

- [54] **ELECTRONIC FLASH UNIT WITH
CONTROLLED LIGHT ENERGY**
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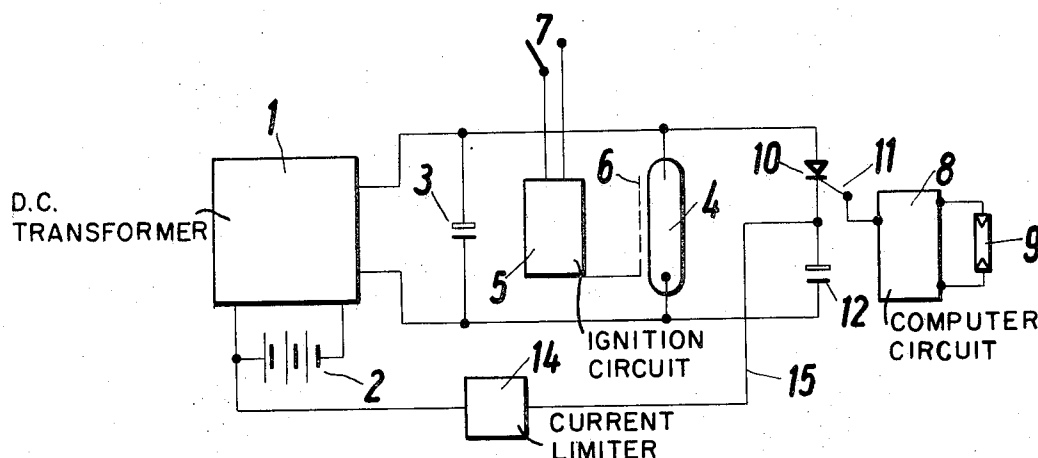
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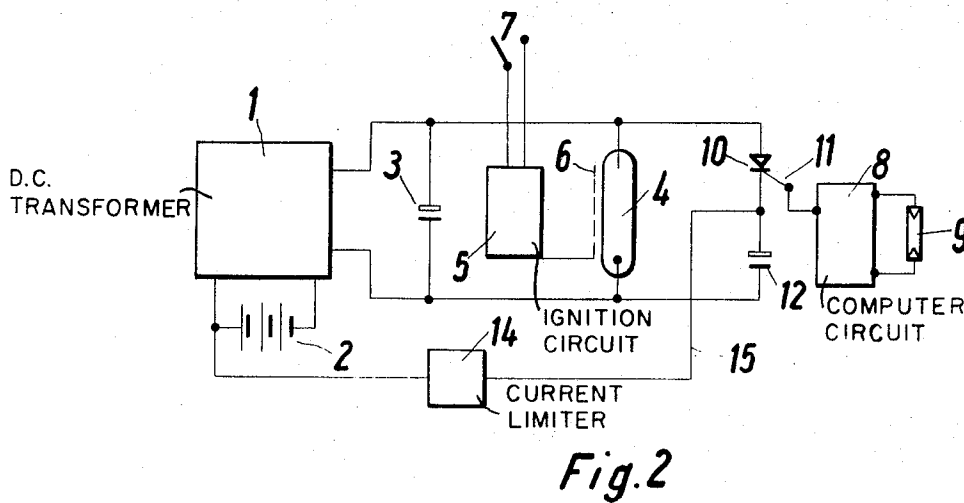
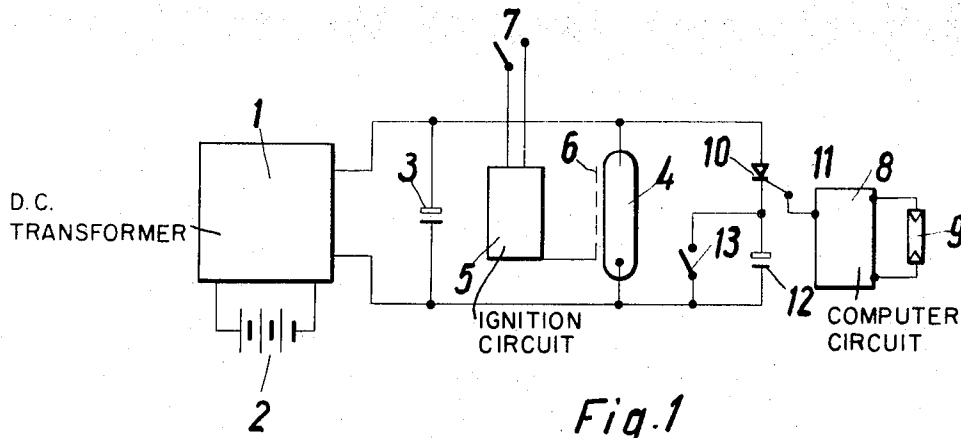
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[57] **ABSTRACT**

In an electronic flash unit circuit arrangement there is provided an electronic flash tube with a shunt circuit lying in parallel to said tube and becoming conductive in dependence on the quantity of light reflected from the subject to be photographed and then short-circuiting said flash tube. This shunt circuit comprises a series connection of an electronic switch element controllable by a control circuit operated by said reflected light quantity and of one or several auxiliary capacitors which take up the excess energy from the storage capacitor whose charge energizes said flash tube. This storage capacitor may be short-circuited by means of a switch or it may be used for improving the energy balance of the entire flash circuit arrangement.

1 Claim, 2 Drawing Figures





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ELECTRONIC FLASH UNIT WITH CONTROLLED LIGHT ENERGY

The subject-matter of the present invention relates to an electronic flash unit which controlled light energy using a shunt circuit lying in parallel to the flash tube and becoming conductive in dependence on the quantity of light reflected from the subject to be photographed and then short-circuiting the flash tube. Such units are known as so-called computer flash units and work in a way by which a regulating circuit for automatic light dosage, e.g., a photo-sensitive resistor (sensor) measures the flash light energy reflected from the subject to be photographed and in accordance with the value measured switches on an electronic switch element connected parallel to the flash tube, e.g., a thyristor, whereby the flash discharge in the flash tube is interrupted.

The invention relates to a particular design of the shunt circuit connected to the flash tube and proceeds from the idea that a capacitor can be discharged by a second capacitor of suitable capacity according to capacity relation.

The circuit arrangement for a flash unit in accordance with the invention is characterized in that the shunt circuit connected to the flash tube consists of the series connection of (a) an electronic switch element controllable by a control circuit (computer circuit) controlled in dependence on the quantity of light reflected from the subject to be photographed, such switch element being e.g., a controllable thyristor, and (b) of one or several auxiliary capacitors which take up the excess energy from the storage capacitor.

According to one embodiment of the invention the auxiliary capacitor or capacitors is/are dimensioned so that their charge will not exceed the quenching potential of the flash tube.

Further the auxiliary capacitor(s) can be short-circuited by mechanical or electronic switches, e.g., by the ignition contact of the ignition circuit of the flash tube.

A further advantageous embodiment of the invention consists in that the electric energy stored in the auxiliary capacitor(s) is used for charging the battery and/or the storage capacitor. For this is it necessary that the terminals of the auxiliary capacitor(s) are connected with the storage capacitor.

The invention is explained in detail below with the aid of the two exemplary designs shown in the drawing. In this drawing

FIG. 1 represents a circuit arrangement in which series connection of a controllable thyristor and of a capacitor in parallel to the flash tube is provided and in which the capacitor is shortable by a switch; and

FIG. 2 shows a similar circuit arrangement of an electronic flash unit in which however the series capacitor of the shunt circuit is connected to the battery over a current limiter, which permits the electric energy of the capacitor to be used for charging the battery.

With reference to FIG. 1, 1 indicates a conventional DC transformer whose DC voltage is drawn from battery 2. To said DC transformer 1 the storage capacitor 3 is connected in a known manner. Connected in parallel to said storage capacitor 3 in a known manner is the flash tube 4, which in a conventional manner can be ignited by means of ignition electrode 6 over ignition circuit 5 by closing the ignition contact 7 (sync contact) if the capacitor 3 is sufficiently charged.

In the shunt circuit connected to the flash tube there now lies in accordance with the invention the series connection of a controllable thyristor 10 and a capacitor 12. The thyristor 10 is controllable by means of control electrode 11, i.e., thyristor 10 can from its blocked state be made conductive by switching a positive voltage on to said control electrode 11, and that in dependence on the computer circuit 8 known as such, which is controlled by a photo-resistor 9, the resistance of which is altered on discharge of a flash in flash tube 4 by the light reflected from the subject.

When, therefore, the sync contact 7 is closed, an ignition voltage is applied to ignition electrode 6 over ignition circuit 5, which can be formed in a known manner, so that a flash is discharged in flash tube 4, on whose main electrodes the potential of storage capacitor 3 lies. Provided that the illumination by the flash light is sufficient, computer part 8, in dependence on the reflected quantity of light, which influences the resistance value of the photosensitive resistor 9, controls the electronic switch, i.e., the thyristor 10 over such switch's control electrode 11, into the conductive state, as now computer circuit 8 applies a positive voltage on to control electrode 11. The shunt over series connected thyristor 10 and auxiliary capacitor 12 is now conductive, and the latter can thus take up the excess load of storage capacitor 3, which is no longer needed for illumination. The flash tube 4 extinguishes early in dependence on photosensitive resistor 9 and in collaboration with computer circuit 8 so that a genuine regulation of the flash light as a function of the reflected quantity of light takes place.

The load of auxiliary capacitor 12 can e.g., be short-circuited by a mechanical switch 13, which can also be made as an electronic switch, so that capacitor 12 can for the next shot again take up the excess load of storage capacitor 3.

The circuit arrangement shown in FIG. 2 represents another embodiment of the invention. Here the same flash circuit is used as in FIG. 1, merely with the difference that instead of short-circuiting switch 13 a circuit 15 conducts the potential present at auxiliary capacitor 12 to DC transformer 1 and/or battery 2 over a current limiter 14. In this way the energy of auxiliary capacitor 12 can be exploited to charge battery 2 and thus improve the energy balance of the entire arrangement. Instead of being conducted over a current limiter 14 the charging voltage of auxiliary capacitor 12 can also be conducted over a separate oscillator circuit to DC transformer 1.

In the circuit arrangement in accordance with the invention the single capacitor 12 can also be replaced by several capacitors in parallel or series connection. The energy present at these auxiliary capacitors can then e.g., be conducted again direct to storage capacitor 3 by a parallel-serial commutation.

What is claimed is

1. In an electronic flash unit which includes in combination a flash tube, a first capacitor for energizing the flash tube, a light sensitive control circuit having an output dependent on the portion of the light emission of the flash tube reflected from the subject to be photographed, and quenching means including a normally disabled controllable electronic gate connected in shunt with the flash tube, the control circuit being coupled to the control gate to enable the gate when the output of the control circuit has reached a predeter-

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mined value for bypassing the remaining energy of the first capacitor from the flash tube, an improved construction for the quenching means which comprises:
 a second capacitor; and
 means for connecting the second capacitor in series 5
 with the gate across the flash tube;

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power supply means including a battery for energizing the first capacitor, and means for applying the voltage across the second capacitor to the battery for charging the battery.

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