

PATENT SPECIFICATION

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(54) FLASH APPARATUS

(71) We, FRANKE & HEIDECHE G.m.b.H., a German Body Corporate, trading as ROLLEI-WERKE FRANKE & HEIDECHE, of 196 Salzdhumerstrasse, 5 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 10 following statement:—

The present invention relates to an electronic flash unit for use as an auxiliary flash apparatus, particularly for studio installations, in which light flux is provided 15 by an electronic main flash unit and one or more auxiliary flash units and in which an exposure measuring device receives reflected light from the subject to the camera and automatically terminates the light flux 20 when a desirable exposure has been reached.

In such a flash arrangement the overall illumination impression of subject and background is detected by the exposure-measuring apparatus independently of the 25 desired distribution of the individual light fluxes of the respective flash units, and the flash radiation can be broken off at any desired moment according to the desired overall illumination detected by the exposure-measuring apparatus. It is essential here that all flash units should light up and extinguish simultaneously without time 30 delay or with no substantial time delay.

35 A known flash arrangement of this kind comprises an exposure-measuring and flash-limiting apparatus fitted close to the camera, which apparatus is connected with the synchronous switch of the camera 40 shutter and controls the simultaneous ignition of all flash tubes and the simultaneous tripping of all extinguishing arrangements in the connected independent electronic flash units. The individual flash 45 units are connected with one another and

with the exposure-measuring and flash-limiting apparatus by two core cables.

Since the laying of cables is extremely hindering in studio operation, in a further 50 known flash arrangement of the initially stated kind the simultaneous ignition and extinguishing of all electronic flash units are affected by an exposure-measuring and flash-limiting apparatus which radio-controls 55 the ignition and extinguishing devices of the individual electronic flash units through remote control transmitters and remote control receivers. Such remote control transmitters and receivers however, are very expensive and hardly find 60 acceptance in flash arrangements for simple studio installations, on account of their high costs.

The present invention enables a flash arrangement of the initially stated kind to 65 be provided in which the ignition and extinguishing of the individual electronic flash units takes place without connecting cables, on the one hand, and on the other hand no particular remote control transmitter is required, and the technical expense of which is substantially reduced in 70 comparison with the known flash arrangements.

According to the present invention there 75 is provided an electronic flash unit for use as an auxiliary flash unit with a camera and an electronic main flash unit, comprising a light detecting device for receiving, in use, light flux from the main flash unit, 80 a light emitting device, and ignition and extinguishing devices, the arrangement being such that, in use, the ignition device ignites the light emitting device in response to the receipt of light by the light detecting 85 device and the extinguishing device extinguishes the light emitting device in response to termination of the receipt of light by said light detecting device.

Such a flash unit may thus be used, as 90

an auxiliary flash unit optionally with other similar auxiliary flash units in combination with a main flash unit and an exposure measuring device, the main flash unit comprising a light emitting device, an ignition device actuatable to ignite the light emitting device and an extinguishing device actuated by the exposure measuring device when a predetermined quantity of light has been received thereby to extinguish the light emitting device. The combination may include a camera having a synchronous contact connected with the ignition device of the main flash unit.

In the auxiliary flash unit or units the light detecting device is preferably a photoelectric measuring device which is responsive to the rate of rise of light flux received thereby from the main flash unit to actuate the ignition device and which is responsive to the rate of fall-off of said received light flux to actuate the extinguishing device.

In an expedient preferred development of the invention the photoelectric measuring apparatus consists of a photo-transistor, the collector-emitter path of which lies in series with a resistor or inductance connected to the emitter and the emitter is connected through a first capacitor with the ignition device and through a second capacitor with the extinguishing device. If the exposure-measuring device of the combination is installed in the main electronic flash unit, an ordinary commercial so-called computer flash unit can be used as the main electronic flash unit. It is advantageous here if the computer or the exposure-measuring device comprises a photoelectric measuring member spatially separable from the main flash unit and this is fitted close to the camera. The exposure-measuring device then measures the overall illumination of the subject, as it is also detected by the camera, and an exact exposure of the photographic image in accordance with the light distribution prevailing on the subject is guaranteed.

An embodiment of the invention is illustrated in the drawing, wherein:
Figure 1 shows the circuit diagram of a main electronic flash unit with a built-in exposure-measuring device.

Figure 2 shows the circuit diagram of an auxiliary electronic flash unit.

Figure 3 shows a time diagram of the light flux radiated by the main electronic flash unit, the electronic flash unit being ignited at the moment t_0 and extinguished at the moment t_1 .

Figure 4 shows a circuit element which can be connected between the terminals A-B in place of the circuit element in Figure 2 and

Figures 5 and 6 each show a circuit element which can be connected between the

terminals C-D in place of the circuit element in Figure 2.

In Figure 1 a storage capacitor 1 can be charged up from a direct-current voltage source, for example a voltage transformer 2. The series connection of a flash tube 3 and a switch thyristor 4 lies parallel with the storage capacitor 1. The ignition device of the switch tube 3 consists of an ignition transformer 5 the secondary winding of which is connected with the ignition electrode of the flash tube 3 and the primary winding of which lies in series with an ignition capacitor 6 and a switch 7 (synchronous contact) arranged in the camera and closing when the shutter is in the open position. The ignition capacitor 6 is chargeable through a voltage divider circuit consisting of the resistors 8 and 9. The series-connection of a resistor 10 and a capacitor 11 is connected in parallel with the flash tube 3, while a resistor 12 is in parallel with the switch thyristor 4. The connection point between resistor 10 and capacitor 11 is connected through a thyatron 13 to the zero potential of the circuit. The series-connection of capacitor 26 and resistors 27 and 28 is connected in parallel with the thyatron 13. The connection point between the resistors 27 and 28 is connected with the control electrode of the switch thyristor 4.

The thyatron 13 is turned on by an exposure-measuring device when a settable value of the light quantity reflected by the subject is reached. For this purpose its ignition electrode is connected with the secondary winding of an ignition transformer 14 the primary winding of which lies together with a thyristor 15 in the discharge circuit of a capacitor 16. The control electrode of the thyristor 15 is connected to the connection point of the series connection of a photo-transistor 17 and a capacitor 18. The cathode of the thyristor 15 is additionally connected to the adjustable tapping of a potentiometer 19 which is connected in series with a resistor 20, parallel with the series-connection of photo-transistor 17 and capacitor 18. The current supply of the measuring device takes place, during the flash radiation of the flash tube 3, by discharge of a capacitor 21 through a resistor 22, the flash tube 3, the switch thyristor 4 and the resistors 20 and 19. In order to achieve a constant voltage a Zener diode 23 is connected in parallel with the resistors 20 and 19. The capacitor 16 is chargeable through a voltage divider circuit consisting of the resistors 24 and 25.

In Figure 2 there is illustrated the circuit diagram of one of as many auxiliary electronic flash units as desired. As in Figure 1, here a storage capacitor 31 is

time moment t_1 . The disappearance of the light flux emitted by the selected electronic flash unit in Figure 1 is recorded by the photo-electric measuring device, consisting of the transistor 41, of each of the auxiliary electronic flash units in such manner that the current flowing through the photo-transistor as a result of its illumination suddenly drops. Thus the voltage on the resistor 42 collapses and the rate of variation of this voltage passes by way of the capacitor 50 to the cathode of the thyristor 46. Thus the cathode is briefly connected to a potential which lies lower, by at least the ignition voltage of the thyristor 46, than the zero potential of the control electrode of the thyristor 46. Thus the thyristor 46 ignites through and the capacitor 47 can discharge itself through the switched-through thyristor 46 and the primary winding of the ignition transformer 45. The discharge current in the primary winding induces an ignition pulse in the secondary winding of the ignition transformer which ignites the thyatron through its ignition electrode. The switched-through thyatron 44 takes over the discharge current of the storage capacitor 31 so that the flash tube 33 is de-energised and the flash radiation of the auxiliary electronic flash units is terminated.

As appears from the description, thus the rising flank of the light flux radiated according to Figure 3 by the main electronic flash unit according to Figure 1 is used to ignite the auxiliary electronic flash units, and from the sudden drop-off of the light flux on extinguishing of the main electronic flash unit according to Figure 1 a signal is formed in the auxiliary electronic flash unit or units for the actuation of the respective extinguishing devices.

The auxiliary electronic flash units, like the main electronic flash unit according to Figure 1, can comprise in place of the thyatron 44 short-circuiting the storage capacitor 31 a series connection of flash tube and switch thyristor, a similar extinguishing device being associated with the switch thyristor as with the switch thyristor 4 in Figure 1.

WHAT WE CLAIM IS:—

1. An electronic flash unit for use as an auxiliary flash unit with a camera and an electronic main flash unit, comprising a light detecting device for receiving, in use, light flux from the main flash unit, a light emitting device, and ignition and extinguishing devices, the arrangement being such that, in use, the ignition device ignites the light emitting device in response to the receipt of light by the light detecting device and the extinguishing device extinguishes the light emitting device in response

to termination of the receipt of light by said light detecting device.

2. A flash unit as claimed in claim 1, wherein the light detecting device is a photoelectric measuring device which is responsive to the rate of rise of light flux received thereby from the main flash unit to actuate the ignition device and which is responsive to the rate of fall-off of said received light flux to actuate the extinguishing device.

4. A flash unit as claimed in claim 2, wherein the photoelectric measuring device comprises a photo-transistor, the collector-emitter path of which lies in series with a resistor or inductance connected to the emitter and the emitter is connected through a first capacitor with the ignition device and through a second capacitor with the extinguishing device.

4. A flash unit as claimed in claim 3, wherein the ignition device comprises a thyristor the anode-cathode path of which lies in series with a chargeable capacitor and the primary winding of a pulse transformer and the control electrode of which is connected through the first capacitor with the emitter of the phototransistor.

5. A flash unit as claimed in claim 3, wherein the extinguishing device comprises a thyristor the anode-cathode path of which lies in series with a chargeable capacitor and the primary winding of a pulse transformer, its cathode being connected on the one hand through a resistor, an inductance or a diode with the zero potential and on the other through the second capacitor with the emitter of the photo-transistor, while its control electrode is connected to the zero potential.

6. The combination of at least one electronic flash unit as claimed in any preceding claim, an exposure measuring device and an electronic main flash unit, the main flash unit comprising a light emitting device, an ignition device actuatable to ignite the light emitting device and an extinguishing device actuated by the exposure measuring device when a predetermined quantity of light has been received thereby to extinguish the light emitting device.

7. The combination as claimed in claim 6, wherein the exposure measuring device is positioned in the main flash unit.

8. The combination of claim 6 together with a camera having a synchronous contact connected with the ignition device of the main flash unit and wherein the exposure measuring device is a photoelectric measuring member spatially separable from the main flash unit and positioned adjacent the camera.

9. A flash unit as claimed in claim 1 substantially as hereinbefore described with reference to and as shown in Figures 130



time moment t_1 . The disappearance of the light flux emitted by the selected electronic flash unit in Figure 1 is recorded by the photo-electric measuring device, consisting of the transistor 41, of each of the auxiliary electronic flash units in such manner that the current flowing through the photo-transistor as a result of its illumination suddenly drops. Thus the voltage on the resistor 42 collapses and the rate of variation of this voltage passes by way of the capacitor 50 to the cathode of the thyristor 46. Thus the cathode is briefly connected to a potential which lies lower, by at least the ignition voltage of the thyristor 46, than the zero potential of the control electrode of the thyristor 46. Thus the thyristor 46 ignites through and the capacitor 47 can discharge itself through the switched-through thyristor 46 and the primary winding of the ignition transformer 45. The discharge current in the primary winding induces an ignition pulse in the secondary winding of the ignition transformer which ignites the thyatron through its ignition electrode. The switched-through thyatron 44 takes over the discharge current of the storage capacitor 31 so that the flash tube 33 is de-energised and the flash radiation of the auxiliary electronic flash units is terminated.

As appears from the description, thus the rising flank of the light flux radiated according to Figure 3 by the main electronic flash unit according to Figure 1 is used to ignite the auxiliary electronic flash units, and from the sudden drop-off of the light flux on extinguishing of the main electronic flash unit according to Figure 1 a signal is formed in the auxiliary electronic flash unit or units for the actuation of the respective extinguishing devices.

The auxiliary electronic flash units, like the main electronic flash unit according to Figure 1, can comprise in place of the thyatron 44 short-circuiting the storage capacitor 31 a series connection of flash tube and switch thyristor, a similar extinguishing device being associated with the switch thyristor as with the switch thyristor 4 in Figure 1.

WHAT WE CLAIM IS:—

1. An electronic flash unit for use as an auxiliary flash unit with a camera and an electronic main flash unit, comprising a light detecting device for receiving, in use, light flux from the main flash unit, a light emitting device, and ignition and extinguishing devices, the arrangement being such that, in use, the ignition device ignites the light emitting device in response to the receipt of light by the light detecting device and the extinguishing device extinguishes the light emitting device in response

to termination of the receipt of light by said light detecting device.

2. A flash unit as claimed in claim 1, wherein the light detecting device is a photoelectric measuring device which is responsive to the rate of rise of light flux received thereby from the main flash unit to actuate the ignition device and which is responsive to the rate of fall-off of said received light flux to actuate the extinguishing device.

4. A flash unit as claimed in claim 2, wherein the photoelectric measuring device comprises a photo-transistor, the collector-emitter path of which lies in series with a resistor or inductance connected to the emitter and the emitter is connected through a first capacitor with the ignition device and through a second capacitor with the extinguishing device.

4. A flash unit as claimed in claim 3, wherein the ignition device comprises a thyristor the anode-cathode path of which lies in series with a chargeable capacitor and the primary winding of a pulse transformer and the control electrode of which is connected through the first capacitor with the emitter of the phototransistor.

5. A flash unit as claimed in claim 3, wherein the extinguishing device comprises a thyristor the anode-cathode path of which lies in series with a chargeable capacitor and the primary winding of a pulse transformer, its cathode being connected on the one hand through a resistor, an inductance or a diode with the zero potential and on the other through the second capacitor with the emitter of the photo-transistor, while its control electrode is connected to the zero potential.

6. The combination of at least one electronic flash unit as claimed in any preceding claim, an exposure measuring device and an electronic main flash unit, the main flash unit comprising a light emitting device, an ignition device actuatable to ignite the light emitting device and an extinguishing device actuated by the exposure measuring device when a predetermined quantity of light has been received thereby to extinguish the light emitting device.

7. The combination as claimed in claim 6, wherein the exposure measuring device is positioned in the main flash unit.

8. The combination of claim 6 together with a camera having a synchronous contact connected with the ignition device of the main flash unit and wherein the exposure measuring device is a photoelectric measuring member spatially separable from the main flash unit and positioned adjacent the camera.

9. A flash unit as claimed in claim 1 substantially as hereinbefore described with reference to and as shown in Figures



charged up through a voltage transformer 32. The flash tube 33 is connected parallel with the storage capacitor. Its ignition electrode is connected with the secondary winding of an ignition transformer 34 the primary winding of which lies together with a thyristor 35 in the discharge circuit of a capacitor 36. The capacitor 36 is chargeable through the resistors 37 and 40 to a partial voltage corresponding to the division ratio of a voltage divider circuit 37; 38 and 39 connected in parallel with the storage capacitor 31.

The series-connection of a photo-transistor 41 and a resistor 42 is connected in parallel with the resistor 39. In place of the resistor 42 an inductance 51 according to Figure 4 can also be connected between the emitter of the photo-transistor and zero potential, that is between the connection points A and B. The connection point between the emitter of the photo-transistor and the resistor 42 is connected through a first capacitor 43 with the control electrode of the thyristor 35.

The extinguishing device of the auxiliary flash unit consists of a thyatron 44 connected in parallel with the storage capacitor, of which thyatron the ignition electrode is connected with the secondary winding of an ignition transformer 45. The primary winding of the ignition transformer 45 lies together with a thyristor 46 in the discharge circuit of a capacitor 47. The capacitor 47 is chargeable through the resistors 37 and 48 to a partial voltage corresponding to the divider ratio of the voltage divider circuit 37; 38 and 39. The cathode of the thyristor 46 is further connected through a resistor 49 with the zero potential of the circuit arrangement, the control electrode of the thyristor 46 likewise lies at zero potential. An inductance 52 or a diode 53 can also be connected between the cathode of the thyristor and zero potential, that is between the connection points C and D, in accordance with Figures 5 and 6 in place of the resistor 49.

The manner of operation of the flash arrangement according to Figure 1 and Figure 2 is as follows:—

The main flash unit according to Figure 1 and the auxiliary flash unit or units according to Figure 2 are directed in any desired position according to the desired light distribution upon the subject. The photo-transistor 17 in the exposure-measuring device is formed as external sensor and arranged directly on the camera. In the condition ready for flashing the storage capacitors 11 and 26 are charged to working voltage and the capacitors 6; 16; 36; 47 to a corresponding partial voltage. On actuation of the camera release with the shutter in the open position the

switch contact 7 is closed and the capacitor 6 discharges itself through the primary winding of the ignition transformer 5. The discharge current of the capacitor 6 through the primary winding of the ignition transformer 5 induces a current surge in the secondary winding which ignites the flash tube. Thus the potential at the anode of the switch thyristor 4 rises suddenly. This potential jump is transmitted through the capacitors 11 and 26 and causes a voltage drop on the resistor 28 which is greater than the ignition voltage of the switch thyristor 4, so that the latter switches through. The flash tube 3 emits a light flux which has the time course reproduced in Figure 3. This light flux arrives directly or by way of reflection on the subject or the background upon the photo-transistor 41 of the auxiliary electronic flash units according to Figure 2 and here causes a current flux through the photo-transistor 41 and the resistor 42. The voltage variation on the resistor 42 passes by way of the capacitor 43 to the control electrode of the thyristor 35 and ignites the latter. Thus the capacitor 36 discharges itself through the switched-through thyristor 35 and the primary winding of the ignition transformer 34. The discharge current induces a current pulse in the secondary winding of the ignition transformer 34 which ignites the flash tube 33 through the ignition electrode, so that this tube emits a light flux. The delay with which the auxiliary electronic flash unit or units according to Figure 2 ignite after the selected electronic flash unit in Figure 1 is negligible.

The light emitted by the electronic flash units is reflected by the subject and a part of the reflected light arrives on the sensor in the form of the photo-transfer 17 fitted close to or on the camera. According to the intensity of the light flux a greater or lesser current will flow through the photo-transistor 17, which current in a specific time interval charges up the capacitor 18 to a predeterminable voltage. When this voltage is achieved the thyristor 15 ignites through and the capacitor 16 can discharge itself through the switched-through thyristor 15 and the primary winding of the ignition transformer 14. The charge current in the primary winding induces an ignition pulse in the secondary winding of the ignition transformer 14 for the ignition of the thyatron 13. When the thyatron becomes conductive the capacitor 11 and the capacitor 26 discharge themselves, so that the thyristor 4 is blocked in known manner. Thus the discharge circuit of the storage capacitor 1 is interrupted and the flash radiation of the flash tube 3 breaks off suddenly — as shown in Figure 3 at the

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2, 4, 5 or 6 of the accompanying drawings.
10. A combination as claimed in claim
6 substantially as hereinbefore described
with reference to and as shown in the ac-
5 companying drawings.

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