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 (72) Inventor: RICHARD JOSEPH BRESSON



(54) PHOTOGRAPHIC CAMERAS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to photographic cameras and more particularly to exposure control apparatus for use therewith.

According to the present invention there is provided a photographic camera comprising a shutter release, an adjustable diaphragm, lens focusing means, photosensitive means for producing a signal in response to received scene illumination, an electrochemical transducer for driving the diaphragm for setting an aperture dependant on said signal, a socket for connecting an auxiliary source of illumination and means coupled to the lens focusing means and responsive to the connection of an auxiliary source of illumination to the socket for controlling the setting to which the diaphragm is driven by the transducer in accordance with the setting of the lens focusing means.

In the accompanying drawings:

Fig. 1 is an exploded perspective view of the shutter and diaphragm mechanisms for the exposure control apparatus constructed in accordance with one form of the present invention;

Fig. 2 and 3 are elevations, to a reduced scale, of the shutter and diaphragm mechanisms shown in Fig. 1 in various stages of operation; and

Fig. 4 is a circuit diagram for controlling the mechanism shown in Figs. 1-3 and including a time delay circuit for controlling the exposure interval and a diaphragm control circuit for varying the exposure aperture.

An exposure control system according to the present invention includes an adjustable diaphragm mechanism including a member movable to any position along a path for varying an exposure aperture in accordance with the level of scene light, and a shutter mechanism controlled by an electronic time-delay circuit that establishes the length of an exposure interval. The time-delay circuit preferably is of the integrating type for continuously measuring the total accumulated amount of light energy impinging on a radiation sensitive element in the timing circuit. After the diaphragm mechanism has been actuated to adjust the exposure aperture in accordance with the level of scene illumination, the shutter mechanism is then actuated to initiate an exposure interval under the control of the electronic timing circuit that terminates the exposure interval in accordance with the amount of illumination actually received during the exposure interval by the radiation sensitive element in the timing circuit. The shutter timing circuit can compensate for the exposure aperture setting, for example, by adjustment of an electrical parameter of the timing circuit to vary its time constant, preferably by varying the aperture of the radiation sensitive element used in the timing circuit in accordance with the adjustment of the exposure aperture by the diaphragm mechanism. The subject matter of this invention is related to how such an exposure control system may operate in a flash mode.

Referring now to Fig. 1, an exposure control apparatus includes an objective 10 for forming an image on photographic film F, a two-bladed diaphragm mechanism 12 for establishing a variable exposure aperture in alignment with an optical axis 14 of the objective, and a two-bladed shutter mechanism 16 for initiating and terminating an exposure through the objective.

The diaphragm mechanism 12 includes a

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pair of blades 18 and 20 that are slidably mounted upon support means (not shown) for equal and opposite movement relative to the optical axis 14. Each of these blades has a tapered aperture 22 and 24 respectively, overlying each other to define an exposure aperture 25 aligned with the optical axis 14. The apertures 22 and 24 are disposed with their tapered portions extending in opposite directions with respect to each other along the line of travel of the two diaphragm blades, such that opposite movement of the blades 18 and 20 will enlarge that or diminish the size of the exposure aperture 25. Each of the blades 18 and 20 also has a second tapered aperture 26 and 28, respectively, similar to the tapered apertures 22 and 24, overlying each other to define a variable aperture 29 overlying a radiation sensitive assembly 30. A lens 32 having an optical axis 33 is located to form an image of an object scene on the radiation sensitive assembly 30 through the variable aperture 29. Thus, opposite movement of the diaphragm blades 18 and 20 will result in a variation of the size of the variable aperture 29 over the radiation sensitive assembly 30 simultaneously with the variation of the size of the exposure aperture 25. The diaphragm blades 18 and 20 are each connected to opposite ends of an armature 35 rotatably driven by an electromechanical transducer 36 which, as illustrated, is a servo motor having input leads 38, 40 and 42. The operation of this servo motor will be described hereinafter in further detail with respect to the circuit shown in Fig. 4.

The shutter mechanism 16 is a conventional two-blade system, which is shown in Fig. 1 in its cocked position preparatory to actuation to effect an exposure. The shutter mechanism includes a pair of shutter blades 44 and 46 which are slidably mounted upon support means (not shown) for movement relative to the exposure aperture 25. When the blade 44, which is the "opening" shutter blade in this embodiment, it in its cocked position shown, it is retained against the bias of a spring 48 by means of a latch member 50 which is biased by means of a spring into latching engagement with a detent 53, in which position the latch member engages a pin 54. The "opening" shutter blade 44 has a second detent 56 for engagement with a detent 58 on the blade 46 which, in this embodiment, is the "closing" shutter blade. Thus, blade 46 is retained in its cocked position against the bias of a spring 60 by the engagement of the detents 56 and 58. In their respective cocked positions, the "opening" shutter blade 44 is retained in a covering relationship with respect to the exposure aperture 25, and the "closing" shutter blade 46 is retained in an uncov-

ering position with respect to the exposure aperture. When the blades are in their respective cocked positions, the spring 48 urges the "opening" shutter blade 44 to an uncovering position with respect to the exposure aperture 25, and the spring 60 urges the "closing" shutter blade 46 to a covering position over the exposure aperture 25.

The "closing" shutter blade 46 also includes a second detent 66 having a cam surface adapted to engage a retaining lever 70 pivotally mounted on a pin 72 and biased by means of a spring 74 in a counterclockwise direction into engagement with the detent 66. The opposite end of retaining lever 70 is connected to an electromagnetic keeper 76 positioned adjacent a pole of an electromagnet 78 when the "closing" shutter blade 46 is in its cocked position. The electromagnet 78 is energized and de-energized by means of an electronic timing circuit described hereinafter with respect to Fig. 4. When the electromagnet 78 is energized it holds the retaining lever 70 in its retaining position shown in Fig. 1, to hold the "closing" shutter blade 46 in its uncovering position when the detents 56 and 58 become disengaged upon release of the "opening" shutter blade 44 for movement to its uncovering position, thereby initiating an exposure interval. Thereafter, when the electromagnet 78 is de-energized, the bias of spring 60 overpowers the bias of the weaker spring 74 to cause the detent 66 to cam the retaining lever 70 in a clockwise direction, thereby releasing the "closing" shutter blade 46 for movement to a covering position with respect to the exposure aperture and thereby terminate the exposure interval.

For actuation of the shutter mechanism 16 to effect an exposure, there is provided a shutter actuation button 80 mounted in an external position on the camera so as to be accessible to a camera operator. The shutter actuation button 80 is mechanically coupled by means of a coupling mechanism (not shown) to engage a detent 84 on latch member 50 so as to move the latter in a clockwise direction, when the shutter actuation button 80 is depressed. Initial movement of the shutter actuation button 80 causes a surface 86 thereon to engage a contact of a normally open switch S1, thereby causing the switch S1 to be closed. Continued movement of the shutter actuation button 80 causes engagement with the detent 84 and rotation of the latch member 50 in a clockwise direction out of engagement with the detent 53 on the "opening" shutter blade 44, thereby releasing the blade for movement under the influence of spring 48 to an uncovering position with respect to the exposure aperture 24 to thereby initiate an exposure interval. When the "opening" blade 44 moves away from its cocked position, it moves out of

engagement with one of the contacts of a normally closed switch S2, thereby causing switch S2 to open.

As shown in Fig. 1, the shutter mechanism is in its cocked position preparatory to actuation of the shutter mechanism to effect exposure by the operator. When the camera operator depresses the shutter actuation button 80, switch S1 closes energizing the exposure control circuit shown in Fig. 4, then latch 50 is rotated in a clockwise direction to release the "opening" shutter blade 44 for movement to its uncovering position with respect to the exposure aperture 25 to initiate an exposure interval and open the timing switch S2. When "opening" shutter blade 44 moves to its uncovering position, the detent 56 moves out of engagement with the detent 58 on the "closing" shutter blade 46. However, the electromagnet 78 is energized by the exposure control circuit when the switch S1 is closed, as described below, and retaining lever 70 is held in its retaining position by the electromagnet 78 to prevent the "closing" shutter blade 46 from moving away from its unblocking position. After a period of time determined by the circuit in response to the level of illumination detected by a photosensitive element in the circuit, the electromagnet 78 is de-energized to release the "closing" shutter blade 46 for movement to its blocking position to terminate the exposure interval. Following an exposure, the shutter blades can be returned to their cocked positions by movement of a cocking lever 62 to engage a detent 64 thereon with the detent 56 on the "opening" shutter blade to move the shutter blades back to their cocked position, shown in Fig. 1.

As described above when the shutter actuation button 80 is pressed, switch S1 is closed prior to the release of the opening shutter blade 44. Closure of the switch S1 energizes the circuit, shown in Fig. 4, from a potential source such as a battery 90. When the switch S1 is closed, a circuit is completed between the battery 90 and a trigger circuit 92, which may illustratively take the form of the well known "Schmitt Trigger". Because of the bias potential applied by the battery 90 to the trigger circuit 92, the trigger circuit 92 is energized from its first or non-conductive state to its second or conductive state. When the trigger circuit 92 is disposed in its conductive state, a current is caused to flow through a coil 94 associated with the electromagnet 78 thereby to retain the "closing" shutter blade 46 in its initial uncovering position after the "opening" shutter blade 44 has moved away from its initial position.

The trigger circuit 92 has an input terminal 96 which is connected to the common point between a capacitor 100, and the radia-

tion sensitive assembly 30 and in particular, a radiation sensitive element 98 whose impedance varies as a function of incident scene illumination. As will be explained later, the capacitor 100 and the radiation sensitive element 98 act as an integrating circuit to control the release of the "closing" shutter blade 46 to terminate the exposure interval. As shown in Fig. 4, the switch S2 serves to short circuit the capacitor 100 until the "opening" shutter blade 46 is released from its cocked position and to open the normally closed switch S2 to initiate the exposure interval. Thus, as the "opening" shutter blade 44 is released to permit scene illumination to be directed to the film F, the capacitor 100 is charged at a rate dependent upon the scene illumination directed through the variable aperture 29 on to the radiation sensitive element 98. The potential stored upon the capacitor 100 will increase to a threshold level to cause the trigger circuit 92 to be switched from its second or conductive state to its first or non-conductive state thereby de-energizing the electromagnet 78. As a result, the retaining lever 70 is no longer attracted by the electromagnet 78, and the bias of spring 60 is sufficient to move the closing shutter blade 46 covering position with respect to the exposure aperture 25 to terminate the exposure interval.

The radiation sensitive assembly 30 includes a second radiation sensitive element 102 having an impedance which varies as a function of incident scene illumination. As shown in Fig. 4, the radiation sensitive element 102 is connected to an input terminal 38 of an aperture control circuit 110. An example of a control circuit that can be used to control the aperture according to this invention is disclosed in Letters Patent No. 1139286. When switch S1 is closed, battery 90 applies a suitable biasing potential through input leads 40 and 42 to the aperture control circuit 110 to cause the aperture control circuit 110 to energize a pair of drive coils 112 and 114 of the transducer 36 as a function of an input signal applied to the input terminal from the radiation sensitive element 102. In one example of this invention, the aperture control circuit 110 may take the form of a differential amplifier which serves to vary the energizing current through the drive coils 112 and 114 to rotate the armature 35 in one direction or the other dependent upon whether a greater current is directed through drive coils 112 or 114.

As shown in Fig. 1, the electromechanical transducer 36 drives the armature 35 in either a clockwise or counter-clockwise direction respectively to decrease or increase the size of the apertures 25 and 28. As will be explained in detail later, the diaphragm blades 18 and 20 are initially set so that the

11 apertures 25 and 29 are set at their minimal size to minimize the effects of the memory of the radiation sensitive elements 98 and 102. When switch S2 is closed, the armature 5 35 of the electromechanical transducer 36 will normally be rotated by the drive coils 112 and 114 to increase the size of the exposure apertures 25 and 29 to an aperture size dependent upon the level of illumination directed through the variable apertures 10 29 on to the radiation sensitive element 102. As the size of variable aperture 29 increases, more radiation will be directed onto the radiation sensitive element 102 to decrease the resistance of impedance presented by this 15 element. As explained above, when switch S1 is closed, trigger circuit 92 is disposed in its conductive state to complete a circuit from the positive terminal of battery 90 through the radiation sensitive element 102, a variable resistance 106, the terminals 97 and 99 of the trigger circuit 92 to the negative terminal of the battery 90. A voltage divider will be formed by the radiation sensitive 20 element 102 and the variable impedance 106 across the battery 90 to provide a varying signal at the input lead 38 that is functionally related to the level of scene radiation upon the radiation sensitive element 102. As the resistance of the radiation sensitive 25 element 102 decreases, the potential applied to the input terminal increases until the applied potential is equal to a predetermined reference potential of the aperture control circuit 110. At this potential, a null condition is achieved and the circuit 110 applies 30 equal currents through the drive coils 112 and 114 so that substantially equal, counter-balanced forces are applied to the armature 35. Thus, the diaphragm blades 18 and 20 are driven to set the size of exposure aperture 25 as a function of the scene radiation. In this first mode of operation, the size of the exposure aperture 25 has been adjusted 40 for relatively high levels of scene radiation to provide proper exposure of the film F. The amount of light directed onto the radiation sensitive element 102 has also been adjusted to a substantially fixed quantum 45 dependent upon the intensity of this scene illumination as well as the size of the variable aperture 29; as a result, the resistance of the element 102 will be adjusted as the size of aperture 29 varies, to a predetermined value 50 related to the potential level at which the exposure aperture control circuit 110 achieves a null condition. Thus, for varying intensities of radiation within a predetermined first range, the diaphragm blades 18 and 20 will be driven to vary the size of the 55 apertures 25 and 29 so that a substantially constant amount of illumination will be directed on to the radiation sensitive element 102 and correspondingly, the impedance of the radiation sensitive element 102 will be 60

adjusted to a predetermined value. In a similar manner, the resistance presented by the radiation sensitive element 98 at null condition will be adjusted to a substantially constant, predetermined impedance for 65 varying intensities of radiation within the first range.

As shown in Fig. 4, there is provided a feedback coil 113 disposed to sense the flux generated by the drive coils 112 and 114 to provide a feedback signal to the differential amplifier 110 to retard the rate of change at which the drive coils 112 and 114 are driven, in response to changes of the impedance of the radiation sensitive element 102. 70

In the first mode of operation, the variable aperture 29 is opened from its minimal setting to an opening at which the size of exposure aperture 25 is adjusted for proper film exposure to thereby minimize the memory effect 75 of the radiation sensitive elements 98 and 102. The resistivity of radiation sensitive elements 98 and 102 vary as an inverse function of the level of incident radiation; after an initial exposure to a high level of radiation, the radiation sensitive elements 98 and 102 may not respond accurately to a decrease in the level of incident radiation and their resistivity may remain relatively low. As a result of this "memory" effect, the radiation 80 sensitive elements 98 and 102 are not able to respond accurately to lower levels of radiation once they have been exposed to high levels of radiation. Thus, to minimize the memory effect, the size of variable aperture 29 is increased from its minimal opening 85 until a null condition is reached.

In the operation of the shutter mechanism and the diaphragm mechanism shown in Fig. 1, the shutter actuation button 80 is depressed to first close switch S1 to thereby 90 adjust the size of the apertures 25 and 29 through the operation of the aperture control circuit 110 as explained above. In one illustrative embodiment of this invention, this operation will require approximately 40 milli seconds and will be substantially completed by the time the "opening" shutter blade 44 is released and the switch S2 is 95 opened to commence the exposure interval and the timing operation. Thus, in the first mode of operation when the exposure interval commences, the impedance of the radiation sensitive element 98 has been adjusted to a substantially predetermined value so 100 that the capacitor 100 will charge to the threshold level of the trigger circuit 92 within a substantially constant period of time. Thus, the exposure intervals for the first mode of operation will be a substantially constant 105 value. 110

It may be noted however, that the mechanism shown in Fig. 1 and the circuit shown in Fig. 4 will be mass produced, and the variations may occur within the manufactur- 115 120 125 130

ing tolerances of these devices so that the impedance of the radiation sensitive element 102 may not always be the exact same value, and the apertures 25 and 29 may not be adjusted to the correct exposure openings. Under these conditions, the integrating circuit including radiation sensitive element 98 and the capacitor 100 may serve to compensate for this variation by adjusting the exposure interval to a slightly different length of time thereby compensating for any slight error in the size of the exposure aperture 25.

The exposure control apparatus described above is adapted not only to operate in a first range of levels of scene radiation, but also to expose film to scene radiation of relatively lower intensities which would require longer exposure intervals. If the level of scene radiation is low enough, a supplementary light source or an extended exposure interval may be needed which would require firm camera support. The circuitry shown in Fig. 4 includes a suitable indicator means such as an indicator lamp 122 which operates, when the shutter actuation button 80 is initially pressed to close switch S1 to provide an indication that the scene illumination is too low to provide a normal exposure of the film and that either firm camera support or an additional light source must be used. The radiation sensitive element 102 is connected to an input terminal 116 of a trigger circuit 118 which serves to energize the indicator lamp 122. The trigger circuit 118 may illustratively take the form of the well known "Schmitt Trigger" and operates to provide a conductive path between its output terminal 120 and its terminal 119 in response to the application to its input terminal 116 of a potential signal below a predetermined threshold level. When the circuit path between the terminals 120 and 119 becomes nonconductive, the indicator lamp 122 is de-energized. As explained above, when switch S1 is closed, the trigger circuit 92 is actuated to provide a low conductive path between its terminals 97 and 99 thereby establishing a circuit from the positive terminal of the battery 90 through the radiation sensitive element 102, and the variable resistance 106 to the negative terminal of the battery 90. Thus, if the radiation directed onto the radiation sensitive element 102 is below a predetermined level, the impedance of the element 102 will be sufficient that the voltage applied to the input terminal 116 will fall below the threshold value of the trigger circuit 118 and a low conductive path is established between its terminals 120 and 119 to energize the indicator lamp 122. When indicator lamp 122 is energized, the operator is informed that there is insufficient illumination to provide a proper exposure without an additional source of radiation, such as a flash cube, or

that a tripod is needed for an extended or time exposure. If the operator chooses, he may place the camera on a tripod and continue to press the shutter actuation button 80 to initiate a time or extended exposure of the film F.

In the second mode of operation, the level of radiation is relatively low compared to the first range so that the impedance presented by the radiation sensitive element 102 will be correspondingly higher. As a result, the potential developed at the input lead 38 of the aperture control circuit 110 will not be sufficient to achieve a null condition and the circuit 110 will continue to energize the drive coils 112 and 114 to drive the diaphragm blades 18 and 20 to open the apertures 25 and 29 to their maximum settings. The openings of the apertures 25 and 29 will normally occur within the relatively short period of time before switch S2 is opened to initiate the timing process. In the second mode of operation, sufficient film exposure is not achieved at the maximum opening of the aperture 25 and the predetermined exposure interval used in the first mode of operation. In order to achieve proper film exposure, the exposure interval is extended for a period of time to achieve proper exposure with the aperture 25 set at its maximum opening. More specifically, when the switch S2 is opened, the capacitor 100 begins to charge at a rate determined by the impedance of the radiation sensitive element 98 which, as explained above, is dependent upon the scene radiation directed through the aperture 29 onto the radiation sensitive element 98. The capacitor 100 stores the charge until the threshold level of trigger circuit 92 has been reached at which time the trigger circuit 92 is disposed in its first or non-conductive state thereby de-energizing the coil 78 and releasing the closing shutter blade 46 to terminate the exposure interval.

As explained above, the indicator lamp 122 will be energized when the scene illumination is no longer sufficient to achieve proper film exposure without the aid of a tripod or an auxiliary source of light. The indicator lamp 122 is used to provide an indication of the end of the exposure interval. More specifically, when the trigger circuit 92 is disposed in its non-conductive state, the circuit through which the indicator lamp 122 is energized, is broken to de-energize the indicator lamp 122.

In the second mode of operation, the indicator lamp 122 will be energized to indicate that there is insufficient scene illumination to achieve proper film exposure. Instead of taking an extended or time exposure, it may be desired to use an auxiliary source of illumination such as a flash lamp 230 (see Fig. 3) which may be attached to the camera as by inserting into an assembly 226. In the

flash mode of operation, the illumination is primarily determined in many instances by the illumination provided by the flash lamp which radiates a substantially predetermined amount of light. Further, the exposure interval is fixed as will be explained later for a time period in excess of the useful duration (e.g. 30 milliseconds) of illumination from the flash lamp 230 so that film exposure is determined primarily by the focus distance between the camera apparatus and the object or scene to be photographed. In accordance with the teachings of this invention, a mechanism is provided for coupling the objective 10 to the mechanism for setting the size of the aperture 25 as a function of the focus distance. More specifically, the objective 10 is set for a particular focus distance as derived from a rangefinder or perhaps by estimation. As shown in Fig. 1, the objective 10 may be set at its correct focus distance by a focusing member 200 having an attached knob 202 which is disposed on the exterior of the camera to be manipulated by the operator. The focusing member 200 has a plurality of teeth 204 thereon which are disposed in engagement with teeth 11 on the objective 10; thus as the knob 202 is moved in a lateral direction, the objective 10 is rotated to adjust the focus thereof.

In the first mode of operation wherein no flashlamp is inserted within the assembly 226, the focusing member 200 is disassociated or decoupled from the exposure aperture setting mechanism. More specifically, the assembly 226 includes a finger 228 disposable in a first position as shown in Figs. 1 and 2 and in a second position as shown in Fig. 3. The insertion of a flash lamp 230 causes the finger 228 to assume the second or extended position in which it engages and rotates a flash mode lever 224 in a counterclockwise direction (as seen in Fig. 3). In the first mode of operation where no flash lamp 230 is inserted within the assembly 226, the flash mode lever 224 is biased by means of a spring 225 to a position wherein a tab 223 thereof engages a tab 219 integrally connected with a slide 214 to hold the slide 214 in the position shown in Figs. 1 and 2. The slide 214 includes a tab 217 which engages a pin 234 affixedly connected to a first lever 232. As shown in Fig. 1, the first lever 232 is pivotally mounted by means of a pin 236 upon a bracket 238 which is fixedly mounted on a portion of the camera housing. The first lever 232 has a second pin 235 extending therefrom to engage a second lever 242 which is pivotally mounted on a pin 244. In turn, the pin 244 is connected to the focusing member 200 in a manner to permit the second lever 242 to rotate thereabout. A spring 246 has one end connected to the focusing member 200 and the other end connected to the second lever 242 to

bias the lever 242 in a counter clockwise direction. As will be explained later, the first and second levers 232 and 242 may be moved under the influence of the slide 214 so as to limit the movement of the diaphragm mechanism 12. However, with the flash mode lever 224 retaining the slide 214, the first and second levers 232 and 242 are retained in their positions as shown in Figs. 1 and 2 and out of engagement with a pin 252 mounted on the blade 18 of the diaphragm mechanism 12. Further, the shutter actuation button 80 may be depressed without effecting the movement of the slide 214. More specifically, a spring 206 is disposed to urge a pin 208 into engagement with a tab 211 associated with control lever 210. The control lever 210 is pivotally mounted so that the tab 211 engages the pin 208 and a second tab 212 thereof engages a tab 216 affixed to the slide 214. Thus, when no flash lamp is inserted in the assembly 226, the shutter actuation button 80 may be depressed downwardly with the result that the pin 208 compresses the spring 206 without imparting motion to the control lever 210.

With regard to Fig. 3, the flashlamp 230 is inserted into the assembly 226 to cause the finger 228 to extend from its first position as shown in Fig. 2 to its second, extended position as shown in Fig. 3. In response thereto, the flash mode lever 224 is rotated in a counterclockwise direction as shown to the right is dependent upon the position the tab 219 of the slide 214. In the flash mode of operation, when the actuating button 80 is depressed, the pin 208 now serves to rotate the control lever 210 in a counterclockwise direction as shown in Fig. 3. In turn, the tab 212 of the control lever 210 engages the tab 216 of the slide 214 to impart a motion to the slide 214 to the lefthand side as shown in Fig. 3 against the bias of the spring 220. The spring 246 imparts a counterclockwise motion to the second lever 242 which engages the pin 235 of the first lever 232 and imparts a similar, counterclockwise motion to the first lever 232. Thus, the pin 234 of the first lever 232 is urged against the tab 217 of the slide 214 to follow the motion of the slide 214. As the first lever 232 rotates in a counterclockwise direction, under the influence of the spring 246, the pin 235 moves generally to the right as shown in Fig. 3 to allow the second lever 242 to engage the pin 252 mounted on the diaphragm blade 18 of the diaphragm mechanism 12 and move the diaphragm blade 18 to the right-hand side, as viewed in Fig. 3, until the second lever 242 comes to rest against a surface 250 of a cam member 248 fixedly mounted on the camera housing. Thus, the distance that the diaphragm blade 18 is urged

to the right is dependent upon the position of the pin 244 about which the lever 242 rotates; the position of the pin 244 is in turn directly related to the focus distance as set by the camera operator. The spring 246 exerts a sufficient force to direct the diaphragm blade 18 to the righthand side to set the position of the diaphragm blades 18 and 20 and also the size of the exposure aperture 25 as a function of the focal distance. As the diaphragm blade 18 is moved further to the righthand side, the exposure aperture 25 is made smaller, as shown in Fig. 2, and as the diaphragm blade 18 is moved to the lefthand side, as shown in Fig. 3, the exposure aperture 25 is made larger. As a result, the size of the exposure aperture 25 and thus the exposure of the film is made dependent upon the position of the focusing member 200 and in turn upon the focus distance, i.e. distance between the camera apparatus and the scene to be photographed.

With reference to Fig. 4, the diaphragm mechanism 12 is controlled by the excitation of the pair of drive coils 112 and 114 which serve to move the diaphragm blades 18 and 20 by the electromechanical transducer 36 as more specifically shown in Fig. 1. As explained above, scene illumination is directed through the variable aperture 29 on to the radiation sensitive element 102 and the impedance or resistivity of the element 102 is a function of the incident scene illumination to provide a signal to be applied to the differential amplifier 110 to energize drive coils 112 and 114. The apertures 25 and 29 are set initially at their minimum opening and the differential amplifier 110 normally serves to energize the electromechanical transducer 36 to increase the size of the apertures 25 and 29. As the variable aperture 20 continues to open, more scene illumination is directed on to the radiation sensitive element 102. The resistance and the signal developed across the element 102 will continue to vary until a null condition is achieved by the differential amplifier 110, thereby achieving a balance in the energization of the drive coils 112 and 114.

In the flash mode of operation, the incident scene illumination is normally insufficient to permit film exposure without the aid of an additional support or auxiliary light source. Thus, the resistivity of the radiation sensitive element 102 will be high and the differential amplifier 110 will continue to drive the electrochemical transducer 36 and thereby the diaphragm blades 18 and 20 to open the aperture 29 without reaching a null condition. Thus, the circuitry of Fig. 4 and the electrochemical transducer 36 serve as means for opening the exposure aperture 25 and to move the diaphragm blade 18 to the lefthand side as shown in Fig. 3 until pin 252 engages the second lever 242. As

explained above, the lever 242 under the influence of the spring 246 moves the diaphragm blade 18 to the righthand side as shown in Fig. 3 against the influence of the electromechanical transducer 36 to set the size of the exposure aperture 25 as a function of the focal distance.

With reference to Fig. 3, the insertion of the flash lamp 230 serves to release the slide 214 so that when it is moved to the lefthand side under the influence of the shutter actuation button 80, a switch 222 is closed. With reference to Fig. 4, the closed switch 222 connects a resistor 101 in parallel across the radiation sensitive element 98 and in circuit with capacitor 100. In the flash mode, the primary source of illumination is normally derived from the flash lamp 230 and the exposure interval must be adjusted primarily as a function of the useful portion of the duration of the flash lamp 230 (e.g. 30 milliseconds). The impedance of the resistor 101 is chosen to determine the exposure interval primarily as a function of the useful portion of the flash derived from the lamp 230. Thus, when a flashlamp 230 is inserted within the assembly 226, the exposure interval will be determined primarily by the resistor 101 and the size of the exposure aperture 25 will primarily be determined by the position of the focusing member 200 and thereby the focal distance. In an illustrative embodiment of this invention, a switch 222a coupled to the switch 222 to be opened by the movement of the slide 214 to the lefthand side, may be inserted in the circuit of Fig. 4. Thus, a high or infinite impedance is presented to the differential amplifier 110 to drive rapidly the electromechanical transducer 36 and thus the diaphragm mechanism 12 toward the maximum size of the exposure aperture 25. As a result, the differential amplifier 110 is unbalanced by the open switch 222a to a maximum degree to energize the electromechanical transducer 36. Under cold conditions when the diaphragm mechanism 12 may tend to move sluggishly, the electromechanical transducer 36 will be driven harder to ensure the desired movement of the blades 18 and 20.

WHAT WE CLAIM IS:—

1. A photographic camera comprising a shutter release, an adjustable diaphragm, lens focusing means, photosensitive means for producing a signal in response to received scene illumination, an electromechanical transducer for driving the diaphragm for setting an aperture dependant on said signal, a socket for connecting an auxiliary source of illumination and means coupled to the lens focusing means and responsive to the connection of an auxiliary source of illumination to the socket for controlling the setting to which the diaphragm is driven by the

to the right is dependent upon the position of the pin 244 about which the lever 242 rotates; the position of the pin 244 is in turn directly related to the focus distance as set by the camera operator. The spring 246 exerts a sufficient force to direct the diaphragm blade 18 to the righthand side to set the position of the diaphragm blades 18 and 20 and also the size of the exposure aperture 25 as a function of the focal distance. As the diaphragm blade 18 is moved further to the righthand side, the exposure aperture 25 is made smaller, as shown in Fig. 2, and as the diaphragm blade 18 is moved to the lefthand side, as shown in Fig. 3, the exposure aperture 25 is made larger. As a result, the size of the exposure aperture 25 and thus the exposure of the film is made dependent upon the position of the focusing member 200 and in turn upon the focus distance, i.e. distance between the camera apparatus and the scene to be photographed.

With reference to Fig. 4, the diaphragm mechanism 12 is controlled by the excitation of the pair of drive coils 112 and 114 which serve to move the diaphragm blades 18 and 20 by the electromechanical transducer 36 as more specifically shown in Fig. 1. As explained above, scene illumination is directed through the variable aperture 29 on to the radiation sensitive element 102 and the impedance or resistivity of the element 102 is a function of the incident scene illumination to provide a signal to be applied to the differential amplifier 110 to energize drive coils 112 and 114. The apertures 25 and 29 are set initially at their minimum opening and the differential amplifier 110 normally serves to energize the electromechanical transducer 36 to increase the size of the apertures 25 and 29. As the variable aperture 20 continues to open, more scene illumination is directed on to the radiation sensitive element 102. The resistance and the signal developed across the element 102 will continue to vary until a null condition is achieved by the differential amplifier 110, thereby achieving a balance in the energization of the drive coils 112 and 114. In the flash mode of operation, the incident scene illumination is normally insufficient to permit film exposure without the aid of an additional support or auxiliary light source. Thus, the resistivity of the radiation sensitive element 102 will be high and the differential amplifier 110 will continue to drive the electrochemical transducer 36 and thereby the diaphragm blades 18 and 20 to open the aperture 29 without reaching a null condition. Thus, the circuitry of Fig. 4 and the electrochemical transducer 36 serve as means for opening the exposure aperture 25 and to move the diaphragm blade 18 to the lefthand side as shown in Fig. 3 until pin 252 engages the second lever 242. As

explained above, the lever 242 under the influence of the spring 246 moves the diaphragm blade 18 to the righthand side as shown in Fig. 3 against the influence of the electromechanical transducer 36 to set the size of the exposure aperture 25 as a function of the focal distance.

With reference to Fig. 3, the insertion of the flash lamp 230 serves to release the slide 214 so that when it is moved to the lefthand side under the influence of the shutter actuation button 80, a switch 222 is closed. With reference to Fig. 4, the closed switch 222 connects a resistor 101 in parallel across the radiation sensitive element 98 and in circuit with capacitor 100. In the flash mode, the primary source of illumination is normally derived from the flash lamp 230 and the exposure interval must be adjusted primarily as a function of the useful portion of the duration of the flash lamp 230 (e.g. 30 milliseconds). The impedance of the resistor 101 is chosen to determine the exposure interval primarily as a function of the useful portion of the flash derived from the lamp 230. Thus, when a flashlamp 230 is inserted within the assembly 226, the exposure interval will be determined primarily by the resistor 101 and the size of the exposure aperture 25 will primarily be determined by the position of the focusing member 200 and thereby the focal distance. In an illustrative embodiment of this invention, a switch 222a coupled to the switch 222 to be opened by the movement of the slide 214 to the lefthand side, may be inserted in the circuit of Fig. 4. Thus, a high or infinite impedance is presented to the differential amplifier 110 to drive rapidly the electromechanical transducer 36 and thus the diaphragm mechanism 12 toward the maximum size of the exposure aperture 25. As a result, the differential amplifier 110 is unbalanced by the open switch 222a to a maximum degree to energize the electromechanical transducer 36. Under cold conditions when the diaphragm mechanism 12 may tend to move sluggishly, the electromechanical transducer 36 will be driven harder to ensure the desired movement of the blades 18 and 20.

WHAT WE CLAIM IS:—

1. A photographic camera comprising a shutter release, an adjustable diaphragm, lens focusing means, photosensitive means for producing a signal in response to received scene illumination, an electromechanical transducer for driving the diaphragm for setting an aperture dependant on said signal, a socket for connecting an auxiliary source of illumination and means coupled to the lens focusing means and responsive to the connection of an auxiliary source of illumination to the socket for controlling the setting to which the diaphragm is driven by the



transducer in accordance with the setting of the lens focusing means.

2. A photographic camera as claimed in Claim 1, wherein the means coupled to the lens focusing means on connection of an auxiliary source of illumination to the socket acts to limit movement of the diaphragm towards its maximum aperture.
3. A photographic camera as claimed in Claims 1 or 2, wherein connection of an

auxiliary source of illumination to the socket allows disconnection of the photosensitive means from the transducer on operation of the shutter release.

4. A photographic camera substantially as hereinbefore described, with reference to and as shown in the accompanying drawings.

L. A. TRANGMAR, B.Sc., C.P.A.
Agent for the Applicants.

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