

SPECIFICATION

Camera focussing system

The present invention relates to a system in a photographic or cinematographic camera having a lens for adjusting the lens between a subject to be photographed and a camera and/or for indicating when the lens is focussed, the system including a radiation emitting means for producing a measuring beam, a radiation receiving means, a signal processing circuit responsive to the radiation receiving means, and an output circuit responsive to the output of the signal processing circuit.

With such a system, there is a danger, particularly when taking close-up photographs, that radiation reflected back from the subject to be photographed to the camera will cause damage to the eyes of the photographer.

According to the present invention there is provided in a photographic or cinematographic camera having a lens, a focussing system for adjusting the lens in accordance with the distance between a subject to be photographed and the camera and/or for indicating when the lens is focussed, the system including a radiation emitting means for producing a measuring beam, a radiation receiving means for receiving radiation emitted by the emitting means, a signal processing circuit responsive to the radiation receiving means, an output circuit responsive to the output of the signal processing circuit, and a circuit controlled by a signal from the signal processing circuit for regulating the radiation intensity of the radiation emitting means, the regulating circuit preventing the intensity of the radiation incident on the receiving means exceeding a predetermined value.

In the system of the present invention, when a subject to be photographed is located within the close-up range of the camera, and consequently the intensity of radiation reflected from the subject to the camera is relatively high, the regulating circuit prevents the intensity of such radiation exceeding a predetermined value by reducing the output intensity of the radiation emitting means. Also, by regulating the radiation emitting means, the range of the focussing system is increased.

Conveniently, the emitting means is driven by a pulse generator circuit and the regulating circuit comprises a semi-conductor element for controlling the radiation intensity of the emitting means, an amplifier for controlling the semi-conductor element, and a rectifier, the output of the rectifier being connected to an input of the amplifier and the input of the rectifier being connected to said signal from the signal-processing circuit, said signal being an analogue signal derived from the output of an AC amplifier forming part of the signal-processing circuit. The output of the rectifier will be an analogue signal which represents the intensity of radiation incident on the receiving means and reflected back from the subject to be photographed and it will be free from noise.

The semi-conductor element may be controlled by a timer; the timer being operated by a timing switch. The provision of a timer allows the intensity of the emitted radiation to increase to its operating level during a predetermined time after the timing switch has been operated.

Preferably, the time constant of the timer is selected so that regulating the radiation intensity of the emitting means does not cause the emitting means to oscillate.

The system may include a power supply switch ganged to the timing switch.

The present invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a diagram of the optical system of a camera focussing system,

Figures 2 and 2A show a circuit diagram of one focussing system embodying the present invention,

and Figures 3 and 3A show a circuit diagram of another focussing system embodying the present invention.

The two camera focussing systems to be described below have the same optical arrangement and this is shown in Figure 1. The arrangement includes a camera housing 1 and a radiation emitting means in the form of an infra-red emitting diode 2 positioned in the lens. The radiation from the diode 2 is focussed by a lens 3 positioned in front of the diode 2. The arrangement further includes a lens 4 and a high-speed shutter 5, and the optical axis is indicated by reference numeral 6.

The arrangement further includes a radiation receiving means in the form of two infra-red sensitive diodes 7 and 8. The diodes 7 and 8 are positioned in front of a lens 9, which moves in the directions shown by arrows A and B on rotation of a lens focussing ring 10. Radiation emitted by the diode 2 and reflected back from a subject to be photographed towards the camera is focussed by a lens 11 which, together with the lens 9, sharply focusses the radiation in the plane of the diodes 7 and 8. The sharply focussed radiation in the plane of the diodes 7 and 8 can be moved backwards and forwards by rotating the ring 10.

In the first embodiment of the present invention, the infra-red emitting diode 2 and the infra-red sensitive diodes 7 and 8 are connected to the circuit arrangement shown in Figure 2, as will now be described.

Referring now to Figure 2 there is shown a battery 12, the negative pole of which is connected to a negative supply line and the positive pole of which is connected through a power supply switch 13, a diode 16 and a resistor 17 to a positive supply line. A capacitor 14 is connected in parallel with the battery 12 and switch 13 and a further capacitor 15 is connected between the two supply lines, the capacitors 14 and 15 and the diode 16 acting to stabilise the supply voltage. A pair of resistors 18 and 19 are connected between the positive and negative supply lines and the junction of these two resistors

is connected to an earth line, the resistors 18 and 19 being of identical value so that the potential differences between the positive supply line and the earth line and between the earth line and the negative supply line are equal.

The cathode of the infra-red sensitive diode 7 is connected to the inverting input of an operational amplifier 20, the non-inverting input of which is connected to the earth line, and the cathode of the infra-red sensitive diode 8 is connected to the inverting input of an operational amplifier 21, the non-inverting input of which is also connected to earth.

A pair of resistors 22 and 23 are connected in series as feedback resistors between the output of amplifier 20 and its inverting input and a further pair of resistors 24 and 25 are connected in series as feedback resistors between the output of amplifier 21 and its inverting input. The resistors 22, 23 and 24, 25 determine the DC amplification of the two amplifiers 20, 21. The junction of resistors 22 and 23 is connected by a capacitor 26 to the earth line and a junction between the resistors 24 and 25 is connected by a capacitor 27 to the earth line. As the impedance of the capacitors 26 and 27 falls with increasing frequency, the AC amplification of amplifiers 20 and 21 increases with frequency. Preferably, the resistors 22 and 23 are identical to the resistors 24 and 25 and the capacitor 26 is identical to the capacitor 27.

The output of amplifier 20 is connected by a coupling capacitor 28 to the inverting input of an operational amplifier 29, the output of which is connected through a feedback resistor 30 to its non-inverting input, and the non-inverting input is connected to the earth line through a resistor 31. The two resistors 30 and 31 determine the amplification factor of amplifier 29. The amplifier 29 functions as an AC amplifier.

The output of amplifier 21 is connected through a coupling capacitor 33 to the inverting input of an operational amplifier 32, the output of which is connected to a feedback resistor 34 to its inverting input and the inverting input is connected to the earth line through a resistor 35. The two resistors 34 and 35 determine the amplification factor of amplifier 32 and this amplifier also functions as an AC amplifier.

The output of amplifier 29 and the output of amplifier 32 are connected respectively to the switching elements 38 and 37 of a first multiplex stage 36. The output of the switching elements 38 and 37 to a high-pass filter comprising an operational amplifier 39, resistors 40 and 41, and capacitors 42 and 43. The high-pass filter is arranged so that interference signals caused by incandescent lamps and fluorescent lights, having a frequency equal to double mains frequency, are removed.

The output of high-pass filter 39 to 43 is connected by a coupling capacitor 44 to the non-inverting input of an operational amplifier 45, the output of which is connected by a feedback resistor 46 to its non-inverting input and the non-

inverting input of which is connected to the earth line by a resistor 47. The operational amplifier 45 functions as an AC amplifier. The output of amplifier 45 is connected by a coupling capacitor 48 to the non-inverting input of the operational amplifier 49, the output of which is connected to its inverting input by a resistor 50 and the inverting input of which is connected to the earth line by a resistor 51. The resistors 50 and 51 determine the amplification factor of amplifier 49. The coupling capacitor 48 is also connected to earth by a resistor 52 which discharges the capacitor when there is no signal.

The amplifiers 20, 21, 29, 34, 39, 45 and 49 together with their associated elements form a signal-processing circuit.

The capacitor 48 is also connected to a terminal A which is connected to a regulating circuit, as shown in Figure 2A. In the regulating circuit, the terminal A is connected to the anode of a diode 100, the cathode of which is connected through a capacitor 101 to a terminal B, which in turn is connected to the negative supply line. A discharge resistor 102 is connected in parallel with the capacitor 101, and the diode 100, capacitor 101 and resistor 102 function as a rectifier. The cathode of diode 100 is also connected through a resistor 103 to the inverting input of an operational amplifier 104, the output of which is connected to its inverting input by a variable resistor 105, which determines the amplification factor of this amplifier, and the non-inverting input of which is connected to the negative supply line.

The amplifier 104 inverts the signal appearing at the cathode of diode 100 and the output is connected through a resistor 106 and a capacitor 107 to the negative supply rail. The resistor 106 and capacitor 107 form a timer. The timing switch 13 is connected in parallel with the capacitor 107 and is mechanically ganged to the power supply switch 13. The junction of resistor 106 and capacitor 107 is connected to the base of an NPN transistor 111, the collector of which is connected to a terminal D, for a purpose to be described below, and the emitter of which is connected to the negative supply rail. Transistor 111 functions as a controllable resistance semi-conductor element.

The output of amplifier 49 is connected to the inputs of the two switching elements 44 and 45 of a second multiplex stage 53. The output of switching element 54 is connected to the clock input of a D-flip-flop 56 and the output of switching element 55 is connected to the clock input of a second D-flip-flop 57.

The D-inputs of the two flip-flops 56 and 57 are connected to the positive supply line.

The Q-output of flipflop 57 and the $\bar{Q}$ -output of flip-flop 56 are connected to the two inputs of an OR-gate 58, the output of which is connected by a resistor 59 to the base of a transistor 60.

The Q-output of flip-flop 56 is connected to one input of an OR-gate 62. The other input of OR-gate 62 is connected through a switch 61 to the

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positive supply line, and the switch 61 is associated with the lens adjustment mechanism in such a way that it is closed when the lens is focussed on infinity. The output of OR-gate 62 is connected by a resistor 63 to the base of a transistor 64. The switch 61 is also connected to the negative supply line through a resistor 65.

The collector of transistor 60 is connected through a light-emitting diode 66 and a resistor 67 and the switch 13 to the positive pole of battery 12 and the collector of transistor 64 is connected through a light-emitting diode 68 and a resistor 69 and switch 13 to the positive pole of battery 12. The light-emitting diodes 66 and 68 indicate to the camera user by means of arrows marked on them the direction in which the camera lens should be rotated in order to focus it.

The system further includes a square-wave pulse generator 70, the output of which is connected to the clock input of a counter 71. The Q1 output of counter 71 is connected to one input of a NOR-gate 72, the other input of which is connected to the pulse generator 70. The output of NOR-gate 72 is connected to the first input of an AND-gate 73. The second input of AND-gate 73 is connected to the Q4 output of counter 71. The Q2 output and the Q4 output of counter 74 are connected to the two inputs of an AND-gate 72, the output of which is connected to the reset input R of counter 71. Thus, the duration of pulses appearing at the Q4 output is equal to the duration of pulses appearing at the Q2 output, and shorter than the duration of pulses appearing at the Q3 output.

The Q3 output of counter 71 is connected to the clock input of a D-flip-flop 75 the D-input of which is connected to its $\bar{Q}$ -output. The $\bar{Q}$ -output of flip-flop 75 is connected to the control input of switching element 38 of multiplex stage 36 and the $\bar{Q}$ -output is connected to the control input of switching element 37. The connection between the $\bar{Q}$ -output and the D-input of flip-flop 75 causes this flip-flop to change state each time it receives a pulse from the Q3 output of counter 71. Thus, the switching elements 37 and 38 are switched on alternately.

The pulse generator 70, the counter 71, the NOR-gate 72, the AND-gate 73, the AND-gate 74 and flip-flop 75 together comprise a pulse generator circuit and, as will be described below, the output of AND-gate 73 is used to drive the infra-red emitting diode 2.

The Q-output of flip-flop 75 is connected to the first input of an AND-gate 76 and a $\bar{Q}$ -output is connected to the first input of an AND-gate 77. The second inputs of AND-gates 76 and 77 are connected to the Q-output of a further D-flip-flop 78, the clock input of which is connected to the Q4 output of counter 71. The reset input R of D-flip-flop 78 is connected to the output of AND-gate 74, and the D-input of flip-flop 78 is connected to the positive supply line. Thus, flip-flop 78 is set each time it receives a pulse from the Q4 output of counter 71 and it is reset each time it receives a pulse from AND-gate 74. Thus,

flip-flop 78 supplies a pulse to AND-gate 76 and 77 which is in phase with the Q4 output of flip-flop 71. The outputs of AND-gate 76 and 77 are connected respectively to the control inputs of switching elements 54 and 55 of the second multiplex stage 53. Thus, whilst the first multiplex stage is driven by the pulses from the Q3 output of counter 71 the second multiplex stage is driven by the pulses from the Q4 output of counter 71. Also, the switching element of the first multiplex stage 36 are switched on for a longer duration than the switching elements of multiplex stage 53.

A resistor 80 and a capacitor 79 are connected in series between the positive and negative supply lines so as to form a delay stage and the junction of these two elements is connected to the third input of AND-gate 73. The time constant of this delay stage is selected so that a positive potential only appears at the output of AND-gate 73 when the pulse generator 70 has stabilised at its operating frequency after being switched on.

The output of AND-gate 73 is connected by a resistor 81 to the base of a transistor 82, the collector of which is connected through switch 13 to the positive pole of battery 12 and the emitter of which is connected to the base of a transistor 83. The collector of transistor 83 is connected to the cathode of infra-red emitting diode 2, the anode of which is connected to the positive pole of battery 12 through switch 13, and the emitter of transistor 83 is connected by terminal B to the collector of transistor 111 shown in Figure 2A. Thus, the diode 2 is energised in phase with the pulses from the Q4 output of counter 71, for duration equal to the duration of pulses produced by pulse generator 70.

A resistor 85 and a capacitor 86 are connected between the Q4 output of counter 71 and the earth line so as to form a delay stage. The junction of resistor 85 and capacitor 86 is connected to the input of an inverter 87, the output of which is connected to one input of an AND-gate 88. The other input of AND-gate 88 is connected to the Q4 output of counter 71. The output of AND-gate 88 is connected to one of the inputs of each of AND-gates 89 and 90, the other inputs of which are connected respectively to the outputs of AND-gates 76 and 77. The output of AND-gate 89 is connected to the reset input R of the flip-flop 56 and the output of AND-gate 90 is connected to the reset input R of flip-flop 57. Thus the flip-flops 56 and 57 are reset by the AND-gate 89 and 90, the timing of the reset pulses being determined by the time constant of delay stage 85, 86. During each cycle of counter 71, one of the switching elements 55 and 54 will be switched on for a duration determined by the pulse appearing at the Q4 output. Whilst one of these switching elements is switched on, if the associated one of diodes 7 and 8 emit a pulse, then the associated one of flip-flops 57 and 56 will be set. Also, during each cycle of counter 71, one of the flip-flops 56 and 57 will be reset as a result of receiving a pulse from one of the AND-gates 89 and 90. When the camera lens is focussed, the diodes 7 and 8 will

will receive similar radiation and so both transistors 64 and 60 will be turned on thereby energising both light-emitting diodes 66 and 68 thereby indicating that focus has been obtained.

- 5 The signal appearing at terminal A is rectified by the rectifier 100, 101, and 102; and then inverted by amplifier 104. After opening switch 108, the potential across capacitor 107 will rise to the output voltage of amplifier 104 during a period
10 determined by the values of resistor 106 and 107 to drive transistor 111. The current through the emitting diode 2 is consequently reduced by transistor 111 so that the intensity of radiation
15 incident on the camera exceeds neither the value which is acceptable for the human eye nor the value which causes overloading of the signal-processing circuit.

- As may be appreciated, the flip-flops 56 and 57, and transistors 60 and 64 and the associated
20 components form an output circuit.

- Referring now to figures 3 and 3A, the embodiment shown there is generally similar to the embodiment shown in Figure 2 and 2A and similar elements have been denoted by the same
25 reference numerals. However, in this embodiment the OR-gate 58 of Figure 2 is replaced by a NOR-gate 94, and the transistors 60 and 64 and light-emitting diodes 66 and 68 are replaced by a
30 motor control circuit comprising a transistor 91, a transistor 92, and a motor 93 for adjusting the camera lens. The emitter of transistor 91 is connected to the emitter of transistor 92 and both
35 emitters are connected to one terminal of the DC motor 93. The other terminal of motor 93 is connected to the earth-line. The collector of transistor 91 is connected to the positive pole of
40 battery 12 through switch 13 and the collector of transistor 92 is connected to the negative supply line. The base of transistor 91 is connected to the output of OR-gate 62. One input of NOR-gate 94 is connected to the Q-output of flip-flop 56 and the
45 other input is connected to the Q-output of flip-flop 57. The output of NOR-gate 94 is connected through resistor 59 to the base of the transistor 91. In operation, the motor 93 will be rotated
50 clockwise or anti-clockwise until the two infra-red sensitive diodes 7 and 8 are similarly irradiated at which stage the lens will be in focus and the motor 93 will be de-energised.

- Referring now to Figure 3A, a transistor 111' is used in place of the transistor 111 of Figure 2A. The collector of this transistor is connected to a terminal F which, as shown in Figure 3, is

- 55 connected to the base of transistor 81. Also, in this embodiment, the emitter of transistor 83 is connected to the negative supply line through a resistor 84.

CLAIMS

1. In a photographic or cinematographic
60 camera having a lens, a focussing system for adjusting the lens in accordance with the distance between a subject to be photographed and the camera and/or for indicating when the lens is
65 focussed, the system including a radiation emitting means for producing a measuring beam, a radiation receiving means for receiving radiation emitted by the emitting means, a signal
70 processing circuit responsive to the radiation receiving means, an output circuit responsive to the output of the signal processing circuit, and a
75 circuit controlled by a signal from the signal processing circuit for regulating the radiation intensity of the radiation emitting means, the regulating circuit preventing the intensity of the radiation incident on the receiving means
exceeding a predetermined value.
2. A system as claimed in Claim 1 in which the
80 emitting means is driven by a pulse generator circuit and in which the regulating circuit comprises a semi-conductor element for
controlling the radiation intensity of the emitting means, an amplifier for controlling the semi-
85 conductor element, and a rectifier, the output of the rectifier being connected to an input of the amplifier and the input of the rectifier being
90 connected to said signal from the signal processing circuit, said signal being an analogue signal derived from the output of an AC amplifier forming part of the signal processing circuit.
3. A system as claimed in Claim 3 in which the
95 semi-conductor element is controlled by a timer, the timer being operated by a timing switch.
4. A system as claimed in Claim 3 in which the time constant of the timer is selected so that
100 regulating the radiation intensity of the emitting means does not cause the emitting means to oscillate.
5. A system as claimed in claim 3 or claim 4 including a power supply switch ganged to the
105 timing switch.
6. A focussing system in a photographic or cinematographic camera substantially as hereinbefore described with reference to and as shown in Figures 1, 2, and 2A, or Figures 1, 3 and 3A.



will receive similar radiation and so both transistors 64 and 60 will be turned on thereby energising both light-emitting diodes 66 and 68 thereby indicating that focus has been obtained.

5 The signal appearing at terminal A is rectified by the rectifier 100, 101, and 102, and then inverted by amplifier 104. After opening switch 108, the potential across capacitor 107 will rise to the output voltage of amplifier 104 during a period
10 determined by the values of resistor 106 and 107 to drive transistor 111. The current through the emitting diode 2 is consequently reduced by transistor 111 so that the intensity of radiation incident on the camera exceeds neither the value
15 which is acceptable for the human eye nor the value which causes overloading of the signal-processing circuit.

As may be appreciated, the flip-flops 56 and 57, and transistors 60 and 64 and the associated
20 components form an output circuit.

Referring now to figures 3 and 3A, the embodiment shown there is generally similar to the embodiment shown in Figure 2 and 2A and similar elements have been denoted by the same
25 reference numerals. However, in this embodiment the OR-gate 58 of Figure 2 is replaced by a NOR-gate 94, and the transistors 60 and 64 and light-emitting diodes 66 and 68 are replaced by a motor control circuit comprising a transistor 91, a
30 transistor 92, and a motor 93 for adjusting the camera lens. The emitter of transistor 91 is connected to the emitter of transistor 92 and both emitters are connected to one terminal of the DC motor 93. The other terminal of motor 93 is
35 connected to the earth line. The collector of transistor 91 is connected to the positive pole of battery 12 through switch 13 and the collector of transistor 92 is connected to the negative supply line. The base of transistor 91 is connected to the
40 output of OR-gate 62. One input of NOR-gate 94 is connected to the Q-output of flip-flop 56 and the other input is connected to the Q-bar output of flip-flop 57. The output of NOR-gate 94 is connected through resistor 59 to the base of the transistor
45 91. In operation, the motor 93 will be rotated clockwise or anti-clockwise until the two infra-red sensitive diodes 7 and 8 are similarly irradiated at which stage the lens will be in focus and the motor 93 will be de-energised.

50 Referring now to Figure 3A, a transistor 111' is used in place of the transistor 111 of Figure 2A. The collector of this transistor is connected to a terminal F which, as shown in Figure 3, is

connected to the base of transistor 81. Also, in this embodiment, the emitter of transistor 83 is connected to the negative supply line through a resistor 84.

CLAIMS

1. In a photographic or cinematographic camera having a lens, a focussing system for adjusting the lens in accordance with the distance between a subject to be photographed and the camera and/or for indicating when the lens is focussed, the system including a radiation
60 emitting means for producing a measuring beam, a radiation receiving means for receiving radiation emitted by the emitting means, a signal processing circuit responsive to the radiation receiving means, an output circuit responsive to the output of the signal processing circuit, and a circuit controlled by a signal from the signal processing circuit for regulating the radiation
65 intensity of the radiation emitting means, the regulating circuit preventing the intensity of the radiation incident on the receiving means exceeding a predetermined value.

2. A system as claimed in Claim 1 in which the emitting means is driven by a pulse generator circuit and in which the regulating circuit
80 comprises a semi-conductor element for controlling the radiation intensity of the emitting means, an amplifier for controlling the semi-conductor element, and a rectifier, the output of the rectifier being connected to an input of the amplifier and the input of the rectifier being
85 connected to said signal from the signal processing circuit, said signal being an analogue signal derived from the output of an AC amplifier forming part of the signal processing circuit.

3. A system as claimed in Claim 3 in which the semi-conductor element is controlled by a timer, the timer being operated by a timing switch.

4. A system as claimed in Claim 3 in which the time constant of the timer is selected so that
95 regulating the radiation intensity of the emitting means does not cause the emitting means to oscillate.

5. A system as claimed in claim 3 or claim 4 including a power supply switch ganged to the
100 timing switch.

6. A focussing system in a photographic or cinematographic camera substantially as hereinbefore described with reference to and as shown in Figures 1, 2, and 2A, or Figures 1, 3 and
105 3A.