

PATENT SPECIFICATION

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(54) ELECTRONIC FLASH UNIT /

(71) We, FRANKE & HEIDECHE G.m.b.H., a German Body Corporate, trading as ROLLIE-WERKE FRANKE & HEIDECHE, of 196 Salzdahlumerstrasse, 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 invention relates to an electronic flash unit of the kind which comprises a flash tube, a thyristor connected in series with the flash tube between the flash tube cathode and a reference potential, an exposure measuring device and a device controlled by the exposure measuring device for blocking the thyristor in order to quench the flash tube.

In a known electronic flash unit of this kind, the device for blocking the thyristor consists of a charged capacitor which is connected to the current-carrying thyristor, via an electronic switch, in such a way that the anode-cathode current of the thyristor sinks below the value of the holding current and the thyristor consequently passes over to its blocking phase. To activate the blocking device, the control electrode of the electronic switch is connected to the exposure measuring device, in which the light reflected by the photographic object is measured and, when a particular value is reached, a signal is generated to trigger the electronic switch of the blocking device.

In order to enable the photographer to check the operation of the blocking device, including the exposure measuring device, continuously, the electronic switch in the known electronic flash unit is designed as an electronic structural element emitting visible light, by way of example as a gas-filled short-circuiting tube or thyatron. The light emitted by the electronic switch

is conducted via a light guide bar through the housing of the flash-light unit, so that the photographer can observe at what time the electronic switch lights up. Since the lighting-up time of such a thyatron or gas-filled tube is only a few milliseconds, a fluorescent, luminescent or phosphorescent disc is provided on the surface of the flash housing at the end of the light guide bar. Due to the after-glow of this disc, it is possible for the photographer to see, even after completion of the flash process, whether the blocking device has become operative during the preceding flash radiation.

This operational indication for the exposure measuring device and the blocking device of the thyristor, which is the so-called computer part of the flash unit, has a decisive disadvantage. Although the after-glow of the fluorescent disc indicates to the operator that the blocking device for the thyristor has become operative once, when there is a plurality of flash releases in rapid succession, he cannot find out whether the computer has worked in each individual case. Therefore, he is also unable to find out at what time the computer has failed for the first time. Moreover, such an indicating device with a light guide bar is comparatively expensive and, due to the space required for it, it cannot be used in so-called compact flash units, in which all structural elements are housed in a very narrow space.

Furthermore, such an indicating device is always dependent on a design of the electronic switch as a structural element emitting visible light. However, in specific cases of application, particularly in order to achieve high-speed flash sequences, such as a gas-filled switch tube, which can only be quenched by the collapse of the voltage on its anode-cathode path, has to be replaced by a semiconductor element, preferably a

thyristor, which can be forcibly blocked in spite of voltage being applied to its anode-cathode patch. Such a thyristor does not, however, emit any visible light, so that in these cases there is no basis whatsoever for an indicating device.

The task underlying the invention therefore is to provide, in an electronic flash unit of the kind mentioned at the beginning, an indicating device for the operation of the computer part of the flash unit which does not depend on whether the switching element inserted in the device for blocking the thyristor emits visible light or not and which allows the photographer to check after each flash release, even in a rapid succession of flashes, whether the computer part of the flash unit has become operative.

According to the present invention, there is provided an electronic flash unit of the initially stated kind in which a capacitor is connected in parallel with the thyristor so as to charge during the time between blocking of the thyristor and quenching of the flash tube, and a device to indicate when the charge on this capacitor reaches a predetermined value.

In an advantageous development of the invention, there is, for this purpose, connected in parallel with the capacitor a voltage divider, the divided voltage of which is applied across a glow lamp. The glow lamp lights up as soon as the capacitor voltage exceeds a particular set value and goes out as soon as the capacitor has been discharged to such an extent that this voltage value is not reached. Depending on the rating of the capacity of the capacitor and the resistors of the voltage divider, the discharge time of the capacitor can be selected so that, when the flashlight photograph has been taken and the camera has been put down, the photographer is able to recognize from the lighting of the glow lamp whether the computer has worked or not. At the moment when the flash tube and thyristor are ignited for another photograph, the capacitor is suddenly discharged via the thyristor, so that the glow lamp goes out and does not light up again until after the blocking of the thyristor. If the thyristor is not blocked, but is blocked only after the complete discharge of the storage capacitor in a non-conductive manner the capacitor is not charged and the glow lamp remains dark, so that the photographer can see that the computer part has not become operative, that is to say that the flash unit has given out full or maximum light.

In an electronic flash unit comprising an ignition device for the thyristor which responds directly to ionization of the flash tube, a resistor is connected in parallel

with the thyristor. In this case, the circuit arrangement provided by the invention to indicate the operation of the computer of the flash unit has to be modified, according to a further development of the invention, to the effect that a diode is inserted between the connecting point of the thyristor and flash tube and the capacitor in such a way that the anode of the diode is connected to the capacitor. By means of this diode a discharge of the capacitor via the resistor disposed in parallel with the thyristor is prevented. In order to ensure in this case that the capacitor is discharged upon each ignition of the flash tube and that the glow lamp goes out as a result, the connecting point of the diode and capacitor is connected, according to an advantageous further development of the invention, to the anode of the flash tube via a further diode.

An embodiment of the invention is shown in the drawings, in which:—

Figure 1 shows the circuit arrangement for a flash unit in which the flash tube and thyristor are ignited jointly and simultaneously, and

Figure 2 shows a circuit arrangement for a flash unit in which the ignition device for the thyristor responds directly to ionization of the electronic flash tube.

The electronic flash unit shown in Figure 1 comprises a storage capacitor 1, a flash tube 2 and a thyristor 3, which are connected in series, the anode of the thyristor being connected to the cathode of the flash tube, and the cathode of the thyristor being connected to the zero potential of the storage capacitor 1. The storage capacitor 1 can be charged via a voltage transformer or voltage converter 4 to an operating voltage of, for example, 360 V direct voltage.

The flash tube is ignited via its ignition electrode by an ignition device, which is connected to the synchronous contact of the camera. In Figure 1, the ignition device for the electronic flash tube 2 consists of a capacitor discharge circuit comprising a capacitor 5, the primary winding 6a of a pulse transformer 6 and the synchronous contact 7. The series connection of the capacitor 5 and the primary winding 6a is connected, in series with a resistor 8, in parallel with the storage capacitor 1. The secondary side of the pulse transformer 6 comprises two secondary windings 6b and 6c, the secondary winding 6b being connected to the ignition electrode of the flash tube 2 and the secondary winding 6c to the control electrode of the thyristor 3.

The blocking device for the thyristor 3 consists of the series circuit which comprises a capacitor 9 and a thyristor 10 and which is connected in parallel with the

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anode-cathode path of the thyristor 3. The connecting point of the capacitor and anode of the thyristor 10 is connected to the positive pole of the storage capacitor 1 via a resistor 11. The control electrode of the thyristor 10 is connected to a generally known exposure measuring device 16.

A capacitor 12 is connected to the connecting point of the flash tube 2 and thyristor 3, on the one hand, and to the zero potential, and consequently to the negative plate of the storage capacitor 1, on the other hand, that is to say it is disposed parallel to the anode-cathode path of the thyristor 3. A voltage divider, consisting of the resistors 13 and 14, is connected in parallel with the capacitor 12. A glow lamp 15 is arranged parallel to the resistor 14 of the voltage divider.

The circuit arrangement shown in Figure 1 operates as follows:—

In its operable condition, the storage capacitor 1, the ignition capacitor 5 and the quenching capacitor 9 are charged to the operating voltage. If the synchronous contact 7 is now closed the capacitor 5 is discharged via the primary winding 6a of the pulse transformer 6. In both secondary windings 6b and 6c of the pulse transformer there develops respectively a pulse causing a simultaneous ignition of the flash tube 2 and the thyristor 3. The storage capacitor 1 is discharged via the flash tube 2 and the thyristor 3, the flash tube radiating light.

The light impinging on the photographic object from the flash tube is partly reflected by the same, and the reflected light is intercepted by the exposure measuring device 16. When a predetermined value of the measured light is reached, a positive control pulse arrives at the control electrode of the thyristor 10, so that this electrode ignites through and the positive plate of the quenching capacitor 9 is suddenly applied to zero potential. Consequently, a negative voltage is applied to the anode-cathode path of the thyristor 3 for the duration of the discharge of the capacitor 9, whereby the thyristor 3 blocks. Since the time taken for the blocking of the thyristor 3 is substantially shorter than the quenching time of the flash tube 2, the flash tube 2 will, to begin with, continue to carry current until the capacitor 12 is charged. At this moment the flash tube blocks, and the flash process is completed.

As soon as the voltage on the capacitor 12 exceeds a particular value, the glow lamp 15 starts to burn and indicates the preceding activity of the computer (exposure measuring device 16 and blocking device 9, 10). The glow lamp is lit until the capacitor 12 has been discharged via the resistors 13 and 14 to such an extent that the operating voltage

of the glow lamp 15, which lies across the resistor 14, is not reached. By a suitable selection of the capacity of the capacitor 12 and the resistors of the voltage dividers 13 and 14, it is possible to apportion the discharge time of the capacitor 12, and consequently the length of time during which the glow lamp 15 is lit, so that, after having put down the camera, the photographer can find out by casting a glance at the glow lamp 15, which is visible through the housing of the flash unit, whether the computer has worked during the preceding flashlight photograph. As soon as a new flash is released by closure of the synchronous contact 7 and the thyristor 3 thus becomes conductive, the capacitor 12 is suddenly short-circuited and the glow lamp 15 goes out. In this way, it is possible to check in the case of each flashlight photograph whether the computer of the flash unit works satisfactorily.

The main difference between the circuit arrangement of the flash unit shown in Figure 2 and the one shown in Figure 1 is that the thyristor and electronic flash tube are not ignited simultaneously but that, upon the closing of the synchronous contact 7, the flash tube ignites through and the thyristor is ignited via a further ignition device, which responds to ionization of the electronic flash tube 2. As in Figure 1, the circuit arrangement comprises the series connection of a storage capacitor 21, an electronic flash tube 22 and a thyristor 23. The thyristor 23 is inserted between the cathode of the flash tube and the zero potential, that is to say the negative plate of the storage capacitor 21. The storage capacitor 21 can be charged via a voltage converter 24 or voltage transformer to an operating voltage of, for example, 360 V direct voltage. The ignition device for the electronic flash tube 22 consists of a discharge circuit, in which a capacitor 25, the primary winding of a pulse transformer 26 and a synchronous contact 27 are arranged. The series circuit of the capacitor 25 and the primary winding of the pulse transformer 26 is connected, in series with a resistor 28, across the storage capacitor 21. The ignition electrode of the electronic flash unit 22 is connected to the secondary winding of the pulse transformer 26.

The quenching device for the thyristor 23 consists of the series connection of a capacitor 29 and an electronic switch, in this case a gas-filled switching tube 30, which is connected in parallel with the anode-cathode path of the thyristor 23. In order to charge the capacitor 29, the connecting point of the capacitor and the switching tube is connected via a resistor 130

31 to the positive pole of the storage capacitor 21. The ignition electrode of the switching tube is connected to a generally known exposure measuring device 36.

5 The ignition device for the thyristor 23 comprises a resistor 32, which is connected directly in parallel with the anode-cathode path of the thyristor 23. Furthermore, it contains the series connection of a
10 capacitor 33 and a voltage divider which consists of the resistors 34 and 35 and whose divider tap is connected to the control electrode of the thyristor 23. This series connection is inserted between the
15 connecting point of the resistor 31 and capacitor 29 and the zero potential.

The series connection of a diode 37 and a capacitor 38 is connected to the connecting point between the thyristor 23 and
20 the electronic flash tube 22, on the one hand, and to the zero potential, that is to say the negative plate of the storage capacitor 21, on the other hand, so that this series connection of the diode 37 and
25 capacitor 38 is connected in parallel with the thyristor 23 and the resistor 32 respectively. A voltage divider, consisting of the resistors 39 and 40, is connected, in turn, in parallel with the capacitor 38, a
30 glow lamp 41 being connected in parallel with the resistor 40. The connecting point between the diode 37 and the capacitor 38 is connected to the anode of the flash tube 22 via a further diode 42.

35 The mode of operation of the circuit arrangement shown in Figure 2 is as follows:—

In the operable condition of the electronic flash unit, the storage capacitor 21,
40 the ignition capacitor 25, the quenching capacitor 29 and the capacitor 33 are charged to the operating voltage. Upon closure of the synchronous switch 27, there develops, as is described in connection with
45 Figure 1, in the secondary winding of the pulse transformer 26 a pulse which ignites the flash tube 22 via the ignition electrode. With the ionization of the flash tube, the potential on the anode of the thyristor 23
50 rises suddenly, whereby the potential on the plate of the capacitor 38 connected to zero potential also rises, so that a voltage drops via the resistor 35 towards the zero potential. This voltage drop causes the thyristor 23 to ignite via the control electrode.
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As soon as a signal, in the shape of a positive pulse, reaches the ignition electrode of the switching tube 30 from the exposure measuring device 36, the ignition
60 electrode ignites through and the capacitors 29 and 33 are discharged via the switched-

through switching tube, whereby the thyristor 23 blocks, as described in the foregoing. After blockage of the thyristor 23, the capacitor 38 is charged by the
65 after-burning of the flash tube 22. From a certain voltage level of the capacitor 38, the glow lamp 41 starts to light up and goes out as soon as the voltage on the capacitor 38 drops below this level, due to
70 the discharge of the capacitor 38 via the resistors 39 and 40. As soon as the electronic flash tube 22 and the thyristor 23 are ignited through during the next flash process, the capacitor 38 is discharged via
75 the diode 42 and the glow lamp, which may still be burning, is extinguished.

WHAT WE CLAIM IS:—

1. An electronic flash unit which comprises a flash tube, a thyristor connected in
80 series with the flash tube between the flash tube cathode and a reference potential, an exposure measuring device, a device controlled by the exposure measuring device for blocking the thyristor in order to
85 quench the flash tube, a capacitor, which is connected in parallel with the thyristor so as to charge during the time between blocking of the thyristor and quenching of the flash tube, and a device to indicate
90 when the charge on this capacitor reaches a predetermined value.

2. An electronic flash unit as claimed in claim 1, wherein a voltage divider lies in parallel with the capacitor and said indicating device is a glow lamp across
95 which the divided voltage from the voltage divider is applied.

3. An electronic flash unit as claimed in claim 1 or 2, comprising a resistor disposed in parallel with the thyristor, and a diode inserted between the connecting point of the thyristor and flash tube and the capacitor in such a way that the anode of the diode is connected to the connecting
105 point and the cathode of the diode is connected to the capacitor.

4. An electronic flash unit as claimed in claim 3, wherein the connecting point of the diode and the capacitor is connected to
110 the anode of the flash tube via a further diode.

5. An electronic flash unit substantially as described herein with reference to and as illustrated by the accompanying drawing.
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For the Applicants:
MATTHEWS, HADDAN & CO.,
Chartered Patent Agents,
33, Elmfield Road,
Bromley,
Kent.



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15 connecting point of the resistor 31 and capacitor 29 and the zero potential.

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90 when the charge on this capacitor reaches a predetermined value.

2. An electronic flash unit as claimed in claim 1, wherein a voltage divider lies in parallel with the capacitor and said
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3. An electronic flash unit as claimed in claim 1 or 2, comprising a resistor disposed in parallel with the thyristor, and a diode inserted between the connecting point of the thyristor and flash tube and the capacitor in such a way that the anode of the diode is connected to the connecting
105 point and the cathode of the diode is connected to the capacitor.

4. An electronic flash unit as claimed in claim 3, wherein the connecting point of the diode and the capacitor is connected to
110 the anode of the flash tube via a further diode.

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33, Elmfield Road,
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