

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO A PHOTOGRAPHIC OR CINEMATOGRAPHIC CAMERA

(71) We, AGFA-GEVAERT AKTIENGESELLSCHAFT, a body corporate organised according to the Laws of Federal Republic of Germany, of Leverkusen, Federal Republic of 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 photographic or cinematographic camera which includes means arranged to cause the emission of pulses while the actual exposure set, at any time, differs from a required exposure, and regulating means responsive to the pulses arranged to adjust an exposure factor to balance the actual and required exposures. A camera of this type is described and claimed in U.K. Patent Specification Serial No. 1 407 547.

It is an object of the invention to provide an improved form of photographic or cinematographic camera of the above type.

According to the invention a photographic or cinematographic camera includes exposure control means having a photo-sensitive device and arranged to determine whether the actual aperture is the aperture appropriate to the prevailing illumination and to cause pulse production means to emit pulses while the actual aperture differs from the aperture appropriate to the prevailing illumination, there being provided diaphragm regulating means arranged to adjust the actual aperture in response to the said pulses so that the actual aperture tends towards the appropriate aperture, and switching means arranged to enable energisation of the diaphragm regulating means in order to effect the response of the diaphragm regulating means to the pulses when the said pulses are present, and to prevent energisation when the pulses are absent.

The diaphragm regulating means of the photographic or cinematographic camera may include a motor for effecting stepwise adjustment of the actual aperture in response to the said pulses, and the switching means is arranged to energise the motor for a period which exceeds the duration of each pulse.

In an embodiment of the photographic or cinematographic camera according to the invention, the motor is a stepping motor having a plurality of coils, the switching means is arranged to energise the coils in a forward sequence in response to pulses applied to a first input terminal of the diaphragm regulating means and to the switching means, and the switching means is arranged to energise the coils in the reverse sequence in response to pulses applied to a second input terminal of the diaphragm regulating means and to the switching means.

Since, in general, electric motors require a relatively high current in operation, preventing their energization when no change in exposure is required ensures that the energy consumption is small in the steady state relative to that during changes of exposure. In the rest state it is not necessary to maintain the electric motor in an energized state since the magnetic inertia of the system will hold it in its set position. Therefore the power consumption is reduced by the switching means.

In an embodiment of the invention, the switching means comprises a controllable semiconductor device that is arranged in a power supply circuit for the diaphragm regulating means. Preferably, the controllable semiconductor device is a transistor which is arranged to interrupt the power supply circuit for the diaphragm means, and the switching means further includes another transistor which is arranged to switch the controllable semiconductor device on and off in response to

the pulses from the pulse production means.

A capacitor may be connected between the base and the emitter of the second transistor. The capacitor will smooth the alternating signal applied to the second transistor so that it will be switched through for the duration of a pulse train.

One form of camera constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing which is a circuit diagram of an aperture control device.

Referring to the accompanying drawing, the aperture regulating means comprises an exposure measuring section 1, a pulse generator 2, a gate circuit 3, a stepping control means 4 and a stepping motor 5. The stepping motor 5 is coupled to an aperture diaphragm 7 either directly or by means of a mechanical transmission 6. The diaphragm 7 may be the actual diaphragm through which exposure of the film is made or may be an auxiliary control diaphragm. In the latter case the motor 5 must also be coupled to the actual diaphragm.

The exposure-measuring section comprises a photoresistor 8 which is arranged behind the diaphragm 7 and is connected in series with a fixed resistor 9. The tapping between the photoresistor 8 and the fixed resistor 9 is connected to the inverting input of an operational amplifier 10. The non-inverting input of the operational amplifier 10 is connected to a resistor 11. Feedback is provided from the output of the amplifier 10 through a resistor 12 to the inverting input. The power supply for the operational amplifier 10 is derived from two series connected batteries 13 and 14.

The pulse generator 2 includes an astable multivibrator, having two transistors 15 and 16, which is also supplied by the batteries 13 and 14. Connected to the collectors of the transistors 15 and 16 respectively are resistors 17 and 18.

The collector of the transistor 15 is coupled to the base of the transistor 16 by a capacitor 19 and the collector of the transistor 16 is coupled to the base of the transistor 15 by a capacitor 20.

The frequency of oscillation of the multivibrator 2 is determined by the time constants of the combination of the capacitor 19 with a resistor 21 and the combination of the capacitor 20 with a resistor 22. The collector of the transistor 16 is connected, through a resistor 23 to the base of an output transistor 24 to the emitter of which is connected a resistor 25.

The gate circuit 3 includes two emitter follower amplifiers. One of the emitter followers comprises a NPN transistor 26 to the emitter of which is connected one pole of a resistor 27. The other pole of the

resistor 27 is connected to the tapping between the two batteries 13 and 14. Connected to the collector of the transistor 26 is one terminal of a diode 28 the other terminal of which is connected to the emitter of the transistor 24. The base of the transistor 26 is coupled by a resistor 29 to the output of the operational amplifier 10.

The second emitter follower comprises a PNP transistor 30, that is to say, of the opposite type to the transistor 26. A resistor 31 connected to the emitter of the transistor 30 is also connected to the tapping between the two batteries 13 and 14. The collector of the transistor 30 is connected through a diode 32 to the emitter of the transistor 24. The base of the transistor 30 is connected through a resistor 33 to the output of the operational amplifier 10.

The emitter of the transistor 26 is connected through a diode 34 to a first input E1 of the stepping control means 4. The emitter of the transistor 30 is connected through a diode 35 to the base of a transistor 36. A resistor 37 is connected in the collector of the transistor 36 which is also connected to a second input E2 of the stepping control means 4. The potential produced by the astable multivibrator 2 oscillates between the positive potential of the battery 13 and the negative potential of the battery 14. The reference potential of the gate circuit 3 is, however, zero, that is to say, the potential of the tapping between the batteries 13 and 14. Thus when the transistor 26 is driven, only pulses, that are positive relative to the zero reference, are applied to the input E1 of the stepping control means 4. When the transistor 30 is driven only negative pulses are present at the emitter of the transistor 30. The pulses at the emitter of the transistor 30 are inverted by the transistor 36 and are then applied to the input E2 of the stepping control means 4. Since, however, when there is a non-zero signal at the output of the operational amplifier 10 only one of the two transistors 26 or 30 is switched on at a given time, positive pulses appear either at the input E1 or at the input E2.

The stepping control means 4 is shown as a block diagram and operates in the manner of a ring counter (see United Kingdom Patent Specification No. 1 407 574. The stepping motor 5 has four coils 38, 39, 40 and 41 and a permanent-magnet armature 42.

The input E1 is connected through a diode 43 to the base of a transistor 44. The input E2 is also connected through a diode 46 to the base of the transistor 44. The collector of the transistor 44 is connected to a resistor 45 and the emitter of the transistor 44 is connected to the tapping between the two batteries 13 and 14. The collector of the transistor 44 is also connected through a

diode 47 to the base of a controllable semiconductor device represented by a bipolar transistor 48. A capacitor 49 is connected between the base and the emitter of the transistor 48. The collector-emitter path of the transistor 48 is arranged in the power supply line of the coils 38 to 41 of the stepping motor 5. The switching means includes the controllable semiconductor device represented by the transistor 48 and the further controlling transistor 44.

The method of operation of the circuit described above is as follows:

It is assumed that when the camera is brought into operation the aperture stop appropriate to the prevailing illumination differs from the aperture stop actually set. Consequently, there is a potential difference between the two inputs of the operational amplifier 10. Depending on the polarity of the potential difference, there is a positive or negative potential at the output of the operational amplifier 10. The polarity of the potential indicates whether the stop actually set is larger or smaller than the appropriate stop.

The astable multivibrator 2 generates pulses at a frequency determined by the time constants of the capacitor/resistor couplings 19 and 21 and 20 and 22. At the emitter of the output transistor 24 of the multivibrator there are pulses that are alternately positive and negative relative to the tapping between the batteries 13 and 14. If there is a positive potential at the output of the operational amplifier 10, the transistor 26 of the gate circuit 3 is switched through and the transistor 30 is switched off. The positive pulses of the astable multivibrator 2 produce at the emitter resistor 27 of the transistor 26, positive pulses which are supplied through the input E1 to the stepping control means 4. The coils 38 to 41 are energized in sequence in phase with the control pulses, and the permanent-magnetic armature 42 rotated step by step.

If a negative potential is present at the output of the operational amplifier 10, the transistor 26 is switched off and the transistor 30 is switched through. Consequently the negative pulses are applied by way of the diode 32 to the emitter of the transistor 30. These negative pulses are inverted by the transistor 36 and appear at its collector as positive pulses, so that positive pulses also appear at the input E2 of the stepping control means 4. Energization of the coils 38 to 41 is now effected in the reverse direction.

The positive pulses at the inputs E1 and E2 are delivered through the diodes 43 and 46 respectively to the base of the transistor 44 and the transistor 44 is thus switched on. Consequently the potential at the resistor 45 drops, and the pulse peaks of the pulse series

are taken through the diode 47 to the capacitor 49 and stored there. Consequently there is a negative potential at the base of the transistor 48. As a result the transistor 48 is switched on and the coils 38 to 41 of the stepping motor 5 can consequently be energized in sequence. If the pulse series is now terminated, a positive potential does not appear either at the input E1 or at the input E2. The result is that the transistor 44 is switched off which in turn means that the transistor 48 is switched off. Thus the power supply for the coils 38 to 41 of the stepping motor 5 is interrupted during the pauses between the pulse series.

WHAT WE CLAIM IS:—

1. A photographic or cinematographic camera which includes exposure control means having a photo-sensitive device and arranged to determine whether the actual aperture is the aperture appropriate to the prevailing illumination and to cause pulse production means to emit pulses while the actual aperture differs from the aperture appropriate to the prevailing illumination, there being provided diaphragm regulating means arranged to adjust the actual aperture in response to the said pulses so that the actual aperture tends towards the appropriate aperture, and switching means arranged to enable energisation of the diaphragm regulating means in order to effect the response of the diaphragm regulating means to the pulses when the said pulses are present, and to prevent energisation when the pulses are absent.

2. A photographic or cinematographic camera as claimed in claim 1, wherein the diaphragm regulating means includes a motor for effecting stepwise adjustment of the actual aperture in response to the said pulses, and the switching means is arranged to energise the motor for a period which exceeds the duration of each pulse.

3. A photographic or cinematographic camera as claimed in claim 2, wherein the motor is a stepping motor having a plurality of coils, the switching means is arranged to energise the coils in a forward sequence in response to pulses applied to a first input terminal of the diaphragm regulating means and to the switching means, and the switching means is arranged to energise the coils in the reverse sequence, in response to pulses applied to a second input terminal of the diaphragm regulating means and to the switching means.

4. A photographic or cinematographic camera as claimed in claim 1 or claim 2, wherein the switching means includes a controllable semiconductor device that is arranged in a power supply circuit for the motor.

5. A photographic or cinematographic



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diode 47 to the base of a controllable semiconductor device represented by a bipolar transistor 48. A capacitor 49 is connected between the base and the emitter of the transistor 48. The collector-emitter path of the transistor 48 is arranged in the power supply line of the coils 38 to 41 of the stepping motor 5. The switching means includes the controllable semiconductor device represented by the transistor 48 and the further controlling transistor 44.

The method of operation of the circuit described above is as follows:

It is assumed that when the camera is brought into operation the aperture stop appropriate to the prevailing illumination differs from the aperture stop actually set. Consequently, there is a potential difference between the two inputs of the operational amplifier 10. Depending on the polarity of the potential difference, there is a positive or negative potential at the output of the operational amplifier 10. The polarity of the potential indicates whether the stop actually set is larger or smaller than the appropriate stop.

The astable multivibrator 2 generates pulses at a frequency determined by the time constants of the capacitor/resistor couplings 19 and 21 and 20 and 22. At the emitter of the output transistor 24 of the multivibrator there are pulses that are alternately positive and negative relative to the tapping between the batteries 13 and 14. If there is a positive potential at the output of the operational amplifier 10, the transistor 26 of the gate circuit 3 is switched through and the transistor 30 is switched off. The positive pulses of the astable multivibrator 2 produce at the emitter resistor 27 of the transistor 26, positive pulses which are supplied through the input E1 to the stepping control means 4. The coils 38 to 41 are energised in sequence in phase with the control pulses, and the permanent-magnetic armature 42 rotated step by step.

If a negative potential is present at the output of the operational amplifier 10, the transistor 26 is switched off and the transistor 30 is switched through. Consequently the negative pulses are applied by way of the diode 32 to the emitter of the transistor 30. These negative pulses are inverted by the transistor 36 and appear at its collector as positive pulses, so that positive pulses also appear at the input E2 of the stepping control means 4. Energization of the coils 38 to 41 is now effected in the reverse direction.

The positive pulses at the inputs E1 and E2 are delivered through the diodes 43 and 46 respectively to the base of the transistor 44 and the transistor 44 is thus switched on. Consequently the potential at the resistor 45 drops, and the pulse peaks of the pulse series

are taken through the diode 47 to the capacitor 49 and stored there. Consequently there is a negative potential at the base of the transistor 48. As a result the transistor 48 is switched on and the coils 38 to 41 of the stepping motor 5 can consequently be energized in sequence. If the pulse series is now terminated, a positive potential does not appear either at the input E1 or at the input E2. The result is that the transistor 44 is switched off which in turn means that the transistor 48 is switched off. Thus the power supply for the coils 38 to 41 of the stepping motor 5 is interrupted during the pauses between the pulse series.

WHAT WE CLAIM IS:—

1. A photographic or cinematographic camera which includes exposure control means having a photo-sensitive device and arranged to determine whether the actual aperture is the aperture appropriate to the prevailing illumination and to cause pulse production means to emit pulses while the actual aperture differs from the aperture appropriate to the prevailing illumination, there being provided diaphragm regulating means arranged to adjust the actual aperture in response to the said pulses so that the actual aperture tends towards the appropriate aperture, and switching means arranged to enable energisation of the diaphragm regulating means in order to effect the response of the diaphragm regulating means to the pulses when the said pulses are present, and to prevent energisation when the pulses are absent.

2. A photographic or cinematographic camera as claimed in claim 1, wherein the diaphragm regulating means includes a motor for effecting stepwise adjustment of the actual aperture in response to the said pulses, and the switching means is arranged to energise the motor for a period which exceeds the duration of each pulse.

3. A photographic or cinematographic camera as claimed in claim 2, wherein the motor is a stepping motor having a plurality of coils, the switching means is arranged to energise the coils in a forward sequence in response to pulses applied to a first input terminal of the diaphragm regulating means and to the switching means, and the switching means is arranged to energise the coils in the reverse sequence, in response to pulses applied to a second input terminal of the diaphragm regulating means and to the switching means.

4. A photographic or cinematographic camera as claimed in claim 1 or claim 2, wherein the switching means includes a controllable semiconductor device that is arranged in a power supply circuit for the motor.

5. A photographic or cinematographic

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5 camera as claimed in claim 4, wherein the
controllable semiconductor device is a
transistor which is arranged to interrupt the
power supply for the diaphragm regulating
means, and the switching means further
includes another transistor which is
arranged to switch the controllable
semiconductor device on and off in
response to the pulses from the pulse
production means.

10 6. A photographic or cinematographic
camera as claimed in claim 5, wherein the
controllable semiconductor device is a

bipolar transistor, and a capacitor is con-
nected between the base and emitter 15
electrodes of the said bipolar transistor.

7. A photographic or cinematographic
camera substantially as herein described
with reference to, and as illustrated by, the
accompanying drawing.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303—306 High Holborn,
London, WC1V 7LH.

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