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(54) PROCESSING OF FILM UNITS

(71) We, POLAROID CORPORATION, a corporation organised and existing under the laws of the State of Delaware, United States of America, of 730 Main Street, Cambridge, Massachusetts 02139, 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 the processing of film units and, particularly, to the processing of self-developing film units in a camera.

In one known camera a section of a film unit which has been treated with processing liquid is advanced from the camera while an untreated section of the film unit still remains within the camera. This is possible, because the surface of the film unit includes a thin, light transmissive layer, for example, a polymeric film derived from ethylene glycol terephthalic acid, or a cellulose derivative such as cellulose triacetate, and a rupturable pod of processing liquid that includes an opacifying constituent. The photosensitive layer of the film unit is exposed through the transparent surface layer and, as the film unit is subsequently advanced between a pair of spread rollers towards the film exit of the camera, the spread rollers progressively distribute a mass of the processing liquid between the transparent layer and the photosensitive layer of the film unit. The opacifying constituent of the processing liquid protects the exposed portions of the film from ambient light subsequently incident upon the transparent layer. The recorded image is transferred to an image receiving layer by a diffusion-transfer process, and once this process has been completed the developed image is viewable through the transparent layer.

One of the problems in such a camera is due to a phenomenon generally referred to as "light-piping." More specifically, light-

piping is the transmission of unwanted light into the camera through the transparent surface layer once the film unit emerges through the camera exit. Such light can cause undesirable "fogging" of the film.

To understand this phenomenon more clearly, it should be recognised that the photosensitive portion of the film unit is backed by an opaque support layer. Thus, once the processing liquid has been spread across the photosensitive layer or layers the development process may be completed when the film unit itself is exposed to ambient light while untreated sections of the film unit still remain on the opposite side of the spread rollers within a light protected chamber of the camera. Light may then be reflected internally within the light transparent layer and may scatter or diffuse lengthwise therealong into the light protected camera chamber until it reaches a point in advance of the liquid mass being spread between the film unit's transparent and photosensitive layers. Such light can cause "fogging" of the yet untreated film.

One solution to this light-piping problem is to include an opacifying pigment in the light transparent layer itself. Such an opacifying pigment may comprise carbon black particles in such amounts as to offer little resistance to light rays passing therethrough during an exposure but at the same time substantially precluding the piping of light lengthwise through the layer. This is possible because light attempting to pass lengthwise through the layer must travel a much larger distance than light passing through the thickness of the layer. Even so, there is inevitably a reduction in the amount of light transmitted to the photosensitive layer.

It is also desirable to keep to a minimum the amount of processing liquid which must be included in each film unit since the cost of the processing liquid is a substantial part of the total cost of a unit.

In accordance with the present invention photographic processing apparatus for distributing a processing liquid between a pair of juxtaposed elements of a stiff film unit, includes means for moving a mass of the processing liquid between the elements in response to relative motion between the elements and the liquid moving means; means located on the side of the liquid moving means from which successive incremental sections approach the liquid moving means for restraining the movement of the elements in a direction transverse to the direction of the relative motion between the elements and the liquid moving means, and means located on the other side of the liquid moving means for progressively engaging successive incremental sections of each film unit as it emerges on the other side of the liquid moving means such that portions of the film unit still disposed on the first-mentioned side of the liquid moving means are urged towards the restraining means to control the movement of the mass of processing liquid between the elements.

In a preferred embodiment of the invention a single unitary member forming both a light shield and a deflector for each film unit is positioned in an extension housing such that film units emerging from between a pair of spread rollers are both shielded from ambient light and deflected downwards toward a film exit in the extension housing. The light shield-deflector is moved from an operative position into an inoperative position in response to the folding of the camera from an extended configuration into a collapsed configuration.

Where the film units include a light transmissive layer, the layer may include an opaque pigment but, due to the shielding of the film unit during its passage from the spread rollers to the film exit, the amount of pigment required to prevent light-piping through the light transmissive layer is kept to an absolute minimum. Moreover, the untreated sections of the film unit on the opposite side of the spread rollers are urged by the deflector toward the upper wall of the film chamber housing a stack of film units and this assists in controlling the movement of the mass of processing liquid. Consequently the amount of processing liquid required is not so great as it would be in the absence of this deflection.

In order that the invention may be more clearly understood, one example will now be described with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic perspective view of a collapsible camera in its operative condition.

Figure 2 is a perspective view of the camera of Figure 1 in its collapsed or storage condition;

Figure 3 is a diagrammatic, partially cut-away, side elevation view of the camera shown in Figure 1;

Figure 4 constitutes a fragmentary diagrammatic side elevation view in section of a form of film unit suitable for use in the camera of Figure 1;

Figure 5 constitutes a view similar to that of Figure 4 of another form of film unit suitable for use with the camera of Figure 1;

Figure 6 is an enlarged section of the camera as viewed in Figure 3 illustrating a phase of the film processing operation;

Figure 7 constitutes a view of the section of the camera shown in Figure 6 when the camera is in its collapsed or storage condition.

Figure 8 is an exploded diagrammatic presentation in perspective of a light shielding member and certain components associated with its mounting and operation within the camera of Figure 1; and

Figures 9 and 10 diagrammatically represent fragmentary perspective views of the film unit container or magazine employed in the camera of Figure 1.

Referring first to Figures 1 to 3 of the drawings, a camera 10 includes housing members 12, 14, 16 and 18 which are pivotally coupled to one another at pivots 20, 22, 24 and 26 for relative movement between a compact collapsed inoperative condition (Figure 2) and an extended operative condition (Figures 1 and 3). Additionally, an extension housing member 28 is coupled to the front of the housing member 18 at pivot 30. In this connection, the housing member 28 mounts a spread roller assembly 32 including juxtaposed rollers 34 and 36, the rollers being resiliently biased towards one another by a spring 38. With the camera extended, the spread roller assembly 32 is positioned across an entrance 40 to a film magazine receiving chamber 42. Consequently, the pivotal connection between the housing members 18 and 28 permits the latter to be displaced with respect to the former to remove the spread roller assembly 32 from its blocking position across the entrance 40 to facilitate the loading of the camera with a film magazine 44. Each film magazine 44 includes a stack of self-developing film units 46. Additionally, each film magazine 44 has a picture framing aperture 48 which, when the magazine is appropriately positioned within the receiving chamber 42, is aligned with the optical system of the camera 10 to facilitate film exposure operations. Disposed within the film magazine 44 is a spring assembly 50 that acts against a plate 52 to continually urge the film unit 46 closest to the picture framing aperture 48 into the proper focal plane for exposure purposes. An elongated opening 54 is provided in the housing of the film magazine 44 to facilitate

the advancement of each film unit 46 from the magazine towards the spread roller assembly 32 after its exposure.

The member 12 comprises a housing for the camera's lens-shutter assembly 56 and an actuator button 58 for initiating camera operations, and is adapted to rotate about the pivot 26 into a position (See Figure 7) in front of the spread roller assembly 32 adjacent the housing member 28 when the camera is rearranged from its extended condition into its collapsed condition. When the camera is extended as shown in Figures 1 and 3, the housing members 12, 14, 16 and 18 co-operate with a collapsible bellows 60 secured thereto to form a six-sided exposure chamber 62.

In addition to an objective lens 63 mounted in the housing member 12, the camera's optical system includes a planar mirror 64 mounted on an interior wall of the housing member 16 to reflect light rays passing through the objective lens towards the camera's focal plane. A plate-like reflex member 66 is pivotally coupled to the housing member 18 at a pivot 68 for displacement between its position shown in Figure 3 wherein it overlies the picture framing aperture 48 and its position shown in phantom in that figure of the drawings wherein it is disposed in overlying adjacency with respect to the planar mirror 64. This reflex member 66 includes a viewing surface 70 preferably comprising a suitable Fresnel configuration and a planar light reflective surface 72. The operation of this reflex member 66 will subsequently be set forth in more detail. The optical system of the camera 10 further includes a collapsible viewing device 74 appropriately mounted to the housing member 14. This viewing device 74 comprises a curved mirror 76, an eye lens 78 and appropriate housing structure, including telescoping blades 80 serving to define a viewing chamber 82 when the viewing device is extended. Appropriate linkages 84 and 86 are included with the viewing device 74 to respectively effect the erection of the curved mirror 76 and eye lens 78 into their operative positions responsive to the camera's being rearranged from its collapsed or storage condition into its extended operative condition.

This unique arrangement of optical elements provides the camera 10 with a single lens reflex characteristic wherein it is operated first in a viewing and focusing mode and thereafter in an exposure and processing mode. As best seen in Figure 3, during the viewing and focusing mode of operation, the reflex member 66 rests in light-tight engagement over the film magazine's picture framing aperture 48. The camera's lens-shutter assembly 56 includes a normally opened shutter which, when the camera is extended,

permits image-carrying light rays from the objective lens 63 to pass across the chamber 62 to impinge upon the mirror 64 that reflects such light rays onto the viewing surface 70 of the reflex member 66 whereon is thus formed an image of the scene to be photographed. Light rays emanating from the image formed on the viewing surface 70 of the reflex member 66 are directed upwardly therefrom to mirror 64 from which they are thence reflected towards the camera's housing member 14. As these light rays are reflected from the mirror 64, they pass first through a small aperture 88 in the bellows 60 that serves to define an entrance pupil for the viewing device 74, and then through a larger aperture 90 in housing member 14 to impinge upon the curved mirror 76. This curved mirror 76 includes a concave ellipsoidal shaped reflecting surface which redirects these light rays rearwardly through the lens 78 toward an eye station 92. A real, erect, and unreverted aerial image diagrammatically designated by an arrow 94 is formed by the concave mirror 76 and magnified by the eye lens 78 to facilitate viewing and focusing from the eye station 92. In this connection, the housing member 12 additionally serves to mount a focus control knob 96 (See Figure 1) which may be manually rotated to effect an appropriate rearward or forward displacement of the lens 63.

To record an image of a subject on the forwardmost film unit 46, the camera's normally opened shutter is closed and the reflex member 66 pivoted into its position shown in phantom in Figure 3. Thus, when the shutter is subsequently actuated, image-carrying light rays from the subject enter the camera's chamber 62 through the objective lens 63 and are reflected by the reflective surface 72 of the reflex member 66 onto the film unit 46 disposed across the picture framing aperture 48 of the film magazine 44.

To briefly summarize film exposure operations, the camera 10 is first arranged into its extended condition with the reflex member 66 positioned across the picture framing aperture 48 of the magazine 44. The photographer then views an aerial image of the subject through the eye lens 78 while adjusting the focus control knob 96. Once the image on the viewing surface 70 of the reflex member 66, as viewed through the viewing device 74, is in sharp focus, the photographer actuates the button 58 mounted on the housing member 12. Means (not shown) are included in the camera 10 which are responsive to the actuation of the button 58 to effect the following sequence of system operations. First, the normally open shutter closes and a blocking member (not shown) covers the aperture 88 in the bellows 60 causing the exposure chamber 62 to assume

a light-tight condition. Next the reflex member 66 is pivoted upwardly within the chamber 62 into its position shown in phantom in Figure 3 uncovering the picture framing aperture 48 and the film unit 46 most adjacent thereto. The camera's shutter is then opened to admit image-carrying light rays from the scene into the exposure chamber 62, which light rays are then reflected by the surface 72 of the reflex member 66 onto the forwardmost film unit 46 to effect the recording of a latent image therein. After an appropriate exposure interval, the shutter again closes, the reflex member 66 is returned to its initial position wherein it overlies the picture framing aperture 48 and the shutter and viewing device aperture 88 are opened. In connection with these operations, it should be noted that the camera 10 includes an automatic exposure control system (not shown), which may take any suitable form, operable to automatically define the aforementioned appropriate exposure control interval. The power supply for the automatic exposure control system, for certain system operations previously described and for system operations yet to be described, may typically comprise a suitable battery 93 contained with each film magazine 44 or, alternatively, provided within the camera 10 separate from the film magazine.

The film unit 46 illustrated in Figure 4 has an inherent stiffness and includes no waste materials, i.e., no materials which must necessarily be discarded by the photographer after the film unit has been exposed and processed. As supplied, the film unit 46 includes a rupturable pod 100 of processing fluid 102. Additionally, it includes a transparent or light transmissive layer or element 104, an image-receiving layer or element 106 and a photosensitive system or element 108, which element 108 may itself comprise a plurality of layers or elements, disposed on an opaque layer or support element 110. When the film unit 46 is disposed within the film magazine 44 adjacent the picture framing aperture 48 (see Figure 3), its light transparent element 104 is disposed adjacent the reflective surface 72 of the reflex member 66. Thus, when the photographer depresses the button 58 (See Figure 1) in part causing the reflex member 66 to assume its position shown in phantom in Figure 3, the image-carrying light rays from the scene being photographed are directed through the film unit's light transparent element 104 and its image-receiving element 106 onto its photosensitive element 108. Subsequently, as the exposed film unit 46 is advanced from the film magazine 44 between the rollers 34 and 36, the compressive force exerted thereon by the rollers first effects a rupturing of the pod 100 and then the progressive advancement of the mass of fluid 102 initially

retained therein lengthwise across the film unit intermediate its light transmissive element 104 and its photosensitive element 108, more specifically being actually disposed between its image-receiving element 106 and its photosensitive element 108. As previously indicated, a suitable opacifying constituent is included within the processing fluid 102 to preclude ambient light rays incident upon sections of the transparent element 104 after its emergence from the camera housing from contacting adjacent sections of the still photosensitive element 108. As is well known in the art, the processing fluid 102 coats with the exposed photosensitive system to form a viewable image in the image-receiving element 106 by a diffusion-transfer process. It should be noted that the film unit 46 may comprise either a processing fluid 102 and an element 108 having a photosensitive system capable of cooperating therewith to produce either an image in the image-receiving element 106 which is viewable in black-and-white or an image in the image-receiving element which is viewable in full-colour. The opacifying agent in the fluid 102 in combination with the opaque support 110 permits the processing operation to be completed while the film unit 46 itself is exposed to ambient light. The image thus produced in the image-receiving element 106 is viewable through the film unit's light transparent element 104.

As previously suggested and as will subsequently be discussed in more detail, the light transmissive element 104 of the film unit 46 may include an opaque pigment dispersed therethrough to alleviate undesirable fogging of untreated portions of the exposed film unit by the aforementioned light-piping phenomenon.

With respect to the advancement of the film units 46 from the film magazine 44 and through the rollers 32 and 34, the camera 10 also includes a picking mechanism (not shown) and a gear drive (not shown) for the roller 34, both of which are suitably energized by the aforementioned battery 93 of the camera system. The picking mechanism engages the rear edge of an exposed film unit 46 and advances it from the magazine 44 through the magazine's opening 54 into the bite of the rollers 34 and 36. Once the leading edge of the exposed film unit 46 is engaged between the rollers 34 and 36, the drive roller 34 effects further advancement of that film unit from the camera 10. Preferably, operation of the picking mechanism and gear drive arrangement for the roller 34 is automatically responsive to the actuation of the button 58 (See Figure 1) and sequenced to be energized immediately following the return of the reflex member 66 to its position wherein it overlies the picture framing aperture 48 (See Figure 3).

Referring now to Figures 9 and 10 of the drawings, it will be seen that certain features of the film magazine 44 have been more clearly illustrated therein. In this respect, the film magazine 44 includes a plurality of specially configured and strategically located projections 112 which in part serve to define the magazine's elongated opening 54. As each exposed film unit 46 is advanced from the magazine 44, these projections exert a compressive force thereon at selected positions widthwise thereof. Thus, once the pod 100 of the film unit has been ruptured, these projections 112 are adapted to control the movement of the mass of processing fluid 102 between the image-receiving element 106 and the photosensitive element 108 of the exposed film unit 46 as it is advanced from the magazine 44. More specifically, they influence or serve to "flatten" the meniscus, i.e., the leading edge of the fluid mass widthwise of the film unit 46. Preferably, the film magazine 44 including its projections 112 is formed of an appropriate polymer such as polystyrene which is somewhat flexible when moulded into a relatively thin structure. Under such circumstances, the portion 114 of the film magazine 44 from which the projections 112 depend, has an inherent flexibility. Thus, in order to preclude any undesirable flexing of this portion 112 of the magazine 44 during film processing operations, the camera 10 includes a rigid support member 116 against which the magazine portion 114 is seated when the magazine is properly positioned within the receiving chamber 42 of the camera. The magazine 44 is also preferably formed with a finger 118 which assures that only one film unit 46 at a time is advanced from the magazine 44 towards the rollers 34 and 36 responsive to operation of the aforementioned picking mechanism.

Referring next to Figures 6, 7 and 8, it will be recalled that the housing member 28 is pivotally connected to housing member 18 to facilitate the loading of a film magazine 44 into the camera 10 and its subsequent removal therefrom. This housing member 28 extends below and in front of the spread roller assembly 32. The light shielding plate 120 is pivotally connected to the housing member 28 adjacent its leading edge 121 by an elongated generally U-shaped spring 122 which continually urges that plate towards its operative position against a stop 124 (See Figure 6). As the camera is rearranged from its extended condition into its collapsed condition, its lens-shutter housing 56 engages the light shielding plate 120 and effects a displacement thereof into its position depicted in Figure 7. It will be noted that at such times, i.e., when the camera 10 is in its collapsed or storage condition, the lens-shutter housing 56 occupies at least a por-

tion of the space occupied by the light shielding plate 120 when this latter component of the camera is in its operative position. Thus, it will be seen that provision has been made for the light shielding plate 120 without otherwise increasing the size of the camera 10 or complicating its operation.

The housing member 28 is formed with an elongated opening 128. Mounted to the member 28 so as to extend across its opening 128 is a resiliently flexible sheet metal component 130 which may be formed of any suitable material such as tempered steel (stainless and carbon), phosphor bronze, beryllium copper. It will be recognized that this sheet metal component 130 serves to provide the camera 10 with exit means 131 for each film unit 46 subsequent to its emergence from the spread roller assembly 32. In this respect, as the exposed film unit 46 is advanced from the spread roller assembly 32, it impinges upon the light shielding plate 120 which redirects its path of movement towards the sheet metal component 130 and more particularly towards the leading and free edge 132 thereof. In its normal position (See Figure 7) the leading edge 132 of the component 130 is positioned in close adjacency to, and preferably seated against, the edge 134 of the opening 128 in the housing member 28. However, as the film unit 46 moves from the spread roller assembly 34 into engagement with the sheet metal component 130, it deflects that component away from the opening's edge 134 thereby permitting the film unit to exit from the camera 10 between the sheet metal component's deflected free edge 132 and the edge 134 of the housing member's opening 128. At the same time, once the film unit 46 has cleared the rollers 34 and 36, it is not permitted to fall out of the camera, since it is retained by the force of the sheet metal component 130 which presses it against the edge 134 of the opening 128. Also, the trailing edge of any film unit 46 so retained by the exit means 131 is seated against the plate 120. Thus, if a second film unit 46 should be exposed prior to removing the first film unit 46 from the exit means 131, its leading edge will engage the trailing edge of the first film unit and push that film unit through the exit means.

This unique arrangement has a number of highly important advantages over heretofore devised systems. First, at least a major portion of the light transmissive element 104 of an exposed film unit 46 intermediate the spread roller assembly 32 and the camera's exit means 131 is shielded from ambient light by the plate 120. In this connection, while the chamber 136 is not completely light-tight, the light shielding plate 120 tends to "shade" the portion of the film unit's light transmissive element 104 disposed therein from ambient light. Thus, the in-

tensity of ambient light rays incident upon that portion of the film unit's light transmissive element 104 is greatly reduced. Thus the light shielding plate 120 cooperates with the opacifying pigment in the film unit's light transmissive element 104 to preclude undesirable fogging by the aforementioned light-piping phenomenon, of those portions of the film unit 46 yet untreated with the processing fluid 102. In other words, it is no longer necessary for the opacifying pigment in the light transmissive element 104 to, by itself, carry this burden. Consequently, other factors remaining unchanged, the quantity or density of the opacifying pigment in the light transmissive element 104 may be reduced and still effectively preclude substantially any ambient light rays from being light-piped through that element 104 to exposed untreated portions of the film unit 46. Since the quantity of the opacifying pigment in the light transmissive element 104 can now be reduced or minimized, any adverse effect of that opacifying pigment on the transmissions of image-carrying light rays focused by the camera's objective lens 63 to the film unit's photosensitive element 108 during film exposure operations, or on the ability to sequentially view the image developed in the image-receiving element 106 through the transparent element 104, is similarly reduced or minimized.

In this same contact, another advantage is derived from this unique arrangement wherein the light shielding plate 120 deflects the exposed film unit 46, from the normal path it assumes in emerging from the spread roll assembly 32, towards the exit means 131 of the camera 10 which is disposed out of alignment with that normal path. More particularly, this arrangement permits a greater length of the film unit 46 to be shielded from ambient light within the confines of a housing structure of given size intermediate the spread roller assembly 32 and the camera's exit means than would be the case if the film unit 46, with its inherent stiffness, were permitted to substantially continue along its normal path as it emerged from the roller assembly towards an appropriately positioned exit means.

Obviously, it is desirable that the various functions required to be performed by the camera 10 be accomplished with a minimum power drain on the camera's battery 93. Along these lines, it will be appreciated that the thickness of the layer of fluid 102 distributed between the image-receiving element 106 and the photo-sensitive element 108 of exposed film units 46 during film processing operations is a function of the compressive force exerted on the film unit as it passes between the spread rollers 34 and 36. At the same time, the power drain on the camera's battery is a function of the load

on these spread rollers 34 and 36. Consequently, it has heretofore been found desirable to place a practical limit on the force of the spring 38 so as to not unduly load the camera's power source, and to compensate for this situation by providing a quantity of processing fluid 102 with each film unit 46 which is in excess of that actually required to process that film unit. The penalty paid for this compromise is an increased film unit cost.

Another factor influencing the thickness of the layer of processing fluid 102 spread between the image-receiving element 106 and the photosensitive element 108 of the film unit 46 is the compressive force exerted on the film unit in the area thereof in advance of the spread rollers 34 and 36, i.e., adjacent the camera's rigid support member 116 (See Figure 3). More specifically, it has been found that the thickness of the fluid layer decreases as this compressive force is increased. In this respect it is believed that the shear rate of the fluid 102 increases as this compressive force is increased thereby producing a fluid layer of decreased thickness. This compressive force is a function of the force of the spring assembly 50. However, any attempt to further reduce the thickness of the fluid layer by increasing the force of the spring assembly 50 directly increases the power drain on the camera's battery. More specifically, the frictional forces which must be overcome by the camera's picking mechanism (not shown) in advancing an exposed film unit 46 from the magazine 44 into the bite of the rollers 34 and 36 are a function of the load exerted on the film units by the spring assembly 50.

One of the significant advantages of the above described processing system is that it provides means for controlling the movement of the mass of processing fluid 102 between the elements 106 and 108 of an exposed film unit 46 and therefore the thickness of the processing fluid layer spread therebetween without resorting to the undesirable expediency of either further increasing the load on the rollers 34 and 36 of the force of the spring assembly 50. This aspect of the processing system may best be understood by referring to Figure 6 of the drawings. It will first be recognized that the camera's rigid support member 116 and/or the film magazine's portion 114 constitute means for restraining the movement of adjacent portions of an exposed film unit 46, under the influence of the spring assembly 50, in a direction transverse the direction of the relative motion between the film unit and the spread roller assembly 32. Since the film unit 46 has an inherent stiffness and is deflected downwardly by the light shielding plate 120 (See Figure 6) away from the path it would otherwise follow in emerging from

the spread roller assembly 32, an effect of that light shielding plate is to urge progressive sections of the film unit against the aforementioned restraining means of the camera system in advance of the spread roller assembly. Thus, the light shielding plate 120 effects a compressive force on the exposed film unit immediately in advance of the spread roller assembly 32 thereby effecting a reduction in the thickness of the layer of processing fluid 102 spread between the film unit's image-receiving element 106 and photosensitive element 108.

Obviously, the force with which the plate 120 urges the film unit 46 against adjacent portions of the film magazine 44 is a function of the extent to which that plate deflects the film unit. Figure 6 depicts one particular arrangement which has provided satisfactory results. For instance, prior to the present invention a particular camera system of the type illustrated effected the distribution of a layer of fluid on the order of .0026" in thickness between the image-receiving element 106 and the photosensitive element 108 of a Figure 4 type of film unit 46. The image area of the film unit was on the order of 3.14" square and the total processing fluid employed was approximately .43 cubic cm. By incorporating a light shielding plate 120-exit means 131 arrangement in that same camera structure, the thickness of the layer of fluid spread by the otherwise unchanged camera system was reduced to approximately .0024" and produced a photograph of the same quality. This constituted a savings of approximately .035 cubic cm. of processing fluid. In this instance the camera arrangement was similar to that depicted in Figure 6. In this same context, the effect of the projections 112 of the magazine 44 (See Figures 9 and 10) in controlling the contour of the fluid meniscus is a function of the force by which the film unit 46 is pressed thereagainst. Consequently, the light shielding plate 120 additionally constitutes means for controlling the movement of the mass of fluid 102 across the film unit 46 in that it acts through the relatively stiff film unit to urge that unit against the projections 112.

It will be recognized that the structural parameters per se of the film unit 46 provide for the formation therein of a transfer image upon exposure and processing which is viewable as a geometrically reversed image of the subject. Accordingly, to provide a transfer image formation which is not geometrically reversed when viewed, the camera 10 includes an image reversing optical system. Another type of film unit suitable for use with the camera of Figure 1 is diagrammatically depicted in Figure 5 of the drawings. As such, it comprises a light transparent or light transmissive element 188 through

which its photosensitive element 190, that itself may comprise a plurality of layers or elements, is exposed to image-carrying light rays from the scene being photographed. An image receiving element 192 is spaced from the photo-sensitive element 190 by an opaque element 194. The light transparent element 188 of the film unit 186 may, for example, be formed of a material similar to that employed to form the element 104 of the film unit 46 of Figure 4 including an opaque pigment to alleviate the light-piping problem. Additionally, the processing fluid 196 initially retained in the film unit's rupturable pod 198 may include an opaque constituent so that it presents an opaque layer between the light transmissive element 188 and photosensitive element 190 once it has been distributed therebetween. During the processing operation the fluid 196 effects the formation of a geometrically non-reversed viewable image in the image-receiving element 192 from the latent image initially recorded in the photosensitive element 190. Consequently, camera structure incorporating the present invention for use with this type of film unit 196 would not require an optical system capable of correcting for a right-left reversal of the viewable image.

A camera for use with self-developing film units each having a light transmissive outer surface element extending lengthwise thereof, and which includes a processing station at which exposed film units are treated with a processing liquid, an exit through which the treated units may be withdrawn from the camera (the exit being out of alignment with the processing station such that the treated units are fed along a non-linear path between the processing station and the exit), and a light shield so arranged that the treated section of a film unit is shielded from ambient light during its passage along the non-linear path, is separately claimed in our copending Application 16372/73 (Serial No. 1,393,183) from which the present Application has been divided.

WHAT WE CLAIM IS:—

1. Photographic processing apparatus for distributing a processing liquid between a pair of juxtaposed elements of a stiff film unit, the apparatus including: means for moving a mass of the processing liquid between the elements in response to relative motion between the elements and the liquid moving means; means located on the side of the liquid moving means from which successive incremental sections approach the liquid moving means for restraining the movement of the elements in a direction transverse to the direction of the relative motion between the elements and the liquid moving means; and means located on the other side of the liquid moving means for progressively engaging successive incremental sections of

the spread roller assembly 32, an effect of that light shielding plate is to urge progressive sections of the film unit against the aforementioned restraining means of the camera system in advance of the spread roller assembly. Thus, the light shielding plate 120 effects a compressive force on the exposed film unit immediately in advance of the spread roller assembly 32 thereby effecting a reduction in the thickness of the layer of processing fluid 102 spread between the film unit's image-receiving element 106 and photosensitive element 108.

Obviously, the force with which the plate 120 urges the film unit 46 against adjacent portions of the film magazine 44 is a function of the extent to which that plate deflects the film unit. Figure 6 depicts one particular arrangement which has provided satisfactory results. For instance, prior to the present invention a particular camera system of the type illustrated effected the distribution of a layer of fluid on the order of .0026" in thickness between the image-receiving element 106 and the photosensitive element 108 of a Figure 4 type of film unit 46. The image area of the film unit was on the order of 3.14" square and the total processing fluid employed was approximately .43 cubic cm. By incorporating a light shielding plate 120-exit means 131 arrangement in that same camera structure, the thickness of the layer of fluid spread by the otherwise unchanged camera system was reduced to approximately .0024" and produced a photograph of the same quality. This constituted a savings of approximately .035 cubic cm. of processing fluid. In this instance the camera arrangement was similar to that depicted in Figure 6. In this same context, the effect of the projections 112 of the magazine 44 (See Figures 9 and 10) in controlling the contour of the fluid meniscus is a function of the force by which the film unit 46 is pressed thereagainst. Consequently, the light shielding plate 120 additionally constitutes means for controlling the movement of the mass of fluid 102 across the film unit 46 in that it acts through the relatively stiff film unit to urge that unit against the projections 112.

It will be recognized that the structural parameters per se of the film unit 46 provide for the formation therein of a transfer image upon exposure and processing which is viewable as a geometrically reversed image of the subject. Accordingly, to provide a transfer image formation which is not geometrically reversed when viewed, the camera 10 includes an image reversing optical system. Another type of film unit suitable for use with the camera of Figure 1 is diagrammatically depicted in Figure 5 of the drawings. As such, it comprises a light transparent or light transmissive element 188 through

which its photosensitive element 190, that itself may comprise a plurality of layers or elements, is exposed to image-carrying light rays from the scene being photographed. An image receiving element 192 is spaced from the photo-sensitive element 190 by an opaque element 194. The light transparent element 188 of the film unit 186 may, for example, be formed of a material similar to that employed to form the element 104 of the film unit 46 of Figure 4 including an opaque pigment to alleviate the light-piping problem. Additionally, the processing fluid 196 initially retained in the film unit's rupturable pod 198 may include an opaque constituent so that it presents an opaque layer between the light transmissive element 188 and photosensitive element 190 once it has been distributed therebetween. During the processing operation the fluid 196 effects the formation of a geometrically non-reversed viewable image in the image-receiving element 192 from the latent image initially recorded in the photosensitive element 190. Consequently, camera structure incorporating the present invention for use with this type of film unit 196 would not require an optical system capable of correcting for a right-left reversal of the viewable image.

A camera for use with self-developing film units each having a light transmissive outer surface element extending lengthwise thereof, and which includes a processing station at which exposed film units are treated with a processing liquid, an exit through which the treated units may be withdrawn from the camera (the exit being out of alignment with the processing station such that the treated units are fed along a non-linear path between the processing station and the exit), and a light shield so arranged that the treated section of a film unit is shielded from ambient light during its passage along the non-linear path, is separately claimed in our copending Application 16372/73 (Serial No. 1,393,183) from which the present Application has been divided.

WHAT WE CLAIM IS:—

1. Photographic processing apparatus for distributing a processing liquid between a pair of juxtaposed elements of a stiff film unit, the apparatus including: means for moving a mass of the processing liquid between the elements in response to relative motion between the elements and the liquid moving means; means located on the side of the liquid moving means from which successive incremental sections approach the liquid moving means for restraining the movement of the elements in a direction transverse to the direction of the relative motion between the elements and the liquid moving means; and means located on the other side of the liquid moving means for progressively engaging successive incremental sections of



each film unit as it emerges on the other side of the liquid moving means such that portions of the film unit still disposed on the first-mentioned side of the liquid moving means are urged towards the restraining means to control the movement of the mass of processing liquid between the elements.

2. Apparatus according to claim 1 in which the restraining means includes means for controlling the shape of the meniscus of the moving mass of processing liquid.

3. Apparatus according to claim 1 or claim 2 in which the means for progressively engaging successive incremental sections of each film unit further guides the film unit towards an exit through which the film units are withdrawn from the apparatus.

4. Apparatus according to claim 3 in which the exit is formed in an extension housing extending in a direction substantially parallel to the direction of the relative motion between the elements and the liquid moving means.

5. Apparatus according to any one of the claims 1 to 4 in which the means for progressively engaging successive incremental sections of each film unit is movable between an inoperative position and an operative position.

6. Apparatus according to claim 5 in which the engaging means is pivotally mounted for movement between its inoperative position and its operative position.

7. Apparatus according to claim 5 or claim 6 including means for resiliently urging the engaging means toward its operative position.

8. Apparatus according to any one of the claims 5 to 7 in which the engaging means is moved from its operative position into its inoperative position in response to the folding of the processing apparatus from an extended configuration into a collapsed configuration.

9. Apparatus according to any one of the claims 5 to 7 in which the engaging means is automatically displaced from one of its positions into the other of its positions in response to the movement of the apparatus between collapsed and extending configurations.

10. A camera including processing apparatus according to any one of the claims 1 to 9.

11. A camera according to claim 10 as appendant to claim 8 further including a component which is displaced into a position occupying at least a portion of the space occupied by the engaging means in its operative position when the camera is collapsed.

12. A camera according to claim 11 in which the component comprises a lens housing.

13. A camera according to claim 10 as appendant to claim 4 in which the exit includes means for gripping the portion of a film unit disposed therein when a film unit is moved into the exit.

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