

SPECIFICATION

Photographic camera exposure control system

- 5 The present invention relates to a photographic camera exposure control system including a shutter, an electromagnet for controlling the shutter, a pulse generator the frequency of which is controlled by a light sensitive element and a timing capacitor, a
- 10 counter responsive to the output of the pulse generator and producing an output signal after counting a predetermined number of pulses for controlling the electromagnet and thereby determining the exposure time, and a start switch for
- 15 resetting the counter each time a photograph has been taken.

A control system of this type is described in German Patent Specification 2,219,523. In this system, the exposure time is determined by

20 counting the pulses from the pulse generator, whereby after a predetermined number of pulses the electromagnet is either de-energised or energised. At low lighting levels, there is the disadvantage that the shutter may remain open too long. There is also

25 the risk that at excessively high lighting levels an electromagnet in the form of a holding magnet may not be de-energised. The result is that the battery is rapidly discharged.

When undertaking flash light photography, it is

30 known that when the flash lamp is in the ready position the exposure time may be limited to a predetermined value. It is also known that in order to achieve this a fixed value resistor may be connected in parallel with the light sensitive element or

35 connected in series with the timing capacitor instead of the light sensitive element. Also, in order to obtain the longest exposure time, the resistor may also be placed in parallel with the light sensitive element.

According to the present invention there is

40 provided a photographic camera exposure control system including a shutter, an electromagnet for controlling the shutter, a first pulse generator the frequency of which is controlled by a light sensitive element and a timing capacitor, a first digital counter

45 responsive to the output of the first pulse generator and producing an output signal after counting a predetermined number of pulses, a second pulse generator the frequency of which is independent of the light level, the second pulse generator being

50 enabled upon fitting a flash gun to the camera or on operation of a selector switch, a second digital counter responsive to the output of the second pulse generator and producing an output signal after counting a predetermined number of pulses, a start

55 switch for resetting the counters each time a photograph has been taken, a gate the two inputs of which are connected to the outputs of the first and second digital counters, and a controllable semi-conductor element responsive to the output of

60 the gate for controlling the electromagnet, exposure being terminated when one of the counters produces its output signal.

This system has the advantage that the first pulse generator, the frequency of which is dependent on

65 the light level, and the second pulse generator, the

frequency of which is independent from the light level, are not directly connected to each other and that both pulse generators may form part of an integrated circuit.

- 70 The first pulse generator except for the light sensitive element, the second pulse generator, and the counter may form part of an integrated circuit, the capacitors of the pulse generator being semi-conductor layer capacitors and each forming
- 75 part of a Miller integrator.

The system may further include a second controllable semi-conductor element connected in parallel with the timing capacitor and responsive to the output of the first pulse generator and a third

80 controllable semi-conductor element connected in parallel with the timing capacitor and responsive to the start switch.

Thus, under the control of the start switch, the third controllable semi-conductor element renders

85 the first pulse generator operative.

The system may further include a measuring resistor and a fourth controllable semi-conductor element associated with the measuring resistor and responsive to the start switch, the arrangement

90 being such that before commencing each exposure the measuring resistor is connected in series with the light sensitive element whilst the timing capacitor is short circuited.

Thus, in addition to resetting the counters and

95 enabling the timing capacitor to be charged during each exposure, the start switch also causes the measuring resistor to be short circuited during an exposure so that the light sensitive element may be used to control the exposure.

The light sensitive element, the timing capacitor, and the measuring resistor may be connected in series, the fourth semi-conductor being connected in parallel with the measuring resistor and the third and fourth semi-conductor elements being arranged

100 so that when one is conductive the other is non-conductive.

The present invention will now be described by way of example with reference to the accompanying drawing which is a circuit diagram of a photographic camera exposure control system embodying the

110 present invention.

Referring now to the drawing, there is shown a battery 1 and 2 which may be connected by a switch 3 to an exposure control system. The system

115 includes a light sensitive element in the form of a photo resistor 4 connected in series with a timing capacitor 5 and a measuring resistor 6. The connection of the photo resistor 4 and the timing capacitor 5 is connected to the input of a threshold circuit 7 consisting of an operational amplifier 8 and a voltage divider 9 and 10. The voltage divider 9, 10 determines the threshold value of the operational amplifier 8.

The output of the threshold circuit 7 is connected

125 by a resistor 11 to the base of a transistor 12, the collector emitter path of which is connected in parallel with the timing capacitor 5. The photo resistor 4, the timing capacitor 5, the threshold circuit 7 and the transistor 12 form a pulse generator, the frequency of which is determined by the photo

130

resistor 4 and the timing capacitor 5.

The output of the threshold circuit 7 is connected by a resistor 13 to the input of a counter 14 which consists of flip-flops 15, 16, 17 and a further flip-flop

18. The $\bar{Q}$ outputs of the flip-flops of the counter 14 are connected to a selector switch 19 which is set in accordance with the sensitivity of the film being used. The selector switch 19 is connected to one input of an OR-gate 20, the output of which is connected by a resistor 21, to the base of a transistor 22.

The collector of the transistor 22 is connected to an electromagnet 23 which controls the closure of the camera shutter.

By means of a switch 24 which is operated by a selector switch or on fitting a flash lamp to the camera, a further pulse generator 25 may be energised. The pulse generator 25 comprises a capacitor 26, a timing resistor 27, and inverters 28, 29. The output of the pulse generator 25 is connected to the input of a counter 30 having a first flip-flop 31 and a final flip-flop 32. The frequency of the pulse generator 25 is selected in accordance with the desired duration of the counting cycle of counter 30.

The time constant of the photo resistor 4 and the timing capacitor 5 is selected so that under maximum brightness it is small in relation to the shortest possible exposure time.

The system further includes a start switch 33 operated in a manner not shown here before the operation of the shutter release or at the latest before the beginning of the exposure phase of the shutter. The start switch 33 applies a positive potential by a resistor 34 to the base of a transistor 35 connected in parallel with the timing capacitor 5. The start switch 33 also applies a positive potential when closed, as shown in the drawing, via a resistor 36 to the reset inputs R of counters 14 and 31.

The start switch 33 also applies a positive potential via a resistor 37 to the base of a transistor 38, the collector of which is connected to a resistor 39 and also to the base of a transistor 40, the collector emitter path of which is connected in parallel with the measuring resistor 6.

The connection of the timing capacitor 5 and the measuring resistor 6 is connected to the input of a threshold circuit 41, the output of which is connected to a light emitting diode 42. The light emitting diode 42 indicates before a photograph is taken if the light level is sufficient for obtaining a properly exposed photograph.

The threshold circuit 41 consists of an operational amplifier 43, one of the inputs of which is connected to a voltage divider 44, 45. The output of the operational amplifier 43 is connected to a zener diode 46, which is also connected to the base of a transistor 47 having an emitter resistor 48.

Before the shutter is operated, both counters 14, 31 are reset. Transistor 35 is then on thereby short circuiting timing capacitor 5. In this condition, the threshold circuit 7 does not generate pulses. Transistor 40 is off so the photo resistor 4 and the measuring resistor 6 are effectively connected in series. When the light level is sufficient, the voltage supply to the amplifier 43 by the photo resistor 4 and

the measuring resistor 6 will be greater than the voltage applied by the voltage divider 44, 45. The transistor 47 will therefore be off and the light emitting diode 42 will be de-energised. In the absence of a sufficiently high lighting level, the voltage applied by the photo resistor 4 and the measuring resistor 6 will be less than the voltage applied by the voltage divider 44, 45, with the result that the transistor 47 will be switched on and the light emitting diode 42 will be energised thereby indicating to the camera user that the light level is insufficient and that artificial lighting should be used.

It is now assumed that switch 24 is open, i.e. that no flash lamp is being used or that the associated selector switch has not been operated. On operation of the shutter release, not shown, the switch 33 is opened and transistor 35 is switched off. Transistor 40 is switched on so that photo resistor 4 and the timing capacitor 5 are effectively connected in series. Also, the positive potential is disconnected from the reset inputs R of counters 14, 30. The threshold circuit 7 will now start producing output pulses. These pulses are counted by counter 14 which reaches the end of its counting cycle after a predetermined period in accordance with the position of selector switch 19 so that the positive potential previously applied to the input of OR-gate 20 is removed with the result that the transistor 22 is switched off. The electromagnet 23 then releases its armature and initiates closure of the shutter.

When a flash lamp arrangement is used or the selector switch associated with switch 24 is operated, switch 24 is closed and the pulse generator 25 is switched on. The fixed frequency pulses are counted by counter 30 which after a predetermined period applies a control pulse to the OR-gate 20. After the pre-determined period the transistor 22 is switched off by counter 30, although a control pulse has not been received by the OR-gate 20 from counter 14 as a result of the existing light level.

As may be appreciated, all the electronic components with the exception of the photo resistor 4 but including the timing capacitor 5, the threshold circuit 7, the transistor 12, the counter 14, the pulse generator 25, and the counter 30 may be formed as an integrated circuit. The capacitors 5 and 26 may be formed as semi-conductor layer capacitors and each may form part of a Millar integrator.

CLAIMS

1. A photographic camera exposure control system including a shutter, an electromagnet for controlling the shutter, a first pulse generator the frequency of which is controlled by a light sensitive element and a timing capacitor, a first digital counter responsive to the output of the first pulse generator and producing an output signal after counting a predetermined number of pulses, a second pulse generator the frequency of which is independent of the light level, the second pulse generator being enabled upon fitting a flash gun to the camera or on operation of a selector switch, a second digital

13



resistor 4 and the timing capacitor 5.

The output of the threshold circuit 7 is connected by a resistor 13 to the input of a counter 14 which consists of flip-flops 15, 16, 17 and a further flip-flop 18. The Q outputs of the flip-flops of the counter 14 are connected to a selector switch 19 which is set in accordance with the sensitivity of the film being used. The selector switch 19 is connected to one input of an OR-gate 20, the output of which is connected by a resistor 21, to the base of a transistor 22.

The collector of the transistor 22 is connected to an electromagnet 23 which controls the closure of the camera shutter.

By means of a switch 24 which is operated by a selector switch or on fitting a flash lamp to the camera, a further pulse generator 25 may be energised. The pulse generator 25 comprises a capacitor 26, a timing resistor 27, and inverters 28, 29. The output of the pulse generator 25 is connected to the input of a counter 30 having a first flip-flop 31 and a final flip-flop 32. The frequency of the pulse generator 25 is selected in accordance with the desired duration of the counting cycle of counter 30.

The time constant of the photo resistor 4 and the timing capacitor 5 is selected so that under maximum brightness it is small in relation to the shortest possible exposure time.

The system further includes a start switch 33 operated in a manner not shown here before the operation of the shutter release or at the latest before the beginning of the exposure phase of the shutter. The start switch 33 applies a positive potential by a resistor 34 to the base of a transistor 35 connected in parallel with the timing capacitor 5. The start switch 33 also applies a positive potential when closed, as shown in the drawing, via a resistor 36 to the reset inputs R of counters 14 and 31.

The start switch 33 also applies a positive potential via a resistor 37 to the base of a transistor 38, the collector of which is connected to a resistor 39 and also to the base of a transistor 40, the collector emitter path of which is connected in parallel with the measuring resistor 6.

The connection of the timing capacitor 5 and the measuring resistor 6 is connected to the input of a threshold circuit 41, the output of which is connected to a light emitting diode 42. The light emitting diode 42 indicates before a photograph is taken if the light level is sufficient for obtaining a properly exposed photograph.

The threshold circuit 41 consists of an operational amplifier 43, one of the inputs of which is connected to a voltage divider 44, 45. The output of the operational amplifier 43 is connected to a zener diode 46, which is also connected to the base of a transistor 47 having an emitter resistor 48.

Before the shutter is operated, both counters 14, 31 are reset. Transistor 35 is then on thereby short circuiting timing capacitor 5. In this condition, the threshold circuit 7 does not generate pulses. Transistor 40 is off so the photo resistor 4 and the measuring resistor 6 are effectively connected in series. When the light level is sufficient, the voltage supply to the amplifier 43 by the photo resistor 4 and

the measuring resistor 6 will be greater than the voltage applied by the voltage divider 44, 45. The transistor 47 will therefore be off and the light emitting diode 42 will be de-energised. In the absence of a sufficiently high lighting level, the voltage applied by the photo resistor 4 and the measuring resistor 6 will be less than the voltage applied by the voltage divider 44, 45, with the result that the transistor 47 will be switched on and the light emitting diode 42 will be energised thereby indicating to the camera user that the light level is insufficient and that artificial lighting should be used.

It is now assumed that switch 24 is open, i.e. that no flash lamp is being used or that the associated selector switch has not been operated. On operation of the shutter release, not shown, the switch 33 is opened and transistor 35 is switched off. Transistor 40 is switched on so that photo resistor 4 and the timing capacitor 5 are effectively connected in series. Also, the positive potential is disconnected from the reset inputs R of counters 14, 30. The threshold circuit 7 will now start producing output pulses. These pulses are counted by counter 14 which reaches the end of its counting cycle after a predetermined period in accordance with the position of selector switch 19 so that the positive potential previously applied to the input of OR-gate 20 is removed with the result that the transistor 22 is switched off. The electromagnet 23 then releases its armature and initiates closure of the shutter.

When a flash lamp arrangement is used or the selector switch associated with switch 24 is operated, switch 24 is closed and the pulse generator 25 is switched on. The fixed frequency pulses are counted by counter 30 which after a predetermined period applies a control pulse to the OR-gate 20. After the pre-determined period the transistor 22 is switched off by counter 30, although a control pulse has not been received by the OR-gate 20 from counter 14 as a result of the existing light level.

As may be appreciated, all the electronic components with the exception of the photo resistor 4 but including the timing capacitor 5, the threshold circuit 7, the transistor 12, the counter 14, the pulse generator 25, and the counter 30 may be formed as an integrated circuit. The capacitors 5 and 26 may be formed as semi-conductor layer capacitors and each may form part of a Millar integrator.

CLAIMS

1. A photographic camera exposure control system including a shutter, an electromagnet for controlling the shutter, a first pulse generator the frequency of which is controlled by a light sensitive element and a timing capacitor, a first digital counter responsive to the output of the first pulse generator and producing an output signal after counting a predetermined number of pulses, a second pulse generator the frequency of which is independent of the light level, the second pulse generator being enabled upon fitting a flash gun to the camera or on operation of a selector switch, a second digital



14

counter responsive to the output of the second pulse generator and producing an output signal after counting a predetermined number of pulses, a start switch for resetting the counters each time a
5 photograph has been taken, a gate the two inputs of which are connected to the outputs of the first and second digital counters, and a controllable semi-conductor element responsive to the output of the gate for controlling the electromagnet, exposure
10 being terminated when one of the counters produces its output signal.

2. A system as claimed in Claim 1 in which the first pulse generator except for the light sensitive element, the second pulse generator and the counter
15 form part of an integrated circuit, the capacitors of the pulse generators being semi-conductor layer capacitors and each forming part of a Miller integrator.

3. A system as claimed in Claim 1 or Claim 2
20 including a second controllable semi-conductor element connected in parallel with the timing capacitor and responsive to the output of the first pulse generator and a third controllable semi-conductor element connected in parallel with
25 the timing capacitor and responsive to the start switch.

4. A system as claimed in Claim 3 including a measuring resistor and a fourth controllable semi-conductor element associated with the
30 measuring resistor and responsive to the start switch, the arrangement being such that before commencing each exposure the measuring resistor is connected in series with the light sensitive element whilst the timing capacitor is short circuited.

35 5. A system as claimed in Claim 4 in which the light sensitive element, the timing capacitor, and the measuring resistor are connected in series and the fourth semi-conductor element is connected in parallel with the measuring resistor and in which the
40 third and fourth semi-conductor elements are arranged so that when one is conductive the other is non-conductive.

6. A photographic camera exposure control system substantially as hereinbefore described with
45 reference to and as shown in the accompanying drawings.