United States Patent

Ackermann

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[54] ELECTRONIC FLASH UNIT WITH PRELIMINARY FLASH FOR AUTOMATIC TIMING

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **315/151**, 95/115, 250/205, 315/241 P

[51] **Int. Cl.** **H05b 31/04**

[58] **Field of Search** ..... 315/149, 151, 152, 153, 154, 315/156, 159, 183, 241 P; 95/1, 1.1, 10, 11.5

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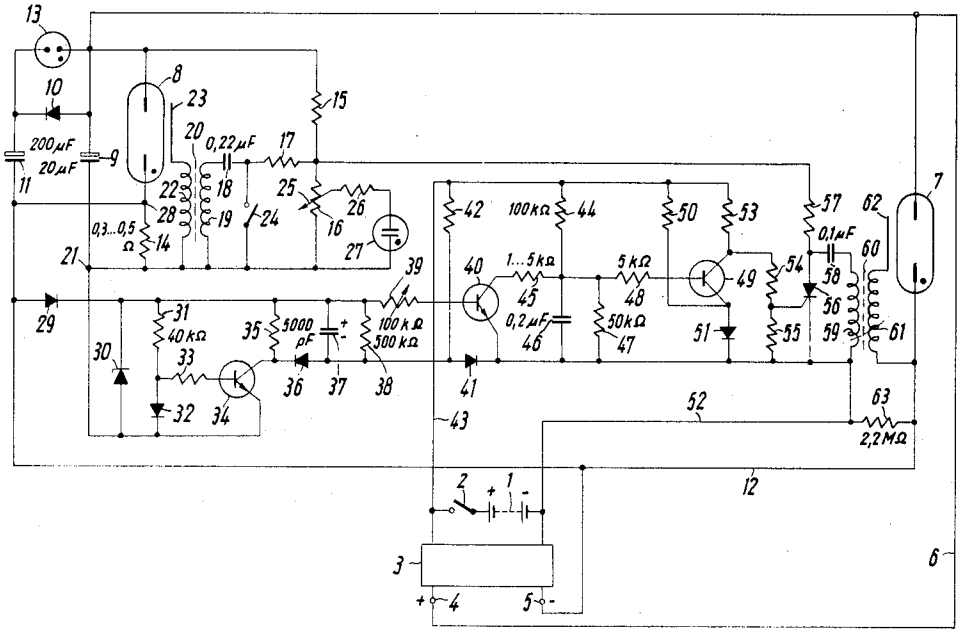
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[57] **ABSTRACT**

The main flash of the flash unit is initiated immediately after a preliminary flash. A photoelectric element receives the light reflected from the subject during the preliminary flash. The electrical signal corresponding to the light received is integrated and the main flash terminated after a delay depending upon the integrated signal.

21 Claims, 9 Drawing Figures



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3 Sheets-Sheet 1

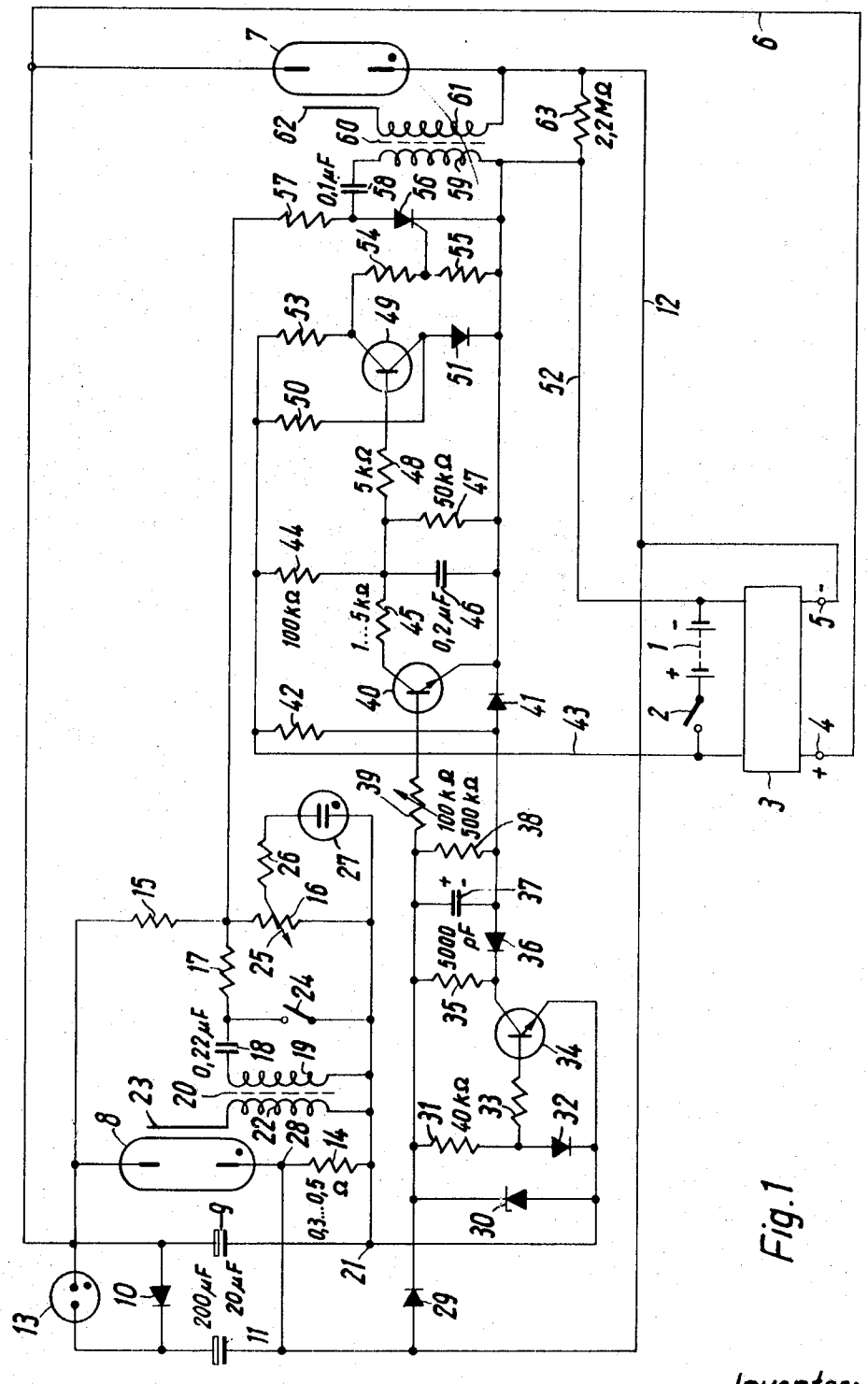


Fig. 1

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Fig. 2e

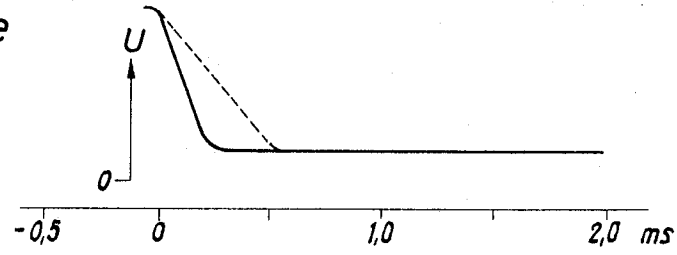


Fig. 2f

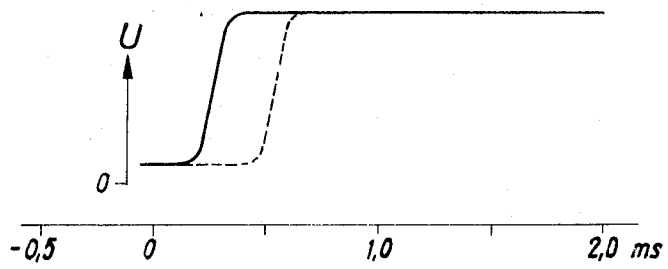


Fig. 2g

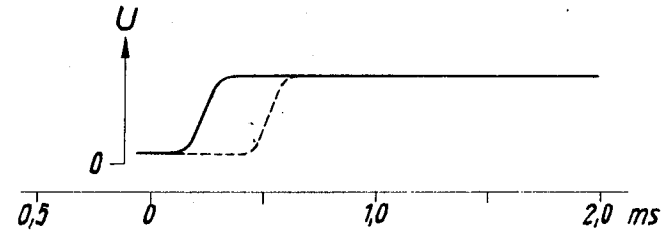
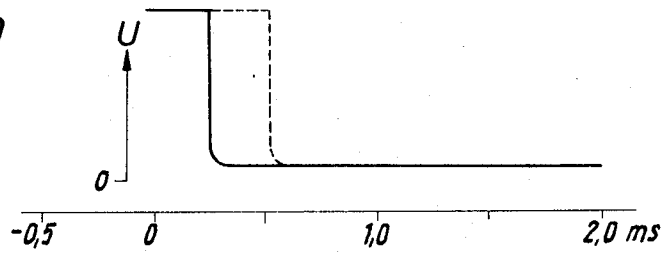


Fig. 2h



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Fig. 2a

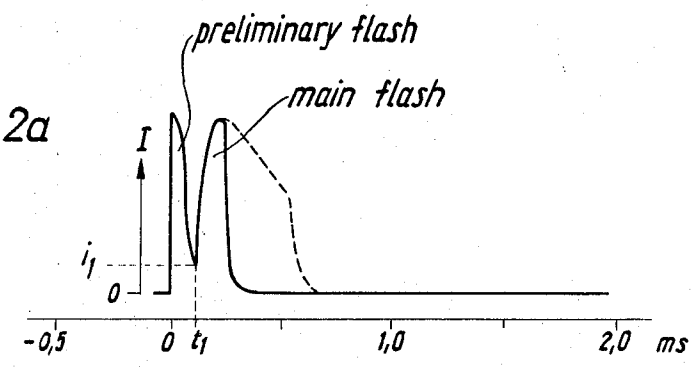


Fig. 2b

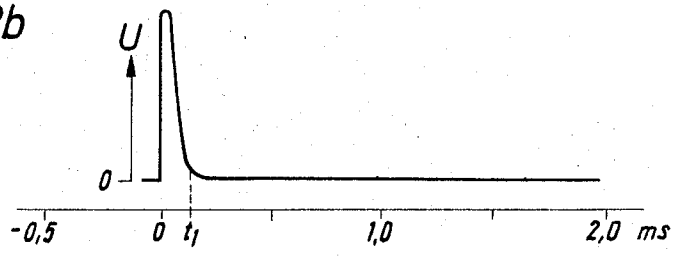


Fig. 2c

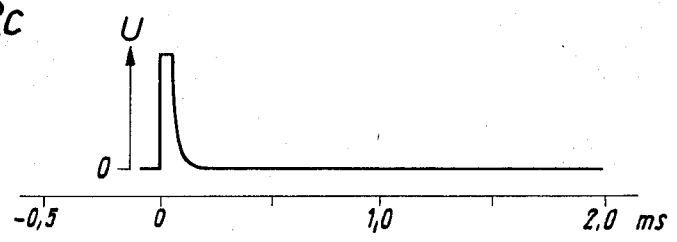
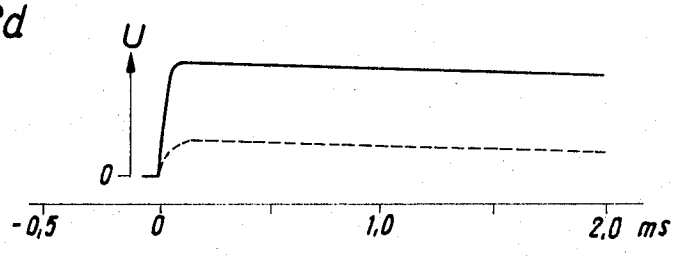


Fig. 2d



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ELECTRONIC FLASH UNIT WITH PRELIMINARY FLASH FOR AUTOMATIC TIMING

BACKGROUND OF THE INVENTION

This invention relates to an electronic flash unit as used in photography and having automatic control of the amount of light supplied by the flash. In particular, the present invention relates to an automatic flash unit wherein a preliminary flash precedes the main flash and a photoelectric element furnishes an electrical signal corresponding to the light reflected by the object to be photographed. The electrical signal is integrated and the amount of light furnished by the main flash is regulated in dependence upon the integrated signal corresponding to the total amount of light reflected from the object during the preliminary flash.

Electronic flash units with automatic regulation of the amount of light furnished by a main flash illuminate a subject to be photographed in such a manner that the subject to be photographed receives the correct amount of illumination regardless of the distance between camera and subject.

A known electronic flash unit comprises an arrangement for initiating a preliminary flash. It further comprises an arrangement for controlling the voltage on a storage capacitor by means of an electrical timing circuit in dependence upon the general level of illumination and the illumination supplied by the preliminary flash. In these known electronic flash units a time interval elapses between initiation of the preliminary flash and the initiation of the main flash. During this time element two things occur. First, the amount of light reflected by the object is determined and, secondly, the storage capacitor is either discharged from a maximum value or charged from a minimum value until the voltage across said capacitor reaches the value required to assure correct illumination by the main flash. Only when the capacitor voltage has reached this value is the main flash initiated. Furthermore, the known flash unit requires the activation in a predetermined order of a plurality of switch contacts which can only be furnished through use of a special release contact in the camera. Thus this type of electronic flash unit is useful only in connection with a specially constructed camera which of course limits its use considerably.

SUMMARY OF THE INVENTION

It is an object of this invention to furnish a flash unit which does not have the above-mentioned drawbacks and still requires a minimum of equipment.

This invention is an electronic flash unit and comprises light-flash-generating means for generating a preliminary flash and a main flash immediately following said preliminary flash. It further comprises a photoelectric element mounted to receive light corresponding to the light falling on said photosensitive material. The photoelectric element furnishes a first signal corresponding to the light falling thereon when the photoelectric element is energized. The flash unit in accordance with this invention further comprises means for energizing said photoelectric element only during said test flash. Further, terminating means are furnished which terminate the main flash in response to a terminating signal. The terminating signal is generated after a delay time period following the preliminary flash and thus the initiation of the main flash which varies as a function of the first signal.

A preferred embodiment of the present invention further comprises an integrating circuit for integrating said first signal and wherein the delay time period during which the main flash is active is controlled in dependence upon the integrated first signal.

Further, the terminating means for terminating the main flash are, preferably, embodied in a quench tube which short circuits the flash tube upon receipt of the terminating signal.

A so-constructed electronic flash unit has the advantage that it functions without mechanical contacts for controlling its various operations and may be used with any commercially available camera.

Furthermore, in another special embodiment of the present invention, the initiation of the main flash may take place while the tube is still ionized at the end of the preliminary flash and thus a single ignition circuit can be used. This results in the saving of a number of circuit components, namely, at least, one ignition capacitor, one ignition transformer and an ignition electrode for the flash bulb.

The following ignition arrangement has also been proven advantageous: A first storage capacitor, for storing the energy for the preliminary flash is directly connected in parallel with the flash tube. A second storage capacitor for storing the energy required for the main flash is connected in series with a diode and the series connection is connected in parallel with the flash tube. The polarity of the diode is such that charging current can flow to the second storage capacitor. The diode is shunted by the contacts of an electronic switch. When the voltage across the electronic switch reaches a value resulting from the voltage difference between a substantially discharged first storage capacitor and the charged second storage capacitor, the switch becomes conductive allowing discharge of the second storage capacitor through the flash tube, thus initiating the main flash.

Thus the main flash is initiated automatically following the preliminary flash.

Further, in accordance with this invention, the photoelectric element and the integrating circuit are energized only during the preliminary flash. Thus the amount of light reflected by the object is determined only during the occurrence of the preliminary flash. The amount of light reflected by the main flash does not influence the timing of said main flash.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a circuit diagram of an electronic flash unit in accordance with this invention;

FIG. **2***a* is a timing diagram showing the variation of current through the flash tube as a function of time;

FIG. **2***b* is a diagram showing the voltage variation across a resistance in series with the flash tube as a function of time;

FIG. **2***c* is a diagram showing the variation of operating voltage for the integrator circuit as a function of time;

FIG. **2***d* is a diagram showing the variation of voltage across the integrating capacitor with respect to time;

FIG. **2***e* shows the variation of discharge voltage across the time delay capacitor as a function of time;

FIG. **2***f* shows the variation of collector-emitter voltage of the second transistor with respect to time;

FIG. **2***g* is a diagram showing the voltage variation at the control electrode of the thyristor with respect to time; and

FIG. **2***h* is a diagram showing the voltage variation at the ignition capacitor of the quench-tube ignition circuit with respect to time.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the invention will now be described with reference to the drawing.

An electronic flash circuit is shown in FIG. **1**. It comprises a battery **1** which is connected to a DC voltage supply by means of a single-pole switch **2**. The DC voltage supply **3** is shown only in block form. The relatively low voltage supplied by battery **1** is converted by a DC voltage supply **3** into a high voltage which has a positive terminal **4** and a negative terminal **5**. Positive terminal **4** is connected with the anode of a gaseous discharge tube **7**, for example a quench tube, via line **6**. Line **6** also connects the positive terminal **4** of the high-voltage supply to the anode of the flash tube **8**, one terminal of first

storage capacitor 9 and the anode of a diode 10 connected in series with the second storage capacitor 11. The negative high-voltage terminal 5 is connected directly to the cathode of the gaseous discharge tube 7 via a line 12. Line 12 also connects terminal 5 to the cathode of the flashlamp 8 at a terminal 28 to which is also connected the other terminal of second storage capacitor 11. Diode 10 is shunted by an electronic switching element 13 which may also be a gas-discharge tube. Terminal 28 (directly connected to cathode of flash tube 8) and a terminal 21 connected to the other terminal of first storage capacitor 9 are interconnected by a low-ohmic resistance 14.

The ignition circuit for flash tube 8 comprises a first voltage divider connected in parallel with storage capacitor 9. This first voltage divider comprises a fixed resistance 15 and an adjustable resistance 16. At the common point of the two resistances a resistance 17 is connected. The other terminal of resistance 17 is connected to ignition capacitor 18 whose other terminal is connected via the primary winding 19 of an ignition transformer 20 with the negative terminal of first storage capacitor 9, that is with circuit point 21. A secondary winding 22 of ignition transformer 20 is connected between circuit point 21 and the ignition electrode 23 of flash tube 8. A release contact switch 24 is connected between the common point of capacitor 18 and resistance 17 and terminal 21. This contact may be operable in synchronism with the camera release.

Adjustable resistance 16 has a slider arm 25. Connected from slider arm 25 to circuit point 21 is the series combination of an indicator lamp 27 and a series resistance 26.

Above-mentioned line 12 is also connected to the anode of a diode 29 whose cathode is directly connected to the cathode of a Zener diode 30. The other side of Zener diode 30 is connected to circuit 21. A voltage divider comprising a resistance 31 and a diode 32 connected with opposite polarity to the polarity of diode 30 is connected in parallel with diode 30. The anode of diode 32 is connected to the base of a transistor 34 via a photoelectric element 33 which may for example be a photoresistance. The emitter of transistor 34 is connected to circuit point 21, while its collector is connected to the cathode of diode 29 via a collector resistor 35. Connected in parallel with resistor 25 is a series combination of integrating capacitor 37 and blocking means, namely a diode 36 whose anode is connected to the integrating capacitor. A resistance 38 of a relatively high resistance is connected in parallel with capacitor 37. This part of the circuit, namely transistor 34 and integrating capacitor 37 all comprise part of an integrating circuit.

The terminal of resistor 38 which is connected to the anode of diode 36 is also connected to the anode of a diode 41 whose cathode is connected to the emitter of delay transistor 40. The other terminal of resistor 38 is connected to the base of transistor 40 via a variable resistor 39. The positive side of battery 1 may be connected, via a switch 2, to one terminal of a resistor 42 whose other terminal is connected to the anode of diode 41. The positive potential of battery 1 is also applied, via line 43, to a voltage divider comprising a resistance 44 and a capacitor 46. The terminal of capacitor 46 not connected to resistor 44 is connected to the negative side of the battery. The emitter of transistor 40, the delay transistor, is also connected to the negative side of the battery, while its collector is connected to the common point of resistor 44 and capacitor 46 via a resistor 45. Connected in parallel with capacitor 46 is a resistor 47 which is also connected to the base of second transistor 49 via a resistor 48. Transistor 49 acts as an electronic switch. The emitter of transistor 49 is connected to the voltage divider tap of a voltage divider comprising a resistor 50 and a diode 51 connected between the positive and negative side of the battery. Specifically, the anode of diode 51 is connected to the emitter, the cathode of diode 51 being connected to the negative side of the battery. The collector resistance connecting collector of transistor 49 to the positive side of the battery when switch 2 is closed is resistor 53. A voltage divider comprising a resistor 54 and a resistor 55 is connected from collector of transistor 49 to the negative side of the battery. At the voltage divider tap of this voltage divider is connected the control electrode of a thyristor 56. The anode of thyristor 56 is connected to the common point of resistors 15 and 16 via a resistor 57, while its cathode is directly connected to the negative side of the battery via line 52. The anode of thyristor 56 is further connected to the series combination of a capacitor 58 and the primary 59 of an ignition transformer 60 whose secondary winding 61 is connected between the cathode of quench tube 7 and an ignition electrode 62 of said tube. The primary winding terminal not connected to capacitor 58 and the secondary winding terminal connected to the cathode of the quench tube are interconnected by means of a protective resistance 63.

The above described circuit operates as follows:

When switch 2 is closed, that is when the flash tube circuit is energized, the DC high-voltage supply 3 furnishes a high-DC voltage at terminals 4 and 5 which charges the first and second capacitor, namely capacitors 9 and 11 respectively, via lines 6 and 12 to a determined voltage. The capacity of capacitor 9 is approximately one-tenth of the capacity of second capacitor 11. Thus the voltage across capacitor 9 first reaches a value which causes a sufficient voltage to be furnished across resistor 16 to cause the indicator lamp 27 to light. Lighting of indicator lamp 27 indicates to the user of the flash unit that a flash can now be generated. Simultaneously, ignition capacitor 18 has become charged via the first voltage divider comprising resistors 15 and 16 and resistor 17.

It is now assumed that switch contact 24 is closed either through activation of the camera release or through activation of a separate flash release. Ignition capacitor 18 can now discharge through the primary winding 19 of ignition transformer 20, all of which elements are part of ignition circuit means. The current pulse resulting from the discharge induces a signal in secondary winding 22 which causes ignition of flash tube 8 via its ignition electrode 23. The flash tube then furnishes a preliminary flash whose function is as follows:

The current flowing through flash tube 8 during the preliminary flash, a current supplied only by first capacitor 9, causes resistance means, namely resistor 14 to furnish a voltage drop. Second capacitor 11 cannot discharge at this time since diode 10 blocks its discharge current. The voltage drop appearing across resistor 14 during the preliminary flash appears between anode of diode 29 and the anode of Zener diode 30. Diode 29 thus has a forward voltage applied to it, while Zener diode 30 is, as is usual, operated in the reverse direction. The stabilized voltage appearing across Zener diode 30 is in turn applied to the voltage divider comprising resistor 31 and diode 32. The voltage across diode 32 determines the operating point of transistor 34. A part of the light furnished by the preliminary flash is reflected by the subject to be photographed and is applied to photoresistor 33. Depending upon the magnitude of so applied light, the resistance of photoresistor 33 changes thus changing the base current of transistor 34 and correspondingly, the emitter-collector impedance of transistor 34. This emitter collector impedance also forms part of a voltage divider, and together with resistor 35 is connected across the Zener diode 30. Thus integrating capacitor 37 the voltage across which is the integrated first signal (the first signal being the current flowing through photoresistor 33) charges to a voltage whose magnitude depends upon the collector-emitter impedance of transistor 34. For example if a relatively large amount of light is applied to photoresistance 33, its resistance is relatively low, a relatively large amount of base current flows in transistor 34, the collector emitter impedance is small, the voltage drop across resistor 35 is large, and the voltage across capacitor 37 therefore also is relatively large. The integrating capacitor is charged to a voltage roughly proportional to the amount of light applied to photoresistance 33. At the end of the preliminary flash capacitor 37 retains the voltage which has a polarity as is indicated in the drawing, since diode 36 prevents a short time constant discharge. Diode 36 therefore constitutes blocking means.

At the end of the preliminary flash capacitor 9 has discharged to a determined voltage value which may be sufficient to maintain ionization of flash tube 8. Thus a predetermined potential difference exists between the positive terminal of the fully charged second capacitor 11 and the positive terminal of the substantially discharged first capacitor 9. This voltage difference is sufficient to cause ignition of tube 13, the first switching element which is connected in parallel with unidirectional conductor means, namely diode 10. This causes a substantial short-circuiting of diode 10 and second capacitor 11 can now discharge its energy via flash tube 8. The flash tube then emits the main flash which illuminates the subject to be photographed while the camera shutter is open. Discharge current of second capacitor 11 flows only through flash tube 8 and not over resistance 14. Thus no voltage drop is developed across resistance 14 for energizing photoresistance 33 and transistor 34. The integrating circuit and the circuit comprising the photoelectric element are thus energized during the preliminary flash only.

Meanwhile, the voltage developed across integrating capacitor 37 has affected the base circuit of transistor 40, the delay transistor. Closing of switch 2 has already sufficiently energized transistor 40 that the transistor can immediately react to changes of voltage appearing across capacitor 37. The higher the voltage appearing across capacitor 37, the lower is the emitter-collector impedance of delay transistor 40. Thus a delay capacitor 46 which has charged through resistor 44 will then discharge more or less rapidly via resistor 45 and the emitter-collector impedance of transistor 40, depending upon the magnitude of the latter impedance. When a particular degree of discharge has been reached, that is when the voltage across capacitor 46 has decreased to a predetermined value, transistor 49 is blocked causing its emitter-collector circuit to exhibit a high impedance. This high impedance of the emitter-collector circuit of second transistor 49 causes a sufficiently high potential to be applied to the control electrode of thyristor 56, the second switching element, to switch to the conductive state. But this thyristor is connected in the ignition circuit for quench tube 7 and allows a discharge of capacitor 58 through the primary winding of transformer 60, whose secondary thus applies a voltage to the ignition electrode of quench tube 7 which is sufficient to cause ignition of said tube. Since the quench tube is connected in parallel to flash tube 7 and, in the conductive state, has a resistance which is substantially lower than the flash tube resistance, the available energy is shunted away from the flash tube and the latter is extinguished suddenly, causing the main flash to terminate.

Thus the time at which quench tube 7 is ignited, causing the flash to be extinguished is determined by the amount of light reflected from the subject during the preliminary flash. Adjustable resistance 39 allows adjustment of the delay circuit to suit different sensitivities of the photographic or photosensitive material. That is when photosensitive material of relatively low sensitivity is used, resistor 39 is adjusted in such a way that its resistance is higher than when more highly sensitive material is used. The higher resistance corresponds to a higher emitter-collector impedance of transistor 40 and therefore a slower discharge of capacitor 46. The latter in turn causes a time delay prior to blocking of transistor 49 and the subsequent ignition of thyristor 56. Thus the main flash duration is longer.

FIGS. 2*a*–2*h* show the variation of voltages and current at different points in the circuit as a function of time.

FIG. 2*a* shows the variation of current through flash tube 8 as a function of time. The diagram clearly indicates the substantially instantaneous ignition of flash tube 8 in case of the preliminary flash and the decrease of current to a value i_1 necessary to maintain ionization of the tube up to a time t_1. At time t_1 capacitor 9 has discharged sufficiently to allow switch 13 to become conductive, thus starting the main flash. If the light reflected from the object during the preliminary flash was relatively low, the main flash will have the form indicated by dashed lines in FIG. 2*a* and the subsequent Figures. When little light has been reflected from the object, the duration of the main flash must be relatively large in order to allow the subject to be sufficiently illuminated. The solid line indicates a main flash of relatively short duration.

FIG. 2*b* shows the variation of voltage across resistance 14. It is seen that this voltage exists only during the time of the preliminary flash.

FIG. 2*c* shows the variation of voltage across Zener diode 30, that is the operating voltage for the integrating circuit and the transistor circuit containing photoresistance 33.

The voltage across integrating capacitor 37 as a function of time is shown in FIG. 2*d*. The height of the voltage depends upon the amount of light falling upon the photoresistance during the preliminary flash. The dashed line indicates a small amount of reflected light, while the solid line indicates a relatively large amount. FIG. 2*e* shows the voltage discharge of capacitor 46. The discharge time of this capacitor depends upon the voltage across capacitor 37. The shorter discharge time results from the higher voltage on capacitor 37.

The solid curve in FIG. 2*f* indicates the variation of voltage between the collector of transistor 49 and line 52, the negative terminal of battery 1, with respect to time. At first transistor 49 is in a conductive condition causing this voltage to be substantially equal to zero. At the same time the control electrode of thyristor 56 is also at a substantially zero voltage (see FIG. 2*g*). Upon discharge of capacitor 46, the voltage at transistor 49 (see FIG. 2*f*) rises, as does the voltage at the control electrode of thyristor 56, until, at a determined voltage across transistor 49 the thyristor ignites causing a substantially instantaneous discharge of ignition capacitor 58 (see FIG. 2*h*).

While the invention has been illustrated and described as embodied in particular types of circuitry, it is not intended to be limited to the details shown, since various modifications and circuit and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Electronic flash unit for use in creating an image on photosensitive material, comprising in combination, light-flash-generating means for generating a preliminary flash, and a main flash immediately following said preliminary flash; a photoelectric element mounted to receive light corresponding to the light falling on said photosensitive material, said photoelectric element furnishing a first signal corresponding to the light falling thereon when energized; means for energizing said photoelectric element only during said preliminary flash; terminating means connected with said light-flash-generating means, for terminating said main flash in response to a terminating signal; and terminating signal furnishing means interconnected with said terminating means and said photoelectric element, for furnishing said terminating signal after a delay time period following said preliminary flash and thus the initiation of said main flash, said delay time period varying as a function of said first signal.

2. An electronic flash unit as set forth in claim 1, wherein said light-flash-generating means comprise a gaseous discharge tube having an ignition electrode.

3. An electronic flash unit as set forth in claim 2, wherein said light-flash-generating means further comprise ignition circuit means for furnishing a signal to said ignition electrode for starting said test flash; and additional circuit means for furnishing energy for said main flash while said flash tube is still ionized from said test flash.

4. An electronic flash unit as set forth in claim 3, wherein said gaseous discharge tube has a first and second main electrode; further comprising a first capacitor having a first ter-

minal connected to said second main electrode, for furnishing the energy for said test flash; and wherein said additional circuit means comprise a second capacitor having a first terminal connected to said first main electrode and a second terminal, unidirectional conducting means for interconnecting said second main electrode and the second terminal of said second capacitor, said unidirectional conducting means interconnecting said terminals in such a manner that said second capacitor cannot discharge through said gaseous discharge tube, said additional circuit means further comprising a first switching element connected in parallel with said unidirectional conducting means and adapted to short circuit said unidirectional conducting means when the voltage difference between the second terminal of said second capacitor and the first terminal of said second capacitor reaches a predetermined voltage difference.

5. An electronic flash unit as set forth in claim 4, wherein said first switching element is a gas tube.

6. An electronic flash unit as set forth in claim 1, wherein said means for energizing said photoelectric element only during said test flash comprise means for furnishing an operating voltage to said photoelectric element only during said test flash.

7. An electronic flash unit as set forth in claim 6, further comprising an integrating circuit connected between said photoelectric element and said terminating signal furnishing means for integrating said first signal; wherein said delay time period varies in dependence upon the integrated first signal; and wherein said means for furnishing an operating voltage to said photoelectric element comprise means for furnishing an operating voltage to said photoelectric element and to said integrating circuit, only during said test flash.

8. An electronic flash unit as set forth in claim 7, further comprising a DC voltage supply having a battery; wherein said DC voltage supply is connected in such a manner that it furnishes the energy for said light flash generating means and for said terminating means; and wherein said battery furnishes the operating voltage for said delay means, both during said test flash and said main flash.

9. An electronic flash unit as set forth in claim 4, wherein said means for energizing said photoelectric element only during said test flash comprise resistance means connected to furnish a voltage drop as a function of the discharge current of said first capacitor; and means for applying said voltage drop to said photoelectric element as an operating voltage therefor.

10. An electronic flash unit as set forth in claim 9, further comprising an integrating circuit connected to said photoelectric element for integrating said first signal; and wherein said means for applying said voltage drop to said photoelectric element comprises means for applying said voltage drop to said photoelectric element and to said integrating circuit.

11. An electronic flash unit as set forth in claim 10, wherein said photoelectric element is a photoresistor.

12. An electronic flash unit as set forth in claim 4, wherein the capacitance of said first capacitor is approximately one-tenth of the capacitance of said second capacitor.

13. An electronic flash unit as set forth in claim 4, wherein said resistance means comprise a resistor connected between the first main electrode of said gaseous discharge tube and the second electrode of said first capacitor.

14. An electronic flash unit as set forth in claim 10, wherein said integrating circuit comprises an integrating capacitor, connected to charge during said test flash in dependence upon said first signal, thus acquiring an integrator capacitor voltage corresponding to the total light received in said photoelectric element, at the end of said test flash; and blocking means for blocking the discharge of said integrating capacitor through said integrating circuit.

15. An electronic flash unit as set forth in claim 14, wherein said integrating circuit further comprises a transistor having a control circuit and an emitter-collector circuit; wherein said photoelectric element is connected in said control circuit; wherein a collector resistor is connected in said emitter-collector circuit; wherein said blocking means comprise a diode; and wherein said diode, in series with said integrating capacitor is connected in parallel with said collector resistor.

16. An electronic flash unit as set forth in claim 14, wherein said terminating means comprise a quench tube, having a first and second main quench tube electrode and a quench-tube ignition electrode, connected in parallel with said gaseous discharge tube; and wherein said terminating signal is a signal applied to said ignition electrode.

17. An electronic flash unit as set forth in claim 16, wherein said means for furnishing said terminating signal comprise a quench-tube ignition circuit connected to said quench-tube ignition electrode, said quench-tube ignition circuit having a second switching element; and wherein said terminating signal is generated in response to activation of said second switching element.

18. An electronic flash unit as set forth in claim 17, wherein said means for generating said terminating signal further comprise delay means interconnecting said integrating capacitor and said second switching element.

19. An electronic flash unit as set forth in claim 18, wherein said delay means comprise a delay capacitor; means for applying a DC voltage to said delay capacitor; circuit means for controlling the discharge of said delay capacitor in dependence on said integrator capacitor voltage; and wherein activation of said second switching element takes place when the voltage on said delay capacitor is less than a predetermined voltage value.

20. An electronic flash unit as set forth in claim 19, wherein said second switching element is a thyristor, having a thyristor control electrode and an anode-cathode circuit; wherein said anode-cathode circuit of said thyristor is connected in said quench-tube ignition circuit; wherein said delay means comprise voltage-divider means having a voltage-divider tap for furnishing voltage to said ignition electrode of said thyristor; and means for raising the voltage at said voltage-divider tap when the voltage on said delay capacitor is less than said predetermined voltage value.

21. An electronic flash as set forth in claim 20, wherein said means for raising the voltage at said voltage-divider tap comprise a second transistor having an emitter-collector circuit connected in such a manner that the voltage at said voltage-divider tap is below the activation point for said thyristor when said transistor is conductive; and means for blocking said second transistor when said voltage on said delay capacitor is less than said predetermined voltage value.

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