

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS RELATING TO PHOTOGRAPHIC APPARATUS

(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:—

This invention relates to photographic apparatus, and particularly to cameras having film-advancing apparatus for advancing film units of the self-developing type.

One known type of film-advancing apparatus includes a member which enters one of a series of indentations or apertures in a film unit before advancing the film unit out of its exposure position. The film is then fed between a pair of processing rollers which are adapted to spread a processing liquid between the elements of the film unit while simultaneously continuing the movement of the film unit toward the exterior of the camera. One problem with such apparatus is that of getting the film-engaging member into register with the aperture or indentation in the film unit without deflecting the leading end of the film unit out of alignment with a withdrawal slot in the film cassette.

Another known type of film-advancing apparatus, described for example in U.S. Patent 3,447,437 uses a friction drive between the apparatus and the leading end of a film unit. The term "leading end" as used herein means that portion of the film unit which is closest to the film exit in the film cassette. Again the problem arises that the engagement between the friction drive and the leading end of the film unit may deflect the leading end out of alignment with the exit opening in the cassette.

Still another known type of film-advancing apparatus, as shown for example in U.S. Patent Nos. 2,477,324 and 2,873,658, includes means for engaging a film unit near its trailing

end and advancing the film unit into the bite of a pair of non-rotating processing rollers. The major drawback with apparatus of this type is that the film unit must be substantially rigid or thick either to withstand the pressure exerted thereon when moving the unit into the bite of the processing rollers and/or to enable the unit to drive the processing rollers as they are moving therebetween. Increasing the thickness and/or rigidity of a film unit adds to the manufacturing costs thereof, and in the case of increased thickness, subtracts from the compactness of the film cassette (assuming a constant number of film units) and the camera with which the cassette is to be used.

Apparatus embodying the present invention is for use with a film assemblage which comprises a stack of thin, flexible film units in a cassette and in which a photosensitive area of the foremost unit is urged into a position adjacent an exposure aperture with the leading end of the unit aligned with an exit at one end of the cassette and the trailing end of the unit aligned with an opening at the opposite end of the cassette. In accordance with the present invention photographic apparatus for use with a film assemblage of this type includes means for exposing the foremost film unit through the exposure aperture in the cassette, first film-advancing means so arranged that when the cassette is mounted in the apparatus the film advancing means extends into the opening in the cassette to engage the trailing end of the foremost film unit and, in use, to move the leading end of the unit, subsequent to exposure, through the exit in the cassette, second film-advancing means for engaging the leading end of the unit after its movement through the exit, and means coupled to a motor for driving the first film-advancing means to move the leading end of the unit through the exit and for driving the second film-advancing means while the unit is in engagement therewith.

In a preferred embodiment of the invention

the first film-advancing means includes a reciprocating cantilever having its free end engageable with the trailing end of the foremost film unit. The second film-advancing means includes rotatable processing rollers which continue the uninterrupted movement of the film unit out of the cassette while simultaneously rupturing a container of processing liquid located near the leading end of the film unit and spreading the liquid between photosensitive and image receiving elements of the film unit to initiate formation of a visible image within the film unit.

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

Figure 1 is a perspective view, partly in section, of a folding, single-lens reflex camera;

Figure 2 is an enlarged, exploded perspective view of certain components of the camera shown in Figure 1;

Figure 3 is an elevational view of the components of Figure 2 shown in an assembled condition;

Figure 4 is a view similar to Figure 3 showing the relationship between components during an intermediate phase of their operation;

Figure 5 is a perspective view of a portion of a film unit;

Figure 6 is an elevational view of a modified film-advancing means; and

Figure 7 is an elevational view of another modified film-advancing means.

Referring first to Figure 1, a foldable camera 10 includes a plurality of housing sections 12, 14, 16 and 18 which cooperate with a flexible opaque bellows 20 to define sides of an exposure chamber 22. Housing sections 12, 14, 16 and 18 are pivotally coupled for movement, along with a collapsible viewfinder 24, from the operative position shown to a folded or collapsed position.

Housing section 12 includes a generally rectangular shaped member 26 having a rectangular shaped opening 28 therein. Opening 28 is adapted to receive an upstanding rib 30 located on the forward wall 32 of a film cassette 34 for properly positioning the foremost film unit located within the cassette in position for exposure to light transmitted through cassette exposure opening 36. A spring wound or battery driven motor 38 is located near one end of opening 28 and a pair of rollers 40 and 42 having suitable means for resiliently biasing the rollers toward each other is mounted adjacent an opposite end of opening 28. Motion-transmitting means in the form of a gear train 44 extends along one side of member 26 and is coupled between the motor 38 and roller 40 for driving the latter in a counterclockwise manner (as viewed in Figure 1) to transport a film unit engaged between the rollers toward the exterior of the camera.

Camera 10 is provided with a reflex member 46 pivotally attached to rectangular shaped member 26 at lugs 48 and 50 for movement between a viewing position wherein it cooperates with rib 30 on cassette 34 to define a lighttight seal therebetween, and an exposure position wherein it lies closely adjacent a mirror 52 mounted on an interior surface of housing section 14. The reflex member 46 includes a support (not shown) having a mirror or similarly specularly reflecting surface 54 on one side thereof and a viewing surface 56 on the other side configured to have a texture and optical design to facilitate focusing of the image. Reflex member 46 is spring loaded to the up or exposure position and is provided with a linkage system including a crank 58 and ram 60 for moving the reflex member 46 to the down or viewing and focusing position.

The film-advancing apparatus of the camera includes a first component or first film-advancing means for engaging a film unit, subsequent to exposure, and moving it into the bite of a second component or second film-advancing means, i.e., rollers 40 and 42, for subsequent delivery to the user of the camera. The first component of the film-advancing apparatus (see Fig. 2) includes a generally T-shaped member 62 mounted on a flange 64 for reciprocating motion, i.e., toward and away from the rollers 40 and 42. T-shaped member 62 includes a main body portion 66 having three elongated slots 68, 70 and 72 therein which are adapted to slideably receive pins 74, 76 and 78 mounted on flange 64. Pins 74, 76 and 78 have enlarged end portions for retaining T-shaped member 62. Member 62 further includes a leg 80 having a hole 82 therein for receiving one end of a spring 84. Spring 84 has its other end connected at 86 to flange 64 for resiliently biasing T-shaped member 62 toward the left, i.e., away from the rollers 40 and 42. A resilient arm 86 extends from one end of T-shaped member 62 in cantilever fashion and includes a downwardly turned film-engaging member 88 which is adapted to engage the trailing end of a film unit 39 prior to moving it out of the cassette 34 via exit 35 and into the bite of rollers 40 and 42. It will be noted that member 88 is configured such that its free end does not extend to a position wherein it could engage the trailing end of more than one film unit. Alternatively, member 88 could be replaced by a block of resilient material 89 having a high coefficient of friction, e.g., polyurethane foam, as shown in Fig. 6. Material 89 may be adapted to engage either the top surface of the film unit or it may engage the top and end surfaces simultaneously. In any event, the engagement between the film-engaging member and the film unit is at a location outside of the area in which the image is to be formed. Also extending from T-shaped member 62 is a flange 90 which is adapted to be engaged by means to be described later for moving the first component of the film-advancing apparatus from

the position shown in Fig. 2 to a second position wherein the film unit is advanced into engagement with the second component, i.e., the rollers 40 and 42.

5 Returning briefly to the gear train 44, it can be seen that it includes a plurality of gears 92—116. The gear train includes two power paths, i.e., one which couples the gear 118 located on one end of roller 40 with drive gear 92 and a second path which interconnects drive gear 92 with a timing gear 110. The first path includes drive gear 92 (which is coupled to the motor 38), idler gears 94, 98, 102, 104, 112, 114 and 116, reduction gears 96 and 100, 10 integral with gears 94 and 98, respectively, and roll drive gear 118. The second path includes drive gear 92, idler gears 94, 98, 102, 104 and 108, reduction gears 96, 100, 106 and timing gear 110. Obviously, timing gear 110 rotates completely independent of idler gear 112 and reduction gear 106 is integral with idler gear 104.

During the focusing mode of operation, reflex member 46 is in the down position 25 closely adjacent the film container 34; the camera's shutter and lens assembly 120 is open to allow the entry of light into chamber 22; and the remaining sub-systems, i.e., the gear train 44, ram 60 and crank 58 assume positions substantially as shown in Figs. 1 and 3. After the image has been properly focused on viewing surface 56, as seen through viewfinder 24, the camera's shutter release button 122 is depressed to initiate operation of the camera's 35 control program.

Initiation of the control program fully closes the shutter 120 and closes the circuit to motor 38. Motor 38 drives the gear train 44 for a period of time sufficient to rotate a point on timing gear 110 counterclockwise through an angle of approximately ten degrees. As noted previously, reflex member 46 is spring biased toward the up position. However, reflex member 46 is prevented from moving to the up position because of its connection with link 58 and ram 60. Ram 60 (see Figure 1) has a cam follower 124 mounted on one side thereof which is in engagement with the high point 126 of a cam 128 fixedly mounted on timing gear 110, when the image is being focused. Rotation of timing gear 110 in a counterclockwise direction moves the high point 126 of cam 128 to a position allowing the ram 60, which is being urged to the right by the reflex member up springs, to move to the right as the reflex member moves to the up or exposure position. The shutter 120 is then opened and image-producing light is directed along an optical path and reflected by mirror 54 toward cassette 34 to expose the foremost film unit, i.e., the one closest to wall 32 of cassette 34. A photocell 121 provides an input to the control system for closing the shutter when the correct exposure time has elapsed. After the shutter has been closed, the motor 38 is started

again to drive the gear train 44. This second starting of the motor 38 rotates gear 102 and pin 130, which extends from gear 102 inwardly toward frame member 64, in a clockwise direction. During this rotation, pin 130 revolves into a position wherein it engages flange 90 and moves the first component of the film-advancing apparatus including film-engaging section 88 to the right (as viewed in Figure 1) to move the exposed film unit into the bite of the rotating rollers 40 and 42. As best seen in Fig. 2, film cassette 34 has an elongated opening 31 in forward wall 32 which extends part way down the trailing end wall 33 of the cassette. Opening 31 allows film-engaging section 88 to extend into the cassette to a position just rearwardly of the trailing end 37 of a film unit 39 in preparation for moving the film unit through exit 35 (see Figure 1) in cassette 34 and into the bite of rollers 40 and 42.

At this point it should be noted that film units 39 which consist chiefly of superposed photosensitive and image-receiving elements 41 and 43, respectively, a rupturable container 45 containing a supply of processing liquid and means 47 for securing the elements 41 and 43 in face-to-face relation, are relatively thin and flexible. For example, the maximum thickness of a film unit at a point intermediate its ends is approximately .014 inch, while that at container 45 is approximately .048 inch. Since the leading end of the foremost film unit, i.e., the end having container 45, located within the cassette 34 is in alignment with the exit 35, it is especially beneficial to advance the foremost film unit by engaging the film unit at or near its opposite or trailing end rather than engaging the film unit near its leading end. The reason for this is that engagement of the thin, flexible film unit near its leading end may result in deflecting a portion of the leading end of the film unit out of alignment with the exit 35, thereby preventing movement of the film unit into the bite of rollers 40 and 42. In other words, if any deflection of the film unit is to take place in response to engagement of the film unit by the film-engaging member, it should take place at a position remote from the leading end of the film unit.

Rollers 40 and 42 apply compressive pressure to the container 45 of processing liquid located near the leading edge of the film unit to rupture the container and spread the contents thereof between the photosensitive and image-receiving elements of the film unit to initiate a diffusion transfer process of the type described in U. S. Patent No. 3,415,644. After the processing liquid has been spread, rollers 40 and 42 transport the film unit to the operator of the camera in a condition which does not require any other mechanical processing. Shortly after the processing liquid has been spread between elements of the film unit, the

high point 126 on cam 128 rotates to a position in which it now drives cam follower 124 and ram 60 to the left, thereby driving reflex member 46 to the down position. The shutter

5 120 now is allowed to assume a fully open condition and the circuit to the motor 38 opened to complete the cycle.

The gear ratio between the various gears in gear train 44 is such that gear 102 must rotate through more than one revolution in order for the rollers 40 and 42 to be driven a sufficient period of time to move the exposed film unit out of engagement with the rollers. For that reason, a disabling means in the form of a latch 140 is provided for holding T-shaped member 62 in the second position, i.e., to the right, for a period of time at least sufficient to enable the exposed film unit to move out of engagement with the rollers 40 and 42. By thus holding T-shaped member 62 in the second position, flange 90 is maintained in a position which precludes repeated engagement by pin 130 during subsequent revolutions of gear 102 and the resulting actuation of the film-engaging member 88 to move another film unit out of the cassette 34 before the film unit has been exposed. Latch 140 is pivotally coupled to flange 64 by a pin 142 and is resiliently biased in a clockwise direction by any suitable means such as spring 144. Latch 140 includes a detent 146 which is adapted to be cammed downwardly against its spring bias by inclined surface 79 of T-shaped member 62 as the latter moves toward the right. When T-shaped member 62 reaches its second position, i.e., the film unit is now in the bite of the rollers 40 and 42 and the T-shaped member is in the position shown in Fig. 4, detent 146 is urged by spring 144 in a clockwise direction into a recess 81 in T-shaped member 62 to releasably retain the latter against movement to the left under the influence of spring 84. A release member including an arm 150 having a cam follower 152 at its end extends from latch 140 and is adapted to be engaged by a peripheral surface of cam 128 for rotating latch 140 in a counterclockwise direction to move detent 146 out of recess 81, thereby allowing T-shaped member 62 to return to its first or starting position (see Fig. 3) under the influence of spring 84. This latter movement of arm 150 from the position shown in Fig. 4 to the unlatching position occurs just prior to cam 128 rotating in a counterclockwise manner into the position shown in Fig. 3. Accordingly, cam 128 functions to drive reflex member 46 to the down position and as an enabling means for permitting the first component of the film-advancing apparatus, i.e., film-engaging member 88, to return to the position shown in Fig. 3.

An alternative embodiment of the first component of the film-advancing apparatus is shown in Fig. 7. In this embodiment, arm 86 is replaced by a rack 200 extending rearwardly

from T-shaped member 62. Rack 200 includes a plurality of teeth 202 operatively meshed with the teeth of a gear 204 for rotating the latter upon reciprocating movement of the former. Gear 204 is drivingly coupled to a disc or wheel 206 by a shaft 208 and a one-way clutch 210. Wheel 206, which may be formed of any suitable material having a high coefficient of friction, e.g., rubber, is mounted in position to engage the foremost element located within the film cassette upon insertion of the latter into the camera. As is obvious from Fig. 7, movement of rack 200 to the right will produce a counterclockwise rotation of wheel 206 to move the foremost element out of the cassette and into the bite of rollers 40 and 42. After the foremost element (initially a dark slide and thereafter a film unit) has been moved out of the cassette, clutch 210 allows rack 200 to return to its original position without rotating wheel 206.

From the foregoing it can be seen that there has been disclosed a novel and reliable film-advancing apparatus for moving thin, flexible film units from an exposure position towards the exterior of the camera. The film-advancing apparatus includes two components which are operated to cooperate with each other to provide for the uninterrupted movement of the exposed film unit from its exposure position to a position in which the user can handle the film unit. However, it should be noted that the movement of the exposed film unit toward the exterior of the camera may be in two or more stages. For example, gears 112 and 114 could be replaced by a hand crank operatively coupled to gear 116, as shown in phantom lines in Figure 1, for allowing manual operation of the rollers 40 and 42. Where the second component of the film-advancing apparatus, i.e., rollers 40 and 42, are driven independently of the operation of the first component, it is preferred that the exposed film unit be moved far enough into the bite of the rollers 40 and 42 to ensure that the rollers will be able to engage the film unit and, upon manual operation of the rollers, advance the film unit toward the exterior of the camera. Accordingly, any suitable means, e.g., a pair of cams, may be provided for pregapping the rollers 40 and 42 a sufficient distance away from each other so as to allow the leading end of the exposed film unit to be moved to a point slightly to the right (as viewed in Fig. 3) of a plane containing the axes of rollers 40 and 42. After the leading end of the film unit has been located as described, the cams could be moved to allow the rollers 40 and 42 to return to their normal position, thereby engaging the leading end of the film unit in their bite. The rollers 40 and 42 may then be rotated to advance the film unit toward the exterior of the camera while simultaneously spreading the contents of container 45 between the photosensitive and image-receiving elements of the film unit.

WHAT WE CLAIM IS:—

1. Photographic apparatus for use with a film assemblage of the type including a stack of thin, flexible film units in a cassette, a photosensitive area of the foremost unit being urged into a position adjacent an exposure aperture with the leading end of the unit aligned with an exit at one end of the cassette and the trailing end of the unit aligned with an opening at the opposite end of the cassette, the apparatus comprising: means for exposing the foremost film unit through the exposure aperture in the cassette, first film-advancing means so arranged that when the cassette is mounted in the apparatus the film advancing means extends into the opening in the cassette to engage the trailing end of the foremost film unit and, in use, to move the leading end of the unit, subsequent to exposure, through the exit in the cassette; second film-advancing means for engaging the leading end of the unit after its movement through the exit; and means coupled to a motor for driving the first film-advancing means to move the leading end of the unit through the exit and for driving the second film-advancing means while the unit is in engagement therewith.

2. Photographic apparatus as defined in claim 1 wherein the first film-advancing means includes film-engaging means at least a portion of which extends to the rear of the foremost film unit to engage the unit along a rear edge thereof.

3. Photographic apparatus as defined in claim 2 wherein the film-engaging means engages and moves only one film unit at a time.

4. Photographic apparatus as defined in claim 2 wherein the film-engaging means is mounted for frictional engagement with the foremost film unit.

5. Photographic apparatus as defined in claim 4 wherein the film-engaging means is mounted for reciprocating movement.

6. Photographic apparatus as defined in claim 4 wherein the film-engaging means is mounted for rotary movement.

7. Photographic apparatus as defined in any one of the preceding claims in which the first and second film-advancing means are driven together such that the movement of the unit through the exit is substantially uninterrupted.

8. Photographic apparatus as defined in any one of the preceding claims wherein the second

film-advancing means includes a pair of rollers adapted to rupture a container of processing liquid mounted on the foremost film unit and spread the contents thereof between elements of the unit as the latter is advanced between the rollers.

9. Apparatus according to any one of the preceding claims further including shutter release means for initiating operation of a shutter assembly to expose the foremost film unit through the exposure aperture in the cassette, and means responsive to actuation of the shutter release means for energising the motor.

10. A method of exposing and processing a succession of discrete photographic film units stacked within a film cassette having an exposure aperture through which the film units are adapted to be sequentially exposed, an exit through which a foremost film unit is movable subsequent to exposure and an opening through which first film-advancing means engage the foremost film unit in the stack and move the foremost film unit subsequent to exposure through the exit and into engagement with second film-advancing/pressure-applying means, the method comprising: positioning the film cassette within photographic apparatus and moving the foremost film unit into the focal plane of the photographic apparatus; resiliently urging the stack of film units toward the focal plane to maintain the foremost film unit in the focal plane; exposing the foremost film unit through the exposure aperture; energising a motor coupled to the first and second film-advancing means to engage a trailing end portion of the foremost film unit and move the unit, leading end first, through the exit and into engagement with the second film-advancing/pressure-applying means to continue the movement of the unit while simultaneously spreading a processing liquid between elements of the unit to initiate a diffusion transfer process.

11. Apparatus according to claim 1 substantially as herein described with reference to the accompanying drawings.

For the Applicants:
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
51/52 Chancery Lane,
London WC2A 1HN.

