

## PATENT SPECIFICATION

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## (54) CAMERA

(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:—

The present invention relates to a camera which includes processing means for processing successive film units after they have been exposed at an exposure station, and, in particular, to a reflex camera.

One difficulty which arises when manufacturing such a camera is that of accommodating the mechanism for driving the processing means and for operating the reflex mirror within a compact housing.

In accordance with the present invention a photographic camera comprises a generally rectangular housing for supporting a stack of film units, means for exposing and processing successive film units to form visible images thereon, and a motor for driving the processing means, the motor and the processing means being positioned adjacent two opposite sides of the housing and the drive transmission between the motor and the processing means extending along a third side of the housing.

In a preferred embodiment of the invention the camera is foldable from an erected configuration to a compact parallelepiped configuration, the housing forming the base of the parallelepiped with narrow side and end walls, and the drive transmission means comprises a linear gear train extending along one of the narrow side walls and with the motor lying adjacent one of the narrow end walls. The gear train includes a first branch for rotatably driving the processing means and a second branch with a greater reduction ratio than the first branch for selectively moving the erecting mechanism against a spring bias into a cocked position.

The erecting mechanism is preferably

driven through a ram one end of which includes a cam follower spring biased against a cam attached to the output gear of the second branch of the gear train. In a single lens reflex camera the erecting mechanism erects the reflex mirror from its cocked viewing position into its terminal exposure position and the other end of the ram is connected through a crank assembly to a hinge extending from the erecting mechanism. Preferably the same spring which biases the erecting mechanism out of its cocked position also biases the cam follower against the cam via the crank assembly and the ram. In the initial position of the cam before an exposure is commenced the erecting mechanism is held in its cocked position against its spring bias by the crank assembly. At the commencement of a photographic exposure cycle the cam is rotated slightly and the follower moves from a high dwell portion to a juxtaposed sudden return portion of the cam. The resulting movement of the ram pivots the crank assembly about the hinge to a point at which the erecting mechanism is released from its cocked position for movement into its terminal position. After an exposure has been completed further rotation of the cam brings the ram back to its original position and the crank assembly urges the erecting mechanism against its spring bias back into its cocked position.

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

Figure 1 is a pictorial representation of a single-lens reflex camera in a compact folded configuration.

Figure 2 is a pictorial representation of the single-lens reflex camera of Figure 1 showing its erected shape with portions broken away to reveal internal structure.

Figure 3 is a top view of the body or housing portion of the camera of Figure 2 with portions broken away or removed to more clearly reveal the gear train and motor drive assembly thereof;

Figure 4 is a side elevational view of the

gear train of Figure 3 with portions removed to reveal internal structure;

Figure 5 is a rear fragmentary view of the motor and drive assembly of the camera of Figure 2 with portions broken away to more clearly reveal internal structure.;

Figure 6 is a sectional view of portions of the drive system of Figure 5 as taken through the plane 6—6 of Figure 5;

Figure 7 is an exploded perspective view of portions of the drive assembly of Figures 5 and 6;

Figure 8 is a side elevational view of the camera of Figure 2, similar to Figure 4 but showing the orientation of components during an intermediate stage of a photographic cycle;

Figure 9 is a side elevational view of the camera of Figure 2 showing the orientation of components of the kinetic drive and gear assembly during a post exposure interval operation;

Figure 10 is a displacement diagram of a cam as used in conjunction with the timing output stage of the drive assembly shown in Figures 2, 4, 8 and 9;

Figure 11 is a schematic representation of the dual power flow or branch circuits of the gear train of the camera of Figure 2;

Figure 12 is a chart showing the relative actuation times of important components of the camera of Figure 2 during a photographic cycle; and

Figure 13 is a circuit diagram illustrating a control system for use with the camera of Figure 2.

In the description to follow, the general structure of the camera is described initially (Figures 1 and 2) following which a photographic cycle carried out by the components thereof is outlined. To supplement the description of this photographic cycle, requirements of the control system of the camera are generally set forth. Next, the arrangement of the operating components of the camera permitting its compact, thin, foldable shape is described. Following the above, the spring loaded mounting of the reflex operator assembly of the camera is described in detail (Figures 5—7) to facilitate a following description of the gear train assembly of the camera and its attendant dual circuit torque multiplication separation feature (Figures 3, 4, 10 and 11). Next, the gear train and associated kinematic linkage providing for mechanical logic is detailed (Figures 4, 8 and 9). Following the above, a unique latching feature of the reflex operator assembly is described along with a phase switching operation carried out by the linkage. The interrelationship of all operating components of the camera is then described in detail in connection with a component activity chart based upon one revolution of a timing gear of the gear train (Figure 12). Finally, a control circuit suited for operation with the

mechanical features of the camera is described in connection with Figure 13.

### Camera — General Structure

Referring to Figure 1, an automatic camera is illustrated in a configuration wherein it is folded for purposes of being carried in the pocket of a garment. Camera 10 is formed having a very thin and compact configuration, substantially all of its bulk being contained within a rectangularly shaped base 12. In the folded configuration shown, the upper surface of the camera 10 includes a rear wall 14 which is hinged at 16 to one end of the base 12. Located in folded position next to rear wall 14 is a forward wall 18 hinged thereto at 20. Forward wall 18 is, in turn, pivotally connected to an exposure control housing 22 through a hinge 24. When camera 10 is folded, exposure control housing 22 nests inwardly within base 12. Supported above the walls 14 and 18 is a top cap 26 of a collapsible optical entrance assembly as is illustrated in Figure 2 at 28.

Referring additionally to Figure 2, the camera 10 is shown in its erected state. Thus erected, exposure control housing 22 is withdrawn from its nesting orientation within base 12 so as to position an optical objective or taking lens assembly 32 for making an exposure. A photocell entrance assembly 34 is also oriented in conjunction with the field of lens assembly 32. Exposure housing 22 additionally incorporates a release or start button 36 which is manually depressed to commence a photographic cycle. In the erected configuration shown, rear wall 14 is supported by erecting linkages as at 40 in a position angularly extending from base 12 at hinge 16. By virtue of the latter connections, forward wall 18 is angularly oriented between hinges 20 and 24 to form the upward surface of the erected camera. When so erected, these components combine to form an exposure chamber indicated generally at 42. The light-tight integrity of chamber 42 is provided by a flexible, opaque bellows, a fragment of which is shown at 44.

Base 12 is configured at the bottom of exposure chamber 42 to receive and support a disposable film retaining cassette structure, a portion of which is shown at 50. Cassette structure 50 is of rectangular configuration and retains a stacked array of discrete film units, the uppermost one of which is positioned as at 52, in coincidence with the exposure plane of the camera 10. Light access to the uppermost film unit 52 is made through a rectangular opening or film frame formed within the cassette as at 54. To position the film cassette 50 properly within the base 12, frame members as at 56 are formed therewithin which communicate with the upstanding ridge of the film frame 54. Cassette 50 also contains a flat battery power

supply in its lowermost portion which communicates with terminals (not shown) in the base 12. Additionally, the forwardmost peripheral side of the cassette 50 is formed having an egress opening or slot at 58 through which the uppermost film unit 52 automatically is removed for processing following its exposure.

Film units as at 52 include all the materials necessary to produce positive photographic prints. In this regard, one feature of the units 52 resides in the provision of a rupturable container of processing fluid secured to the photosensitive composite in a position such that it is located near to slot 58. When the unit 52 is drawn through slot 58 and between pressure applying rolls 120 and 122, the container selectively ruptures and uniformly dispenses a processing fluid therewithin. Image-forming results from this processing procedure. The developing process is now well known in the art and involves the formation of transverse image-forming substances in an exposed photosensitive element of the unit accompanied by their diffusion in a manner forming a visible positive image. The processing fluid within each unit 52 includes an opacifying agent which is spread as a layer to provide a background for the photosensitive transfer image evolved during development. As may be apparent, such film units require a processing technique ensuring a properly regulated, smooth or continuous spreading of fluid to assure a uniformly developed image.

In the orientation shown in Figure 2, the components of the camera 10 provide for its operation in a viewing mode in which framing and focusing are carried out by the operator. In this configuration, a reflex operator assembly, shown generally at 60, is retained in a spring loaded or cocked orientation over the film frame 54, blocking the passage of light therethrough. Operator assembly 60 is configured on one side (uppermost in Figure 2) to support a viewing surface 62 which faces into the exposure chamber 42 when in a viewing operational mode. Assembly 60 supports a mirror or similarly specularly reflecting surface 64 upon its somewhat flat surface opposite viewing surface 62. The operator assembly 60 is coupled to the rear of base 12 through hinge extensions 68 and 70 positioned at each side of the rearward edge thereof. Turning momentarily to Figure 5, these hinge extensions are seen to be journaled for rotation, respectively, about shafts 72 and 74. Shafts 72 and 74 are supported, respectively, from dual extensions 76 and 78 of the frame of base 12.

When in the viewing operational mode shown, camera 10 establishes an optical path extending from taking or objective lens system 32 within exposure housing 22 to a mirror or specularly reflecting surface (not shown) fixed within the exposure chamber 42 to the

inward side of rear wall 14, thence to the viewing surface 62 upwardly facing from operator assembly 60. Viewing surface 62 is configured having a texture and optical design facilitating the focusing of the image of the scene to be photographed. This image may be viewed by the camera operator through optical entrance assembly 28.

During a viewing mode of operation, the exposure control system of the camera 10 provides for an open shutter condition with widest available aperture. This is achieved within the control program through the use of a dual bladed shutter shown generally at 90. Shutter 90 is structured having two mutually coacting blades 92 and 94 which reciprocally move by virtue of their coupling with a reciprocating beam 96. Blade 92 is coupled to one end of beam 96 at a pin and slot union 98, while blade 94 is coupled through a pin and slot union 100 at an opposite tip thereof. Blades 92 and 94 are formed having selectively tapered aperture openings which combine to define progressively varying apertures 102 as the beam 96 is rotated about its center point. An aperture 102 of the maximum dimension defined by the blades 92 and 94 is illustrated in Figure 2. The size of the aperture at 102 will vary in dependence upon light levels and related exposure parameters during an exposure interval. Blades 92 and 94, respectively, additionally incorporate secondary tapered aperture openings 104 and 106 which overlap and mutually co-act to define progressive apertures over a photocell or the like positioned behind entrance assembly 34. With such an arrangement, an input corresponding both to scene brightness and to the instant size of the aperture as at 102 may be supplied to a photosensing control network.

#### *Photographic Cycle — In General*

Aperture opening 102 is normally retained in its fully open condition by virtue of tension exerted by a spring 108 connected between beam 96 and the exposure control housing 22. Uppermost film unit 52 is isolated from light directed into the exposure chamber 42 during viewing and focusing procedures by operator assembly 60. Formed of materials opaque to light, the operator assembly 60 is dimensioned to be capable of covering film frame opening 54 in light sealing fashion.

The initial portion of a photographic cycle of camera 10 includes operational steps which convert the camera from the viewing operational mode shown in Figure 2 to an exposure operational mode. Conversion is carried out by closing shutter 90 and pivotally moving operator assembly 60 to a position resting against the inward side of housing rear wall 14. This uncovers the exposure plane at 52 and establishes an altered optical path extending from lens system 32 to reflective

surface 64 on the inward side of operator assembly 60, thence to the exposure plane at 52. Closing motion is imparted to blades 92 and 94 of shutter 90 from a solenoid 110 supported within the housing 22. Solenoid 110 is formed having a centrally disposed plunger 112, the comb-shaped end of which is pivotally attached in eccentric fashion to reciprocating beam 96. As the winding of solenoid 110 is energized, plunger 112 is retracted to rotate beam 96 and cause the shutter blades 92 and 94 to close the aperture at 102.

When operator assembly 60 has reached its fully erect position, an exposure interval is commenced by de-energizing the winding of the solenoid 110. With this de-energization, shutter blades 92 and 94 are permitted to slideably move in mutual correspondence under the drive of spring 108 to define a gradually increasing aperture opening at 102. Simultaneously, the subsidiary openings 104 and 106 of the shutter 90 admit a correspondingly increasing amount of light into the photo-sensing network of the control system of the camera. When an appropriate amount of light has been admitted for exposure of a film unit 52, the winding of solenoid 110 is again energized to terminate an exposure by withdrawing plunger 112 to rotate reciprocating beam 96 against the bias of spring 108.

As the photographic cycle continues, following each exposure interval, exposure chamber 42 is secured by maintaining the winding of solenoid 110 in an energized state for an interval of sufficient length to permit the camera 10 to reassume its viewing mode orientation.

In addition to mode reconversion following an exposure interval, the camera 10 automatically processes an exposed film unit 52. In a preferred arrangement, this processing is carried out by automatically moving uppermost exposed film unit 52 through slot 58 and into engagement with the driven processing rolls 120 and 122 of a processing station indicated generally at 124. A pick mechanism (not shown) is utilized to impart the initial movement introducing film unit 52 between rolls 120 and 122.

#### *Control System Requirements — In General*

The number of process control steps performed by the mechanism of camera 10 to achieve fully automatic operation is somewhat significant. For instance, following viewing and focusing with the camera 10 in its viewing mode orientation, a photographic cycle is commenced with the depression of start button 36. This causes the shutter assembly 90 to close and secure the exposure chamber 42. Following an appropriate interval required to close the shutter 90, operator assembly 60 is moved to its erect, exposure mode orienta-

tion. When operator assembly 60 is so erected, shutter 90 regulates an exposure interval, following which shutter 90 is closed and retained in a closed position while the operator assembly 60 is returned to its cocked, viewing mode orientation. Simultaneously with the movement of operator assembly 60 into the latter position, the exposed film unit 52 is moved through processing station 124. As operator assembly 60 reaches its downward cocked position, shutter 90 is opened to its fullest extent and the entire control system is automatically shut down. Because of the programmed delays for securing exposure chamber 42 and for providing appropriate conversion between viewing and exposure orientations of operator assembly 60, the control system of the camera requires a physical monitoring of process steps as they occur as well as a powering capacity for physically carrying out all of the operations. Further, all of the above processing operations and their related control elements must be confined within a camera structure which can be folded to the thin, compact shape shown in Figure 1.

#### *Drive System — Geometry*

The thin, compact shape of the camera is achieved by positioning the processing rolls 120 and 122 along the forward edge of cassette 50 with a motor 130 for driving the rolls positioned along the opposite edge of the cassette next to the hinged connection of operator assembly 60. A gear train 126 extending along a third side of the cassette transmits the drive from the motor to the processing rolls.

Operator assembly 60 is spring driven from its viewing mode orientation into its exposure mode orientation but is cocked by a drive system powered from the motor 130.

#### *Reflex Operator Assembly Mounting and Drive*

Referring to Figs. 3 and 5, motorized drive components for powering gear train 126 are revealed in detail along with the spring-driven mounting of operator assembly 60. Motive power is derived from the electric motor 130 attached to the rear portion of frame 12 adjacent the rear edge of cassette 50. The output shaft 132 of motor 130 is connected to the first drive pinion 134 of gear train 126 through a supporting arrangement including a spring-type slip clutch 136. Spring clutch 136 is frictionally attached between output shaft 132 of motor 130 and the drive shaft 138 of pinion 134. Fixed to pinion 134, shaft 138 is rotatably supported within a bushing 140 fixed to an inner portion 144 of frame 12. An E-ring 142 is connected to shaft 138 within an appropriate groove formed in the circumference thereof. Spring clutch 136 is configured such that it will

tend to unwind and release from frictional engagement between shaft 132 and shaft 138 should the load from gear train 126 exceed a predetermined limit. The incorporation of

5 this form of clutch additionally facilitates the assembly of the entire drive unit.

Operator assembly 60 is driven between both of its operational positions by a four-bar linkage assembly depicted generally at 10 145. The constituent components of this four-bar linkage 145 commence with the pivotal coupling at shaft 72 of hinge extension 68 of the operator assembly 60. Hinge extension 68 is configured having a second bore retaining another shaft 146 spaced forwardly from shaft 72. Extension 68 additionally is formed having an access slot 148 within which pivotal connection between shaft 146 and a draw-down link 151 is effected. Draw-down link 20 150 is pivotally connected through a shaft 152 to the tip of dual arm portions 154 of a bell crank shown generally at 156. Forming the final component of the four-bar linkage 145, hub portion 158 of bell crank 156 is rotatably mounted upon the necked or stepped-down portion 160 of a cylindrical shaft 162. Portion 160 of shaft 162 is rotatably supported within a bushing 164 fixed, in turn, to an extension 166 of camera frame 12. 25 An E-ring 170 restrains shaft 162 from lateral movement within its mountings. The opposite end of shaft 162 is rotatably supported with a bushing 168. Bushing 168 is retained within portion 144 of frame 12.

35 Referring additionally to Figure 6, the operation of the bell crank assembly in driving operator assembly 60 into its exposure mode orientation and retaining the assembly 60 in its viewing mode orientation is more clearly revealed. For instance, operator assembly 60 is retained in its viewing mode orientation by virtue of the outward orientation of the dual arms 154 of bell crank 156. Operator assembly 60 is driven to its exposure mode orientation, as shown partially and in phantom at 60', by a driving force exerted from bell crank 156 through the linkage 145. The resultant orientations of bell crank 156 and draw-down link 150, respectively, are shown in phantom at 156' and 150'. As may be evidenced from the drawings, operator assembly 60 is driven into its exposure mode orientation as well as returned to its viewing mode orientation by forces exerted from bell crank 156 through draw-down link 150. 55

Operator assembly 60 is driven from bell crank 156 into its exposure mode orientation by force derived from a low-rate multi-turn torsion spring 172. A stationary end 174 of spring 172 is fixed or grounded to frame portion 144, while its opposite end 176 is configured to abut against a tang or extension 178 of a cylindrically-shaped sleeve 180. 60

65 Referring additionally to Figure 7, sleeve

180 is generally configured as a hollow right cylinder having a thickened end portion 184 (Figure 5), the internal surface of which is bored to fit over the stepped-up diametral portion 186 of shaft 162. Sleeve 180 is fixed to and co-rotatable with shaft 162 as a result of its connection thereto by pin 188. Beyond thickened portion 184, sleeve 180 is formed having a diameter suited to provide for its slideable coupling over hub 158 of bell crank 156. This same portion of sleeve 180 additionally is cut away to provide top and bottom abutting or key surfaces shown, respectively, at 190 and 192. When assembled in conjunction with bell crank 156, surface 192 of sleeve 180 will selectively abut against dual arm portions 154 of bell crank 156. During normal operation of the assembly, when spring 172 is loaded or wound, its movable end 176 abuts against tang 178 of sleeve 180, thereby urging it to rotate in a counterclockwise direction as viewed in Figure 6. Thus spring loaded, surface 192 of sleeve 180 is capable of exerting spring derived rotational force against arm portion 154 of bell crank 156 biasing the latter to move correspondingly. Accordingly, when shaft 162 is free to rotate, operator assembly 60 is driven by spring 172 into its viewing mode orientation. 70 75 80 85 90 95

Mounted coaxially with spring 172 over the central portion of shaft 162 is a spiral override spring 191. Located within the interior of sleeve 180, one end of 194 of spring 191 is connected within the thickened portion 184 of sleeve 180. The opposite tip 196 of spring 191 is connected to bell crank 156 by insertion within a slot 198 formed in hub portion 158. Spring 191 is selectively prewound and has a strength sufficient to urge the bell crank toward positioning contact surface 192 of sleeve 180. 100 105

With the arrangement thus described, when shaft 162 is rotated, rotational force will be transmitted through both the override spring 191 and sleeve 180 into bell crank 156. Rotation of sleeve 180 from shaft 162 also winds spring 172 from tang 178. As the united sleeve 180 and bell crank 156 are rotated, operator assembly 60 is repositioned by the four-bar linkage 145 into its viewing mode orientation adjacent the exposure plane at 52. Spring 191 provides a lost-motion or override function permitting the motor 130 to operate for a select interval following the seating of operator assembly 60 within its viewing mode position. This feature eliminates a need for close manufacturing tolerances of the control system and, additionally, provides a safety override should the operator assembly 60 be jammed during conversion from its exposure mode position. In the latter regard, it may be noted that the cutaway portion of sleeve 180 does not fully capture the extensions 154 of bell crank 156. As seen in Figure 110 115 120 125 130

6, a spacing allowing about 45° of relative rotation is provided between surface 190 of sleeve 180 and arm portion 154 of bell crank 156.

- 5 Rotational force is imparted to shaft 162 through its connection with a drive bell crank 204 mounted upon shaft 162 outwardly from bushing 168. Bell crank 204 is fixed to portion 186 of shaft 162 by a pin 206 extending  
10 therethrough. Configured having an upwardly extending arm portion 208, the tip portion of bell crank 204 is bored at 210 to provide a pivotal connection with the pin 212 of a kinematic linkage with which it is associated.

### 15 *The Gear Train — Torque Multiplication Separation*

- The thinness and compactness of the camera 10 is basically realized by the design feature of positioning processing station 124 along the forward edge of cassette 50; mounting motor 130 and spring drive for operator assembly 60 along the opposite parallel edge of cassette 50 and by incorporating thin gear train 126 with an associated kinematic linkage along a third edge thereof. Gear train 126 operates processing station 124 under critical rotational speed criteria, while its associated kinematic linkage develops cycle phase timing and requisite power outputs which are re-directed toward the rear of the camera for the purpose, inter alia, of selectively manipulating operator assembly 60.

- Referring to Figures 3, 4 and 11, gear train 126 and its associated kinematic linkage are revealed in more detail. Gear train 126 consists of two power flow circuits, one leading to processing station 124 and the other leading to an intermediate output stage for developing rearwardly directed control motion. Looking to Figure 11, the first power flow circuit, extending from input or first drive pinion 134 to the processing station 124, is illustrated schematically. This power flow circuit must meet the critical requirement of

providing smooth and continuous power flow into the driven roll 122 of processing station 124. Further, the nominal speed of rotation of roll 122 must fall within acceptable limitations in order to provide proper spreading of processing fluids within a film unit as at 52. The first circuit includes input gear 134, two reduction gears as at 220 and 222, five idler gears 224—232 and an output gear 234 coupled with roll 122 of processing station 124. As is evident from the drawings, gears 220, 222 and 226 are of a dual component variety to provide a requisite torque-multiplication factor within the compound gearing circuit.

The second power flow circuit of gear train 126 consists of input gear 134, three reduction gears 220, 222 and 226 and two idler gears 224 and 236.

The gear components within gear train 126 have maximum diameters somewhat corresponding with the height of base 12 of the camera and are mounted between one side 244 of an inner frame of the camera and an outer plate 246 extending along the length thereof. Plate 246 is mounted upon inner frame 244 by stand-off elements which are not illustrated in the interest of clarity. Inner frame 244 additionally serve as the mounting for roll 122 of processing station 124.

The dual power flow gear circuit arrangement permits gear train 126 to perform a variety of power and manipulative functions during a photographic cycle, while assuring a smooth and continuous rotational drive input to roll 122 of processing station 124. This continuous power input to processing station 124 is developed by configuring the second power flow circuit to have a reduction ratio or torque multiplication factor which is substantially higher than that of the first power flow circuit. Following is a tabulation showing exemplary gear design data establishing a torque multiplication factor separation for the two power flow circuits.

Gear Circuit Torque Multiplication Factor (T.M.F.)

| First Circuit  |            |            |            |            | T.M.F.  |
|----------------|------------|------------|------------|------------|---------|
| Gears Meshing  | 220<br>134 | 222<br>220 | 224<br>222 | 234<br>232 | =21.7/1 |
| Tooth Ratio    | 50/12      | 50/16      | 50/12      | 20/50      |         |
| Second Circuit |            |            |            |            |         |
| Gears Meshing  | 220<br>134 | 222<br>220 | 224<br>222 | 238<br>226 | =217/1  |
| Tooth Ratio    | 50/12      | 50/16      | 50/12      | 48/12      |         |

With the above described separation of torque multiplication factors between the two circuits of the gear train 126, motorized activities required for moving operator assembly 60 and performing other functions will have a dismissable effect upon the requisite uniformity of the rotational drive into output gear 234. In this regard, it may be noted from the above exemplary tabulation that the torque multiplication factor (T.M.F.) for the first and second gear train 126 circuits are separated by an order of magnitude.

#### *The Gear Train — Second Circuit and Kinematic Linkage*

Referring to Figure 4, the output torque developed from the second power flow circuit at timing gear 238 is returned or transmitted back to shaft 162 by a kinematic linkage including an elongate ram 250 operating between and in conjunction with a radial or disc cam 252 and the arm portion 208 of drive bell crank 204. Cam 252 is fixed to and co-rotatable with timing gear 238. A radial cam follower 254, fixed to the inward side of ram 250, provides selective follower contact with the profile of cam 252. Appropriate radially directed contact between follower 254 and the profile of cam 252 is provided by a slideable connection between an elongate slot 256 formed within the forward portion of ram 250 and the axle 258 of timing gear 238. The opposite end of ram 250 is pivotally connected through pin 212 to the arm portion 208 of drive bell crank 204. As a result of the latter connection, a positive drive condition is available between follower 254 and the profile of cam 252. This positive drive results from a bias exerted from drive spring 172 through bell crank 156 and shaft 162 into drive bell crank 204. Spring 172 continuously biases ram 250 to urge follower 254 toward the profile of cam 252. Simultaneously spring 172 exerts a bias through the earlier described four-bar linkage 145 for moving operator assembly 60 into its erect exposure mode orientation.

The second power flow circuit of gear train 126 is designed to drive timing gear 238 at a rate providing for its rotation only through 360° during a photographic cycle. As a result of this correspondence of period of rotation of the gear 238 with the duration of a photographic cycle, the kinematic linkage including ram 250 is capable of performing several regulatory functions. For instance, selective switching which provides for monitoring the program of a photographic cycle. To derive this regulation, the profile of cam 252 is selectively configured.

Referring to Figure 10, a displacement diagram showing the action of cam 252 during the 360° of revolution of timing gear 238 is revealed. In the diagram, the zero and 360° positions represent the orientation of

timing gear 238 as well as cam 252 at the commencement or end of any given photographic cycle. The diagram reveals that cam 252 incorporates an initial, high dwell portion 260 extending through about the first 10° of cam rotation. Juxtaposed to high dwell portion 260 is a sudden return portion 261 which drops off immediately following high dwell portion 260 and continues as a low dwell 262 from 10° to 90°. Preferably, contact is not made between follower 254 and cam 252 during this low dwell interval.

Intermediate high dwell portion 260 and low dwell portion 262, the cam profile incorporates a rising profile 264. Referring additionally to Figure 4, the orientation of ram 250 and cam 252 when operator assembly 60 is in its viewing mode orientation is revealed. In this orientation, arm portion 208 of drive bell crank 204 is held in its maximum rearward position. When bell crank 204 is so positioned, bell crank 156 of the four-bar linkage 145, in turn, is retained in the solid line position shown in Figure 6 as a result of its connection with shaft 162 through override spring 191. The downward position of bell crank 156 holds operator assembly 60 in its spring loaded, viewing mode orientation by virtue of its connection with bell crank 156 through draw-down link 150. Cam 252 and ram 250 serve to selectively latch the operator assembly 60 at its downward position. For instance, at the commencement of a photographic cycle, motor 130 is briefly energized to cause rotation of timing gear 238 through about 10°. As the sudden return portion 262 of the cam 252 is reached, ram 250 is released for translational movement under the drive spring 172 bias exerted through drive bell crank 204. Simultaneously, bell crank 156 of the four-bar linkage 145 is driven upwardly to rapidly raise the operator assembly 60 to its erect exposure mode orientation. Motor 130 is de-energized as the operator assembly 60 approaches its terminal position. The resultant orientation of cam 252, ram 250, the four-bar linkage 145 as well as operator assembly 60 is shown in Figure 8. To assure that no dynamic impact of such nature as to introduce unwanted vibration into the camera 10 is present during the above described unlatching operation, the sudden return portion of the profile of cam 252 is "softened" as indicated at 261 in Figure 10. This softening is provided by slightly rounding the contour of the cam at the point of fall-off. The latching and release operation carried out by cam 252 and ram 250 results in an important elimination of electromechanical latches and the like from the structure of the camera. In particular, such latches or the like necessarily would be mounted along the top surface of the camera frame. As such, they would contribute to an unwanted thickening of the housing at

base 12. With the present arrangement, the latching step is carried out by multi-function components mounted along the side and back of the base 12.

- 5 Figure 8 also reveals the presence of a small gap between the contact surface of follower 254 and the low dwell portion 262 of the profile of cam 252. This gap assures that ram 250 will be capable of travelling a distance sufficient to permit operator assembly 60 to fully rise to its exposure mode position against back wall 14.

#### Kinematic Linkage — Phase Switching

- 15 To provide a necessary correlation between mechanical events occurring during a photographic cycle and an electrical control network operating in conjunction with the mechanism thus far described, ram 250, operating in response to the single cycle of rotation of cam 252, provides a position responsive switch actuating function. In the embodiment described herein, such switching is used in a cycle phasing manner to provide for initial de-energization of motor 130 as well as system shut-down at the end of a photographic cycle.

- 20 Returning to Figure 4, an embodiment of such a cycle phase switch is generally shown at 270. Switch 270 is configured having an electrically insulated base 272 which is fixed to the inner side of outer plate 246. Two electrically conductive resilient contacts 274 and 276 extend upwardly from switch base 272. Switch 270 further includes a mechanical motion amplifier configured as a lever 278 pivotally mounted upon a stud 280 extending from outer plate 246. Lever 278 additionally is configured to support an outwardly extending stud 282 which is positioned for selective contact with a tab 284 formed integrally with and extending downwardly from ram 250. Pivotal movement of lever 278 in a direction toward the front of the camera 10 is limited by a stud 286 fixed to and extending from outer plate 246. Switch 270 is selectively actuated in correspondence with the movement ram 250. For instance, when camera 10 is in a viewing mode configuration, ram 250 is in a position wherein tab 284 contacts stud 282 in a manner holding the lever 278 in a position causing contacts 274 and 276 to close a circuit. This orientation is shown in Figure 4. With the initial energization of motor 130 and consequent release of ram 250 over the sudden return portion 262 of cam 252, tab 284 is removed from contact with stud 282 to permit lever 278 to permit forwardly and cause contacts 274 and 276 to assume an open circuit orientation. The latter orientation is illustrated in Figure 8. It may be noted from the foregoing description that switch 270 will remain closed for whatever length of time the high dwell portion of the periphery of cam 252 is moved

across follower 254. Accordingly, operator assembly 60 is not released for movement into its exposure mode orientation until timing gear 238 and its associated cam 252 are in a predetermined angular orientation. This feature contributes to the simplification of the design of the camera, for instance, by minimizing a need for close tolerances and eliminating coasting errors which may otherwise accumulate from one photographic cycle to another.

#### The Timing Gear Cycle

Referring additionally to Figure 12, the relative interoperation or phasing of ram 250, cam 252, processing station 124 and operator assembly 60 are graphically portrayed as they occur during one 360° cycle of timing gear 238. Ram 250 is depicted at 290 as being restrained by the high dwell portion of cam 252 for about 10° of rotation. Following the rapid fall-off of ram 250 permitting exposure assembly 60 to assume its erect exposure mode orientation, the low dwell portion 262 of cam 252 is rotated past follower 254 as exhibited at 292. Operation of cam 252 as well as its associated timing gear 238 during this period takes place following an exposure interval and re-energization of motor 130. The low dwell interval depicted at 292 is inserted within the cam 252 program for the purpose of completely isolating the second power flow circuit from the first power flow circuit at the commencement of the processing of a film unit 52 at station 124. When units as at 52 are initially introduced between rolls 120 and 122, a forwardly positioned pod containing processing fluid must be ruptured. To assure the presence of a proper torque output at station 124 during this introduction, no other loads are imposed upon motor 130 from gear train 126. The commencement and termination of the processing operation are depicted by the extent of bar 294. Note that the processing period 294 commences at about 54° of timing gear rotation and is completed at about 248°.

Following the release of operator assembly 60 for movement into its erect, exposure mode orientation, a photographic cycle continues with the opening of the blades of shutter 90 for a regulated exposure interval. At the termination of this interval, solenoid 110 is energized to close the shutter following which motor 130 is again energized. Energization of motor 130 causes timing gear 238 to resume rotation such that cam 252 rotates through low dwell as depicted at 292, following which follower 254 of ram 250 is again re-engaged by rising profile portion 264. Continued rotation of timing gear 233 during this period of a photographic cycle causes ram 150 to be driven rearwardly, in turn, driving the arm portion 208 of drive bell crank 204 rearwardly. An orientation of the gear train

assembly 126 and its associated kinematic linkage during this cocking procedure is illustrated in Figure 9. Returning to Figure 12, the interval during which the rising profile portion 264 of cam 252 is moved before follower 254 is shown at 296. As depicted by phasing bar 298, the point of engagement of rising profile portion 264 with follower 254 commences at about 142° of timing gear 238 rotation. Cocking movement of operator assembly 60 from its exposure mode orientation toward its viewing mode orientation commences simultaneously with the start of ram 250 displacement. This movement is indicated by phasing bar 300.

A comparison of the period of displacement activity of ram 250 as depicted at 298 with the period of movement of the operator assembly 60 as indicated at 300, shows that ram 250 continues to be moved by cam 252 after operator assembly 60 has been re-seated. For instance, operator assembly 300 starts its downward movement at about 142 degrees of rotation of timing gear 238 and comes to rest at 310 degrees.

Turning to Figures 5 through 7, the operation of spring 191 in conjunction with the four-bar linkage 145 including bell crank 156 is portrayed. As ram 250 is urged rearwardly (toward the observer in Figure 5) by the rising profile portion 264 of cam 252, shaft 162 is rotated, in turn, rotating or carrying spring 191 from its connection at 194. The opposite tip 196 of spring 191 rotates bell crank 156 outwardly to drive or pull operator assembly 60 downwardly through the four-bar linkage 145. Simultaneously, drive spring 172 is wound as a consequence of its engagement with tang 178 on sleeve 180. When operator assembly 60 is seated against frame 56 (Figure 2) bell crank 156 halts. Continued movement of shaft 162 from the activity of cam 252 is taken up in override fashion by spring 191. The amount of override, which may vary in accordance with manufacturing tolerance variations, is taken up by a small relative separation between surface 192 of sleeve 180 and the arm extension 154 of bell crank 156. To prevent shock or the like when the four-bar linkage 145 is initially driven from drive spring 172 and from override spring 191 through contact surface 192, the rapid fall-off portion of cam 252 is rounded as described earlier at 261 in connection with Figure 10.

Returning to Figure 4, as timing gear 238 is rotated through one cycle of 360 degrees, arm 278 of switch assembly 270 closes contacts 274 and 276. This closure signals the control system of the camera that operator assembly 60 is down and that the timing gear 238 is in position for a next succeeding photographic cycle.

Closure of switch 270 de-energizes motor 130 as well as the control circuit of the

camera, thereby automatically shutting down the entire system. Should the drive mechanism of the camera coast following shutdown, the above described override features of the erecting system for operator assembly 60 provides for correction in the next following photographic cycle. For instance, the operator assembly 60 will not be released until timing gear 238 has rotated to its proper position. Accordingly, no coasting errors or the like will accumulate from one photographic cycle to another.

Closure of the contacts of switch 270 provides for a complete shut-down of the control system of the camera. In this regard, the winding of solenoid 110 is de-energized to permit the blades of shutter 90 to resume their fully open status. Shutter blades 92 and 94 thus being open, camera 10 is returned to its viewing mode orientation.

#### Control Circuit

Referring to Figure 13, a control circuit for causing the camera 10 to perform in the manner described is depicted. A photographic cycle is commenced with the depression of actuating button 34 to close a switch 300. When closed, switch 300 energizes main power lines 302 and 304 from a battery 306. As noted earlier, it is preferred that battery 306 be included as a component of disposable cassette 50. Energization of lines 302 and 304 initially enables a mode conversion timing function 308 from along lines 310 and 312. Conversion timing function 308 includes an R—C timing network and triggering circuit such as a differential comparator and is activated in conjunction with the movement of operator assembly 60. In this regard, the output 314 of timing function 308 remains at the ground potential of power line 304 until such time as the operator assembly 60 reaches its exposure mode configuration. For purposes of facilitating the description to follow, when the outputs of such triggering systems or comparators are at the ground reference potential of line 304, they are referred to as "low" and when they assume the voltage status of source line 302, they are referred to as being "high".

Output 314 is coupled through a diode 316, bias resistor 318 and line 320 to the base electrode of a PNP transistor Q<sub>1</sub>. The emitter of transistor Q<sub>1</sub> is coupled through a line 322 to main power line 301 and its collector is connected with a secondary or logic power line 324. The "low" status at output 314 of mode conversion timing function 308 at the commencement of a photographic cycle serves to forward bias the base-emitter junction of transistor Q<sub>1</sub>, thereby powering logic power line 324 from power line 302.

Energization of logic power line 324 from transistor Q<sub>1</sub> serves initially to energize the

shutter solenoid 110 by forward biasing the base-emitter junction of an NPN transistor  $Q_2$ . Forward biasing current is directed to the base of transistor  $Q_2$  from line 324 through a line 326, bias resistor 328, diode 330 and diode 332. The emitter of transistor  $Q_2$  is coupled to reference power line 304, while its collector is coupled to power line 324 through line 334 including resistors 336 and 338. An "on" status at transistor  $Q_2$ , in turn, forward biases the base-emitter junction of a PNP transistor  $Q_3$ , the base of which is connected to line 334 and resistor 336 from line 340. The emitter of transistor  $Q_3$  is connected with power line 324 and its collector is connected along a line 342 through resistors 344 and 346 to ground reference line 304. Conduction through line 342, in turn, forward biases the base-emitter junction of an NPN transistor  $Q_4$ , the base of which is connected to line 334 through line 348. The emitter of transistor  $Q_4$  is coupled to ground reference line 304, while its collector is connected through the winding 350 of a shutter actuating solenoid to power line 302. Winding 350 forms a component of the earlier described shutter solenoid 110. Accordingly, solenoid 110 is depicted functionally by a dashed boundary 110 in the instant figure.

The time interval required for solenoid 110 to cause shutter 90 to close and thereby secure exposure chamber 42 is followed by an R—C timing network 356 comprised of resistor 368 and a capacitor 370 operating in conjunction with a differential comparator 358. Differential comparator 358 is coupled to logic power line 324 from along line 360, and to ground reference line 304 from along line 362. The comparator 358 is of conventional design, operating as a non-inverting amplifier. The output of comparator 358 at line 364 may assume a "high" or "low" status in response to the receipt at its input line 366 of a voltage signal, respectively, above or below a predetermined reference level. This signal is derived from the R—C timing network 356. Input 366 of differential comparator 358 is coupled to line 372 at a point within network 356 intermediate resistor 368 and capacitor 370.

Timing network 356 is designed having a time constant selected to reach the trigger level of differential comparator 358 in a period of time corresponding with the time required to assure that the blades of shutter 90 have moved from a fully open position to a fully closed position. During this timing interval, the output at line 364 assumes a "low" status. Timing operation of the network 356 is permitted as a result of the "off" status of an NPN transistor  $Q_5$ . The collector of transistor  $Q_5$  is coupled to line 372 intermediate resistor 368 and capacitor 370, and its emitter is connected through line 374 to ground reference line 304. Thus connected, transistor

$Q_5$  is used to selectively shunt capacitor 370 and reset network 356. To forward bias transistor  $Q_5$  and thereby shunt capacitor 370, biasing current is supplied to the base thereof from logic power line 324 through line 376, bias resistor 378, line 380 and diode 382. At the commencement of an exposure interval, however, this current is diverted through diode 384 across a closed switch 390 to ground reference line 304. Switch 390 is a phase cycle switch corresponding to switch 270 described earlier herein. Until operator assembly 60 is released for movement from its cocked position, switch 390 remains closed.

When timing network 356 achieves the threshold or reference voltage of comparator 358 following a period of time adequate to permit solenoid 110 to fully close the blades of shutter 90, the output at line 364 goes "high". A "high" output at line 364 terminates a clamping current flow from logic power line 324 into line 392, bias resistor 394 and output line 364 of differential comparator 358. As a result, current now passes through diode 396 to forward bias the base-emitter junction of an NPN transistor  $Q_6$ . The emitter of transistor  $Q_6$  is connected with power reference line 304 and its collector is connected with power line 302 through a line 398 including bias resistors 400 and 402. As current is conducted through transistors  $Q_6$ , the base-emitter junction of a NPN transistor  $Q_7$  is forward biased. The base of transistor  $Q_7$  is coupled to line 398 from along line 404, while its emitter is coupled to power line 302. The collector of transistor  $Q_7$  is coupled along a line 406 which, in turn, is connected to the terminals of a d.c. motor 408 and with ground reference line 304. Motor 408 corresponds with motor 130 of camera 10. With the forward biasing of transistor  $Q_7$ , motor 408 is energized and operator assembly 60 is released for movement into its exposure mode orientation. As the operator assembly 60 leaves its cocked orientation, switch 390 is opened to de-energize motor 408 and activate mode conversion timing function 308.

This initial de-energization of motor 408 is carried out by the reassertion of a forward biasing current flow along line 376, through bias resistor 378, line 380 and diode 382 to the base of NPN transistor  $Q_5$ . With the opening of the phase cycle switch 390, this forward biasing current is no longer diverted through diode 384 and the switch. As a consequence, timing capacitor 370 of timing network 356 is shunted to ground reference line 304 through line 374. With the shunting of capacitor 370, the output at line 364 of differential comparator 358 goes "low" and current at line 392 is diverted from the base of transistor  $Q_6$  into the output 364 of differential comparator 358. As a consequence, the forward bias exerted at transistor  $Q_6$  is removed and conduction through line 298 is

terminated. As a result, the forward bias of transistor  $Q_7$  is removed and motor 408 is de-energized. The initial energization of motor 408 is very brief, amounting to the period of time required for timing gear 238 to rotate through about  $10^\circ$ .

Early in a photographic cycle, while switch 390 is closed, the timing operation of mode conversion timing function 308 is restrained by a current diverting clamp including a line 412, diode 414, line 416 and switch 390. Line 416 is connected between logic power line 324 and reference level power line 304 and includes a current limiting resistor 418 and diode 420 as well as switch 390. With the opening of switch 390, line 412 no longer communicates with ground reference line 304 through line 416, and function 308 is permitted to commence timing the period required for operator assembly 60 to move from its viewing mode orientation into its exposure mode orientation.

An opening of switch 390 also permits the forward biasing of the base-emitter junction of an NPN transistor  $Q_8$ . The base of transistor  $Q_8$  is connected with logic power line 324 through a line 422 including diode 424 and a bias resistor 426. Current flow through line 422 is diverted through line 428 and diode 430 into line 416 whenever switch 390 is closed. Accordingly, with the closure of switch 390, transistor  $Q_8$  is "off". The emitter of transistor  $Q_8$  is coupled to ground reference line 304, while its collector is connected through resistor 318 and line 320 to the base of transistor  $Q_1$ . A latching arrangement is provided thereby which serves to hold transistor  $Q_1$  "on" as long as switch 390 is open.

The opening of switch 390 de-activates another clamping arrangement including line 436 which extends through a diode 438 and bias resistor 440 to logic power line 324. Coupled to line 436 at a point intermediate diode 438 and bias resistor 440 is a line 442 incorporating diodes 444 and 446 and extending to the base of an NPN transistor  $Q_9$ . The emitter of transistor  $Q_9$  is connected to ground reference line 304 and its collector is connected through line 448, bias resistor 450 and line 452 to the base of a PNP transistor  $Q_{10}$ . A resistor 454 is connected in line 448 between line 452 and logic power line 324 to provide "turn-off" bias at transistor  $Q_{10}$ . The emitter of transistor  $Q_{10}$  is connected to logic power line 324 through line 458 and its collector is connected with an exposure function power line 460.

Transistors  $Q_9$  and  $Q_{10}$  being thus interconnected, when transistor  $Q_8$  is forward biased by current from line 442, through diodes 444 and 446, conduction to ground line 304 will be completed and the base-emitter junction of transistor  $Q_{10}$  will be forward biased. However, when switch 390

is closed, current otherwise forward biasing transistor  $Q_9$  is diverted along the clamping arrangement including line 436 and switch 390. When switch 390 is opened, another clamping arrangement including diode 462 and line 464 provides a current diverting path to the output 314 of mode conversion timing function 308 in order to retain transistor  $Q_9$  in a reverse biased state while timing function 308 is timing out the period required for operator assembly 60 to reach its exposure mode orientation. During this period, the output at line 314 will be "low" and, as a consequence, clamping line 464 is permitted to provide a diverting function.

When timing function 308 has timed out the movement of operator assembly 60, output line 314 assumes a "high" status, thereby terminating the flow of current through line 464. As a consequence, biasing current is introduced from line 324 through line 436 to forward bias transistor  $Q_9$ . An "on" status at transistor  $Q_9$  promotes a corresponding "on" status at transistor  $Q_{10}$ , thereby energizing line 460 from line 324 through line 458. Energization of line 460, in turn, energizes an exposure control function 470. Exposure control 470 is connected with line 460 from along line 472 and with ground reference power line 304 from along line 474.

Conduction across transistor  $Q_9$  also activates a current diverting line 476 extending from line 326, through diode 478 and to the collector side of transistor  $Q_9$ . When activated, line 476 serves to divert biasing current passing through line 326 and bias resistor 328 from the base of transistor  $Q_2$ . As a result, transistor  $Q_2$  is reverse biased into an "off" status simultaneously with the energization of exposure function power line 460. When transistor  $Q_2$  is reverse biased, transistors  $Q_3$  and  $Q_4$  correspondingly are reverse biased. As transistor  $Q_4$  is turned "off", winding 350 of solenoid 110 is de-energized to release the elements of camera shutter 90 for movement from a fully closed position toward an open position.

During the ensuing exposure interval, the output at line 480 of exposure control function 470 remains "low" until an exposure detecting function therein reaches the threshold value of a differential comparator also contained therein. When this threshold level is reached, the comparator triggers to rapidly change the output at line 480 to a "high" status. During an exposure interval, when the output at line 480 is "low", current is permitted to pass from line 460 through a bias resistor 482 to communicate with ground level through control function 470 and line 474. When the output at line 480 goes "high" at the termination of an exposure interval, current passes from line 460 through bias resistor 482 and diode 484 to the base of NPN transistor  $Q_{11}$ . The emitter of tran-

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sistor  $Q_{11}$  is connected to ground reference line 304 and its collector is connected through line 486, bias resistor 488 and line 490 to the base of a PNP transistor  $Q_{12}$ . A "turn-off" bias resistor 492 is connected between line 490 and power line 324. The emitter of transistor  $Q_{12}$  is connected with logic power line 324 and its collector is connected to line 494. Line 494 is connected through a bias resistor 496 to the base of an NPN transistor  $Q_{13}$  which functions to reactivate timing network 356. Line 494 additionally is coupled through line 498, bias resistor 500 and diode 502 to line 326 leading, in turn, to the base of transistor  $Q_2$ .

At the end of an exposure interval, the output of exposure control function 470 at line 480 will assume a "high" status to cause the forward biasing of transistor  $Q_{11}$ . When forward biased, transistor  $Q_{11}$  draws the base-emitter junction of transistor  $Q_{12}$  into a forward biased condition. As a consequence, current flows from line 324 through line 494. Line 494, in turn, energizes line 498 to cause a forward biasing of the base-emitter junction of transistor  $Q_2$  from along line 326. As noted earlier, when transistor  $Q_2$  is forward biased, transistors  $Q_3$  and  $Q_4$ , correspondingly, are forward biased to energize the winding 350 of solenoid 110. This energization causes shutter 90 to reclose and terminate an exposure. When energized, line 494 also forward biases the base-emitter junction of transistor  $Q_{13}$ . The emitter of transistor  $Q_{13}$  is connected to ground reference power line 304 and its collector is connected to line 376. When current from line 496 forward biases transistor  $Q_{13}$ , current from line 376 is diverted from line 380 and a forward bias at transistor  $Q_3$  is removed. As a result, the shunt about timing capacitor 370 is removed and timing network 356 commences to time-out the period required for the blades 92 and 94 of shutter 90 to close. The output at line 364 of differential comparator 358 remains "low" until this shutter timing period terminates, at which time the output of the differential comparator 358 at line 364 assumes a "high" state. While the output at line 364 remains "high", the base-emitter junction of transistor  $Q_6$  is forward biased from along line 392 and diode 396. When transistor  $Q_6$  is forward biased, transistor  $Q_7$ , in turn, is forward biased to cause motor 408 to be re-energized from line 406 and power line 302.

As described in detail earlier in conjunction with motor 130, continued energization of motor 408 causes timing gear 238 to be rotated, thereby rotating cam 252 to drive ram 250 rearwardly. Additionally, rotational drive is provided for processing station 124. As operator assembly 60 reaches its viewing mode position and following an appropriate overtravel of spring 192, switch 390 (represented as switch 270 in the mechanical draw-

ings) again is closed. When switch 390 closes, forward biasing current otherwise directed to transistor  $Q_3$  is diverted through diode 430 and line 416 to the switched power reference level line 304. Transistor  $Q_3$  is reverse biased and, in turn, transistor  $Q_1$  is reverse biased. The resultant de-energization of logic power line 324 shuts down the entire circuit to terminate a photographic cycle.

The control circuit described above ideally cooperates with the earlier described functional components of camera 10. In particular, the circuit performs throughout a complete photographic cycle in response to the actuation of the single-phase controlling switch as shown at 270. By operating in conjunction with a single cycle of rotation of cam 152, the system is capable of accommodating variations of exposure intervals during a photographic cycle. Note further that the circuit responds to ram 250 actuation of switch 270 to de-energize motor 130 twice during a cycle. Further, when responding to switch 270 for the second time, the circuit is automatically shut down in preparation for a succeeding exposure cycle. Under the foregoing, it may be seen that the logic of the circuit desirably complements the mechanical logic of camera 10.

#### WHAT WE CLAIM IS:—

1. A photographic camera including a generally rectangular housing for supporting a stack of film units, means for exposing and processing successive film units to form visible images thereon, and a motor for driving the processing means, the motor and the processing means being positioned adjacent two opposite sides of the housing and the drive transmission between the motor and the processing means extending along a third side of the housing.

2. A camera according to Claim 1, wherein the camera is foldable from an erected configuration to a compact parallelepiped configuration, the said housing forming the base of the parallelepiped with narrow side and end walls, and wherein the motor lies adjacent one narrow end wall and the drive transmission means extends along one of the narrow side walls.

3. A camera according to Claim 1 or Claim 2, in which the drive transmission means includes a linear gear train connected between the motor and the processing means.

4. A camera according to Claim 1, further including a reflex member movable under spring bias from a cocked position into a terminal position, the drive transmission means including a first gear train for rotatably driving the processing means and a second gear train with a greater reduction ratio than the first gear train for driving the reflex member against its spring bias into its cocked position.

5. A camera according to claim 4 in which

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#### WHAT WE CLAIM IS:—

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2. A camera according to Claim 1, wherein the camera is foldable from an erected configuration to a compact parallelepiped configuration, the said housing forming the base of the parallelepiped with narrow side and end walls, and wherein the motor lies adjacent one narrow end wall and the drive transmission means extends along one of the narrow side walls.

3. A camera according to Claim 1 or Claim 2, in which the drive transmission means includes a linear gear train connected between the motor and the processing means.

4. A camera according to Claim 1, further including a reflex member movable under spring bias from a cocked position into a terminal position, the drive transmission means including a first gear train for rotatably driving the processing means and a second gear train with a greater reduction ratio than the first gear train for driving the reflex member against its spring bias into its cocked position.

5. A camera according to claim 4 in which

the reflex member is selectively retained in its cocked position.

6. A camera according to claim 5 in which the reflex member is released for movement under its spring bias in response to a predetermined rotation of the second gear train.

7. A camera according to any one of the claims 4—6 in which the reflex member commences movement against its spring bias into its cocked position subsequent to the start of processing of a film unit.

8. A camera according to any one of the claims 4—7 further including a cam coupled for co-rotation with the output gear of the second gear train and operatively linked with the reflex member.

9. A camera according to claim 8 in which the linkage between the cam and the reflex member includes a cam follower, and in which the periphery of the cam includes a high dwell portion, the reflex member being retained in its cocked position in response to the follower moving over the high dwell portion.

10. A camera according to claim 9 in which the high dwell portion of the cam is juxtaposed with a sudden return portion such that the reflex member is abruptly released for movement under its spring bias as the follower moves off the high dwell portion.

11. A camera according to any one of the claim 8—10 in which the periphery of the cam further includes a low dwell portion and a rising profile portion, the reflex member being operatively linked with the low dwell portion when processing of a film commences and being subsequently linked with the rising profile portion to move the reflex member against its spring bias into its cocked position.

12. A camera according to claim 11 in which the low dwell portion lies intermediate the sudden return portion and the rising profile portion, the low dwell portion being shaped to remain out of contact with the follower surface to ensure movement of the reflex member fully into its terminal position.

13. A camera according to claim 11 or claim 12 further including a lost motion linkage between the cam and the reflex member, the rising profile portion of the cam being

configured to drive a linkage member between the reflex member and the follower surface an additional predetermined distance after the reflex member is driven into its cocked position.

14. A camera according to claim 13 including a switch actuable in response to the linkage movement such that the motor is de-energized when the output gear of the second gear train has rotated sufficiently to move the follower surface the additional predetermined distance.

15. A camera according to claim 4 wherein the first and second gear trains comprise first and second branches of an elongate gear train extending along the said third side of the housing.

16. A camera according to claim 15 wherein the reflex member is linked with the output gear of the second gear train by a kinematic linkage including an elongate ram supported within the housing and translationally movable along the elongate gear train.

17. A camera according to any one of the claims 4—16 in which the output gear of the second gear train rotates one revolution for each focusing/exposure/processing cycle.

18. A camera according to claim 17 as dependent on claim 9 in which the motor is energised twice during each photographic cycle, the first energisation being of sufficient duration to move the sudden return portion of the cam before the follower surface.

19. A camera according to claim 18 in which the rising profile portion of the cam is moved against the follower surface during the second energisation of the motor.

20. A camera according to any one of the claims 4—19 in which movement of the reflex member from its cocked position to its terminal position converts an optical path in the camera from a viewing mode configuration to an exposure mode configuration.

21. A camera according to claim 1 and substantially as herein described with reference to the accompanying drawings.

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