United States Patent [19]

Maitani et al.

[11] **4,065,777**

[45] **Dec. 27, 1977**

[54] **PHOTOMETRIC APPARATUS FOR SINGLE LENS REFLEX CAMERA**

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[73] Assignee: **Olympus Optical Company, Ltd.**, Tokyo, Japan

[21] Appl. No.: **717,089**

[22] Filed: **Aug. 24, 1976**

Related U.S. Application Data

[62] Division of Ser. No. 505,956, Sept. 13, 1974, Pat. No. 3,994,001.

[51] **Int. Cl.²** **G03B 7/08**

[52] **U.S. Cl.** ..... **354/23 R**; 354/59; 354/51; 354/60 R

[58] **Field of Search** ..... 354/23 R, 31, 56, 59, 354/241-244, 354

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Primary Examiner—L. T. Hix
Assistant Examiner—William B. Perkey
Attorney, Agent, or Firm—Ostrolenk, Faber, Gerb & Soffen

[57] **ABSTRACT**

A photometric apparatus for single lens reflex camera and of the type in which an exposure value is determined by photometry of light which is transmitted through a photographic optical system and is reflected by at least one of the surfaces of a shutter blind and a film, said apparatus comprising a photoelectric transducer element for receiving light reflected by at least one of the surfaces of a shutter blind and a film, and an operational amplifier for biasing the photoelectric transducer element to maintain the voltage applied thereacross substantially null, thereby enabling a photometric output of the photoelectric transducer element to be effectively derived even when the amount of light received is minimal. The shutter blind is provided with a surface upon which at least two portions thereof have different coefficients of reflectivity to reduce adverse effects of reflected light upon the desired exposure period.

3 Claims, 21 Drawing Figures

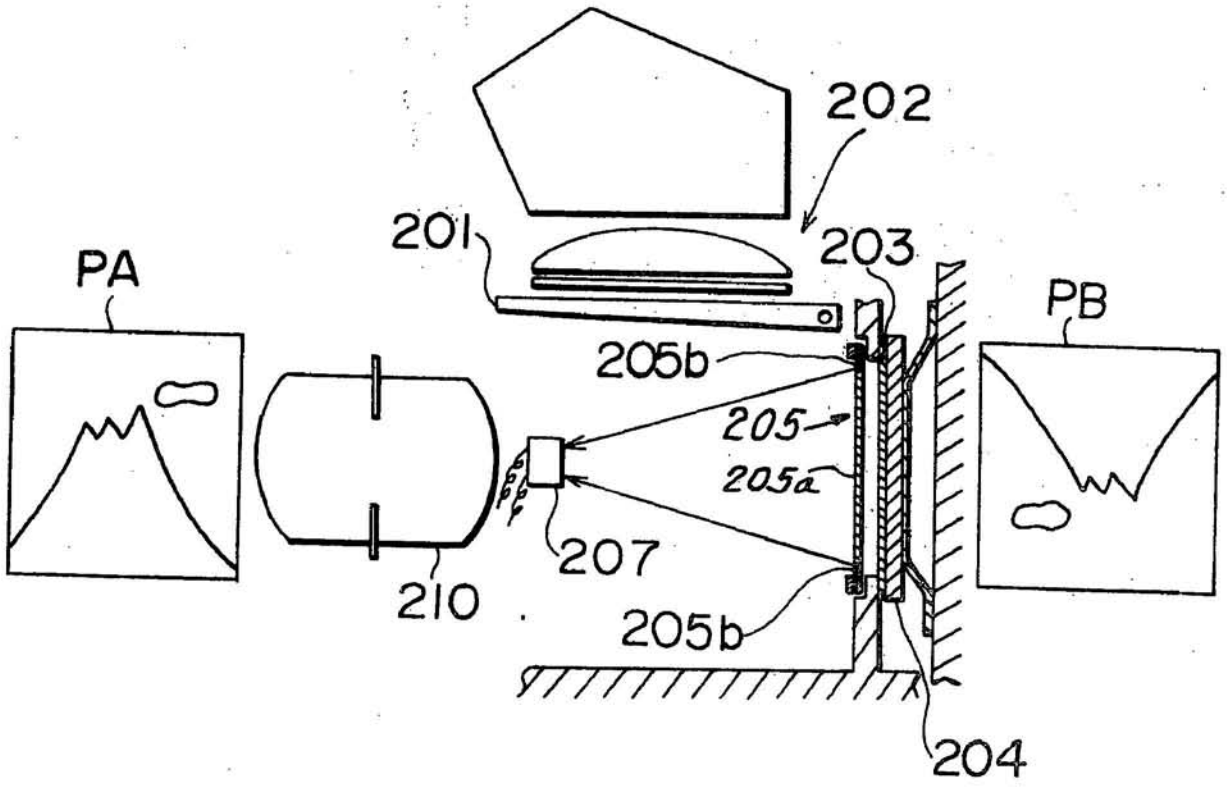
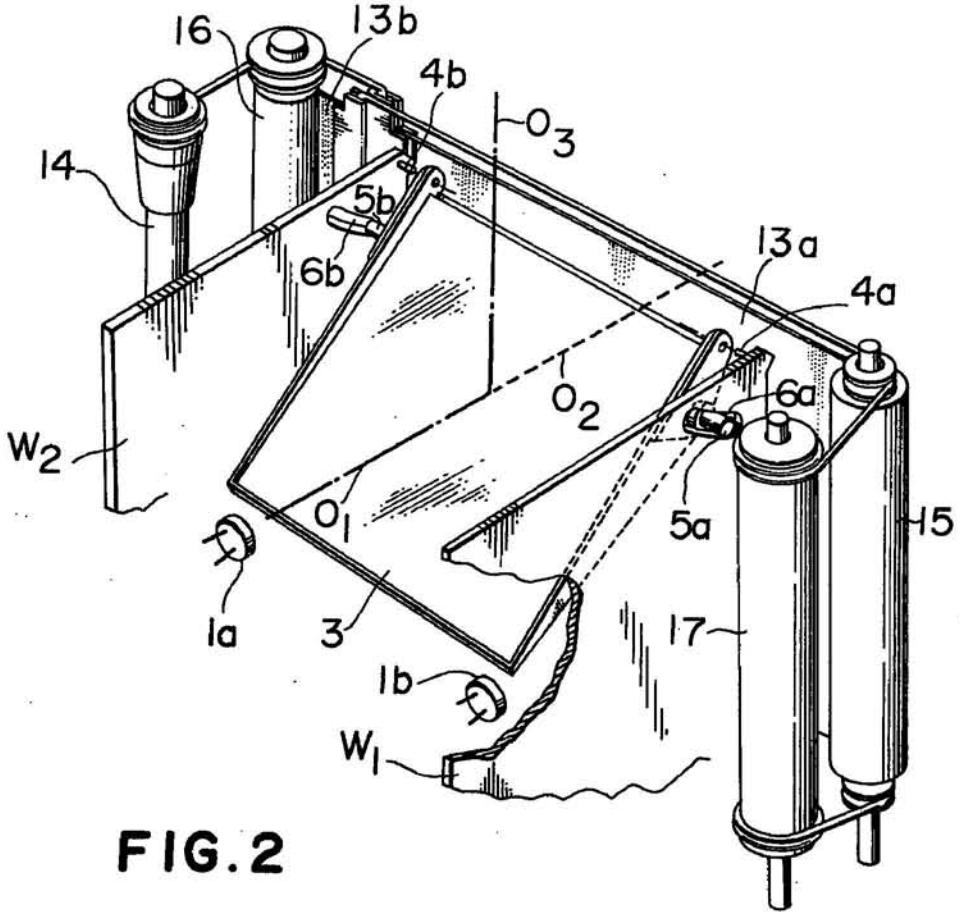


FIG. 1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4b
O_3
14
5b
6b
13a
4a
O_2
6a
W_2
O_1
5a
15
1a
3
17
1b
W_1

FIG. 2

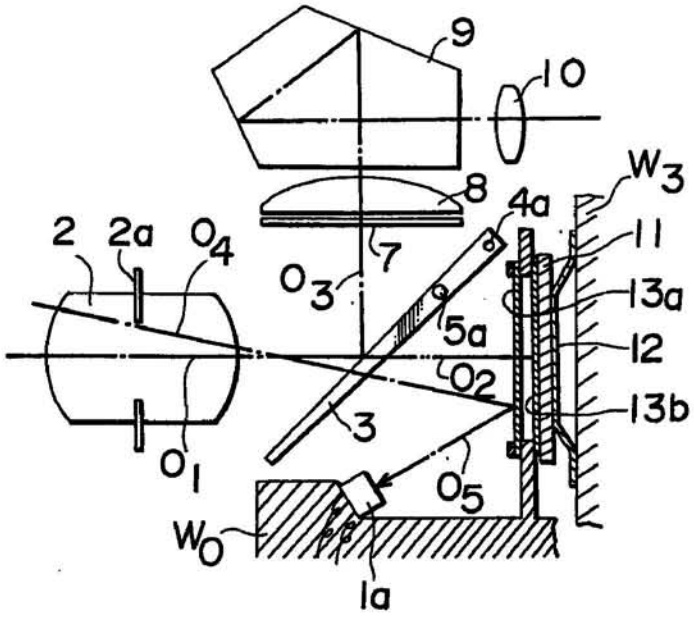
9
10
W_3
8
4a
2
2a
O_4
7
11
O_3
13a
5a
12
O_2
13b
3
O_1
O_5
W_0
1a

FIG. 3

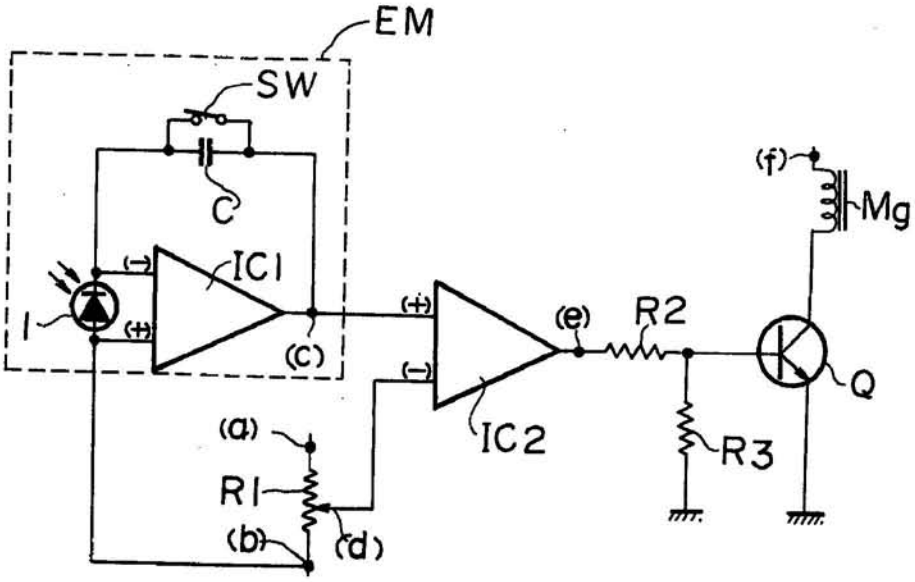

FIG. 4

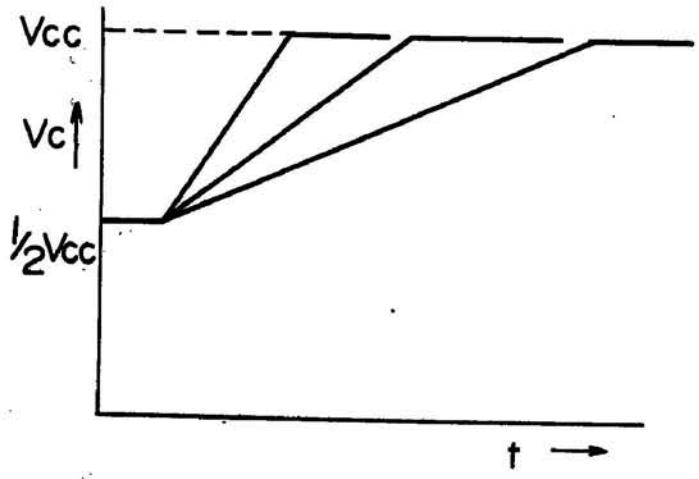

FIG. 5

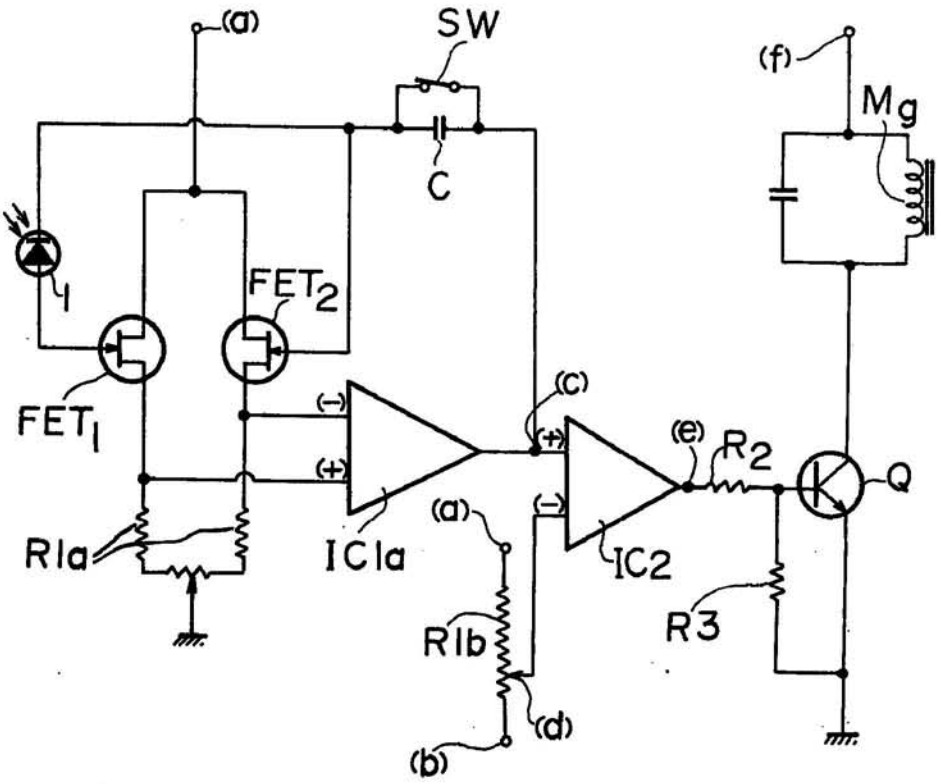

FIG. 6

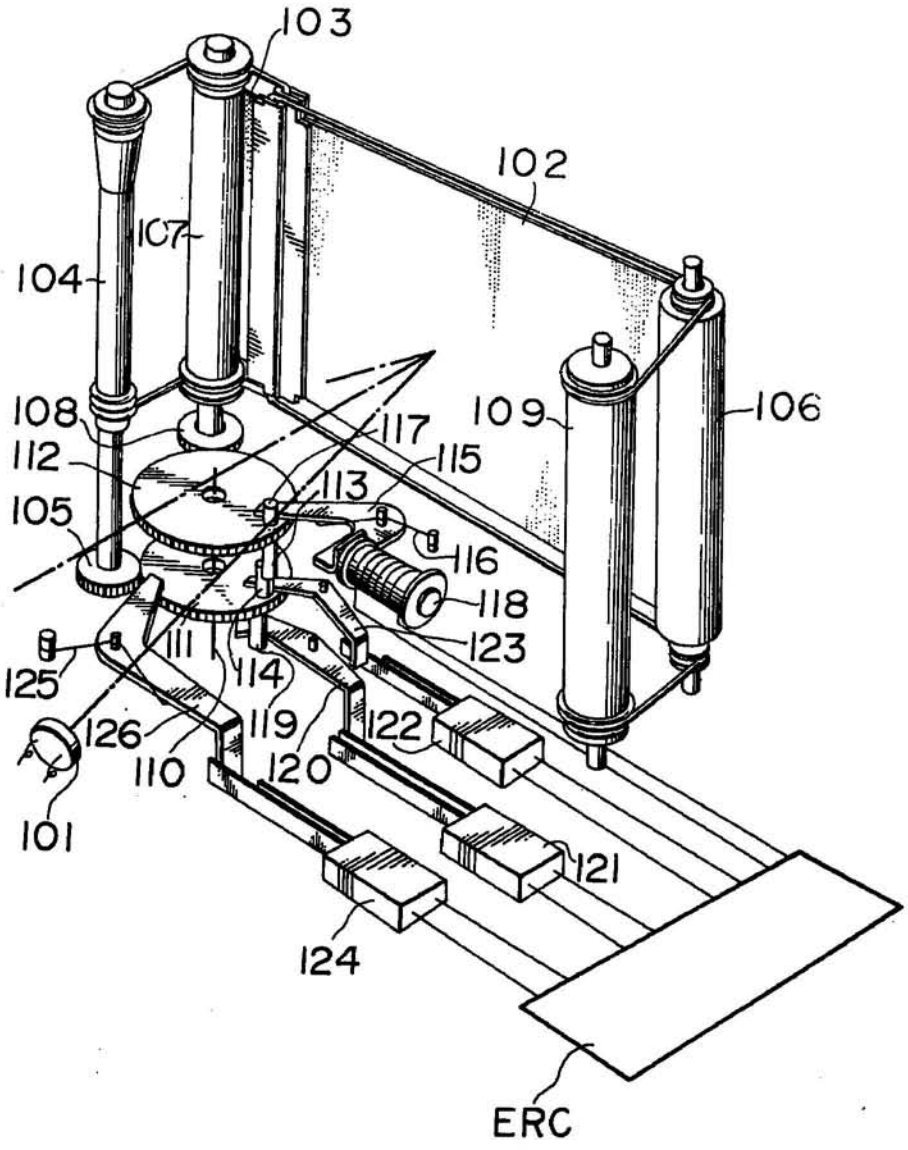
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FIG. 7

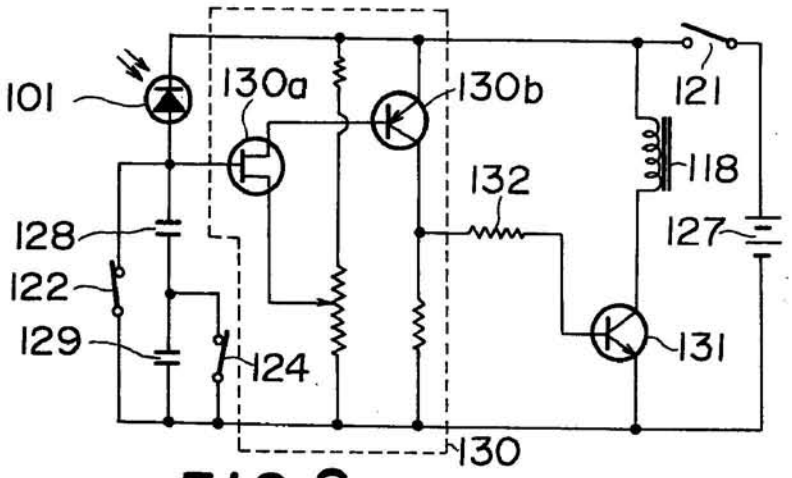


FIG. 8

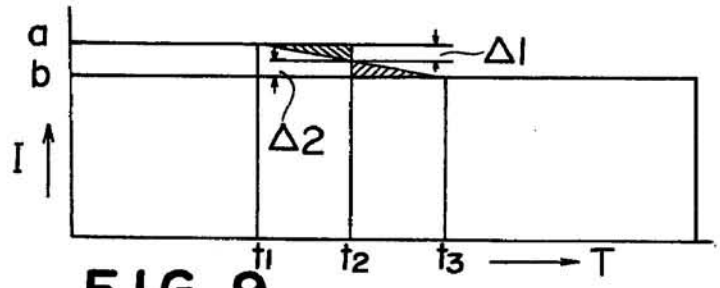


FIG. 9

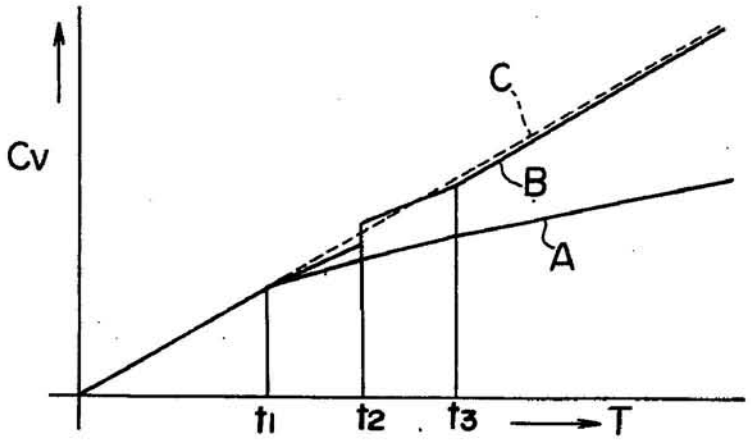
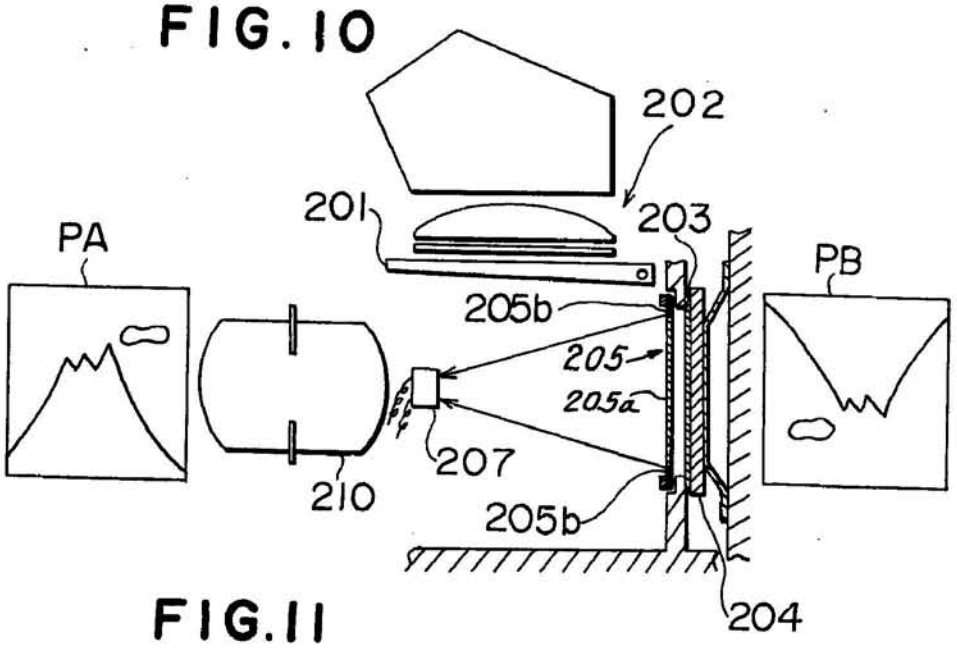


FIG. 10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201
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PA
PB
205b
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210
205b
204

FIG. 11

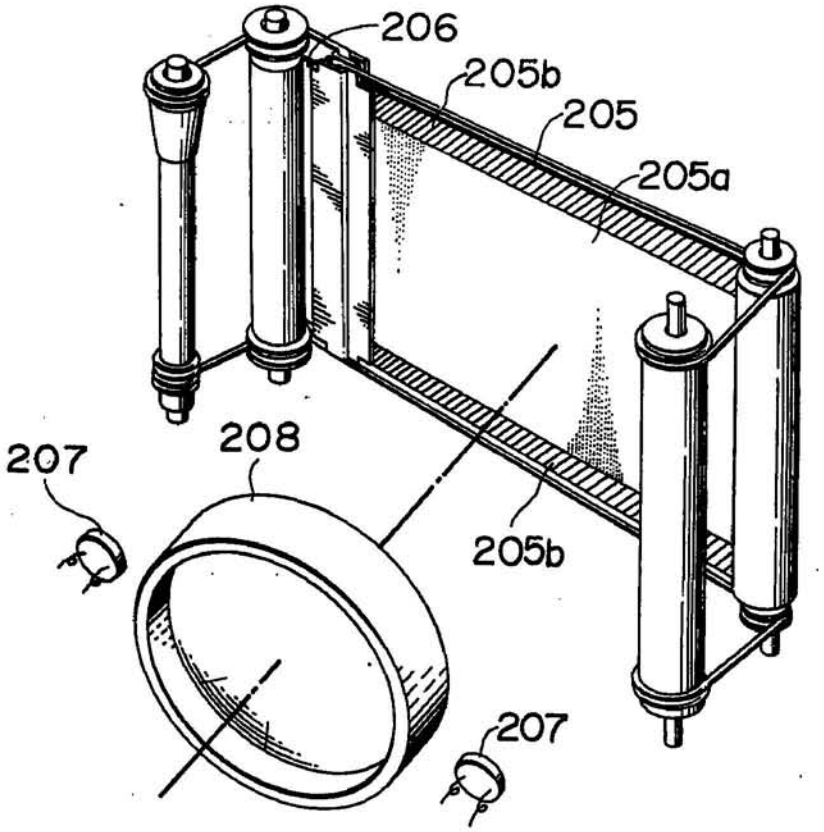
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FIG. 12

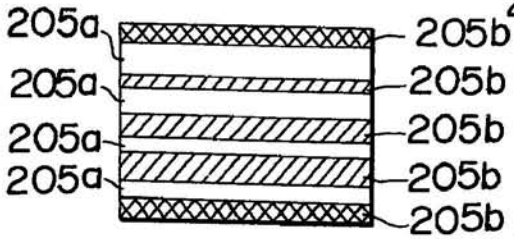


FIG. 13

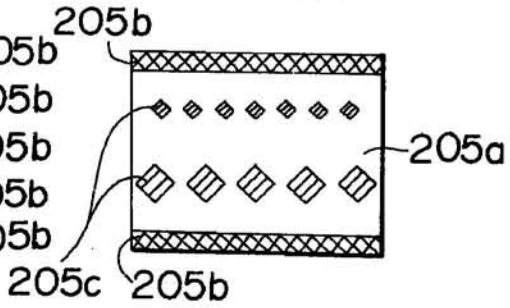


FIG. 14

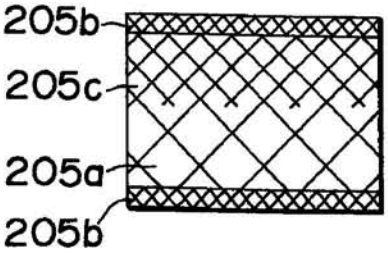


FIG. 15

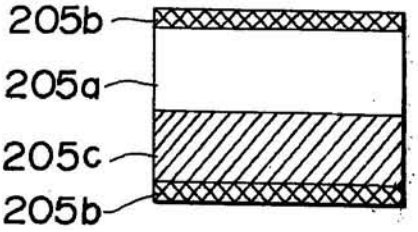


FIG. 16

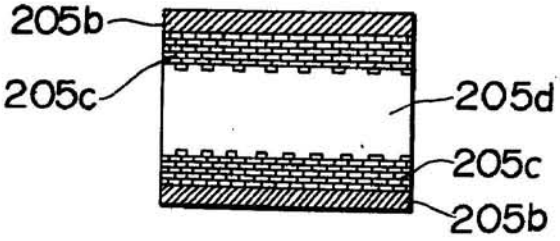
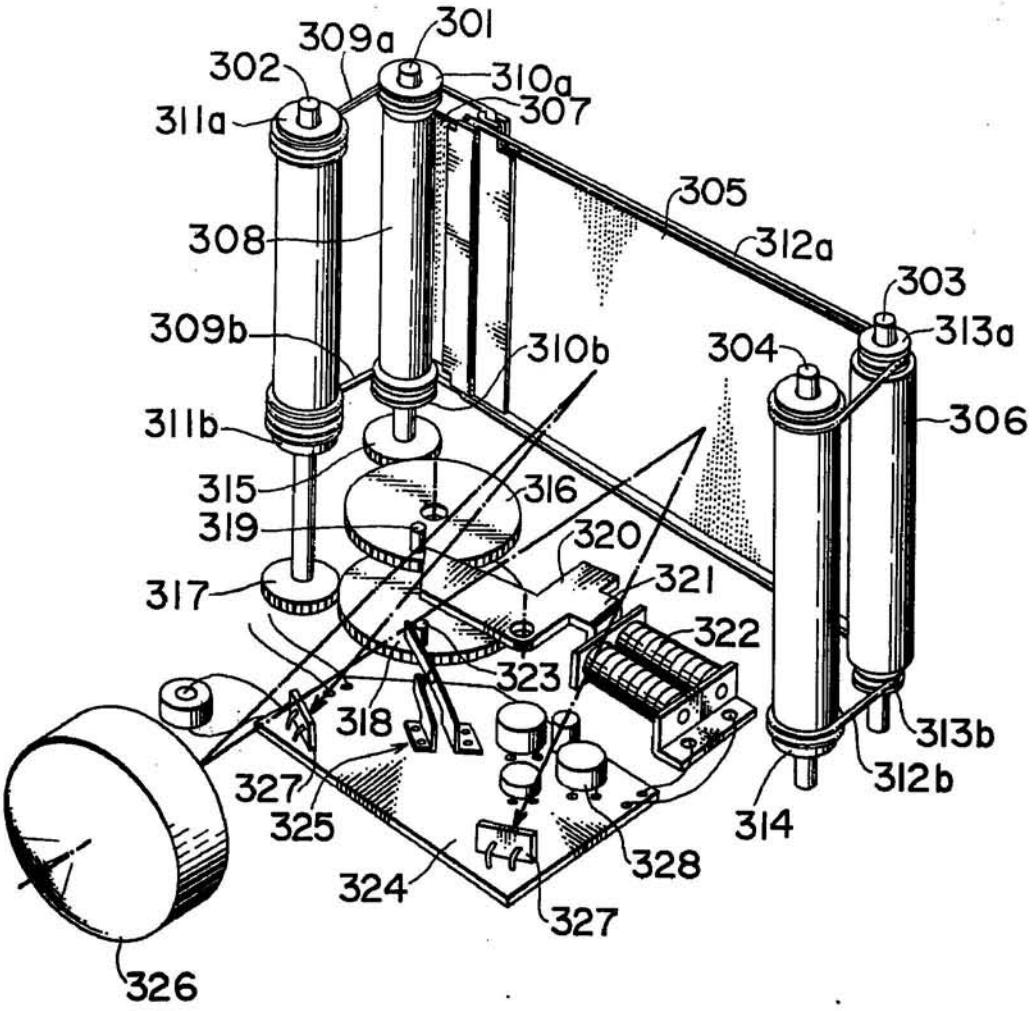


FIG.17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301
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312a
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309b
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FIG. 18

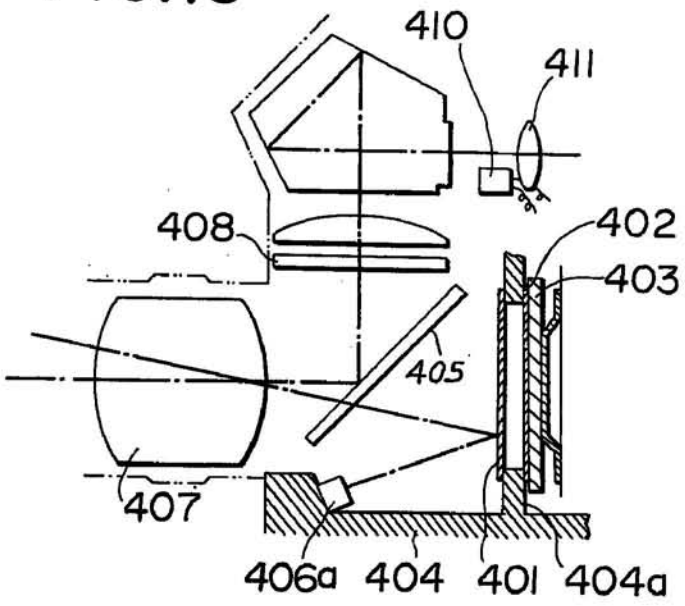
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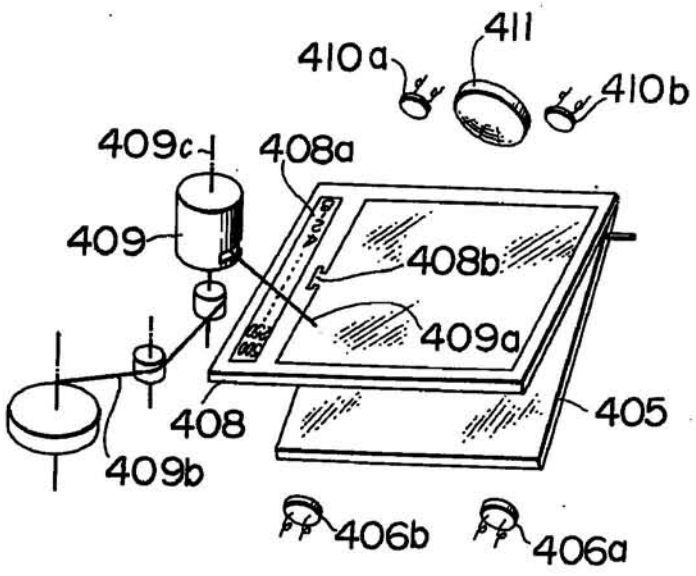
FIG. 19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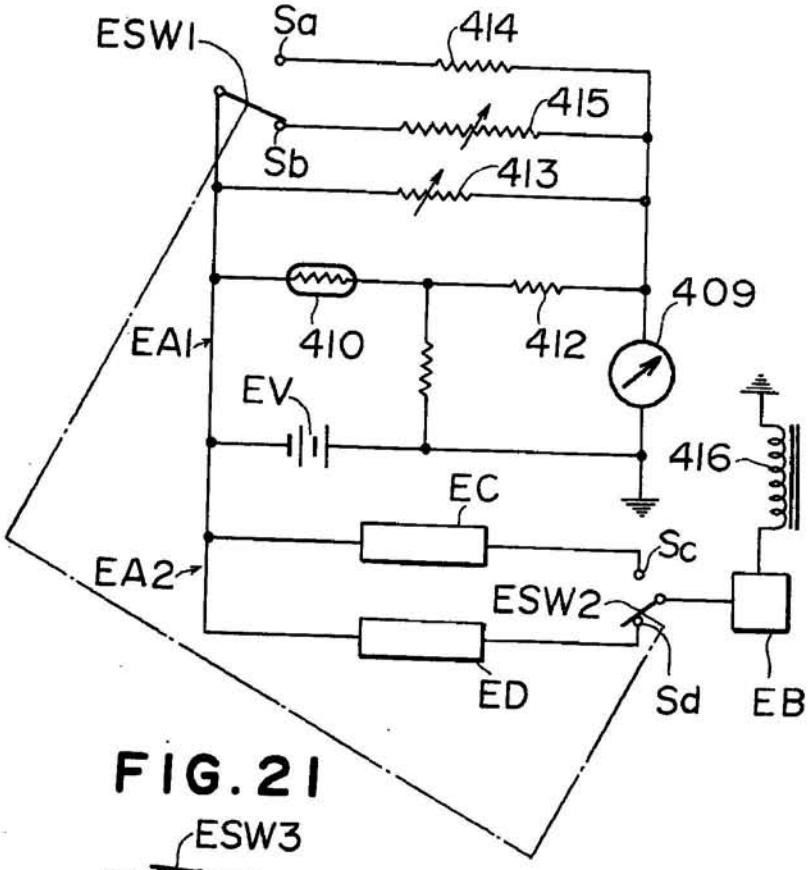
406b
406a

FIG. 20


ESW1
Sa
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Sb
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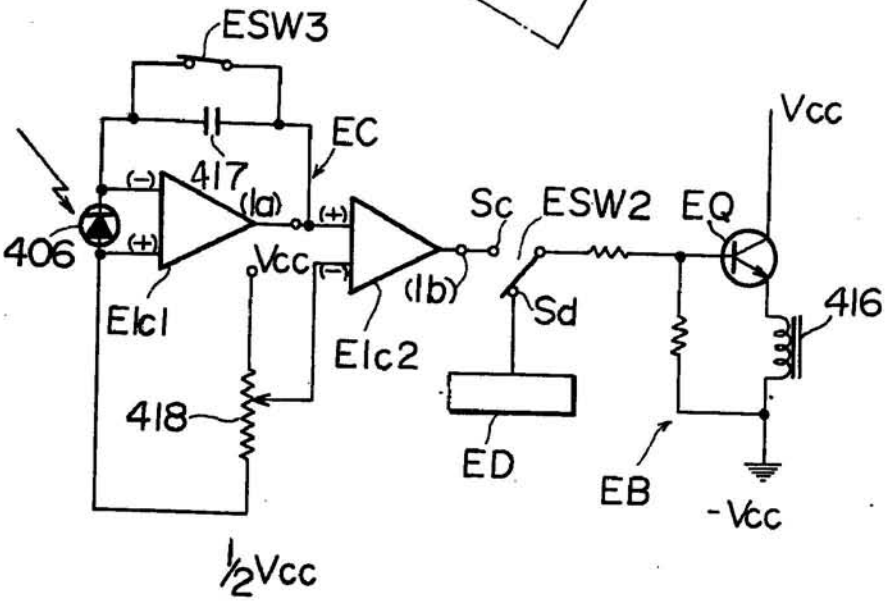
409
410
412
EA1
EV
416
EC
Sc
EA2
ESW2
ED
Sd
EB

FIG. 21


ESW3
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(-)
(+)
(a)
406
Vcc
Sc
ESW2
EQ
(+)
(-)
(b)
Sd
416
Elc1
Elc2
418
ED
EB
-Vcc
½Vcc

PHOTOMETRIC APPARATUS FOR SINGLE LENS REFLEX CAMERA

This is a division of Application Ser. No. 505,956, filed Sept. 13, 1974 now U.S. Pat. No. 3,994,001.

BACKGROUND OF THE INVENTION

The invention relates to a photometric apparatus for single lens reflex cameras of the type in which an exposure value is determined by photometry with a photoelectric transducer element which senses light reflected from an object being photographed which light is transmitted through a photometric optical system and is further reflected by at least one of the surfaces of a film and a shutter blind.

In a conventional single lens reflex camera, the light which is transmitted through a photographic optical system is made to be directly incident on a photoelectric transducer element which is interposed on a light path at a position nearer an object being photographed than a film. This arrangement requires the provision for storage of a photometric result until a shutter blind is allowed to operate. As a result, an expensive memory is required in a photometric system of this type. In addition, because photometry is interrupted when the film is being exposed, there resulted an inconvenience such that when exposure factors vary, a close adherence to such variation can not be followed. Additionally, there is a need for a change-over switch which is operated upon shutter release in order to permit a recovery of the stored photometric value from the memory, thereby adding to the complexity and the possibility of occurrence in failures of the system.

There has been a proposal which overcomes such inconveniences by determining an exposure value by photometry with a photoelectric transducer element of light from an object being photographed which is transmitted through a photographic optical system and is reflected by at least one of the surfaces of a shutter blind and a film. However, as the light which is transmitted through the photographic optical system is weakened, the reflected light from the surface of either the shutter blind or the film will be still further reduced in intensity as a result of the diaphragm setting, presenting a difficulty in that the operation of the photoelectric transducer element becomes critical. The situation is even more aggravated by the fact that the circuit arrangement usually employed is such that the transducer element is applied with a voltage from an operational amplifier which receives an output therefrom. The voltage applied from the operational amplifier prevents a minimal output from the transducer element from being determined with a sufficient accuracy, thus making it impossible to provide photometry of light having a minimal intensity.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a photometric apparatus which comprises a photoelectric transducer element for receiving light reflected from at least one of the surfaces of a film and a shutter blind, and an operational amplifier for biasing the transducer element so as to maintain the voltage applied thereacross substantially null, thereby enabling an effective photometric value to be derived from a critical operation of the transducer element.

In accordance with the invention, the photoelectric transducer element is biased by means of the operational amplifier, avoiding the application of an unnecessary voltage across the element, so that a critical operation of the transducer element in response to a weak light can be effectively determined as a photometric value.

It is another object of the invention to add to the photometric apparatus a photometry correction circuit which is operated by a switch interlocked with the movement of the first blind of the shutter so as to eliminate a difference in the optical reflectivity between the shutter blind and film surfaces.

It is a further object of the invention to provide a first blind of the shutter which comprises reflecting surfaces of high and low reflectivities, thereby minimizing the influence of the reflection light upon the film.

It is still another object of the invention to provide an ideally compact camera by locating the photoelectric transducer element and a photometry trigger switch on a printed circuit board including a shutter control circuit, and by positioning the printed circuit board below a reflecting mirror which switches between a view finder light path and a photographic light path.

It is an additional object of the invention to provide, in addition to the photoelectric transducer element which receives a reflected light from at least one of the surfaces of a shutter blind and a film, a second photoelectric transducer element which is responsive to a reflected light from a reflecting mirror which switches between a view finder light path and a photographic light path, so as to permit a display of the shutter operation by means of the second transducer element.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the general arrangement, partially broken away, of a single lens reflex camera in which the photometric apparatus according to the invention is incorporated;

FIG. 2 is an elevational view, partly in section, of part of the single lens reflex camera shown in FIG. 1;

FIG. 3 is a circuit diagram of a shutter control unit including the photometric apparatus according to one embodiment of the invention;

FIG. 4 is a diagram showing the charging of a capacitor which is used in a time constant circuit;

FIG. 5 is a circuit diagram of another shutter control unit including the photometric apparatus according to another embodiment of the invention;

FIG. 6 is a fragmentary perspective view of a single lens reflex camera, illustrating another application of the photometric apparatus according to the invention;

FIG. 7 is a circuit diagram showing a shutter control unit including the photometric apparatus according to a further embodiment of the invention;

FIG. 8 graphically shows the mode of operation of a photometry correction circuit;

FIG. 9 graphically shows a differential charging of the capacitor with and without photometry correction;

FIG. 10 is a schematic elevation, partly in section, of the single lens reflex camera incorporating the photometric apparatus according to still another embodiment of the invention;

FIG. 11 is a fragmentary perspective view of the single lens reflex camera shown in FIG. 10;

FIGS. 12 to 16 are plan views illustrating examples of the reflecting surface of the first blind of the shutter;

FIG. 17 is a perspective view of a single lens reflex camera incorporating the photometric apparatus according to a still further embodiment of the invention;

FIG. 18 is a schematic side elevation, partly in section of the single lens reflex camera shown in FIG. 17;

FIG. 19 is a perspective view showing the relative positioning of the light path switching reflecting mirror and the photoelectric transducer element;

FIG. 20 is a circuit diagram of a display device for displaying the operation of the shutter which may be used in the apparatus of the invention; and

FIG. 21 is a circuit diagram of a shutter control unit incorporating the photometric apparatus according to an additional embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, there is shown a part of a single lens reflex camera in which the photometric apparatus according to the invention is incorporated. Referring to these Figures, a pair of photoelectric transducer elements 1*a* and 1*b* are secured to the bottom plate W_0 of a camera body at positions below and on the opposite lateral sides of a reflecting mirror 3 which switches light that is transmitted through a photograhic optical system 2 (see FIG. 2) along a light path O_1 between a photographic light path O_2 and a. The reflecting mirror 3 is swingably mounted at pivots 4*a*, 4*b* on a pair of sidewalls W_1, W_2. The reflecting mirror also carries a pair of studs 5*a* and 5*b* which are fitted in a pair of arcuately elongate slots 6*a* and 6*b* formed in the sidewalls W_1 and W_2, respectively, so as to constrain the extent of rotation thereof. When the shutter is not released, the reflecting mirror 3 assumes its lower position shown in FIG. 2 in which it is inclined by an angle of 45° with respect to the light path O_1 to guide the light from the light path O_1 to the finder light path O_3.

The finder light path O_3 comprises a matt glass 7, a magnifying lens 8, a pentaprism 9 and an eyepiece 10, as shown in FIG. 2, and the image of an object focussed on the matt glass 7 can be observed through the eyepiece 10.

When the shutter is released, the reflecting mirror 3 rotates clockwise, as viewed in FIG. 2, by interlocked movement therewith to connect the light path O_1 with the photographic light path O_2. A film 11 is disposed on the photographic light path O_2 at a position where the image of an object being photographed is focussed, and is maintained in a planar configuration as a result of pressure from a rear plate 12 which is mounted on a rear lid W_3.

The first blind 13*a* and the second blind 13*b* of the shutter are disposed immediately in front of the film 11. The first blind 13*a* isolates the film 11 from the photograhic light path O_2 subsequent to a film winding operation until the shutter is released to move the reflecting mirror 3 upwards. Under this condition, the first blind 13*a* is taken up by a first blind winding drum 14 (see FIG. 1), and as the mirror 3 moves up upon shutter release, the first blind runs across the film 11 by being taken up on a take-up drum 15, thereby allowing the film 11 to be exposed to the photographic light path O_2. On the other hand, the second blind 13*b* is normally wound on a second blind winding drum 16, and a secnd blind take-up drum 17 is constrained by an electromagnet *Mg* (see FIG. 3) which is energized upon shutter release and deenergized at a time depending on a photometric result, whereupon the electromagnet permits the drum 17 to take up the second blind 13*b*, thus causing it to run across the film to isolate it from the photographic light path O_2.

FIG. 3 shows a unit for controlling the electromagnet Mg and includes the photometric apparatus EM according to one embodiment of the invention. It is to be noted that the photoelectric transducer elements 1*a* and 1*b* are designated by a single reference numeral 1 for the purpose of convenience. In practice, these elements are connected in parallel, but may be connected in series. These transducer elements comprise a photovoltaic element such as silicon blue cell, and operate to produce a photometric voltage in response to a light path O_4 from an object being photograhed which is transmitted through the photometric optical system 2 and reflected by the surface of the first blind 13*a* or film 11 along a path indicated at O_5.

Referring to FIG. 3, the transducer element 1 is connected across the non-inverting input terminal (+) and an inverted input terminal (−) of an operational amplifier IC1 having a gain of unity, the terminal (+) being connected with a power source (not shown) through a resistor R1. Denoting the terminal of the resistor R1 which is located nearer the power source by (*a*) and its opposite terminal by *b*, the arrangement is such that a source voltage of Vcc is applied to the terminal *a* while a voltage of $\frac{1}{2}$ Vcc is applied to the terminal *b*. The output terminal *c* of the operational amplifier IC1 is connected with the inverted input terminal (−) thereof through a time constant capacitor C which is shunted by a trigger switch SW. The output terminal *c* of the operational amplifier IC1 is also connected with the non-inverting input terminal (+) of a differential amplifier IC2, the inverted input terminal (−) of which is connected with to an adjustable aim at point *d* on the resistor R1. The movable point *d* is adjusted to a suitable position on the resistor R1 so as to apply an optimum voltage to the differential amplifier IC2 depending on the information such as film speed which is necessary to taking a picture. The output terminal *e* of the differential amplifier IC2 is connected with one terminal of a resistor R2, the other terminal of which is connected with the base electrode of transistor Q, the base being connected with to ground potential through resistor R3. The transistor Q has its emitter connected to ground and has its collector connected in series with the electromagnet Mg, and the source voltage Vcc is applied to the opposite terminal *f* of the electromagnet.

In operation, when the shutter is released, the reflecting mirror 3 moves up. Before the first blind 13*a* initiates its movement, the photometry trigger switch SW is closed by interlocked motion with the shutter release, whereby the output voltage of the operational amplifier IC1 or the voltage Vc at the terminal *c* is negatively fed back to its inverted input terminal (−), thus becoming equal to the voltage of $\frac{1}{2}$ Vcc which is applied to the non-inverting input terminal +. Consequently, the voltage applied to the inverted input terminal (−) of the differential amplifier IC2 will be greater than the output voltage of the operational amplifier IC1 which is applied to the non-inverting input terminal (+) thereof, so that the transistor Q is rendered conductive to energize the electromagnet *Mg*. The energization of the electromagnet *Mg* is effective to constrain the second blind take-up drum 17 from rotation, so that the second blind 13*b* can not move.

When the first blind 13*a* initiates its movement upon shutter release, the trigger switch SW is opened by interlocked movement with the movement of the first blind 13*a*, and as a result, the output of the operational amplifier IC1 is now fed back through the capacitor C

in a manner such that no voltage is applied across the photoelectric transducer element 1. A current will flow therethrough in proportion to the amount of light incident on the transducer element 1 as reflected initially by the first blind 13*a* and subsequently by the film 11, thus charging the capacitor C. As the capacitor C charges, the output voltage Vc of the operational amplifier IC1 will rise in a manner proportional to the amount of light incident on the transducer element 1, eventually reaching a value equal to the source voltage Vcc, for example. When this occurs, the voltage applied to the non-inverting terminal (+) of the differential amplifier IC2 will become greater than the voltage applied to the inverted input terminal (−) thereof, so that the output voltage will be reversed, rendering the transistor Q non-conductive to deenergize the electromagnet Mg and thus release the second blind take-up drum 17 for rotation. Thereupon, the second blind runs to isolate the film 11 from the photographic light path O_2 after a given period of exposure which is determined by the photometric value.

In the present embodiment, it will be noted that initialy a bias voltage of ½ Vcc is initially applied to the non-inverting input terminal (+) while a voltage of the same value is applied to the inverted terminal of the operational amplifier IC1 by the feedback from the output thereof, so that a net voltage applied externally across the transducer element 1 is null or substantially null. This permits the capacitor C to be charged in a linear manner commencing from a voltage of ½ Vcc until a voltage of Vcc is reached, thereby assuring a very precise control of the exposure period even when the output voltage of the photoelectric transducer element 1 is minimal as when a diaphragm 2*a* (see FIG. 2) of the photographic optical system 2 is set at a small value. On the contrary, if a voltage is applied to the transducer element 1 from the operational amplifier IC1 as in the usual practice, the output of the transducer element 1 will be adversely influenced by the applied voltage, preventing an exact determination of a minimal output. It should be understood that the particular value of the bias voltage need not be restricted to ½ Vcc, but may be freely established as required.

In the above embodiment, it is essential that the operational amplifier IC1 has a relatively high input impedance. This would require a special integrated circuit such as one including a field effect transistor in the circuit of IC1. However, the use of such a special integrated circuit may be avoided by an arrangement shown in FIG. 5 wherein a general purpose operational amplifier IC1*a* is used in combination with a pair of field effect transistors FET_1 and FET_2 which are connected in parallel to form an impedance conversion circuit. Specifically, the field effect transistors have their source electrodes connected in common to a power supply while their drain electrodes are connected to ground through resistors R1*a*. The gate of the transistor FET_1 is connected with one terminal of the transducer element 1 while the gate of the transistor FET_2 is connected with the other terminal of the transducer elemnt 1. The remainder of the circuit is the same as shown in FIG. 3.

FIG. 6 shows another embodiment of the photometric apparatus according to the invention which assures a proper amount of exposure regardless of differential reflectivities of the surfaces of the shutter blind and a film, by providing a correction circuit for correcting its output when the transducer element receives light reflected by both the surfaces of the shutter blind and a film as the trailing end of the first blind moves across an image field. The correction circuit is operated by a switch which is operated in interlocked relationship with the running of the first blind. In the description to follow, it is assumed that the surface of the shutter blind has a greater reflectivity than the reflectivity of the film surface.

A photoelectric transducer element 101 comprising a photovoltaic element is disposed below the lower extremity of the reflecting mirror so as not to intercept the path of light from an object being photographed, and has its light receiving surface directed toward the focal plane of the photographic optical system. The focal plane shutter includes a first blind 102 and a second blind 103, the latter being located rearwardly of the first blind or nearer the film. A first blind winding drum 104 is integrally provided with a gear 105 and is urged to rotate clockwise by a spring, not shown, which is provided on a first blind take-up drum 106. A second blind winding drum 107 is integrally provided with a gear 108, and is urged to rotate clockwise by a spring which is mounted on a second blind take-up drum 109. The gears 105 and 108 respectively mesh with gears 111 and 112 rotatably mounted on a shaft 110. A projection 113 is fixedly mounted on the underside of the gear 112 which is associated with the second blind, to engage a projection 114 fixedly mounted on the upperside of the gear 111 associated with the first blind, thereby defining a start position. The setting of the engaging position is effected by a rotation of a lever 115 against the resilience of a spring 116 in interlocked relationship with a film winding operation so as to cause its one end to engage a projection 117 fixedly mounted on the upperside of gear 112 and its other end to bear against the attracting surface of an electromagnet 118. The position of the gear 111 is defined by a projection 119, which is fixedly mounted on the underside of this gear and which engages a pawl portion of a lever 120 which is urged to rotate counter-clockwise. Under this condition, the other end of the lever 120 is located close to a main switch 121 so as to turn it on and to release the gear 111 to permit movement of the first blind 102 in interlocked relationship with the shutter release operation. A lever 123 is located so as to be acted upon by the projection 114 on the gear 111 to turn a photometry trigger switch 122 off during the initial phase of rotation thereof. A lever 126 is urged to rotate counter-clockwise by a spring 125 and has its one end extending into the path of travel of the projection 114 so as to turn a switch 124 off when the gear 111 has undergone nearly one-half revolution. The switches 121, 122 and 124 as well as the electromagnet 118 are electrically connected to an electronic shutter circuit ERC shown in FIG. 7.

Referring to FIG. 7, connected across a battery 127 in series with a normally open main switch 121 are a time constant circuit comprising photoelectric transducer element 101 and capacitors 128, 129; a switching circuit 130 indicated in a box shown by broken lines and including FET 130*a* and a transistor 130*b*; and a circuit including a transistor 131 and a resistor 132 for energizing an electromagnet 118 which is operative to permit the shutter 103 to be closed. The main switch 121 is closed upon shutter release, and a normally closed switch 122 connected across the series connection of capacitors 128 and 129 is opened simultaneously with an opening of the shutter when it is released. It will be seen that the time constant circuit commences its operation

from the time the switch **122** is opened. One of the capacitors **129** is shunted by a normally closed switch **124** which is opened when the trailing edge of the first blind **102** of the shutter passes through the approximate central position of an image field. The correction for the output of the photometric circuit is initiated when the switch **124** is opened.

In FIG. **6**, the various parts are shown in the positions which they assume subsequent to a film winding operation. Upon shutter release, the lever **120** rotates clockwise against the resilience of the spring to turn on (i.e. close) the main switch **121** and is also disengaged from the projection **119**, whereby the first blind **102** initiates its movement under the action of the spring located on the first blind take-up drum **106**, causing the gear **111** to rotate counter-clockwise. During the initial phase of the rotation, the projection **114** opens switch **122**, thereby enabling the operation of the time constant circuit comprising the photoelectric transducer element **101** and the capacitor **128** so as to measure reflected light. When the gear **111** has rotated through nearly one-half revolution, the projection **114** causes the lever **126** to rotate against the resilience of the spring **125**, opening switch **124** to thereby connect the capacitor **129** into the time constant circuit. Subsequently the gear **111** continues to rotate to bring projection **114** into engagement with the projection **113** on the gear **112**, so that the stop position can be positively defined even if the release is maintained.

Simultaneously with the initiation of movement of the first blind, a current will flow through the transistor **131** to energize the electromagnet **118**, maintaining the lever **115** in engagement with the projection **117** on the gear **112** to thereby block the movement of the second screen **103**. An exposure of the film is effected under this condition, and when a proper amount of exposure has been achieved on the film, the switching circuit **130** operates to interrupt the current flow through the transistor **131**, thereby deenergizing the electromagnet **118**. Thereupon, the lever **115** rotates clockwise to be disengaged from the projection **117** under the action of the spring **116**, whereby the second blind **103** is driven to run by the take-up drum **109**, thus terminating a photographing operation. At this time, the projection **113** on the gear **112** rotates through one revolution and engages with the projection **114** on the gear **111**, whereupon its rotation is interrupted.

FIG. **8** graphically shows the current I on the ordinate which is obtained by photometry of light reflected from the surfaces of the shutter blind and the film and plotted over time T which represents the period of movement of the first blind of the focal plane shutter. By the time t_1 when the trailing edge of the first blind **102** moves completely into the image field, the film is not exposed so that reflected light which reaches the transducer element **101** represents solely the reflected light from the first blind **102**. Thus, the current remains at a constant value *a*. Subsequently as the trailing edge of the firt blind **102** moves across the image field, that area of the first blind which is irradiated by the light from an object being photographed will decrease gradually, and when the trailing edge of the first blind **102** assumes approximately a central position in the image field, the current will be reduced by an amount of $\Delta 1$. This is indicated at time t_2, at which time the switch **124** is turned off so that the current will continue to decrease by an amount $\Delta 2$ until a constant value *b* is reached at time t_3 when the first blind **102** has moved past the image field. Subsequently, the photocurrent *b* which is produced by the light reflected from the film is maintained. The ideal change in current will be that in which the current *a* owing to the reflected light from the first blind is maintained until time t_2 and thereafter the current *b* owing to the reflected light from the film is maintained. The error between such ideal current change and that obtained in accordance with the invention is minimized as indicated by the following expressions representing the ratio of areas; ratio by the time t_2:

$$\frac{a\{t_1 + (t_2 - t_1)\} - \frac{1}{2}\Delta 1(t_2 - t_1)}{a\{t_1 + (t_2 - t_1)\}}$$

ratio by the time t_3:

$$\frac{a\{t_1 + (t_2 - t_1)\} + b(t_3 - t_2) - \frac{1}{2}\Delta 1(t_2 - t_1) + \frac{1}{2}\Delta 2(t_3 + t_2)}{a\{t_1 + (t_2 - t_1)\} + b(t_3 - t_2)}$$

Reducing the above expressions with typical values, the rate by the time t_2 is 1 : 0.95 while the rate by the time t_3 is nearly 1 : 1. Thus, the error is small enough that the infuence on the proper exposure is negligible.

FIG. **9** graphically shows the variation of the photocurrent of FIG. **8** in terms of a change in the amount to which the capacitor is charged, or Cv. If the reflectivity of the shutter blind is different from that of the film surface, the light input to the photometric circuit without correction will follow a curve A. In accordance with the invention, a correction is made in the electrical circuit to maintain the same information. Specifically, the switch **124** is opened at a time $\{t_1 + (t_2 - t_1)\}$ to change or reduce the composite capacitance of the time constant circuit so as to maintain the integrating characteristic constat even though a reduction occurs in the amount of light received. As shown by a curve B, the opening of the switch **124** at a time t_2 produces a discontinuity, but the error from an ideal curve indicated by broken line curve C is minimal, closely following it. In this manner, a compensation can be provided for a difference in the reflectivity.

In the above embodiment, the reflectivity of the first blind has been assumed to be greater than that of the film, but where the reflectivity of the film is greater than that of the first blind, switch **124** may be replaced by a normally open switch to achieve the similar result.

FIG. **10** shows an apparatus according to the invention in which the shutter blind comprises portions of high and low reflectivities. Specifically, a single lens reflex camera **202** having a movable reflecting mirror **201** includes a film **203** in its rear part which is urged against and retained by a pressure plate **204**. A first blind **205** and a second blind **206** of the shutter which are adapted to run immediately in front of the film **203** are mounted on the respective blind shafts with known means. The first blind **205** of the shutter comprises a surface **205***a* and a surface **205***b* on its side which is irradiated by light from an object being photographed. The surface **205***a* has a high reflectivity as obtained by coatng of material having a high reflectivity, while the surface portions **205***b* have a very low reflectivity and are located at the upper and lower marginal edge of the first blind **205** where diffuse light may have adverse influences upon the film **203**, the surfaces **205***b* being formed of a surface frosted, black cloth or the like. As

shown in FIG. 11, photoelectric transducer elements 207 are fixedly mounted on the camera body at positions such as on either side of the mount 208 for a photographic optical system 210 where they do not intercept light from an object being photographed and are positioned so as to be capable of receiving light from the object being photographed which is reflected by the high reflectivity portion 205*a* of the first blind of the shutter or by the surface of the film 203. It will be appreciated that the transducer element 207 has its terminals connected with a shutter timing circuit, not shown, so as to control the timing of the initiation of movement of the second blind 206 in dependence upon the amount of light received. With the above arrangement, the transducer element 207 receives light reflected from the high reflectivity portion 205*a* of the first blind when the reflected mirror 201 moves up, and then receives light from the film surface 203 subsequwnt to the movement of the first blind 205, thereby determining an exposure period depending upon the brightness of an object being photographed. The portions 205*b* having a very small reflectivity prevent diffused light from reaching the film surface 203.

When taking pictures, it often occurs that an object being photographed comprises an upper portion of high luminance and a lower portion of low luminance, as depicted at PA in FIG. 10, or for the light which is transmitted through the photographic optical system 210, the upper portion has a low luminance while the lower portion has a high luminance, as indicated at PB. For an object being photographed of this kind, a exposure period will be normally in the range from 1/60 to 1/125 second, so that the exposure period will be determined only by reflected light from the surface of the first blind 205*a* of the shutter.

In such an instance, a correction can be made in respect of the amount of light incident onto the light receiving element 207 by using the first blind as shown in FIGS. 12 to 16 which comprises a portion 205*a* of a high reflectivity and another portion 205*c* of somewhat reduced, intermediate reflectivity. FIG. 14 shows the reflecting surface of the first blind when a photometry should be principally directed to the lower portion; FIG. 15 shows the reflecting surface of the first blind when the photometry is principally directed to the upper portion; and FIG. 16 shows the reflecting surface of the first blind when the photometry is directed principally to the central portion. It is also possible to use a suitable combination of high reflectivity portions 205*a* and intermediate reflectivity portions 205*b* and 205*c* as indicated in FIGS. 12 and 13, depending upon the purposes of taking pictures. It should be understood that variation in the reflectivity should preferably be continuous although not shown. By using a selected arrangement, adverse influences upon the film can be removed and a correction can be made in accordance with a variable distribution of luminance of an object being photographed.

FIG. 17 shows an apparatus according to the invention in which certain elements such as a photoelectric transducer element, a photometry trigger switch and the like are disposed on a printed circuit board which is arranged below the reflecting mirror where a free space is relatively available, thus providing a compact structure. Referring to FIG. 17, winding shafts 301 and 302 are vertically mounted on one side of an exposure window while take-up shafts 303 and 304 are vertically mounted on the opposite side, all in a parallel arrangement. A take-up drum 306 is coaxially and integrally fixed on the take-up shaft 303, and the leading portion of a first blind 305 is fixedly attached to the drum. A winding drum 308 is coaxially and integrally fixed on the winding shaft 301, and the trailing portion of a second blind 307 is fixedly attached to the winding drum 308. Ribbon-shaped drawing members 309*a* and 309*b* have one of their ends fixed to the upper and lower ends of the first blind 305, and pass around pulleys 310*a* and 310*b* respectively, which are freewheelingly mounted on the winding shaft 301, to be suitably fixed to wheels 311*a* and 311*b* which are fixedly mounted on the winding shaft 302. In this manner, the first blind 305 extends across and immediately in front of the film surface. In a similar manner, drawing members 312*a* and 312*b* have one of their ends fixed to the upper and lower ends of the second blind 307, and pass around pulleys 313*a* and 313*b* freewheelingly mounted on the first blind take-up shaft 303 to have their other ends suitably fixed to a drum 314 which is fixedly mounted on the take-up shaft 304. In this manner, the second blind also extends immediately in front of the film surface. A gear 315 which is fixedly mounted on the bottom end of the second blind winding shaft 301 meshes with a large diameter gear 316 which is disposed below a movable reflecting mirror, not shown, while a gear 317 fixedly mounted on the bottom end of the first blind winding shaft 302 meshes with a large diameter gear 318 which is coaxially disposed with the gear 316. The gears 316 and 318 are rotatably mounted on a common axle, and a projection 319 is fixedly mounted on the upper surface of the gear 316. A detent arm 320 has its one end extending into the path of rotation of the projection 319. The detent arm 320 is rotatably mounted on a stationary member of a camera, and is urged by a spring, not shown, to rotate counter-clockwise so as to have an attracting piece 321 which is provided on its other end displaced from electromagnet 322. A projection 323 is fixedly mounted on the upper surface of the gear 318, and extending into the path of rotation of the projection 323 is a movable piece of a trigger switch 325 associated with electronic shutter which is provided on a printed circuit board 324. Also mounted on the printed circuit board 324 are photoelectric transducer elements 327 so as to receive light from an object being photographed which is transmitted through a photographic lens 326 and reflected by the surface of the shutter blind, the reflected light being incident on the transducer elements in a normal direction. In addition, electrical elements such as transistors or the like are suitably located on the printed circuit board, and are designated by reference numeral 328.

In the position shown, the film has been wound and the shutter has been charged. The attracting piece 321 of the detent arm 320 is pushed forward by the electromagnet 322 and is prevented from returning. Under this condition, the transducer elements 327, 327 initiate the photometry of light from an object being photographed. When a shutter button is depressed to release the shutter, the constraint on the gear 318 is released, whereby a spring (not shown) internally housed within the first blind take-up drum 306 causes the first blind 305 to run. Simultaneously, the gear 318 rotates counterclockwise, opening trigger switch 325. At the same time with the opening of trigger switch 325, the time constant circuit of the electronic shutter circuit operates, and deenergizes the electromagnet 322 after an exposure period which is commensurate with the brightness of light from an object being photographed. Thus, the

detent arm 320 is released, rotating counter-clockwise to disengage from the projection 319, whereby the second blind 307 initiates movement to complete a photographing operation.

FIGS. 18 and 19 show another apparatus of the invention employing a first photoelectric transducer element for receiving light reflected by a shutter blind or film surface, and a second photoelectric transducer element for receiving light reflected by the reflecting mirror. It is to be understood that a first blind 401 and a second blind (not designated) are adapted to run in interlocked relationship with the other camera operations such as the operation of release member. A film 402 is urged by a pressure plate 403 on the rear lid of the camera aganst a rail surface 404*a* of a camera body 404. A light path switching reflecting mirror 405 is pivotally mounted on the camera body so as to move upward upon shutter release. First photoelectric transducer elements 406*a* and 406*b* which may comprise a photovoltaic element such as solar cell or the like are similar to the photometric elements illustrated in the other embodiments of the invention, and are fixedly mounted on the camera body 404 at positions in which they do not intercept light from an object being photographed which is transmitted through a photographic optical system 407. The transducer elements 406*a* and 406*b* have their light receiving surfaces positioned so as to be capable of receiving light reflected by the first blind 401 or the film surface 402 when the reflecting mirror 405 moves upward. In the subsequent description, both elements 406*a* and 406*b* will be referred to by a single reference numeral 406. A focussing plate 408 is located at a position which is conjugate with the film surface 402 with respect to the reflecting mirror 405, and along its one side are provided indices 408*a* for indicating an exposure period and an index 408*b* for a manual exposure setting. A galvanometer 409 is pivotally mounted on the camera body in a manner such that its pointer 409*a* can provide an indication on the indices 408*a* and 408*b*, and is adapted to be rotated about the axis 409*c* in interlocked relationship with a diaphragm presetting ring, not shown, through a transmission string 409*b*. Second photoelectric transducer elements elements 410*a* and 410*b* are secured to the camera body on the opposite sides of an eyepiece 411 so as to be capable of receiving light reflected by the reflecting mirror 405. In the description to follow, the elements 410*a*, 410*b* will be designated by a single reference numeral 410

A display circuit EA1 for operating the galvanometer 409 is arranged as shown in FIG. 20. Specifically, the transducer element 410 has its one terminal connected with the negative pole of a power supply EV, and its opposite side connected with a positive pole of the power supply through a resistor 412 and the galvanometer 409 in series. A varible resistor 413 for presetting a film speed is connected across the power supply in shunt with the transducer element 410. A fixed resistor 414 for automatic exposure and a variable resistor 415 for manual exposure which is in interlocked relationship with a shutter ring, not shown, are connected with contacts S*a*, S*b* of a changeover switch ESW1 so as to be selectively connected across the power supply EV in shunt with the transducer element 410.

On the other hand, a timing circuit EA2 for controlling the movement of the second blind of the shutter is arranged as follows: An electromagnet 416 which constrains the second blind from running has its one terminal grounded at the body and its other terminal connected with a switching circuit EB so as to be turned on and off by the latter. An automatic exposure circuit EC and a manual exposure circuit ED each have one terminal connected with the negative pole of the power supply EV and their remaining terminal connected with contacts S*c*, S*d* of a change-over switch ESW2 which is interlocked with the change-over switch ESW1 so as to be selectively connected with the switching circuit EB.

The automatic exposure circuit EC has an arrangement as shown in FIG. 21. Specifically the first transducer element 406 is connected across the (−) terminal and (+) terminal of a first operational amplifier EIC1, the output terminal (1*a*) of which is connected with the (−) terminal thereof through a parallel connection of a trigger switch ESW3 and a time constant capacitor 417 to form a photometric circuit, the trigger switch being opened in interlocked relationship with the running of the first blind of the shutter. A second operational amplifier EIC2 has its (+) terminal connected with the output terminal (1*a*) of the first operational amplifier, while its output terminal (1*b*) is connected with the contact S*c* of the change-over switch ESW2. A variable resistor 418 for introducing information such as film speed or the like is adapted to be adjusted together with the variable resistor 413 in the display circuit EA1.

With the above arrangement, when an automatic exposure is used to take a picture, the change-over switches ESW1 and ESW2 are thrown to the automatic exposure side, namely to the contacts S*a* and S*c*. When the camera is directed to an object being photographed, the second transducer element 410 receives light from the object being photographed as reflected by the reflecting mirror 405, thereby deflecting the pointer 409*a* of the galvanometer depending upon the brightness of the object being photographed. It will be understood that the deflection varies with the setting of the resistor 413 and a rotation of the galvanometer 409 which occurs as a result of rotation of a diaphragm presetting ring. Thus, by suitably presetting the relative position of the pointer 409*a* of a galvanometer and the indices 408*a* for indicating an exposure period, an exposure period is presented to the user prior to exposing the film. Upon depression of a shutter button, diaphragm blades are moved to define a preset diaphragm value and the reflecting mirror 405 moves up, whereby light from an object being photographed reaches the surface of the shutter blind 401. Thus the first transducer element 406 receives reflected light from the surface of the shutter blind 401 under the preset diaphragm. Before the first blind moves, the trigger switch ESW1 is closed, so that the voltage at the output terminal (1*a*) of the operational amplifier EIC1 will be equal to one-half the supply voltage Vcc. The operational amplifier EIC2 operates as a comparator, and since the output voltage V1*a* of the photometric circuit is less than the voltage applied to (−) terminal of the operational amplifier EIC2 which is obtained by a voltage division of the supply voltage Vcc and ½ Vcc, the output voltage of this amplifier will be a positive voltage, whereby transistor EQ conducts to energize the electromagnet 416, which therefore constrains the second blind from moving. Then the first blind 401 moves, and as the trigger switch ESW3 is opened, the time constant capacitor 417 will be charged with a constant current which is supplied by a short-circuit current of the transducer element 406 which varies linearly with the luminance of the light being received to thereby produce a linear variation in the output voltage V1*a* of the photometric circuit, in view of the fact

that feedback is made through the time constant capacitor **417** so as not to apply voltage across the first transducer element **406**.

This variation depends on the amount of light which is transmitted through the photographic lens and reflected by the shutter blind or film surface. When the amount of such light is high, the output voltage V1*a* of the photometric circuit will rise very rapdily. As the output voltage V1*a* of the photometric circuit gradually increases and becomes greater than the voltage applied to the (−) terminal of the operational amplifier EIC2, the output voltage of the operational amplifier EIC2 will instantaneously change from a positive voltage to zero volts, thereby rendering the transistor EQ nonconductive to deenergize the electromagnet **416**, which therefore release the second blind to initiate its movement and thereby terminate a photographing operation.

In a manual exposure operation, the change-over switches ESW1 and ESW2 are thrown to the contacts S*b* and S*d*, respectively. A proper exposure can be achieved by rotating the galvanometer **409** by means of the diaphragm presetting ring or by the operation of the variable resistor **415** which is interlocked with the shutter ring so as to make the pointer **409***a* of the galvanometer coincident with the manual exposure index **408***b*. Subsequently, the depression of a shutter button initiates a shutter operation, and the adjustment of the timing at which the movement of the second blind is initiated is determined by adjustment of a variable resistor in the manual exposure circuit, not shown, interlocked with the variable resistor **415** to control the turning off of the electromagnet **416**. Such circuit is known and therefore will not be described in detail.

It will be seen that in an automatic exposure operation, the first transducer element **406** controls an exposure period while the second transducer element **410** allows such exposure period to be displayed, and that in a manual exposure operation, the exposure can be controlled by means of the second photoelectric transducer element **410**.

It should be noted that the photoelectric transducer element used in the present invention may comprise elements other than a photovoltaic element by suitable design of the circuit.

What is claimed is:

1. A photometric apparatus for a single lens reflex camera and of the type in which an exposure value is determined by photometry of light which is transmitted through a photographic optical system and which is reflected by at least one of the surfaces of a shutter blind and a film, comprising a photoelectric transducer element for receiving reflected light from at least one of the surface of a shutter blind and a film, and an operational amplifier for biasing the transducer element so as to maintain the voltage applied thereacross substantially null the first blind of the shutter comprising a surface of high reflectivity which forms a light reflecting portion, and a surface of low reflectivity located at an area other than the light reflecting portion.

2. A photometric apparatus according to claim **1** in which the surface of low reflectivity is located on the both lateral edges of the first blind while the surface of high reflectivity is located at an area other than the marginal edges.

3. A photometric circuit according to claim **1**, further including a surface of intermediate reflectivity intermediate the surfaces of high and low reflectivities.

* * * * *

United States Patent [19]

Matsuzaki et al.

[11] **4,074,290**

[45] **Feb. 14, 1978**

[54] APPARATUS FOR SYNCHRONIZING AN ELECTRONIC FLASH WITH A CAMERA

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[73] Assignee: **Olympus Optical Co., Ltd.**, Tokyo, Japan

[21] Appl. No.: **631,935**

[22] Filed: **Nov. 14, 1975**

Related U.S. Application Data

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[30] **Foreign Application Priority Data**

July 2, 1974 Japan 49-75693

[51] **Int. Cl.**[2] **G03B 7/16**

[52] **U.S. Cl.** ..... **354/34**; 354/33; 354/50; 354/60 F

[58] **Field of Search** ..... 354/27, 32, 33, 34, 354/35, 60 F, 50, 60 R

[56] **References Cited**

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Primary Examiner—Russell E. Adams

Attorney, Agent, or Firm—Ostrolenk Faber Gerb & Soffen

[57] **ABSTRACT**

An apparatus for activating an electronic flash by operating an X contact when the first blind of a focal plane shutter has terminated its movement to fully open an exposure light path, irrespective of an exposure period establishing operation. Where an electronic focal plane shutter is combined with an auto-strobo, a photometric circuit within the electronic circuit is used to measure the radiation from the auto-strobo, and to control the amount of exposure to a proper value. Where a proper amount of exposure is available by natural light when the shutter is opened, a closing movement of the shutter is utilized to cause the trigger capacitor of the electronic flash to be discharged, thereby disabling the illumination of the electronic flash.

4 Claims, 10 Drawing Figures

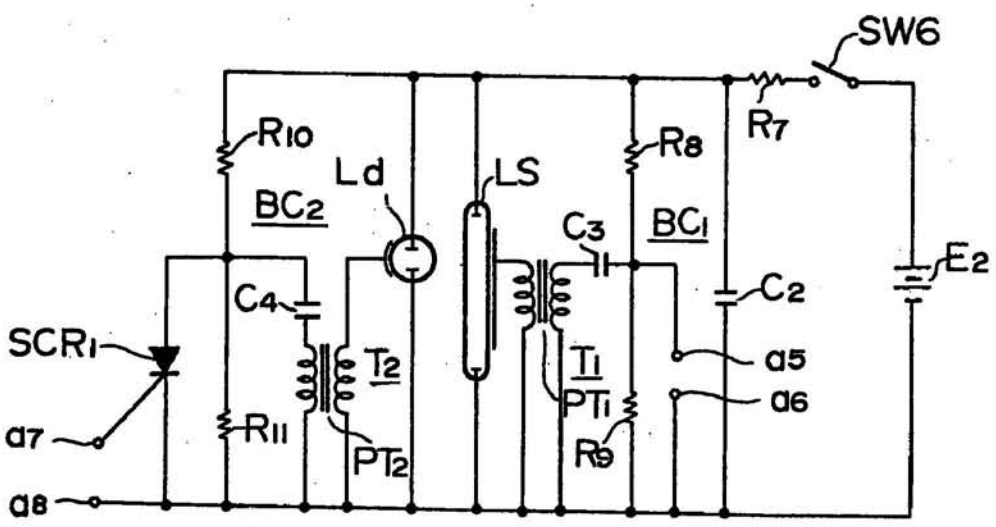


FIG. 1

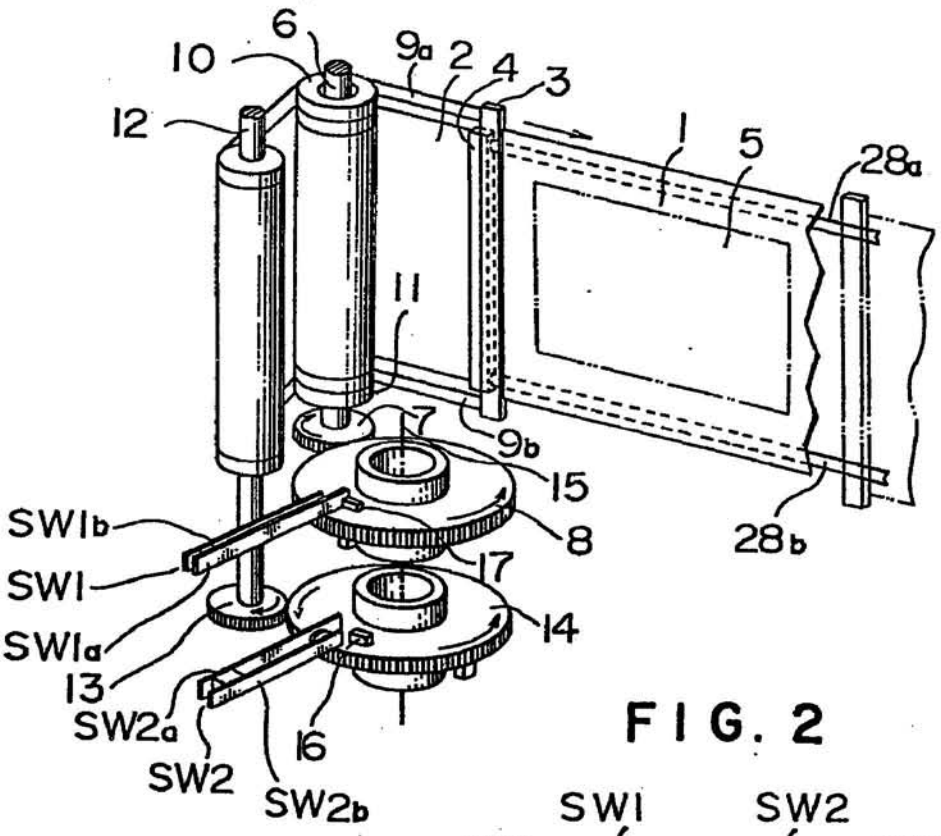


FIG. 2

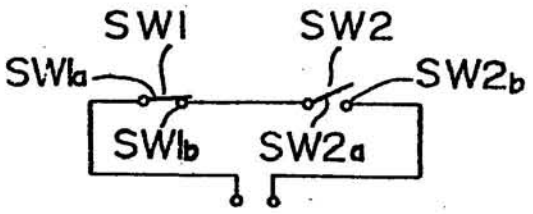


FIG. 3

	SW1	SW2
FOR EXPOSURE PERIOD GREATER THAN 1/60 SECOND		
FOR EXPOSURE PERIOD LESS THAN 1/60 SECOND		

FIG. 4

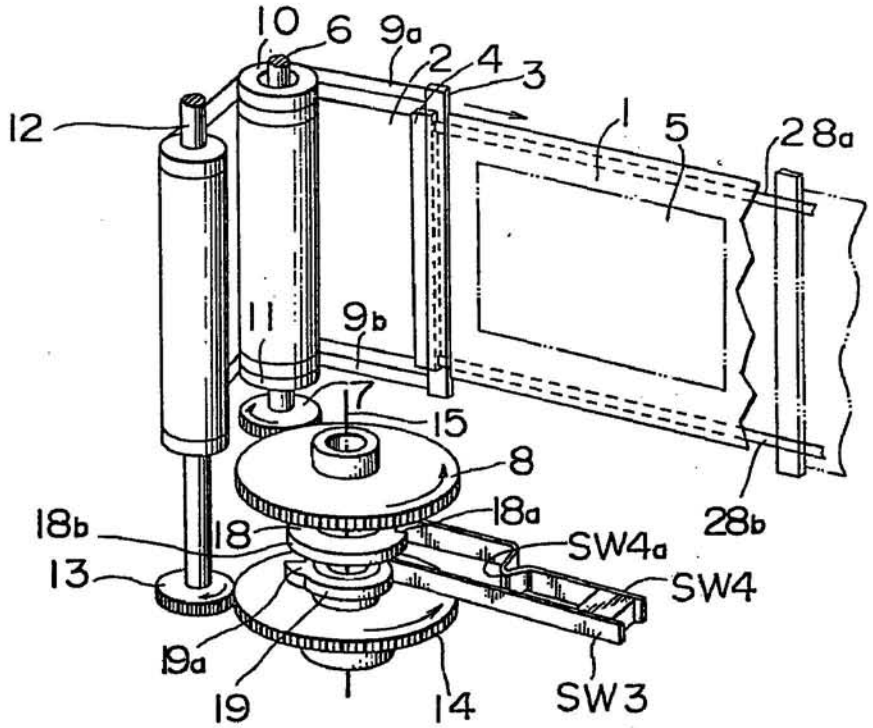


FIG. 5

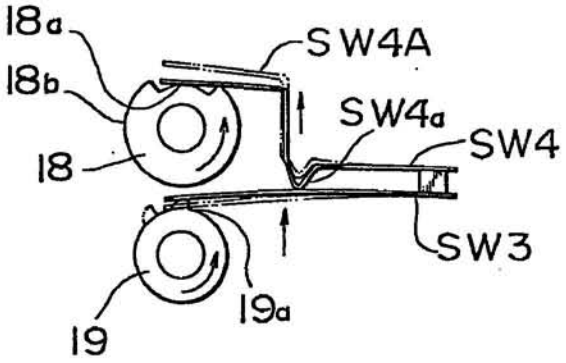


FIG. 6

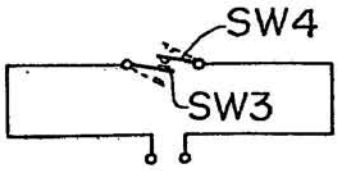


FIG. 7

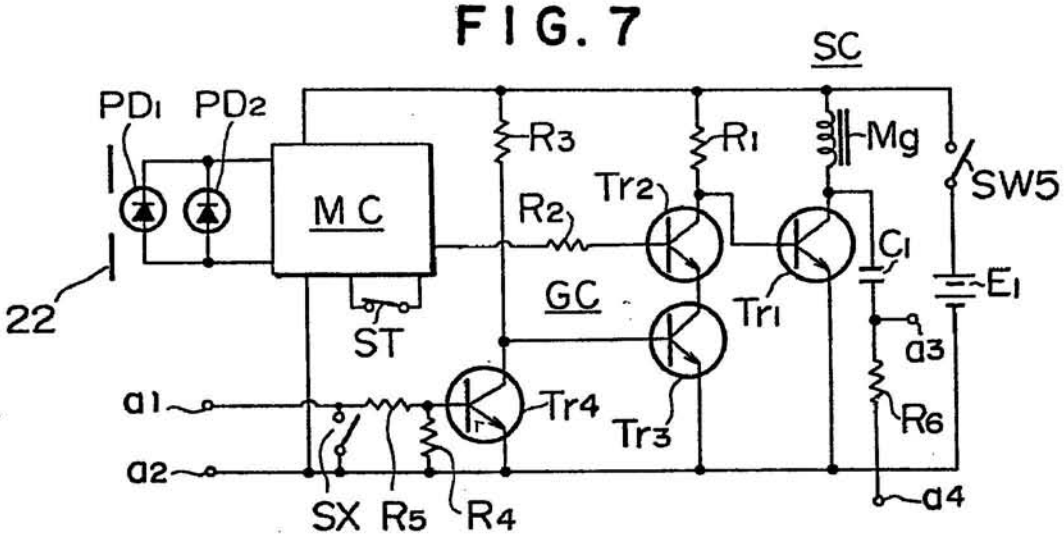


FIG. 8

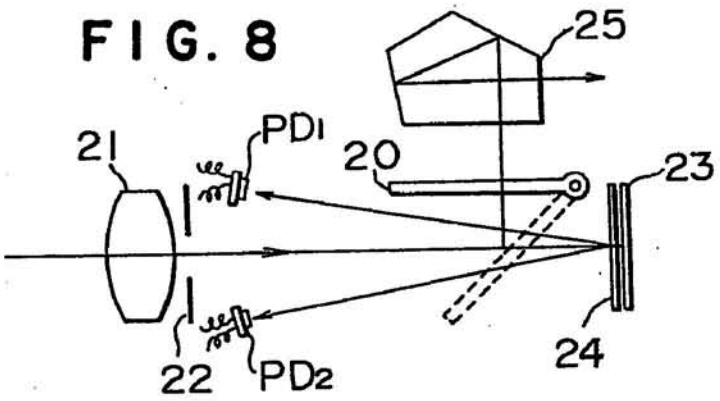


FIG. 9

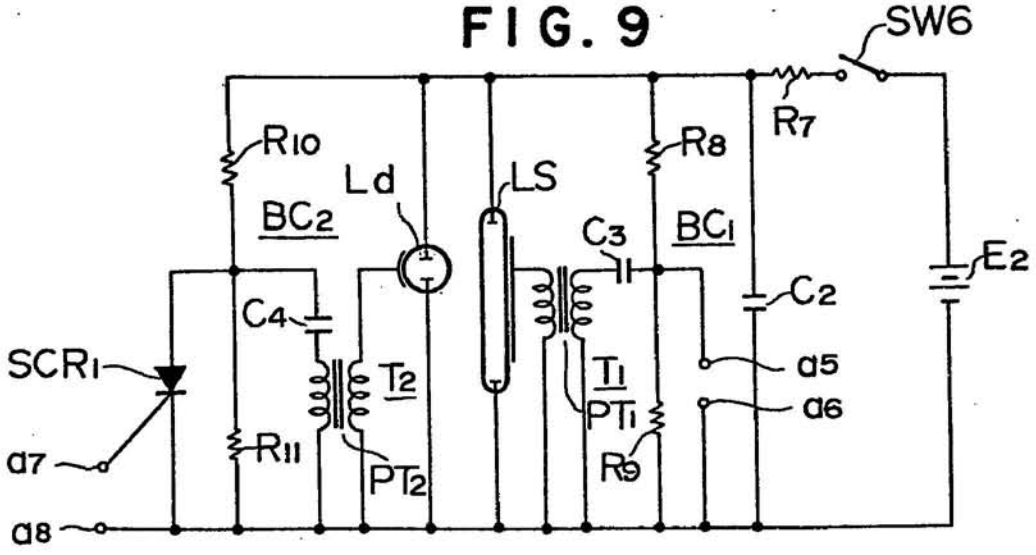
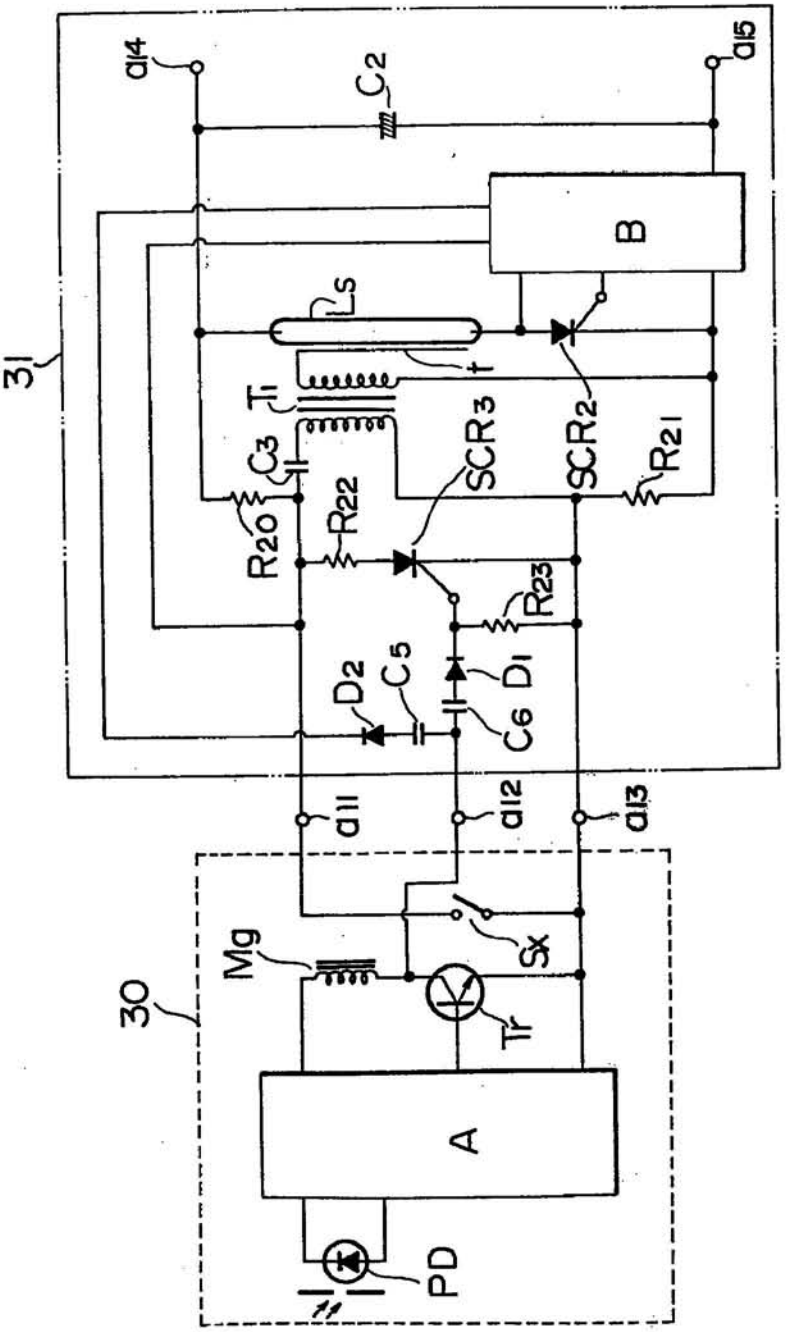


FIG. 10


a14
a15
C2
B
Ls
T1
C3
SCR3
SCR2
R21
R20
R22
R23
D2
C5
D1
C6
31
a11
a12
a13
Mg
Sx
Tr
30
A
PD

APPARATUS FOR SYNCHRONIZING AN ELECTRONIC FLASH WITH A CAMERA

This is a division of application Ser. No. 504,856, filed Sept. 11, 1974, now U.S. Pat. No. 3,987,468.

BACKGROUND OF THE INVENTION

The invention relates to an apparatus for synchronizing an electronic flash with a camera including a focal plane shutter for the purpose of taking a picture under flashlight. When an electronic flash is used to take a picture under flashlight with a camera including a focal plane shutter the synchronizing contact must be changed to the X contact. Simultaneously the exposure period must be previously controlled so that a shutter speed or exposure period assumes a value at which a synchronized flashlight photographing is possible (which is referred to hereinafter as X-period), which is usually set to be greater than 1/125 to 1/60 second. Such value of the shutter speed corresponds to an exposure period which is defined from the termination of movement of the first blind of the shutter to fully open an exposure light path until the second blind moves to close the open exposure path. Such pre-establishing of the shutter speed is necessary because a focal plane shutter employs a slitwise exposure while an electronic flash represents a source of flashlight having a very short duration. If a picture is taken with a shutter speed established on the order of 1/250 second or the like, only one-half or one quarter of the scene to be photographed will be irradiated by the flashlight. This explains why the shutter speed must be established to an X-period. However, it often occurs that a photographer forgets to set the shutter speed to correspond to an X-period when taking a picture under flashlight, and becomes aware of this fact only after the exposed film is developed.

When using an electronic flash to take a picture under synchronized flashlight, it is known that the intensity of reflected light from an object being photographed varies as the distance between the camera and the object varies, thereby necessitating an adjustment of the diaphragm each time a picture is taken. To avoid such inconveniences, an adjusted flashlight emitter referred to as auto-strobo has been recently developed. This comprises a flash tube bypassed by a discharge tube in combination with a photometric circuit which is operative, upon illumination of the flash tube, to measure reflected light from an object being photographed and to cause a discharge of the discharge tube when the amount of light being measured reaches a proper amount of exposure, thus short-circuiting the flash tube to interrupt its operation and thus assuring a proper exposure. As is well known, an EE camera includes its own photometric circuit, which however is not used when the above mentioned auto-strobo is used to take a picture under flashlight.

Another difficulty occurs with the combination of the auto-strobo and an EE camera having an electronic focal plane shutter. The illumination of the strobo is controlled by the X contact which is closed by the operation of the shutter within the EE camera, which is in turn controlled by the EE circuit. Specifically, a release operation of the shutter causes the first blind of the shutter to move, and the X contact is closed when the photographic path becomes open. As the reflected light from an object being photographed reaches a proper amount of exposure, an electromagnet which has been constraining the second blind of the shutter from moving is deenergized to permit movement of the second blind, thus terminating a photographing operation. The arrangement is such that if a given amount of exposure has been reached by natural light before the X contact is closed, an inhibit signal is applied to the strobo unit. However, depending on the relative timing of the inhibit signal generated and the closure of the X contact, the X contact may be closed to cause an illumination of the strobo unit. At this time, since the second blind of the shutter has already moved into the photographic path, vignetting is caused on the film surface by the presence of the second blind, thus resulting in a failure of synchronization.

SUMMARY OF THE INVENTION

It is a first object of the invention to provide an apparatus for synchronizing an electronic flash with a camera having a focal plane shutter capable of instantly providing an indication to a photographer, when taking a picture under synchronized flashlight, whether or not a shutter speed value within the X-period range has been established to cause a synchronized flashlight photographing, by merely recognizing the illumination or non-illumination of the electronic flash subsequent to the depression of a shutter button.

As a result, in accordance with the invention, if a shutter speed is established to a value which is on the higher speed side of the X-period, the circuit for causing an illumination of the electronic flash is prevented from being completed, so that if a photographer attempts to take a picture under flashlight without establishing the shutter speed to an X-period, no flash will be produced by the electronic flash, thus warning the photographer in a simple manner. In other words, the arrangement is such that the electronic flash can not be activated unless a shutter speed within the X-period range is established. Consequently, the photographer can be immediately informed whether or not a shutter speed within the X-period range is established, by merely taking notice of the illumination or non-illumination of the electronic flash, thus avoiding the inconvenience that the photographer may continue to take the pictures on the entire roll of film without knowing the failure of establising an X-period, which he becomes away of only after developing the exposed film.

It is a second object of the invention to provide an apparatus for synchronizing an electronic flash with a camera having an electronic focal plane shutter, which permits the illumination from the electronic flash to be controlled by a photometric circuit contained within the shutter.

This permits a photometric circuit, which has usually been incorporated into an electronic flash as in the autostrobo, to be dispensed with, while assuring a proper amount of exposure under flashlight. Also the size of the electronic flash used can be minimized while at the same time improving the efficiency of use of the photometric circuit within the camera.

It is a third object of the invention to provide an apparatus for synchronizing an electronic flash with a camera having an electronic focal plane shutter in which the illumination of the electronic flash is prevented when a proper amount of exposure is reached by natural light before the electronic flash is to be illuminated while permitting the electronic flash to be illuminated in the event a given amount of exposure is not reached at the time when the X contact is to be closed.

In accordance with the invention, if a given amount of exposure is reached by natural light before the electronic flash is to be illuminated, a signal is derived from the electromagnet which controls the movement of the second blind of the shutter to discharge a trigger capacitor for the electronic flash before the X contact is closed, thus disabling the illumination of the electronic flash. In this manner, an asynchronous photographing is avoided.

It will be appreciated that the invention enables a satisfactory photographing operation under synchronized flashlight to be achieved while requiring of a photographer only the operations of coupling the electronic flash with the camera and depressing a release button to confirm the activation of flashlight. A synchronized photographing operation during daytime is also simplified.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the X contact associated with the electronic flash of a focal plane shutter which may be used in the apparatus according to the invention;

FIG. 2 is a wiring diagram showing the electrical connection of the X contact of FIG. 1;

FIG. 3 is a sequence diagram showing the closure of switches SW1 and SW2 which constitute together the X contact;

FIG. 4 is a perspective view showing another example of the X contact of a focal plane shutter which may be used in the apparatus according to the invention;

FIG. 5 is a plan view illustrating the operation of the X contact of FIG. 4;

FIG. 6 is a wiring diagram showing the electrical connection of the X contact of FIG. 4;

FIG. 7 is a circuit diagram of the photometric circuit and shutter control circuit of the electronic shutter contained within the camera associated with the apparatus of the invention;

FIG. 8 is a simplified schematic view of a camera having a TTL (through-the-lens) electronic shutter, illustrating the manner of incidence of light on a light receiving element contained in the photometric circuit of FIG. 7;

FIG. 9 is a circuit diagram of an exemplary adjusted strobo unit; and

FIG. 10 is a circuit diagram showing another embodiment of the invention for synchronizing an electronic shutter with a camera in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

As shown in FIG. 1, a focal plane shutter comprises a first blind 1 and a second blind 2. As is well known, a slit forming member 3 is fixed to the trailing edge of the first blind 1 and a slit forming member 4 is fixed to the forward edge of the second blind 2 to thereby form a slit which is moved across an exposure window 5 to permit an exposure. The trailing edge portion of the second blind 2 is fixedly mounted on a winding shaft 6 on which a gear 7 is fixedly mounted. The gear 7 meshes with a gear 8 of a larger diameter. The slit forming member 3 which is fixed to the trailing edge of the first blind 1 has a pair of traction strings 9*a*, 9*b* secured to its upper and lower end portions, which strings are passed around guide pulleys 10, 11, rotatably mounted on the winding shaft 6, and secured to a first blind winding shaft 12. A gear 13 is fixedly mounted on the winding shaft 12, and meshes with a gear 14 of a larger diameter. The gears 8 and 14 having a larger diameter are rotatably mounted on an axle 15, and the arrangement is such that the gear 14 undergoes nearly one revolution in the direction indicated by an arrow as the slit forming member 3 traverses across the exposure window 5 when the first blind 1 moves, while the gear 8 undergoes nearly one revolution about the axle 15 in the direction indicated by an arrow as the slit forming member 4 traverses across the exposure window 5 in following relationship with respect to the member 3. These larger diameter gears 8 and 14 serve to wind the first and second blinds 1, 2 onto their respective winding shafts 6 and 12, respectively upon completion of taking a picture, by being integrally rotated through one revolution about the axle 15 in interlocked relationship with a film winding operation. When the both blinds 1 and 2 are wound, a shutter drive spring, not shown, is charged.

The width of the slit defined between the slit forming members 3 and 4 is determined by the relative timing of movement of the second blind 2 with respect to that of the first blind 1, which is in turn established in accordance with a preset exposure period.

As mentioned previously, the gear 14 undergoes nearly one revolution as the slit forming member 3 traverses across the exposure window 5, and the gear 8 undergoes one revolution as the slit forming member 4 traverses across the exposure window 5 to close an exposure light path. Thus it will be seen that the exposure path which passes through the exposure window 5 remains fully open after one revolution of the gear 14 and before the gear 8 initiates its rotation. A satisfactory synchronization is assured for taking a picture under flashlight if the flashlight is activated under the open condition of the exposure window.

In accordance with the invention, the synchronizing contact or X contact comprises a first switch which is closed when the exposure light path is fully open as a result of movement of the first blind 1, and a second switch which is opened as the second blind 2 initiates its movement in order to close the open exposure light path. Specifically, a tab 16 is disposed on the gear 14, and a movable contact SW2*a* of a normally open switch SW2 is located in the path of travel of the tab 16 which operates as a switch control member. Similarly, a tab 17 which operates as a switch control member is disposed on the gear 8, and a movable contact SW1*a* of a normally open switch SW1 is located within the path of travel of the tab 17. When the second blind 2 is wound by a film winding operation, the tab 17 bears against the movable contact SW1*a* to move it into contact with a fixed contact SW1*b*, thus closing the normally open switch SW1. As shown in FIG. 2, the switches SW1 and SW2 are connected in series to constitute the X contact for an electronic flash.

With the X contact as constructed in this manner, when the shutter is charged in interlocked relationship with the winding of a film, the gears 8 and 14 rotate clockwise about the axle 15 through nearly one revolution, whereby the tab 17 on the gear 8 bears against the movable contact SW1*a* to close the switch SW1 while the tab 16 on the gear 14 remains at a position close to but spaced from the movable contact SW2*a*. When a shutter speed is established to a value within the X-period range, the first blind 1 will move in the direction indicated by an arrow upon shutter release, thereby fully opening the exposure window 5. When the exposure path is fully open, gear 14 will have rotated about

the axle 15 through one revolution, whereby the tab 16 bears against the movable engagement SW2*a* to move it into contact with a fixed contact SW2*b*, thus closing the switch SW2. Since the switch SW1 is already closed, the closure of the switch SW2 results in a closure of the X contact, thus illuminating the electronic flash to permit a photographing under synchronized flashlight. Upon lapse of an established exposure period, the second blind 2 commences its movement, whereby the gear 8 rotates counter-clockwise about the axle 15, thus opening the switch SW1. The opening of the switch SW1 occurs immediately before the slit forming member 4 associated with the second blind 2 moves into the open exposure path. When the switch SW1 is opened, the X contact remains open even though the switch SW2 may be closed. It will be appreciated that the X contact comprising both switches SW1 and SW2 is closed only when a shutter speed or an exposure period within the X-period is established. Stated differently, if an exposure period greater than the X-period is established, it is assured that the both switches SW1 and SW2 will be closed as shown in FIG. 3 when the exposure path is fully open. The illumination of the electronic flash under this condition ensures a completely synchronized flashlight photographing. In FIG. 1, characters 28*a* and 28*b* represent traction strings associated with the second blind 2.

While in the above described embodiment, the switches SW1 and SW2 which together constitute the X contact are opened and closed by gears which undergo a rotation through nearly one revolution in interlocked relationship with the running of the first and second blinds, it should be obvious that these switches may be directly operated by the first and second blinds 1 and 2, respectively. The only requirement is that the switch SW2 is closed when the first blind 1 has completed its movement to fully open the exposure light path while the other switch SW1 is opened immediately before the second blind 2 which has started running moves into the open exposure light path.

FIGS. 4 to 6 show another embodiment of the X contact, and corresponding parts are designated by like reference characters as used in FIG. 1. In the embodiment shown in FIG. 4, the synchronizing contact or X contact comprises a pair of movable contacts, one of which is displaced into contact with the other in interlocked relationship with the movement of the first blind 1 as it runs to fully open the exposure light path, thereby closing the contact to cause an illumination of the electronic flash. Subsequently, when the second blind 2 initiates its movement in order to close the fully open exposure light path, the other movable contact is moved away from said one movable contact in interlocked relationship with the movement of the second blind 2, immediately before the second blind moves into the open exposure path, thus opening the previously closed contact.

Specifically, the X contact comprises a pair of independently movable blade contacts SW3 and SW4, both of which are formed of a resilient material. These blade contacts are disposed in opposing relationship with each other, and a bend SW4*a* formed in the movable blade contact SW4 and a mating portion of the movable blade contact SW3 form a cooperating pair of electrical contacts. The movable blade contact SW4 is resiliently biased toward the movable blade contact SW3, while the latter is resiliently bised to move away from the other movable blade contact SW4. Both movable blade contacts SW3 and SW4 have their free ends extending adjacent to the axle 15 mentioned before. The movable blade contact SW4 is adapted to be displaced by a cam 18 which operates as a switch control member and is integrally mounted on the gear 8 while the movable blade contact SW3 is adapted to be displaced by a projection on a disc 19 which operates as a switch control member and is integrally mounted on the gear 14. The disc 19 is fixedly mounted on the boss of the gear 14, and rotates through nearly one revolution as the gear 14 rotates through nearly one revolution in the direction indicated by an arrow, with its projection 19*a* bearing against the movable blade contact SW3 to cause it to move toward the other movable blade contact SW4, thus closing the pair of electrical contacts mentioned above. The cam 18 is fixedly mounted on the boss of the gear 8 and comprises a planar cam having a portion of reduced diameter 18*a*, and in the charged position of the shutter, the free end of the movable blade contact SW4 bears against the portion of reduced diameter 18a of the cam 18, but as the gear 8 commences its rotation through one revolution, the remaining portion of the cam, shown at 18b, displaces the movable blade contact SW4, whereby the electrical engagement between the movable blades SW3 and SW4 is interrupted.

In operation, it is initially assumed that a shutter speed is established to define an exposure period which is within the X-period. Upon shutter release, the first blind 1 moves, and by the time it has fully opened the exposure light path, the gear 14 has undergone nearly one revolution, so that the projection 19*a* displaces the movable blade contact SW3 as shown in FIGS. 5 and 6 into engagement with the blade contact SW4. Thus, the X contact is closed, and the electronic flash is activated under the fully open condition of the exposure light path, permitting a photographing operation under synchronized flashlight. Subsequently, when the established exposure period has elapsed, movement of the second blind 2 initiated. As it begins to move, the movable blade contact SW4 which has been in abutment against the portion of reduced diameter of 18*a* will be engaged by the remainder 18*b* of the cam 18 as it rotates together with the gear 8, whereby the blade contact SW4 will be displaced to a position SW4A shown in FIG. 5 in chain lines. This displacement moves the movable blade contact SW4 away from the other movable blade contact SW3, whereby the electrical contact therebetween is interrupted to open the X contact. It will be appreciated that the X contact will be closed only when an exposure period greater than the X-period is established in the similar manner as in the previous embodiment.

While in the above embodiment, the pair of movable blade contacts SW3 and SW4 which together constitute the X contact have been displaced by cam 18 and disc 19 having projection 19*a* and which are mounted on the gears 8 and 14, respectively, it should be understood that they may be directly moved by the first and second blinds 1 and 2, respectively. This may be achieved, for example, by utilizing the slit forming member 3 of the first blind 1 to urge one of the movable blade contacts SW3 into contact with the other movable blade contact engagement SW4 when this member has completed its movement and by utilizing the movement of the second blind 2 to move the movable blade contact SW4 away from the movable blade contact SW3 to open the X contact when the second blind 2 has initiated its movement. The only requirement is that one of the movable

blade contacts, SW3, is moved into contact with the other movable blade contact SW4 when the first blind 1 has completed its running to fully open the exposure light path and the movable blade contact SW4 is moved away from the movable blade contact SW3 when the second blind 2 has initiated its movement to move into the open exposure light path.

Referring to FIGS. 7 and 8, a control of the illumination of an adjusted strobo or auto-strobo by means of a photometric circuit contained within an electronic focal plane shutter, in particular an electronic focal plane shutter of TTL (through-the-lens) type, will now be described. Initially describing the arrangement on the side of a single lens reflex camera having an electronic focal plane shutter of TTL type which is not adapted to store a photometric value, FIG. 7 shows a photometric circuit MC which does not store a photometric value, a gate circuit GC and a shutter control circuit SC, connected in parallel with each other and connected through a power switch SW5 with a first d.c. power supply E1, the power switch being closed immediately in response to the initiation of a shutter release operation. The photometric circuit MC is conventional in that it comprises light receiving elements PD1 and PD2 such as photodiodes for receiving reflected light from an object being photographed (not shown), an integrator circuit and a switching circuit. The photometric operation is initated by an opening of a trigger switch ST which is opened in synchronism with the opening movement of the shutter or the start of movement of the first blind of a focal plane shutter which is initiated in response to a shutter release operation with a time delay after the closure of the power switch SW5. The light receiving elements PD1 and PD2 of the photometric circuit MC are adapted to receive light incident upon a film 23 and the first blind 24 of the focal plane shutter having the same reflectivity as the film 23 as reflected therefrom, the light being incident on the film 23 through an objective 21 and a diaphragm 22 when a movable reflecting mirror 20 moves up in response to a shutter release operation as shown in FIG. 8. A pentaprism 25 is disposed for conducting light incident onto and reflected by the reflecting mirror 20 to a finder window, not shown, when the mirror 20 is set within the light path as shown by dotted lines.

The shutter control circuit SC comprises a first NPN transistor *Tr*1, the collector of which is connected in series with an electromagnet *Mg*. The electromagnet *Mg* locks the second blind of the focal plane shutter against movement when it is energized, and permits the second blind to move when it is deenergized. The transistor *Tr*1 is shunted by a differentiator circuit comprising a capacitor C1 and a resistor R6 connected in series, the resistor R6 being connected across a pair of terminals *a*3 and *a*4 which are adapted to apply a shutter closing signal to an electronic flash. The gate circuit GC comprises a pair of NPN transistors *Tr*2 and *TR*3 connected in series, with a resistor R1 connected to the collector of the transistor *Tr*2 and to the power switch SW5, and an NPN transistor *Tr*4 which has its collector connected through a resistor R3 with the power switch SW5. The base of the transistor *Tr*3 is connected with the collector of the transistor *Tr*4. One input terminal, that is, the base of the transistor *Tr*2 is connected through a resistor R2 with the output terminal of the photometric circuit MC, and the other input terminal or the base of the transistor *Tr*4 is connected through a resistor R5 with a terminal *a*1. Another terminal *a*2 is connected with the emitter of the transistor *Tr*4, and the base and the emitter of the transistor *Tr*4 are interconnected by a resistor R4. An inhibit signal from the electronic flash is applied across these terminals. The output terminal of the gate circuit GC, or the collector of the transistor *Tr*2, is connected to a control signal input for the shutter control circuit SC, that is, the base of the transistor *Tr*1. A synchronizing contact or X contact SX which is closed when the first blind of the focal plane shutter has moved to fully open the exposure light path is connected across the terminals *a*1 and *a*2.

Referring to FIG. 9, the arrangement on the side of an adjusted strobo unit will be described. As shown, a second d.c. power supply E2 has its positive terminal connected through a power switch SW6 and a resistor R7 with one plate of a main capacitor C2, the other plate of which is connected directly with the negative terminal of the power supply E2. The capacitor C2 is shunted by a parallel combination of a flash discharge tube *Ls* and a bypass discharge tube Ld which are associated with trigger circuits T1 and T2, respectively. The first trigger circuit T1 comprises a voltage divider BC1 comprising a pair of resistors R8 and R9 connected in series across the flash discharge tube Ls, with the resistor R9 being shunted by a series circuit comprising a trigger capacitor C3 and the primary winding of a first pulse transformer PT1. The secondary winding of the first pulse transformer PT1 is connected across a trigger electrode associated with the flash discharge tube *Ls* and one of the main electrodes thereof. The resistor R9 has its opposite ends connected to a pair of terminals *a*5 and *a*6, across which the X contact SX is connected as a start switch. Thus, an inhibit signal is applied from the terminals *a*5, *a*6 to the base-emitter path of the transistor *Tr*4 in the gate circuit GC.

The second trigger circuit T2 comprises a voltage divider BC2 comprising a series connection of resistors R10 and R11 in shunt with the discharge tube *Ld*, with the resistor R11 being shunted by a series circuit comprising a capacitor C4 and the primary winding of a second pulse transformer PT2. The secondary winding of the second pulse transformer PT2 is connected across an auxiliary electrode and one of the main electrodes of the discharge tube *Ld*. The resistor R11 is also shunted by a start switch which comprises a three terminal thyristor SCR1, which has its gate connected with a terminal *a*7 and its cathode connected with a terminal *a*8. The pair of terminals *a*7 and *a*8 are connected with the pair of terminals *a*3 and *a*4 in the shutter control circuit SC, whereby a shutter closing signal from the circuit SC may be applied to the gate of the thyristor SCR1 as an illumination interrupt signal.

With the above arrangement, an electronic flash is loaded on the camera and its terminals *a*5 and *a*6 connected with the terminals *a*1 and *a*2 of the camera. Also the terminals *a*7 and *a*8 are connected with the terminals *a*3 and *a*4. By closing the power switch SW6 of the electronic flash, the main capacitor C2 can be charged to a sufficient level to cause an illumination of the flash discharge tube *Ls*, and the capacitors C3 and C4 can also be charged. Thereupon, the terminal voltage across the resistor R9 will be applied as an inhibit signal across the base and emitter of the transistor *Tr*4 through the mating terminals *a*5–*a*1 and *a* 6–*a*2.

When the shutter of the camera is released under this condition, the power switch SW5 will be closed together with the initiation of the release operation, whereby the transistor *Tr*4 having an inhibit signal ap-

plied to its base will be turned on to prevent conduction of the transistors *Tr*3 and *Tr*2, which ultimately results in a conduction of the transistor *Tr*1. As a consequence, the electromagnet *Mg* will be energized, locking the second blind against movement. Subsequently, the reflecting mirror **20** will move up, followed by the initiation of movement of the first blind of the focal plane shutter, and the trigger switch ST will be opened in synchronism therewith, initiating the operation of the photometric circuit MC. When the first blind has run through its complete stroke or when the exposure light path is fully open, the X contact SX will be closed to turn off the transistor *Tr*4, whereby the resistor R9 in the trigger T1 is short-circuited, thus enabling the charge on the trigger capacitor C3 to be instantaneously discharged through the primary winding of the pulse transformer PT1. Thereupon, a high tension pulse will be induced across the secondary winding of the pulse transformer PT1 to trigger the flash discharge tube Ls into conduction, which therefore emits a flash. The flash from the tube Ls irradiates an object being photographed. Light reflected from the object being photographed impinges through the objective **21** and diaphragm **22** of the camera onto the film **23**, thus allowing an exposure thereof, and is also reflected by the film **23** to impinge upon the light receiving elements PD1 and PD2 of the photometric circuit MC which is then operating.

When a photometric value reaches a proper amount of exposure, the photometric circuit MC produces a shutter closing signal, which is applied to the base of the second transistor *Tr*2 for turning *Tr*2 on. Since the transistor *Tr*4 is already turned off thereby conditioning the transistor *Tr*3 to be ready to be turned on, the shutter closing signal permits the both transistors *Tr*2 and *Tr*3 to conduct simultaneously, thus rendering the first transistor *Tr*1 non-conductive. As a result, a pulse signal is developed across the terminals *a*3 and *a*4 of the differentiator circuit, and is applied through terminals *a*7 and *a*8 to the gate-cathode path of the thyristor SCR1 to cause its conduction. The conduction of the thyristor SCR1 causes the capacitor C4 of the trigger circuit T2 to discharge in an impulse manner through the thyristor and the primary winding of the second pulse transformer PT2, so that high tension pulse is induced across the secondary winding of this transformer to be applied to the discharge tube *Ld* to initiate conduction. Thereupon, the flash discharge tube *Ls* becomes shortcircuited by the discharge tube *Ld,* whereafter the discharge current from the capacitor C2 will be bypassed by the discharge tube *Ld,* thus interrupting the illumination of the flash discharge tube *Ls.* Simultaneously, the turning off of the transistor *Tr*1 deenergizes the electromagnet *Mg,* whereby the second blind is released to move, thus closing the shutter to terminate a photographing operation. Therefore, it will be seen that the illumination of the electronic flash is controlled by a shutter closing signal derived from the photometric circuit MC of a camera, and that a complete synchronization is assured since the electronic flash can be activated in the fully open condition of the shutter.

When a flashlight photographing by means of an electronic flash is attempted to take a picture of a man under counter-light, bright illumination, inconveniences may be caused such that the electronic flash fails to operate or a synchronized flashlight photographing is prevented if an arrangement is such that the photometric circuit MC supplies a shutter closing signal directly to the shutter control circuit SC, since in this instance the photometric circuit MC may produce a shutter closing signal before the shutter is fully open or the first blind has completed its movement, to thereby permit a movement of second blind before the electronic flash is activated because the latter is adapted to be activated under the fully open condition of the shutter.

However, in accordance with the invention, the shutter closing signal produced by the photometric circuit MC is supplied to the shutter control circuit SC through the gate circuit GC, which passes the closing signal to the shutter control circuit SC only when the X contact SX is closed, so that even if the photometric circuit MC produced a shutter closing signal before the shutter is fully open, a closing movement of the shutter is not initiated and the illumination interrupt signal will not be supplied to the electronic flash until after the shutter becomes fully open to permit an activation of the electronic flash. Thus, a satisfactory synchronized photographing is assured as mentioned before even when a picture is taken of a man under counter-light, bright illumination.

If an electronic flash is not loaded on the camera, no inhibit signal will be fed from the electronic flash to the terminals *a*1 and *a*2, so that the transistor *Tr*4 normally remains off while the transistor *Tr*3 normally remains on. In other words, a signal from the photometric circuit MC is passed through the gate circuit GC to the shutter control circuit SC any time, thus assuring a proper operation of the camera.

While the above embodiment deals with a single lens reflex camera of TTL type incorporating a photometric circuit which does not store a photometric value, a conventional bladed shutter employs a photometric circuit of the type which stores a photometric value, so that the invention can be equally applied to such cameras.

In this manner, in accordance with the invention, the photometric circuit of the camera can be used to provide a control of the illumination of a flash tube within an electronic flash, thus eliminating the need for a photometric circuit in the electronic flash while permitting the same effect to be achieved as that of a flashlight photographing using an adjusted strobo. Thus, a flashlight photographing operation with a proper amount of exposure is facilitated, and consequently the electrionic flash used may be a compact and inexpensive one. In addition, the utilization of the photometric circuit of the camera is maximized.

The invention also provides an arrangement in which an electronic flash is prevented from emitting light when a given amount of exposure is reached by natural light before the illumination of the electronic flash should take place and in which the electronic flash is activated only when a given amount of exposure is not reached when the X contact is to be closed. Referring to FIG. **10**, an electrical circuit shown within a box **30** indicated in broken lines represents an electronic shutter circuit provided on the part of an EE camera while an electrical circuit shown within a box **31** indicated in chain lines represents the principal part of an autostrobo of a series controlled type. Both electrical circuits are electrically connected together through connection terminals *a*11 *a*12 and *a*13. The electronic shutter includes a light receiving element PD which comprises a photoelectric transducer element such as a photodiode, phototransistor, silicon photocell or the like having a rapid response to a natural light (continuous

light) as well as a flash from the strobo unit. The electronic shutter includes a block A of a conventional design and having its last stage formed by the series circuit comprising an electromagnet *Mg* for permitting the movement of the second blind and a switching transistor *Tr*. As before, the electromagnet *Mg* is energized by the conduction of the transistor Tr when the first blind initiates its movement upon shutter release, thereby constraining the second blind of the shutter from movement. When a proper amount of exposure is reached, the block A operates to turn off the transistor *Tr*, thereby deenergizing the solenoid to permit the second blind to move. The transistor *Tr* has its emitter connected with the connection terminal *a*13 and its collector connected with the connection terminal *a*12, while the X contact SX is connected between the connection terminals *a*11 and *a*13.

The main electrical circuit of the strobo unit comprises a main capacitor C2 connected across a pair of power supply terminals *a*14, *a*15; a series circuit comprising a flash discharge tube *Ls* and a thyristor SCR2 which are connected across the capacitor C2 through a conduction control circuit B for the thyristor SCR2; another series circuit connected across the first mentioned series circuit and comprising a resistor R20, a trigger capacitor C3, the primary winding of a triggering pulse transformer T1 and a resistor R21; a further series circuit comprising a current limiting resistor R22 and a thyristor SCR3 connected in series across the pair of connection terminals *a*11 and *a*13; an additional series circuit comprising a capacitor C6, diode D1 and resistor R23 connected across the pair of connection terminals *a*12 and *a*13; and a connection circuit including a capacitor C5 and diode D2 in series between the connection terminal *a*12 and the conduction control circuit B. The secondary coil of the triggering transformer T1 has its one end connected with a trigger electrode t and its other end connected with a cathode of the thyristor SCR2. The gate of the thyristor SCR2 is supplied with a firing voltage from the conduction control circuit B while the gate of the thyristor SCR3 is supplied with a firing voltage from the junction between the diode D1 and the resistors R23. The junction between the resistor R20 and the trigger capacitor C3 is connected with the connection terminal *a*11, which is also connected to the conduction control circuit B.

When an electronic flash is coupled with the electronic shutter, the light from the flash discharge tube Ls as reflected from an object being photographed is received by the element PD within the electronic shutter for processing within the electronic shutter circuit, and when a proper amount of the exposure has been reached, the electromagnet Mg is deenergized to permit the second blind of the shutter to start moving. Since the mechanical operation of the shutter blind is slower in operation than the time interval during which the electronic flash is activated, it is impossible to rely on the closing movement of the second blind alone in order to control the light from the electronic flash. In view of this, a release signal indicative of the deenergization of the electromagnet *Mg* is derived to be passed through a path including the capacitor C5 and diode D2 to be applied to the conduction control circuit B so as to interrupt the conduction of the thyristor SCR2, thus terminating the illumination of the flash discharge tube *Ls*. In this manner, a proper amount of exposure is assured.

In operation, if a given amount of exposure is reached by natural light before the strobo unit is to be activated, the block A produces a signal which permits the second blind to move immediately after the movement of the first blind, whereby the transistor Tr is turned off to deenergize the electromagnet *Mg*. This release signal is derived at the connection terminal *a*12 and applied through the capacitor C6 and diode D1 to the gate of the thyristor SCR3 as a firing voltage, thus rendering this thyristor conductive. The conduction of the thyristor SCR3 causes the trigger capacitor C3 to be discharged through the current limiting resistor R22. Consequently, even if the X contact SX is closed subsequently by the operation of the first blind, any voltage applied to the trigger electrode t will be insufficient to cause an illumination of the discharge tube *Ls*. If a release signal is obtained from the electromagnet *Mg* subsequent to the closure of the X contact SX, the charge on the trigger capacitor C3 will be discharged through the triggering transformer T1, and at the same time the thyristor SCR2 will be turned on, thereby initiating the illumination of the flash discharge tube *Ls*. However, this illumination will be immediately interrupted since simultaneously with the release signal from the electromagnet *Mg*, this signal will operate the control circuit B through the capacitor C5 and diode D2 to turn off the thyristor SCR2 in the manner mentioned previously.

In this manner, the invention assures a satisfactory synchronized flashlight photographing in any instance, including a synchronized photographing during daytime.

What is claimed is:

1. An apparatus for synchronizing an electronic flash with a camera having a focal plane shutter provided with first and second blinds, said apparatus comprising:
   - a normally disabled photometric circuit having switch means for enabling said circuit to initiate a photometric operation in synchronism with initiation of an opening movement of the shutter first blind to subsequently produce a shutter closing signal at a time delay controlled by the amount of time required for the photometric value to reach a given amount of exposure;
   - a shutter control circuit having a control input, said shutter control circuit preventing the remaining blind from running to thereby keep the shutter open in the absence of a shutter control signal at said control input and for enabling the remaining blind to run and thereby close the shutter when a shutter closing signal is applied to said control input;
   - an electronic flash unit including means for initiating illumination thereof as soon as the first blind has completed running;
   - gate means for enabling the shutter closing signal to be coupled to the shutter control circuit only when the shutter first blind has moved to its fully open position;
   - means for interrupting the illumination of the electronic flash unit when the shutter closing signal is supplied from the photometric circuit as a result of photometry thereby a light reflected from an object being photographed, due to either natural light or flash light from the electronic flash unit or both.

2. An apparatus according to claim 1 in which the shutter control circuit comprises a series circuit including a transistor and an electromagnet, said electromagnet being effective in its energized condition to lock the

second blind of the focal plane shutter against movement, the deenergization of the electromagnet permitting the second blind to move.

3. An apparatus for synchronizing an electronic flash with a camera having a focal plane shutter provided with first and second blinds, the apparatus comprising:

a photometric circuit having switch means for initiating operation of the photometric in synchronism with initiation of an opening movement of the first blind of the shutter to produce a shutter closing signal at a time when a photometric value reaches a given amount of exposure;

a shutter control circuit for closing the remaining blind of the shutter in response to said shutter closing signal derived from the photometric circuit;

an electronic flash unit activated for flash illumination by second switch means operated in synchronism with the completion of the opening movement of the shutter first blind which occurs at the time that the exposure light path is fully open;

means for interrupting the flash illumination of the electronic flash unit responsive to the shutter closing signal which occurs when the photometric circuit determines that reflected light from an object being photographed, which object is irradiated either by natural light or flash illumination from the electronic flash unit or both, reaches the given amount of exposure;

said electronic flash unit including an energy storing capacitor discharged by said switch means when said light path is fully open and means coupled across said energy storing capacitor for developing an inhibit signal when the flash unit is in an inactivated state;

a gate circuit interposed between the photometric circuit and the shutter control circuit for inhibiting the coupling of the shutter closing signal from the photometric circuit to the shutter control circuit in response to said inhibit signal, said inhibit signal being interrupted by closure of said switch means which occurs in synchronism with the initiation of the flash illumination of the electronic flash unit.

4. An apparatus according to claim 3 in which the gate circuit comprises a first series circuit including a first resistor and a first transistor, and a second series circuit including a second resistor and second and third transistors, the output from the photometric circuit being applied to the base of the second transistor through a third resistor, the output of the first transistor being applied to the base of the third transistor, the inhibit signal from the auto-strobo being applied across the base and emitter of the first transistor.

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