

PATENT SPECIFICATION

(11)

1 374 247

1 374 247

- (21) Application No. 20163/74 (22) Filed 24 Aug. 1971
 (62) Divided out of No. 1 374 245
 (31) Convention Application No. 104 488 (32) Filed 11 June 1971 in
 (33) Belgium (BE)
 (44) Complete Specification published 20 Nov. 1974
 (51) International Classification G03B 15/05
 (52) Index at acceptance
 G2A 401 483 497 704 711 BJ



(54) ELECTRONIC PHOTOFLASH

(71) We, PONDER & BEST, INC. a corporation organized under the laws of the State of California, United States of America, of 1630 Stewart Avenue, Santa Monica, State of California, United States of America, (formerly of 11201 West Pico Boulevard, Los Angeles, California 90064), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electronic photoflash devices.

According to the invention there is provided a photoflash device including a photoflash tube, means connected for triggering the tube into its conductive state when operating power is applied to the tube, a power source for supplying power for the device, a light sensing circuit arranged for sensing the light reflected from a subject illuminated by the light produced by the tube and for producing an output signal upon receipt of a predetermined quantity of light, pulse generating means connected in series between the power source and the tube for generating, and applying to the tube, a train of electrical pulses constituting the tube operating power upon the tube being triggered into its conductive state, each pulse produced by said means resulting in the production of less than the predetermined quantity of light, and means connecting the light sensing circuit to said pulse generating means for causing the occurrence of the light sensing means output signal to prevent the generation of subsequent pulses by said generating means.

There is thus provided an automatic flash device which includes a circuit for delivering a train of relatively short electrical pulses, rather than a single pulse, to the photoflash tube and means for controlling the circuit so as to simply terminate the

production and delivery of the short pulses in response to a control signal indicating that the subject being photographed has received the quantity of light necessary for producing the desired exposure.

Advantages and preferred features of the invention will become apparent from the following description, given by way of example and with reference to the accompanying drawings in which:—

Figure 1 is a circuit diagram of an electronic photoflash device embodying the present invention.

Figure 2 is a series of waveform diagrams illustrating the operation of prior art automatic photoflash devices and the comparable operation of devices disclosed herein.

Figure 3 is a block diagram of a system for generating impulses equipped with a control device for the quantity of radiant energy, also embodying the present invention.

Figure 1 shows a circuit comprising an energy storage capacitor 592, a photoflash tube 594, a trigger circuit 595 for initiating the production of light flashes by the tube 594, a light sensing and measuring circuit 596, a pulse control switching circuit 593, and a unit 591 which contains the remaining necessary components of the photoflash, including a power supply and any necessary actuation switches.

In the operation of this circuit, capacitor 592 is initially charged by the power supply in the unit 591. The voltage across capacitor 592 is applied across the main terminals A and K of tube 594 via circuit 593, and in particular via resistor 59305.

Capacitor 59304 of circuit 593 is connected across the main terminals of tube 594 via a resistor 59303 and as a result capacitor 59304 becomes charged to substantially the voltage across capacitor 592. Also connected across capacitor 592 is a voltage divider arrangement composed of resistors

[Price 25p]

59 313, 59 314, 59 308 and 59 309 and constituting a part of circuit 593. Due to the provision of this voltage divider arrangement, an operating capacitor 59 307 connected across resistor 59 314 is charged to a voltage having a value which is a predetermined fraction of the voltage across capacitor 592. Similarly, capacitor 59 312 is charged to the voltage across resistor 59 309, which is also a predetermined fraction of the voltage across capacitor 592.

When the flash tube 594 is triggered into its conductive state by the operation of triggering circuit 595, the positive triggering pulse is conveyed capacitatively to the anode of tube 594 and thus to the emitter of PNP transistor 59 306 via the path defined by capacitor 59 304, line 59 310 and capacitor 59 307. This renders transistor 59 306 conductive to apply the voltage on capacitor 59 307 to the gate electrode of thyristor 59 301 to render the latter conductive. As a result, a transient current flow path is established through thyristor 59 301 and capacitor 59 304 from capacitor 592 to the anode of tube 594, the previously applied charge voltage across capacitor 59 304 being added to that across capacitor 592. The resulting current flow through tube 594 will produce a light flash pulse. While this current flow continues, it acts to charge capacitor 59 304 in the direction opposite to that of its initial charge and the current flow continues until that capacitor becomes fully charged in such opposite direction, at which time current flow through thyristor 59 301 will cease and that thyristor will switch into its blocking state.

The current path defined by resistors 59 308 and 59 309 has the effect of urging the potential on line 59 310 in a negative direction, toward the potential on the cathode K of tube 594, and this has the effect of causing a positive pulse to be applied to the emitter of PNP transistor 59 311 via capacitor 59 312. This causes a triggering voltage to be applied to the gate electrode of thyristor 59 302, which up until this point had been non-conductive.

When thyristor 59 302 becomes conductive, it establishes a current flow path via which capacitor 59 304 discharges through tube 594. Since, at the time that thyristor 59 302 becomes conductive, tube 594 will not yet have had an opportunity to deionize, the discharge of capacitor 59 304 will cause another light pulse to be produced.

The resulting current pulse through tube 594 will continue, with the amplitude of the current diminishing progressively, until capacitor 59 304 has become substantially completely discharged. At this time, since current is no longer flowing through thyristor 59 302, this thyristor will switch into its blocking state.

During the discharge of the capacitor 59 304, the current path constituted by resistors 59 313 and 59 314 will urge the potential on line 59 310 in a positive direction, toward the voltage on the positive plate of capacitor 592. This has the effect of once again applying a trigger voltage to the gate of thyristor 59 301 so as to render that thyristor conductive, thereby reestablishing the current path via which capacitor 592 can discharge through capacitor 59 304 and tube 594, thus causing another light flash pulse to be produced by the tube.

The cycle then repeats and, if no external influences are exerted on the circuit 593, continues until capacitor 592 becomes substantially completely discharged.

The external influence which would halt the continued repetition of the above-described cycle is the application of a positive voltage to the base of NPN transistor 59 315. Such a positive voltage would act to inhibit the triggering of transistor 59 302 and thus to prevent further discharge of capacitor 592 and the production of light flash pulses by tube 594.

In the circuit of Figure 1, this positive voltage is provided by light sensing and measuring circuit 596. The energization of this circuit is effected by means of a gating arrangement which includes a series path constituted by a capacitor 59 316 and a resistor 59 317 connected between line 59 310 of circuit 593 and a point in circuit 596. The gating arrangement further includes a portion of circuit 596 including two diodes 59 601 and 59 602 and an energy storage capacitor 59 603.

Before tube 594 is triggered to produce a train of light flash pulses, DC blocking capacitor 59 316 prevents any current flow through resistor 59 317 so that no voltage will appear across capacitor 59 603. Thus, sensing circuit 596 remains deactivated.

Then, when the first positive pulse appears on line 59 310 as a result of the production of a triggering pulse by circuit 595, a current pulse will be delivered through resistor 59 317 and diode 59 601 to charge that capacitor. This starts the operation of sensing circuit 596. During the production of succeeding pulses in circuit 593, the above-described gating circuit will operate in the manner of a "pumping diode" to supply periodic charging pulses to capacitor 59 603.

After circuit 596 has been placed in operation, the light reflected from the subject being photographed is received by a photo-transistor forming part of circuit 596 to vary the conductance of that transistor. The instantaneous conductance variations are integrated in a known manner until a predetermined integration voltage level is reached, at which time a switching transistor

connected in cascade with the phototransistor is rendered conductive to produce the positive voltage which is applied to the base of transistor 59 315.

- 5 Exemplary values for the main specific components are the following: full charge voltage across capacitor 592 : 360 V (between 300 and 1000 μ F); the capacitance of capacitor 59 304 : 6 μ F; and the resistance of resistor 59 305 : 400 k Ω .

- 10 A comparison of the operation of a circuit such as that of Fig. 1 with the operation of prior art automatic flash limiting circuits is illustrated in the diagrams of Figure 2. The upper three diagrams of that figure relate to prior art circuits, while the corresponding lower three diagrams depict the operation of the circuit such as that of Fig. 1.

- 15 Diagram 601, which is identical with that shown in U.S. Patent No. 3,303,988, illustrates the intensity of the light flash as a function of time. The cross-hatched area represents the total quantity of light emitted by the photoflash when the light flash is terminated at an instant A. The broken lines illustrate the intensity of the light flash produced when successively later quenching pulses are applied at instants B and C.

- 20 Diagram 602 illustrates the associated flash triggering pulse, while diagram 603 illustrates the quenching pulses for terminating the light emission at the various instants A, B and C.

- 25 Diagram 604 illustrates the waveform of the light intensity with respect to time produced by the photoflash tube in a circuit such as that of Fig. 1. Here again, the total cross-hatched area illustrates the total quantity of light produced during an exposure.

- 30 Diagram 605 illustrates the flash trigger pulse which initiates the production of the light flash pulses, while diagram 606 illustrates the signal which blocks the production of further electrical energy pulses, and thus further light pulses.

- 35 It will be readily appreciated that one substantial advantage of the novel arrangement of Figure 1 is that its light terminating operation does not involve the bypassing, and hence dissipation, of the remaining energy stored in the flash tube storage capacitor after a light flash has been terminated. Rather, in the circuit, the light flash is terminated by simply preventing the production of further energy pulses so that the energy stored by the supply capacitor at the time of flash termination remains stored thereon and is not wasted by being simply dissipated through a short circuit. Moreover, this result is achieved by a circuit employing standard commercially available components.

- 40 The system shown in the block diagram of Fig. 3 comprises the photoflash capacitor

582, the photoflash tube 584, equipped with its triggering circuit 585, a sensor-calculator circuit 586 and a commutation circuit 583, while all the other components of a photoflash unit are represented by block 581.

70 To illustrate the principle of working of the commutation circuit 583 we symbolise the components of this circuit as an inverter switch constituted by two contacts 5831 and 5832 with a cooperating movable contact or tap 5833, capacitor 5834 and resistor 5835.

80 The explanation of the working of the system according to the block diagram of Fig. 18 is as follows:—

85 The capacitor 582 of the photoflash is charged by an energy source which is in block 581. The voltage of this capacitor 582 is applied to the two terminals of the flashtube 584 via contacts 5832, 5833 and the capacitor 5834 on the one hand, and via the resistor 5835 on the other hand. Because no current circulates in the flashtube 584, while it is in stand-by condition, the capacitor 5834 is discharged by the resistor 90 5835.

95 When the flashtube 584 is fired by means of the triggering device 585, a current is established in the flash tube 584 and has as first effect to produce light and as second effect to charge the capacitor 5834. As soon as the capacitor 5834 is charged completely, the current in the flash tube 584 will cease. The cessation of the current provokes the inversion of the position of tap contact 100 5833, which has as effect to apply the voltage of capacitor 5834 which has just been charged to the terminals of the flashtube 584 via the contacts 5833 and 5831. The de-ionisation time of the flash tube 584 is 105 sufficiently long for the current to begin again to circulate as soon as the voltage of the capacitor 5834 is applied to its terminals. The capacitor 5834 will discharge completely through the flashtube and as soon as its voltage ceases, the discharge current will also cease, which provokes reversion of the tap 5833 to its initial position. In this moment the voltage of the capacitor 582 is again applied to the terminals of the flashtube 584 via the contact 5832, the tap 5833 and the capacitor 5834 which has just been discharged. Again the time of de-ionisation of the flashtube 584 is sufficiently long for the current to start again to circulate as soon as the voltage of the capacitor 582 which constitutes the energy supply for the flash tube 584 is completely discharged or the reversing of the tap 5833 has been prevented due to the control circuit 586, for instance, when the quantity of light delivered by the flash tube 584 is sufficient. In this second case the capacitor 582 ceases to discharge itself and the light emission of the flashtube is interrupted.

The connection 5836 is provided for sending to the sensor-calculator 586 the information of the moment of the start of the light flash, while the 5837 link is provided for receiving the order of the moment for ending the light flash.

WHAT WE CLAIM IS:—

1. An electronic photoflash device including a photoflash tube, means connected for triggering the tube into its conductive state when operating power is applied to the tube, a power source for supplying power for the device, a light sensing circuit arranged for sensing the light reflected from a subject illuminated by the light produced by the tube and for producing an output signal upon receipt of a predetermined quantity of light pulse generating means connected in series between the power source and the tube for generating, and applying to the tube, a train of electrical pulses constituting the tube operating power upon the tube being triggered into its conductive state, each pulse produced by said means resulting in the production of less than the predetermined quantity of light, and means connecting the light sensing circuit to said pulse generating means for causing the occurrence of the light sensing means output signal to prevent the generation of subsequent pulses by said generating means.

2. A photoflash device as claimed in claim 1 wherein, in use, successive pulses produced by said generating means are spaced from one another by a time interval no greater than the time required for the tube to deionize upon termination of the delivery of light flash producing energy thereto.

3. A photoflash device as claimed in claim 1 or claim 2, further comprising means connected between said generating means and said light sensing circuit for causing the pulses produced by said generating means to supply energizing power to the light sensing circuit.

4. A photoflash device as claimed in any of claims 1 to 3 wherein said pulse generating means are arranged to begin generating such train of pulses in response to the application of a triggering signal to the tube by the triggering means.

5. A photoflash device substantially as described herein with reference to Figures 1 and 3 of the accompanying drawings.

Agents for the Applicant,
STANLEY, POPPLEWELL,
FRANCIS & ROSS,
Chartered Patent Agents,
20/21 Tooks Court,
Cursitor Street,
London EC4A 1LB.

The connection 5836 is provided for sending to the sensor-calculator 586 the information of the moment of the start of the light flash, while the 5837 link is provided for receiving the order of the moment for ending the light flash.

WHAT WE CLAIM IS:—

1. An electronic photoflash device including a photoflash tube, means connected for triggering the tube into its conductive state when operating power is applied to the tube, a power source for supplying power for the device, a light sensing circuit arranged for sensing the light reflected from a subject illuminated by the light produced by the tube and for producing an output signal upon receipt of a predetermined quantity of light pulse generating means connected in series between the power source and the tube for generating, and applying to the tube, a train of electrical pulses constituting the tube operating power upon the tube being triggered into its conductive state, each pulse produced by said means resulting in the production of less than the predetermined quantity of light, and means connecting the light sensing circuit to said pulse generating means for causing the occurrence of the light sensing means output signal to prevent the generation of subsequent pulses by said generating means.

2. A photoflash device as claimed in claim 1 wherein, in use, successive pulses produced by said generating means are spaced from one another by a time interval no greater than the time required for the tube to deionize upon termination of the delivery of light flash producing energy thereto.

3. A photoflash device as claimed in claim 1 or claim 2, further comprising means connected between said generating means and said light sensing circuit for causing the pulses produced by said generating means to supply energizing power to the light sensing circuit.

4. A photoflash device as claimed in any of claims 1 to 3 wherein said pulse generating means are arranged to begin generating such train of pulses in response to the application of a triggering signal to the tube by the triggering means.

5. A photoflash device substantially as described herein with reference to Figures 1 and 3 of the accompanying drawings.

Agents for the Applicant,
**STANLEY, POPPLEWELL,
FRANCIS & ROSS,**
Chartered Patent Agents,
20/21 Tooks Court,
Cursitor Street,
London EC4A 1LB.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1974.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

