

PATENT SPECIFICATION (11)

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(54) DISCHARGE-TYPE FLASH APPARATUS

(71) We, FRANKE & HEIDECHE G.m.b.H., a German Body Corporate, trading as ROLLEI-WERKE FRANKE & HEIDECHE, of 196 Salzdhahmerstrasse, Braunschweig, Germany, 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:—

The present invention relates to a discharge-type flash apparatus in which the duration of the flash is controlled in accordance with the measurement of the quantity of light reflected from the subject, the output being adapted by automatically actuating additional storage capacitors, in such a way that their addition, when a certain selectable light quantity threshold value is reached, is interrupted or becomes inoperative, in accordance with British Patent Specification No. 1,295,204.

The above mentioned specification describes the automatic successive addition of storage capacitors in stages, their addition being rendered inoperative by the short-circuiting of a flash tube. It is true that this system only entails one photo-electric converter which controls the termination of the flash discharge by short-circuiting, in a known manner. According to British Patent Specification No. 1,295,204, to which the present application is an application for a patent of addition, an independent photo-electric converter may be provided for terminating the succession of operations actuating the respective additional storage capacitors.

The present invention may simplify the system by providing one single photo-transistor both to control the quenching device for the termination of the flash discharge and to interrupt the actuation of the additional capacitor.

According to the present invention, there is provided an electronic flash apparatus including a single flash tube, a main capacitor and an additional capacitor arranged to be automatically connected into circuit with the flash tube for determining the luminous

intensity of the flash, photoelectric control means for detecting the luminous intensity of the flash reflected back by the subject and for providing a control signal, electronic switch means associated with said additional capacitor, and responsive to said control signal to effect or prevent connection of the additional capacitor with the flash tube, an integration capacitor connected with the switch means and chargeable at a fixed rate, a short circuiting device connected with the flash tube for extinguishing the same and an integration circuit chargeable by said control signal so as to trigger the short circuiting device when a predetermined threshold is reached across the integration circuit, wherein to effect connection of the additional capacitor with the flash tube a first switch of the switch means is triggered when a predetermined threshold voltage is reached by the integration capacitor and wherein to prevent connection of the additional capacitor with the flash discharge tube a second switch of said switch means is triggered by the control signal via the integration circuit of the flash tube short circuiting device and a differentiation capacitor, to short circuit the integration capacitor, thereby to determine the luminous intensity of the flash discharge in accordance with a preset threshold value of the luminous intensity.

A constructional embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing which shows a circuit diagram for an example of an apparatus with one single additional capacitor.

The apparatus contains a storage capacitor 1 which is charged via a rectifier 2. An additional storage capacitor 3 is charged via a decoupling diode 4. A flash tube 5 is connected in parallel with the storage capacitor 1, as is also a voltage divider comprising resistors 6, 7, to which is connected a primary quenching ignition circuit comprising a capacitor 8, a primary winding 9 of a quenching transformer, a potentiometer 10 and a fixed resistor 11, as well as

a primary flash ignition circuit comprising a capacitor 12, and a primary winding 13 of an ignition transformer of the capacitor actuating valve 14. A secondary winding 15 of the quenching transformer is connected with an electrode 16 of a quenching valve 17 and a secondary winding 18 of the ignition transformer connected with the primary flash ignition circuit, which winding 18 is connected with an electrode 19 of the actuating valve 14.

When the flash tube 5 is ignited by means of electrode 20, a photo-transistor 21 receives a voltage which is maintained at 10 volts by a Zener diode 22. The current emitted by the photo-transistor is stored up by an integration circuit comprising capacitors 23, 25, 26 and a resistor 24 so that when a bias voltage, selectable by the potentiometer 10, is reached, an ignition thyristor 27 connected in parallel with the capacitor 8 and winding 9 is triggered so that the quenching valve 17 is ignited. The discharge of the storage capacitor 1 is thus terminated by a short circuit and the flash tube 5 is extinguished. Apart from the use of the photo-transistor 21 this quenching circuit corresponds to the customary structure.

Across the primary flash ignition circuit comprising capacitor 12 and winding 13 of the actuating valve 14, is provided a further thyristor 28 which can be triggered by the slow voltage increase across capacitor 29 or resistor 30. When the thyristor 28 is in its conductive state the capacitor 12 discharges across the primary winding 13, so that the actuating valve 14 is ignited via the secondary winding 18 of the ignition transformer, as a result of which the additional storage capacitor 3 is connected in parallel with the flash tube 5. The components of the illustrated circuit are so dimensioned that with a slow voltage increase as a result of weak illumination of the phototransistor 21 by light reflected from the subject, this triggering operation takes place prior to the ignition of the quenching valve 17.

A third thyristor 31 is connected in parallel with the capacitor 29. When the photo-transistor 21, being brightly illuminated, charges up the integration capacitor 23 with a very high current, the voltage change through the integration capacitor 23 becomes so great that it is transmitted through the coupling capacitor 32 to the trigger connection of the thyristor 31. The more rapidly the voltage change via the integration capacitor 23 takes place, the greater will be the voltage impulse in the trigger connection of the thyristor 31, so that this latter is triggered, thus discharging the capacitor 29, as a result of which the thyristor 28 can no longer be triggered

by the capacitor 29. In this case, therefore, the capacitor 3 remains inoperative. If, therefore, a great deal of light reaches the photo-transistor 21, so that the charging of the capacitor 1 will certainly be sufficient to produce the necessary quantity of light, the actuation of the capacitor 3 is thus prevented.

An additional interlocking system is also provided, in that the gate or trigger electrode of the thyristor 31 is connected to the anode circuit of the flash tube via a capacitor, a protective resistor 33, a variable resistor 34 and a small ohmic resistor 35. The resistor 35 is so small that when the flash apparatus is actuated in the normal manner no appreciable voltage occurs. Not until the quenching takes place, when a multiple of the flash current flows through the quenching valve 17, will the voltage in the resistor 35 become so great that the thyristor 31 is thus triggered. This ensures that the capacitor 3 will not be rendered operative during or immediately after the quenching process. This is an additional safety measure.

It will be obvious that the system can also be designed for the inclusion of further additional storage capacitors.

WHAT WE CLAIM IS:—

1. An electronic flash apparatus including a single flash tube, a main capacitor and an additional capacitor arranged to be automatically connected into a circuit with the flash tube for determining the luminous intensity of the flash, photoelectric control means for detecting the luminous intensity of the flash reflected back by the subject and for providing a control signal, electronic switch means associated with said additional capacitor, and responsive to said control signal to effect or prevent connection of the additional capacitor with the flash tube, an integration capacitor connected with the switch means and chargeable at a fixed rate, a short circuiting device connected with the flash tube for extinguishing the same and an integration circuit chargeable by said signal so as to trigger the short circuiting device when a predetermined threshold is reached across the integration circuit, wherein to effect connection of the additional capacitor with the flash tube a first switch of the switch means is triggered when a predetermined threshold voltage is reached by the integration capacitor and wherein to prevent connection of the additional capacitor with the flash discharge tube a second switch of said switch means is triggered by the control signal via the integration circuit of the flash tube short circuiting device and a differentiation capacitor, to short circuit the integration capacitor.



a primary flash ignition circuit comprising a capacitor 12, and a primary winding 13 of an ignition transformer of the capacitor actuating valve 14. A secondary winding 15 of the quenching transformer is connected with an electrode 16 of a quenching valve 17 and a secondary winding 18 of the ignition transformer connected with the primary flash ignition circuit, which winding 18 is connected with an electrode 19 of the actuating valve 14.

When the flash tube 5 is ignited by means of electrode 20, a photo-transistor 21 receives a voltage which is maintained at 10 volts by a Zener diode 22. The current emitted by the photo-transistor is stored up by an integration circuit comprising capacitors 23, 25, 26 and a resistor 24 so that when a bias voltage, selectable by the potentiometer 10, is reached, an ignition thyristor 27 connected in parallel with the capacitor 8 and winding 9 is triggered so that the quenching valve 17 is ignited. The discharge of the storage capacitor 1 is thus terminated by a short circuit and the flash tube 5 is extinguished. Apart from the use of the photo-transistor 21 this quenching circuit corresponds to the customary structure.

Across the primary flash ignition circuit comprising capacitor 12 and winding 13 of the actuating valve 14, is provided a further thyristor 28 which can be triggered by the slow voltage increase across capacitor 29 or resistor 30. When the thyristor 28 is in its conductive state the capacitor 12 discharges across the primary winding 13, so that the actuating valve 14 is ignited via the secondary winding 18 of the ignition transformer, as a result of which the additional storage capacitor 3 is connected in parallel with the flash tube 5. The components of the illustrated circuit are so dimensioned that with a slow voltage increase as a result of weak illumination of the phototransistor 21 by light reflected from the subject, this triggering operation takes place prior to the ignition of the quenching valve 17.

A third thyristor 31 is connected in parallel with the capacitor 29. When the photo-transistor 21, being brightly illuminated, charges up the integration capacitor 23 with a very high current, the voltage change through the integration capacitor 23 becomes so great that it is transmitted through the coupling capacitor 32 to the trigger connection of the thyristor 31. The more rapidly the voltage change via the integration capacitor 23 takes place, the greater will be the voltage impulse in the trigger connection of the thyristor 31, so that this latter is triggered, thus discharging the capacitor 29, as a result of which the thyristor 28 can no longer be triggered

by the capacitor 29. In this case, therefore, the capacitor 3 remains inoperative. If, therefore, a great deal of light reaches the photo-transistor 21, so that the charging of the capacitor 1 will certainly be sufficient to produce the necessary quantity of light, the actuation of the capacitor 3 is thus prevented.

An additional interlocking system is also provided, in that the gate or trigger electrode of the thyristor 31 is connected to the anode circuit of the flash tube via a capacitor, a protective resistor 33, a variable resistor 34 and a small ohmic resistor 35. The resistor 35 is so small that when the flash apparatus is actuated in the normal manner no appreciable voltage occurs. Not until the quenching takes place, when a multiple of the flash current flows through the quenching valve 17, will the voltage in the resistor 35 become so great that the thyristor 31 is thus triggered. This ensures that the capacitor 3 will not be rendered operative during or immediately after the quenching process. This is an additional safety measure.

It will be obvious that the system can also be designed for the inclusion of further additional storage capacitors.

WHAT WE CLAIM IS:—

1. An electronic flash apparatus including a single flash tube, a main capacitor and an additional capacitor arranged to be automatically connected into a circuit with the flash tube for determining the luminous intensity of the flash, photoelectric control means for detecting the luminous intensity of the flash reflected back by the subject and for providing a control signal, electronic switch means associated with said additional capacitor, and responsive to said control signal to effect or prevent connection of the additional capacitor with the flash tube, an integration capacitor connected with the switch means and chargeable at a fixed rate, a short circuiting device connected with the flash tube for extinguishing the same and an integration circuit chargeable by said signal so as to trigger the short circuiting device when a predetermined threshold is reached across the integration circuit, wherein to effect connection of the additional capacitor with the flash tube a first switch of the switch means is triggered when a predetermined threshold voltage is reached by the integration capacitor and wherein to prevent connection of the additional capacitor with the flash discharge tube a second switch of said switch means is triggered by the control signal via the integration circuit of the flash tube short circuiting device and a differentiation capacitor, to short circuit the integration capacitor,



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citor, thereby to determine the luminous intensity of the flash discharge in accordance with a preset threshold value of the luminous intensity.

- 5 2. An apparatus as claimed in Claim 1, wherein the gate electrode of the second electronic switch is additionally coupled to the anode circuit of the flash tube so that it does not ignite on ignition of the flash
10 tube but does ignite when the short-circuiting element is ignited.

3. An apparatus as claimed in Claim

1 and 2, wherein the first and second switches of the electronic switch means each comprises a thyristor.

4. An apparatus, substantially as described herein with reference to, and as illustrated by, the accompanying drawings.

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