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DRAWINGS ATTACHED

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(54) IMPROVEMENTS RELATING TO PHOTOGRAPHIC APPARATUS

(71) We, INTERNATIONAL POLAROID CORPORATION, a corporation existing and organised under the laws of the State of New Jersey, United States of America, of 5 1 Exchange Place, Jersey City, New Jersey, 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, 10 to be particularly described in and by the following statement:—

This invention is concerned with folding cameras.

According to the invention a first camera 15 housing section has means for positioning a photosensitive element at a film plane for exposure and a second housing section has means for positioning a mirror with its reflective surface in a reflecting plane, the 20 position of which is determined by the position of the second section; the first and second sections are interconnected to permit their relative movement between a folded position in which the reflecting plane and 25 film plane are substantially parallel with each other and an extended position in which the reflecting plane forms an acute angle other than 45° with the film plane; the camera further includes means for 30 releasably securing the first and second sections in the extended position and means for so positioning a photographic lens that when the first and second sections are in the extended position the lens lies within 35 the acute angle formed by the reflecting plane and the film plane, with the optical axis of the lens oriented to direct scene light on to the reflecting plane from which it is redirected on to the film plane.

40 In the preferred camera embodying the invention the photographic lens is mounted in a third housing section pivotally coupled to the first and second sections.

45 In order that the invention may be better understood, one example of apparatus em-

bodimenting the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 is a perspective view of the camera constructed in accordance with the invention and shown in an operative or 50 extended condition;

Figure 2 is a perspective view of the camera illustrated in a folded or transport 55 condition;

Figure 3 is a sectional view of the camera, the section being taken between the sides of the camera and the camera being illus- 60 trated with a film pack in operative position in the camera;

Figure 4 is an enlarged sectional view similar to Figure 3 showing a portion of 65 the camera;

Figure 5 is a perspective view of components of the camera and a film pack; 65

Figure 6 is an enlarged perspective view of components of the camera; and

Figure 7 is a circuit diagram showing an electrical circuit for controlling the oper- 70 ation of the camera.

The camera 10 of Figures 1 to 4 comprise a housing including a first section 12, a second section 14, a third section 16, and a fourth section 18. The first housing section 12 may be characterized as the rear housing 75 section and includes means for holding an assemblage or pack of film units with one of the film units located in position for exposure. The first housing section is pivotally connected at one end to one end of 80 second housing section 14 at a hinge 20 and near its opposite end to third housing section 16 at pivots 22, the location of which will be described more fully hereafter. Housing sections 14 and 16 are coupled at 85 hinges 24 and 26 respectively to fourth housing section 18 so that the four housing sections form, in effect, a four-bar linkage which is movable between an extended or operative position (see Figure 1) in which 90

the housing sections are spaced apart to provide four sides of a chamber, and a folded or transport position (shown in Fig. 2) in which the first and third housing sections are located beside one another substantially in a line and the second and fourth housing sections are located in line with one another and in face-to-face adjacency with the first and third housing sections.

The first housing section 12 essentially comprises a generally rectangular rear wall 28 (Figure 3), the dimensions of which are slightly greater than the dimensions of the film pack adapted to be employed in the camera, dependent side walls 30 and 32 and a door 34 pivoted about hinge 20 which is supported at its ends on side walls 30 and 32. Door 34, which forms a part of rear wall 28 and an end wall for the rear housing section, is retained in the closed position by a latch 36 and may be opened to permit loading of a film pack into the camera housing.

The camera is adapted to be employed with film assemblage or film pack 40 (Figure 4 and 5) including a plurality of film units 42 preferably of the type shown and described in detail in British Patents Nos. 1,224,371 and 1,224,372. Film units of this type each incorporates all of the materials necessary to produce a positive photographic print including a photosensitive element 44, a second or image-receiving element 46 which is transparent and is secured in face-to-face relation with the photosensitive element, and a rupturable container 48 of processing liquid secured to one end of the photosensitive and second elements for dispensing its liquid contents therebetween in response to the application of compressive pressure to the container. Each film unit is adapted to be processed by advancing the film unit, container foremost, between a pair of pressure-applying members which dispense the liquid contents of the container therefrom between the photosensitive and second elements and spread the liquid between and in contact with the two elements toward the trailing end thereof. The image-forming process is well-known in the art and involves the formation of transferable image-forming substances in the exposed photosensitive element and diffusion of the image-forming substances to another layer within the film unit where they are deposited to form a visible, positive image. In the particular example shown herein and described in the aforementioned applications, the processing liquid includes an opacifying agent which is spread in a layer between the photosensitive element, which is preferably opaque to actinic light, and the transparent image-receiving element 46 for providing a

background for the positive transfer image which serves to mask any image formed in the photosensitive element.

Camera size can be reduced and a higher degree of compactness achieved by eliminating the necessity for a processing or imbibition chamber in the camera in which the film unit is advanced and retained in a light-free environment during image formation. Accordingly, the film unit is designed to be advanced from the camera into the light immediately as the processing liquid is distributed within the film unit which means that spreading of the processing liquid must be effective to prevent further exposure of the photosensitive elements almost immediately as it (liquid spreading) occurs. The opacifying agent in the processing liquid functions to prevent exposure of the photosensitive element to transmitted by the transparent second element 46.

A number of film units 42 are provided in stacked relation in an opaque container 50 having a forward wall 52 provided with an exposure aperture 54 substantially co-extensive in size and shape with the image to be formed and an end wall 56 formed with a slot 58 through which the film units may be moved one at a time. A spring 60 and pressure plate 62 are provided in film pack container 50 behind the film units for supporting the forwardmost film unit in position for exposure against forward wall 52 and in alignment with exit slot 58. Openings 64 (Figure 5) are provided in forward wall 52 adjacent the sides thereof and in the region of the containers 48 to enable engagement between the forwardmost film unit and a component of the camera for advancing the leading end of the forwardmost film unit from container 50 through slot 58 following the exposure of the film unit. The film pack is initially supplied with a dark slide (not shown) located between forward wall 52 and the forwardmost film unit 42 so as to cover exposure aperture 54 and prevent the exposure of the film units. The dark slide may be initially the same size as a film unit and can be withdrawn from the film pack through slot 58 in the same manner as the film unit.

As previously indicated, rear housing section 12 includes holding means for positioning film pack 40 in the camera with the forwardmost film unit 42 supported in position for exposure. In the form shown, these holding means comprise a plate 66 (Figure 4) formed with a rectangular exposure aperture 68 mounted near its end opposite door 34 for pivotal movement about a pin 70 and biased in a clockwise direction by a torsion spring 71 engaged around pin 70 which urges the end of plate

66 closest door 34, toward rear wall 28 against a stop (not shown) which locates the rear surface of plate 66 slightly forwardly of the focal surface of the camera lens so as to locate the photosensitive element of the forwardmost unit at the focal surface of the lens. Film pack 40 is thicker at the end enclosing containers 48 than it is at the opposite end and the pivotal mounting of plate 66 is provided to enable the introduction of a film pack into the camera through door 34 into the position shown in Fig. 3.

The first section 12 of the camera housing also includes means for processing each film unit following exposure and in the form shown, these means comprise a pair of rolls 72 and 74 mounted in juxtaposition for rotation about axes located substantially in a plane perpendicular to rear wall 28, with the bite of the rolls located closely adjacent and in substantial alignment with slot 58 in film pack container 50. Means are provided for mounting the rolls in juxtaposition and biasing the rolls toward one another so as to apply compressive pressure to a film unit during movement of the film unit between the rolls. In the form shown, these mounting means comprise a frame 75 shown in detail in Fig. 6 and including a transverse member 76 having two forwardly extended arms 78 at its ends in which shafts on the ends of rolls 74 are journaled. A pair of arms 80 extend from the ends of transverse member 76 toward the opposite end of the rear section of the camera housing and include forwardly extended arms 82 on which a pair of levers 84 are pivotally mounted at their ends. Roll 72 is mounted for rotation on the opposite ends of levers 84 and is biased toward roll 74 by a pair of torsion springs 85 each engaged at one end in one of arms 80 and engaged at its opposite end in a portion of one of levers 84.

A drive motor and transmission to be described more fully hereafter are provided for rotating either or both rolls 72 and 74 to advance a film unit between the rolls while applying compressive pressure to the film unit. Means are provided in the rear housing section for feeding the leading edge, (i.e., edge of container 48) of the forwardmost film unit, following the exposure thereof, through slot 58 into the bite of rolls 72 and 74 so that the latter may engage, advance, and process a film unit. These last-mentioned feeding means are illustrated as comprising a pair of friction rolls 86 (Figures 3 and 5) each mounted on one end on a lever 88 in position to engage the forwardmost film unit through openings 64 in forward wall 52 of a film pack container 50. Levers 88 are pivotally mounted on frame 75 to pivot about the

same centres as arms 80, the location of these centres being indicated by the holes at the ends of the perpendicular extensions of arms 82 (Figure 6), and are biased by torsion springs 90 so as to urge friction rolls 86 rearwardly into engagement with a film unit. Rolls 86 are designed to be rotated in engagement with the forwardmost film unit to advance it into the bite of rolls 72 and 74 and for this purpose, are driven from roll 72 by an endless flexible drive coupling such as an O-ring 92. Rolls 86 are rotated during the rotation of rolls 72 and 74 and provision is made for disengaging rolls 86 from the film unit as soon as the leading edge portion of the film unit becomes engaged between rolls 72 and 74 and thereby prevent the movement of the next succeeding film unit into the bite of the pressure rolls during processing of the preceding film unit. These last-mentioned means include a pair of levers 94 each pivotally mounted intermediate its ends with one end engaged with a shaft on the end of roll 72 and the other end engaged with the end of lever 88 opposite roll 86 for pivoting lever 88 in a clockwise direction to disengage roll 86 from the forwardmost film unit as roll 72 is displaced forwardly relative to roll 74 and frame 75 as a film unit enters the bite of rolls 72 and 74. The pivotal mounting shown multiplies the motion of rolls 86 to provide for a relatively large displacement of rolls 86 in response to a relatively small displacement of roll 72.

Rolls 72 and 74 are preferably driven by an electrically operated motor housed within one of the sections of the camera housing, coupled with roller 74 through a suitable transmission which will be described more fully hereafter, and powered by a battery (not shown) also housed within one of the sections of the camera housing, for example, mounted on door 34 so as to be located between the door and the end of film pack 40. The circuit for controlling the operation of the motor is illustrated in Fig. 7 as including the motor 96, a battery 98, and first and second switches 100 and 102 connected in parallel with one another and in series with the motor and battery. First switch 100 is manually actuated to energize motor 96 which drives rollers 72 and 74 and friction rolls 86. Switch 100 is preferably of the type which closes only momentarily, preferably for a time sufficient to feed the leading end of a film unit into the bite of rolls 72 and 74 which, in turn, advance the film unit beyond the friction rolls into the engagement with the operating lever 104 of a second switch 102 thereby closing the second switch which keeps motor 96 energized as long as a film unit is engaged with the oper-

ating lever to ensure operation of the motor and advancement of a film unit completely between rolls 72 and 74. After the trailing edge of the film unit has been advanced completely between the pressure rolls past the operating lever 104 of switch 102, the latter will open disconnecting the motor from battery 98 and terminating the processing cycle. Switch 100 may be incorporated in the shutter mechanism of the camera and coupled with a manually operable shutter-actuating element such as a shutter release button 162 (Figure 5) so as to initiate a processing cycle immediately following exposure of a film unit. It is anticipated that the processing cycle for each film unit may require a period of the order of 1/3 of a second thus making the operation of the camera semi-automatic and enabling the operator to make exposures and process the exposed film units at the relatively rapid rate of three per second and because the friction feed rolls 86 are displaced from engagement with a film unit during movement of a film unit between the processing rolls it is impossible to advance in process two film units at a time.

Third housing section 16 is generally parallelepiped shaped, is engaged between side walls 30 and 32 of first housing section 12 and is pivotable with respect to the first housing section about the axis of processing roll 74. The third housing section includes an outer wall 106 which, in the folded position of the camera housing, is disposed in essentially the same plane as rear wall 28 and in the operative position of the camera housing, functions as the forward wall of the camera; and an outer wall 108 which in the folded position of the camera constitutes an end wall of the camera and in the operative position of the camera housing sections functions as one of the upper walls of the camera housing. The third housing section also includes side walls 109 engaged between side walls 30 and 32 of the rear housing section. A conventional photographic objective lens 110 is mounted within third housing section 16 with the lens axis disposed perpendicularly to outer or forward wall 106 so that light transmitted through the lens along the lens axis is directed, in the operative position of the camera housing, away from and at an acute angle with respect to the forwardmost film unit; and in the folded position of the camera housing, the axis of lens 110 extends approximately perpendicularly to rear wall 28 and the film units. It will be noted that when the camera is folded, the minimum controlling thickness of the camera is the front-to-rear thickness of lens 110.

Second housing section 14 comprises an outer wall 120 pivotally connected at one end via hinge 20 to rear housing section 12, and

dependent side walls 122 engaged between side walls 30 and 32 of the rear housing section. A substantially planar and preferably front surface, mirror 116 is mounted on the inside of wall 120 for reflecting light from lens 110 toward a film unit positioned for exposure in the rear housing section. The angle at which the axis of lens 110 intersects mirror 116 in the operative position of the camera housing is greater than 45° thus making it possible to locate lens 110 relatively closer to the focal plane of the lens, i.e., plane of the photosensitive element of the foremost film unit, than to the mirror and asymmetrically with respect to the focal plane thus providing for a smaller structure when the camera housing is extended in its operating position and the relatively thin compact structure previously described when the camera is folded and the housing sections are in a transport condition.

The camera includes a conventional view finder, generally designated 117, mounted within the second housing section adjacent one side of mirror 116 and including entrance and exit apertures provided with mirrors 118 at opposite ends of the second housing section.

Third housing section 16 incorporates a shutter mechanism (not shown) which may include a photocell 160 and a button 162 for releasing the shutter to make an exposure and closing switch 100 to initiate a processing cycle. Drive motor 96 (Figure 5) for processing rolls 72 and 74 is also incorporated in the third housing section and is coupled with processing roll 74 via a speed-reducing transmission including gears 164, 166, 168, 170 and 172. The drive motor is preferably of a low torque, very high speed type requiring the reduction gears to provide the torque at rolls 72 and 74 necessary to advance each film unit between the rolls at the proper speed.

Fourth housing section 18 comprises an outer wall 112 pivotally connected at one side to outer wall 120 of second housing section 14 at hinge 24 and along its opposite side to wall 108 of third housing section 16 at hinge 26, and dependent side walls 114 engaged between side walls 122 of the second housing section and outside of the ends of third housing section 16 so that in the folded position of the camera housing, the second and fourth housing sections are located between side walls 30 and 32 of the first housing section and the side walls of the fourth housing section are located between the side walls of the second housing section. Wall 112 includes an opening 124 for receiving the forward end of the view finder 117 when the camera housing is folded, in which position wall 112 appears as an extension of wall 120 of the second

housing section.

The fourth housing section functions essentially as a connection between the second and third housing sections, and as one side of a chamber providing a light path between lens 110 and a film unit positioned for exposure. The two remaining sides of this chamber in addition to those provided by the housing sections are each formed by fan-like bellows 126. Each of these bellows comprises a plurality of interlocking blades 128 all pivoted about a single axis and covered at their ends and along the sides of the two outermost blades by side walls 30, 109, 114, and 122. Blades 128 have generally U-shaped cross sections, are adapted to telescope into one another. The camera also includes means for retaining the camera housing in an operative or erect position and in the form shown, these means include a rigid link 129 (Figure 3) pivoted at one end on second housing section 14 engaged for pivoting and sliding movement at its other end on first housing section 12. A detent (not shown) coupled with a manually operable button is provided on the first housing section for engaging the end of link 129 to retain the latter against movement and thereby secure the housing sections in the erect position shown in Fig. 3.

The third housing section provides the forward wall of the camera, (i.e., the wall facing the subject), when the latter is in an operative condition, and for preventing light from being admitted into the camera housing in the region of processing rolls 72 and 74. Film units, as they are processed, are advanced directly from the camera into the light and accordingly, outer wall 106 of the third section is formed with an opening 130 for passing the film units. A pair of flexible convergent lips 132 are mounted on the inside of wall 106 between the latter and the processing rolls to provide a light-tight passage through which successive film units may be advanced from the camera and prevent the emission of light into the camera. Lips 132 may also function to grip and hold the trailing end of each film unit and prevent it from falling until the operator can grasp the film unit.

A baffle 134 is pivotally mounted within and on rear housing section 12 and is pivotally biased in a clockwise direction against a stop into the operative position shown in Figure 3 in which the baffle prevents exposure of the photosensitive element by off-axis light transmitted by the lens. When the camera housing is folded, the baffle is engaged by means on the second housing section for pivoting it in a clockwise direction to enable the housing to be completely folded.

Our copending Application No. 35636/68 (Serial No. 1 240 532) is directed to the com-

bination of a pair of pressure rollers, film-feeding means for engaging a film unit and moving it into the bite of the pressure rollers, drive means for driving the film-feeding means to feed a film unit into the bite of the pressure rollers and rotating at least one of the pressure rollers, and disengaging means arranged to sense the presence of a film unit engaged between the pressure rollers and coupled with the film feeding means so that when a film unit is engaged between the pressure rollers, the film feeding means is rendered incapable of moving another of the film units toward the bite of the pressure rollers.

Our copending application No. 35635/68, (Serial No. 1 240 531) from which the present application is divided, is directed to a camera of the self-developing type including means within the camera housing for positioning a photosensitive element at a focal plane, processing means adjacent a first end of the focal plane, a mirror oriented at an angle of less than 45° to the focal plane and diverging from the focal plane from the other end of the latter towards the first end, a lens near the first end of the focal plane orientated so that its optical axis diverges from the focal plane at an angle of less than 45° in the direction from the first end of the focal plane towards the other end, the lens directing image light on to the focal plane by reflection from the mirror, and means for moving the photosensitive element into engagement with the processing means.

Another copending application No. 5839/71 (Serial No. 1 240 540) also divided from No. 35635/68, (Serial No. 1 240 531) is directed to a folded camera comprising four body sections relatively movable between folded and extended positions, each having one primary exterior planar surface forming a part of the exterior of the body of the camera in both the folded and the extended positions; these sections are pivotally coupled near their end to form a closed loop to permit their relative movement between a folded position in which the said planar surfaces of the sections are substantially parallel to each other and an extended position in which each of the planar surfaces forms an angle with those of the adjacent sections; extensible light sealing means form a light-tight enclosure with the body sections, one of which includes a photographic objective lens and another of which includes film supporting means for positioning a photosensitive element for exposure.

WHAT WE CLAIM IS:—

1. A folding camera comprising: a first housing section having means for positioning a photosensitive element at a film plane

housing section.

The fourth housing section functions essentially as a connection between the second and third housing sections, and as one side of a chamber providing a light path between lens 110 and a film unit positioned for exposure. The two remaining sides of this chamber in addition to those provided by the housing sections are each formed by fan-like bellows 126. Each of these bellows comprises a plurality of interlocking blades 128 all pivoted about a single axis and covered at their ends and along the sides of the two outermost blades by side walls 30, 109, 114, and 122. Blades 128 have generally U-shaped cross sections, are adapted to telescope into one another. The camera also includes means for retaining the camera housing in an operative or erect position and in the form shown, these means include a rigid link 129 (Figure 3) pivoted at one end on second housing section 14 engaged for pivoting and sliding movement at its other end on first housing section 12. A detent (not shown) coupled with a manually operable button is provided on the first housing section for engaging the end of link 129 to retain the latter against movement and thereby secure the housing sections in the erect position shown in Fig. 3.

The third housing section provides the forward wall of the camera, (i.e., the wall facing the subject), when the latter is in an operative condition, and for preventing light from being admitted into the camera housing in the region of processing rolls 72 and 74. Film units, as they are processed, are advanced directly from the camera into the light and accordingly, outer wall 106 of the third section is formed with an opening 130 for passing the film units. A pair of flexible convergent lips 132 are mounted on the inside of wall 106 between the latter and the processing rolls to provide a light-tight passage through which successive film units may be advanced from the camera and prevent the emission of light into the camera. Lips 132 may also function to grip and hold the trailing end of each film unit and prevent it from falling until the operator can grasp the film unit.

A baffle 134 is pivotally mounted within and on rear housing section 12 and is pivotally biased in a clockwise direction against a stop into the operative position shown in Figure 3 in which the baffle prevents exposure of the photosensitive element by off-axis light transmitted by the lens. When the camera housing is folded, the baffle is engaged by means on the second housing section for pivoting it in a clockwise direction to enable the housing to be completely folded.

Our copending Application No. 35636/68 (Serial No. 1 240 532) is directed to the com-

bination of a pair of pressure rollers, film-feeding means for engaging a film unit and moving it into the bite of the pressure rollers, drive means for driving the film-feeding means to feed a film unit into the bite of the pressure rollers and rotating at least one of the pressure rollers, and disengaging means arranged to sense the presence of a film unit engaged between the pressure rollers and coupled with the film feeding means so that when a film unit is engaged between the pressure rollers, the film feeding means is rendered incapable of moving another of the film units toward the bite of the pressure rollers.

Our copending application No. 35635/68, (Serial No. 1 240 531) from which the present application is divided, is directed to a camera of the self-developing type including means within the camera housing for positioning a photosensitive element at a focal plane, processing means adjacent a first end of the focal plane, a mirror oriented at an angle of less than 45° to the focal plane and diverging from the focal plane from the other end of the latter towards the first end, a lens near the first end of the focal plane orientated so that its optical axis diverges from the focal plane at an angle of less than 45° in the direction from the first end of the focal plane towards the other end, the lens directing image light on to the focal plane by reflection from the mirror, and means for moving the photosensitive element into engagement with the processing means.

Another copending application No. 5839/71 (Serial No. 1 240 540) also divided from No. 35635/68, (Serial No. 1 240 531) is directed to a folded camera comprising four body sections relatively movable between folded and extended positions, each having one primary exterior planar surface forming a part of the exterior of the body of the camera in both the folded and the extended positions; these sections are pivotally coupled near their end to form a closed loop to permit their relative movement between a folded position in which the said planar surfaces of the sections are substantially parallel to each other and an extended position in which each of the planar surfaces forms an angle with those of the adjacent sections; extensible light sealing means form a light-tight enclosure with the body sections, one of which includes a photographic objective lens and another of which includes film supporting means for positioning a photosensitive element for exposure.

WHAT WE CLAIM IS:—

1. A folding camera comprising: a first housing section having means for positioning a photosensitive element at a film plane



for exposure; a mirror; a second housing
section having means for positioning the
mirror with its reflective surface in a re-
flecting plane the position of which is
5 determined by the position of the said
second section; means interconnecting the
first and second sections to permit their
relative movement between a folded position
in which the reflecting plane and the film
10 plane are substantially parallel with each
other and an extended position in which
the reflecting plane forms an acute angle
other than 45° with the film plane; means
for releasably securing the first and second
15 sections in the extended position; a photo-
graphic lens for directing light from a scene
into the camera; and means for positioning
the photographic lens such that when the
first and second sections are in the extended
20 position, the lens lies within the acute
angle formed by the reflecting plane and
the film plane with the optical axis of the
lens oriented to direct scene light on to the
reflecting plane from which it is redirected
25 on to the film plane.

2. A camera as defined in Claim 1,
including a third housing section pivotally
coupled with the first section at a position
remote from the interconnection of the
second section with the first section, and a
member pivotally connected to the third
section and to the second section at a
position remote from its interconnection with
the first section, the member supporting the
third section in fixed relation to the first 35
and second sections in the extended position.

3. A camera as defined in Claim 2, in
which the photographic lens is mounted
within the third section.

4. A camera as defined in Claim 2 or 40
3, including collapsible means joined to the
first, second and third sections and co-
operating therewith in the extended position
to define walls of the chamber.

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