

PATENT SPECIFICATION (11)

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- (21) Application No. 8975/76
(22) Filed 5 March 1976 (19)
(31) Convention Application No. 2 509 497
(32) Filed 5 March 1975 in
(33) Fed. Rep. of Germany (DE)
(44) Complete Specification published 10 Jan. 1979
(51) INT. CL.² G03B 7/00 H02M 3/335
(52) Index at acceptance

H2F 23E2T1 23E2Z 23E3 23E4A 23EY 9R14B 9R14C
9R32C 9R47C 9T5 TRD
G2A 212 C1 C23 C2 DX



(54) CAMERAS

(71) We, AGFA-GEVAERT AKTIENGESELLSCHAFT, a body corporate recognised under the laws of the 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 invention relates to cameras, cine and still, and especially to those having exposure control means.

Mechanical regulating and control means in cameras is increasingly being replaced by electronic circuits as, for example, in the case of exposure control means. Exposure control means of this kind operate efficiently within a voltage range between the full battery voltage and a lower supply voltage. This voltage range depends on the batteries which are to be used, the voltage of which drops slowly during use. Even practically new batteries, however, lose capacity at low temperatures so that their voltage drops sharply compared to their no-load voltage. Difficulties have thus been encountered with exposure control means which does not work efficiently below a given lower supply voltage; this is particularly so in the case of MOS (metal oxide semiconductor)-circuit networks.

The invention provides a camera having exposure control means operable at supply voltages within a range defined by an upper supply voltage and a lower supply voltage, and a d.c. voltage converter, wherein, in use, the exposure control means is supplied by a battery for the camera and by the d.c. voltage converter which is also supplied by the battery, and the d.c. voltage converter is so controlled that the supply voltage for the exposure control means is maintained in said range when the battery voltage is below the lower supply voltage but above a lower limiting value.

The d.c. voltage converter enables the exposure control means to operate properly

even though the battery voltage may have dropped lower than the lower supply voltage value. Thus, for example, the risk that the camera will be adjusted to disturbances at low temperatures is reduced or eliminated. A film may thus be shot right up to its end without it being necessary to change the batteries in between. The fact that the supply voltage for the exposure control means is maintained within the voltage range between the upper and the lower supply voltage overcomes the danger of possible overloading as a result of increasing the supply voltage excessively. When the battery voltage drops below the lower limiting value, the supply voltage to the exposure control means can no longer be maintained in the said range. Between this battery voltage of the lower limiting value and zero, the arrangement may be such that the supply voltage of the d.c. voltage converter is the same as the battery voltage.

Advantageously, the battery and the d.c. voltage converter are arranged in parallel. If desired, however, the battery may be arranged in series with the d.c. converter; in this case, the output voltage of the d.c. converter will supplement the battery voltage to produce the desired output voltage for supplying the exposure control means.

Advantageously, the d.c. voltage converter is, in use, only switched on when the battery voltage is below the value corresponding to the desired minimum supply voltage but above the lower limiting value. If desired, however, the d.c. voltage converter could be arranged to switch on at a battery voltage corresponding to a voltage level greater than the lower supply voltage. Preferably, the d.c. voltage converter is, in use, so controlled that its output voltage is held constant when the battery voltage is below the value corresponding to the desired minimum supply voltage but above the lower limiting value. The fact that the d.c. voltage is so controlled, in use, that its output voltage is held constant means that the current

consumption of the d.c. voltage converter is kept low.

Advantageously, there is provided an actual value stage for producing a voltage for controlling the d.c. voltage converter, which voltage is dependent on the battery voltage when the battery voltage lies within the said range and on the converter output range when the battery voltage lies below the lower supply voltage but above the lower limiting value. Preferably, the actual value stage includes a voltage divider having a zener diode connected from the output of the d.c. voltage converter, a junction of the voltage divider being coupled to the control electrode of a semiconductor controlling the d.c. voltage converter and the battery is arranged for connection to the output of the d.c. voltage converter by way of a unidirectional conducting device. The actual value transistor and the control transistor are only effectively controlled after the threshold value of the Zener diode is exceeded. The breakdown voltage (threshold value) of the Zener diode thus determines the lower battery limiting voltage. Due to the fact that the actual value transistor is connected to the converter output, any load variations on the output side, in the exposure control device cause the control stage to be affected and the converter to be regulated accordingly.

Advantageously, the arrangement is such that, in use, when the battery voltage exceeds the desired minimum supply voltage, a current path is effected between the input and output of the d.c. voltage converter, said current path being blocked to the flow of current in the reverse direction. Preferably, a diode is arranged between the converter input and the converter output. When the battery voltage exceeds the converter output voltage, the diode becomes conductive so that the battery voltage directly supplies the exposure control means and the converter is automatically disconnected.

Advantageously, the d.c. voltage converter is a chopper, the transistor of which is connected in series with the control transistor.

Advantageously, the battery may be connected to the d.c. voltage converter by means of contacts which can be actuated by a relay associated with the camera shutter release, in which the contacts are also in the circuit of a drive motor for the film.

A camera constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing.

The Figure shows a d.c. voltage converter connected to an exposure circuit of a cine camera. The numeral 1 indicates a drive device for transporting the film of the

camera, the numeral 2 denotes a d.c. voltage converter, and the numeral 3 denotes an exposure control circuit.

The drive circuit 1 has an electronic circuit 5 which can be switched on by a trip switch 4. A relay 6 can be activated by means of the trip circuit 5. The relay 6 has a contact 7 in the circuit of a drive motor 8 for the film. In addition there is a speed regulator 9 in this circuit.

The numeral 10 denotes an operating switch and the battery is denoted by the numeral 11.

The d.c. voltage converter 2 may be connected to the battery 11 by the relay contact 7. The d.c. voltage converter 2 has a transistor 12, in the collector circuit of which the primary winding 13 of a transformer 14 is situated. A first secondary winding 15 of the transformer 14 is situated in the base circuit of the transistor 12. The winding 15 is connected in series with a resistor 16. A capacitor is denoted by the numeral 17. A second secondary winding 18 is connected to a diode 19 which serves to rectify the a.c. voltage output of the converter. The d.c. voltage on the output side of the converter is smoothed by a smoothing capacitor 20. A d.c. voltage therefore appears at the capacitor 20.

In parallel with the capacitor 20, there is a series connection of a zener diode 21, a resistor 22 and a further resistor 23. A tapping between the two resistors 22 and 23 is connected to the base of a transistor 24 in the collector circuit of which a resistor 25 is provided, and the collector of which is connected to the base of a control transistor 25¹ whose collector-emitter path is in the emitter circuit of the converter transistor 12. The transistor 25¹ can be thought of as a current-limiting element for the d.c. voltage converter.

The battery 11 can be connected directly with the output of the converter on the d.c. voltage side via a diode 26.

The exposure control circuit 3 connected to the output of the d.c. voltage converter 2 has a light-sensitive voltage divider 27 and 28 and also a fixed voltage divider 29 and 30. Both voltage dividers are connected to a differential amplifier 31, which is connected to a voltage discriminator circuit 32. The output of the discriminator circuit 32 has a first connection, which controls a running signal, to a pulse generator 33, and a second connection, which controls a directional signal, to a stepping motor control circuit 34. From this stepping motor control circuit 34 there lead four connections to corresponding windings 35, 36, 37 and 38 of a stepping motor 39. An aperture 41 can be adjusted in front of the photo-resistor 27 by means of the armature 40 of the stepping motor 39.

Using a second pulse generator 42 which is also connected to the rectified output of the converter, the electronic tripping circuit 51 can be switched on. A selector switch 43 enables different time programmes, for example, self timer shots, single picture shots, automatic title shots, or time lapse shots to be effected in a manner not illustrated.

While the motor 8 is not operative, the battery voltage is only loaded to a small extent by the electronics, so that the battery voltage is considerably higher than when the battery is loaded. Thus the electronics to switch the motor on is fully operable even without the d.c. voltage converter. The manner in which the camera functions is as follows.

It is assumed that the voltage of the battery has dropped to a value in the region of the lower limiting value, but above it. It is also assumed that at this low battery voltage the relay 6 and the motor 8 can still be actuated. Accordingly, after the switch 10 has been closed the battery 11 is connected to the d.c. voltage converter via the relay contact 7. This d.c. voltage converter, which comprises a blocking oscillator, oscillates with a natural frequency, which depends on the parameters of the oscillator, and produces a d.c. voltage larger than the battery voltage. If at this reduced battery voltage the converter output voltage is too low to cause the Zener diode 21 to conduct, the transistor 24 is non-conductive, and the control transistor 25¹ is fully conductive, so that the supply voltage for the blocking oscillator is reduced only by the collector-emitter saturation voltage for the transistor 25¹.

The circuit is so arranged that if the battery 11 has a voltage which is above the lower limiting value but below the lower supply voltage, then the voltage at the output of the d.c. voltage converter is maintained at the lower supply voltage level, at which voltage the exposure control circuit 3 still operates efficiently. If the converter output voltage rises above the lower supply voltage level, the Zener diode 21 conducts, with the result that the voltage at the resistor 23 rises and the transistor 24 becomes conductive. As the transistor 24 becomes more conductive the control transistor 25¹ becomes less conductive, reducing the voltage applied to the converter primary winding and hence the converter output voltage. The values of the individual components are so chosen that the collector-emitter resistance of the transistor 25¹ is caused to vary with the battery voltage, and the supply voltage of the blocking oscillator is caused to remain practically constant. Consequently, the output voltage of the blocking oscillator also remains constant.

The supply current to the converter input is, due to converter output voltage being constant, independent of the battery voltage and consequently constant. At the lower battery voltage value the control transistor 25¹ is fully energised. The d.c. converter input resistor has its lowest value. The converter input current is given by the quotient of the lowest battery voltage value and the low converter input resistance. As the battery voltage increases so does the converter input resistance, since the control transistor 25¹ increasingly tends to be blocked. The respective quotients of battery voltage values and converter input resistance values give almost the same converter input current.

If the battery voltage exceeds the constant output voltage of the converter, which is the same as the lower supply voltage, then the transistor 24 is turned fully on and as a result the transistor 25 is completely blocked. The blocking oscillator therefore takes no current. The diode 26 now operates in the forward direction so that the battery 11 is connected directly to the exposure control circuit 3. Thus the d.c. voltage converter is only switched in when the battery voltage drops to a value which is below the supply voltage value of the exposure control circuit.

WHAT WE CLAIM IS:—

1. A camera having exposure control means operable at supply voltages within a range defined by an upper supply voltage and a lower supply voltage, and a d.c. voltage converter, wherein, in use, the exposure control means is supplied by a battery for the camera and by the d.c. voltage converter which is also supplied by the battery, and the d.c. voltage converter is so controlled that the supply voltage for the exposure control means is maintained in the said range when the battery voltage is below the lower supply voltage but above a lower limiting value.

2. A camera as claimed in claim 1, wherein there is provided an actual value stage for producing a voltage for controlling the d.c. voltage converter, which voltage is dependent on the battery voltage when the battery voltage lies within the said range and on the converter output when the battery voltage lies below the lower supply voltage but above the lower limiting value.

3. A camera as claimed in claim 2, wherein the actual value stage includes a voltage divider having a Zener diode connected from the output of the d.c. voltage converter, a junction of the voltage divider being coupled to the control electrode of a semiconductor controlling the d.c. voltage converter, and the battery is arranged for connection to the output of the d.c. voltage

Using a second pulse generator 42 which is also connected to the rectified output of the converter, the electronic tripping circuit 5 can be switched on. A selector switch 43 enables different time programmes, for example, self timer shots, single picture shots, automatic title shots, or time lapse shots to be effected in a manner not illustrated.

While the motor 8 is not operative, the battery voltage is only loaded to a small extent by the electronics, so that the battery voltage is considerably higher than when the battery is loaded. Thus the electronics to switch the motor on is fully operable even without the d.c. voltage converter. The manner in which the camera functions is as follows.

It is assumed that the voltage of the battery has dropped to a value in the region of the lower limiting value, but above it. It is also assumed that at this low battery voltage the relay 6 and the motor 8 can still be actuated. Accordingly, after the switch 10 has been closed the battery 11 is connected to the d.c. voltage converter via the relay contact 7. This d.c. voltage converter, which comprises a blocking oscillator, oscillates with a natural frequency, which depends on the parameters of the oscillator, and produces a d.c. voltage larger than the battery voltage. If at this reduced battery voltage the converter output voltage is too low to cause the Zener diode 21 to conduct, the transistor 24 is non-conductive, and the control transistor 25¹ is fully conductive, so that the supply voltage for the blocking oscillator is reduced only by the collector-emitter saturation voltage for the transistor 25¹.

The circuit is so arranged that if the battery 11 has a voltage which is above the lower limiting value but below the lower supply voltage, then the voltage at the output of the d.c. voltage converter is maintained at the lower supply voltage level, at which voltage the exposure control circuit 3 still operates efficiently. If the converter output voltage rises above the lower supply voltage level, the Zener diode 21 conducts, with the result that the voltage at the resistor 23 rises and the transistor 24 becomes conductive. As the transistor 24 becomes more conductive the control transistor 25¹ becomes less conductive, reducing the voltage applied to the converter primary winding and hence the converter output voltage. The values of the individual components are so chosen that the collector-emitter resistance of the transistor 25¹ is caused to vary with the battery voltage, and the supply voltage of the blocking oscillator is caused to remain practically constant. Consequently, the output voltage of the blocking oscillator also remains constant.

The supply current to the converter input is, due to converter output voltage being constant, independent of the battery voltage and consequently constant. At the lower battery voltage value the control transistor 25¹ is fully energised. The d.c. converter input resistor has its lowest value. The converter input current is given by the quotient of the lowest battery voltage value and the low converter input resistance. As the battery voltage increases so does the converter input resistance, since the control transistor 25¹ increasingly tends to be blocked. The respective quotients of battery voltage values and converter input resistance values give almost the same converter input current.

If the battery voltage exceeds the constant output voltage of the converter, which is the same as the lower supply voltage, then the transistor 24 is turned fully on and as a result the transistor 25 is completely blocked. The blocking oscillator therefore takes no current. The diode 26 now operates in the forward direction so that the battery 11 is connected directly to the exposure control circuit 3. Thus the d.c. voltage converter is only switched in when the battery voltage drops to a value which is below the supply voltage value of the exposure control circuit.

WHAT WE CLAIM IS:—

1. A camera having exposure control means operable at supply voltages within a range defined by an upper supply voltage and a lower supply voltage, and a d.c. voltage converter, wherein, in use, the exposure control means is supplied by a battery for the camera and by the d.c. voltage converter which is also supplied by the battery, and the d.c. voltage converter is so controlled that the supply voltage for the exposure control means is maintained in the said range when the battery voltage is below the lower supply voltage but above a lower limiting value.

2. A camera as claimed in claim 1, wherein there is provided an actual value stage for producing a voltage for controlling the d.c. voltage converter, which voltage is dependent on the battery voltage when the battery voltage lies within the said range and on the converter output when the battery voltage lies below the lower supply voltage but above the lower limiting value.

3. A camera as claimed in claim 2, wherein the actual value stage includes a voltage divider having a Zener diode connected from the output of the d.c. voltage converter, a junction of the voltage divider being coupled to the control electrode of a semiconductor controlling the d.c. voltage converter, and the battery is arranged for connection to the output of the d.c. voltage



converter by way of a unidirectional conductive device.

4. A camera as claimed in claim 3, wherein the actual value stage also includes a transistor connected to the output of the d.c. voltage converter, the junction of the voltage divider being connected to the base of the transistor with the Zener diode in the base-collector part of the divider, and the collector of the transistor being connected to the control electrode of the semiconductor.

5. A camera as claimed in any one of claims 1 to 4, wherein the d.c. voltage converter is, in use, only switched on when the battery voltage is below the value corresponding to the desired minimum supply voltage but above the lower limiting value.

6. A camera as claimed in any one of claims 1 to 5, wherein the d.c. voltage converter is, in use, so controlled that its output voltage is held constant when the battery voltage is below the value corresponding to the desired minimum supply voltage but above the lower limiting value.

7. A camera as claimed in any one of claims 1 to 6, wherein the arrangement is such that, in use, when the battery voltage exceeds the desired minimum supply voltage, a current path is effected between the input and the output of the d.c. voltage converter, said current path being blocked to the flow of current in the reverse direction.

8. A camera as claimed in claim 7,

wherein a diode is arranged in the current path.

9. A camera as claimed in any one of claims 1 to 8, wherein in use, the battery and the d.c. voltage converter are arranged in parallel.

10. A camera as claimed in any one of claims 1 to 9, wherein the d.c. voltage converter is a chopper, a transistor of which is so arranged that the current therethrough controls the d.c. voltage converter.

11. A camera as claimed in any one of claims 1 to 10, wherein there is provided a relay-controlled switch actuable both to operate a drive motor for the film and to switch on the d.c. converter.

12. A camera as claimed in any one of claims 1 to 11, wherein the camera is a still camera.

13. A camera as claimed in any one of claims 1 to 11, wherein the camera is a cine camera.

14. A camera substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.

15. A camera as claimed in any one of claims 1 to 14, in combination with a battery for the camera.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1979.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

