EXPOSURE CONTROL SYSTEM FOR PHOTOGRAPHIC CAMERAS

Filed Oct. 25, 1966 2 Sheets-Sheet 1

FIG. 1

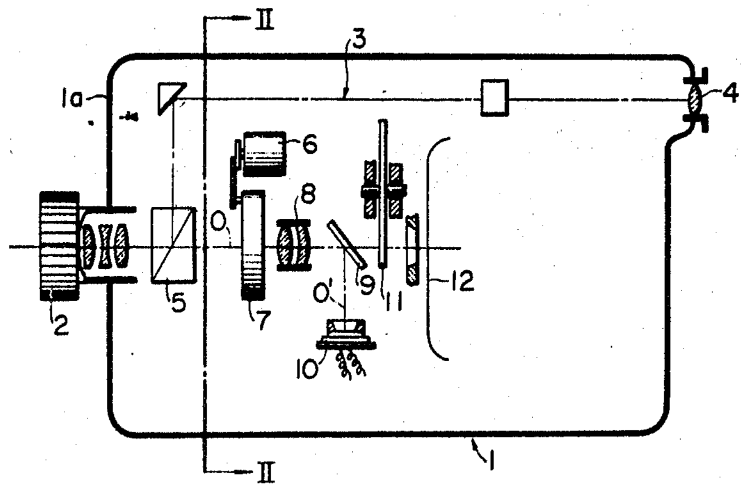

FIG. 2

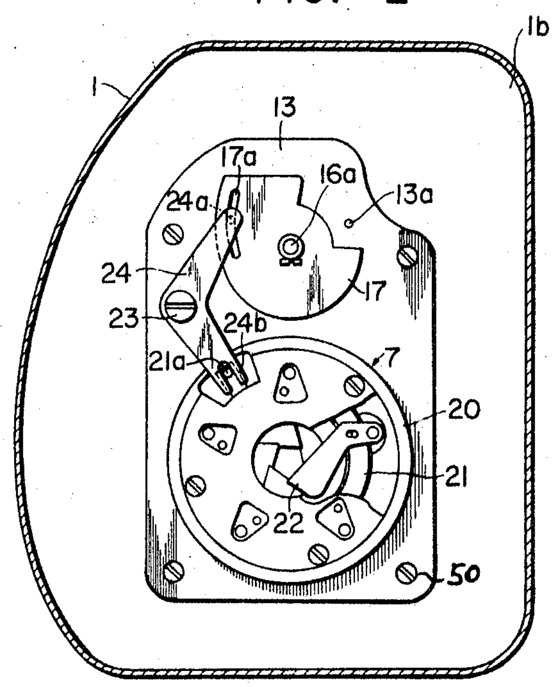

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FIG. 3

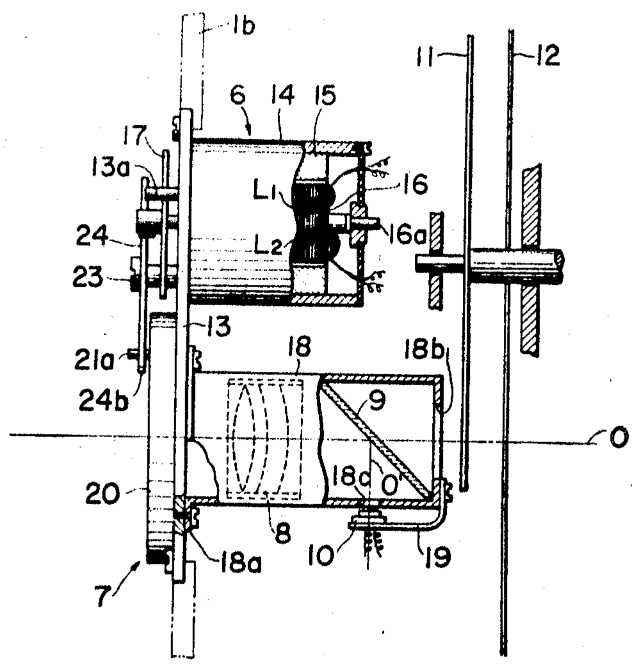
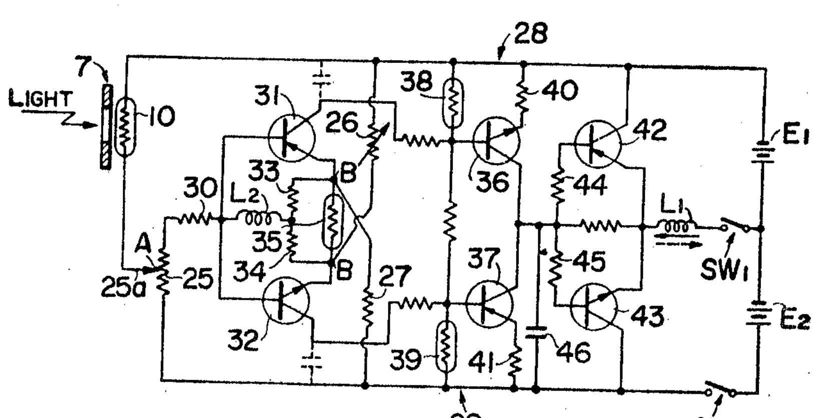


FIG. 4



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EXPOSURE CONTROL SYSTEM FOR PHOTOGRAPHIC CAMERAS

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Int. Cl. G03b 7/08, 9/02
U.S. Cl. 95—64 9 Claims

ABSTRACT OF THE DISCLOSURE

An exposure control system for use in photographic cameras wherein the diaphragm is operated by an electromagnetic device including a permanent magnet and a movable element wound with an energizing coil and a damping coil. The electromagnetic device is controlled by a Wheatstone type electric bridge having a photoresistor in one of the branches. Switching transistors of the p-n-p and n-p-n type are connected between the output terminals of the bridge, and a transistor amplifier is connected to the switching transistors. The diaphragm is controlled in quick and accurate response to changes in brightness of the object to be photographed by connecting the energizing coil between the output terminals of the transistor amplifier and by connecting the damping coil between the output points of the bridge.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an exposure control system for use in photographic cameras, and more particularly to a system for automatically controlling a diaphragm device used in the photographic cameras which may be either still cameras or motion picture cameras.

Description of the prior art

A known exposure control system for use in photographic cameras comprises a bridge circuit of a Wheatstone type having, in one of the branches thereof, a photoconductive element which undergoes a change in its resistance value in response to the change in the intensity of the incident light and which serves as a detecting element to convert the magnitude of the change in the light transmitted from the object to be photographed to the film into a change in the resistance value of said photoconductive element; a switching circuit comprising a p-n-p type transistor and an n-p-n type transistor and being controlled by the voltage generated between the output terminals of the Wheatstone bridge when said bridge is rendered to an unbalanced state due to said change in the resistance value of said photoconductive element; an electromagnetic device (for example, electric motor or electric meter) comprising an energizing coil member inserted for connection between the common emitter electrode of said p-n-p type transistor and said n-p-n type transistor and the terminals of the respective power sources connected to the respective collector electrodes of said transistors, and at least a permanent magnet which interacts with said energizing coil member; said exposure control system being operative in such manner that said energizing coil member is displaced by a current in the energizing coil of said energizing coil member in a direction complying with the polarity of the voltage generated between the output terminals of said Wheatstone bridge to actuate the

diaphragm device in synchronism with the displacement of said coil member and to also maintain the amount of light transmitted from the object to be photographed to the film constant by controlling the Wheatstone bridge so as to be rendered to a balanced state again.

In the known exposure control system described above, the amount of light transmitted to the film is not always precisely controlled on account of the occurrence of oscillation of the movable element including said energizing coil member back and forth about the equilibrium point of said bridge or on account of the occurrence of stepwise displacement of said movable element during its displacement motion which result: from the response characteristic of the photoconductive element represented by a change in its resistance value corresponding to the change in the amount of the incident light, or in other words, the time delay which takes place in the photoconductive element in effecting a change in its resistance value in response to the change in the intensity of the incident light thereto; from the performance characteristics of the switching transistors; from the state of magnetic coupling between the electric control circuit and the electromagnetic device; from the inertia of the movable element including said energizing coil member; and from a failure in the actuation of said switching transistors in case the voltage generated between the output terminals of said Wheatstone bridge is small.

SUMMARY OF THE INVENTION

It is, therefore, the primary object of the present invention to provide an exposure control system of the type described, comprising switching transistors, a movable element and a damping coil member wound around said movable element and being operative so that the polarity of the voltage induced in said movable element due to its displacement is reversed with respect to the polarity of the voltage generated between the output terminals of the Wheatstone bridge, said damping coil member being inserted between the common base electrode and the common emitter electrode of the switching transistors, to thereby cause a constant current to flow in the energizing coil member to insure that said movable element always effects movements at a constant speed and that said movable element instantaneously stops its movement upon said bridge being rendered to a balanced state, whereby a correct diaphragm aperture may always be determined.

Another object of the present invention is to provide an exposure control system which is adapted to change the diaphragm aperture into a precise size in response to a slight change in the brightness of the object to be photographed, by preventing the deterioration of the performance sensitivity due to the influence of the base voltage of the switching transistors and by immediately displacing the movable element upon the occurrence of a slight voltage between the output terminals of the Wheatstone bridge.

Still another object of the present invention is to provide an exposure control system which is adapted to work so that the diaphragm aperture is smoothly and continuously altered, by eliminating the alternating current of a relatively high frequency which is apt to be caused to flow in the energizing coil member and thereby effecting a smooth and continuous displacement of said movable element.

A further object of the present invention is to provide an exposure control system which is suitable for a TTL (through the lens) system.

The present invention and other objects thereof will become more clearly understood by reading the following detailed descriptions with reference to the accompanying drawings which are given simply by way of examples.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a somewhat schematic representation of an embodiment of the present invention equipped with the exposure control means of the present invention;

FIG. 2 is a front elevational view, in an enlarged scale, taken along the line II—II in FIG. 2;

FIG. 3 is a side elevational view, with part broken away, of the exposure control means in FIG. 2; and

FIG. 4 is a wiring diagram of the electric control circuit which is connected to the exposure control means of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings, an adjustable focusing lens group **2** is mounted to the front wall **1*a*** of the camera housing **1**.

In the background of said lens group **2** is disposed a half prism **5** for introducing a part of the light reflected from the object to be photographed into the optical system **3** used for a range finder.

An eyepiece **4** of the range finder is adjustably mounted to an upper portion of the rear wall of the camera housing. In the background of said half prism **5** and on the lens axis O of the focusing lens group **2** are arranged, successively on one line, a diaphragm device **7** which is operated by an electromagnetic device **6**, a master lens group **8**, and a half mirror **9**. The light reflected by said half mirror **9** is adapted to enter into a photoresistor element **10** comprising a photoconductive material such as cadmium sulfide, while the main light which has passed through said half mirror **9**, is adapted to be transmitted to the surface of a film **12** through a suitable shutter device **11**.

Though not shown, the shutter device **11** and the film **12** are driven synchronously by a known means. Said electromagnetic device **6** and said photoresistor element **10** are connected to said electric control circuit as will be described later.

Referring next to FIGS. 2 and 3, the structure of the exposure control means including said electromagnetic device **6**, said diaphragm device **7**, a master lens group **8**, a half mirror **9** and a photoresistor element **10** will be described in detail.

The aforesaid electromagnetic device **6** is mounted to the back of a base plate **13** which is detachably mounted, by means of screws **50** or the like (not shown), to the front part of the camera housing **1** which is partly shown with dot-dash line **1*b***. This electromagnetic device **6** has a casing **14** of a cylindrical shape. A cylindrical magnet **15** is fixed to the internal peripheral surface of said casing **14**.

A cylindrical movable element **16** having a main shaft **16*a*** which is rotatably supported by the side walls of said casing **14** is inserted inside said cylindrical magnet **15** in concentric relationship therewith. The cylindrical movable element **16** is wound with an energizing coil L_1 and also with a damping coil L_2 which are connected to the electric control circuit as will be described later independently of each other, and is so arranged as to be operative in such a manner that when a current is caused to flow in said energizing coil L_1, said cylindrical movable element **16** is adapted to be angularly displaced by virtue of the interaction between the magnetic field produced by said energizing coil L_1 and the magnetic field of said cylindrical magnet **15**. One end of said main shaft **16*a*** extends through the base plate **13** and the front face thereof. A control disk **17** which is restricted in its range of movement by a pin **13*a*** protruding outwardly from the face of the base plate **13** and which is provided with a slot **17*a***, is fixed to said one end of main shaft **16*a***.

Also, on the back of said base plate **13** is securely mounted, adjacent to said electromagnetic device **6**, a box **18** by means of a flange **18*a*** and screws. The end wall of said box **18** located on the side having flange **18*a*** is open, while the opposing end wall is provided with an aperture **18*b*** through which a flux of light of the image to be photographed is passed. Said half mirror **9** is disposed inside said box **18** at an angle of 45 degrees relative to said master lens group **8** and said lens axis O. The box **18** is provided with an opening **18*c*** on that portion of its peripheral wall located in the path of the reflected light O′ coming from the half mirror **9**.

A photoresistor **10** constituting one arm of the Wheatstone bridge in the electric control circuit which will be described later is positioned so as to face said opening **18*c*** by means of a bracket **19**.

On the front surface of said base plate **13** is mounted, coaxially with said lens axis O, said diaphragm device **7** comprising a housing **20**, a diaphragm operating ring **21** rotatably mounted in said housing **20**, and a plurality of diaphragm blades **22** operated by said diaphragm operating ring **21**. With respect to the aforesaid arrangement of the box **18** and the diaphragm device, it should be understood that the internal diameter of the box **18** is in agreement with at least the widest diaphragm aperture of the diaphragm device **7**. A crank lever **24** is pivotally mounted to a shaft **23** provided on said base plate **13** so that the lever can make a pivotal movement about said shaft **23**. A pin **24*a*** is provided on one end of said crank lever so as to protrude outwardly therefrom and to engage in the slot **17*a*** formed in said control disk **17**, while a fork portion **24*b*** formed on the other end of the crank lever engages a pin **21*a*** formed on the diaphragm operating ring **21** so as to protrude outwardly therefrom.

It is important to note that an arrangement is provided so that during the movement of the slot **17*a*** of the control disk **17** from one end to the other end with respect to the pin **24*a*** of said crank lever, the diaphragm blades **22** effect a movement from their position of the widest diaphragm to their position of the narrowest diaphragm aperture.

In FIG. 4 is shown an electric control circuit comprising an electric switching circuit which comprises an electric bridge of Wheatstone type including a photoresistor **10** and two switching transistors of a p-n-p type and an n-p-n type connected between the output terminals of said electric bridge, a transistor amplifier composed of transistors connected to said switching circuit, an energizing coil L_1 connected to the output side of said transistor amplifier, and a damping coil L_2 connected between the junction of the common base electrode and the respective emitter electrodes of the switching transistors. The Wheatstone bridge comprises a photoresistor **10** which undergoes a change in its resistance value in response to a change in the intensity of the incident light, a variable resistor **25** to match the emulsion speed of the film used, a variable resistor **26** adapted to set the shutter speed, and a resistor **27**. The junction between one end of said photoresistor **10** and said variable resistor **26** is connected by line **28** to the negative terminal of said power source E_1, while the junction of one end of the variable resistor **25** and the resistor **27** is connected by line **29** to the positive terminal of the power source E_2. The other terminal of the photoresistor **10** is connected to a slider **25*a*** of the variable resistor **25**, while the other end of said variable resistor **25** is connected, through a bias resistor **30**, to the common base electrode of the p-n-p type and the n-p-n type switching transistors **31** and **32**.

Between the respective emitter electrodes of the transistors **31** and **32** are inserted, for connection in series, two resistors **33** and **34**.

In addition, another resistor or a thermistor **35** is inserted for connection in parallel to both of said resistors **33** and **34**. Also, one end of the resistor **27** is connected to the joint of the resistor **33** and the thermistor **35**, and one end of a variable resistor **26** is connected to the junction of the thermistor **35** and the resistor **34**. Each of the collector electrodes of the switching transistors **31** and **32** is connected, through a resistor, to each of the base electrodes of transistors **36** and **37**, while thermistors **38** and **39** are inserted for connection between the base electrodes and lines **28** and **29**, respectively, said base electrodes being connected to each other by means of a resistor.

Furthermore, the respective emitter electrodes of said transistors **36** and **37** are connected, through resistors **40** and **41**, to the lines **28** and **29**, respectively. The common collector electrode of the transistors **36** and **37** is connected to the junction of the resistors **44** and **45** which are connected to the respective base electrodes of the transistors **42** and **43**. An electric condenser **46** having a polarity is inserted for connection between said junction and the line **29**. A resistor is inserted for connection between the junction of the resistors **44** and **45** and the common emitter electrode of the transistors **42** and **43**.

The respective collector electrodes of said transistors **42** and **43** are connected to the lines **28** and **29**, respectively. The aforedescribed energizing coil L_1 is inserted for connection, through a first switch SW_1 which is normally rendered open except during the period of photographing, between the common emitter electrode of the transistors **42** and **43** and the neutral point of said power sources E_1 and E_2.

Also, a damping coil L_2 which will be later described is inserted between the emitter electrodes of said transistors **31** and **32**. It is important to note that said energizing coil L_1 and said damping coil L_2 are wound around the movable element **16** in such manner that they are not magnetically coupled to each other and also that said damping coil L_2 is connected in such fashion that the polarity of the induced voltage generated in said coil is opposite to the polarity of the unbalanced voltage generated between the output terminals A and B of the Wheatstone bridge. A second switch SW_2 which is normally rendered open except during the period of photographing is inserted between the collector electrode of the transistor **43** and the positive terminal of the power source E_2. Said first switch SW_1 and said second switch SW_2 are actuated to close in synchronism with the release operation of the shutter release member (not shown). These switches are arranged so that the closing of these switches is effected in such manner that said second switch SW_2 is closed after said first switch SW_1 is closed, while the opening of these switches is effected in such fashion that said first switch SW_1 is rendered open after said second switch SW_2 is rendered open.

Description will now be directed to the function of said camera equipped with the exposure control system of the present invention.

Let us assume that the resistance value of the photoresistor **10** which is determined by the intensity of the photograph light which enters through the diaphragm device **7** and the master lens group **8** and which enters the photoresistor **10** after being reflected from the half mirror **9**, is designated as R_1, that the resistance value of the variable resistor **25** set in compliance with the emulsion speed of the film used is designated as R_2, that the resistance value of the variable resistor **26** set synchronously with the setting operation of the shutter speed is designated as R_3, and that the resistance value of the resistor **27** is designated as R_4. Now, if the Wheatstone bridge is in its balanced state, or in other words, if these resistance values are in the relationship $R_1 \cdot R_4 = R_2 \cdot R_3$, then there is generated no voltage whatsoever in the output terminals A and B of said bridge even when both the first switch SW_1 and the second switch SW_2 are rendered into closed state by virtue of the release operation of the shutter release member, and as a consequence, neither one of the transistors **31** and **32** is actuated. Accordingly, there is no appreciable current flowing in the energizing coil L_1, and the movable element **16** remains immovable in its present position. Assuming now that a change has occurred in the intensity of the light incident to the photoresistor **10**, or in other words in the brightness of the object to be photographed, causing a change in its resistance value and that as a result the relationship between the resistance values of the respective resistors has been altered to $R_1 \cdot R_4 > R_2 \cdot R_3$, there is generated an unbalanced positive voltage in the output terminal A of the Wheatstone bridge and an unbalanced negative voltage in the output terminal B, and as a consequence, the transistor **31** is rendered to a "cutoff" state, while the mating transistor **32** is brought into an "active" state. Accordingly, the transistors **36** and **42** are rendered to an "off" state, and the transistors **37** and **43** are put into an "active" state, causing a current to flow in the energizing coil L_1 in the direction of the arrow indicated in dotted line. On the contrary, if the relationship between the respective resistors is altered to $R_1 \cdot R_4 < R_2 \cdot R_3$, an unbalanced negative voltage is generated in the output terminal A and an unbalanced positive voltage is generated in the output terminal B, causing the state of the transistors **31**, **36** and **42** to be shifted to an "active" state, respectively, while the transistors **32**, **37** and **43** are rendered to "cutoff" state, respectively. As a consequence, a current in the direction of the solid line is caused to flow in the energizing coil L_1. When a current in the direction of either the dotted arrow or the solid arrow, which is the reverse of the former, flows through the energizing coil L_1, the movable element **16**, in response to the current, rotates and changes its position either clockwise or counterclockwise about the main shaft **16*a***. More specifically with reference to FIG. 2, when a current in the direction of the solid line flows in the energizing coil L_1, or in other words, when the light incident to the photoresistor **10** is intensified, the rotary shaft **16*a*** of the electromagnetic device **16** effects clockwise rotation, causing the control disk **17** to rotate clockwise. As a consequence, the slot **17*a*** of the control disk **17** causes, through the pin **24*a***, the crank lever **24** to make clockwise rotation about the pivotal shaft **23**. This clockwise rotation of the crank lever **24** causes the fork portion **24*b*** of the crank lever **24** to engage the pin **21*a*** of the diaphragm operating ring **21** to rotate the latter ring **21** counterclockwise so as to move the diaphragm blades **22** till they assume a position of a reduced diaphragm aperture. As a natural consequence, the amount of light entering through the diaphragm aperture and into the box **18** is reduced. A portion of this reduced incident light passes straight along the lens axis O, and through the shutter device **11**, reaches the film **12** to expose the latter to said light, while the remaining portion of the incident light is reflected from the half mirror **9** and this reflected light passes through the opening **18*c*** to reach the photoresistor **10**. The intensity of the light reaching the photoresistor **10** is gradually reduced with the gradual narrowing of the diaphragm blades. When the resistance R_1 of the photoresistor **10** has reached, as a result of the reduced intensity of the light reaching the photoresistor **10**, a value at which the Wheatstone bridge is again put into a state of equilibrium, the movable element **16** ceases its movement. On the other hand, when a current in the direction of the dotted line is passed through the energizing coil L_1, or in other words, when the amount of the light incident to the photoresistor **10** is reduced, the movable element **16** and accordingly the diaphragm device **7** effect a movement in a direction reverse to that stated in connection with the foregoing operation, gradually increasing the amount of light reaching the photoresistor **10** until the resistance value R_1 thereof puts the Wheatstone bridge into a state of equilibrium again at which the movable element **16** ceases its movement.

Accordingly, the amount of light reaching the film **12** is always of a constant value independently of the brightness of the object to be photographed.

The afore-discussed control means is advantageous in that it effectively eliminates, by the provision of the damping coil L_2 having the foregoing structure and the foregoing connection pattern, the undesirable occurrence of oscillation of the movable element **16** accruing from the "light amount"—"resistance value" characteristic of the photoconductive material principally constituting the photoresistor **10** and also eliminates the inertia of said movable element **16** which is due to a sharp change in the amount of light.

A photoconductive material, in general, would not undergo a change in its resistance value immediately after a change has taken place in the amount of light incident thereto, but it requires a certain small length of time or delay in time before its resistance value effects a change in response to said change in the intensity of the incident light. The control means of the present invention works, to compensate for the foregoing defective nature of the photoconductive material, in the following manner. When there occurs a change in the resistance value of the photoresistor **10**, causing the movable element **16** to rotate to change its position, said movable element **16** will cease its movement for a moment when there is established a state of equilibrium in the Wheatstone bridge, or in other words, when there is formed a relationship $R_1 \cdot R_4 = R_2 \cdot R_3$. On account of the aforesaid delay in time, however, the resistances are placed, immediately after the cease of movement of said element **16**, into a relationship $R_1 \cdot R_4 \neq R_2 \cdot R_3$, again rendering the Wheatstone bridge to an unbalanced state.

More concretely, when, for example, there occurs an increase in the amount of light incident to the photoresistor **10** causing the resistance value R_1 of said resistor **10** to be reduced, the movable element **16** acts to cause the diaphragm aperture of the diaphragm means **7** to reduce its diameter or size and to thereby increase the resistance value R_1, with a result that the Wheatstone bridge is placed again into a balanced state. However, the resistance value R_1 of the photoresistor **10** continues to increase for a very short extended length of time after the Wheatstone bridge has already reached the equilibrium state. Such delay in the action of the photoresistor **10** causes a voltage of reverse polarity to be generated between the output terminals A and B of the Wheatstone bridge so that the movable element **16** is displaced in the direction opposite to the initial direction, to widen the diaphragm aperture. With the widening of the diaphragm aperture, the amount of light incident to the photoresistor **10** increases, resulting in that the resistance value R_1 of the photoresistor **10** reduces again. As a consequence, the polarity of the voltage generated between the output terminals A and B of the Wheatstone bridge is again reversed, so that the movable element **16** is actuated again to reduced the size of the diaphragm aperture. The movable element **16** thus oscillates back and forth across the equilibrium point and accordingly the diaphragm aperture is not immediately fixed at an appropriate value. However, such phenomenon is effectively eliminated by the damping coil L_2. Specifically, the movement of the movable element **16** causes an induced voltage to be produced in the damping coil L_2 by virture of the permanent magnetic field which is resulted by the cylindrical magnet **15**. Since this induced voltage acts so as to reduce the unbalanced voltage generated between the output terminals A and B of the bridge, it serves to substantially prevent the alternate "on-off" actions of the transistors **31** and **32** back and forth across the equilibrium point of the bridge due to the time delay in the making of a change in the resistance of the photoresistor **10**, and to thereby bring the movable element **16** to a halt immediately upon the bridge being rendered to a balanced state.

Furthermore, since the magnitude of the induced voltage generated in the damping coil L_2 is proportionate to the displacement velocity of the movable element **16**, the latter would not change its value R_1 of the photoresistor **10**, but instead, the movable element **16** can be displaced always at a substantially constant velocity.

Let us now designate the resistance values of the biasing resistor **30**, and the resistors **33** and **34** as r_1, r_2 and r_3, respectively, and the maximum unbalanced voltage generated between the output terminals A and B of the bridge as e_{max}, and the induced voltage generated in the damping coil L_2 when the movable element **16** has made a displacement at the highest possible speed as e'_{max}. It will be easily understood by those skilled in the art that a most effective damping action of the damping coil L_2 is obtained by selecting the values r_1, r_2 and r_3 so as to satisfy the following relationship:

$$\frac{R_1+r_1}{r_2}=\frac{R_1+r_1}{r_3}\doteq\frac{e_{max.}}{e'_{max.}}$$

Also, in the aforesaid control means, it sometimes occurs that neither of the transistors **31** and **32** is actuated depending upon the magnitude of the unbalanced voltage generated between the output terminals of the bridge resulting principally from the V_{BE}—I_B characteristic of the transistors **31** and **32**. More specifically, when the resistance value of the photoresistor **10** effects a very limited change, the magnitude of the unbalanced voltage generated between the output terminals A and B is accordingly very small. In such case, neither of the transistors **31** and **32** is actuated. Since in the arrangement of the present invention, a resistor or a thermistor **35** is inserted for connection between one of the output terminals, namely, between B and B of the bridge to eliminate the aforesaid inconvenience, it is possible to prevent the dynamic sensitivity of said transistors **31** and **32** from diminishing owing to the influence of the voltage V_{BE} between the base electrode and the emitter electrode of these transistors, and it is also possible to actuate either the transistor **31** or the transistor **32** even when an unbalanced voltage of a slight degree is generated between the output terminals A and B of the bridge.

By the use of said thermistor in the electric control circuit, it is also possible to prevent a change in the dynamic sensitivity of the transistors **31** and **32** due to a change in the ambient temperature from taking place.

Furthermore, in the control means described above, the current which flows in the energizing coil L_1 tends to contain an alternating component of a relatively high frequency due mainly to such factors as the structure of the electromagnetic device **6** per se, or due to the coupling relation between the electric control circuit and the electromagnetic device **6**, resulting in an inconvenience that the movable element **16** will make a stepwise movement during its displacement motion.

Since, according to the present invention, there is inserted an electric condenser **46** between line **29** and the junction of the resistors **44** and **45** connected to the base electrodes of the transistors **42** and **43**, the aforesaid alternating component is positively bypassed so that the alternating component can be removed from the current flowing through the energizing coil L_1. As a consequence, the movable element **16** can always effect a smooth and continuous motion of displacement.

In this instance, said condenser **46** may be inserted between line **28** and the junction of the resistors **44** and **45** connected to the base electrodes of the transistors **42** and **43**, and furthermore, an identical effect can be obtained by inserting, as are indicated by the dotted lines in FIG. 4, a condenser between the collector electrode of the transistor **31** and the junction of the resistor **10** and the variable resistor **26**, and by inserting still another one between the collector electrode of the transistor **32** and the junction of the variable resistor **25** and the resistor **27**, respectively.

As has been discussed, the diaphragm device **7** is controlled, according to the present invention, smoothly and positively in compliance with the brightness of the object to be photographed, after taking the emulsion speed of the film used and the shutter speed into consideration, and accordingly the face of the film is exposed always to a constant and adequate amount of light.

Since an arrangement is provided that the opening of the switches SW_1 and SW_2 is effected in such manner that the first switch SW_1 is opened after the second switch SW_2 has been opened as has been described, the circuit comprising the transistors **32**, **37** and **43** is rendered to a "cutoff" state first. The circuit including the transistors **31**, **36** and **42**, at this moment, is still in the "active" state regardless of the resistance value of the photoresistor **10**. As a consequence, when the switch SW_2 is opened, a current in the direction of the solid line flows in the energizing coil L_1, causing the diaphragm blades **22** to quickly move toward the position of the narrowest diaphragm aperture or the position of perfect closure. As a consequence, at each photographing operation, the diaphragm blades **22** are started always at the position of the narrowest diaphragm aperture or the position of perfect closure. Said second switch SW_2 may be inserted between the collector of the transistor **42** and the negative terminal of the power source E_1. In such arrangement, the diaphragm blades **22** will be started always at the position of the widest diaphragm aperture.

The exposure control means of the present invention which is applied to a cinecamera has been described. It is needless to say that the exposure control means of the present invention may be applied also to a still camera. It should be understood clearly by those skilled in the art that various modifications, alterations and improvements of the structure and the functions of the minor parts of the exposure control means of the present invention which has been described with reference to the accompanying drawings may be made without departing from the spirit of the present invention.

We claim:

1. An exposure control system for photographic cameras with an objective lens system, comprising: a diaphragm aperture; a Wheatstone-type bridge having a photoresistor in one of its branches; means to direct a part of light passing through said aperture onto said photoresistor; a diaphragm control means responsive to an unbalance voltage generated between the output terminals of said bridge by light directed on said photoresistor to adjust said diaphragm aperture to cause said bridge to regain a balanced state; said diaphragm control means comprising an electromagnetic device including at least one permanent magnet, a movable element influenced by the magnetic field of said magnet, a diaphragm adjusting means, coupled to said electromagnetic device, and an electric control circuit for actuating said electromagnetic device; said electric control circuit comprising said Wheatstone-type bridge, switching transistors of p-n-p type and n-p-n type connected between the output terminals of said bridge and having a common base electrode, and at least two amplifying transistors, one for and connected with each of the collector electrodes of said switching transistors, said amplifying transistors having a common emitter electrode; said movable element wound with an energizing coil connected between the common emitter electrode of said amplifying transistors and power sources and also wound with a damping coil connected between the output points of connection of said bridge in such manner that the polarity of the voltage is reverse to the polarity of the unbalance voltage generated between the output terminals of said bridge.

2. An exposure control system for photographic cameras according to claim **1**, further comprising: a biasing resistor connected between one of the output points of connection of said bridge and the common base electrode of said switching transistors; two resistors of an equal resistance value connected in series between the emitter electrodes of said switching transistors; said damping coil member connected between said common base electrode of said switching transistors and the point of connection of said two resistors in series; means to provide the selection of the ratio of the resistance value of either one of said two resistors in series to the total resistance value of said biasing resistor substantially equal to the ratio of the voltage induced in said damping coil member, when said movable element effects displacement at the maximum permissible displacement velocity, to the maximum unbalanced voltage produced between the output points of said bridge.

3. An exposure control system for photographic cameras according to claim **1** further comprising a resistor connected between the respective emitter electrodes of said switching transistors, thereby to prevent a reduction in the dynamic sensitivity of said switching transistors.

4. An exposure control system as claimed in claim **3**, said resistor inserted between the emitter electrodes being a thermistor.

5. An exposure control system for photographic cameras according to claim **1** further comprising: two biasing resistors connected in series between the base electrodes of said two amplifying transistors; and an electric condenser connected between the series junction of said two biasing resistors and the collector electrode of either one of said two amplifying transistors.

6. An exposure control system for photographic cameras according to claim **1** further comprising electric condensers connected between the respective collector electrodes of said switching transistors and the input points of connection of said bridge.

7. An exposure control system for photographic cameras according to claim **1** further comprising a first switch means connected to said energizing coil and a second switch means connected to the collector electrode of either one of said amplifying transistors, said second switch means closing when said diaphragm control means starts its action after said first switch means has been closed; said first switch means opening when said diaphragm control means completes its action after said second switch means has been opened.

8. An exposure control system according to claim **1**, said Wheatstone bridge having a "shutter speed" resistor and means to vary it in compliance with the shutter speed.

9. An exposure control system according to claim **1**, said Wheatstone bridge having an "emulsion speed" resistor and means to vary it in compliance with the emulsion speed of the film used.

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