

PATENT SPECIFICATION

(11)

1 326 487

DRAWINGS ATTACHED



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- (21) Application No. 38358/71 (22) Filed 16 Aug. 1971
(31) Convention Application No. 68 919 (32) Filed 2 Sept. 1970 in
(33) United States of America (US)
(44) Complete Specification published 15 Aug. 1973
(51) International Classification G03B 9/42
(52) Index at acceptance
G2A 14C3 14K 14X

(54) IMPROVEMENTS RELATING TO AUTOMATIC EXPOSURE CONTROL SYSTEMS

(71) We, POLAROID CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 730 Main Street, Cambridge, Massachusetts, 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:—

Automatic exposure control systems for photographic devices evaluate scene brightness with respect to film speed and regulate one or more exposure parameters, such as exposure interval or aperture size, so that the film automatically receives the correct amount of light for a wide range of scene brightness. Such systems generally compromise between achieving large depth of field by using relatively small apertures with long exposure times, and stopping subjects in motion with shorter exposure times but relatively large apertures.

One known system progressively varies the effective aperture from a minimum value toward a maximum value during an exposure interval. When sufficient light has passed through the continually varying aperture, the exposure is terminated either by a separate shutter blade or by the aperture defining blades of the mechanism rapidly reversing their movement.

In an automatic exposure control system for a single lens reflex camera there are additional problems due to the dual function of the camera lens. For example, the shutter and/or the aperture must be opened prior to an exposure interval to permit the photographer to view the subject before taking a photograph.

In accordance with the present invention an exposure control system for photographic apparatus comprises shutter means movable between an open position unblocking the passage of light through an exposure

aperture and a closed position blocking the passage of light through the aperture; non-electrical means for biasing the shutter means towards the open position; and electrical means energisable to drive the shutter means into the closed position against the bias of the said non-electrical means whereby, upon de-energisation of the electrical means, the shutter means reassumes its open condition.

In a preferred embodiment of the invention the non-electrical means comprises a spring and the electrical means comprises a solenoid having a plunger connected to an actuator pivotally coupled to each of a pair of shutter blades. With the solenoid de-energised, the spring retains the actuator in a terminal position in which the blades define a maximum opening across the exposure aperture. When the solenoid is energised the two blades are then drawn toward a second terminal position at which they block the exposure aperture. During an exposure sequence, a control circuit selectively energises the solenoid to initially hold the shutter blades in the blocking position, release them for movement toward the unblocking position to initiate an exposure, and subsequently return them to the blocking position to terminate the exposure. During the exposure interval, the blades therefore define a continually varying effective aperture, and the final energisation of the solenoid to return the blades to the blocking position at the end of the exposure is preferably responsive to the quantity of light transmitted through the effective aperture during the exposure interval.

In a single lens reflex camera embodying the invention, an exposure cycle commences with the solenoid energised so that the aperture is blocked and the camera may be converted from its viewing mode to its exposure mode. The solenoid is then de-energised to initiate an exposure, and after a

predetermined quantity of light has been transmitted through the continually varying effective aperture the exposure is terminated by again energising the solenoid. The energisation is sustained to retain the blades in a light blocking position until the camera is returned to its initial viewing mode. At this point the exposure plane of the camera is automatically covered and the control circuit is therefore able to de-energise the solenoid and allow the blades to open to their fullest extent.

The complete system therefore requires only two shutter blades coupled by an actuator which is itself connected to a solenoid and the shutter opening spring. Since the spring is not required to provide a snap-action only a very low tension spring need be fitted and the load on the solenoid is therefore correspondingly light.

One example of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a side view of a single lens reflex camera having portions broken away to reveal internal structure;

Figure 2 is a front view of the exposure mechanism of the camera of Figure 1 with portions broken away and shown in phantom to reveal the inter-relationship of its components;

Figure 3 is the front view of the exposure mechanism as shown in Figure 2, the components thereof being illustrated in a closed or light blocking orientation;

Figure 4 is a representation of traces from an oscilloscope illustrating the exposure performance of the exposure control system of the camera shown in Fig. 1; and

Figure 5 is a schematic block diagram of the control circuit for the exposure control system.

Referring to Figure 1, a photographic camera is illustrated generally at 10. Configured for single lens reflex operation, camera 10 operates in two modes, a focusing and viewing mode in which the image of a scene to be photographed is arranged and viewed by the operator at a viewing plane, and an exposure mode wherein the predetermined scene image is presented at an exposure plane for recordation upon a photosensitive material or film.

Camera 10 is formed having a forwardly disposed exposure control mechanism housing 12 within which are mounted the basic elements required to regulate an exposure. The components within housing 12 include an objective or taking lens 14, a certain element of which are mounted within a rotatable bezel 16. Bezel 16 is internally threaded and rotatably mounted over an externally threaded cylindrical lens mount 18 fixed, in turn, to a base plate 20. Bezel 16 is rotatable to provide translational

movement of elements of lens 14 along the axis 22 of the optical path of the camera. This rotation is carried out by manual rotation of an externally threaded focusing knob 24. Focusing knob 24 is interconnected in driving relationship with the externally exposed teeth of bezel 16 through an idler gear 26 (Figures 2 and 3). Immediately behind the lens 14 and camera aperture, the base plate 20 supports two shutter blade elements 30 and 32 which are described in detail later herein. Extending forwardly from one side of housing 12 is a shutter release button 34, the depression of which causes the commencement of an exposure cycle.

Additionally mounted within an exposure control mechanism housing 12 is a control circuit (not shown) as well as the film unit processing rolls 36 and 38 and their associated drive mechanism, one gear component of which is shown at 40.

Camera 10 is formed having a bottom support portion 44, a relatively elongated top wall section 46 which will be seen to support reflecting surfaces of a reflex optical system, and a shorter forward wall portion 48. Wall portion 48 serves to support a viewing arrangement shown generally at 50.

Bottom support portion 44 serves as a receiving and retaining chamber for a film laden cassette structure as illustrated generally at 54. Cassette 54 is formed as a generally thin parallelepiped having a top open portion, the rectangular periphery of which is defined by an integrally formed ridge 56. The forwardmost facing side of cassette 54 is formed incorporating an opening or slot 58 aligned with the line of tangency between rolls 36 and 38. Cassette 54 is removably insertable within the cassette receiving chamber of bottom support portion 44 so as to consistently and accurately orient within camera 10 an exposure plane 60 established at the lowermost periphery of the film frame opening defined by ridge 56.

Coincidentally situated at the exposure plane 60 is an uppermost one of a plurality of film units 62. Described in detail in a United States patent to E. H. Land, No. 3,415,646, entitled "Novel Photographic Products and Processes", film units as at 62 include all the materials necessary to produce a positive photographic print. Each unit 62 is physically structured to include a photosensitive element 64 positioned adjacent and in laminar relationship with an image-receiving element 66. Image-receiving element 66 is located upwardly from element 64 and is urged by spring means (not shown) into exposure plane 60. A rupturable container 68 of processing fluid is secured to one end of the laminar assembly of elements 64 and 66 and is located for-

wardly within cassette structure 54. Containers 68 dispense their processing fluid between elements 64 and 66 when subjected to appropriate compressive pressure. Each film unit as at 62 is adapted to be processed when advanced, rupturable container 68 foremost, through slot 58 and between pressure applying processing rolls 36 and 38. The latter manipulation causes container 68 to dispense its fluid contents between elements 64 and 66 and to spread the fluid between and in contact with these two elements. The image-forming process is now well-known in the art and involves the formation of transverse image-forming substances in the exposed photosensitive element 64 accompanied by their diffusion in a manner forming a visible, positive image.

The components of camera 10 normally assume a configuration for operation in a focusing or viewing mode. During an exposure cycle, however, the components reorient to assume an exposure mode configuration. Figure 1 of the drawings is arranged such that the components of the camera 10 are illustrated in solid line fashion in a focusing mode orientation, while their alternate orientation for an exposure mode are shown in dotted line fashion. In the focusing mode configuration, the aperture of the lens system 14 is unblocked by virtue of a normally open orientation at shutter blades 30 and 32 such that scene light may be directed along the optical path of the camera, an axis of which is shown at 22. This optical path 22 passes from the lens system 14 and across the exposure chamber of the camera until impinges upon and is reflected from a specular reflecting surface shown as a mirror 70. Mirror 70 is stationary and fixed to elongated top wall section 46. Upon reflection from mirror 70, the optical path courses to a viewing surface 72. Viewing surface 72 is reflective in nature and may be formed as an echelon or Fresnel Mirror with its incremental sections angularly oriented to redirect the image formed by the rays reflecting from mirror 70 toward the eyepiece lens 74 of viewing arrangement 50. From lens 74, the light reflecting from surface 72 passes through an Amici element or roof prism 76 mounted within an eyepiece housing 78. Housing 78 is attached to forward wall section 48 at a position suitable for viewing from a station as at 80. The presence of this roof prism 78 provides a right-left reversal correction for facilitating operator viewing from station 80.

When in a viewing or focusing mode, the camera 10 is focused by adjusting the taking lens from knob 24 while viewing the image projected to viewing surface 72 from viewing arrangement 50. While the viewing surface 72 serves the optical purpose of re-

directing the image from mirror 70 toward the viewing arrangement 50, the structure supporting it serves the additional function of blocking light from reaching the exposure plane 60. Looking to this structure, viewing surface 72 is shown to be mounted upon or formed as an integral component of an operator unit shown generally at 84. Formed of a material opaque to light, unit 84 is of a generally flat configuration and includes a peripherally disposed rib portion or frame, the cross-section of which is shown at 86. Frame 86 is rectangular in shape and dimensioned to nest over the rib 56 of film cassette 54. As a consequence of this configuration, the operator unit 84 serves to light seal or cap the exposure plane 60 at which a film unit 62 is positioned. Peripheral frame 86 is formed integrally with a supporting hinge arrangement, a portion of which is shown at 88. Hinge arrangement 88 is fixed to an axle 90 which, in turn, is journaled for rotation within the housing of a camera 10. A spur gear 92 is fixed to the axle 90 and is arranged thereon to be driven from a gear train including a drive gear 94. Immediately above axle 90 is a switch housing 96, the function of which is described later herein. Rotational force is imparted to the gear train including gears 92 and 94 from a battery powered electric motor shown generally at 98. Operator unit 84 is biased for upward pivotal movement about axle 90 by a spring 100. Spring 100 is slideably wound about axle 90 and has a movable end 102 embedded within hinge portion 88 and a stationary end 104 fixed to the inward side of top wall portion 46.

Operator unit 84 is retained in the focusing mode orientation against the bias of spring 100 by a solenoid latch 110. Latch 110 is fixed upon an internal structural component of the camera 10 housing as partially shown at 112 and is designed having a plunger element 114 which is biased outwardly when the solenoid 110 is in an unenergized state. When in its extended position, plunger 114 engages a latching tip 116 formed within the periphery of frame 86 to retain the operator unit 84 in its downward orientation.

Disposed upon the inward surface of forward wall portion 48 is a single bladed shutter assembly 120. Assembly 120 includes a shutter blade 122 pivotally mounted upon a post 124 and biased by a helical spring 126 into a position unblocking the passage of light into viewing arrangement 50. Blade 122 is also coupled with the plunger of a solenoid 128. When energized, solenoid 128 drives the blade 122 into a position blocking the passage of light through viewing arrangement 50.

When camera 10 is operating in its ex-

posure mode, solenoid 128 is energized and shutter blade 122 of assembly 120 is moved into the light blocking orientation as shown in phantom at 122'. Additionally, operator unit 84 is released from latching engagement with plunger 114 of solenoid latch 110. When so released, the unit 84 moves under the bias of spring 100 to a position abutting elongated top wall section 46 as shown in phantom at 84'. Operator unit 84 is configured having a specularly reflecting surface 130 formed on its inner face opposite surface 72. When moved into the exposure mode orientation shown at 84', specularly reflecting surface 130 assumes the orientation shown at 130' and, as a consequence, is introduced in operative position within the exposure chamber. Further, exposure plane 60 is uncovered to assume a position at the terminus of an altered optical path passing from lens system 14 and specular surface 130.

Operator unit 84 is held in the exposure mode orientation shown at 84' as a result of the bias exerted by spring 100. To return it to its focusing and viewing mode orientation, motor 98 is energized to cause the rotation of such drive train gears as at 92 and 94 which, in turn, cause the pivoting of the unit to its alternate position in engagement with solenoid latch 110. Additionally, a de-energization of solenoid 128 will permit blade 122 of shutter assembly 120 to return to a position unblocking the passage of light through viewing assembly 50.

A more detailed description of an operator unit as at 84 and shutter assembly as at 120 is provided in our co-pending application 26974/71 (serial No. 1,292,239).

From the foregoing it will be apparent that automatic operation of the camera 10 requires a shutter and aperture control which must accommodate to the somewhat involved mechanical logic involved in converting back and forth between a viewing or focusing mode and an exposure mode of operation. For instance, at the commencement of an exposure cycle, the shutter of the camera must be opened to provide the widest possible aperture and the operator unit 10 must be in its downward position blocking the passage of light to exposure plane 60. As shutter release button 34 is depressed, the shutter must be closed to block the passage of light along optical path 22 while the operator unit 84 rises under the force of spring 100 to its exposure mode orientation at 84'. The shutter must then again open to expose an uppermost film unit as at 62. This exposure is preferably carried out under predetermined program relating optimum exposure interval and aperture values with scene light level. Following an exposure interval, the shutter must be

held in its light blocking or closed position while the operator unit 84 is driven to its downward position blocking the passage of light into the exposure plane 60. When the operator unit 84 is in this light blocking focusing mode position the shutter must again be opened and establish maximum aperture. Additionally, throughout this sequence of events, the viewing arrangement as at 50 must be selectively blocked and unblocked by shutter 120 to preserve the light-tight integrity of the exposure chamber.

While performing under the logic criteria outlined above, any shutter or exposure control mechanism should be of a non-complex mechanical design suited for high volume production techniques.

Referring to Figures 2 and 3, the exposure mechanism is illustrated in closer detail. The mechanism is formed having two cooperatively moving shutter blades 30 and 32 which ride transversely within supporting tracks (not shown) formed within base plate 20. Each of the blades 30 and 32 is formed having a selectively shaped aperture opening, respectively depicted at 140 and 142. Depending upon the position of blades 30 and 32, aperture openings 140 and 142 symmetrically overlap over the exposure aperture 144 of the camera 10 to define selectively varying aperture sizes. Each of the blades 30 and 32 is additionally configured having selectively configured and corresponding photocell sweep openings shown respectively at 146 and 148. Openings 146 and 148 are configured in correspondence with the shapes respectively of aperture openings 140 and 142. The openings 146 and 148 move with mutual symmetry over a small aperture 150 providing for passage of light from the scene being photographed to a photosensing element or elements of a light sensitive control circuit.

Blades 30 and 32 define a progression of apertures over opening 144 as a result of their connection with a "walking beam" as shown at 152. Walking beam or actuator 152 is rotatably mounted upon a stud 154 extending from base plate 20. An "E" ring 156 secures the beam 152 upon stud 154. Elongate slots as at 158 and 160 are formed in the outward tip portions of beam 152 for the purpose of providing connection with pins 162 and 164 extending respectively from blades 30 and 32. Thus interconnected, the blades 30 and 32 will move simultaneously and in correspondence with each other to define a symmetrically configured variable aperture opening over the camera aperture 144 as well as over the photocell aperture 150. Elongate slots 158 and 160 serve the function of accommodating the horizontally restricted movement of blades

30 and 32 along a cord through the locus of rotation of the tips of beam 152. Beam 152 is biased to urge blades 30 and 32 into positions defining their largest openings over aperture 144 by a helical spring 166. The movable end of spring 166 is attached to beam 152 at an opening 168 while its stationary end is affixed to a tab 170 extending from the base plate 20. With this correction to spring 166, the exposure mechanism is biased into a "normally open" orientation.

Base plate 20 also supports a solenoid 172 in a position just above spring 166. Solenoid 172 is of conventional design, having an internally disposed cylinder plunger unit 174 which retracts inwardly into the body of the solenoid upon energization thereof. Plunger 174 is coupled to beam 152 through a dual pin linkage 176.

In its normal or relaxed condition, the exposure mechanism assumes the configuration of Figure 2 wherein blades 30 and 32 define a maximum opening over aperture 144 as well as over photocell aperture 150. In this condition, solenoid 172 is not energized and walking beam 152 holds the blades 30 and 32 in the position shown by virtue of the rotational bias exerted by helical spring 166. Energization of solenoid 172 will cause plunger 174 to rapidly withdraw into the body of solenoid 172 and, as a consequence, rotate walking beam 152 into the orientation illustrated in Figure 3. In this orientation, aperture opening 144 of the taking lens optical path is completely closed. A subsequent deenergization of solenoid 172 releases plunger 174 and allows walking beam 152 to rotate under the bias exerted by helical spring 166. This rotation permits openings 140 and 142 of respective shutter blades 30 and 32 to define progressively enlarging apertures as they move toward the terminal position shown in Figure 2. Simultaneously, openings 146 and 148 define a corresponding progressively enlarging aperture over the photocell opening at 150. When detection circuitry associated with the photocell located at opening 150 develops an appropriate exposure terminating signal, solenoid 172 will again be energized to retract plunger 174. A retraction of plunger 174 causes shutter blades 30 and 32 to reassume the closed positions shown in Figure 3. Following an interval required for a camera to reassume its viewing and focusing mode orientation, the solenoid 172 is deenergized to permit blades 30 and 32 to assume the maximum aperture position of Figure 2.

Because of the slight inertia and mechanical friction necessarily present in the operation of shutter blades 30 and 32 and their associated drive system, the time

interval required for their opening from the fully closed orientation of Figure 3 to the fully opened orientation of Figure 2 may correspond with the longest practical exposure interval for hand-supporting a camera, i.e. about 25 milliseconds. During this interval, blades 30 and 32 will define progressively enlarging aperture until they simultaneously reach their terminal positions to define an aperture opening of maximum diameter. Depending upon the level of scene brightness, this progressive aperture enlargement will be interrupted as the shutter is closed by the energization of solenoid 172. A desirable programming of aperture with exposure interval results from such an operation.

Referring to Figure 4, a series of curves representing an analysis of the operation of an exposure control system according to the invention is revealed. The instantaneous amplitudes of the curves represent light flux passing through the shutter mechanism of the invention during an interval of exposure. Each curve represents an oscillogram for a predetermined scene brightness level as appropriately labeled. In establishing the curves, a light sensing network was utilized in conjunction with an aperture sweep system as described earlier in connection with opening 150 and apertures 146 and 148 to control shutter closing solenoid energization.

It may be noted from the curves that while the area under each of the traces represents the integrated value of light flux passing through aperture opening 144 during an exposure, at high bright levels, for instance 1600 c/ft.², the interval of exposure is very short and, as a consequence, the effective aperture opening will be at a relatively high "f" number. These desirable selections of fastest available speed with aperture of smallest practical diameter are retained to the extent possible with diminishing levels of light. Consequently, the earlier discussed desired balance of aperture selection with exposure interval is optimized within the resultant exposure program. Of particular importance, however, this programming of exposure control is achieved with relative simplicity while providing for shutter operation within the logic requirements of a single lens reflex camera. In this regard, the following sequence of events are accommodated for during an exposure cycle by the solenoid actuated control mechanism.

(1) The shutter is in a normally open state establishing maximum aperture diameter under a de-energized condition. In this condition, exposure plane 60 is blocked by operator unit 84 and viewing arrangement 50 is open. Optimum viewing and focusing is available by virtue of the maxi-

maximum aperture diameter established by the shutter.

- (2) An exposure cycle is commenced with the depression of shutter release button 34. Through appropriate circuitry, solenoid 72 is energized to cause the shutter to close. When the shutter is closed operator unit 84 is released for rotation into its exposure mode orientation at 84' and the exposure plane 60 is opened to the optical path of the taking lens 14. Additionally during this conversion, the viewing arrangement 50 is blocked by shutter 120.

- (3) To commence an exposure, solenoid 172 is de-energized to release the blades 30 and 32 to open over a select interval in accordance with the earlier described predetermined exposure program.

- (4) Exposure interval is terminated with the re-energization of solenoid 172 and consequent closure of shutter blades 30 and 32. Blades 30 and 32 are held closed by a continued energization of solenoid 172.

- (5) Operator unit 84 is caused to re-assume its orientation blocking exposure plane 60 as a result of the energization of a motor as at 98.

- (6) As operator unit 84 covers exposure plane 60, viewing arrangement 50 opens with a de-energization of the shutter mechanism at 120 and solenoid 172 is de-energized to permit the shutter blades 30 and 32 to move under the bias of spring 166 to define a maximum aperture opening. The components of camera 10 have now re-assumed a focusing and viewing mode orientation.

- An electronic control system for use with the exposure mechanism and camera heretofore described is illustrated in connection with the schematic diagram of Figure 5. The mechanism of the invention does not require complex control circuits to provide adequate operation. For instance, simple switching actuated by movement of the operator unit 84 can provide many of the functions required in converting between focusing and exposure modes. A light sensing and exposure interval timing circuit may assume a variety of configurations, one such arrangement being disclosed in a United States Patent No. 3,362,309 entitled "Exposure Control Apparatus" by E. P. Cooper, Jr et al.

- Looking to Figure 5, power is supplied to the circuit from a battery or the like as indicated at 180. From power supply 180 power leads extend along lines 182 and 184. The system is energized from power supply 180 upon the momentary depression of a start button indicated at 186 in line 188. Start button 186 will be recognized as corresponding to shutter release button 34 in Figure 1. A momentary depression of button 186 energizes a latching network

190 which causes continual power to be supplied to the circuit until such time as an unlatching signal is received. Accordingly, upon the actuation of network 190, a mirror position (operator unit) control arrangement 192 is activated from along line 194. Such activation supplies an actuating signal along line 196 to an OR gate 198. OR gate 198 conducts this input to cause the energization of a shutter solenoid 200 from along line 202. Shutter solenoid 200 will be recognized as corresponding to solenoid 172 described earlier in connection with Figures 2 and 3. Solenoid 200 is interconnected with power supply lead 182 from along line 204. With the energization of solenoid 200, the shutter assumes a light blocking orientation such as illustrated in connection with Figure 3.

While the shutter solenoid 200 is held in an energized status to retain the shutter in a light blocking orientation, the mirror position function 192 will cause energization of solenoid 110 to release operator unit 84 for movement into its exposure mode orientation disclosed earlier in connection with Figure 1 at 84'. Additionally, solenoid 128 is energized to cause the closure of auxiliary shutter 120 at viewing arrangement 50. When operator unit 84 reaches its exposure mode orientation at 84' a switch or the like, for instance, as may be located at 96, is tripped to cause mirror position function 192 to actuate a timing circuit 206 from along line 208. This actuation, in turn, causes the actuation of a light sensing network as at 210 from along line 212 accompanied by the de-energization of shutter solenoid 200 from mirror position logic 192.

The shutter blades as disclosed at 30 and 32 now open in accordance with an exposure program logic while, aperture opening 146 and 148 defines simultaneous corresponding aperture openings across a photocell located behind opening 150. This mechanical arrangement is shown schematically in Figure 5 as a shutter 214 mechanically linked to shutter solenoid function 200 along dashed line 216 and a photocell sweep function 218 mechanically linked to shutter 214 along dashed line 220 and mechanically related to the light sensing network 210 from along dashed line 222. The photocell sweep function 218 mechanically inserts instantaneous aperture size or position information into the light sensing network 210.

Circuit input to timing circuit 206 is completed from power lead 182 through a line 224. When light sensing network 210 evolves an electrical value representing proper exposure, timing circuit 206 is appropriately actuated from along line 212 to cause the re-energization of shutter

solenoid 200 from along a line as at 226. Note that line 226 is coupled into OR gate 198. Timing circuit 206 retains shutter solenoid 200 in an energized state through OR gate 198 while simultaneously providing a signal along line 228 to a motor control circuit indicated at 230. Motor control circuit 230 functions to switch "on" a motor 232 from along line 254. Motor 232 will be recognized as corresponding to that shown and described at 98 in Figure 1.

With the energization of the motor function 232, the camera will be caused to cock or re-assumed a focusing mode orientation. This accomplished in Figure 1 by the driving of operator unit 84 into latching engagement with the plunger 114 of the now de-energized solenoid 110. The mechanical linkage between motor 232 and the mirror carrying operator unit 84 is indicated in Figure 5 by a dashed line 236 coupling a mirror drive 238. Information as to the proper positioning of mirror 238, as by switching or the like, is indicated by dashed line 240 which couples mirror drive 238 with mirror position function 192.

Motor 232 may also perform a film processing function as indicated schematically at 242. Mechanical coupling between the processing function, as partially shown to include rolls 36 and 38 in Figure 1, is indicated in Figure 5 by dashed line 244. While not shown in Figure 1, this linkage may be effected by belt drive or the like between motor 98 and drive mechanism components as shown at 40. Upon the completion of a last requisite mechanical function, any convenient detecting arrangement, for instance a switch associated with the drive system of rolls 36 and 38 may be used to de-energize latching network 190. This function is indicated by a line 246 coupling process function 242 with a latching network release 248, the latter being coupled with latching network 190 from along line 250. As latching network 190 is de-energized, all power to the circuit is interrupted and, as a consequence, all solenoids are de-energized to permit the camera 10 to assume its focusing viewing mode orientation.

From the foregoing it may be noted that a somewhat involved reflex logic is provided within the camera 10 while the components forming its exposure control system are of relatively simple construction and operation. This desirable simplicity is achieved through such features as the use of a solenoid drive and, in particular, the use of such an electromagnetic drive system to cause the shutter mechanism to assume a closed status.

WHAT WE CLAIM IS:—

1. An exposure control system for

photographic apparatus comprising: shutter means movable between an open position unblocking the passage of light through an exposure aperture and a closed position blocking of the passage of light through the aperture; non-electrical means for biasing the shutter means toward the open position; and electrical means energisable to drive the shutter means into the closed position against the bias of the said non-electrical means whereby, upon de-energisation of the electrical means, the shutter means re-assumes its open condition.

2. An exposure control system for photographic apparatus comprising shutter blade means resiliently biased toward a position unblocking the passage of scene light through an exposure aperture but movable toward a blocking position against the resilient bias in response to the energisation of an electromagnetic drive means, and a control circuit for successively energising, de-energising, and re-energising the electromagnetic drive means during an exposure sequence such that the shutter blade means are initially driven against the resilient bias into the blocking position, released for movement toward the unblocking position to initiate an exposure, and subsequently driven back to the blocking position to terminate the exposure.

3. An exposure control system according to claim 2 in which the shutter blade means progressively varies the effective exposure aperture when moved between the blocking and unblocking positions.

4. An exposure control system according to claim 3 in which the de-energising of the electro-magnetic drive means during an exposure sequence is responsive to the quantity of light transmitted through the effective exposure aperture as the shutter blade means moves toward the unblocking position.

5. An exposure control system according to any one of the claims 2 to 4 in which the blocking and unblocking positions are terminal positions of the shutter blade movement.

6. An exposure control system according to any one of the preceding claims 2 to 5 in which the control circuit includes a photosensitive element responsive to light transmitted through the exposure aperture.

7. An exposure control system according to any one of the preceding claims 2 to 6 in which the shutter blade means includes two co-operating shutter blades.

8. An exposure control system according to claim 7 in which the shutter blade means further includes an actuator pivotally coupled to each shutter blade.

9. An exposure control system according to claim 8 in which the electromagnetic drive means includes a solenoid having a



solenoid 200 from along a line as at 226. Note that line 226 is coupled into OR gate 198. Timing circuit 206 retains shutter solenoid 200 in an energized state through OR gate 198 while simultaneously providing a signal along line 228 to a motor control circuit indicated at 230. Motor control circuit 230 functions to switch "on" a motor 232 from along line 254. Motor 232 will be recognized as corresponding to that shown and described at 98 in Figure 1.

With the energization of the motor function 232, the camera will be caused to cock or re-assumed a focusing mode orientation. This accomplished in Figure 1 by the driving of operator unit 84 into latching engagement with the plunger 114 of the now de-energized solenoid 110. The mechanical linkage between motor 232 and the mirror carrying operator unit 84 is indicated in Figure 5 by a dashed line 236 coupling a mirror drive 238. Information as to the proper positioning of mirror 238, as by switching or the like, is indicated by dashed line 240 which couples mirror drive 238 with mirror position function 192.

Motor 232 may also perform a film processing function as indicated schematically at 242. Mechanical coupling between the processing function, as partially shown to include rolls 36 and 38 in Figure 1, is indicated in Figure 5 by dashed line 244. While not shown in Figure 1, this linkage may be effected by belt drive or the like between motor 98 and drive mechanism components as shown at 40. Upon the completion of a last requisite mechanical function, any convenient detecting arrangement, for instance a switch associated with the drive system of rolls 36 and 38 may be used to de-energize latching network 190. This function is indicated by a line 246 coupling process function 242 with a latching network release 248, the latter being coupled with latching network 190 from along line 250. As latching network 190 is de-energized, all power to the circuit is interrupted and, as a consequence, all solenoids are de-energized to permit the camera 10 to assume its focusing viewing mode orientation.

From the foregoing it may be noted that a somewhat involved reflex logic is provided within the camera 10 while the components forming its exposure control system are of relatively simple construction and operation. This desirable simplicity is achieved through such features as the use of a solenoid drive and, in particular, the use of such an electromagnetic drive system to cause the shutter mechanism to assume a closed status.

photographic apparatus comprising: shutter means movable between an open position unblocking the passage of light through an exposure aperture and a closed position blocking of the passage of light through the aperture; non-electrical means for biasing the shutter means toward the open position; and electrical means energisable to drive the shutter means into the closed position against the bias of the said non-electrical means whereby, upon de-energisation of the electrical means, the shutter means re-assumes its open condition.

2. An exposure control system for photographic apparatus comprising shutter blade means resiliently biased toward a position unblocking the passage of scene light through an exposure aperture but movable toward a blocking position against the resilient bias in response to the energisation of an electromagnetic drive means, and a control circuit for successively energising, de-energising, and re-energising the electromagnetic drive means during an exposure sequence such that the shutter blade means are initially driven against the resilient bias into the blocking position, released for movement toward the unblocking position to initiate an exposure, and subsequently driven back to the blocking position to terminate the exposure.

3. An exposure control system according to claim 2 in which the shutter blade means progressively varies the effective exposure aperture when moved between the blocking and unblocking positions.

4. An exposure control system according to claim 3 in which the de-energising of the electro-magnetic drive means during an exposure sequence is responsive to the quantity of light transmitted through the effective exposure aperture as the shutter blade means moves toward the unblocking position.

5. An exposure control system according to any one of the claims 2 to 4 in which the blocking and unblocking positions are terminal positions of the shutter blade movement.

6. An exposure control system according to any one of the preceding claims 2 to 5 in which the control circuit includes a photosensitive element responsive to light transmitted through the exposure aperture.

7. An exposure control system according to any one of the preceding claims 2 to 6 in which the shutter blade means includes two co-operating shutter blades.

8. An exposure control system according to claim 7 in which the shutter blade means further includes an actuator pivotally coupled to each shutter blade.

9. An exposure control system according to claim 8 in which the electromagnetic drive means includes an solenoid having a

WHAT WE CLAIM IS:—

1. An exposure control system for



plunger movable in response to the energisation of the solenoid and coupled with the said actuator.

- 5 10. A single lens reflex camera having a viewing mode in which the image of a scene may be viewed before and after an exposure, and an exposure mode for exposing a photosensitive material in the exposure plane of the camera, the camera including an exposure control system according to any one of the preceding claims 2 to 9 and further including reflex operator means for blocking the exposure of photosensitive material in the vicinity of the exposure plane following the return of the shutter blade means to the blocking position at the termination of an exposure.

- 15 11. A camera according to claim 9 in which the electro magnetic drive means is de-energised when the camera is in the viewing mode.

12. A camera according to claim 10 or claim 11 in which the reflex operator means is operative to unblock the passage of scene light to the exposure plane when the camera is converted to the exposure mode.

13. A camera according to any one of the claims 10 to 12 in which the electromagnetic drive means is energised to drive the shutter blade means to the blocking position when the camera is converted from the viewing mode into the exposure mode.

14. An exposure control system according to claim 1 substantially as herein described with reference to the accompanying drawings.

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