primary electrodes

prior to the elapse of the deionization time, current will continue to flow through the lamp, thereby preventing the storage capacitor from being recharged. It is therefore apparent that a need exists for circuitry which allows for a fast charge time of the capacitors in a flash lamp firing circuit while providing for the flash lamp to deionize between successive firings.

SUMMARY OF THE INVENTION

In accordance with principles illustrative of this invention, circuitry is provided for allowing a minimum time interval between successive firings of a flash lamp. A relatively low value of resistance is in series between the voltage supply and the storage and trigger capacitors in order to achieve a fast charging rate for these capacitors. In the return path of the flash lamp and storage capacitor, gating means is provided which is selectively enabled only when the capacitors are being charged. This provides a break in the current path of the flash lamp to allow the flash lamp to deionize, while still providing a fast charging rate of the capacitor through the use of a low series resistance.

Circuitry is also advantageously provided which permits the use of a power supply with poor regulation. This circuitry senses the voltage to which the storage capacitor is charged and disables the aforementioned gating means in the return path when the charge on the storage capacitor has reached the desired voltage level.

DESCRIPTION OF THE DRAWING

The foregoing will become more readily apparent upon reading the following description in conjunction with the drawing in which:

FIGS. 1(*a*) and 1(*b*), with FIG. 1(*a*) placed to the left of FIG. 1(*b*), together depict a detailed circuit schematic of an illustrative circuit operating in accordance with the principles of this invention.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENT

Turning now to the drawing, flash lamp **1** comprises envelope **2** containing an ionizable gas, primary electrodes **3** and **4** and trigger electrode **5.** The trigger electrode has been illustratively shown as a single electrode **5** inserted through envelope **2** into the gap between primary electrodes **3** and **4.** However, the trigger electrode alternatively may comprise a plurality of electrodes inserted through envelope **2,** or may comprise a wire wrapped around envelope **2,** or may even comprise a conductive strip positioned longitudinally along the side of flash lamp **1.**

It should be noted that in the following discussion, and in the drawing, all voltage values are merely illustrative and are in no way meant to be limiting. The actual voltages chosen in applying the principles of this invention will depend upon individual circuit requirements.

Capacitor **10** is the storage capacitor for primary electrodes **3** and **4** and resistor **11** limits the charging current from the 800 volt supply to capacitor **10.** Capacitor **20** is the trigger capacitor which supplies the energy for trigger transformer **21.** The charging current for capacitor **20** from the 250 volt supply is limited by resistor **22.**

Transistors **30** and **31,** in combination with transistor **32,** comprise a gate for the charging of capacitors **10**

and 20. To charge capacitors 10 and 20, transistors 30 and 31 are turned on by the action of transistor 32. Turning transistor 32 off will permit transistor 31 to conduct, which will in turn permit transistor 33 to turn transistor 30 on. Transistors 30 and 31 are operated in series because the 800 volt supply exceeds the voltage rating of the individual transistors. It should be noted that if the voltage rating of a transistor is adequate to sustain the 800 volt supply, then network 34 which includes transistor 33 may be dispensed with and only a single transistor, i.e., transistor 31, is necessary in series with capacitor 10. The function of network 34 is to divide the supply voltage between transistors 30 and 31. The sum of the initial charging currents through capacitors 10 and 20 must not exceed the current rating of transistors 30 and 31. However, the time constant of the combination of capacitor 10 and resistance 11 and capacitor 20 and resistance 22 must be less than or equal to one third of the time allowed for recharging the capacitors. After capacitors 10 and 20 have charged to their correct voltages, transistor 32 is switched on which in turn switches off transistors 30 and 31. The emitter of transistor 33 and the base of transistor 30 are then at a voltage of one half the 800 volt supply and diode 35 is required in order to prevent capacitor 10 from partially discharging through the otherwise forward biased base-collector junction of transistor 30.

After the capacitors 10 and 20 are charged to their correct voltages and transistors 30 and 31 are in the blocking state, flash lamp 1 is ready to be flashed. A trigger signal pulse applied to terminal 50 from an external controller, not shown, is coupled through pulse transformer 51. This pulse causes silicon controlled rectifier 52 to conduct which in turn discharges capacitor 20 through transformer 21. This produces a high voltage pulse at trigger electrode 5 of the flash lamp which initiates the ionization of the gas in lamp 1. This gas then conducts, thereby creating a discharge path for capacitor 10, discharging capacitor 10. Since transistors 30 and 31 are still in the off condition, the gas in lamp 1 will deionize after it is flashed and SCR 52 will also stop conducting and revert to the nonconducting state. Diode 53 prevents capacitor 20 from obtaining a reverse charge from the 800 volt supply. Transistors 30 and 31 must be kept in the off condition for the duration of the lamp deionization time.

In order to terminate the charging of capacitor 10 at the proper time, potentiometer 60 is adjusted so that transistors 61, 62 and 63 conduct when the voltage across capacitor 10 reaches the desired level. At the start of a cycle, the voltage at point A is at the potential of the 800 volt supply. This causes transistor 61 to be turned on, which in turn causes transistors 62 and 63 to be on. When transistor 63 is on, latch 66, which is comprised of cross-coupled NAND gates, will be in a first state with the output on line 64 at a high potential, turning on transistor 32 which causes transistors 30 and 31 to be nonconducting. When a gating signal from an external controller, not shown, is applied at terminal 67 indicating that it is desired to charge the flash lamp firing capacitors, latch 66 will change state, placing a low potential on line 64. This will turn off transistor 32 causing transistors 30 and 31 to switch on which in turn will cause the potential at point A to drop. Transistors 61, 62 and 63 will then turn off. The gating signal applied to terminal 67 may now be removed and latch 66 will keep line 64 at a low potential. Because transistors 30 and 31 are conducting, capacitors 10 and 20 will charge, and the potential at point A will increase. When the potential at point A reaches the desired voltage to which capacitor 10 is to be charged, transistors 61, 62 and 63 will turn on. Latch 66 will then change state, thereby returning line 64 to a high potential which will turn on transistor 32 which then turns off transistors 30 and 31, terminating the charging of capacitor 10.

At this point it should be noted that a separate 250 volt supply for charging capacitor 20 is not really necessary. This supply can be eliminated by using the 800 volt supply to charge capacitor 20. This can be accomplished by any one of various alternative methods. Illustratively, two of these are: (1) Choose silicon controlled rectifier 52 with a high enough voltage rating to operate with the 800 volt supply and use trigger transformer 21 with a different turns ratio to accommodate the higher primary voltage; (2) Use the same silicon controlled rectifier 52 and trigger transformer 21 but increase resistor 22 so that capacitor 10 charges to the 800 volt level but capacitor 20 will only charge to 250 volts during the same interval.

The operation of the illustrative circuit will now be summarized. When the external controller, not shown, determines that flash lamp 1 is to be fired, a gating signal is applied to terminal 67. This causes latch 66 to assume a state whereby a low potential is applied to line 64, turning off transistor 32. Transistors 30 and 31 are then turned on and capacitors 10 and 20 are charged. When capacitor 10 is sufficiently charged so that the potential at point A is at a predetermined level, transistors 61, 62 and 63 conduct, changing the state of latch 66 and causing the gate comprised of transistors 30 and 31 to open. The external controller then applies a trigger pulse to terminal 50. Flash lamp 1 then fires, capacitor 10 discharging across primary electrodes 3 and 4. Since transistors 30 and 31 are turned off, no power is applied to electrodes 3 and 4 and the gas in flash lamp 1 can deionize. A gating signal is not applied again to terminal 67 until at least the deionization time of flash lamp 1. This gating signal is only applied immediately prior to the desired triggering of the lamp, otherwise charge might leak off capacitors 10 and 20, decreasing the flash intensity. If flash lamp 1 were to be fired continuously, a delay element could be connected between terminals 50 and 67, eliminating the need for a separate gating signal at terminal 67. The magnitude of the delay would be at least the deionization time of the lamp.

It is understood that the above-described arrangement is merely illustrative of the application of the principles of my invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of my invention.

What is claimed is:

1. Apparatus responsive to a gating signal and a trigger signal supplied by an external controller for firing a flash lamp, said flash lamp comprising an envelope containing an ionizable gas, a pair of primary electrodes extending into said envelope, and a trigger electrode adapted to cause partial ionization of the gas within said envelope upon the application of a high voltage pulse thereto, said apparatus comprising

a storage capacitor connected across said pair of primary electrodes,

a trigger capacitor,

a trigger transformer having a primary winding and a secondary winding, said primary winding being connected to said trigger capacitor and said secondary winding being connected to said trigger electrode,

a first voltage souce connected to charge said storage capacitor,

a second voltage source connected to charge said trigger capacitor,

first gating means including a control terminal and arranged to provide a discharge path for said trigger capacitor through said trigger transformer primary winding upon the application of said trigger signal to said control terminal, a high voltage pulse being generated across said secondary winding in response to the discharge of said trigger capacitor,

voltage sensing means responsive to the voltage across said storage capacitor for supplying a first signal when the voltage across said storage capacitor is greater than a predetermined value,

connecting means for providing a path for said gating signal from said external controller when said capacitors are to be charged,

bistable latching means having a first input terminal connected to said voltage sensing means and a second input terminal connected to said connecting means, said latching means being responsive to said first signal for assuming a first state and responsive to said gating signal from said connecting means for assuming a second state, and

second gating means connected to said storage capacitor and responsive to the state of said latching means for providing a charging path for said storage capacitor only when said latching means is in said second state.

2. The apparatus of claim **1** wherein said storage capacitor and said trigger capacitor share a common charging path including said second gating means.

3. The apparatus of claim **2** further including a delay element connected between said control terminal of said first gating means and said signaling means for supplying said gating signal to said signaling means a predetermined time after the application of said trigger signal to said control terminal, said predetermined time being greater than the deionization time of said flash lamp.

* * * * *