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Mashimo

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[54] **ELECTRONIC FLASH DEVICE**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **315/241 P**, 315/241 R

[51] **Int. Cl.** **H05b 37/00**

[58] **Field of Search** ..... 315/241 P, 241 S, 315/241 R

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Assistant Examiner—Lawrence J. Dahl
Attorney—David Toren et al.

[57] **ABSTRACT**

An electronic flash device comprising:

a direct current power source,

an oscillating device having a capacitor, and supplied with current from said power source,

a main capacitor for storing energy for flash illumination,

a charging circuit provided between said oscillating device and said main capacitor,

a detecting means for detecting the charging amount across the main capacitor,

a switching means controlled by said detecting means and connected to the charging circuit which opens to change the mode of oscillation of the oscillating device, and

a flashing tube connected to said main capacitor.

8 Claims, 2 Drawing Figures

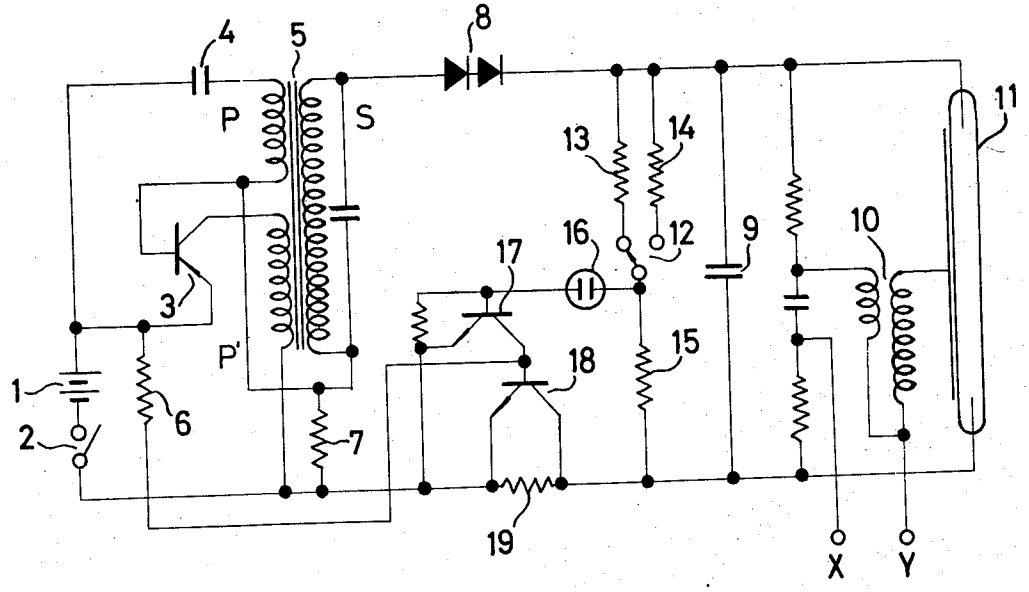

FIG.1

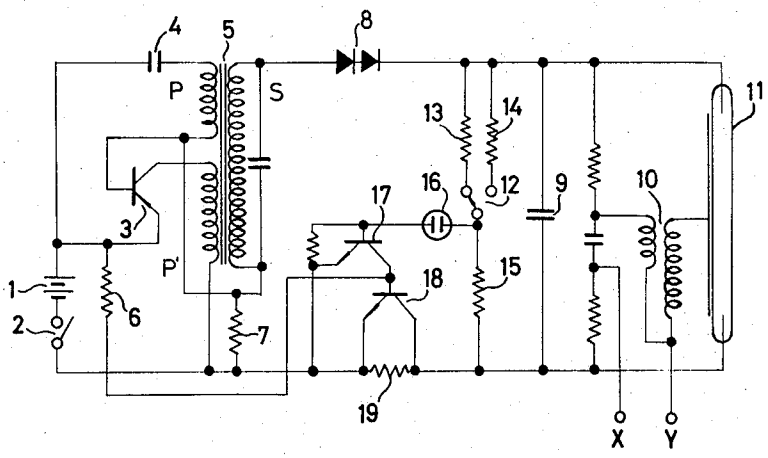
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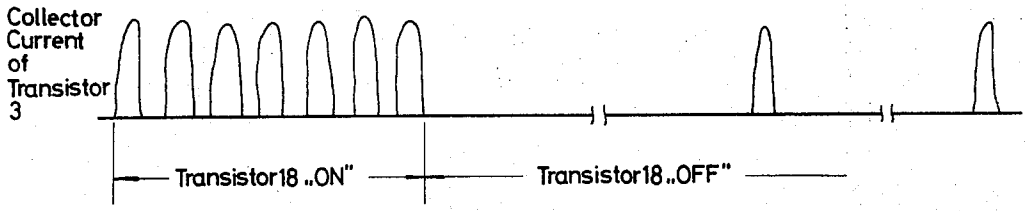
FIG.2


Collector Current of Transistor 3
Transistor18 „ON"
Transistor18 „OFF"

ELECTRONIC FLASH DEVICE

The present invention relates to an electronic flash device, and more particularly relates to an electronic flash device which comprises a main capacitor charged by an output of an oscillator and when the charging amount across the main capacitor reaches a certain value, the mode of the oscillation of the oscillator is changed.

A conventional flash device in which a main capacitor is charged by the output of an oscillator takes a considerably long time for the charging of the main capacitor, and it has been long desired to shorten the charging time. And in the conventional flashing device, a large bias current is passed to a transistor for oscillating the oscillator in order to shorten the charging time. However, when a large current is passed through the oscillating transistor, a considerable large current passes even after the charge across the main capacitor has reached a certain value so that current consumption is too much and increased temperature of various circuit elements is caused.

A flash device was proposed in which the bias current of the oscillating transistor is controlled by a controlling transistor when the charge across the main capacitor reaches a certain value so as to decrease the charging current to a small current only enough to make up the lowering of the charging voltage of the main capacitor.

However, as the above flash device contains the controlling transistor in the circuit of the oscillator, it has such defects that the circuit structure is complicated and the initial rise-up of the oscillator is bad.

An object of the present invention is to provide a flash device which has eliminated the above defects.

Another object of the present invention is to a flash device in which when the charge across a main capacitor reaches a certain value, the mode of oscillation is changed by a controlling circuit provided in a charging circuit.

Still another object of the present invention is to provide a flash device in which when the charge across the main capacitor reaches a certain value the mode of oscillation of an oscillator is changed and the charging voltage of the main capacitor is maintained so as to obtain a constant flash illumination.

A further object of the present invention is to provide a flash device in which when the charge across a main capacitor reaches a certain value, the mode of oscillation of an oscillator is changed so as to save consumption of a power source.

The present invention will be described referring to the attached drawings.

FIG. 1 is a schematic view of a concuit structure of one embodiment of the present flash device.

FIG. 2 shows the collector current of the oscillating transistor shown in FIG. 1.

In FIG. 1, 1 is a power source such as a dry element cell and Ni-Cd cell. 2 is a power source switch and when this switch is closed an oscillator as mentioned later starts oscillation and its output is charged across the main capacitor. 3 is a transistor for oscillation, 4 is a capacitor in an oscillation circuit. This capacitor 4 is required only to obtain the collector current of the transistor 3 and may be eliminated in other cases. 5 is a transformer both for oscillation and boosting, which has a primary coils, P, P' and a secondary coil S. 6 is

a resistor provided in a supply circuit for supplying current to an oscillation control circuit, 7 is a resistor for setting the bias value of the oscillating transistor. 8 is a diode provided in a charging circuit of the main capacitor 9, which rectifies the alternating current boosted by the transformer 5 into the direct current. 10 is a triggering circuit, 11 is a flash tube, 12 is a changeover switch of the charge detecting circuit of the main capacitor 9, which changes the flash amount of the flash device from large to small or from small to large. 13, 14 and 15 are resistors constituting the detecting circuit. 16 is a neon lamp provided at the output portion of the detecting circuit. 17 and 18 are transistors constituting the oscillation control circuit, and to the base of the transistor 17 the neon lamp 16 is connected. The relation between the neon lamp and the oscillation control circuit is such that when the neon lamp 16 is illuminated the transistors 17 and 18 become conductive. The transistor 18 is connected to the charging circuit of the main capacitor 9 and cuts or passes the charging current according to the illumination or turn-off of the neon lamp.

In the circuit structure shown in FIG. 1, the charging current is cut or passed not directly by the transistor 18, but the resistor 19 is inserted in the charging circuit of the main capacitor 9 by the conductivity or non-conductivity of the transistor 18. X and Y are synchronizing terminals.

Next, the functions of the flash device shown in FIG. 1 will be explained. When the power-source switch 2 is turned "on," the oscillation circuit 3, 4, P starts to oscillate and an alternating current of high voltage is generated in the secondary coil S of the boosting transformer. This alternating current is rectified by the diode 8 and passes into the large capacity main capacitor 9 and charges it. In the course of the charging, the load impedance of the oscillation circuit takes a low value and thus a large current passes. Under this condition the neon lamp 16 of the detecting circuit 13, 14, and 15 is turned off, the oscillating transistor 17 is "off" and the transistor 18 is "on," and the resistor 19 of the charging circuit is short-circuited by the transistor 18. In the course of charging the main capacitor, the oscillator makes oscillation of the oscillation transistor in saturation as shown in FIG. 2 and the duration angle of oscillation wave is broad, and the charging current obtained by rectifying the oscillation is also large. As the charge across the main capacitor progresses and the voltage at the bleeding point of the detecting circuit reaches a standard value the neon lamp is illuminated. In this way, the transistor 17 of the control circuit becomes "on," the transistor 18 becomes "off" and the resisting element 19 is inserted in the charging circuit of the main capacitor. Thereby, the load of the oscillator is reduced and the oscillation transforms from the saturated oscillation to the CR oscillation which is determined by the integrated value of the capacitor 4 and the resistor 7 (see FIG. 2). While the oscillator is making CR oscillation, the duration angle of oscillation wave is very narrow and thus the consumption of the power source is negligibly small. And the charging of the main capacitor by its output is very small so that the terminal voltage is almost constant at the standard value and desired illumination is obtained. It has been confirmed by experiments that control of the oscillation made as above can be made by selecting the value of the resisting element 19 more than several kilo

ohms. Therefore, by providing the control circuit as shown, the oscillation is automatically controlled when the charge across the main capacitor reaches the standard value and the neon lamp is illuminated so that the illumination of the flash device is maintained at an almost constant value and waste consumption of the power source is prevented. By changing over the switch 12 desired guide numbers can be selected.

As above described, in the flash device according to the present invention, when the charge across the main capacitor progresses and illumination of a prescribed guide number is obtained, the oscillation of the power source circuit is automatically controlled, and as the circuit structure is very simple, it can be set in a small device and can prevent waste consumption of the power source. Thus the present invention is very advantageous for minimize the size of the device and the cell.

What is claimed is:

1. An electronic flash apparatus for photographic purposes, comprising a low voltage battery, first circuit means responsive to the battery and including an oscillating transistor for producing varying voltages, a voltage transformer having a low voltage primary winding and a high voltage secondary winding, said parimary winding being coupled to said first circuit means so as to induce a high voltage in the secondary winding in response to the varying voltage in the primary winding, rectifying means coupled to said secondary winding, a main capacitor coupled to said rectifying means and chargeable by said rectifying means, detecting means for detecting the level of charge across said main capacitor, impedance means connected in series with said main capacitor for limiting the current flow to said main capacitor and in said secondary winding as well as said primary winding to a given average level, and switching means connected in parallel with said impedance means and responsive to said detecting means for becoming conductive when said detecting means indicates that the level of charge of said capacitor means is less than a predetermined value and for becoming non-conductive when said detecting means indicates that the level of charge of said capacitor means exceeds the predetermined value.

2. An apparatus as in claim **1**, wherein said impedance means includes a resistor and said first circuit means includes an RC time constant circuit having a time constant exceeding a predetermined value connected to said transistor, said transistor having a base, said time constant circuit being connected to said base.

3. An apparatus as in claim **1**, wherein said switching means is a transistor having a low compression resistance characteristic.

4. An apparatus as in claim **1**, wherein said detecting means includes a bleeder resistor connected in parallel with said capacitor and a neon tube coupled to said bleeder resistor, said switching means including an input transistor and an output transistor connected in cascade, said input transistor being connected to the neon tube and the input of the output transistor being connected to the battery to render it conductive when the capacitor is not charged to the predetermined level.

5. An electronic flash apparatus for photographic purposes, comprising a battery, a voltage transformer having a low voltage primary and a high voltage secondary winding, first circuit means responsive to said battery and including an oscillating transistor for producing a varying voltage, said first circuit means being connected to said low voltage primary winding to cause said primary winding to induce a high voltage in said secondary winding, rectifying means responsive to said secondary winding for producing a rectified voltage, said transistor having a base, an RC time constant circuit having a time constant greater than a predetermined value and connected to the base of said transistor, a main capacitor connected to said rectifying means and being charged by said rectifying means, detecting means for detecting the level of charge across said main capacitor, impedance means connected in series with said main capacitor for limiting the charging rate to a given level, switching means responsive to said detecting means and connected across said impedance means for becoming conductive and bypassing said impedance means when said detecting means detects that the level of charge across said capacitor is less than a predetermined value and for becoming non-conductive when said detecting means detects at the level charge across said capacitor means exceeds the predetermined value, and second circuit means for charging the capacitor of said RC circuit in response to said switching means to a polarity opposite to that which the charged capacitor is charged by said oscillating transistor when said oscillating transistor is conductive.

6. An apparatus as in claim **5**, wherein the capacitor of said RC time constant circuit is connected between the battery and the primary winding and the resistor of the RC time constant circuit is connected between the base of the oscillating transistor and the battery.

7. An apparatus as in claim **5**, wehrein said switching means includes a transistor having a low compression resistance characteristic.

8. An apparatus as in claim **5**, wherein said detecting means includes a bleeder resistor connected across said capacitor and a neon tube coupled to said bleeder resistor, said switching means including an input transistor and an output transistor connected in cascade with said input transistor, said input transistor being connected to the neon tube and the input of said output transistor being connected with the battery to render said output transistor conductive when the level to which the main capacitor is charged is less than the predetermined level.

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