

[54] SHUTTER DEVICE

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[51] Int. Cl. G03b 15/03, G03b 9/58

[58] Field of Search 95/11.5 R, 64 R, 64 A, 53 EB, 95/10 C, 10 CE

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[57] ABSTRACT

A shutter device with a synchronizer contact which comprises a shifting member which shifts from its standard position with a constant shutter opening rate, and a blade for determining a blade opening in correspondence to the amount of the shifting movement; said synchronizer contact being closed by the shifting member at the time when the blade opening reaches a value determined for an appropriate artificial exposure.

12 Claims, 13 Drawing Figures

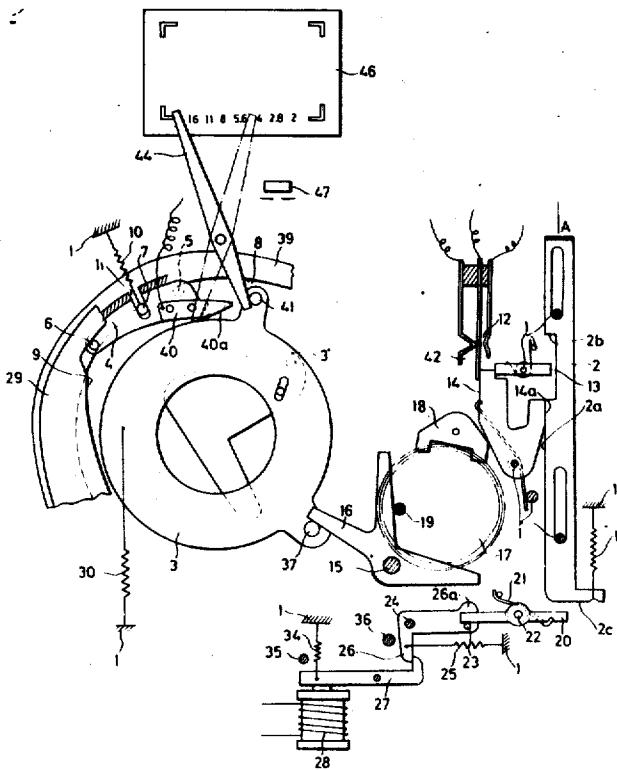


FIG. 1

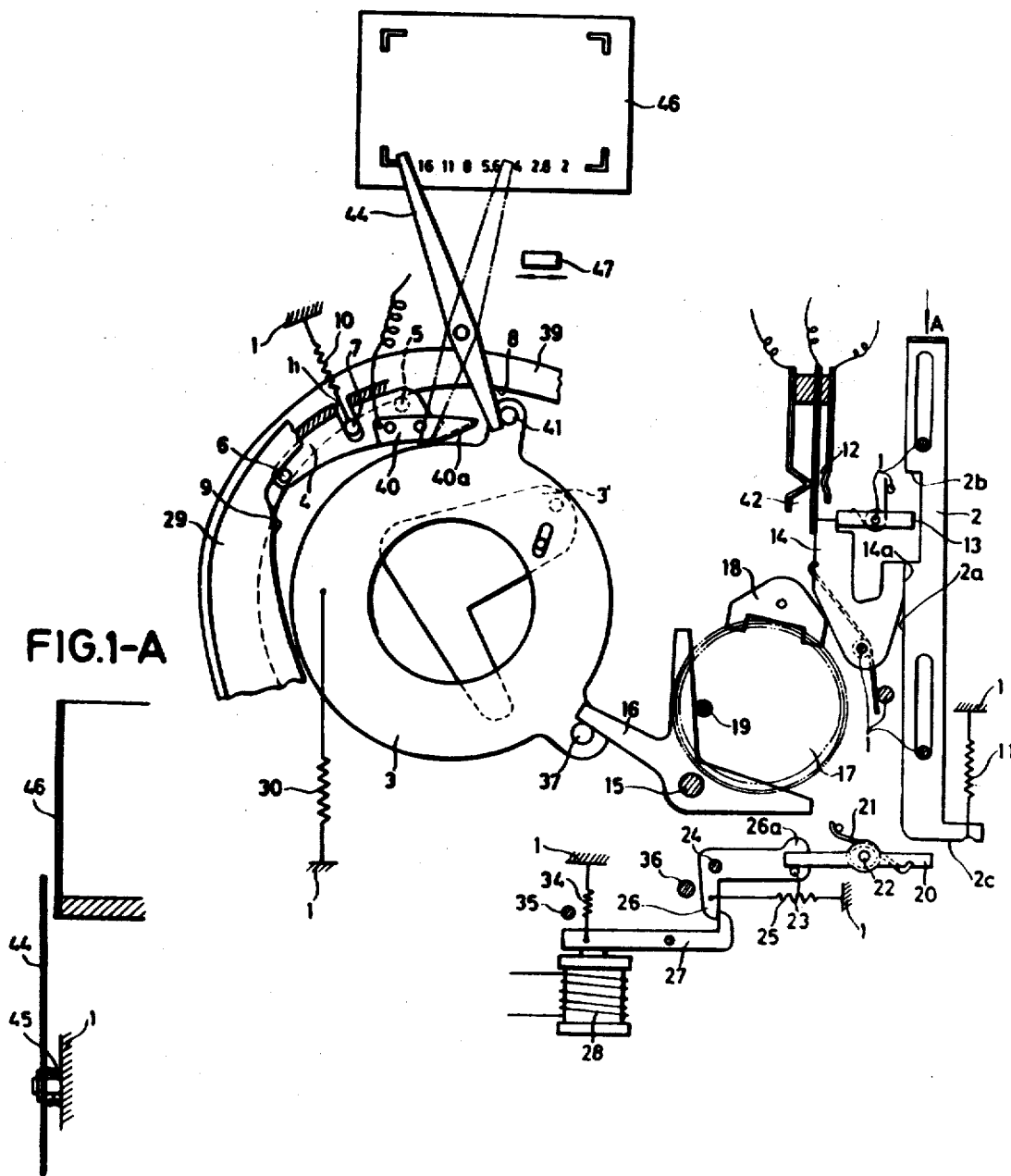


FIG. 1-A

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FIG. 2

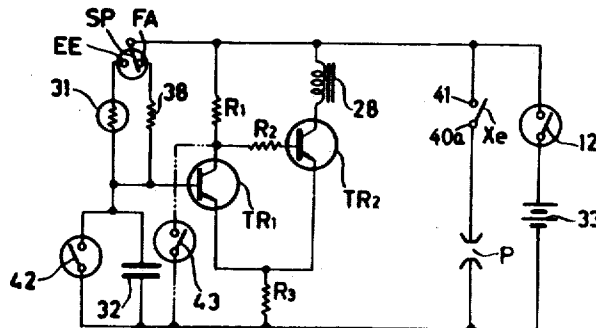


FIG. 3

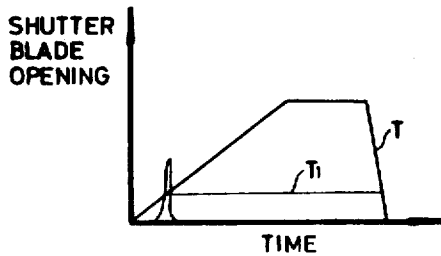


FIG. 4

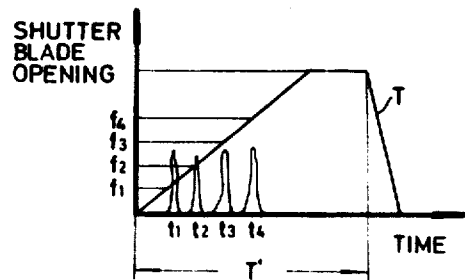


FIG.5

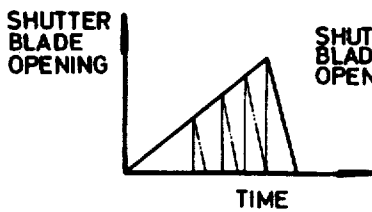


FIG. 6

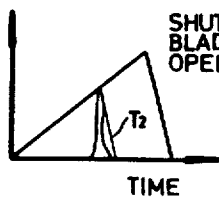
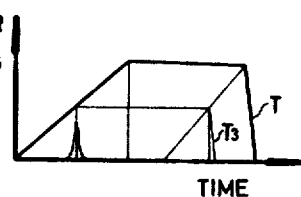


FIG.7



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FIG. 8

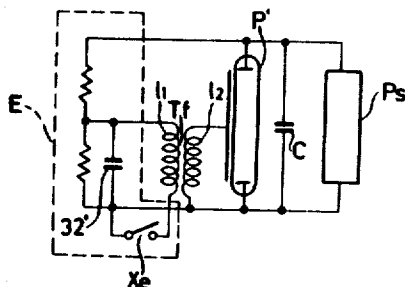


FIG. 9

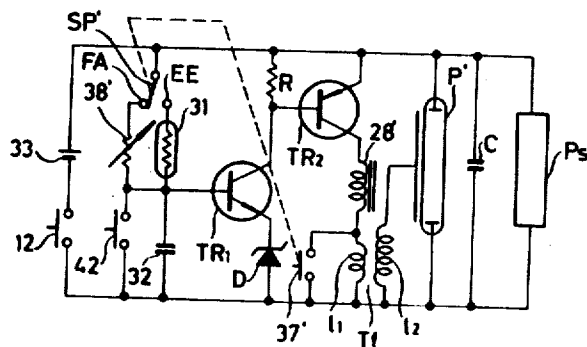
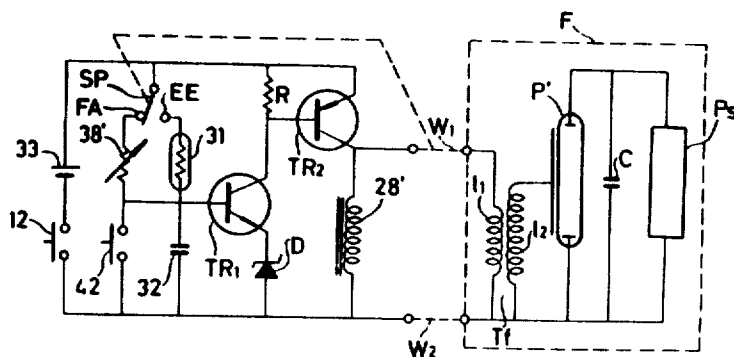


FIG. 10



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FIG. 11

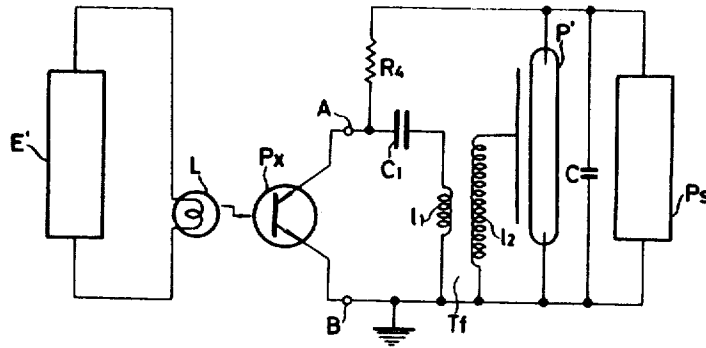
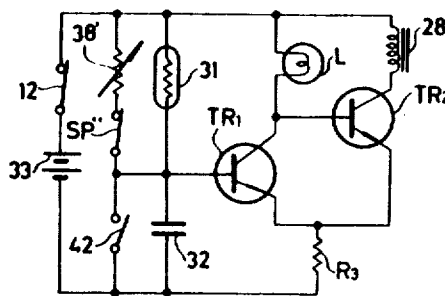


FIG. 12



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SHUTTER DEVICE

In a conventional photographing with artificial lighting, shutter speed is set at a constant speed such as 1/30 to 1/60 second and a diaphragm opening is determined by a flash automechanism with exposure factors such as photographing distance, film sensitivity and guide number, etc. and the timing for closing synchronized contacts and when the shutter is fully opened a synchronizer switch for a flash device contacts for its illumination.

It is also known to provide a camera with a shifting member which shifts from a standard position with a constant speed, and with a diaphragm blade, or shutter blade which also serve as diaphragm blade in which camera diaphragm opening is determined by the amount of shifting of the shifting member.

One of the objects of the present invention is to improve the above-mentioned known camera by providing a shutter device with a synchronizer contact. The main features of the present invention lie in a shutter device with a synchronizer contact which comprises a shifting member which shifts from its standard position with a constant shutter opening rate, and a blade for determining a blade opening in correspondence to the amount of the shifting movement; said synchronizer contact being closed by the shifting member at the time when the blade opening reaches a value determined for an appropriate artificial exposure.

The present invention shall be described in details referring to the attached drawings in which:

FIG. 1 is a front elevation showing schematically the arrangement of main parts of the shutter device according to the present invention. FIG. 1-A is a side view showing an indicating means of the shutter device shown in FIG. 1. FIG. 2 shows a circuit construction for the shutter device of the present invention. FIG. 3 is a characteristics diagram showing the relationship among the blade opening and the time after the blade opening and a contact time of the synchronizer switch. FIG. 4 is a characteristics diagram showing the similar relationship for a shutter device applicable to a speed light device. FIG. 5 is a characteristics diagram showing the relationship between the shutter blade opening and the time after the beginning of the shutter opening. FIG. 6 is a characteristics diagram showing the relationship among the shutter opening, the time after the beginning of the shutter opening and the time of flash illumination. FIG. 7 is a characteristics diagram showing the relationship among the blade opening the time after the beginning of the blade opening and the time of flash illumination in case of a long time illumination. FIG. 8 is a circuit diagram applicable to the shutter device according to the present invention. FIG. 9 and FIG. 10 are modifications of the circuit shown in FIG. 8. FIG. 11 also shows schematically modification of the circuit shown in FIG. 8 and FIG. 12 shows in detail a part of the circuit shown in FIG. 11.

In FIG. 1, 1 is a fixed member to a camera, 2 is a shutter release lever, 3 is a shutter ring for operating shutter blades, rotatable in a counter clockwise direction for opening the shutter blades. 4 is an adder member for flash-auto mechanism. Pins 5, 6 and 7 are planted on the adder member 4, wherein the pin 5 engages with a distance cam 8 fixed to a distance ring 39 for shooting distance, the pin 6 engages with a change-

over ring 29 with a guide number cam 9, and the pin 7 engages with a groove 1₁ of the fixed member 1 (a shutter casing). As the pin 7 is allowed in the movement only in a radial direction, the adder member 4 swings only around the pin 7. The pins 5 and 6 are forced to contact the distance cam 8 and the guide number cam 9 respectively, by a spring 10 attached to the pin 7. 11 is a returning spring for the release lever 2, and 12 is a main switch for a shutter speed control circuit as illustratively shown in FIG. 2. 13 is a ratch member, forced to rotate in a counter clockwise direction, for a control lever 14 which controls the release motion of a shutter blade 3' and controls the closure of the main switch 12. The lever 14 is forced to rotate in a clockwise direction. 15 and 19 show a delay device for gradually opening the shutter blades 3' through the shutter ring 3, and 20 to 27 show a driving device to give a closing action to the shutter blades when an appropriate exposure is made. The driving device is locked during the time of energization of an electro-magnet 28. The change-over ring 29 is both for EE photographing and artificial light photographing, and the guide number cam 9 for artificial light photographing is provided in the inside of the change-over ring 29.

When the change-over ring 29 is rotated to the position for EE photographing and the release lever 2 is pressed down in the direction of an arrow A, the side portion 14a of the lever 14 disengages with the side portion 2a of the release lever 2 and thereafter the bottom end portion 2c of the lever 2 engages with the lever 20. And this lever 20 is rotated in a clockwise direction against the spring 21 and the engagement of the lever 20 with the pin 23 planted on a lock pawl 26 for locking the shutter closure is released.

Next, the stepped portion 2b of the release lever 2 engages with and rotates the ratch member 13 to release the engagement of the ratch member 13 with the control lever 14. The control lever 14 thus freed rotates in a clockwise direction to close the main switch 12, and at the same time an anchor 18 of the delay device is started to move.

Then, a gear 17 with a pin 19 thereon starts rotating in a clockwise direction by the action of a spring (not shown) for the delay device. As the gear 17 rotates, the lever 16 is freed from the pin 19, and the shutter ring 3 which has been held in a static position by the lever 16 rotates in a counter clockwise direction, following the movement of the pin 19 through the release lever 16 with the aid of a spring 30, thus the shutter starts its opening with a constant rate.

On the other hand as the main switch 12 is closed and a starter switch 42 is opened, the shutter closure control circuit shown in FIG. 2 starts its controlling action. When the starter switch 42 is opened, a capacitor 32 starts accumulation therein through a photo-conductive element 31, and the magnet 28 is maintained in its locked state attracting the lever 27 until the terminal voltage across the capacitor 32 reaches an inverting level V_0 . In this case, it is well known that the time required for the terminal voltage across the capacitor 32 to reach the level E_0 is determined by a formula:

$$V_0 = C_0 V (1 - e^{-R_p C_0})$$

wherein C_0 is the capacitance of the capacitor 32, R_p is the resistance of the photo conductive element 31 and V is the voltage of a power source 33.

After an elapse of time t , as the voltage across the capacitor 32 reaches V_0 , a transistor TR_1 becomes "on," while a transistor TR_2 becomes "off" and the electro-magnet 28 is dienergized. As the result the electro-magnet 28 decreases the attraction of the lever 27, which is in turn rotated by a spring 34 in a clockwise direction until it contacts with a stopper 35, and releases the locking of the lock pawl 26. The lock pawl 26 is then rotated by a spring 25 around an axle 24 in a counter clockwise direction until it contacts with the lever 16, and a convex end 26a of the lock pawl 26 works on the lever 16 to rotate the same in a counter clockwise direction. By this rotation of the lever 16, the shutter ring 3 for the shutter blades 3' is rotated in a clockwise direction pushing the pin 37 to close the shutter blades 3'.

Although omitted in the device shown in FIG. 1, the delay device of the members 16 to 19 comprises a spring for its delay action, and the spring for its delay action is charged for example by a film winding or return back motion of the release bar 2. In the latter case, the device is called an "even-set type."

The relationship between the shutter blade opening and the time after the beginning of the shutter opening for EE photographing for the above embodiment shown in FIG. 1 is illustrated in FIG. 5.

Next, after exposure is completed by the shutter closure the push down force of the release bar 2 is released, then the release bar 2 is pulled upward by the spring 11, and the anchor gear 17 with the pin 19 thereon returns to the position shown in FIG. 1 by means of a member not shown in the drawing. Then the engagement of the bottom end part 2c of the release bar 2 with the lever 20 is freed, and the lever 20 rotates in a counter clockwise direction to rotate the lever 26 at the pin 23 thereon in a clockwise direction by the spring 21 against the spring 25. Further, as the release bar 2 ascends, the side portion 2a of the release bar 2 and the side portion 14a of the lever 14 engage with each other, thus stopping the anchor 18, and at the same time the ratch member 13 comes in contact with the stepped part 2b of the release bar 2, closing the starter switch 42 again and opening the main switch 12 of the shutter speed control circuit. Thus one cycle of photographing procedure in an EE photographing under natural light is completed.

41 is a pin planted on the shutter ring 3, 44 is an indicator member which is rotatably supported around the fixed member 1 at its center and which engages with the pin 41 at its one end for positioning its other end in the view field of a camera finder 46. In the view field of the camera finder 46 are provided indicating numerals for indicating F numbers. In case of a conventional shutter device, an F number of the shutter device is hardly previewed or postviewed. However, the indicating means shown in FIG. 1 is easily functions for the postview of the F numbers, i.e., the shutter speed in this case, because the frictional engagement is provided with the indicating member. 45 is a spring for the frictional engagement and the spring 45 is provided between the fixed member 1 and the indicating

member 44. 47 is a member for resetting the indicating member 44 against its frictional engagement. The member 47 may be associated with the film winding mechanism or the like.

When the change-over ring 29 both for EE photographing and artificial light photographing is changed over to the artificial light photographing, by rotating the same from the state shown in FIG. 1 to clockwise direction, a switch SP of the shutter speed control circuit is changed over from the photo conductive element 31 to a fixed resistor 38, and the energized time of the electro-magnet 28 is indicated by T' in FIG. 4. As the change-over ring 29 is rotated by a predetermined amount for the guide number of artificial light used, and as the distance ring 39 is rotated according to a shooting distance from the camera to an object, the adder member 4 is rotated around the pin 7 by the guide number cam 9 and the distance cam 8, through the pins 5 and 6 respectively and a contact member 40 which is fixed to or elastically supported around the adder member 4 for determining the blade opening and the time for closing synchronizer contacts is shifted within the path of the pin 41 which is planted to a projection of the shutter ring 3 for the shutter blades 3'.

In case when the member 40 is set to engage with the pin 41, the shutter ring 3 is rotated by the operation of the release bar 2 to such a position as corresponding to the prescribed diaphragm value determined by the guide number and the photographing distance, the synchronizer contacts are contacted when the prescribed diaphragm value is obtained by the shutter releasing operation.

In this case, if the spring 10 is made weak as compared with the spring 30, the shutter ring 3 continues its rotation against the spring 10, even after the pin 41 contacts with the cam surface 40a of the member 40, and the mode of the shutter operation is shown by the curve T of FIG. 4.

On the other hand, if the spring 10 is made strong as compared with the spring 30, the pin 41 stops its movement contacting the cam surface 40a, and after a prescribed length of time as determined by the time constant of the time control circuit, the locking of the lock pawl 26 is released, thus closing the shutter, and the mode of the shutter operation is shown by the curve T_1 in FIG. 3.

When the synchronizer switch X_e is commonly used as the starter switch 42 for the capacitor 32 or as a short-circuiting contact 13 for the transistor TR_1 , the shutter starts closing immediately after illumination of a flash tube P, and the mode of the shutter operation is shown by the curve T_2 in FIG. 6, thus other lights than the artificial light source does not affect the photographing.

Also it is possible to arrange the device in such a way that the switches 42, 43 are closed for the shutter closure always with an elapse of a prescribed length of time after the synchronizer contact switch X_e is closed. The mode of the shutter operation for this case is shown by the curve T_3 in FIG. 7.

As the shutter device according to the present invention comprises a shifting member such as the shutter ring 3 which shifts from its standard position with a constant shutter opening rate, and a blade for determining the blade opening in correspondence to the

amount of the shifting movement, the blade openings f_1, f_2, f_3 and f_4 correspond directly to the time for illumination of the flash device t_1, t_2, t_3 and t_4 respectively.

As the present invention is applied to the modes of the shutter operation as follows:

1. The stoppage of the shutter opening at the time of the closure of the synchronizer switch shown by T_1 in FIG. 3 and T_3 in FIG. 7 respectively;

2. The opening of the shutter after the closure of the synchronizer switch shown by T in FIG. 3, FIG. 4 or FIG. 7; and

3. The closure of the shutter at the time of the closure of the synchronizer switch shown by T_2 in FIG. 6, the photographing with artificial lighting is performed without fail under optimum conditions by controlling the action of the shutter in correspondence to the length of illuminating time of the flash tube such as the flash bulb P or the discharge tube P' . When a flash bulb is used, it is necessary to keep the shutter to function in the mode shown in FIG. 3 or FIG. 7 for a certain length of time after the closure of the synchronizer switch.

The shutter device according to the present invention is applicable to a flash photographing with a flash bulb as shown in FIG. 2 in which a program switch S_p for changing over from a terminal EE for EE photographing to a terminal FA for flash photographing is changed over by the change over ring 29 shown in FIG. 1.

However, as the flash bulb P has a rather long time-to-peak and a rather long illumination time, and overexposure is apt to result when the object to be photographed has lights other than the light from the flash bulb. However in such cases as a discharge tube has a short time-to-peak and a short illumination time with strong illumination intensity, the result is that the overexposure is reduced. The circuit shown in FIG. 8 is useful for the above case, in which P_s is a power source for a flash device comprising a main capacitor C , a discharge tube P' and a transformer T_f for triggering the ignition or illumination of the discharge tube P' . E shows a portion provided in a camera in which 32' is a timer capacitor similar to the capacitor 32 but in this case is use also for a capacitor for a triggering circuit, X_s is a synchronizer switch provided in the camera. Other portions of the camera E are omitted in FIG. 8, but are easily understood from the description made referring to FIG. 2. I_1 and I_2 are a first coiling and a secondary coiling for the transformer T_f . In this circuit, the timer capacitor 32' for a time control circuit in the camera E is commonly used in the triggering circuit composed of the first coiling I_1 and the synchronizer switch for rendering the device very compact with a simple construction. Circuits shown in FIGS. 9 to 12 are similar to those of the embodiments shown in FIGS. 1, 2 and 8, but a contactless synchronizer switching means is provided in each of the circuits.

Descriptions will be made in connection with FIGS. 9, 10, 11 and 12 limitedly to members which are not used in the embodiments shown in FIGS. 1, 2 and 8. In FIG. 9, 38' is a variable resistor for photographing informations such as guide number shooting distance or film sensitivity. S_p' is a program switch which is associated with the change-over switch S_p and which is opened when the switch S_p contacts with the terminal FA . R is a collector resistor of the transistor TR_1 for

controlling the transistor TR_2 . D is a Zener diode connected to the emitter of the transistor TR_1 for determination of the inverting level of the transistor TR_1 . In this circuit, an electro-magnet 28' is connected in series with the first coiling I_1 of the transformer T_f , and therefore when the change-over switches S_p and S_p' are changed over for EE photographing, the first coiling I_1 is terminated by the switch S_p' to kill the operational coupling of the transformer for triggering the discharge tube P' .

When the change-over switches S_p and S_p' are changed over for flash photographing as shown in FIG. 9, the electro-magnet 28' and the first coiling I_1 are commonly and simultaneously energized in correspondence with the input level of the time constant circuit to the transistor TR_1 , the shutter device for this circuit is closed by the energized electro-magnet 28' in contrary to the dienergized electro-magnet 28 shown in FIG. 2.

In FIG. 10, the first coiling I_1 of flash device F is provided in parallel with the electro-magnet 28' with the aid of connector means W_1 and W_2 . In this case, the functional behavior is quite similar to that shown in FIG. 9.

E' in FIG. 11 is a main portion of a camera, the details of which are shown in FIG. 12. In FIGS. 11 and 12, R_3 is a common emitter resistor for the transistors TR_1 and TR_2 , L is a lamp one end of which is commonly connected to the collector of the transistor TR_1 and the base of the transistor TR_2 . S_p' is a change-over switch which is closed for flash photographing, and which is opened for EE photographing. P_x is a photo-transistor which is coupled with the lamp L to receive the light therefrom. R_4 is a resistor and C_1 is a capacitor. The resistor R_4 and the capacitor C_1 are connected in series with the first coiling I_1 . The photo-transistor P_x is connected in parallel with the series circuit of the capacitor C_1 and the first coiling I_1 . A and B represent parting terminals of the flash device and the camera. In this case, when the electro-magnet 28 is dienergized for shutter closure, the lamp L is illuminated for shorting the photo-transistor P_x which serves as a synchronizer switch.

What is claimed is:

1. A shutter apparatus for synchronization with a flash, comprising a shutter member movable across a path of light for variably blocking the quantity of light traveling along a path, shifting means coupled to said shutter member and movable along a predetermined path for movement from a starting position toward one of a plurality of positions at each of which the member blocks a different amount of light, speed control retarding means engaging said shifting means for controlling the speed of movement of said shifting means and thereby said shutter member, setting means for setting flash lighting conditions, closeable circuit means for triggering the flash when closed, contact means forming a part of said circuit means and movable by said setting means to a plurality of positions depending upon the flash lighting conditions, and contact actuating means mounted on said shifting means and movable with said shifting means to engage said contact means for closing the circuit means, said contact actuating means and said contact means forming flash synchronizing means.

2. An apparatus as in claim 1, wherein said shutter means includes a blade and wherein said shifting means includes a rotatable shifting member coupled to the blade and moving the blade while said shifting member rotates.

3. An apparatus as in claim 1, wherein said contact means forms a first contact element and said contact actuating means a second contact element.

4. An apparatus as in claim 3, wherein said shutter means comprises a blade and wherein said shifting means includes a rotatable shifting member coupled to the blade and moving said blade while said shifting means rotates.

5. An apparatus as in claim 1, wherein said retarding means includes stopping means for stopping and reversing the movement of said shifting means, said stopping means including a lock member engageable with said shifting means and a drive mechanism releasable at a predetermined time to contact said lock member for driving said shifting means in the reverse direction.

6. An apparatus as in claim 1, wherein said retarding means includes stopping means coupled to said setting means for stopping the movement of said shifting means at a predetermined position and driving said shifting means back to its starting position in response to said setting means.

7. An apparatus as in claim 1, wherein said contact means is movable by said setting means out of the path of said actuating means so as to avoid closing said circuit means.

8. An apparatus as in claim 1, further comprising electric eye means, stopping means forming a portion of said retarding means and responsive to said setting

means for stopping and returning said shifting means to its starting position in response to said electric eye means, said setting means being capable of connecting said electric eye means to cause said stopping means to respond thereto and being capable of moving said contact means out of the path of engagement with said contact actuating means.

9. Apparatus as in claim 1, wherein said contact means is elastically mounted so that said contact actuating means can contact said contact means and then pass over said contact means.

10. An apparatus as in claim 1, further comprising indicating means movable by said shifting means to a position corresponding to the position toward which said shifting means moves, said indicating means including friction means for retaining said indicating means in the position to which it has been moved by said shifting means when said shifting means returns to its starting position.

11. An apparatus as in claim 4, wherein said contact means is movable by said setting means out of the path of said actuating means so as to avoid closing said circuit means.

12. An apparatus as in claim 4, further comprising electric eye means, stopping means forming a portion of said retarding means and responsive to said setting means for stopping and returning said shifting means to its starting position in response to said electric eye means, said setting means being capable of connecting said electric eye means to cause said stopping means to respond thereto and being capable of moving said contact means out of the path of engagement with said contact actuating means.

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