

SPECIFICATION

Photographic Camera with an Exposure Control Circuit and with a Focussing Arrangement

5 This invention relates to a camera having a focus detection arrangement and an exposure control. The invention has as its object of provision of such an exposure control and focus detection arrangement in a simple and space-saving form wherein common components are used for both functions.

10 According to the present invention, there is provided a camera comprising a photographing lens; a focussing member operable to focus the photographing lens, a light source arranged to emit a signal beam towards an object to be photographed, a pair of light-sensitive elements, an optical element arranged to form light from the signal beam which is reflected by said object into a spot on the light-sensitive elements, the optical element and the light-sensitive elements being moved relative to one another as the focussing member is operated so that the position of said spot on the light-sensitive elements depends on the focus condition of the photographing lens; detection means connected to the light-sensitive elements and arranged to detect when said spot falls equally thereon, removal means operable in response to actuation of a shutter release member to remove the spot effect caused by the optical element, and a timer arranged to control exposure time in accordance with the amount of light falling on at least one of the light-sensitive elements after operation of the removal means.

35 In this way, the same light-sensitive elements are used both for automatic focus detection and automatic exposure control, and it is therefore necessary to provide only one light-receiving aperture in the camera for both functions. 40 Because of the constant electrical properties of the light-sensitive elements, the existing components of the exposure control can be used.

This enables the electrical circuitry to be simplified, particularly in the case where integrated circuits are used. Silicon photodetectors are preferably employed as the light-sensitive elements.

50 Suitable means can be used to change the convergence angle of the light received by the light-sensitive elements, so that a small spot is produced thereon by the optical element during focus detection, whereas the whole of the image field is projected thereon during exposure control. This can be achieved either by moving the optical element away from the light-sensitive elements upon operation of the removing means, or by maintaining the optical element in position and moving a correcting lens in front of the light-sensitive elements.

60 In order to reduce the effects of extraneous light on the light-sensitive elements during focus detection, filtering means can be provided which renders the light-sensitive elements responsive only to the frequency of the signal beam and

65 which is itself rendered inoperative by operation of the removal means. The filtering means can take the form of a filter which forms an integral component with the optical element. Where the signal beam has a constant intensity, its frequency is advantageously outside the frequency range of visible light—for example, the signal beam can be a beam of infra red light and infra red filter can be positioned in front of the light-sensitive elements. Alternatively, the intensity of the signal beam can be modulated and the detection means can be arranged to detect the modulation in the light reflected by the object to be photographed.

As indicated above, upon operation of the removal means, the optical element can be moved away from the light-sensitive elements, or alternatively the optical element can be maintained in position in front of the light-sensitive elements and a correcting lens can be moved over the elements. The removal means conveniently comprises a member which is movable relative to the optical axis of the photographing lens and which carries the optical element or the correcting lens, as the case may be. The member preferably forms part of a shutter mechanism and preferably also carries the filter when used.

In a particular arrangement, the member of the removal means is movable relative to the light-sensitive elements and carries optical means thereon, the member being arranged to move the optical means in front of the light-sensitive elements upon actuation of the shutter release member, the optical means being arranged to reproduce the whole of the image field on said at least one of the light-sensitive elements. The optical means is preferably arranged to operate in conjunction with light-correcting or attenuating means which assesses the image field with a predetermined intensity or attenuation characteristic (spectral sensitivity characteristic).

The camera desirably also comprises switching means which is arranged to disconnect the detection means from the light-sensitive elements and to connect the timer thereto upon operation of the removal means. Advantageously, the switching means is operated by said member of the removal means.

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

Fig. 1 is a section through part of a camera according to a first embodiment of the present invention;

Fig. 2 is a plan view of part of the camera shown in Fig. 1;

Fig. 3 is a diagram of electrical circuitry which is associated with the parts shown in Fig. 2; and Fig. 4 is a similar view to Fig. 2 of a second embodiment of the present invention.

Referring first to Fig. 1, the camera shown therein comprises a photographing lens 5 which can be focussed by rotating a focussing ring 9 on a barrel 1 of the lens. Disposed within the lens

barrel 1 are an infra red light source 2 and a lens 3 which forms the light from the source 2 into a measurement or signal beam. Also disposed within the lens barrel 1 in symmetrical relation to the source 2 and lens 3 with respect to the optical axis 6a of the photographing lens 5 is a differential light-sensitive detector. The detector comprises a collector lens 10 which is arranged to collect light from the infra red signal beam which has been reflected by an object to be photographed, a pair of silicon photodiodes 6 and 7, and a lens 8 which is arranged to focus the light collected by the lens 10 into a spot on the light-receiving surfaces of the photodiodes 6 and 7. The lens 8 is arranged to be moved in the directions of arrows A and B as the focussing ring 9 is rotated, so that the position of the spot on the photodiodes 6 and 7 is dependent upon the focus condition of the photographing lens 5. When the lens 5 is properly focussed on the object to be photographed, the spot falls equally on both photodiodes.

Referring now also to Fig. 2, a carrier member 12 is pivotable about a pin 13 and carries an infra red filter 11 which is disposed between the lens 8 and the photodiodes 6 and 7 when the camera is operated in a focus detection mode. The carrier member 12 is in fact formed by a shutter opening plate of a shutter mechanism, and is biased in an anticlockwise direction (as viewed in Fig. 2) by a spring 14. A pivotable latch member 18, which is biased clockwise by a spring 19, holds the plate 12 in a position wherein it covers the photographic aperture of the lens 5 and wherein the filter 11 is positioned in front of the photodiodes 6 and 7. Upon operation of a shutter release member (not shown), the latch member 18 is moved in the direction of arrow C and releases the plate 12 so that the latter can pivot under the action of the spring 14 into a position wherein the photographic aperture of the lens 5 is uncovered. Such pivotal movement of the plate 12 also causes the filter 11 to be replaced by an aperture 15 in front of the photodiodes 6 and 7. The lens 8 is also arranged to be moved away from the photodiodes 6 and 7 in a direction parallel to its optical axis at this time, so that the whole of the image field to be photographed is reproduced on the photodiodes. Alternatively, the lens 8 can be left in position and a correction lens can be provided in the aperture 15. The camera then operates in an exposure control mode.

When the camera is in the exposure control mode, visible light from the object to be photographed reaches the photodiodes 6 and 7 because the infra red filter 11 has now been removed. The photodiodes 6 and 7 are arranged to have a spectral sensitivity characteristic which matches that of the photographic film being used (and therefore also that of the eye). For this purpose, a suitable filter can be provided in the aperture 15, or a suitable spectral sensitivity may alternatively be obtained electrically, for example by using an electrical filter.

A projection 20 on the plate 12 is arranged to

engage a movable member 31 of a changeover switch assembly as the carrier moves from its focus detection position to its exposure control position. The switch assembly comprises a first pair of fixed contacts 21 and 22 which are selectively engageable by a first movable contact, and a second pair of fixed contacts 23 and 24 which are similarly selectively engageable by a second movable contact. The first and second movable contacts are fixed to the member 31 so as to be movable therewith, and are connected respectively to the photodiodes 6 and 7 (See Fig. 3).

Referring now to Fig. 3, the fixed contacts 21 and 23 (which are engaged by the respective movable contacts in the focus detection mode of the camera) are connected respectively to the inputs of a detection circuit 26 which includes a comparator 25 in the form of a differential amplifier and light-emitting diodes 27 and 28 are connected to respective outputs of the detection circuit 26. The detection circuit 26 is arranged to compare the magnitudes of the output signals from the photodiodes 6 and 7 (which are dependent upon the amount of light falling thereon, respectively). In the event that the output signal from the photodiode 6 prevails, then the light-emitting diode 27 is energised; in the event that the output signal from the photodiodes 7 prevails, then the light-emitting diode 28 is energised. When the spot of infra red light falls equally on both photodiodes, the output signals from the latter are equal and neither light-emitting diode is energised.

Although not shown, the light-emitting diodes 27 and 28 are arranged so as to be visible in a viewfinder of the camera and are in the form of curved arrows pointing in opposite rotational directions. The form of each arrow is such that, when the respective light-emitting diode is energised, it indicates the direction in which the focussing ring 9 must be rotated in order to focus the photographing lens 5 and thereby extinguish the energised light-emitting diode. Non-illumination of both arrows indicates that the correct focus has been achieved.

The fixed contacts 22 and 24 of the changeover switch arrangement (which are engaged by the respective movable contacts when the camera is in its exposure control mode) are commonly connected to a timer in the form of an amplifier and threshold value stage 33 which includes a starter transistor 37 for a charging condenser 38, an amplifier 39, a threshold value stage 40 and further control transistors (not shown). A light-emitting diode 34 and an electromagnet 35 are provided in an output circuit of the stage 33, the light-emitting diode 34 being energised when there is insufficient light for a proper exposure and the electromagnet 35 being arranged to control operation of the shutter mechanism. When energised, the electromagnet 35 holds a pivotable shutter closing plate 16 (see Fig. 2) against the action of a spring 17 in a position wherein it does not cover the

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photographic aperture of the lens 5. Upon de-energisation of the electromagnet 35, the plate 16 pivots under the action of the spring 17 so as to cover the photographic aperture and thereby terminate an exposure. A switch 36 is actuated by the plate 12 so as to ensure that the stage 33 is changed over from focus detection operation to exposure control operation.

The circuitry described above is powered by a battery 29 via a control switch 30, which is closed either upon cocking the shutter mechanism by operation of a film advance mechanism, or during the first actuation phase of shutter release. The detection circuit 26 and the amplifier and threshold value stage 33 are provided in a common integrated circuit, and the photodiodes 6 and 7 are preferably arranged on a common carrier for the integrated circuit.

In use, when the camera is in its focus detection mode, the various parts are in the positions illustrated in Figs. 1 to 3, and the detection circuit 26 operates as described above to indicate whether or not the photographing lens 5 is properly focussed. Upon actuation of the shutter release member, and latch member 18 is pivoted as described above to release the shutter opening plate 12, which then pivots so as to remove the infra red filter 11 from in front of the photodiodes 6 and 7 and to replace it by the aperture 15. At the same time, the plate 12 trips the changeover switch assembly, uncovers the photographic aperture of the lens 5 to start an exposure, and opens the switch 36. The condenser 38 of the stage 33 then starts to charge at a rate which is determined by the amount of light falling on the photodiodes 6 and 7. When the voltage across the condenser 38 reaches a predetermined level the electromagnet 35 is de-energised so as to release the shutter closing plate 16 and thereby terminate the exposure.

Referring now to Fig. 4, there is shown a second embodiment of the invention which is generally similar to that described above with reference to Figs. 1 to 3, similar parts being accorded the same reference numerals but primed. In the embodiment of Fig. 4, however, the optical elements associated with the photodiodes 6' and 7' are not provided on the shutter opening plate 12', but are instead mounted on a separate carrier plate 44 which is biased by a spring 45 for anticlockwise rotation about a pivot 46. The plate 44 has an infra red filter 47 and an aperture 51 which correspond respectively to the filter 11 and aperture 15 of the previous embodiment. A latch member 42 holds the plate 44 against the action of the spring 45 in a position wherein the filter 47 is disposed in front of the photodiodes 6' and 7', and is arranged to be rotated in the direction of arrow C against the action of a spring 43 to release the plate 44 upon actuation of a shutter release member. The changeover switch assembly is actuated by a projection 48 on the plate 44.

The shutter opening plate 12' is held by a latch

member 49 against the action of its biasing spring 14' in a position wherein it covers the photographic aperture (denoted as 41) of the photographing lens. The latch member 49 is arranged to be pivoted by the plate 44 against the action of a spring 50 so as to release the plate 12' and thereby open the shutter mechanism. Pins 52 and 53 serve to return the various parts to their starting positions after each exposure.

Upon actuation of the shutter release member, the latch member 42 is moved so as to release the plate 44 which then pivots in an anticlockwise direction, as viewed in Fig. 4. This has the effect of moving the aperture 51 (which may contain optical correcting means as in the previous embodiment) in front of the photodiodes 6' and 7', tripping the changeover switch assembly to start the exposure control operation, and moving the latch member 49 to release the shutter opening plate 12'. The operation of the camera is then as described above in relation to the embodiment of Figs. 1 to 3.

Claims

1. A camera comprising a photographing lens, a focussing member operable to focus the photographing lens, a light source arranged to emit a signal beam towards an object to be photographed, a pair of light-sensitive elements, an optical element arranged to form light from the signal beam which is reflected by said object into a spot on the light-sensitive elements, the optical element and the light-sensitive elements being moved relative to one another as the focussing member is operated so that the position of said spot on the light-sensitive elements depends on the focus condition of the photographing lens, detection means connected to the light-sensitive elements and arranged to detect when said spot falls equally thereon, removal means operable in response to actuation of a shutter release member to remove the spot effect caused by the optical element, and a time arranged to control exposure time in accordance with the amount of light falling on at least one of the light-sensitive elements after operation of the removal means.

2. A camera as claimed in Claim 1 further comprising filtering means which renders the light-sensitive elements responsive only to the frequency of the signal beam, the filtering means being rendered inoperative by operation of the removal means.

3. A camera as claimed in Claim 2, wherein the filtering means is an optical filter which forms an integral component with the optical element.

4. A camera as claimed in Claim 2 or 3, wherein the signal beam is of constant intensity and has a frequency which is outside the frequency range of visible light.

5. A camera as claimed in Claim 4, wherein the signal beam is a beam of infra red light, and the filtering means comprises an infra red filter positioned in front of the light-sensitive elements.

6. A camera as claimed in Claim 2 or 3, wherein the intensity of the signal beam is



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photographic aperture of the lens 5. Upon de-energisation of the electromagnet 35, the plate 16 pivots under the action of the spring 17 so as to cover the photographic aperture and thereby terminate an exposure. A switch 36 is actuated by the plate 12 so as to ensure that the stage 33 is changed over from focus detection operation to exposure control operation.

The circuitry described above is powered by a battery 29 via a control switch 30, which is closed either upon cocking the shutter mechanism by operation of a film advance mechanism, or during the first actuation phase of shutter release. The detection circuit 26 and the amplifier and threshold value stage 33 are provided in a common integrated circuit, and the photodiodes 6 and 7 are preferably arranged on a common carrier for the integrated circuit.

In use, when the camera is in its focus detection mode, the various parts are in the positions illustrated in Figs. 1 to 3, and the detection circuit 26 operates as described above to indicate whether or not the photographing lens 5 is properly focussed. Upon actuation of the shutter release member, and latch member 18 is pivoted as described above to release the shutter opening plate 12, which then pivots so as to remove the infra red filter 11 from in front of the photodiodes 6 and 7 and to replace it by the aperture 15. At the same time, the plate 12 trips the changeover switch assembly, uncovers the photographic aperture of the lens 5 to start an exposure; and opens the switch 36. The condenser 38 of the stage 33 then starts to charge at a rate which is determined by the amount of light falling on the photodiodes 6 and 7. When the voltage across the condenser 38 reaches a predetermined level the electromagnet 35 is de-energised so as to release the shutter closing plate 16 and thereby terminate the exposure.

Referring now to Fig. 4, there is shown a second embodiment of the invention which is generally similar to that described above with reference to Figs. 1 to 3, similar parts being accorded the same reference numerals but primed. In the embodiment of Fig. 4, however, the optical elements associated with the photodiodes 6' and 7' are not provided on the shutter opening plate 12', but are instead mounted on a separate carrier plate 44 which is biased by a spring 45 for anticlockwise rotation about a pivot 46. The plate 44 has an infra red filter 47 and an aperture 51 which correspond respectively to the filter 11 and aperture 15 of the previous embodiment. A latch member 42 holds the plate 44 against the action of the spring 45 in a position wherein the filter 47 is disposed in front of the photodiodes 6' and 7', and is arranged to be rotated in the direction of arrow C against the action of a spring 43 to release the plate 44 upon actuation of a shutter release member. The changeover switch assembly is actuated by a projection 48 on the plate 44.

The shutter opening plate 12' is held by a latch

member 49 against the action of its biasing spring 14' in a position wherein it covers the photographic aperture (denoted as 41) of the photographing lens. The latch member 49 is arranged to be pivoted by the plate 44 against the action of a spring 50 so as to release the plate 12' and thereby open the shutter mechanism. Pins 52 and 53 serve to return the various parts to their starting positions after each exposure.

Upon actuation of the shutter release member, the latch member 42 is moved so as to release the plate 44 which then pivots in an anticlockwise direction, as viewed in Fig. 4. This has the effect of moving the aperture 51 (which may contain optical correcting means as in the previous embodiment) in front of the photodiodes 6' and 7', tripping the changeover switch assembly to start the exposure control operation, and moving the latch member 49 to release the shutter opening plate 12'. The operation of the camera is then as described above in relation to the embodiment of Figs. 1 to 3.

Claims

1. A camera comprising a photographing lens, a focussing member operable to focus the photographing lens, a light source arranged to emit a signal beam towards an object to be photographed, a pair of light-sensitive elements, an optical element arranged to form light from the signal beam which is reflected by said object into a spot on the light-sensitive elements, the optical element and the light-sensitive elements being moved relative to one another as the focussing member is operated so that the position of said spot on the light-sensitive elements depends on the focus condition of the photographing lens, detection means connected to the light-sensitive elements and arranged to detect when said spot falls equally thereon, removal means operable in response to actuation of a shutter release member to remove the spot effect caused by the optical element, and a time arranged to control exposure time in accordance with the amount of light falling on at least one of the light-sensitive elements after operation of the removal means.

2. A camera as claimed in Claim 1 further comprising filtering means which renders the light-sensitive elements responsive only to the frequency of the signal beam, the filtering means being rendered inoperative by operation of the removal means.

3. A camera as claimed in Claim 2, wherein the filtering means is an optical filter which forms an integral component with the optical element.

4. A camera as claimed in Claim 2 or 3, wherein the signal beam is of constant intensity and has a frequency which is outside the frequency range of visible light.

5. A camera as claimed in Claim 4, wherein the signal beam is a beam of infra red light, and the filtering means comprises an infra red filter positioned in front of the light-sensitive elements.

6. A camera as claimed in Claim 2 or 3, wherein the intensity of the signal beam is

modulated and the detection means is arranged to detect the modulation in the reflected light.

7. A camera as claimed in any preceding claim, wherein the light-sensitive elements are fixed

- 5 relative to the optical axis of the photographing lens, and the optical element is movable in a direction perpendicular to said optical axis in response to operation of the focussing member.

8. A camera as claimed in any preceding claim, 10 further comprising switching means arranged to disconnect the detection means from the light-sensitive elements and to connect the timer thereto upon operation of the removal means.

9. A camera as claimed in Claim 8, wherein the 15 removal means includes a member which is movable relative to the optical axis of the photographing lens and which is arranged to operate the switching means upon actuation of said shutter release member.

- 20 10. A camera as claimed in any one of Claims 2 to 8, wherein the filtering means is an optical filter which is carried by said member of the removal means.

11. A camera as claimed in any preceding 25 claim, wherein the removal means includes a member which is movable relative to the light-sensitive elements and which carries optical means thereon, the member being arranged to move the optical means in front of the light-sensitive elements upon actuation of the shutter 30 release member, the optical means being arranged to reproduce the whole of the image field on said at least one of the light-sensitive elements.

- 35 12. A camera as claimed in Claim 11, wherein

the optical means is arranged to operate in conjunction with light-correcting or attenuating means which assesses the image field with a predetermined spectral sensitivity.

- 40 13. A camera as claimed in Claim 11, wherein the optical element is maintained in position in front of the light-sensitive elements upon operation of the removal means, and the optical means comprises a correcting lens.

- 45 14. A camera as claimed in any one of Claims 1 to 10, wherein the optical element is moved in a direction parallel to its optical axis upon operation of the removal means, so that the whole of the image field is reproduced on both of the light-sensitive elements.

- 50 15. A camera as claimed in any one of Claims 9 to 13, wherein the member of the removal means forms part of a shutter mechanism.

- 55 16. A camera as claimed in any preceding claim, wherein the light source, the optical element and the light-sensitive elements are located in a barrel of the photographing lens.

17. A camera as claimed in any preceding 60 claim, wherein the detection means includes a differential amplifier to which output signals from the light-sensitive elements are supplied as respective inputs, and a pair of light-emitting elements are connected to the output of the differential amplifier and are arranged to be 65 selectively energised in accordance with which one of the light-sensitive elements receives the greater part of said spot.

18. A camera substantially as hereinbefore 70 described with reference to Figures 1, 2 and 3 or Figure 4 of the accompanying drawings.

