

[54] **PHOTOGRAPHIC FLASHLIGHT APPARATUS WITH IMPROVED AUTOMATIC LIGHT TERMINATION MEANS**

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[63] Continuation-in-part of Ser. No. 259,475, June 5, 1972, abandoned.

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**..... **H05b 41/32**
[58] **Field of Search**..... **315/149, 151, 159, 241 R, 315/241 P, 129, 135, 340**

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[57] **ABSTRACT**

A photographic flashlight apparatus including a flash capacitor connected across a dc source; a flash tube and a thyristor series-connected across the flash capacitor so as to be made simultaneously conductive through the shutter operation of a photographic camera, whereby the flash tube initiates a light emission by discharging the voltage stored on the flash capacitor; and an automatic light termination circuit which includes a quench element made conductive in a predetermined length of time after the light emission is started by the flash tube and a flash termination capacitor stored with the dc source voltage and coupled between the thyristor and the quench element so as to terminate the light emission automatically upon conduction of the quench element by discharging the stored voltage across the flash termination capacitor through the conducting quench element, flash capacitor and flash tube and by turning off the thyristor forcefully.

An over-flash current shunting circuit is provided in substantially parallel with the flash tube so as to cause at least part of an over-flash current to bypass which might otherwise flow into the flash tube at the instance of the light termination.

22 Claims, 9 Drawing Figures

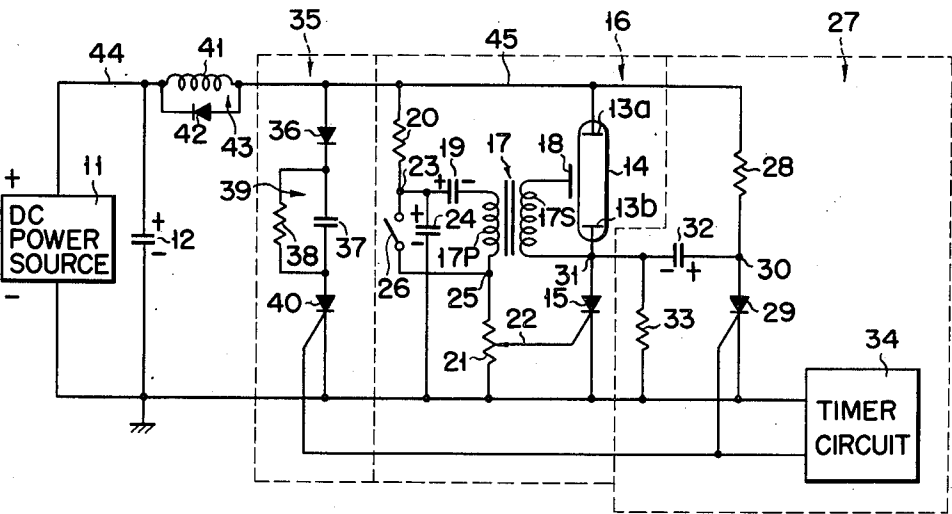


FIG. 1

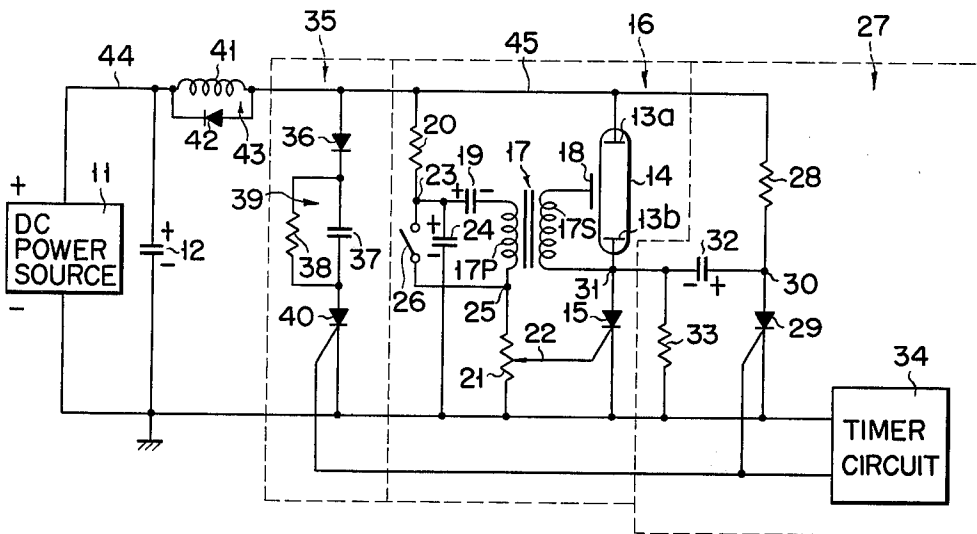


FIG. 2
PRIOR ART

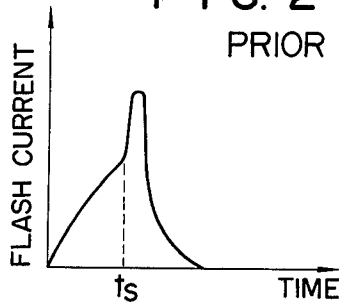


FIG. 3

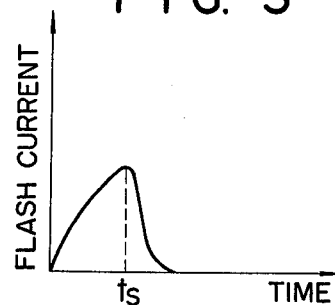


FIG. 4

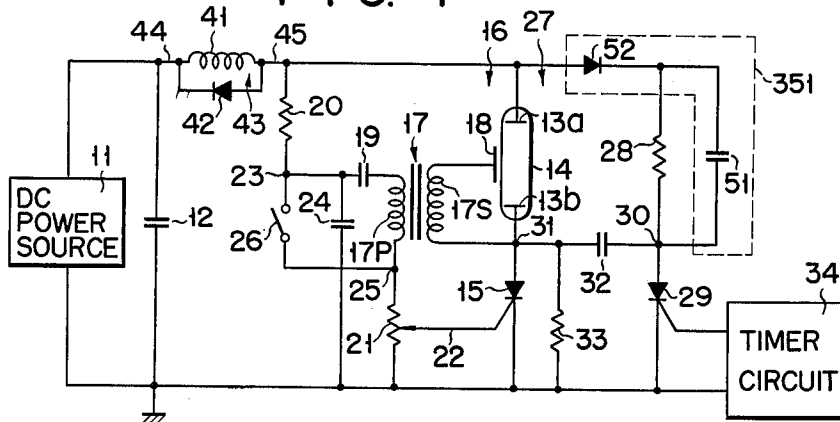


FIG. 5A

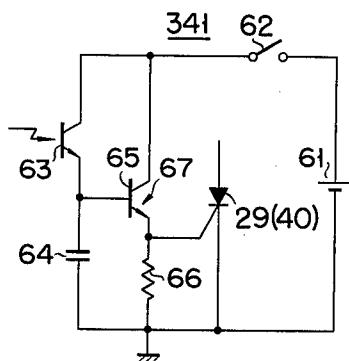


FIG. 5B

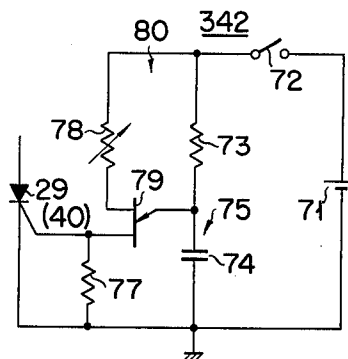


FIG. 6

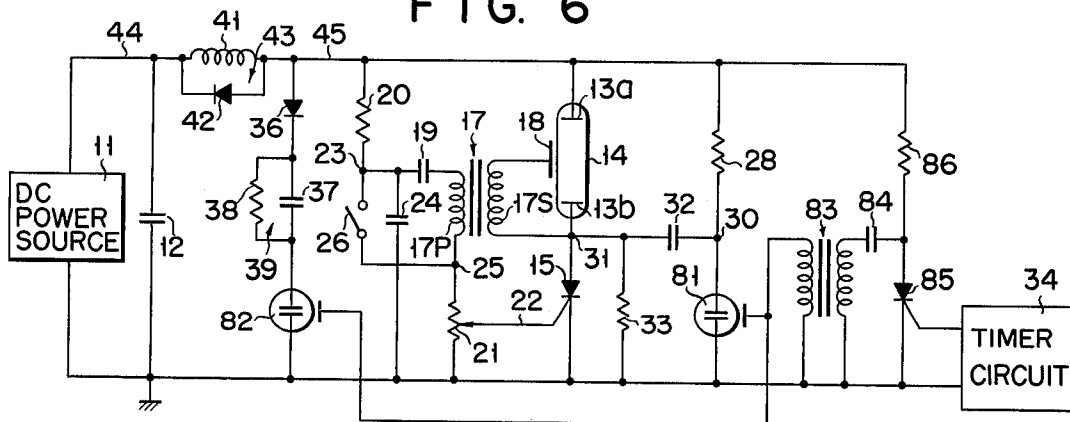
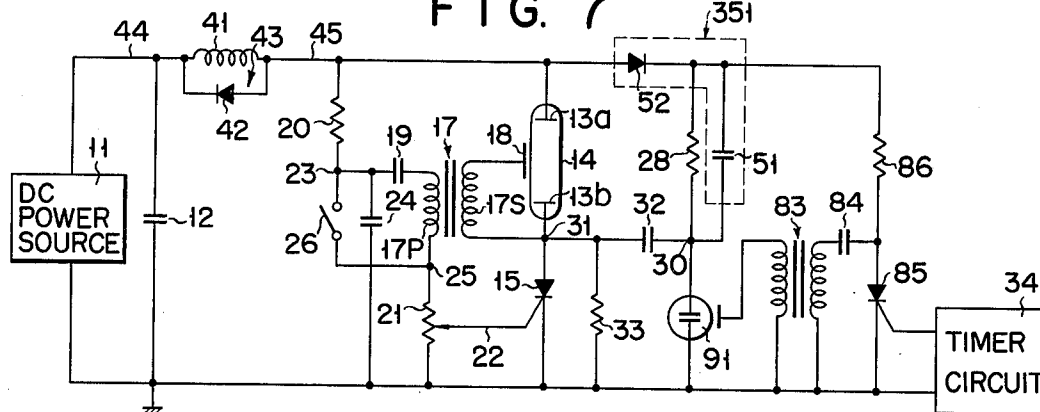
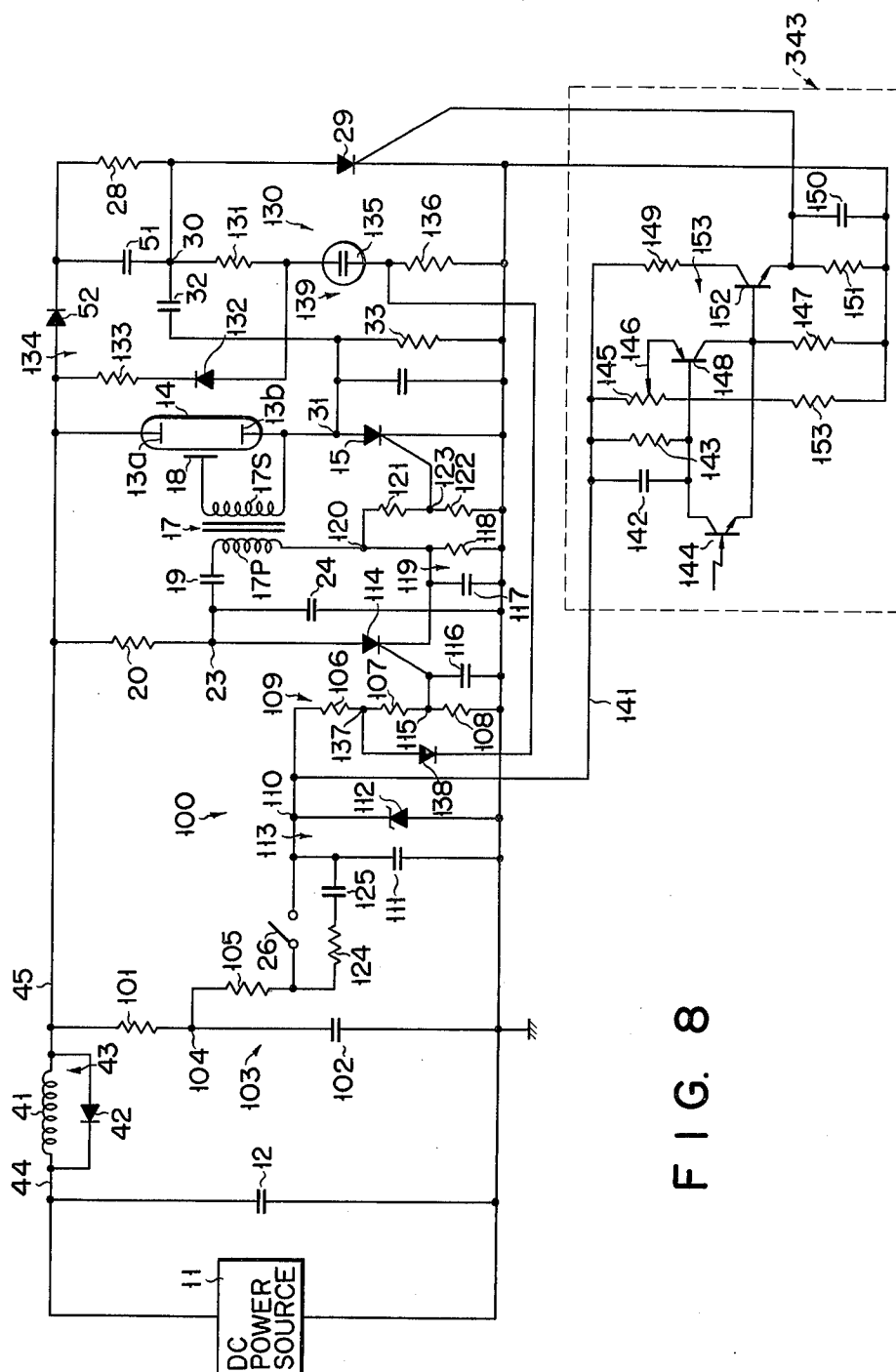


FIG. 7





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PHOTOGRAPHIC FLASHLIGHT APPARATUS WITH IMPROVED AUTOMATIC LIGHT TERMINATION MEANS

CROSS-REFERENCE TO RELATED APPLICATION

This is continuation-in-part of the U.S. Pat. Application Ser. No. 259,475, filed on June 5, 1972, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to an electronic or photographic flashlight apparatus for use with a photographic camera, and more particularly to the improvement of its automatic light termination means.

In the field of photographic flashlight apparatus, there has been preferably accepted the type which is provided with an automatic light termination means capable of automatically terminating the emission of light by a flash tube in a predetermined length of time after said emission is started in synchronism with the shutter operation of the associated camera.

The prior art typical photographic flashlight apparatus of such type comprises a flash capacitor connected across a dc source; a flash tube and a thyristor connected in series across the flash capacitor so as to be made simultaneously conductive through the shutter operation of a photographic camera, whereby the flash tube initiates a light emission by discharging the voltage stored on the flash capacitor; and an automatic light termination means including a quench element made conductive in a predetermined length of time after the light emission is started by the flash tube and a flash termination capacitor which is stored with the dc source voltage and disposed between the thyristor and quench element so as to terminate the light emission automatically upon conduction of the quench element by discharging the voltage stored across the flash termination capacitor through the conducting quench element, flash capacitor and flash tube and by making the thyristor forcedly nonconducting.

However, the flashlight apparatus constructed as mentioned above has the drawback that not only an exposure error is likely to occur but also a flash tube of considerably high withstanding voltage and large current capacity must be used, since an excess voltage about twice of that of the dc source voltage derived from voltage across the flash termination capacitor added to voltage across the flash capacitor is applied to the flash tube at the moment of the flash termination or interruption, resulting in an over-current flow.

Accordingly, the main object of this invention is to provide a photographic flashlight apparatus with improved light termination means in which an optimum exposure is always attained so as to prevent an over-current flowing into the flash tube at the instance of the flash termination.

SUMMARY OF THE INVENTION

A photographic flashlight apparatus according to this invention is characterized in that an exposure control means for causing at least part of an over-flash current to be shunted which might otherwise flow into the flash tube at the moment of the flash termination is provided substantially parallel with the flash tube.

The flashlight apparatus thus constructed has the advantage of not only always effecting an optimum exposure but also admitting of application of a flash tube

having lower withstanding voltage and current capacity than in the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic circuit diagram of a photographic flashlight apparatus embodying this invention;

FIG. 2 is a graph illustrating the relation of flash current and the duration of its introduction as observed with a flash tube used in a prior art flashlight apparatus;

FIG. 3 is a graph showing the relation of flash current and the duration of its introduction as observed with a flash tube used in a flashlight apparatus in accordance with this invention;

FIG. 4 shows a schematic circuit diagram of a photographic flashlight apparatus according to another embodiment of this invention;

FIGS. 5A and 5B show different practical circuit arrangements of the timer circuit shown in FIGS. 1 and 4;

FIG. 6 shows a schematic circuit diagram modified from FIG. 1;

FIG. 7 shows a schematic circuit diagram modified from FIG. 4; and

FIG. 8 shows a schematic circuit diagram of a photographic flashlight apparatus according to still another embodiment of this invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to FIG. 1, a storage or flash capacitor 12 is connected across the positive and negative poles of a dc power source 11 having a relatively high voltage, for example, 300 volts. Connected across both the plates of the flash capacitor 12 is a flashlight source 16 which includes a flash tube 14 having one main electrode 13a connected to one plate of the flash capacitor 12 or the positive pole of the dc source 11 and a thyristor 15 having the anode electrode connected to the other main electrode 13b of the flash tube 14 and the cathode electrode connected to the other plate of the flash capacitor 12 or the negative pole of the dc source 11. The flash tube 14 has the ignition or trigger electrode 18 connected to one end of the secondary winding 17S of an ignition or trigger transformer 17 which comprises the primary and secondary windings electromagnetically coupled to each other. The primary winding 17P of the transformer 17 has one end connected to the positive pole of the dc source 11 via a capacitor 19 and a resistor 20. The other end of the primary winding 17P is connected to the grounded negative pole of the dc source 11 via a variable resistor 21 with the slidable arm 22 connected to the gate electrode of the thyristor 15. A capacitor 24 is connected between the junction 23 of the capacitor 19 with the resistor 20 and the ground. Connected between the junction 23 and the junction 25 of the primary winding 17P with the variable resistor 21 is a normally open switch 26 which is closed in interlocking relationship with the shutter operation of an associated photographic camera (not shown).

Also, an automatic flashlight termination means 27 is provided across both the poles of the dc source 11 which comprises a resistor 28 having one end connected to the positive pole of the dc source 11; a quench element, for example, a thyristor 29 whose main current conduction path is connected between the other end of the resistor 28 and the grounded negative pole of the dc source 11.

tive pole of the dc source 11; a flash termination capacitor 32 having one plate connected to the junction 30 of the resistor 28 and the thyristor 29 and the other plate connected to the junction 31 of the flash tube 14 and the thyristor 15; a resistor 33 connected between the other plate of the flash termination capacitor 32 and the ground; and a timer circuit 34 coupled with the gate electrode of the thyristor 29 so as to cause the thyristor 29 to be turned on in a predetermined length of time (generally 10 μ s to 5 ms) after the emission of light is initiated by the flash tube 14 included in the flashlight source 16 so as to be hereinafter described. The elements or arrangements described above are part of a conventional photographic flashlight apparatus.

The operation of such flashlight apparatus will now be described.

Firstly, let it be assumed that the switch 26 is kept open and predetermined voltages in accordance with that of the dc source 11 are precharged on the capacitors 12, 19, 24 and 32 with the indicated polarity.

When, under this condition, the shutter of the camera is manipulated, the switch 26 is closed in synchronism with the operation of the shutter. Consequently voltage stored on the capacitor 19 is discharged through the closed switch 26 and the primary winding 17P of the transformer 17 so that the transformer 17 is excited and the flash tube 14 is triggered through the secondary winding 17S of the excited transformer 17. At the same time, voltage stored on the capacitor 24 is discharged through the now closed switch 26 and the variable resistor 21, causing the thyristor 15 to be triggered. As a result, voltage stored on the flash capacitor 12 is discharged through the fired flash tube 14 and thyristor 15 included in the flashlight source 16 and the flash tube 14 initiates to produce light toward a foreground subject (not shown) being photographed.

In the predetermined length of time after the emission of light is started by the flash tube 14, the thyristor 29 is triggered by the timer circuit 34. Accordingly, voltage stored on the flash termination capacitor 32 is discharged through the triggered thyristor 29, the flash capacitor 12 and the conducting flash tube 14. At the same time, the discharging voltage impressed across both poles of the flash termination capacitor 32 functions as a backward bias source to the thyristor 15, causing the thyristor 15 to be forcedly made nonconductive.

Therefore, the flash tube 14 acts to initiate the light emission when the switch 26 is closed and terminate said emission when the thyristor 15 is rendered nonconductive by the discharge of the voltage stored across the flash termination capacitor 32.

When, however, constructed only as mentioned above, a flashlight apparatus had the drawback that not only an exposure error was likely to occur but also a flash tube of considerably high withstanding voltage and large current capacity must be used, since an excess amount of voltage about twice of that of the dc source voltage resulting from voltage across the flash termination capacitor 32 added to voltage across the flash capacitor 12 was applied to the flash tube at the instance of the flash termination, giving rise to an over-flash current flow as shown in FIG. 2.

According to this invention, an over-flash current shunting means or exposure correction means 35 de-

signed as hereinunder described is provided substantially parallel with the flash tube.

The exposure correction means 35 comprises a diode 36 provided, if required, and having the anode connected to the positive pole of the dc source 11; a parallel circuit 39 consisting of a bypass capacitor 37 and a resistor 38 and connected at one end to the cathode of the diode 36; and a switch element, for example, a thyristor 40 whose anode-cathode path is connected between the other end of the parallel circuit 39 and the ground. The thyristor 40 has its gate electrode coupled to the timer circuit 34 as in the case of the aforesaid thyristor 29.

The exposure correction means 35 thus arranged acts to cause at least part of the aforesaid over-flash current observed in the prior art which might otherwise flow into the flash tube 14 at the moment of the flash termination to be charged into, and shunted by, the capacitor 37, since the thyristor 40 is turned on simultaneously with the thyristor 29 and the diode 36 is forwardly biased, thereby to prevent, as shown in FIG. 3, the over-flash current from flowing into the flash tube 14. Voltage stored across the capacitor 37 is discharged through the resistor 38 when the thyristor 40 is turned off by the timer circuit 34 in the later described manner so as to render the capacitor 37 ready for the next operation. Therefore, the photographic flashlight apparatus according to this invention can always attain an optimum exposure and also admits of the use of a flash tube having a smaller withstanding voltage and current capacity than in the prior art. Further the flashlight apparatus allows the use of a flash termination capacitor having a smaller capacitance than in the prior art, since a smaller flash current than in the prior art flows through the thyristor 29 upon the light termination. The diode 36 acts to prevent the over-flash current bypassed once by the capacitor 37 from running back to the flash tube 14.

According to this invention, a parallel circuit 43 consisting of an induction coil 41 and a diode 42 of the indicated polarity is further provided between a positive source line 44 including the flash capacitor 12 and a positive source line 45 to which the other circuit portions are connected.

The induction coil 41 is intended to improve the differentiation di/dt of starting transient current i which flows from the flash capacitor 12 and the flash termination capacitor 32 to the flash tube 14 and/or the exposure correction means 35 as well as the absorption of the over-flash current during the starting transient period which flows from the flash capacitor 12 and the flash termination capacitor 32 to the exposure correction means 35. The diode 42 is adapted to prevent the current which flows once from the flash capacitor 12 and the flash termination capacitor 32 to the flash tube 14 and/or the exposure correction means 35 from flowing back to the capacitors 12 and 32.

FIG. 4 shows a schematic circuit diagram of a photographic flashlight apparatus according to another embodiment of this invention. The embodiment is different from that of FIG. 1 in that an exposure correction means 351 is constituted by only a single bypass capacitor 51 connected parallel with the resistor 28.

The operation of the exposure correction means 351 is essentially the same as the exposure correction means 35 used in the embodiment of FIG. 1 excepting that the thyristor 29 concurrently serves as the thyristor

40, the resistor 28 concurrently serves as the resistor 38 and the thyristor 29 can be turned off more easier than in the embodiment of FIG. 1 since voltage stored across the bypass capacitor 51 is discharged through the resistor 28 immediately after the thyristor 29 is turned off. A diode 52 of the indicated polarity is provided between the flash tube 14 and the bypass capacitor 51 to attain the same effect as the diode 36 used in the embodiment of FIG. 1.

FIG. 5A shows a practical circuit arrangement of the timer circuit 34 shown in FIGS. 1 and 4.

The timer circuit 341 comprises a photoelectric conversion element, for example, an npn type phototransistor 63 whose collector is connected to the positive pole of a dc source 61 via a normally open switch 62 closed in interlocking relationship with the shutter operation of the associated camera together with the switch 26 and which is disposed to receive light emitted by the flash tube 14 and reflected from the subject so as to be rendered conductive; an integration capacitor 64 connected between the emitter of the phototransistor 63 and the grounded negative pole of the dc source 61; and an amplifier 67 including an npn type emitter follower transistor 65 whose base is connected to the emitter of the phototransistor 63 and whose collector is connected to the positive pole of the dc source 61 via the switch 62, and a resistor 66 connected between the emitter of the transistor 65 and the ground, the base of the transistor 65 being connected to the gate electrode of the thyristor 29 (and that of the thyristor 40 provided only in FIG. 1).

The operation of the timer circuit 341 will now be described.

When the switch 62 is closed in synchronism with the shutter operation of the camera and light reflected from the subject arrives, the phototransistor 63 is made conductive to produce photocurrent. The photocurrent thus obtained is charged on the capacitor 64 and integrated thereby in proportion to the total amount of light received by the phototransistor 63 with time.

When the integration voltage on the capacitor 64 reaches a predetermined value, the transistor 65 is rendered conductive to cause the thyristor 29 (and the thyristor 40) to be fired. Light reflected from the subject disappears and the switch 62 together with the switch 26 is again opened immediately after the completion of the camera shutter operation.

Accordingly, the phototransistor 63 is rendered nonconductive and voltage stored on the capacitor 64 is discharged through the conducting transistor 65 and the resistor 66 so as to make the capacitor 64 ready for the next operation. The transistor 65 is made nonconductive when the voltage charged across the capacitor 64 is reduced to about zero so as to be ready for the next operation. As a result, no trigger voltage is applied to the thyristor 29 (and the thyristor 40). Therefore, the thyristor 29 (and the thyristor 40) is again turned off when the main current flowing through the anode-cathode path thereof falls below a predetermined value.

FIG. 5B shows another practical circuit arrangement of the timer circuit 34.

The timer circuit 342 is constructed of a relaxation oscillator 80 which comprises a series circuit 75 consisting of a resistor 73 and a capacitor 74 and connected across both poles of a dc source 71 via a normally open switch 72 closed interlockingly with the

shutter operation of the associated camera together with the switch 26; an npn type unijunction transistor or double base diode 79 whose emitter is connected to the junction 76 of the resistor 73 and the capacitor 74, whose first base is connected to the grounded negative pole of the dc source 71 via a resistor 77 and whose second base is connected to the nongrounded side of the series circuit 75 via a variable resistor 78, the first base of the double base diode 79 being connected to the gate electrode of the thyristor 29 (and thyristor 40).

The operation of the timer circuit 342 will now be described.

When the switch 72 is closed in synchronism with the shutter operation of the camera, the capacitor 74 is charged with a proper level of voltage to cause the double base diode 79 to be triggered after a length of time determined by the time constant arrived at by multiplying the resistance of the resistor 73 by the capacitance of the capacitor 74.

As a result, the double base diode 79 is brought to a conducting state and the relaxation oscillator 80 generates an output signal so as to cause the thyristor 29 (and thyristor 40) to be triggered. The switch 72 together with the switch 26 is again opened immediately after the completion of the camera shutter operation. Consequently, voltage stored across the capacitor 74 is discharged through the conducting double base diode 79 and the resistor 77 so as to make the capacitor 74 ready for the next operation.

The double base diode 79 is made nonconductive when the voltage charged across the capacitor 74 is reduced to about zero ready for the next operation.

Accordingly, the timer circuit 342 of FIG. 5B operates in essentially the same manner as the timer circuit 341 of FIG. 5A.

FIG. 6 shows a schematic circuit diagram of one modification of FIG. 1.

The modification is different from the embodiment of FIG. 1 in that conventional quench or switch tubes 81 and 82 are used in place of the thyristors 29 and 40 employed in the embodiment of FIG. 1. The quench tubes 81 and 82 have trigger electrodes coupled with the timer circuit 34 via a common ignition transformer 83, a coupling capacitor 84 and a switching thyristor 85. The thyristor 85 has an anode-cathode path connected via a resistor 86 across the dc source 11 and a gate electrode coupled with the timer circuit 34.

FIG. 7 shows a schematic circuit diagram of one modification of FIG. 4.

The modification is different from the embodiment of FIG. 4 in that a conventional quench tube 91 designed in the same manner as the quench tube 81 is used in place of the thyristor 29 used in the embodiment of FIG. 4.

It will be apparent to those skilled in the art that the modifications of FIGS. 6 and 7 operate in essentially the same manner as the embodiments of FIGS. 1 and 4.

FIG. 8 shows a schematic circuit diagram of a photographic flashlight apparatus according to still another embodiment of this invention.

The embodiment is different from the embodiment of FIG. 1 or 4 in that an availability confirming means 130 constructed as hereinafter described is further provided and a trigger circuit portion 100 for the flash tube

14 and the thyristor 15 is modified as hereinunder described.

The trigger circuit portion 100 includes a series circuit 103 consisting of a resistor 101 and a capacitor 102 and connected between the positive source line 45 and the ground. Connected in series between the junction 104 of the resistor 101 with the capacitor 102 and the ground are a resistor 105, the normally open switch 26 and a series connection 109 of three resistors 106, 107 and 108.

Connected between the junction 110 of the switch 26 and the series connection 109 is a parallel circuit 113 consisting of a capacitor 111 and a zener diode 112. The aforesaid junction 23 is connected to the anode of a thyristor 114. The thyristor 114 has a gate electrode connected to the junction 115 of the resistors 107 and 108 as well as to ground via a capacitor 116 and a cathode connected to ground via a parallel circuit 119 consisting of a capacitor 117 and a resistor 118 as well as to the other end of the primary winding 17P of the aforesaid trigger transformer 17. Connected in series between the junction 120 of the parallel circuit 119 with the primary winding 17P and the ground are a resistor 121 and a resistor 122. The junction 123 of the resistors 121 and 122 is connected to the gate electrode of the thyristor 15.

The operation of the trigger circuit portion 100 will now be described.

Immediately before the shutter of the associated camera is manipulated, the switch 26 is kept open and the capacitors 12, 19, 24, 32 and 102 are precharged with predetermined voltages in accordance with that of the dc source 11. When under this condition, the switch 26 is closed interlockingly with the camera shutter operation, voltage stored on the capacitor 102 is discharged through the resistor 105, the closed switch 26 and the series connection 109 of three resistors 106 to 108 so as to cause a constant voltage smoothed by the capacitor 111, for example, to 10 volts to be induced across the zener diode 112. The constant voltage thus induced is divided by the three resistors 106 to 108. The thyristor 114 is triggered by the divided voltage appearing across the resistor 108. As a result, voltage stored on the capacitor 19 is discharged through the fired thyristor 114 and the primary winding 17P of the transformer 17 so as to cause the flash tube 14 to be triggered. At the same time, voltage stored on the capacitor 24 is discharged through the conducting thyristor 114 and the resistor 118 as well as the series-connected resistors 121 and 122 connected parallel with the resistor 118 so as to cause the thyristor 15 to be triggered. Therefore, the trigger circuit portion 100 of FIG. 8 functions in essentially the same manner as that of FIG. 1 or 4.

A series connection of a resistor 124 and a capacitor 125 may be provided in parallel with the switch 26 in order to shunt spark discharge voltage likely to occur when the switch 26 is closed.

The availability-confirming means 130 includes an availability-confirming element such as an indicator lamp 135 whose one electrode is connected to the aforesaid junction 30 of the flash termination capacitor 32 with the resistor 28 via a resistor 131 and also to the positive power source line 45 via a series connection 134 of a diode 132 having the indicated polarity and a resistor 133. The indicator lamp 135 has the other electrode connected to the ground via a resistor 136 and

also to the junction 137 of the resistors 106 and 107 via a diode 138 of the indicated polarity.

The operation of the availability-confirming means 130 will now be described.

A current conduction path 139 for lighting the indicator lamp 135 is formed by the series route consisting of the resistor 28, resistor 131, indicator lamp 135 and resistor 136.

Thus, prior to the shutter operation of the camera the indicator lamp 135 is designed to be turned on only when sufficient voltage to allow the thyristor 15 to be turned off by the discharge thereof as mentioned above is precharged across the flash termination capacitor 32 and also sufficient voltage to permit the optimum emission of light by the flash tube 14 is precharged across the flash capacitor 12.

That is, in the case where the flash termination capacitor 32 is precharged with the sufficient voltage to cause the thyristor 15 to be turned off by the discharge thereof but the flash capacitor 12 is only precharged with insufficient voltage to permit the optimum emission of light by the flash tube, then current corresponding to the voltage charged on the capacitor 32 is shunted through the resistor 131, the now forwardly biased diode 132 and the resistor 133 by substantially ceasing to flow into the indicator lamp 135 so as to turn off the indicator lamp 135.

In the contrary case where the flash capacitor 12 is precharged with the sufficient voltage to allow the optimum emission of light by the flash tube 14 but the flash termination capacitor 32 is only precharged with insufficient voltage to cause the thyristor 15 to be turned off by the discharge thereof, then part of current proportional to the voltage charged on the capacitor 12 flows through the flash termination capacitor 32 so as to cause the capacitor 32 to be charged, thus still preventing the indicator lamp 135 from being turned on.

Even if, under the condition where either of the flash termination capacitor 32 and the flash capacitor 12 is precharged with the aforesaid sufficient voltage, the switch 26 is closed by the misoperation of the shutter of the camera, part of current corresponding to the voltage obtained by dividing the aforesaid constant voltage induced across the zener diode 112 by the three-series connected resistors 106 to 108 is shunted through the now forwardly biased diode 138 and the resistor 136, preventing the thyristor 114 from being turned on and causing the flash tube 14 to emit light.

Therefore, the provision of the availability-confirming means 130 has the advantage capable of preventing the erroneous camera shutter operation.

In FIG. 8, reference numeral 343 is a timer circuit which is designed to use as a dc source 141 for the operation thereof the aforesaid constant voltage induced across the zener diode 112 upon the closure of the switch 26 interlocking with the shutter operation of the camera.

The timer circuit 343 comprises an npn type phototransistor 144 whose collector is connected to the dc source 141 via a capacitor 142 as well as a resistor 143 and which is disposed to receive light reflected from the subject being photographed; and an amplifier 153 including a pnp type transistor 148 whose base is connected to the collector of the phototransistor 144, whose emitter is connected to the slidable arm 146 of a variable resistor 145 having one end connected to the dc source 141 and whose collector is connected to the

mally open switch which is closed interlockingly with the shutter operation of said camera; and a double base diode whose emitter is connected to the junction of said capacitor with said first resistor, one of the bases of said double base diode being connected to one end of said series circuit via a second resistor and coupled with said quench element, and the other base of said double base diode being connected to the other end of said series circuit via a third resistor.

9. Apparatus as claimed in claim 1 further including an availability-confirming means which comprises an indicator lamp having one electrode thereof connected to the junction of said flash termination capacitor with said quench element as well as to the high potential side of said dc source via a resistor and a diode, the diode being connected with a backward polarity relative to said dc source, the other electrode of said indicator lamp being connected to the low potential side of said dc source via another resistor, said indicator lamp being turned on only when sufficient voltage to permit the emission of light by said flash tube is precharged on said flash capacitor and also sufficient discharging voltage to cause said quench element to be turned off is precharged on said flash termination capacitor.

10. Apparatus as claimed in claim 9, comprising a trigger source for said flashlight source, and wherein said availability-confirming means further includes a further diode coupled between said trigger source and said other electrode of said indicator lamp and being operative to shunt part of the current from said trigger source only upon an erroneous shutter operation of an associated camera under the condition where insufficient voltage to permit the optimum emission of light by said flash tube is precharged on said flash capacitor so as to prevent said flash tube from being triggered.

11. A photographic flashlight apparatus comprising: a flash capacitor connected across a dc source of a predetermined voltage;

a flashlight source connected across said flash capacitor and including a flash tube and a thyristor which are simultaneously rendered conductive upon the shutter operation of a photographic camera so as to initiate a light emission by said flash tube;

an automatic light termination means disposed across said flash capacitor and including a quench element; a timer circuit coupled with said quench element so as to cause said quench element to be turned on a predetermined period of time after the emission of light is initiated by said flash tube; and a flash termination capacitor coupled with said thyristor included in said flashlight source and said quench element and precharged with voltage corresponding to that of said dc source for effecting discharge upon the conduction of said quench element by said timer circuit through said conducting quench element, said flash capacitor and said flashlight source so as to turn off said thyristor;

an exposure correction means including a resistor connected in parallel with a bypass capacitor, said parallel circuit being coupled substantially in parallel with said flash tube and being operative to shunt at least part of an over-flash current which might otherwise flow into said flash tube upon the flash termination thereof; and

an availability-confirming means which comprises an indicator lamp having one electrode thereof connected to the junction of said flash termination ca-

pacitor with said quench element as well as to the high potential side of said dc source via a resistor and a diode, the diode being connected with a backward polarity relative to said dc source, the other electrode of said indicator lamp being connected to the low potential side of said dc source via another resistor, said indicator lamp being turned on only when sufficient voltage to permit the emission of light by said flash tube is precharged on said flash capacitor and also sufficient discharging voltage to cause said quench element to be turned off is precharged on said flash termination capacitor.

12. Apparatus as claimed in claim 11, comprising a trigger source for said flashlight source, and wherein said availability-confirming means further includes a further diode coupled between said trigger source and said other electrode of said indicator lamp and being operative to shunt part of the current from said trigger source only upon an erroneous shutter operation of an associated camera under the condition where insufficient voltage to permit the optimum emission of light by said flash tube is precharged on said flash capacitor so as to prevent said flash tube from being triggered.

13. In a photographic flashlight apparatus comprising:

a flash capacitor connected across a dc source of a predetermined voltage;

a flashlight source connected across said flash capacitor and including a flash tube and a thyristor which are simultaneously rendered conductive upon the shutter operation of a photographic camera so as to initiate a light emission by said flash tube; and

an automatic light termination means disposed across said flash capacitor and including a quench element; a timer circuit coupled with said quench element so as to cause said quench element to be turned on a predetermined period of time after the emission of light is initiated by said flash tube; and a flash termination capacitor coupled with said thyristor included in said flashlight source and said quench element and precharged with voltage corresponding to that of said dc source for effecting discharge upon the conduction of said quench element by said timer circuit through said conducting quench element, said flash capacitor and said flashlight source so as to turn off said thyristor;

the improvement comprising:

an exposure correction means including a parallel circuit which is coupled substantially in parallel with said flash tube between the high potential side of said dc source and the junction of said flash termination capacitor with said quench element, said parallel circuit including a resistor and a bypass capacitor connected in parallel with said resistor, said parallel circuit being operative to shunt at least part of an over-flash current which might otherwise flow into said flash tube upon the flash termination thereof.

14. Apparatus as claimed in claim 13, wherein said exposure correction means further includes a diode connected between said parallel circuit and said flashlight source with a forward polarity with respect to said dc source.

15. Apparatus as claimed in claim 13, wherein said timer circuit included in said automatic light termination means comprises a photoelectric conversion ele-

ground via a resistor 147, and an npn type transistor 152 whose base is connected to the emitter of the phototransistor 144 as well as the collector of the transistor 148, whose collector is connected to the dc source 141 via a resistor 149 and whose emitter is connected to the ground via a capacitor 150 as well as a resistor 151, the emitter of the transistor 152 being connected to the gate electrode of said thyristor 29 and the other end of said variable resistor 145 being connected to the ground via a resistor 153.

It will be apparent to those skilled in the art that the timer circuit 343 constructed as mentioned above operates in essentially the same manner as the timer circuit 341 shown in FIG. 5A.

By way of illustration, a typical circuit defining this invention is constructed as shown in FIG. 8 and by selecting the value of main elements used therein as follows:

Resistors		Capacitors		Induction coil	
20	2.2	MΩ	12	500	μF
28	5.1	KΩ	19	0.047	μF
33	3.9	KΩ	24	0.047	μF
101	1	MΩ	32	2.2	μF
105	10	KΩ	51	10	μF
106	10	KΩ	111	0.047	μF
107	4.7	KΩ	116	0.05	μF
108	1	KΩ	117	0.15	μF
118	150	Ω	125	0.047	μF
121	220	Ω	142	0.068	μF
122	220	Ω	150	0.05	μF
124	10	Ω			
131	470	KΩ			
133	10	KΩ			
136	10	KΩ			
143	220	KΩ			
145	500	Ω			
147	1	KΩ			
149	150	Ω			
151	470	Ω			
153	3.3	KΩ			

What is claimed is:

1. In a photographic flashlight apparatus comprising: a flash capacitor connected across a dc source of a predetermined voltage; a flashlight source connected across said flash capacitor and including a flash tube and a thyristor which are simultaneously rendered conductive upon the shutter operation of a photographic camera so as to initiate a light emission by said flash tube; and an automatic light termination means disposed across said flash capacitor and including a quench element, a timer circuit coupled with said quench element so as to cause said quench element to be turned on a predetermined period of time after the emission of light is initiated by said flash tube, and a flash termination capacitor coupled with said thyristor included in said flashlight source and said quench element and precharged with voltage corresponding to that of said dc source for effecting discharge upon the conduction of said quench element by said timer circuit through said conducting quench element, said flash capacitor and said flashlight source so as to turn off said thyristor; the improvement comprising: an exposure correction means including a series arrangement which is connected across said flash capacitor and which includes a switch element coupled with said timer circuit so as to be made con-

ductive simultaneously with said quench element, and a parallel circuit which includes a resistor and a bypass capacitor coupled in parallel with said resistor, said parallel circuit being operative to shunt through said conducting switch element at least part of an over-flash current which might otherwise flow into said flash tube upon the flash termination thereof.

2. Apparatus as claimed in claim 1, wherein said series arrangement further includes a diode connected in series with said switch element and with a forward polarity with respect to said dc source.

3. Apparatus as claimed in claim 1, wherein said switch element as well as said quench element comprises a thyristor.

4. Apparatus as claimed in claim 1, wherein said switch element as well as said quench element comprises a quench tube.

5. Apparatus as claimed in claim 1 further including an inductor connected between a power source line for said flash capacitor and a power source line for the remaining elements.

6. Apparatus as claimed in claim 1 further including a diode connected in parallel with said inductor with a backward polarity relative to said dc source.

7. Apparatus as claimed in claim 1, wherein said timer circuit included in said automatic light termination means comprises a photoelectric conversion element which is connected to a dc source via a normally open switch which is closed interlockingly with the shutter operation of said camera, and which is disposed to receive light emitted by said flash tube and reflected from a foreground subject so as to produce photocurrent proportional to the received amount of light; and an integration capacitor coupled with said photoelectric conversion element and said quench element for integrating with time the photocurrent flowing through said photoelectric conversion element, said quench element being turned on responsive to the integrated voltage.

8. Apparatus as claimed in claim 1, wherein said timer circuit included in said automatic light termination means comprises a relaxation oscillator which includes a series circuit having a first resistor and a capacitor connected in series with said first resistor, said series circuit being connected to a dc source via a nor-

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ment which is connected to a dc source via a normally open switch which is closed interlockingly with the shutter operation of said camera, and which is disposed to receive light emitted by said flash tube and reflected from a foreground subject so as to produce photocurrent proportional to the received amount of light; and an integration capacitor coupled with said photoelectric conversion element and said quench element for integrating with time the photocurrent flowing through said photoelectric conversion element, said quench element being turned on responsive to the integrated voltage.

16. Apparatus as claimed in claim 13, wherein said timer circuit included in said automatic light termination means comprises a relaxation oscillator which includes a series circuit having a first resistor and a capacitor connected in series with said first resistor, said series circuit being connected to a dc source via a normally open switch which is closed interlockingly with the shutter operation of said camera; and a double base diode whose emitter is connected to the junction of said capacitor with said first resistor, one of the bases of said double base diode being connected to one end of said series circuit via a second resistor and coupled with said quench element, and the other base of said double base diode being connected to the other end of said series circuit via a third resistor.

17. Apparatus as claimed in claim 13 wherein said quench element comprises a thyristor.

18. Apparatus as claimed in claim 13 wherein said quench element comprises a quench tube.

19. Apparatus as claimed in claim 13 further including an inductor connected between a power source line

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for said flash capacitor and a power source line for the remaining elements.

20. Apparatus as claimed in claim 19 further including a diode connected in parallel with said inductor with a backward polarity relative to said dc source.

21. Apparatus as claimed in claim 13 further including an availability-confirming means which comprises an indicator lamp having one electrode thereof connected to the junction of said flash termination capacitor with said quench element as well as to the high potential side of said dc source via a resistor and a diode, the diode being connected with a backward polarity relative to said dc source, the other electrode of said indicator lamp being connected to the low potential side of said dc source via another resistor, said indicator lamp being turned on only when sufficient voltage to permit the emission of light by said flash tube is precharged on said flash capacitor and also sufficient discharging voltage to cause said quench element to be turned off is precharged on said flash termination capacitor.

22. Apparatus as claimed in claim 21, comprising a trigger source for said flashlight source, and wherein said availability-confirming means further includes a further diode coupled between said trigger source and said other electrode of said indicator lamp and being operative to shunt part of the current from said trigger source only upon an erroneous shutter operation of an associated camera under the condition where insufficient voltage to permit the optimum emission of light by said flash tube is precharged on said flash capacitor so as to prevent said flash tube from being triggered.

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