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(54) "IMPROVEMENTS IN AND RELATING TO CAMERAS"

(71) We, AGFA-GEVAERT AKTIENGESELLSCHAFT, a body corporate recognised under German Law, of Leverkusen, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to a camera having electronic exposure control means comprising a photo-sensitive element, a capacitor, a trigger device, and an electro-magnet, and also having means for indicating when the prevailing illumination is inadequate for correct exposure.

A camera of the type mentioned above has previously been proposed in which a photo-resistor is connected to an indicating means by mechanically actuated contacts before an exposure is made, to test the prevailing light conditions. When an exposure is made, the photoresistor is disconnected from the indicating means by the contacts and connected to the capacitor of the exposure control means. The disadvantage of mechanical contacts is that on the one hand they are liable to bounce and on the other hand can become dirty after longer periods of use. The result is the risk of harmful contact resistances.

In a further previously proposed camera of the above type, a second photoresistor is always connected in series with an indicator resistor as a potential divider and to a threshold sensitive device in the indicating means.

It is an object of the invention to create a camera of the above type which has only a single photoresistor both for indicating inadequate light and for exposure control, and in which the switching operations between the two functions take place non-mechanically.

The invention provides a camera having electronic exposure control means including a photosensitive element and a capacitor connected to the input of a trigger device to the output of which is connected an electromagnet

for controlling the camera shutter, the camera also including electrical control means, switch means arranged to switch the control means between a first and second state of conduction, an indicator for indicating whether the brightness of the prevailing illumination is sufficient for correct exposure, and controllable semiconductor means arranged, when the electrical control means is in the first state, to short the capacitor and to enable the instantaneous output of the photosensitive element to be applied to the indicator and, when the electrical control means is in the second state, to remove the short from the capacitor and to connect the photosensitive element in series with the capacitor across an electrical power supply.

In this way the interconnections of the components to complete the indicating means and the exposure control means are made electrically by controllable semiconductor means avoiding the disadvantage of mechanical switching, the semi-conductor means bridging the capacitor, for example, replacing a mechanical short which is liable to contact bounce when closed. Furthermore, many of the components can be incorporated in a single integrated circuit giving a saving in space which permits a reduction in the size of the camera.

Advantageously, the semiconductor means includes a first controllable semiconductor element connected across the capacitor and a second controllable semiconductor element connected in series with the capacitor and the photosensitive element across the power supply, the arrangement being such that, when the control means is in the first state, the first semiconductor is biased on to short the capacitor and the second semiconductor is biased off to disconnect the series arrangement of the photosensitive element and the capacitor across the power supply and when the control means is in the second state the first semiconductor is biased off to remove the short on the capacitor and the second semiconductor is biased on to connect the capacitor and photosensitive

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element in series across the power supply.

The first semiconductor may be arranged, when biased on, to connect the photosensitive element to the indicating means. Alternatively, there may be provided a third semiconductor element arranged between the photosensitive element and the indicating means and which, when the control means is in the first state, is biased on to connect the photo-sensitive element to the indicating means.

The first and second semiconductors may be connected in series, the first semiconductor being connected between the second semiconductor and the photosensitive element, and the second semiconductor is connected in parallel with the indicator resistor and there is provided, connected between the second semiconductor and the control means, means for reversing the bias on the second semiconductor when the control means is switched between the two states, of conduction. Alternatively the second semiconductor may be connected in series with the capacitor between the capacitor and the photosensitive element and there is provided, connected between the second semiconductor and the control means, means for reversing the bias on the second semiconductor when the control means is switched between the two states of conduction and the third semiconductor is connected between the photosensitive element and the indicator resistor. Preferably, the second semiconductor element comprises a Darlington amplifier. The control means, advantageously, comprises at least one potential divider.

Advantageously, the switch means comprises a mechanical switch which is operated by a shutter release member or by a member actuated by the release member. The switch may be biased closed, and is opened to switch the control means from the first state to the second state. Alternatively, the switch means may comprise a two-way switch which is biased to a first position in which it is connected to the control means and is arranged to be switched to a second position in which it forms a holding switch for a power supply switch.

The camera, advantageously, includes a further controllable semiconductor element connected to the control means and arranged, when the control means is in the first state, to connect the electromagnet across the power supply and when the control means is in the second state to connect the electromagnet to the output of the trigger device. Thus, as the electromagnet is energised before being connected to the trigger device, there is no delay when the trigger device is switched on, an actuation of the shutter release.

Two forms of camera constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram for a first form of camera, and

Fig. 2 is a circuit diagram for a second form of camera.

Referring to Fig. 1, of the accompanying drawings the reference 1 indicates a trigger device which has a shutter control magnet 2 connected to its output. A power supply 4 is arranged to be connected to trigger device 1 by a switch 3 which is actuated by a shutter release. Trigger device 1 is connected to a series circuit consisting of a photoresistor 5, the collector/emitter section of a transistor 6, and a capacitor 7. A transistor 8 is connected across the capacitor 7.

A control stage comprising a potential divider 10 and 11 and a potential divider 12 and 13 is connected across the power supply 4 by a switch 9. The base of the transistor 8 is connected to the tapping between the two resistors 10 and 11, and the potential divider 10 and 11 is connected to the base of a reversing transistor 14, which has a resistor 15 connected to its collector. The collector of the reversing transistor 14 is connected to the base of a transistor 16, the emitter of which is connected to the base of the transistor 6 and the collector of which is connected to the collector of the transistor 6.

The tapping between the two resistors 12 and 13 is connected to the base of a transistor 17, the collector of which is connected to the terminal of the photoresistor 5 nearest the transistor 6 and the emitter of which is connected to an indicator resistor 18. The emitter of the transistor 17 is connected to the base of a transistor 19, which has a resistor 20, a luminous diode 21, and a resistor 22 arranged in its collector circuit.

The method of operation is as follows: When the operating switch 3 is closed by the camera-user in a manner which is not shown, the circuit is connected to the power supply 4. The resistors 10 and 11, and 12 and 13 are of such a size that the transistors 8, 14 and 17 connected to them are biased on when the switch 9 is closed. Consequently the capacitor 7 is short-circuited by the collector/emitter section of the transistor 8. In addition, the transistor 16 is biased off, since there is at its base a negative potential from the low-resistance collector/emitter section of the transistor 14. The result is that the transistor 6 is also biased off.

Since the transistor 17 is biased on, the photoresistor 5 is connected in series with the indicator resistor 18 by way of the low-resistance collector/emitter section of the transistor 17. Depending on whether the light conditions are adequate or inadequate, the transistor 19 biased off or on, so that the luminous diode 21, by not lighting up or lighting up, indicates to the camera-user whether the light conditions are adequate or inadequate. If the contact 9 is now opened during a second actuating stroke of the release member, the potential at the bases of the transistors 8, 14 and 17 jumps to

a negative potential value. The result is that the above-mentioned transistors 8, 14 and 17 biased off. The biasing off of the transistor 8 eliminates the short-circuit on the capacitor 7 so that it can charge. The biasing off of the transistor 14 means that the transistor 16, and therefore, the transistor 6 also, are biased on. The result is that the photoresistor 5 and the capacitor 7 are effectively connected in series. The biasing off of the transistor 17 eliminates the effective series-connection between the photoresistor 5 and the indicator resistor 18. The indicating device is, therefore, cut off from the photoresistor 5.

Since the transistor 19 is a pnp transistor, and after the photoresistor 5 has been cut off by the transistor 17, the base of the transistor 19 receives a negative potential, the luminous diode 21 lights up during the making of an exposure and indicates to the camera-user that the shutter is opened.

Referring now to Fig. 2, the reference 50 indicates a power supply, 51 indicates a contact which is closed until the ending of the exposure control operation, and 52 indicates a contact by which the power supply 50 is connected to the circuit. Connected to the output of a trigger device 53 is a shutter control magnet 54 which at the same time is connected to the collector of a transistor 55. The input of the trigger device 53 is connected to a voltage divider which consists of a photoresistor 56, a capacitor 57, a transistor 58 connected across the capacitor 57, an indicator resistor 59, and a transistor 60 which is connected across the indicator resistor 59 and to the transistor 58. By way of the contact 61 of a changeover switch 61 and 62, which is closed in the rest position, a voltage divider consisting of two resistors 63 and 64 is connected across the power supply 50. From the tapping between the two resistors 63 and 64 a connection leads to the base of the transistor 58 which biased on when the voltage divider 63 and 64 is switched on. In addition, the tapping between the two resistors 63 and 64 is connected to the base of a transistor 65, which serves as reversing transistor, the collector of which is connected to the base of the transistor 60. Furthermore, a resistor 66 is connected to the collector of the transistor 65. In addition, the tapping between the two resistors 63 and 64 is connected to the base of the transistor 55. The end of the indicator resistor 59 nearest the collector of the transistor 60 or the capacitor 57 is connected to a first input of a threshold value switch 67, the threshold value of which is adjustable by means of a voltage divider 68 and 69 which is connected to a further input of the threshold value switch 67.

A luminous diode 70 is connected to the output of the threshold value switch 67.

The method of operation is similar to that of the first form of control circuit.

After the contact 52 is closed, the circuit is connected to the power supply 50. The

resistors 63 and 64 are so adjusted, or are of such a size, that when the contact 61 is closed the transistors 58, 65 and 55 are switched through. Consequently the shutter control magnet 54 is energised without any delay, since it is directly connected to the power supply 50. Furthermore, the capacitor 57 is bridged and cannot, therefore be charged. In addition, as the transistor 65 is switched through the transistor 60 is blocked, so that the indicator resistor 59 is connected in series with the photoresistor 56. Depending on the brightness of the prevailing illumination, the threshold value switch 67 is either off or switch through. When there is insufficient light the luminous diode 70 lights up. The resistors 68 and 69 are of such a size that below a certain operating voltage of the power supply 50, with the photoresistor 56 covered, the luminous diode 70 does not light up. This offers the advantage that a battery voltage test can be carried out using the indicating device without the need for adjusting resistors to be arranged in series and in parallel with the luminous diode 70.

On further actuation of the release member, the contact 61 of the changeover switch 61 and 62 is opened and the contact 62 is closed. The result is that the transistors 58, 55 and 65 are biased off. Consequently the shutter control magnet 54 is now effectively connected to the output of the trigger device 53. In addition, the shunt on the capacitor 57 is eliminated. Furthermore, because the transistor 65 is biased off the transistor 60 is switched through so that the indicator resistor 59 is bridged and the photoresistor 56 is effectively connected in series with the capacitor 57. After a delay time, which depends on the brightness of the prevailing illumination has elapsed, the trigger device 53 is switched off and the shutter control magnet 54 is de-energised. the shutter control is thus terminated. In a manner which is not shown, the contact 51 is opened at the end of the exposure control. While the shutter is open the contact 52 is bridged by means of the contact 62 of the changeover switch 61 and 62.

WHAT WE CLAIM IS:—

1. A camera having electronic exposure control means including a photosensitive element and a capacitor connected to the input of a trigger device to the output of which is connected an electro-magnet for controlling the camera shutter, the camera also including electrical control means, switch means arranged to switch the control means between a first and a second state of conduction, an indicator for indicating whether the brightness of the prevailing illumination is sufficient for correct exposure, and controllable semiconductor means arranged, when the electrical control means is in the first state, to short the capacitor and enable the instantaneous output of the photosensitive element to be applied to the indicator and, when the electrical control means is in



a negative potential value. The result is that the above-mentioned transistors 8, 14 and 17 biased off. The biasing off of the transistor 8 eliminates the short-circuit on the capacitor 7 so that it can charge. The biasing off of the transistor 14 means that the transistor 16, and therefore, the transistor 6 also, are biased on. The result is that the photoresistor 5 and the capacitor 7 are effectively connected in series. The biasing off of the transistor 17 eliminates the effective series-connection between the photoresistor 5 and the indicator resistor 18. The indicating device is, therefore, cut off from the photoresistor 5.

Since the transistor 19 is a pnp transistor, and after the photoresistor 5 has been cut off by the transistor 17, the base of the transistor 19 receives a negative potential, the luminous diode 21 lights up during the making of an exposure and indicates to the camera-user that the shutter is opened.

Referring now to Fig. 2, the reference 50 indicates a power supply, 51 indicates a contact which is closed until the ending of the exposure control operation, and 52 indicates a contact by which the power supply 50 is connected to the circuit. Connected to the output of a trigger device 53 is a shutter control magnet 54 which at the same time is connected to the collector of a transistor 55. The input of the trigger device 53 is connected to a voltage divider which consists of a photoresistor 56, a capacitor 57, a transistor 58 connected across the capacitor 57, an indicator resistor 59, and a transistor 60 which is connected across the indicator resistor 59 and to the transistor 58. By way of the contact 61 of a changeover switch 61 and 62, which is closed in the rest position, a voltage divider consisting of two resistors 63 and 64 is connected across the power supply 50. From the tapping between the two resistors 63 and 64 a connection leads to the base of the transistor 58 which biased on when the voltage divider 63 and 64 is switched on. In addition, the tapping between the two resistors 63 and 64 is connected to the base of a transistor 65, which serves as reversing transistor, the collector of which is connected to the base of the transistor 60. Furthermore, a resistor 66 is connected to the collector of the transistor 65. In addition, the tapping between the two resistors 63 and 64 is connected to the base of the transistor 55. The end of the indicator resistor 59 nearest the collector of the transistor 60 or the capacitor 57 is connected to a first input of a threshold value switch 67, the threshold value of which is adjustable by means of a voltage divider 68 and 69 which is connected to a further input of the threshold value switch 67.

A luminous diode 70 is connected to the output of the threshold value switch 67.

The method of operation is similar to that of the first form of control circuit.

After the contact 52 is closed, the circuit is connected to the power supply 50. The

resistors 63 and 64 are so adjusted, or are of such a size, that when the contact 61 is closed the transistors 58, 65 and 55 are switched through. Consequently the shutter control magnet 54 is energised without any delay, since it is directly connected to the power supply 50. Furthermore, the capacitor 57 is bridged and cannot, therefore be charged. In addition, as the transistor 65 is switched through the transistor 60 is blocked, so that the indicator resistor 59 is connected in series with the photoresistor 56. Depending on the brightness of the prevailing illumination, the threshold value switch 67 is either off or switch through. When there is insufficient light the luminous diode 70 lights up. The resistors 68 and 69 are of such a size that below a certain operating voltage of the power supply 50, with the photoresistor 56 covered, the luminous diode 70 does not light up. This offers the advantage that a battery voltage test can be carried out using the indicating device without the need for adjusting resistors to be arranged in series and in parallel with the luminous diode 70.

On further actuation of the release member, the contact 61 of the changeover switch 61 and 62 is opened and the contact 62 is closed. The result is that the transistors 58, 55 and 65 are biased off. Consequently the shutter control magnet 54 is now effectively connected to the output of the trigger device 53. In addition, the shunt on the capacitor 57 is eliminated. Furthermore, because the transistor 65 is biased off the transistor 60 is switched through so that the indicator resistor 59 is bridged and the photoresistor 56 is effectively connected in series with the capacitor 57. After a delay time, which depends on the brightness of the prevailing illumination has elapsed, the trigger device 53 is switched off and the shutter control magnet 54 is de-energised. The shutter control is thus terminated. In a manner which is not shown, the contact 51 is opened at the end of the exposure control. While the shutter is open the contact 52 is bridged by means of the contact 62 of the changeover switch 61 and 62.

WHAT WE CLAIM IS:-

1. A camera having electronic exposure control means including a photosensitive element and a capacitor connected to the input of a trigger device to the output of which is connected an electro-magnet for controlling the camera shutter, the camera also including electrical control means, switch means arranged to switch the control means between a first and a second state of conduction, an indicator for indicating whether the brightness of the prevailing illumination is sufficient for correct exposure, and controllable semiconductor means arranged, when the electrical control means is in the first state, to short the capacitor and enable the instantaneous output of the photosensitive element to be applied to the indicator and, when the electrical control means is in



the second state, to remove the short from the capacitor and to connect the photosensitive element in series with the capacitor across an electrical power supply.

5 2. A camera as claimed in claim 1, wherein the semiconductor means includes a first controllable semiconductor element connected across the capacitor and a second controllable semiconductor element connected in series
10 with the capacitor and the photosensitive element across the power supply, the arrangement being such that, when the control means is in the first state, the first semiconductor is biased on to short the capacitor and the second
15 semiconductor is biased off to disconnect the series arrangement of the photosensitive element and the capacitor across the power supply and when the control means is in the second state the first semiconductor is biased off to remove
20 the short on the capacitor and the second semiconductor is biased on to connect the capacitor and photosensitive element in series across the power supply.

3. A camera as claimed in claim 2 wherein
25 the second semiconductor is connected from a terminal of the capacitor to a conductor of the power supply.

4. A camera as claimed in claim 3, wherein
30 the first semiconductor is arranged, when biased on, to connect the photosensitive element to the indicating means.

5. A camera as claimed in claim 2, wherein
35 there is provided a third semiconductor element arranged between the photosensitive element and the indicating means and which, when the control means is in the first state, is biased on to connect the photosensitive element to the indicating means.

6. A camera as claimed in any one of
40 claims 1 to 5, wherein the indicating means comprises a threshold device and an indicator resistor and the semiconductor means is arranged when in the first state to connect the photosensitive element in series with the resistor,
45 with the junction of the photosensitive element and the resistor connected to the input of the threshold device.

7. A camera as claimed in claim 6 when
50 dependent on claim 5 wherein the second semiconductor is connected in series with the capacitor between the capacitor and the photosensitive element and the third semiconductor is connected between the photosensitive element and the indicator resistor.

8. A camera as claimed in claim 7, wherein
55 the second semiconductor element is a Darlington amplifier.

9. A camera as claimed in any one of
60 claims 1 to 8, wherein the control means comprises at least one potential divider.

10. A camera as claimed in any one of
65 claims 1 to 9, wherein the switch means for the control means comprises a mechanical switch which is operated by a shutter release member or by a member actuated by the release member.

11. A camera as claimed in claim 10,
70 wherein the switch is biased closed, and is opened to switch the control means from the first state to the second state.

12. A camera as claimed in any one of
75 claims 1 to 10, wherein the switch means comprises a two-way switch which is biased to a first position in which it is connected to the control means and is arranged to be switched to a second position in which it forms a holding
80 switch for a power supply switch.

13. A camera as claimed in any one of
85 claims 2 to 12, including the feature of claim 2 which includes a further controllable semiconductor element connected to the control means and arranged when the control means is in the first state, to connect the electromagnet across the power supply and when the control means is in the second state to connect the electromagnet to the output of the trigger
90 device.

14. A camera according to any preceding
95 claim including the feature of claim 2 wherein the control means including means for producing a common switching signal for the semiconductors and inverting means for inverting the sense of switching in response to the common switching signal of the second semiconductor relative to the other semiconductor or semiconductors.

15. A camera substantially as hereinbefore
described, with reference to and as shown in Fig. 1 or Fig. 2 of the accompanying drawings.

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