United States Patent

Cole

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[54] PHOTOGRAPHIC FILM UNIT

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

[51] **Int. Cl.** **G03b 17/50**

[58] **Field of Search** ..... 95/13, 19, 22, 89; 96/76 R, 96/76 C

[56] **References Cited**

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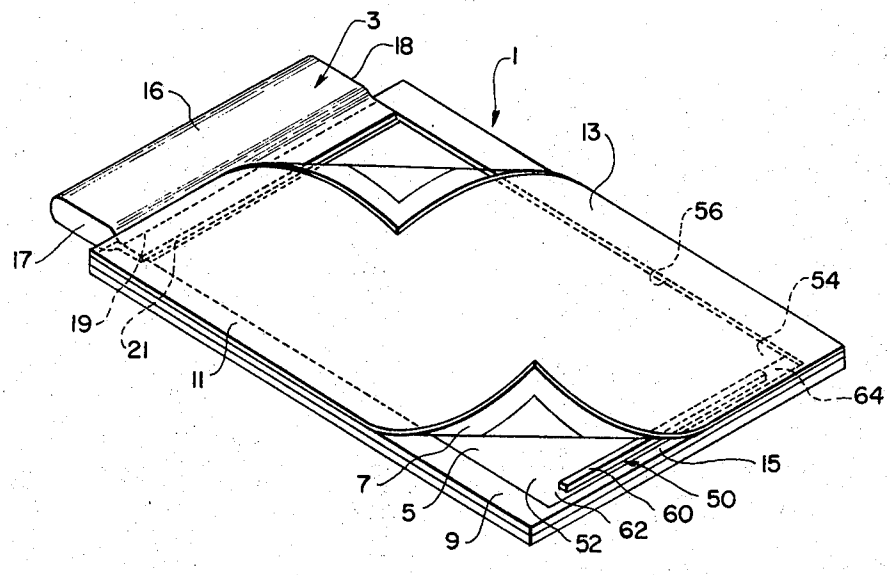
[57] **ABSTRACT**

A self-processing photographic film unit including a fluid flow-controlling mechanism and trap for diverting processing fluid from the center toward the corners of the unit and for collecting any excess processing fluid at the corners. The mechanism and trap are best adapted for use in composite or integral film units and are permanently locatable entirely within the borders of the unit, making unnecessary their separation from the unit after processing.

10 Claims, 6 Drawing Figures



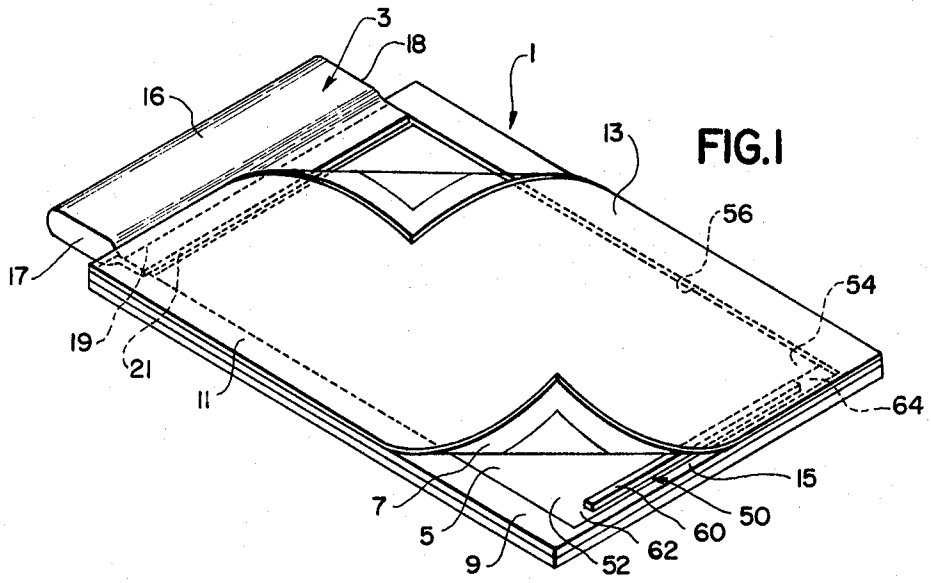


FIG.1

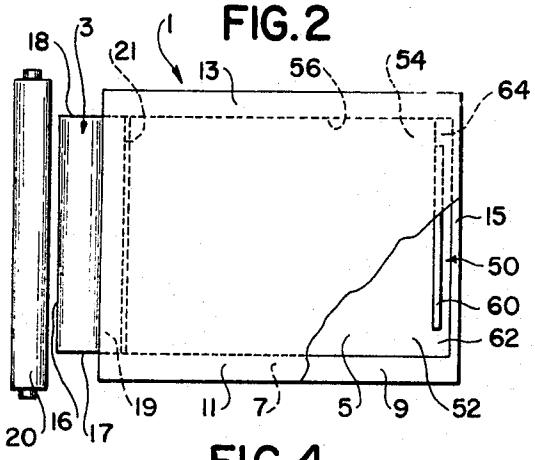


FIG.2

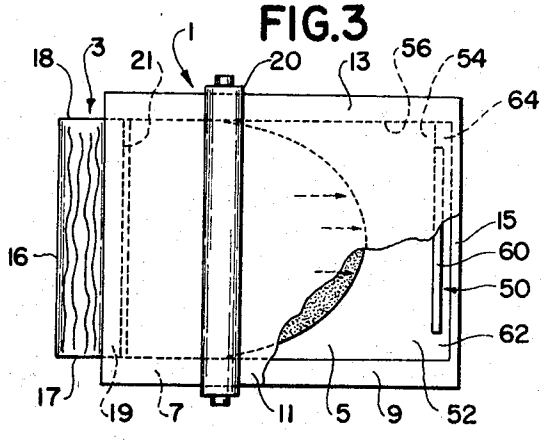


FIG.3

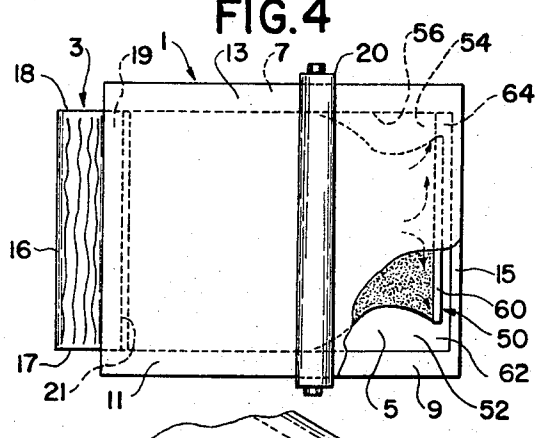


FIG.4

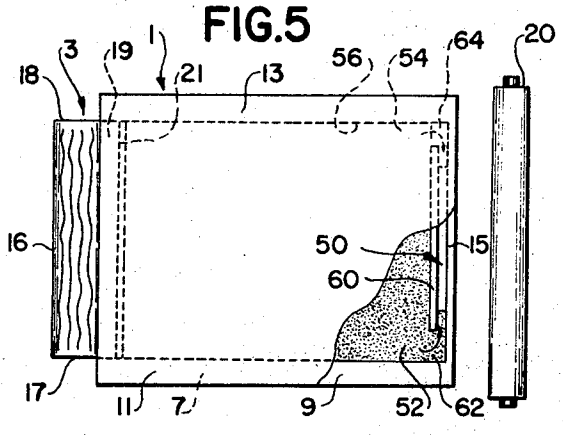


FIG.5

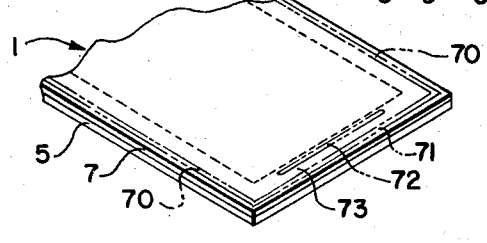


FIG.6

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PHOTOGRAPHIC FILM UNIT

BACKGROUND OF THE INVENTION

The present invention relates to "self-processing" photography and more particularly to film units and photographic assemblages for distributing and for collecting any excess of a fluid composition spread within or across the unit.

It is well known in the photographic arts to provide film units and photographic assemblages with materials for processing the units immediately after their exposure. Generally such units include a photosensitive element comprising a support having thereon at least one layer of photosensitive material, and a receiving element adapted to be registered over the photosensitive element after exposure. A viscous processing composition is released from a rupturable pod located between the two elements at one end of the unit and is spread toward the other end by passing the unit between juxtaposed pressure-applying members that ideally effect an even distribution of the composition in a layer of predetermined thickness and without excess. The fluid composition then permeates the layers of the unit to effect or initiate development of each of said exposed photosensitive layers. An imagewise distribution of diffusible dye or silver then diffuses to or is formed on an image-receiving layer in the receiving element and that element is stripped from the film unit to provide a positive image.

Film units of a preferred type, and with which the present invention will be described, generally are referred to as "preregistered" or "integral" units in which a photosensitive element and a transparent process sheet are preassembled before processing, with a rupturable container or pod therebetween, and remain in a face-to-face composite or superposed relationship after processing. The "bottom side" of the photosensitive element is opaque to light actinic to the photosensitive materials; the process sheet is transparent for exposure of the photosensitive materials from the "top side" of the photosensitive element; and the processing composition includes an opacifying agent that covers the top side of the photosensitive element after the pod is ruptured and cooperates with the opaque bottom side after exposure to permit processing of the unit in daylight. The image-receiving layer may be located either on the process sheet on the side closest to the photosensitive element or, preferably, on the bottom side of the photosensitive element between an opaque layer and a transparent support.

In order to insure that a predetermined exposed area of the film unit to be processed is completely covered by a processing composition layer of uniform thickness, it is usual to supply the container with a quantity of the fluid composition in excess of the minimum amount required. This practice is dictated by the inability to attain the ideal spreading conditions referred to above, and, in turn, dictates the use of means for collecting and retaining the excess composition at the opposite end of the unit from the pod.

Previous collectors for excess processing composition, generally referred to as "traps," are disclosed, for example, in U.S. Pat. No. 2,686,717, and have been provided on extended or trailing end portions of the units as illustrated in U.S. Pat. No. 3,080,805.

Continuous emphasis has been placed on reducing the size of the units to permit their use in more compact cameras, and on eliminating most stripping operations and waste materials left over after processing. These efforts have met only limited success, however, due in part to the fact that the processing composition is highly caustic and must be completely enclosed to prevent damage to the apparatus and injury to its user, and to the significant amount of excess composition used because of inefficient spreading.

In addition to the above, substantial efforts have been directed toward development of a mechanism for spreading the processing composition more efficiently, such that the amount of excess composition and the size of the trap can be reduced without sacrificing quality of the finished print. Previous devices for this purpose have taken many forms, as illustrated in U.S. Pat. Nos. 2,991,703; 3,221,942 and 3,342,600, but, at least in these cases, have concentrated on the leading end of the unit rather than the trailing end where the problem most seriously manifests itself. Still further, solutions of the type illustrated in aforementioned U.S. Pat. No. 2,991,703 require additional mechanisms in the camera that not only add to camera expense but also may significantly increase the force necessary to withdraw the unit from the camera.

The particular properties and configuration of the preferred integral film unit mentioned above even further aggrevate fluid spreading and trapping problems. By way of example only, the fact that the unit remains intact after processing, and the relatively narrow margin around pictures of this type, prevent the use of built-in traps of the relatively large size usable with other types of units. Moreover, the excess fluid must be retained in an area immediately adjacent the finished print or exposure frame of the unit without flowing back over that frame. Still further, the fluid composition must be spread to corners of the exposure frame that may be adjacent a sealed edge of the unit where the sheets are likely to resist separation.

SUMMARY OF THE INVENTION

In accordance with the present invention, a fluid flow-controlling mechanism is provided at a trailing-end portion of the film unit for distributing a processing composition to the trailing-end corners of the exposure frame. The mechanism is particularly adapted for use with integral film units and further may define a trap that is concealable entirely within a border of the unit.

In accordance with a preferred embodiment of the invention, an integral film unit, comprising a photosensitive element, a rupturable container and a process sheet, is provided with a fluid-blocking or fluid-deflecting seal between the element and process sheet across a substantial part of a trailing-end portion of the unit. The seal is adapted to be engaged by the advancing wave front of processing composition as the composition is spread in a first direction across the photosensitive element and for directing the composition toward the corners of the exposure frame in a direction substantially normal to the first direction. The seal also defines an excess-fluid collector or trap that may be concealed within the borders of the unit and that has its main entrances located adjacent the same corners of the exposure frame to which the fluid composition has been directed as set forth above. The collector then receives any excess of the composition at those corners and retains the excess within the unit border.

The invention and its objects and advantages will become more apparent in the detailed description of the preferred embodiment presented below.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the preferred embodiment presented hereinafter, reference is made to the accompanying drawings in which:

FIG. 1 is a pictorial view of an integral film unit in accordance with the present invention with diagonal corners of the process sheet turned back to illustrate interior portions of the unit.

FIGS. 2–5 are schematic representations of the film unit and pressure-applying members at various stages during spreading of the processing composition from a pod, across the exposure frame, and to a trap or excess fluid collector in accordance with the present invention.

FIG. 6 is a partial pictorial view illustrating an alternative embodiment of film unit in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Because photographic film units and apparatus of the self-processing type are well known, the following description is directed in particular to elements forming part of, or

cooperating directly with, the present invention. Elements not specifically shown or described herein should be understood to be selectable from those known in the art.

Referring now to the drawings, and especially to FIG. 1, a preferred embodiment of the invention is illustrated in connection with a film unit 1 and cooperating fluid container or pod 3.

The film unit is illustrated and described more completely in my copending U.S. application Ser. No. 027,990 entitled PHOTOGRAPHIC FILM UNIT FOR DIFFUSION TRANSFER PROCESSING, and filed on Apr. 13, 1970. Briefly, the unit is of the preferred composite or integral type and includes a first sheet or photosensitive element 5 and a second sheet or process element 7 that are supplied before exposure and remain after processing as a precut and laminated structure substantially in the form illustrated. The photosensitive element 5 comprises a transparent support having thereon the following layers in sequence: an image-receiving layer, an opaque reflecting layer, and at least one, and preferably three, silver halide emulsion layers having associated therewith a dye image-providing material. The process sheet 7 is formed of a transparent material, e.g., cellulose triacetate film base, and permits exposure of the photosensitive element from the top side of the unit (the side illustrated in FIG. 1). Photosensitive element 5 and process sheet 7 are preferably, although not necessarily, rectangular and coextensive with one another and are maintained in registered or superposed facing relationship either by direct edge and end seals or by adhesive connections between the sheets and spacing members 9 positioned along the two edges 11 and 13 and the trailing end 15 of the unit.

The above-described film unit can be used to produce positive images in single or multicolors. In a three-color system, each silver halide emulsion layer of the film unit will have associated therewith a dye image-providing material possessing a spectral absorption range substantially complementary to the predominant sensitivity range of its associated emulsion, i.e., the blue-sensitive silver halide emulsion layer will have a yellow dye image-providing material associated therewith, the green-sensitive silver halide emulsion layer will have a magenta dye image-providing material associated therewith, and the red-sensitive silver halide emulsion layer will have a cyan dye image-providing material associated therewith. The dye image-providing material associated with each silver halide emulsion layer may be contained either in the silver halide emulsion itself or in a layer contiguous to the silver halide emulsion layer. In my aforementioned application Ser. No. 027,990, the dye image-providing materials described are nondiffusible couplers capable of reacting with oxidized color developing agent to produce diffusible dyes. Other dye image-providing materials can also be employed in film units useful in the present invention including dye developers, coupling dyes, etc.

The rupturable container 3 may be selected from any of several types and generally comprises a rectangular blank of a vapor impervious material that is folded along a first side edge 16 and is securely sealed or closed along its ends 17 and 18. A second side 19, opposite from folded side 16, is provided along substantially its entire length with a rupturable seal adapted to release a fluid composition supplied in the container upon the application of hydraulic forces generated by passing the container between a pair of juxtaposed pressure-applying members such as rollers 20 (FIGS. 2-5) as might be found in a camera. The container is attached to or cooperates with a leading end of the unit in any suitable manner for discharging its fluid contents between the photosensitive element and process sheet and for this purpose has been illustrated with a flattened discharge mouth 21 inserted into a space or slot provided between the element and process sheet at the leading end of the unit. After exposure of the film unit from the top side, the processing composition containing an opacifier is released from the pod and spread in a layer over at least a predetermined exposure frame of the photosensitive element by passing the entire unit between the pressure-applying members. Since the negative portion of the film unit is surrounded by opaque material to render it light insensitive, the unit can be removed from the camera during development. The processing composition then diffuses into the photosensitive element to either effect or initiate imagewise development of the silver halide emulsion layers. Imagewise distributions of diffusible dye image-providing material which is contained in each silver halide emulsion layer or in a layer contiguous thereto, are formed as a function of the imagewise exposure of each said silver halide emulsion layer. At least a portion of the imagewise distributions of diffusible dye image-providing material diffuse to the image-receiving layer to produce a positive dye image. When the positive image is viewed through the transparent support layer, it will be a right-reading image on the opaque reflecting layer background. The image-receiving layer does not have to be stripped away from the rest of the film unit and no timing of development is required.

While film unit 1 has been described with reference to my above-mentioned U.S. application Ser. No. 027,990, other film units such as the type disclosed in U.S. Pat. No. 3,415,644 issued Dec. 10, 1968 can also be employed in my invention. In addition, integral film units for obtaining a black and white image can also be employed in my invention as will be obvious from the description hereinafter.

The alkaline processing composition employed in the rupturable container is the conventional aqueous solution of an alkaline material, e.g., sodium hydroxide, sodium carbonate or an amine such as diethylamine, preferably possessing a pH in excess of 12, and an aromatic primary amino color developing agent such as a p-phenylenediamine developing agent. The solution also preferably contains a viscosity-increasing compound such as a high molecular weight polymer, e.g., a water-soluble ether inert to alkaline solutions such as hydroxyethyl cellulose or alkali metal salts of carboxymethyl cellulose such as sodium carboxymethyl cellulose. A concentration of viscosity-increasing compound of about 1 to about 5 percent by weight of the processing composition is preferred which will impart thereto a viscosity of about 100 cps. to about 200,000 cps.

While the alkaline processing composition can be employed in a rupturable container, as described previously, to conveniently facilitate the introduction of processing composition into the film unit between the transparent process sheet and the photosensitive element, other methods of inserting processing composition into the film unit could also be employed, e.g., interjecting processing solution with communicating members similar to hypodermic syringes which are attached either to a camera or camera cartridge.

The alkaline solution-permeable, substantially opaque, light-reflective layer in the above-described photographic film unit can generally comprise any opacifier dispersed in a binder as long as it has the desired properties. Particularly desirable are white light-reflective layers since they would be esthetically pleasing backgrounds on which to view a transferred dye image and would also possess the optical properties desired for reflection of incident radiation. Suitable opacifying agents include titanium dioxide, barium sulfate, zinc oxide, barium stearate, silver flake, silicates, alumina, zirconium oxide, zirconium acetyl acetate, sodium zirconium sulfate, kaolin, mica, or mixtures thereof in widely varying amounts depending upon the degree of opacity desired. The opacifying agents may be dispersed in any binder such as an alkaline solution-permeable polymeric matrix such as, for example, gelatin, polyvinyl alcohol, and the like. When it is desired to increase the opacifying capacity of the light-reflective layer, dark-colored opacifying agents may be added to it, e.g., carbon black nigrosine dyes, etc. Another technique to increase the opacifying capacity of the light-reflective layer is to employ a separate opaque layer underneath it comprising, e.g., carbon black, nigrosine dyes, etc., dispersed in an alkaline solution-permeable polymeric matrix such as, for example, gelatin, polyvinyl alcohol, and the like. Such an opaque layer would generally have a density of at least 4 and preferably greater than 7 and would be substantially opaque to actinic radiation.

The transparent process sheet and support for the photosensitive element described above can be any transparent material as long as it does not deleteriously affect the photographic properties of the film unit and is dimensionally stable. Typical actinic radiation transmissive flexible sheet materials include cellulose nitrate film, cellulose acetate film, poly (vinyl acetal) film, poly-styrene film, poly (ethyleneterephthalate) film, polycarbonate film, poly-α-olefins such as polyethylene and polypropylene film, and related films or resinous materials as well as glass.

The respective elements of the film unit described above are selected, pre-cut, and designed to provide a pleasing aesthetic appearance and preferably are stiff enough to be suitable for handling both within and outside of the camera. On the other hand, the structure is sufficiently flexible for manipulation by camera mechanisms and is sufficiently resilient to recover from any normal flexing. In the preferred unit (exposed from the process sheet or top side and viewed from the bottom side through the transparent support), the photosensitive portion of the film unit after processing is hidden from the top side by the opacifying agent in the processing composition and from the bottom side by the opaque reflecting layer. A satisfactory exposure frame and border can be provided by masks or photoresist techniques, either within the unit or externally, and for either covering or preventing diffusion of the image except in the predetermined picture area. Similarly, this border may be applied to the process sheet side of the unit, as well as the picture side, to cover the excess-fluid trap to be described hereinafter.

Referring now more specifically to the details of a preferred embodiment of the present invention, the film unit **1** is provided with a mechanism **50** for effecting more efficient spreading of the fluid composition and preferably also for defining a trap adapted to collect and retain any excess of the processing composition not needed to properly cover the photosensitive element. As illustrated in FIGS. **2–5**, and in previously mentioned U.S. Pat. No. 2,991,703, the composition as it is being spread will define a wave or flow front substantially tongue-shaped or bullet-shaped in configuration with an apex that remains ahead of the rest or main body of the composition unless and except insofar as it otherwise is controlled. Ordinarily this apex travels substantially in a straight line along an axis down the center of the unit as the composition is spread by the rollers in a first direction from the pod at the leading end of the unit, across the exposure frame at a central portion of the unit, and toward the trap at the trailing end of the unit. It is possible, of course, that the apex will be off-center, due, for example, to initial collection of the composition at one end of the pod. However, with modern pod designs, and due to the viscosity of the fluid, it is unlikely that any such off-center position will be significant by the time the flow front reaches the trap. In other words, the apex almost always will be located within the central one third of the unit on either side of the above-mentioned axis before the flow front reaches the trailing end of the unit. Similarly, the use of divided pods or other flow controlling mechanisms at the leading end of the unit or in the camera may substantially flatten or even invert the apex. Again, however, at least with most presently-known mechanisms, the central one-third portion of the flowing fluid composition will advance ahead of the composition adjacent the edges of the unit by the time the composition reaches the trailing end of the unit.

The above phenomena make it difficult to obtain efficient spreading of the processing composition, and, unless a significant excess of fluid is supplied, may result in fluid exhaustion or starvation at the trailing or distal corners **52** and **54** of the exposure frame **56** (see especially FIG. **4**). On the other hand, if a sufficient excess processing composition is supplied, a larger trap usually is necessary to collect and store the excess.

The flow-controlling mechanism of the present invention substantially eliminates the above-mentioned problems by engaging the lead or apex of the flow front at a position adjacent the trailing portion of the exposure frame, and before the trap, to direct fluid composition in a second direction substantially normal to the first-mentioned direction of flow. The mechanism also defines an excess-fluid trap and for this purpose is spaced from the trailing end of the unit by an amount sufficient to hold any such excess. Main entrances to the trap that do not substantially reduce the efficiency of the flow controlling mechanism also are provided adjacent the trailing-end corners of the exposure frame so that these most difficult to cover corners must be properly covered with the processing composition before any excess composition can enter the trap.

In the embodiment illustrated in FIGS. **1–5**, mechanism **50** comprises a blocking or flow controlling member **60** in the form of a spacer similar in materials and configuration to spacing member **9** positioned along the unit trailing end **15** but extending only part of the way across the unit to define the trap main entrances **62** and **64**. The photosensitive element and process sheet are securely adhered to the top and bottom of the blocking member to prevent spreading of the fluid composition into the trap except at the previously-mentioned entrances **62** and **64**, and to insure distribution of the composition to the far corners **52** and **54** of the exposure frame **56** before collection of the excess fluid by the trap. Preferably the blocking member extends crosswise of the unit over a distance equal to or greater than one half the width of the exposure frame, but this distance conceivably could be reduced in the event the smallest possible trap size is not critical. In its greatest possible length, the blocking member could extend even beyond the exposure frame and in such case the trap entrances could be defined by channels cut out of or otherwise formed in spacing members **9** positioned along the unit edges **11** and **13**.

An alternative embodiment of the invention is illustrated in FIG. **6** wherein the sheets are directly sealed together both along their edges and ends **70** and **71** and crosswise of the unit adjacent the trailing-end of the exposure frame to define the flow-controlling mechanism **72** and trap **73**. In this embodiment the separate blocking member **60** is unnecessary and has been eliminated. In most other respects this embodiment is substantially similar to the previously described embodiment and further details are not considered necessary.

Referring now to the operation of the present invention and first to FIG. **2**, the unit is exposed for recording a latent image in the area defined by exposure frame **56** and then is transported to and between a pair of juxtaposed pressure-applying members adapted to rupture the pod and deposit the processing composition contained therein between the photosensitive element and process sheet. Assuming the absence of other flow-controlling mechanisms at the leading end of the unit or in the camera, movement of the unit between the pressure-applying members spreads the fluid in a body having a wave front or leading portion in the center of the unit that advances ahead of the fluid along the edges of the unit. This is represented in FIG. **5**, wherein the flow front has been illustrated in a configuration resembling a tongue or bullet. As the wave front continues to advance to the position illustrated in FIG. **4**, its apex or leading end portion engages the flow-controlling mechanism before the trailing-end corners of the exposure frame have been sufficiently covered. In the absence of the present invention or a significant amount of excess composition, the fluid would be exhausted by flowing directly into the trap and the corners of the exposure frame would be starved of sufficient fluid for processing. With the invention, however, and as illustrated most clearly in FIGS. **4** and **5**, the flow-controlling mechanism directs the leading front of the wave form in a direction substantially perpendicular to its previous direction of movement and into the trailing-end corners of the exposure frame. Should there still be any excess processing composition, it will enter the trap through main entrances **62** and **64** and will be stored within the unit concealed behind or under the unit border. If desired, this border can contain a blotter-like desiccating material to soak up the excess processing composition. Ventilation of the trap to the atmosphere can also be provided by small air holes so that this processing composition will dry down to a solid glue.

In addition, the process sheet and transparent support of the photosensitive element can also be vapor-permeable to permit the processing composition within the film unit to dry.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A photographic film unit for recording a latent image that is processable by a self-contained processing fluid, said film unit comprising:

a photosensitive element including a substantially rectangular exposure area for recording the latent image, said area having an end and corner portions at said end; and

a receiver coupled with said element adjacent to said end for receiving processing fluid from said area, said receiver being substantially closed to the entry of said fluid except at said corner portions.

2. A self-processing film unit for recording a latent image processable by a processing fluid, said film unit defining a first end portion, a central section adapted to be exposed for recording the latent image, and a second end portion, said film unit comprising:

a photosensitive element including a support and photosensitive material for recording the latent image in said central section;

a process sheet registered in superposed relation with said element for aiding in spreading the processing fluid between said element and said sheet in a longitudinal direction from said first end portion, across said central section, and to said second end portion;

means in said second end portion for receiving excess processing fluid remaining after spreading of the fluid across said central section; and

means establishing a restriction between said element and said sheet for directing the processing fluid in a lateral direction substantially normal to said longitudinal direction, said means compelling substantial lateral movement of the fluid as it is spread from said central section to said second end portion.

3. The film unit claimed in claim 2 wherein said directing means comprises a substantially fluid-tight seal between said element and said sheet, said seal being in said second end portion adjacent to said central section.

4. The film unit claimed in claim 3 wherein said film unit further defines a predetermined width and said seal extends substantially in said lateral direction along at least one half of said width.

5. An unexposed self-processing photographic film unit for recording a latent image processable by a processing fluid, said film unit comprising:

first and second substantially flat elements registered in face-to-face relation, each of said elements defining a pair of lateral edges, first and second ends, and an exposure frame intermediate said ends, said first element including a photosensitive material for recording the latent image within said exposure frame, said second element cooperating with said first element to aid in spreading the processing fluid between said elements in a first direction from said first end, across said exposure frame, toward said second end;

means containing the processing fluid for supplying said fluid between said elements at said first end;

means for receiving any excess of said fluid from between said elements at said second end; and

means disposed between said exposure frame and said receiving means for diverting the spreading of said fluid substantially entirely from said first direction to second directions extending toward said lateral edges.

6. The film unit claimed in claim 5 wherein said diverting means prevents substantially all of said fluid from entering said receiving means except at locations adjacent to said lateral edges.

7. The film unit claimed in claim 6 wherein said diverting means is defined by a blocking element having first and second sides securely adhered to said first and second elements respectively.

8. The film unit claimed in claim 6 wherein said diverting means is defined by a direct seal between said first and second elements.

9. In an unexposed, preregistered, self-processing film unit including a pair of juxtaposed sheets and having means defining an end of said unit, a picture-recording area of at least one of said sheets, and a substantially opaque border around said area, said border including a portion having a width extending from said end to said area, said width having a central segment said sheets defining facing surfaces between which a processing fluid is spreadable in a first direction across said area toward said end, the improvement comprising:

fluid control means, extending in a second direction substantially perpendicular to said first direction and spaced from said end by an amount substantially equal to said width, for defining a fluid trap entirely within said border and for defining entrances to said trap requiring substantial lateral movement of the processing fluid along paths substantially parallel with said fluid control means before permitting entry of the fluid into said trap, said fluid control means being substantially closed to the entry of fluid along said central segment.

10. An unexposed photographic film unit adapted to record a latent image processable by a processing fluid, said film unit comprising:

a photosensitive element including an exposure area for recording the latent image, said area having an end and a predetermined width at said end;

a process sheet adapted to facilitate spreading of the processing fluid in a predetermined direction over said area;

means adjacent to said end for receiving any excess of the processing fluid remaining after spreading of the fluid over said area; and

means, including at least one permanent seal disposed between said end and said receiving means, for preventing passage of the processing fluid in said direction over a substantial portion of said width and for permitting passage of the fluid in said direction over a comparatively small portion of said width so as to enter said receiving means.

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