United States Patent [19]

Uchiyama

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[45] **March 13, 1973**

[54] FLASH APPARATUS FOR A CAMERA

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[30] **Foreign Application Priority Data**

Dec. 10, 1969 Japan 44/99571

[52] **U.S. Cl.** ..... **95/10 CT,** 95/11.5 R

[51] **Int. Cl.** **G03b 7/08**

[58] **Field of Search** ..... 95/10 CE, 10 CT, 11.5 R

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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Michael L. Gellner
Attorney—McGlew and Toren

[57] **ABSTRACT**

In the flash apparatus disclosed, an electric shutter is controlled by a photosensitive element forming a time constant circuit with a timer capacitor. A switching element, that responds to current flowing through a triggered flash unit, connects a resistive element in series with the time capacitor to form another time constant circuit. This adjusts the shutter to flash.

19 Claims, 15 Drawing Figures

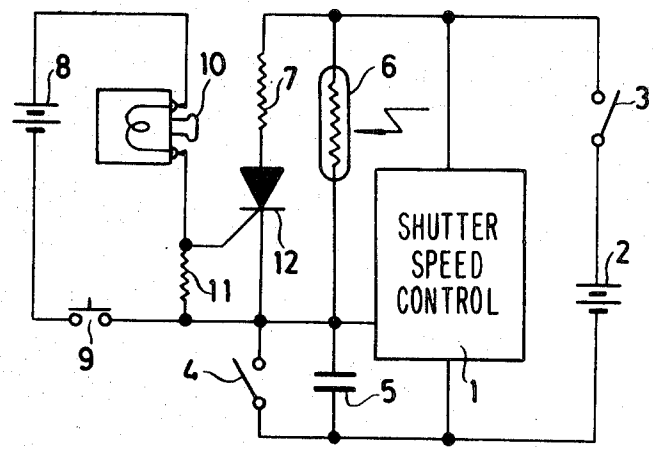


FIG. 1

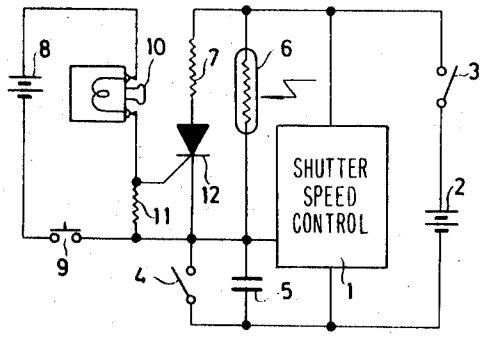


FIG. 2

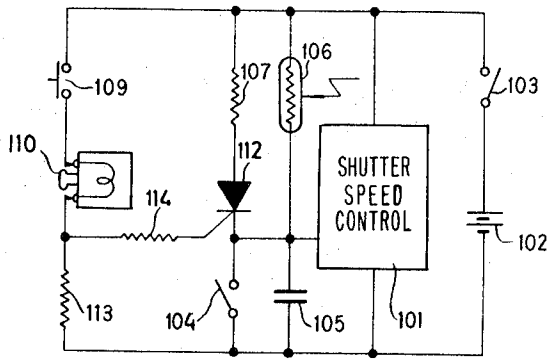


FIG. 3

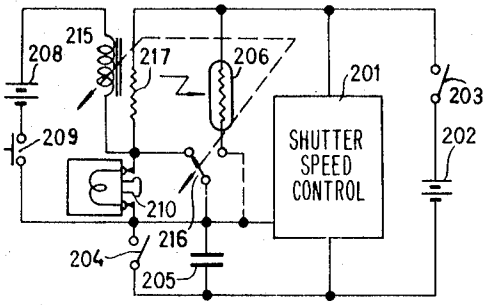
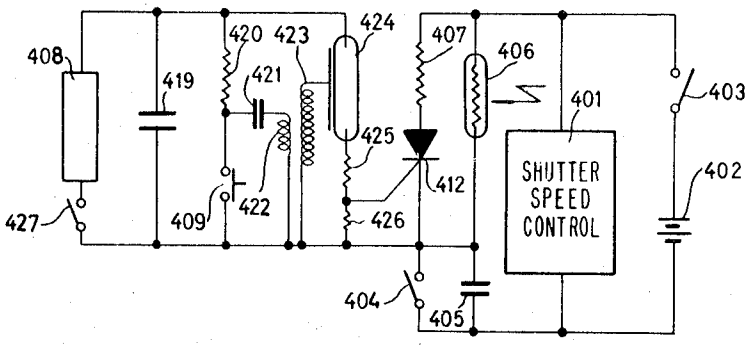


FIG. 4.



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FIG. 5

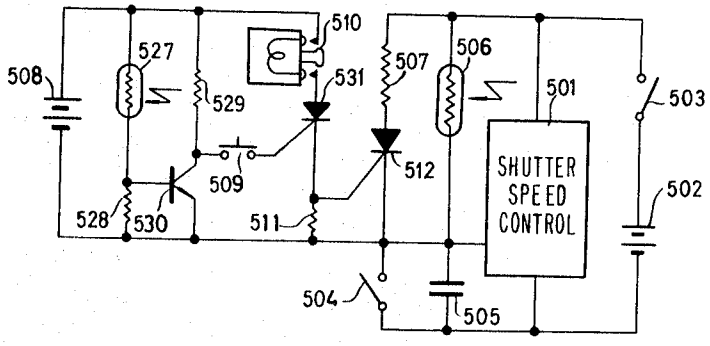


FIG. 6

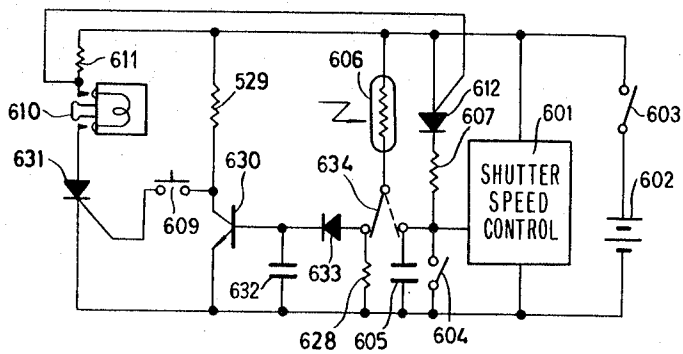
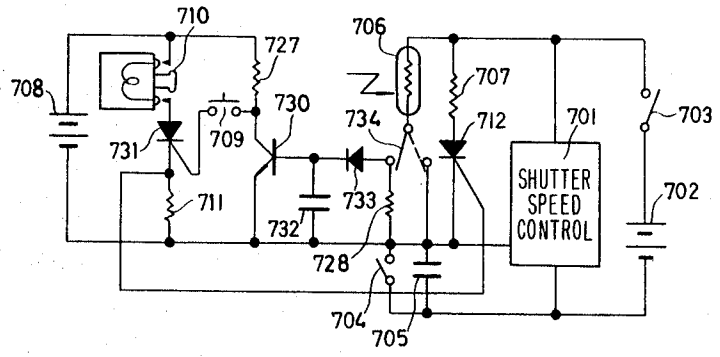


FIG. 7



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FIG. 8

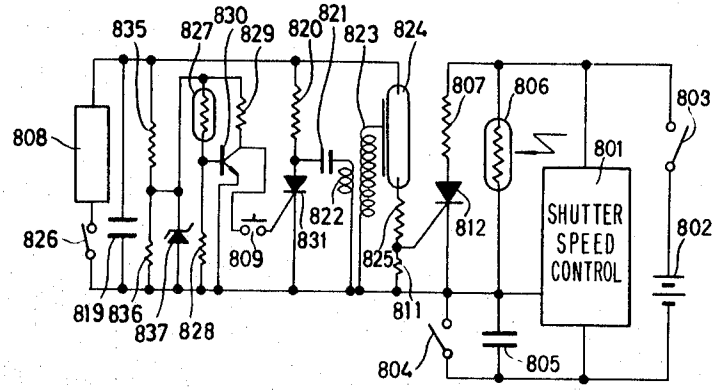


FIG. 9

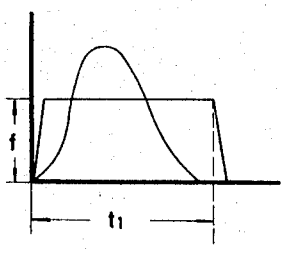


FIG. 10

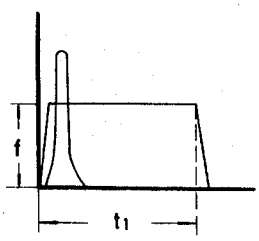


FIG. 11

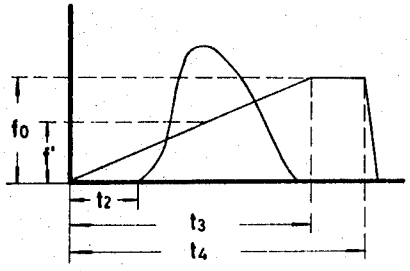
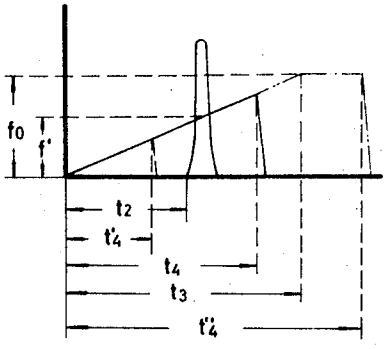


FIG. 12



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FIG. 13

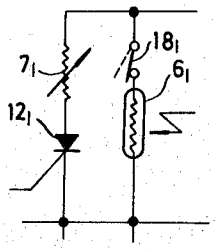


FIG. 14

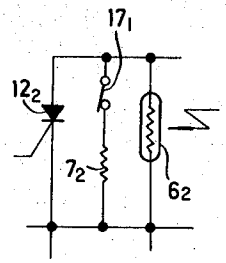
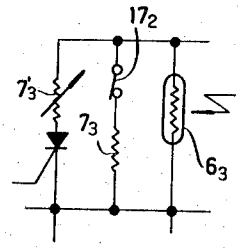


FIG. 15



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FLASH APPARATUS FOR A CAMERA

The present invention relates to a flash photographing apparatus having a time constant circuit for shutter controlling, particularly relates to a flash photographing apparatus in which a shutter speed is automatically changed over to a certain shutter speed for flash photographing by connecting of a flash device with an electric shutter control circuit.

When a flash photographing is made using a flash lamp in an ordinary EE camera having automatic exposure control device, the photographing is made by changing over a shutter speed to a constant speed (for example, one-thirtieth seconds) with consideration of a shooting distance and a diaphragm value and guide number of the flash lamp. Even in recently developed cameras with electric shutter control circuits a constant shutter speed is obtained by changing over a photo-conductive element of the time constant circuit to a solid resistor at the time of flash photographing.

As the change over of the shutter speed in these conventional cameras is done manually, it is inconvenient a camera operation.

One of the objects of the present invention is to overcome the inconvenience of the conventional cameras.

The object and features of the present invention lie in a flash photographing apparatus for a camera having an electric shutter controlled by a photo-sensitive time constant circuit having a timer capacitor comprising a resistive element, resistive element being connected in series with the timer capacitor through a switching means which is turned on by a trigger signal, generated by illumination of a flash lamp to form another time constant circuit for flash photography.

Other features of the present invention lie in that the automatic connection is performed by actuation of a switching element controlled by the potential generated by current flowing through a resistive element which furthermore through a flash lamp at the time of illumination of the flash lamp.

Now the present invention shall be explained by referring to the drawings in which:

FIG. 1 is a circuit diagram showing an example of the flash photographing apparatus according to the present invention.

FIG. 2 shows a modification of the flash photographing apparatus according to the present invention wherein the power source is commonly used both for the flash photographing circuit and the electric shutter control circuit. FIG. 3 shows other modifications of the flash photographing apparatus according to the present invention. FIG. 4 is a circuit diagram showing another example of the flash photographing apparatus according to the present invention in which the apparatus comprises an electronic flash device.

FIGS. 5 to 7 are circuit diagrams having a photo-sensitive illumination preventor which serves only when an object to be photographed is bright enough for EE photographing.

FIG. 8 is a circuit diagram similar to those shown in FIGS. 5 to 7, but with the provision of a speed-light device.

FIGS. 9 to 12 are graphs showing the temporal relation between the blade opening and the flash lamp illumination.

FIGS. 13 to 15 are modifications of partial circuit constructions of the time constant circuit of the photographing apparatus according to the present invention.

In FIG. 1 1 is a shutter speed control circuit such as a Schmitt trigger circuit, 2 is a power source of the shutter speed control circuit, 3 is a main switch, 4 is a starter switch linked with a shutter button, 5 is a timer capacitor, 6 is a photo-conductive element, for example of CdS. 7 is a resistor to obtain a shutter speed for flash photographing, 8 is a power source of a flash circuit, 9 is a synchronizing contact of a camera, 10 is a socket for a flash bulb, 11 is a resistor and 12 is a switching element such as a silicon controlled rectifier.

Next, operation of the above embodiment shall be explained. In ordinary automatic exposure control photographing, as the photo-conductive element 6 receives light from an object to be photographed resistance value of the element 6 correspond to the amount of light from the object, and therefore the shutter speed control circuit 1 is actuated by a time constant of the circuit consisted of the element 6 and the capacitor 5 to control shutter closure by an electromagnet of the shutter speed control circuit 1. In the above case the main switch 3 is made "on" for example by a first step of pressing down of a shutter button, and then the shutter is released for its opening, when the starter switch 4 is opened. Thereafter the capacitor 5 is charged through the photo-conductive element 6.

Next, in flash photographing, the flash bulb is inserted into the socket 10 and the synchronizing contact 9 becomes "on" in synchronism with the start up of the shutter opening, then the bulb flashes by the current supply from the power source 8. As a potential difference is generated due to the current supply through the resistor 11 which is connected in series at the flash circuit, the silicon controlled rectifier 12 is turned on from a non-conductive state to a conductive state. When the silicon controlled rectifier 12 is in a conductive state, the resistor element 7 is connected in parallel with the photo-conductive element 6 of the electric shutter control circuit to secure a shutter speed for flash photographing. In the above case when the light amount from the object is small, the resistance value of the photo-conductive element 6 takes high value, and the value of the resistor 7 is low as compared with the resistance value of the element 6. Therefore the shutter speed is determined mainly by the resistance value of the resistor 7 and thus the shutter speed becomes almost constant. The resistor 7 is preferably selected to attain a constant shutter speed (for example, one-thirtieth second) suitable for flash photographing.

When the amount of light from the object is large, the shutter speed is determined chiefly by the photo-conductive element 6 with exposure correction due to illumination of the flash bulb.

When the above embodiment is used, it is not necessary to change-over the shutter speed manually for flash photographing, and the shutter speed for flash photographing is obtained automatically. Even when a flash bulb does not illuminate for some reason, or no flash bulb is installed, the resistor 7 is not connected in parallel with the photo-conductive element 6 as the silicon controlled rectifier 12 is not turned on, therefore the shutter speed is determined by the photo-conduc-

tive element 6 and the capacitor 5, thus a long-time exposure is automatically when the object is dark. Therefore there is no insufficient exposure as in the case of manual changing-over of the shutter speed. While the apparatus shown in FIG. 1 shows an example using a flash bulb, the apparatus may also be composed of an electronic flash device in a similar manner as shown in FIG. 4. In this case the electric current flowing through a flash discharge tube 424 in FIG. 4 may be made to flow through the resistor 11 so as to put the switching element 12 "on" with the aid of the terminal voltage of the resistor 12.

In FIGS. 2–8 and 14–16 like parts are designated with reference characters whose last two numerals are the same.

Resistors 113 and 114 are used in FIG. 2, when the flash bulb operates the resistor 14 applies the voltage formed by the current through the resistor 113 to trigger the thyristor 112.

In FIG. 3 an electro-magnet 215 is used for changing over a switch 216 from the photo-conductive element 206 to the resistor 207. The switch is normally connected with the photo-conductor 206. The electromagnet 215 is connected in series in the flash circuit, and the switch 216 is changed over by the current flowing through the electro-magnet 215 at the time of illumination of the flash lamp, and the resistor 207 for obtaining the shutter speed for flash photographing is connectable to the timer capacitor 205 for shutter control. As shown by dotted lines in FIG. 3, the resistor 207 may be connected in parallel with the photo-conductive element 206 connected in series with the timer capacitor 205 only when the switch 216 is changed over in associated manner by the electromagnet 215. While the flash bulb is connected to the power source 202 of the electric shutter control circuit through the resistor 207, the bulb will not be illuminated by the current from said power source 202 before the shutter actuation, because the resistor 207 has the resistance value of several kilo ohms to several tens of kilo ohms. The flash bulb is illuminated only when the synchronizer 209 is closed in association with shutter start.

In FIG. 4 is a power source of high voltage, 419 is a main capacitor, 420 is a resistor, 421 is a trigger capacitor, 422 and 423 are coilings of a trans for triggering the illumination of a discharge tube 424, which is connected in series with the resistor 411 and a resistor 425, and 426 is a main switch for the power source 408'. The synchronizer 409 must be associated with shutter actuation in a corresponding manner to the shutter type used therefore.

In FIG. 5, 527 is a photo-conductor of a photo-sensitive illumination preventor against the flash bulb. 528 and 529 are resistors of the base and of the collector respectively of a brightness detection transistor 530. 531 is a silicon controlled rectifier which is turned on only when the object brightness is low, the synchronizer 509 is closed, and a flash bulb is loaded onto the socket 510. The shutter control will be understood from the description of the embodiment shown in FIG. 1.

In FIGS. 6 and 7, the photo-conductor 127 shown in FIG. 5 is omitted and the photo-conductor 606, 706 is commonly serves as the photo-resistor 506 and as the photo-resistor 527 of the embodiment shown in FIG. 5. 632, 732 is a memory capacitor which memorizes the object brightness, 633, 733 is a diode and 634, 734 is a change-over switch. 612' is a silicon controlled rectifier of N-gate as shown in FIG. 6, function of which is similar to that of the silicon controlled rectifier 712 shown in FIG. 5 and FIG. 7. In the embodiments in FIG. 7 or 8, the photo-conductor 606, 706 is first connected in series with the resistor 628, 728 through the switch 634, 734 for the automatic illumination prevention under a bright condition. In this case when the synchronizer 609, 709 is closed to fire the flash bulb, the silicon controlled rectifier 612', 712 is turned on to constitute a time constant circuit of the resistor 607, 707 and the timer capacitor 605, 705. The switch 634, 734 is next connected to the timer capacitor 605, 705 and a time constant circuit is formed in accordance with the photographing condition. And the shutter not shown in each figure is released then shutter time is adjusted by the resistors 607, 707. The switch 34 is reset to its original position by shutter closure or film winding.

Under a bright condition, the photo-conductor 606, 706 may be always connected in series with the timer capacitor 605, 705 through the switch 634, 734 for automatic exposure control photographing. In the latter case, the switch 634, 734 is selectively changed over by insertion of the flash bulb for the flash photographing.

In the above cases it is not necessary to terminate the capacitor 632, 732 because the charges across the capacitor 632, 732 discharges through a path from the base to the emitter of the transistor 630, 730 and because the interval between successive exposures is long enough for the termination or for the resetting action of the memory capacitor 632, 732. The diode 633, 733 serves to hold the brightness signal across the capacitor during the shutter actuation.

Referring to the embodiment shown in FIG. 8, 835 and 836 are resistors, and 37 is a Zener diode. The functions of this embodiment will be understood from the function of both embodiments shown in FIGS. 4 and 5.

Referring to any of FIGS. 9 to 12, the temporal relation between the blade opening and the flash illumination will be understood, in which f is a degree of blade opening, f_o is a maximum opening of the blades, f' is blade opening at the flash peak, t_1 is a shutter time, t_2 is the time from the start of the blade opening to the start of the illumination, t_3 is the time from the start of the blade opening to the time of the maximum blade opening f_o, t_4 is the time from the start of the blade opening to the start of the shutter closure. When the object is too bright, the shutter closure before the flash illumination occurs as shown by $t_{4'}$ while when the object is too dark, the shutter closure at the maximum blade opening a long time after the flash illumination occurs as shown by $t_{4''}$ in FIG. 13.

In FIG. 13, timer resistors 7_1 and 6_1 are connected in parallel to each other. The resistor 7_1 is a variable resistor settled in accordance with the photographing informations.

In FIG. 14, the silicon controlled rectifier 12_2 as one element of the timer resistors is provided in a parallel relation to the resistors 7_2 both as the elements of the timer resistors. When the circuit shown FIG. 14 is applied in the circuit shown in FIG. 4 or FIG. 8 and the

discharge tubes 424, 824 operate as shown in FIG. 9 or FIG. 11 then the rectifiers 12_2 (412, 812) are turned on instantaneously and resistors 7_2, 6_2 are shorted circuited. Therefore, the capacitors 405, 805 are charged up instantly. Shutter speed control circuits 401, 801 are actuated and the shutter 62 is closed. However, the duration of illumination by the discharge tubes 424, 824 is extremely short such as a few miliseconds and shutter's mechanical response delay to the shutter actuation signal is larger than the duration of the discharge tube. Therefore, after the discharge tubes 424, 824 have been illuminated, the shutter is closed. This timer resistors are conveniently applicable to the apparatus with the electronic flash device as shown in FIGS. 4 and 8, which may be referred to FIGS. 10 and 12.

When the silicon controlled rectifier 12, 12_2 is turned on due to the illumination of the discharge tube 424, 824, the timer capacitor 405, 805 is instantaneously charged through the rectifier 412, 812 to close the shutter blade.

FIG. 15 shows a similar construction of the timer resistor shown in FIGS. 13 and 14.

The main features and advantages of the present invention lie in illumination of necessity of manual change-over of the shutter speed for the flash photographing and provision of automatic change-over of the time constant of the shutter control circuit in response to the illumination of the flash lamp.

What is claimed is:

1. A shutter control apparatus for a camera with a flash, comprising photosensitive time constant means having a time constant responsive to light on an object being photographed for producing a shutter controlling signal, said time constant means being switchable between said time constant and another time constant, sensor means responsive to energization of the flash, and switch means responsive to said sensor means and coupled to said time constant means for changing the time constant of said time constant means in response to operation of said sensor means, said sensor means including resistance means in series with the flash and responsive to current through the flash, said resistance means being connected to said switch means for switching said switch means in response to current through said resistance means.

2. An apparatus as in claim 1, wherein said time constant means includes capacitor means and photosensitive means coupled to said capacitor means and having a resistance that depends on the light on an object being photographed, said switch means being connected to said capacitor; said switch means including a portion, which when said switch means assumes an on condition, changes the time constant of said time constant means.

3. An apparatus as in claim 1, wherein said time constant means includes a capacitor and a photoresistor connected in series with each other and said switch means includes a switch connected in series with said capacitor.

4. An apparatus as in claim 1, wherein said time constant means includes a capacitor and a photosensitive element in series with said capacitor and wherein said switch means includes a switch and a resistor, said switch connecting said resistor in series with said capacitor in response to operation of said sensing means.

5. An apparatus as in claim 4, wherein said photosensitive element is a photoresistive element and said switch connects said resistor in parallel with said photoresistive element.

6. An apparatus as in claim 4, wherein said sensor means includes second photosensitive means responsive to light on an object being photographed and actuating means responsive to said second photosensitive means for actuating the flash, said actuating means being connected to said switch for actuating said switch.

7. An apparatus as in claim 4, wherein said sensor means includes actuating means for actuating the flash and a selector for connecting said photosensitive means to said actuating means so that said actuating means responds to said photosensitive means.

8. An apparatus as in claim 4, wherein said switch means includes a thyristor.

9. An apparatus as in claim 4, wherein said switch means includes a thyristor connected in series with a resistance.

10. An apparatus as in claim 1, wherein said sensor means includes second photosensitive means responsive to light on an object being photographed, and actuating means responsive to said second photosensitive means for actuating the flash, said actuating means being connected to said switch means for actuating said switch means.

11. An apparatus as in claim 1, wherein said sensor means includes actuating means for actuating the flash and a selector for connecting said photosensitive means to said actuating means so that said actuating means responds to said photosensitive means.

12. An apparatus as in claim 1, wherein said switch means includes a thyristor.

13. An apparatus as in claim 1, wherein said switch means includes a thyristor connected in series with a resistor.

14. An apparatus as in claim 1, further comprising a unit in series with said detecting element for holding the flash, said unit being adapted to receive a flash bulb having a flash filament.

15. An apparatus as in claim 1, wherein said time constant means comprises capacitor means and photoresistive means as well as resistive means, said switching means selectively connecting said resistive means in series with said capacitor means to change the time constant to one suitable for flash photography when said switch means is on.

16. An apparatus as in claim 1, further comprising a unit for holding the flash, said unit being adapted to hold an electronic flash unit having a flashlight.

17. A shutter control apparatus for a camera with a flash, comprising photosensitive time constant means having a time constant responsive to light on an object being photographed for producing a shutter controlling signal, said time constant means being switchable between said time and another time constant sensor means responsive to energization of the flash, and switch means responsive to said sensor means and coupled to said time constant means for changing the time constant of said time constant means in response to operation of said sensor means, said time constant means including a source, said source being connectable to the flash for applying a driving potential to the flash, said sensor means having a detecting element in

series with the flash for responding to current through the flash, said detecting element being connected to said switch means for switching said switch means on the basis of operation of said detecting element.

18. An apparatus as in claim 7, wherein said time constant means includes a capacitor and a photosensitive element in series with said capacitor and wherein said switch means includes a switch and a resistor, said switch connecting said resistor in series with said capacitor in response to operation of said ensing means.

19. An apparatus as in claim 17, wherein said time constant means comprises capacitor means and photoresistive means as well as resistive means, said switching means selectively connecting said resistive means in series with said capacitor means to change the time constant to one suitable for flash photography when said switch means is on, said time constant means further including a source connectable to the flash for applying a driving potential to the flash.

* * * * *