United States Patent [19]

Sorli

[11] **3,802,887**

[45] **Apr. 9, 1974**

[54] **LARGE FORMAT, SELF-DEVELOPING, PHOTOGRAPHIC FILM UNIT**

[75] Inventor: **Duncan C. Sorli,** Chelmsford, Mass.

[73] Assignee: **Polaroid Corporation,** Cambridge, Mass.

[22] Filed: **May 12, 1972**

[21] Appl. No.: **252,550**

[52] **U.S. Cl.** ..... **96/76 R,** 95/13

[51] **Int. Cl.** **G03c 1/48**

[58] **Field of Search** ..... 96/76 R, 29

[56] **References Cited**

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Primary Examiner—Norman G. Torchin

Assistant Examiner—John L. Goodrow

[57] **ABSTRACT**

A large format, self-developing, film unit which is specially configured for use with a unique film holding cassette and drum processor for distributing a fluid processing composition between photosensitive and image-receiving elements of the film unit. Each film unit element includes a leader having registration structure integrally formed therewith such that the photosensitive and image-receiving elements may be accurately registered with one another and the processing drum.

7 Claims, 10 Drawing Figures

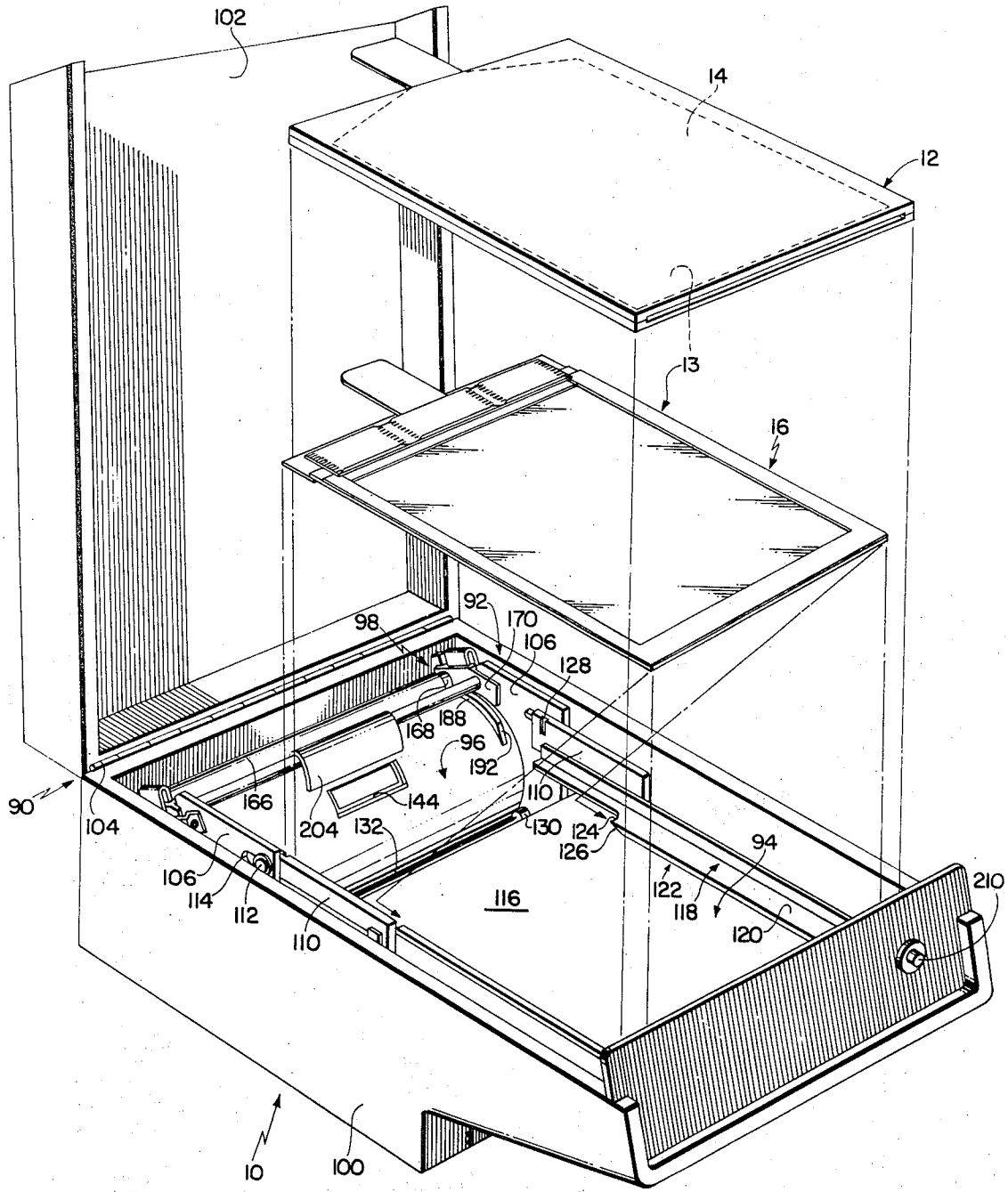

102
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12
13
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188
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166
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FIG. 1

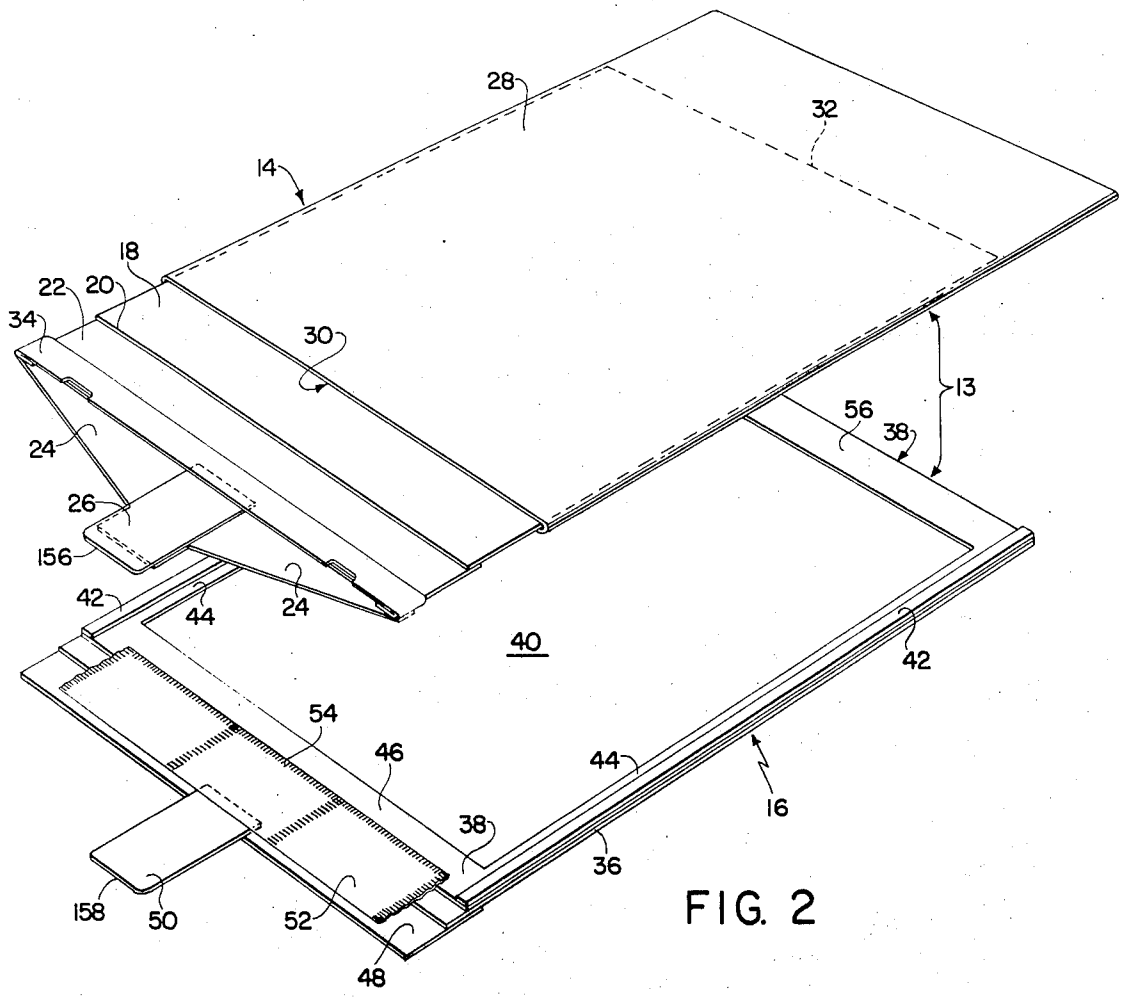

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FIG. 2

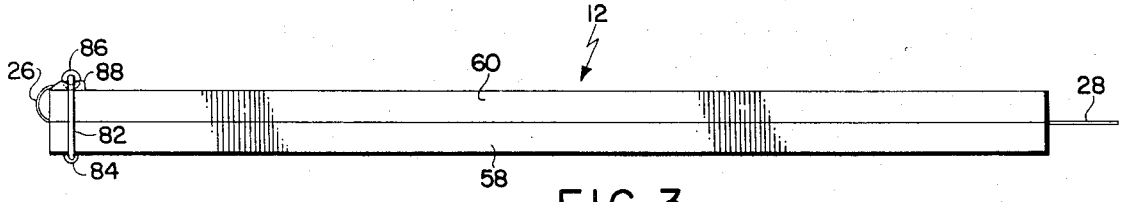

12
86
26
88
60
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82
84
58

FIG. 3

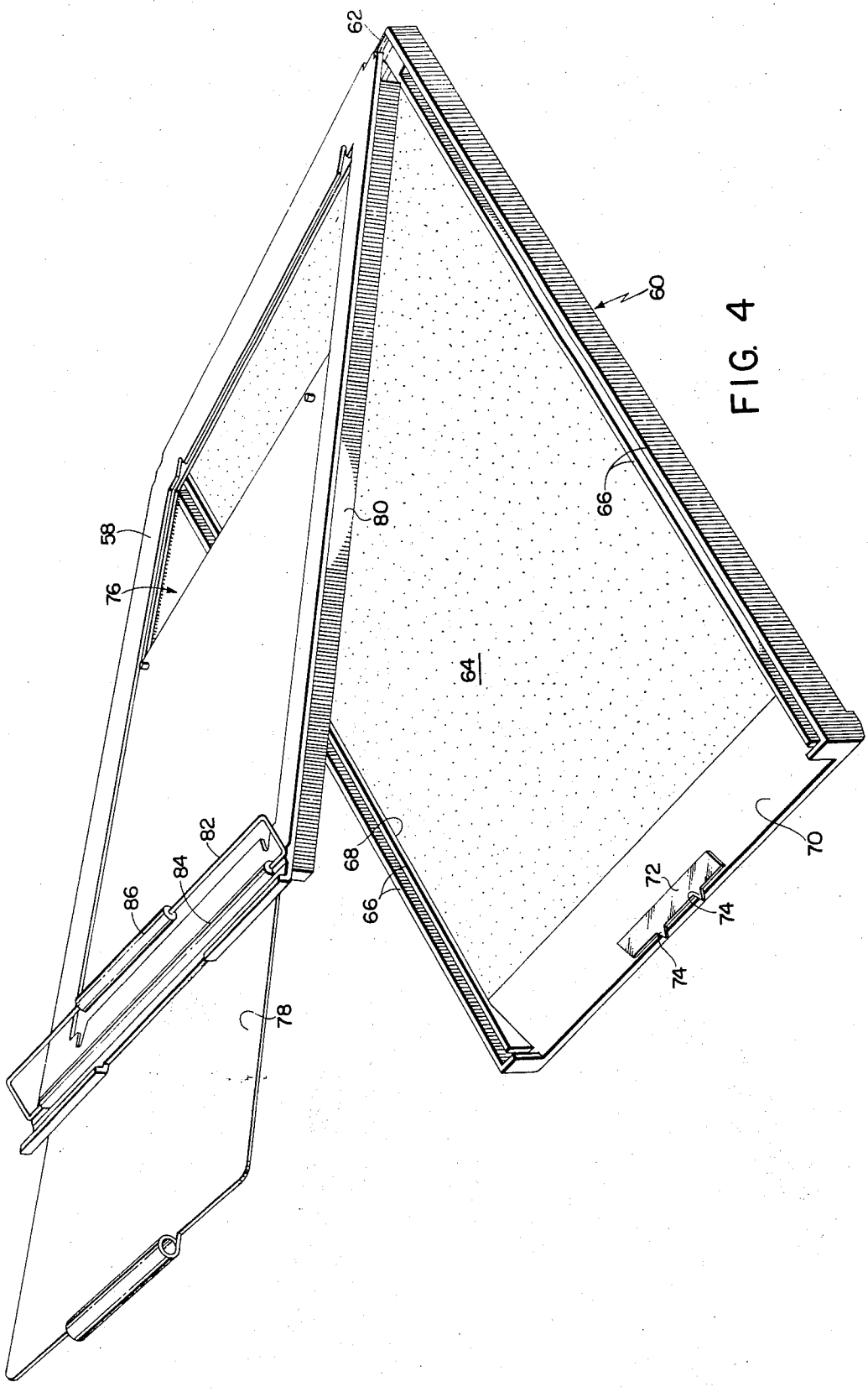


FIG. 4

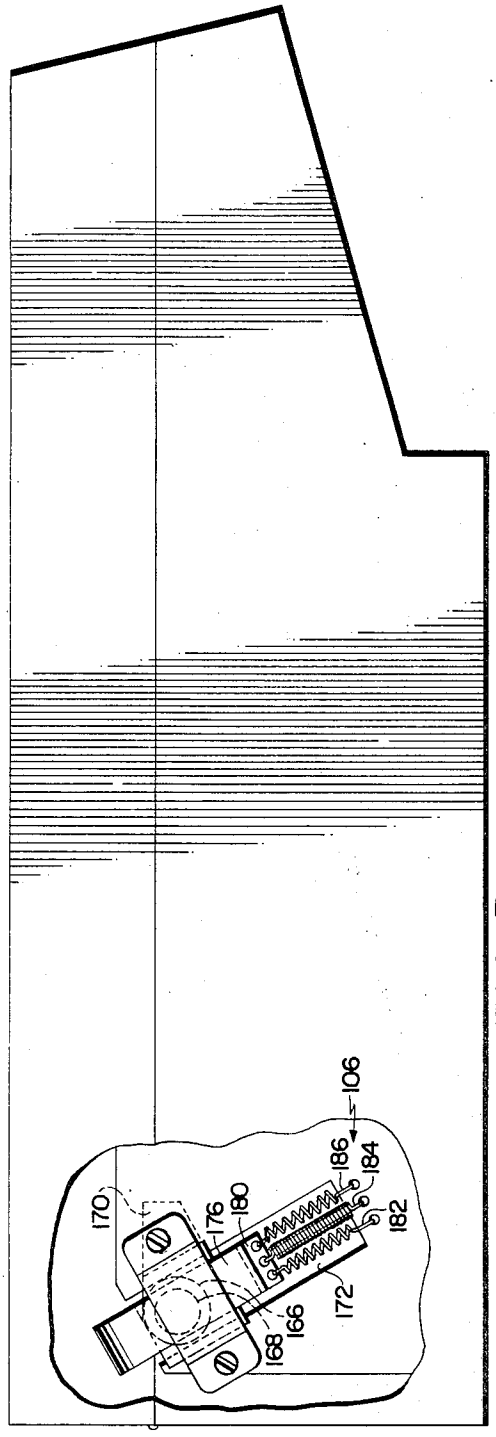

106
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168

FIG. 5

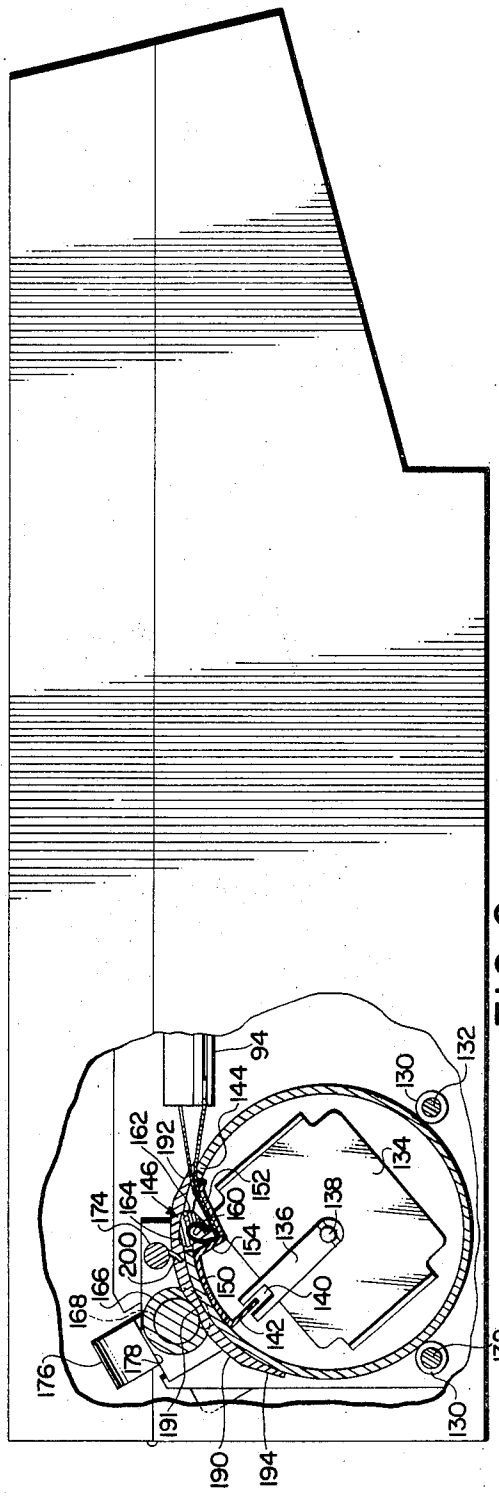

94
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142
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194

FIG. 6

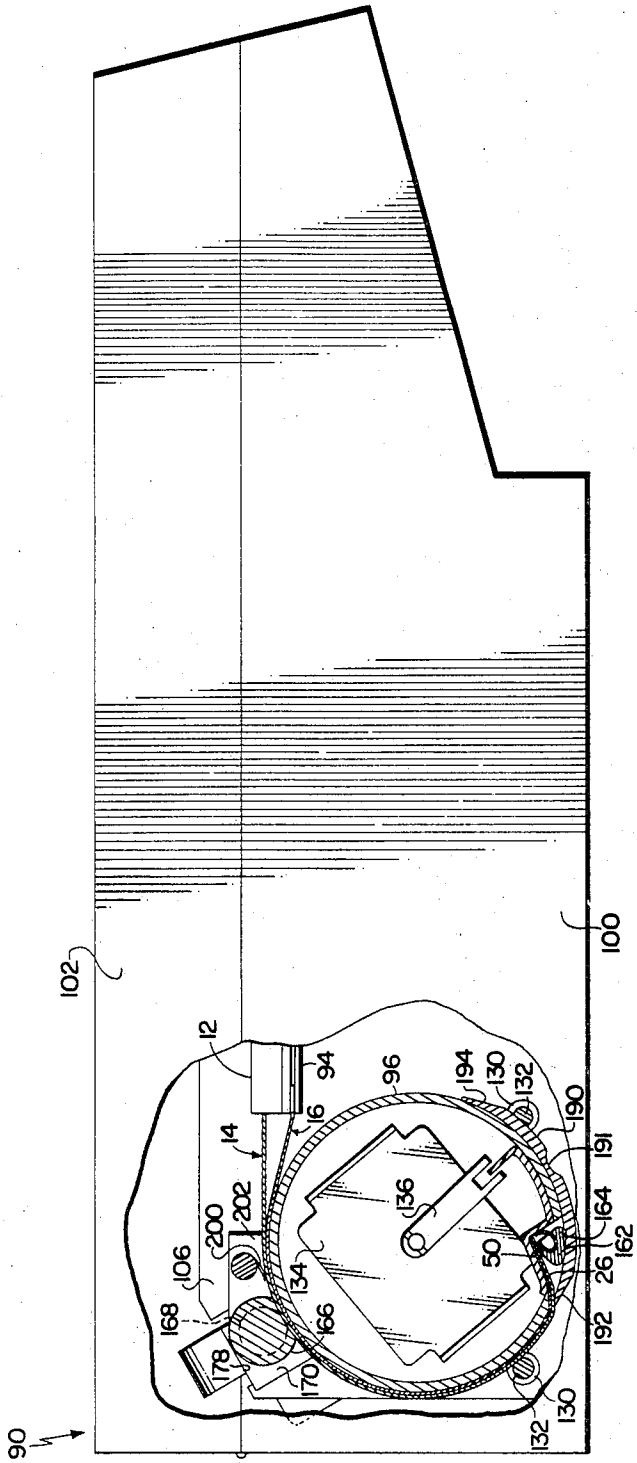

102
100
12
94
96
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136
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178
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132
90

FIG. 7

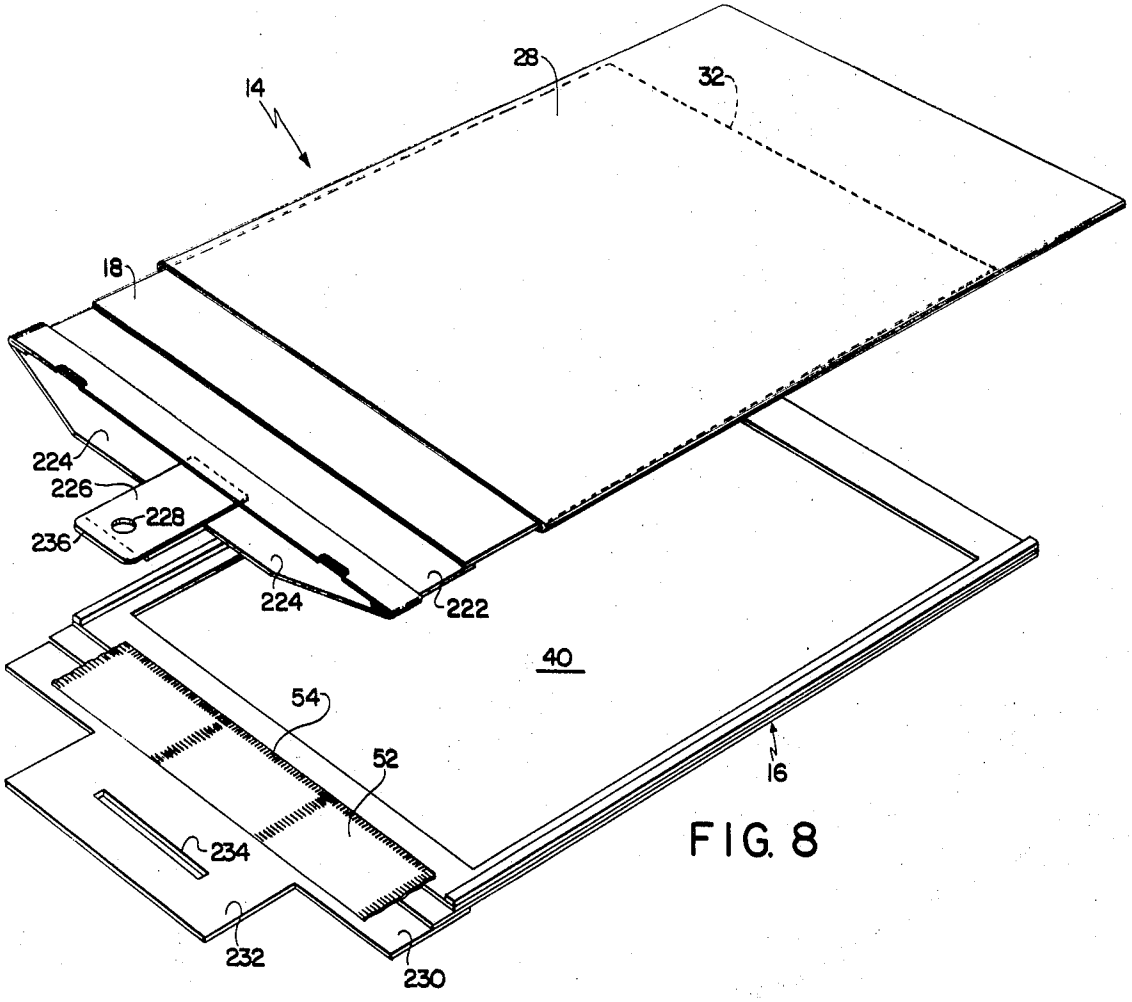

14
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32
18
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226
228
236
224
222
40
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16
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232
230

FIG. 8

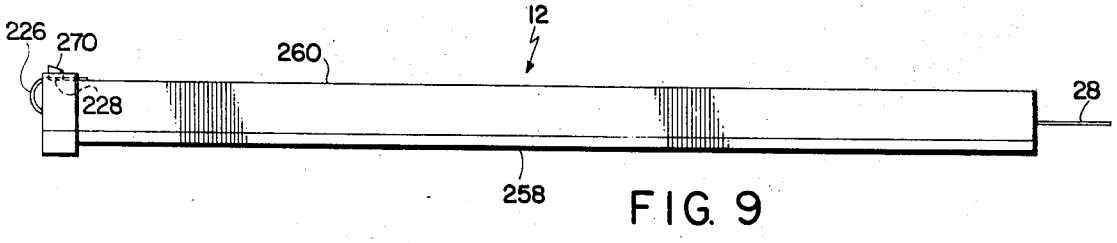

12
226
270
260
228
28
258

FIG. 9

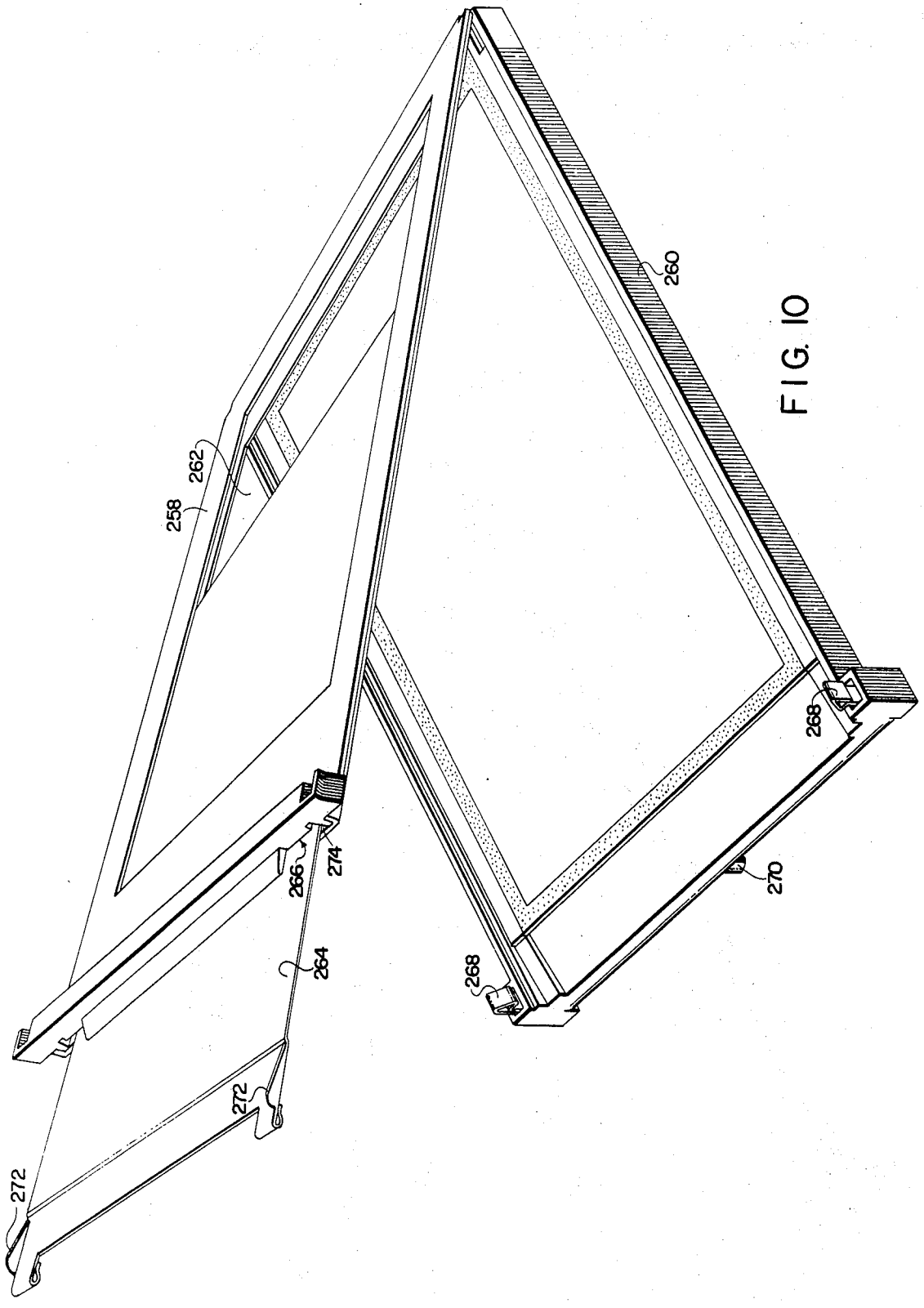


FIG. 10

LARGE FORMAT, SELF-DEVELOPING, PHOTOGRAPHIC FILM UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to photography and, mroe particularly, to large format film units of the self-developing type.

2. Description of the Prior Art

Large format, i.e., 8 × 10 or 10 × 12, self-developing film units have, in the past, been used principally in the radiographic field. They are especially useful for providing fast diagnostic X-rays in emergency medical situations and complement portable X-ray apparatus which is adapted to be used at temporary medical facilities set up at the site of a disaster. Other X-ray applications include the non-destructive testing of materials, structures, welds, etc.

The large format X-ray film unit is adapted to be placed in lighttight cassette and then exposed by conventional X-ray apparatus. After exposure, the cassette is transferred to a special apparatus for processing the exposed film unit.

Typically, each self-developing film unit includes a first support sheet having a photosensitive layer thereon, a second support sheet having an image-receiving layer thereon, and rupturable pod or container having a fluid processing composition therein.

The two sheets are hinged together at their leading ends with the photosensitive and image-receiving layers in face-to-face relation, and the rupturable container is secured to the hinge member such that it is located between the superposed sheets. Generally, the photosensitized sheet is enclosed in an opaque envelope which may be withdrawn from the trailing end of the sheet after the film unit is placed in a lighttight cassette.

The cassette generally is formed by a pair of outer plates, one of which is transparent to X-rays, and an intensifying screen, all of which are hinged together at their respective trailing ends. The intensifying screen is positioned between the outer plates and includes a phospher-coated side which faces the X-ray transparent outer cover plate.

The film unit is placed within the cassette with the opaque envelope covered photosensitized sheet between the intensifying screen and the X-ray transparent cover plate and the image-receiving sheet positioned between the opposite side of the intensifying screen and the second cover plate. After the cassette is closed, a tab or leader, which is coupled to the film unit hinge member and is adapted to extend outwardly from the closed cassette, is releasably secured to the leading end of the cassette such that the opaque envelope may be removed through a light baffled slot at the trailing end of the cassette.

The cassette is then mounted on a conventional or portable X-ray unit for exposure. The X-rays penetrate the outer plate, the first support sheet, and photosensitive layer thereon and impinge the phosphor coating on the intensifying screen which is in face-to-face contact with the photosensitive layer. This causes the phosphor coating to fluoresce and emit actinic radiation which exposes and forms latent images in the photosensitive layer.

After exposure the cassette may be transferred to a film unit processor. Typically, the processor includes a lighttight housing having a pair of juxtaposed pressure applying rollers therein. The film unit tab or leader is fed between the rollers, one or both of which may be manually or mechanically driven, and the film unit is extracted from the cassette and is advanced between the rollers.

The rollers apply a compressive pressure to the film unit which causes the container to rupture and dispense the fluid processing composition between the leading ends of the superposed photosensitive and image-receiving sheets. Further advancement between the rollers causes the fluid to be distributed between and in contact with these two sheets thereby initiating development and transfer to produce a positive image on the image-receiving sheet by a well known diffusion transfer process. After a suitable imbibition period in the lighttight housing, the diffusion transfer process is completed and the film unit is removed to separate the image-receiving sheet from the developed photosensitive sheet.

For examples of the general type of film unit, cassette, and processor described above, reference may be had to U.S. Pat. Nos. 3,371,208, 3,364,834, 2,638,828, and 3,357,331.

There are certain disadvantages to the prior art large format film processing systems. One has to do with the size of the processor in relation to the size of the film unit being processed. Some processors are over twice as long as the length of the film unit to accommodate the cassette on one side of the rollers and provide a dark imbibition chamber on the opposite side of the rollers to receive the processed film unit.

Others are slightly longer than the cassette and include a light baffled entry slot for receiving only the leading end of the cassette, a pair of rollers behind the slot, and an imbibition chamber to the rear of the rollers. Still other processors include a support for receiving a cassette, a pair of rollers at the end of the support, and an extensible imbibition chamber which extend outwardly from the opposite side of the rollers during processing.

While the last two types of processors are relatively compact when they are inoperative, the minimum area required to operate the processors increases significantly when the leading end of the cassette is attached to the processor or the extensible imbibition chamber is extended.

Generally, it is preferable to process a large format film unit such that a maximum compressive pressure is applied to the leading end of the film unit to facilitate rupture of the fluid container. After the fluid is released, the pressure is preferably reduced as the rollers engage the intermediate image-forming portion of the film unit to spread or distribute the fluid in a uniform layer between the two superposed sheets. The trailing end of the film unit generally includes a trap for collecting excess fluid. Preferably, the pressure on the trailing end of the film should be relieved to prevent fluid from being squeezed from the trap area onto the rollers.

While some of prior art processors do include mechanism for pre-programming a preferred pressure profile, it is very difficult to register the film with the rollers such that the pressure changes coincide with predetermined positions on the film unit. Much of the reg-

istration difficulty is attributable to the fact that the circumference of the rollers is relatively small when compared to the length of a film unit. During the course of processing a 12-inch long film unit, each of the rollers may revolve six or seven times. Add such factors such as slippage and the normal manufacturing variance in the dimensions of the film unit, and one skilled in the art will appreciate the complexity of providing accurate pressure profile which is repeatable.

Another limitation of the prior art systems comprising a film unit, cassette holder, and processor is that they are designed solely for processing X-ray film units which may be exposed through the support or base of the photosensitive sheet. Such systems lack provisions for processing a more conventional type of film unit wherein the photosensitive layer is adapted to be exposed to visible light, e.g., directly from the lens of a view camera, prior to having the image-receiving sheet brought into superposition therewith for processing.

SUMMARY OF THE INVENTION

The present invention provides a film unit which is especially well suited for use with a novel large film format processing system.

The processing system is characterized by a compact processor which features a cylindrical processing drum for receiving and supporting two superposed sheets forming a self-developing film unit.

An important feature of the system is that during the course of one single revolution of the drum, the two sheets forming the film unit may be brought into face-to-face relation, processed by the application of a pre-programmed compressive profile, and stored on the drum for imbibition without the need for a separate fixed or extensible imbibition chamber.

Other features of the processor include its reduced size in relation to the size of the sheets forming a large format film unit, a simplified mechanism for regulating the pressure profile, and the adaptability of the processor to handle both conventional and X-ray types of film units.

The processor preferably includes a lighttight housing, a cylindrical drum rotatably mounted on a base within the house, means for supporting a cassette holder adjacent the drum such that the leaders of the two sheets forming a film unit may be attached to the drum, means for rotating the drum through one revolution to cause the two sheets to be wrapped around and supported thereon, and pressure applying means for cooperating with the drum to apply a compressive pressure to the sheets during the course of the one revolution to dispense and distribute the fluid processing composition.

In a preferred embodiment, the pressure applying means are biased towards the drum, and control means, preferably in the form of profile cams mounted on the exterior surface of the drum, cooperate with the biased pressure applying means for moving the pressure applying means towards and away from the drum during the course of the one revolution to engage and disengage the pressure-applying means with predetermined portions of the film unit. The pressure-applying means are uniquely configured to vary the compressive force applied to preselected portions of the film unit to establish a pre-programmed pressure profile along its length.

The film units and cassetts forming part of the novel processing system are uniquely configured such that the two sheets forming the film unit may be disposed in registration with one another and also in registration with the circumference of the drum to insure reliable and repeatable processing.

In one embodiment, the photosensitive and image-receiving sheets forming a film unit may be held in a cassette prior to being wrapped onto the cylindrical drum. In other embodiments the photosensitive sheet may be held in a cassette and the image-receiving sheet and rupturable container may be supported in the processor so as to be brought into superposition with the photosensitive sheet as it is extracted from the cassette.

It is a feature and object of the present invention to provide a large format, self-developing, film unit which is formed by separate photosensitive and image-receiving elements that are adapted to be attached to a drum and brought into superposition thereon, as the drum is rotated, such that a fluid processing composition may be distributed between the two elements.

It is another feature and object to provide such a film unit which includes integrally formed registration means for accurately registering the photosensitive and image-receiving elements with one another and the drum.

It is yet another feature and object of the present invention to provide a film unit including a first element that is adapted to be held in a cassette prior to processing and said first element includes integrally formed means for releasably securing said first element to the cassette.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing wherein:

FIG. 1 is a perspective view of a drum processor, film unit, and cassette embodying the instant invention;

FIG. 2 is a perspective view of a photosensitive element and an image-receiving element which are adapted to be brought into superposition to form a film unit that is adapted to be attached to the drum of the processor of FIG. 1 for processing;

FIG. 3 is an elevational view of the photosensitive element of FIG. 2 located in the cassette of FIG. 1 showing a forwardly extending tab of the element releasably secured to the leading end of the cassette;

FIG. 4 is a perspective view of the cassette of FIG. 1 shown in its open position;

FIG. 5 is an elevational view, partly in section, of the processor of FIG. 1 showing structure for biasing the pressure applying means towards the processing drum;

FIG. 6 is an elevational view, partly in section, of the processor of FIG. 1 showing a film unit attached to the drum which is located in its initial position;

FIG. 7 is an elevational view, partly in section, of the processor of FIG. 6 showing the drum located approximately halfway through its one revolution processing cycle;

FIG. 8 is a perspective view of an alternative embodiment of a self-developing film unit that is adapted to be processed in the processor of FIG. 1;

FIG. 9 is an elevational view of the photosensitive element of the film unit of FIG. 8 located in an alterative embodiment of a film holding cassette; and

FIG. 10 is a perspective view of an alternative embodiment of a film holding cassette shown in its open position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a film unit which forms part of a large format film processing system. As best shown in FIG. 1, the system includes: a drum processor 10; a novel film holding cassette 12; and a specially configured film unit 13 (comprising elements 14 and 16) which is adapted for use with cassette 12 and processor 10.

Processor 10 is especially well suited for processing both X-ray and visible light sensitive film units. Initially, however, the discussion will be limited to the processing of the visible light sensitive film unit 13 shown in FIGS. 1 and 2.

Film unit 13 is formed by two separate and distinct elements, a first film element 14 having one or more photosensitive layers thereon and a second element 16 having one or more image-receiving layers thereon.

Element 14 is adapted to be loaded in film holding cassette 12 and then exposed to visible light from the objective lens of a camera or some other photographic apparatus such that latent images are formed in its photosensitive layer. Subsequent to exposure, film element 14 is adapted to be removed from cassette 12 and placed in superposition with film element 16 (to form film unit 13) such that their respective photosensitive and image-receiving layers are in face-to-face relation.

Processing of film unit 13 is accomplished by distributing a fluid processing composition between and in contact with the two layers to cause development of the latent images in the photosensitive layer and transfer, by diffusion, of certain constituents of the photosensitive layer to the image-receiving layer to form a positive image. After a suitable imbibition period to allow completion of the transfer process, the two superposed elements 14 and 16 are adapted to be separated to reveal the positive image on film element 16.

As best shown in FIG. 2, the photosensitive element 14 includes a generally rectangular support sheet 18 having one or more photosensitive layers coated on one side thereof. Sheet 18 is preferably formed of a conventional paper or plastic film base which may be opaque or slightly translucent. Attached across the leading end 20 of sheet 18 is a paper or plastic leader 22 for facilitating manipulation of sheet 18 during cassette loading and subsequent processing operations. Leader 22 is preferably configured to include a tapered portion 24 (for stiffening the leading end of the film element 14) which terminates in a generally rectangular, centrally disposed, and forwardly extending tab 26, the functions of which will be described hereinafter.

In order to protect the photosensitive layer on sheet 18 from exposure to visible light before film element 14 is loaded in holding cassette 12, element 14 is preferably provided with a removable opaque paper or plastic envelope 28. Envelope 28 is sealed along three edges and includes an opening 30 along the fourth edge through which the trailing end 32 of sheet 18 may be inserted. The opening 30 is light sealed by an opaque overskirt 34 on leader 22 into which the leading end of the envelope 28 is adapted to be inserted. Once film element 14 is loaded into a lighttight cassette 12, envelope 28 may be withdrawn from the trailing end 32 of sheet 18.

The second film unit element 16 preferably comprises a generally rectangular, opaque (or slightly translucent), paper or plastic, support sheet 36 having one or more image-receiving layers coated on one side thereof. A stripable rectangular mask 38 is releasably secured around the marginal edges of the coated surface and serves to define the bounds of a generally rectangular, central image-forming area 40. In a preferred embodiment, a pair of slightly raised spacers or rails 42 are provided on the lateral margins 44 of mask 38 for establishing a predetermined gap between the photosensitive and image-receiving layers, when sheets 18 and 32 are superposed, to control the thickness of the layer of processing fluid distributed therebetween.

Attached to and extending across the leading end 46 of sheet 36 is a paper or plastic leader 48 which terminates in a forwardly extending, centrally disposed, sheet manipulation tab 50.

In this embodiment, film element 16 also includes a rupturable container 52 of a fluid processing composition. Container 52 is preferably formed of a rectangular blank of vapor and liquid impermeable material which is folded over on itself and sealed along three edges to form a cavity for holding the processing fluid. The container is secured to leader 48 such that a relatively weak longitudinal seal 54 faces the image forming area 40 of sheet 36.

With film unit elements 14 and 16 in superposed relation, the film unit 13 is adapted to be advanced, leading end first, between a pair of compressive pressure applying members mounted in processor 10. These pressure applying members compress the walls of container 52 and induce a hydraulic pressure in the fluid which causes the longitudinal seal 54 to rupture thereby dispensing the fluid in a mass along the leading edge of the image forming area 40.

As the superposed elements 14 and 16 are further advanced between the pressure applying members, the mass of liquid is advanced along a wave front which travels from the leading to the trailing end of the image forming area 40. Accordingly, the fluid is distributed between and in contact with the photosensitive and image-receiving layers to initiate the well known diffusion transfer process. As noted earlier, the side rails or spacers 42 on mask 38 serve to regulate the thickness of the fluid layer between sheets 18 and 36. In a preferred embodiment, the trailing end margin 56 of mask 38 is provided with a liquid trap (not shown) for collecting any excess fluid which may extend beyond the trailing end of the image forming area 40.

At this point, it may be well to point out that the chemical composition of film unit 12 has been described in somewhat general terms and that it may be configured to produce either black and white or full color positive images. For a more detailed description of the chemical composition of suitable photosensitive and image-receiving layers and compatible processing fluids, reference may be had to U.S. Pat. No. 2,983,606, issued to H. G. Rogers on May 9, 1961, and

U.S. Pat. Nos. 2,698,236, 2,698,237 and 2,698,245, issued to E. H. Land on Dec. 28, 1954.

The film holding cassette **12**, which is specially configured so as to be compatible with film unit **13** and processor **10**, is best shown in FIGS. **3** and **4**. It is formed by two plate-like members **58** and **60** which are hinged together at their respective trailing ends by a pair of hinges **62** for movement between the opened loading position shown in FIG. **4** and the closed operative position of FIG. **3**. Formed of any suitable opaque material, members **58** and **60** cooperate to form a light-tight enclosure for film element **14** in which it may be transferred from a suitable camera to processor **10**.

The bottom member **60** includes a generally rectangular planar bottom wall **64** having a pair of upstanding U-shaped flanges **66** disposed along its opposite lateral edges **68**. The leading end portion of bottom wall **64** is configured to include a downwardly tapered ramped surface **70** for accommodating the leader portion **22** of film element **14** and facilitating withdrawal of element **14** during processing operation. Attached to ramped surface **70** is a tab retaining member **72** which includes a pair of pointed projections **74** that extend slightly forwardly of the leading edge of bottom wall **64**.

The upper member **58** comprises a generally rectangular frame having a central opening or exposure aperture **76** therein. Slidably mounted in member **58** is a dark slide **78** which may be moved between positions blocking and unblocking exposure aperture **76**. A pair of U-shaped flanges **80** depend from member **58** along its lateral edges and are configured to mate with the flanges **66** on bottom member **60** when cassette **12** is in its closed position to form labyrinth light seals along the sides of the cassette **12**.

Light sealing of the leading and trailing ends of the cassette may be provided by resilient (such as foam rubber) strips (not shown) attached to the interior surface of member **58** such that they extend downwardly and engage the interior surface of bottom wall **64**. Similarly, resilient light sealing strips (not shown) may be provided around the edges of exposure aperture **76** and around the entry slot for dark slide **78**.

The cassette members **58** and **60** are adapted to be latched in the closed position by a rectangular wire latching member **82** which is pivotally coupled to the exterior surface of the leading end of cassette member **58** by tubular member **84**.

With cassette **12** located in its open position, film element **14** is placed on bottom wall **64** between flanges **66** such that its coated photosensitive surface faces exposure aperture **76**. The cassette is dimensioned such that the trailing end of opaque envelope **28** extends between hinges **62** and slightly beyond the trailing end of the cassette when the overskirt **34** on leader **22** is aligned with the leading edge of ramped surface **70**. Accordingly, the major portion of leader **22** including tab **26** extends forwardly of the leading end of cassette **12**.

Cassette member **58** is moved to its closed position, overlying member **60**, and latching member **82** is pivoted around the leading end of the cassette. A centrally mounted roller **86** on latching member **82** engages leader **22** and bends it around the leading edge of member **60** such that the points **74** of tab retainer **72** pierce leader **22**. Roller **86** is adapted to be captured on a recessed detent **88** on the exterior surface of bottom wall **64** and holds tab **26**, in frictional engagement therebetween, flat against wall **64**.

With leader **22** securely held by the tab retainer **72** and the captured roller **86**, the opaque envelope **28** may be withdrawn from sheet **18** through the light sealed opening at the trailing end of cassette **12**.

The cassette may then be mounted in a view camera wherein dark slide **78** is moved to its unblocking position such that the photosensitive coating on sheet **18** may be exposed through aperture **76**. Subsequent to exposure, dark slide **78** is closed and cassette may be transferred to processor **18** where film unit element **14** is adapted to be superposed with film element **16** for processing.

Processor **10**, as shown in FIG. **1**, includes a housing **90** having mounted therein on a base **92**; a platform **94** for supporting a film element **16** and a cassette **12**, holding a film unit element **14**, in overlying relation to one another; a hollow cylindrical drum **96** to which the tabs **26** and **50** of film elements **14** and **16** are adapted to be releasably secured such that elements **14** and **16** may be wrapped around and supported on the exterior surface of drum **96** to form film unit **12** as the drum is rotated; and movably mounted roller assembly **98** which is adapted to cooperate with drum **96** to apply a compressive pressure to film unit **12** to dispense the fluid processing composition from rupturable container **52** and distribute it between elements **14** and **15**.

Housing **90** is formed by a box-like bottom or base housing section **100** and a cover section **102** hinged to base section **100** at hinge **104** for movement between the open position shown in FIG. **1** and a closed position (See FIGS. **4** and **5**) in which it overlies the open top of base section **100** to render the interior of housing **90** lighttight. Housing **90** may be formed of any suitable opaque material such as wood, metal, or plastic.

Base **92** is preferably formed by a pair of mounting plates **106** which are positioned near the forward end of base section **100**. In a preferred embodiment, plates **106** are positioned parallel to and slightly spaced from the interior surface of the side walls of base section **100**.

Extending rearwardly from plates **106** are a pair of L-shaped platform supports **110** which are preferably adjustably coupled to plates **106** by means of bolts **112** which pass through elongated slots **114** therein. This type of coupling allows some degree of movement of platform supports **110** towards and away from drum **96**.

Platform **94** which is fixedly coupled between supports **110** comprises a bottom plate-like wall **116** and a pair of L-shaped flanges **118** disposed along its lateral edges. Each flange **118** includes a horizontal section **120**, part of which is spaced from bottom wall **116** to define a groove or channel **122** therebetween for receiving the lateral edges of film unit element **16**. As best shown in FIG. **1**, flange section **120** is cut out at its leading end **124** such that the trailing end of sheet **36** may fit between the two flanges **118** to insert its lateral edges into channels **122**. In a preferred embodiment, sections **120** may be tapered at **126** to facilitate insertion of sheet **36**.

Film element **16** is inserted into channels **122** and moved rearwardly such that it lies flat on top of platform bottom wall **116** with its image-receiving coating facing upwardly and its leader **48** and tab **50** adjacent to drum **96**.

Cassette 12 is placed on the flanges 118 such that the film unit element 14 therein has its photosensitive coated surface facing downwardly in face-to-face relation with the image-receiving coating on element 16 and its leader 22 and tab 26 adjacent to drum 96. As best shown in FIG. 1, the platform supports 110 each include a groove 128 therein which are adapted to receive the edges of the cassette latching device 82 for accurately locating cassette 12 on platform 94 and preventing forward motion of the cassette as film element 14 is withdrawn therefrom.

At this point, tab 26 may be pulled forward and released from its position between the latch roller 86 and the detent 88 on the exterior surface of cassette member 60. It will be noted that the rotating action of roller 86 facilitates the removal of tab 26 from its captured position.

Drum 96 is preferably formed by a hollow, metal, e.g., stainless steel or aluminum, cylinder which is rotatably supported near its ends on four roller bearings 130. As best shown in FIGS. 1 and 6, two bearing support rods 132 extending between and fixedly secured to mounting plates 106 are provided to support and position roller bearings 130. This type drum mounting arrangement advantageously permits an A.C. or D.C. drum drive motor 134 to be mounted within the drum thereby enhancing the compactness of processor 10. As best shown in FIG. 6, motor 134 is mounted on one of the support plates 106 such that the major portion of the motor housing extends into the hollow cylinder. The motor 134 is preferably coupled to drum 96 by means of a drive arm 136 which is fixedly secured at one end to the motor drive shaft 138 and includes a slot 140 at its opposite end for receiving a radially depending flange 142 that is fixedly secured to the interior surface of drum 96.

The diameter, or more precisely, the outside circumference of drum 96 should be sufficiently large such that the superposed film elements 14 and 16 forming film unit 13 may be wrapped around drum 96 without the leading and trailing ends of the film unit 13 overlapping themselves.

A typical 8 × 10 inch film unit measures approximately 14 inches in length taking into account the attached leaders and tabs. Therefore, a drum having an outside circumference of approximately 15 inches would be preferable. If the larger X-ray film units are also to be processed, the drum should measure approximately 17 inches around. The length of the drum 96 should exceed the width of the film unit by approximately 2 or 3 inches.

The film unit tabs 26 and 50 are adapted to be inserted through an elongated slot 144 centrally disposed in drum 96 and into engagement with a film latching device 146 within the drum which serves to releasably secure the tabs 26 and 50 to drum 96. As best shown in FIG. 6, latching device 146 includes a Z-shaped flange 150 which is secured to the interior surface of drum 96 such that a right angle section formed by surfaces 152 and 154 is in communication with slot 144. The planar leading edges 156 and 158, respectively of tabs 26 and 50 are adapted to slide along surface 152 until they abut surface 154. The abutment of the tab edges 156 and 158 against surface 154 serves as a means for accurately registering the film units 14 and 16 with one another and with drum 96. The tabs 26 and 50 are releasably latched or captured in their aligned positions by means of a curved spring 160 which is in engagement with V-shaped latch release member 162 pivotally mounted on drum 96 at pin 164. As best shown in FIG. 6, the entering tab may slide forwardly between surface 152 and the lower end of release member 162 into abutment with surface 154 If the tab begins to be retracted, member 162 pivots in a counterclockwise direction about pin 164 and its lower end traps the tab by urging it against surface 152. To release the tab from latching device 146, release member 162 is pushed downwardly such that it pivots around pin 164 in a clockwise direction against the bias of spring 160 to increase the spacing between its lower end and surface 152 and permit removal of the tab.

Accordingly, processor 10 is provided with means in the form of surface 154 for cooperating with alignment means (tab leading edges 156 and 158) on film unit 13 to insure that the film elements 14 and 16 are in registration with each other and drum 96.

With the leading ends of the film unit 13 attached to drum 96, the drum may be rotated in a counterclockwise direction (as viewed in FIG. 6) to cause film unit element 14 to be extracted from cassette 12 and to be brought into superposition with film element 16 as both elements are wrapped around and supported on drum 96 during the course of one revolution thereof.

In order to apply the compressive pressure to the superposed elements during the course of said one revolution, processor 10 is provided with the movably mounted roller assembly 46. Assembly 46 includes an elongated cylindrical roller 166 (preferably 1 inch to 1 ½ inches in diameter) which is preferably formed of a suitable metal or alloy such as stainless steel. In an alternative embodiment roller 166 may be formed of rubber. Roller 166 is configured to include integrally formed reduced diameter end sections 168 which are rotably mounted (by roller bearings not shown) in roller mounting brackets plates 170.

As best shown in FIG. 6, roller 166 is adapted to be positioned on the opposite side of drum 96 from platform 94 such that its axis of rotation is substantially parallel to the axis of rotation of durm 96. In its preferred position, a line passing through the axes of rotation of drum 96 and roller 66 forms an angle of approximately 30 degrees with a vertical centerline passing through the axis of roation of drum 96.

As best shown in FIG. 5, base mounting plates 106 have angled slots 172 therein for receiving roller mounting brackets 170 at the preferred angle. Brackets 170 preferably include end channels or slots for receiving the opposite edges of plate 106 which define the sides of slots 172. Therefore, plates 106 cooperate with mounting brackets 170 to form a tongue and groove sliding arrangement to permit the mounting brackets 170 (and therefore roller 166) to be guided and moved toward and away from drum 96.

Also coupled between mounting brackets 170 is a rod 174 for supporting auxiliary film engaging structure to be described hereinafter.

Each mounting bracket 170 is spring biased towards the bottom of slot 172 by means of a biasing member 176 having a U-shaped end 178 which is configured to bear against the top surface of bracket 170. The The opposite end 180 extends down into slot 172 and is coupled to mounting plate 106 by three springs 182, 184, and 186.

In a preferred embodiment, the center spring **184** is slightly longer than springs **182** and **186** such that it is not under stress when springs **182** and **186** hold the central portion of roller **166** against the exterior of drum **96.** It is only when roller mounting brackets **170** and roller **166** are moved away from drum **96** that spring **184** is stressed and thereby exerts a downward force on roller **166.**

In order to move roller **166** towards and away from drum **96** during the course of one revolution of the drum, a pair of profile cams **188** are provided on the exterior surface of drum **96** such that they will engage the reduced dimaeter end sections **168** of roller **166.**

As best shown in FIGS. **1** and **6,** each profile cam **188** is rounded to conform to the cylindrical shpae of the drum and includes; a central section **190** having a recess or detent **191** therein for capturing a roller end section **168;** a leading end section having a ramped surface **192** which slopes down toward drum **96** for moving roller **166** towards the drum; and a trailing end section having a ramped surface **194** which slopes up from the drum surface for moving roller **166** away from drum **96.**

In FIG. **6,** the drum is shown in its initial loading position with slot **144** therein facing platform **94.** Roller **166** is captured by means of its end sections **168** being held in detents **191** by springs **182, 184,** and **186.** It will be noted that in the initial capture position, the central portion of roller **166** is spaced from drum **96** by profile cams **188** and that all three springs are in a stressed condition.

Motor **134** is energized to cause drum **96** to rotate in a counterclockwise direction (as viewed in FIG. **6**), and as the drum begins to rotate, the leading ends of the two film elements **14** and **16** are brought into superposition on the surface of the drum **96.** Cams **188** raise the roller **166** slightly such that its end sections **168** are disengaged from detents **191** and end sections **168** follow the stop surfaces of cams **188.** As the leading end ramped surfaces **192** pass under end sections **168,** the roller **166** is lowered toward the superposed elements supported on the drum. The length of the cams **188** are configured such a that as the roller end sections **168** are disengaged from ramped surfaces **192,** the central portion of roller **166** engages element **14** such that the roller **166,** in cooperation with drum **96,** applies a compressive pressure to the leading edge of rupturable container **52.** It will be noted that the relatively thick leading end of the film unit (caused by container **52**) maintains the roller **166** at a sufficient distance from the drum so that all three springs **182, 184,** and **186** are in a stressed condition and jointly contribute to applying a maximum conpressive pressure to container **52.**

As the seal **54** of container **52** ruptures and the fluid is dispensed between the photosensitive and image-receiving layers, roller **166** moves closer to the drum **96** and spring **184** relaxes to its unstressed condition. Thus during the spreading or distribution phase of the operation, the compressive pressure is reduced since only springs **182** and **186** are acting on roller **166.**

In order to prevent fluid leakage at the lateral edges of a film unit during spreading, a pair of resilient fingers **200** depending from rod **174** engage the lateral edge margins of sheet **18** to apply an additional compressive pressure along the edge spacers **42.**

As best shown in FIG. **7,** the height of platform **94** is set such that film element **14** exits from cassette **12** along a substantially flat plane and engages drum **96** at a tangent point **202.** Engagement with roller **166** takes place further along the drum (approximate the distance of the previously mentioned 30° arc). Once the trailing end of film element **14** has cleared cassette **12,** there is a tendency for it not to follow the contours of the drum but to curl slightly outwardly therefrom. This problem is solved by a resilient piece of material **204** (such as rubber) attached to rod **174** (see FIG. **1**) such that its lower free end engages the trailing end of film element **14** and holds it against the drum surface in front of roller **166.**

After the fluid has been dispensed, roller **166** spreads it between elements **14** and **16.** As the trailing end of the image-forming area is finally coated, the end sections **168** of roller **166** are engaged by the trailing end ramped surfaces **194** of profile cams **188** and they begin to lift roller **166** away from drum **96** thereby relieving the compressive pressure on the trapping area of the film unit **13.**

At this point motor **134** is preferably de-energized. The inertia of drum **96** is sufficient to continue its counterclockwise rotation to return it to its starting position wherein the end sections **168** of roller **166** are captured in the detents **191** formed in sections **190** of cams **188.** It will be noted that as the trailing end ramped surfaces **194** of profile cams **188** engage the roller end sections **168** to move roller **166** away from drum **96,** forces are developed at the interface therebetween which tend to counteract the counterclockwise inertia of the drum and provide a braking action to insure that the roller end sections **168** will be captured in detents **191.** Also, as cams **188** move the roller **166** away from drum **96,** all three pair of springs **182, 184,** and **186** are stressed thereby increasing the frictional forces between the roller end sections **168** and the top surfaces of cams **188** to aid the braking action.

Control of motor **134** to effect its energization and de-energization may be accomplished by means of any suitable circuit which will supply power to the motor by actuating a switch **210** mounted on housing **100** and which may be subsequently turned off by opening a second switch when the drum **96** has rotated through the major portion of its one revolution. The second switch may be actuated by a cam (not drawn) coupled to the motor drive shaft **138.** One skilled in the art will recognize that there are many types of commonly used circuits such as those including latching relays, SCR's, etc., which will accomplish the desired function.

After completion of the one revolution processing cycle, and a suitable imbibition period in the dark environment of housing **100,** the film unit **13** may be removed from drum **96** and film elements **14** and **16** may be separated to reveal the positive image formed on sheet **36.**

The advantages of the drum processor **10** are many. It is simple in its construction. During the course of a single revolution of the drum; film element **14** is extracted from the cassette **12** and is brought into superposition with film element **16** to form film unit **13;** the film unit **13** is supported on the drum and is subjected to a pre programmed compressive pressure profile by rollers **166** and drum **96;** and at the end of the revolution, the drum acts as a support for the processed film unit during the imbibition period.

Compactness is achieved by mounting the drive motor **134** within the hollow drum. Also, by supporting

the processed film unit on the drum during imbibition, the need for a separate imbibition chamber is eliminated.

The use of the profile cams **188** to precisely bring the roller **166** into and out of contact with the film unit **13** provides a simple, direct, and repeatable method of solving the film to drum registration problem. Also, the cams, in cooperation with the biasing springs, provide a simple and accurate method of establishing an accurate compressive pressure profile.

It will be obvious to those skilled in the art that once the leading edges of **156** and **158** of film unit tabs **26** and **50** are in abutment with the drum latching member surface **154,** that the location of any particular portion of film unit **13** (on drum **96**) becomes quite predictable. Therefore, the length of cams **188** may be selected such that roller **166** is precisely engaged with any portion of the film unit. By varying the height of the cams above the drum and altering their shape, the pressure profile may be suitably adjusted for any particular film unit **13.**

For example, if processor **10** is to be used to process both 10 inch and 12 inch long film units, a drum having an exterior circumference of **17** inside would be used. In this case, the processor would be equipped with two sets of interchangeable profile cams. A longer set for use with the 10 inch film unit, and a shorter set for use with the 12 inch film unit. It will be understood that the spacing between the cams may be varied to accommodate film units having different widths, or they may be spaced at a fixed distance apart as long as the widest film unit that will be processed on the drum **96** will fit therebetween.

An alternative method of processing different length film units on a drum having fixed cam lengths would be to vary the length of the tabs **26** and **50** on the film elements **14** and **16.**

One skilled in the art will appreciate that platform **94** may bw moved closer to or further away from durm **96** to accommodate longer or shorter cassettes and that the width of the platform may be varied by providing a set of interchangeable cassette support flanges.

It will be understood that it is within the scope of the present invention to provide an even more compact processor by eliminating platform **94** and the major portion of the processor housing which surrounds the platform. In its most compact form, the modified housing may simply have a slot for receiving the leading end of cassette **12** adjacent to the drum slot **144.** In this instance, the first film element **16** would be attached to the drum by its tab **50** and the operator would manually hold the cassette at the entry slot and attach the tab **26** of film unit **14** to the drum **96.**

A more convenient embodiment of film unit **13** and cassette **12** for use with an abbreviated version of processor **10** (or for that matter for use with the processor as depicted in FIG. **1**) is shown in FIG. **8.**

The main difference between this film unit and the one shown in FIG. **2** is in the configuration of the leaders and tabs at the leading ends of the elements **14** and **16.** Therefore, the earlier description of sheets **18** and **36,** container **52,** envelope **28,** mask **38,** etc., will not be repeated.

Film element **14** includes a leader **222,** attached to and extending across the leading end **20** of sheet **18,** having a forwardly extending tapered section **224** (for stiffening the leading end of element **14** and more evenly distributing any force applied thereto across the leading end of sheet **18**) which terminates in a generally rectangular forwardly extending tab **226.** In a preferred embodiment, tab **226** also includes a centrally disposed hole **228** therein the function of which will be described hereinafter.

Film element **16** includes a leader portion **230** attached to and extending across the leading end of sheet **36.** Extending forwardly of leader **230** is a generally rectangular tab **232** having a centrally disposed elongated slot **234** therein for receiving tab **226** on film element **14** and a forward portion of the tapered leader section **224.** In this embodiment, the tab **232** may be folded lengthwise on itself such that slot **232** is at the leading end of the tab **232.** The leading end of tab **226** is inserted through slot **234** until the leading edges of tapered section **224** engage the ends of slot **234.** Thus section **224** acts as a shoulder and controls the registration of the two sheets **18** and **36.**

The leading end of tab **226** is attached to drum **96** with its leading planar edge **236** providing the means for registering the film unit with respect to the drum **96** as previously described. In this case, the film elements **14** and **16** are releasably secured to the drum by means of a single tab **226** on element **14.** As the drum is rotated, film element **14** carries film element **16** along with it by means of the interconnection of their respective leaders at slot **234.**

The above described film unit is especially well suited for use with an alternative embodiment of cassette **12** shown in FIG. **10.**

In this embodiment, the cassette is again formed by a pair of hinged outer plates **258** and **260.** Plate **258** is formed as a generally rectangular frame which defines a rectangular exposure aperture **262** therein. The exposure aperture **262** is adapted to be blocked and unblocked by a plate-like dark slide **264** which is slidably coupled to frame **258.** As may be seen in FIG. **10,** frame **258** is provided with an elongated slot **266** at its leading end for receiving dark slide **264.** The film element **14** is placed on the bottom wall of plate **260** with its envelope enclosed photosensitive coated side facing the exposure aperture **262.** The cassette plates **258** and **260** are closed and latched to one another by spring biased latching members **268** located at the leading end of plate **260** such that they may engage detents (not shown) on plate **258.** As in the previous embodiment, the tab **226** extends forwardly of the light sealed opening at the forward end of the cassette **12.** Tab **226** is adapted to be folded back over the leading end of plate **260** and attached to its exterior surface by a projection **270** thereon which extends through the hole **228** in tab **226.**

With tab **226** releasably secured to plate **260,** the opaque envelope **28** may be withdrawn from sheet **18** through the light baffled opening at the trailing end of the cassette. The cassette then may be mounted on an appropriate camera to expose the photosensitive layer through exposure aperture **262.**

It will be noted that the dark slide **264** is provided with a pair of upstanding flanges **272** near its leading end which are adapted to slide through a pair of slots **274** in the leading end of frame **258** when dark slide **264** is in its fully inserted or blocking position. The function of flanges **272** are to engage and pivot upwardly a resilient light shielding member (not shown) depending from the upper edge of slot **266** toward the

bottom thereof. With this light shield retracted by flanges **272**, the image-receiving element **16** of FIG. **8** may be inserted into the closed cassette, on top of the dark slide **264**, with its image-receiving layer facing downwardly towards the photosensitive layer of film element **14** on the opposite side of dark slide **264**.

With both elements **14** and **16** held in the cassette, tab **226** of element **14** is removed from engagement with projection **270** and its leading edge is slipped through the slot **234** in tab **232** of film element **16**.

Thus with the leading ends of elements **14** and **16** coupled together, the cassette may be hand held at the entry slot of an abbreviated processor **10** (or may be placed on platform **94** of the processor shown in FIG. **1**) such that tab **226** may be attached to drum **96** for processing.

It will be noted that in another embodiment of the cassette shown in FIG. **10**, the same type of roller latching device **82** and tab retainer device **72** (shown in FIG. **4**) may be used instead of the latches **258** and tab holding projection **270**.

Also, it is within the scope of the present invention to provide holes in the film tabs and utilize a projection or stud on drum **96** which is adapted to extend through such holes to releasably secure the tabs to drum **96**.

Up until now, the discussion has been limited to visible light sensitive film units in which the photosensitive element was exposed and then the image-receiving element was superposed with element **14** to form the film unit **13** either in the processor **10** or in cassette **12** by slipping in the element **16** over the dark slide **264**.

As disclosed in the introduction, X-ray sensitive film units are generally provided with a single leader coupled to sheets **18** and **36** such that it forms a hinge therebetween and supports ruptured container.

A central forwardly extending tab is attached to the leader and previously served solely to secure the leading end of film unit to the cassette so that the opaque envelope may be withdrawn from the photosensitive element **14** without slippage of the film unit within an appropriate X-ray cassette.

Therefore to utilize such film units with the processor **10**, the tab only has to be reconfigured to include an appropriate leading planar edge which is adapted to abut against surface **254** of device **146**. It goes without saying, that processor **10** may be supplied with another set of interchangeable profile cams and appropriate platform inserts which are specifically designed for use with an X-ray film unit and cassette.

Since certain changes may be made in the above system, apparatus, and products without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A film unit formed by two separate film elements which are adapted to be brought into superposition by being wrapped around and supported on a cylindrical drum that forms part of a processor in which a fluid processing composition is adapted to be distributed between and in contact with preselected portions of said superposed elements, the processor being of the type having means, including a locating surface, associated with the drum and being adapted to cooperate with at least one of said two separate film elements for accurately locating said two separate film elements in a predetermined relationship with the drum, and a latching device for releasably securing at least one of said two separate film elements to the drum, said film unit comprising:

a first film unit element including a first support sheet having a photosensitive layer on one side thereof and first leader means attached to a leading end of said first support sheet;

a second film unit element not connected to said first film unit element and including a second support sheet having an image-receiving layer on one side thereof and second leader means attached to a leading end of said second support sheet, at least one of said first and second leader means being adapted to be coupled to the latching device associated with the drum such that said first and second support sheets may be wrapped around the drum and be brought into superposition with their respective photosensitive and image-receiving layers in face-to-face relation in response to rotation of the drum;

a rupturable container of fluid processing composition secured to one of said first and second leader means such that it is positioned between said first and second film unit elements when said first and second sheets are brought into superposition on the drum, said container being adapted to be ruptured by pressure applying means associated with the processor to dispense and distribute said fluid between and in contact with said photosensitive and image-receiving layers; and

first and second registration means integrally formed with said first and second leader means, respectively, and adapted to cooperate with each other for accurately registering said first and second film elements with each other, at least one of said first and second registration means also being adapted to cooperate with the locating surface associated with the drum for accurately locating said first and second film unit elements in the predetermined relationship with the drum.

2. A film unit as defined in claim **1** wherein said first and second leader means include, respectively, first and second forwardly extending centrally disposed tabs, and said first and second registration means includes, respectively, planar leading edges of said first and second tabs which are adapted to bear against the locating surface on the drum to register said first and second film elements with one another and the circumference of the drum.

3. A film unit as defined in claim **2** wherein said first and second tabs on said first and second leader means are adapted to be engaged by the latching device on the drum so that said first and second tabs serve to couple said first and second film elements to the drum.

4. A film unit as defined in claim **1** wherein said first film element further includes a removable opaque envelope enclosing said first support sheet having said photosensitive layer on one side thereof.

5. A film unit as defined in claim **4** wherein said first film element is adapted to be held in a light-tight cassette and said film unit includes means for releasably securing said first leader means to the leading end of the cassette such that said opaque envelope may be withdrawn from said first support sheet from the trailing end of the cassette.

6. A film unit as defined in claim 1 wherein said first leader means includes a first centrally disposed and forwardly extending tab which is adapted to be engaged by the latching device associated with the drum to releasably secure said first leader means to said drum, and a tapered section intermediate said first tab and said leading end of said first support sheet, said first registration means including a leading planar edge of said tapered section adjacent to and extending transversely of said first tab, and said second leader means includes a second tab having a transverse elongated slot therein through which said first tab is adapted to be inserted, said leading planar edge of said tapered section on said first leader means being wider than said slot so as not to pass therethrough, said second registration means including portions of said second tab to the sides of said slot against which said leading planar edge of said tapered section bears to couple and register said first and second film unit with one another.

7. A film unit as defined in claim 6 wherein said first registration means further includes a planar leading edge on said first tab, said planar leading edge being adapted to bear against the locating surface associated with the drum for registering said first and second film unit elements, now coupled together, with the circumference of the drum.

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