United States Patent

Nerwin

[15] **3,680,456**

[45] **Aug. 1, 1972**

[54] PHOTOGRAPHIC FILM ASSEMBLAGE

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[73] Assignee: **Eastman Kodak Company,** Rochester, N.Y.

[22] Filed: **Oct. 2, 1970**

[21] Appl. No.: **77,485**

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

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

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

[56] **References Cited**

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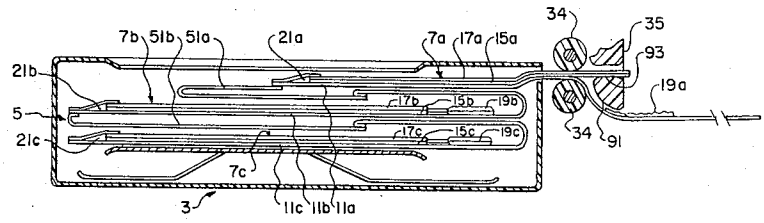
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2,903,951	9/1959	Land	95/19
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Fred L. Braun
Attorney—Robert W. Hampton and J. Addison Mathews

[57] **ABSTRACT**

An assemblage of self-processing photographic film units each including pre-registered photosensitive and process elements strippably mounted on a carrier sheet, with a cooperating pod (supply container for fluid processing composition) and trap (collector for excess fluid processing composition) permanently secured to the carrier sheet. The film units are interconnected to form the assemblage by leaders extending from the leading end of one unit to the trailing end of a next preceding unit. The leaders are strippably attached to the next preceding unit for automatic threading as the next preceding unit is withdrawn from the assemblage.

8 Claims, 15 Drawing Figures



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SHEET 1 OF 4

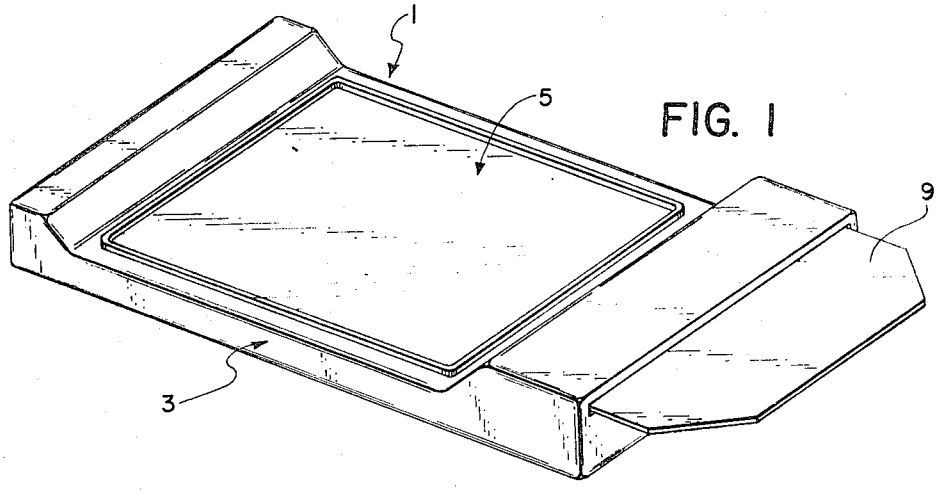


FIG. 1

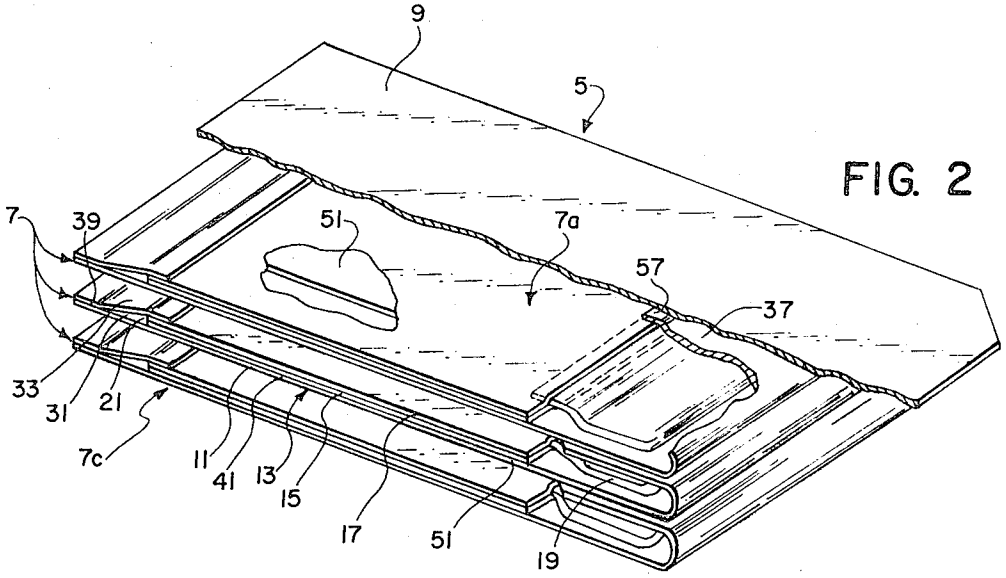


FIG. 2

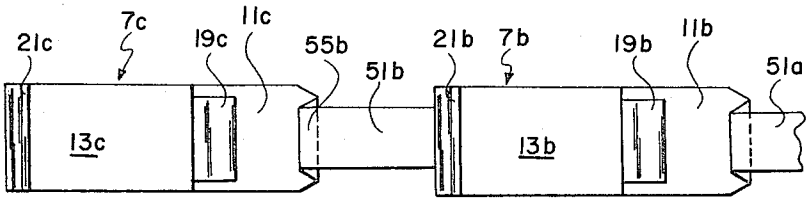


FIG. 3

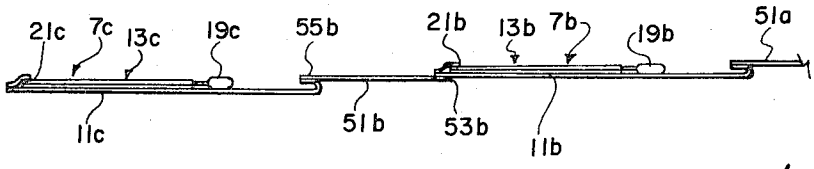


FIG. 4

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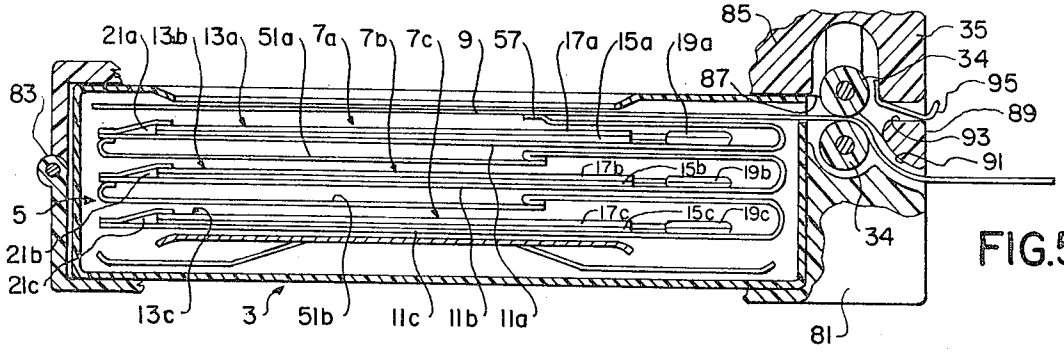


FIG.5

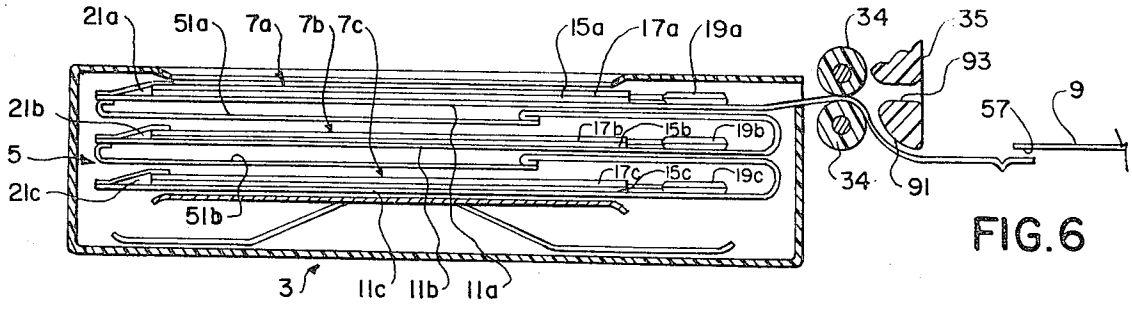


FIG.6

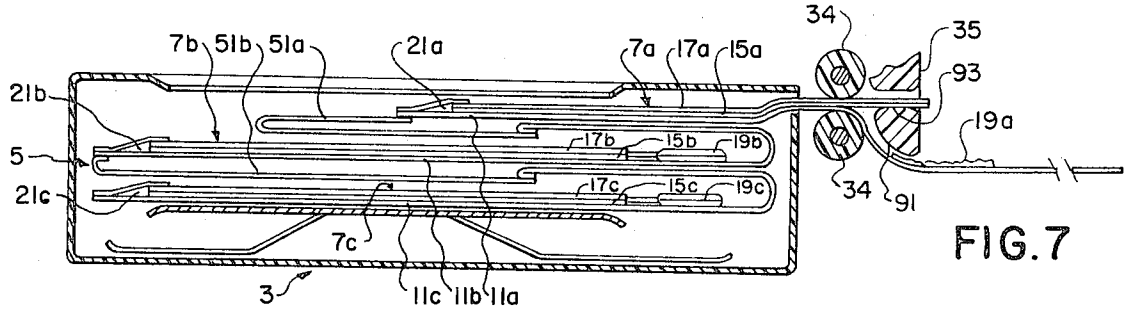


FIG.7

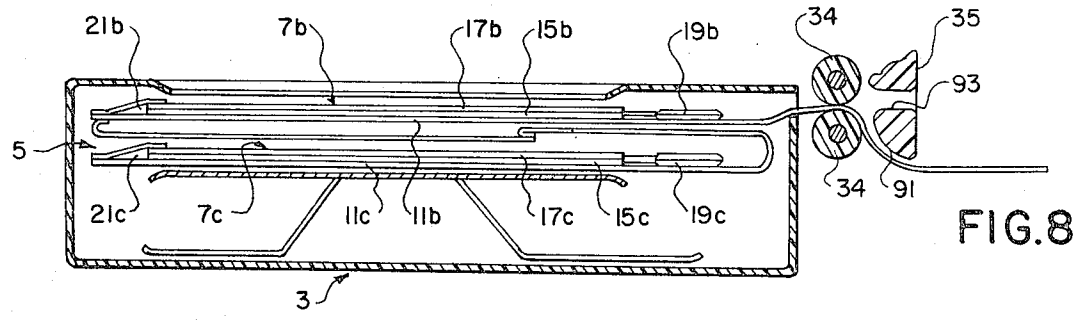


FIG.8

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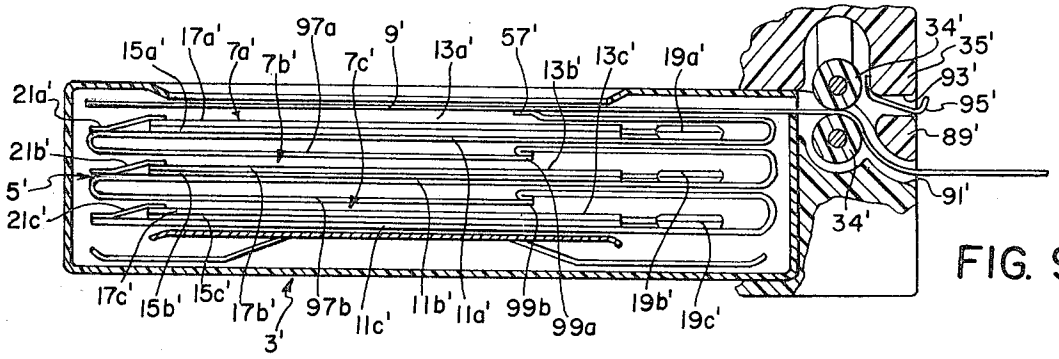


FIG. 9

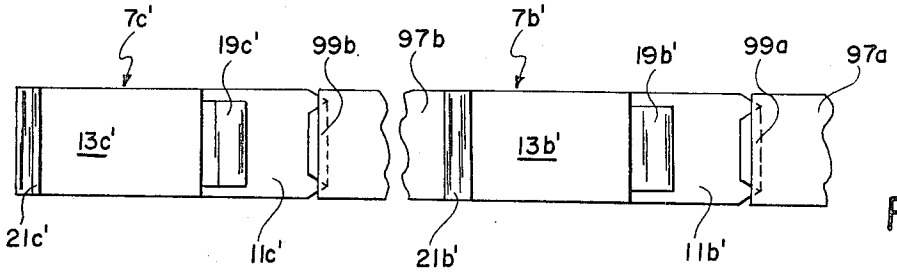


FIG. 10

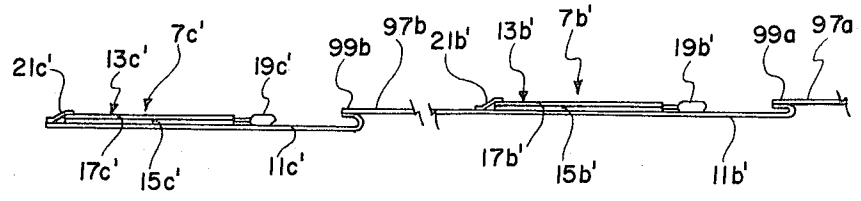


FIG. 11

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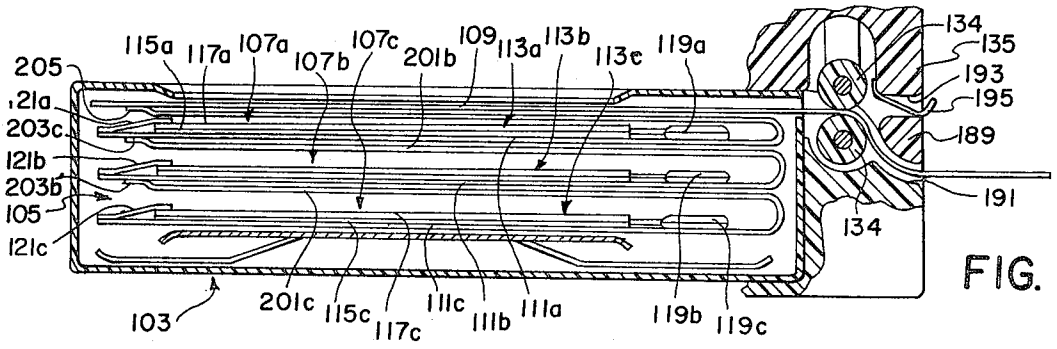


FIG. 12

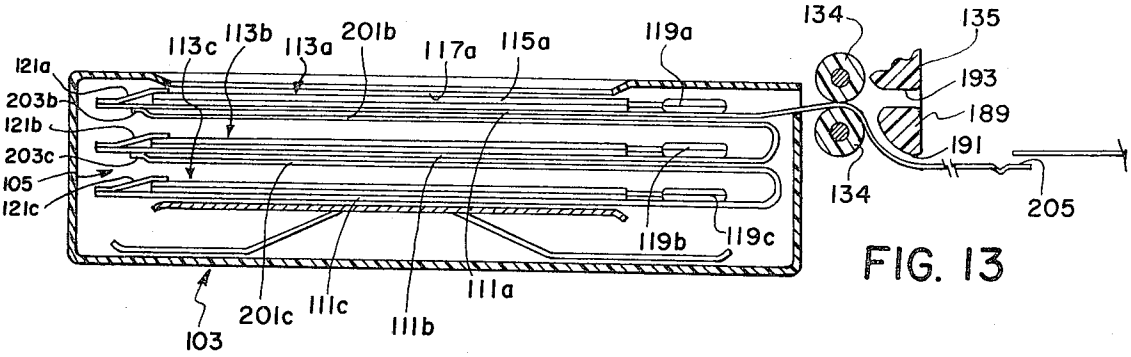


FIG. 13

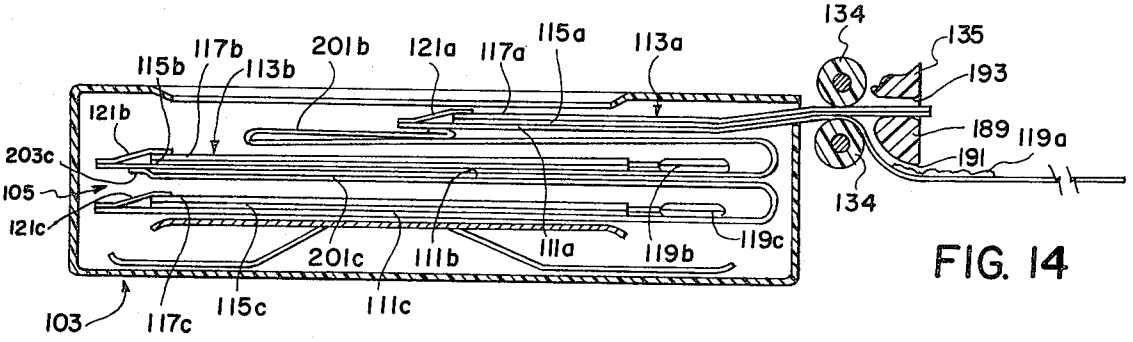


FIG. 14

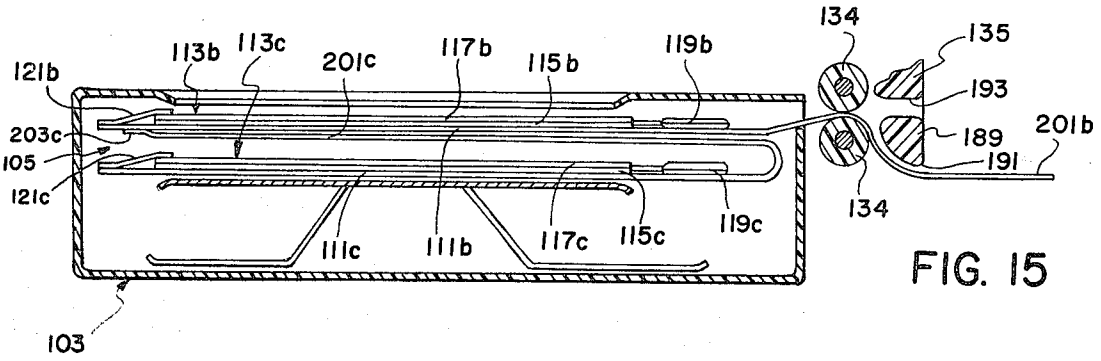


FIG. 15

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PHOTOGRAPHIC FILM ASSEMBLAGE

CROSS REFERENCE TO RELATED APPLICATIONS

Reference is made to my U.S. Patent Application Ser. No. 70,836, entitled FILM UNIT, filed on Sept. 9, 1970; my U.S. Patent Application Ser. No. 70,835, entitled PHOTOGRAPHIC FILM UNIT, filed on Sept. 9, 1970; and to commonly assigned copending U.S. Application Ser. No. 33,677, entitled PHOTOGRAPHIC APPARATUS, filed on May 1, 1970 in the name of D. M. Harvey.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to assemblages of self-processing photographic film.

It is well known in the photographic arts to provide film units 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 second element adapted to be registered over the photosensitive element for processing. A viscous processing composition is released from a rupturable pod at one end of the unit and is spread toward the other end by passing the unit between juxtaposed pressure-applying members that distribute the composition in a layer of predetermined thickness between the two elements. The distributed fluid composition then permeates the layers of the unit to effect development of the photosensitive layers, and an imagewise distribution of dye or silver is formed on or diffuses to an image-receiving layer, either in the photosensitive element or in the second element, to form the finished print.

In most presently commercial film units, generally referred to as being of the "peel-apart" type, the photosensitive and second elements are spaced apart during exposure and are brought into superposition for processing. The image or print-receiving layer is in the second element, and that element is stripped from the rest of the unit after processing to provide a positive, right-reading print. Such units are disclosed, for example, in U.S. Pat. Nos. 3,080,805 and 3,511,659.

The present invention is concerned with more recently developed film units, generally referred to as "pre-registered" or "integral" units, in which a photosensitive element and a process sheet or second element are intended to be supplied in a composite, permanently registered or integral form. In this case the elements are superposed prior to exposure and remain substantially in the same physical form after processing. The process sheet is transparent, to permit exposure of the photosensitive materials from the "top side" of the unit, and the image or print-receiving layer is located either in the process sheet or, preferably, in the photosensitive element, to provide a positive image without being stripped from the rest of the unit. Film units of this latter type are disclosed, for example, in commonly assigned, copending U.S. Patent Application Ser. No. 027,990, entitled PHOTOGRAPHIC FILM UNIT FOR DIFFUSION TRANSFER PROCESSING, filed Apr. 13, 1970, now abandoned, in the name of H. E. Cole; in the cross-referenced U.S. Applications Ser. Nos. 70,835, 70,836, and 33,677; and in French Pat. Nos. 2,006,225 and 2,006,256 published on Dec. 26, 1969.

Film units of the peel-apart and certain of the integral types have been supplied with leaders to facilitate their handling in photographic apparatus. Additionally, the leaders often serve to interconnect a plurality of film units arranged in an assemblage or pack, and, at least in the case of peel-apart units, to couple the photosensitive and image-receiving elements of each respective film unit. Various different types of such leaders are disclosed, for example, in the above-mentioned U.S. Applications and in U.S. Pat. Nos. 2,477,304; 2,558,856; 3,046,861; 3,080,805; 3,152,529; 3,309,201 and 3,511,659.

The present invention is concerned with improved means for facilitating the handling of film units in photographic apparatus, and for interconnecting a plurality of film units in an assemblage or pack. More specifically, the invention is concerned with such means as applied to the particular problems encountered in film units of the pre-registered and integral types.

2. Description of the Prior Art

The development of commercially practical film units of the pre-registered or integral type has constituted a significant step toward reducing many of the problems inherent in peel-apart units, especially as encountered in first superposing and then separating the photosensitive and print-receiving elements. At the same time, however, numerous and often unexpected new problems have been encountered. By way of example only, the leader arrangements utilized with peel-apart units generally are not entirely satisfactory for transporting and interconnecting integral units. Similarly, with peel-apart units, it is relatively easy to separate the finished print from its leaders, and also from its pod, trap, and other materials left over as waste after processing. Such separation is facilitated by the moistened interface at the point of separation between the print-receiving element and the photosensitive element, resulting from the distribution of a processing composition therebetween. In integral units, on the other hand, the finished print permanently remains attached to the photosensitive element, as well as to the process sheet, and separation of the leaders and other processing waste materials becomes much more difficult because it cannot occur at the moistened interface provided by the distributed processing composition.

In commonly assigned copending U.S. Application Ser. No. 33,677, entitled PHOTOGRAPHIC APPARATUS, and filed on May 1, 1970 in the name of D. M. Harvey, an integral film unit and continuous leader have been disclosed that suggest solutions to many of these newly encountered problems, and the solutions presented therein generally have been considered satisfactory. In at least certain respects, however, that unit and leader arrangement may not be sufficiently versatile in application to permit its use in different types of packs. For example, it is desirable to be able to manufacture packs of integral film units particularly adapted to be manually withdrawn from the packs. Moreover, and especially in view of the tremendous volume usually involved in the production of such units, it is important that the unit be simple and inex-

pensive to manufacture and to assemble into packs containing a plurality of such units.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the present invention, an assemblage and pack of self-processing photographic film units are provided, including leader arrangements for interconnecting the film units within the assemblage and for transporting the film units within and from the assemblage. The units are arranged in a stack for sequential exposure and processing by an associated camera, and are interconnected such that the withdrawal of one of the units from the stack also automatically withdraws a leading end portion of a leader of the next successive unit and then leaves that last-mentioned leader in a position where it may be grasped for withdrawing that next successive unit. The camera intended to be used with the assemblage includes opposed pressure-applying members, and the leader arrangement for transporting the units from the assemblage is effective for pulling the units between such members to initiate processing and also for automatically threading the above-mentioned leading end portion between the members.

The film units are of the integral type including pre-registered photosensitive and process elements, and, in accordance with one feature of the preferred embodiment, the film units each include a carrier sheet, a container for processing composition, and a trap for collecting any excess of such composition. The container and trap are coupled to the photosensitive and process elements for depositing the composition between the elements at their leading ends and for collecting any excess of the composition from their trailing ends. The container and trap also are securely attached to the carrier sheet for disposal therewith after processing. The integral photosensitive and process elements, on the other hand, easily are separable from the carrier sheet, the pod, and preferably also from the trap, for retention as the finished print. Additionally, an extended portion of the process sheet serves as the leader for interconnecting the units in the assemblage and for transporting film units from the assemblage.

It is an object of the present invention to provide an assemblage of integral film units, and a pack containing such an assemblage, that are particularly adapted for inexpensive manufacture and manual operation.

Another object of the invention is to provide an assemblage of film units including a leader arrangement for interconnecting the film units and for transporting the film units within and from the assemblage.

A further object is to provide such an assemblage wherein the withdrawal of one film unit from the assemblage automatically moves a leader portion of a next successive unit to a position where it may be grasped for manually withdrawing that next successive unit from the assemblage.

Still another object of the invention is to provide such an assemblage for use in a camera having opposed pressure-applying members, and wherein the units are adapted to be withdrawn, and the leader portions are adapted automatically to be threaded, between the pressure members.

It is a further object to provide an assemblage of film units including individual carrier sheets for supporting the photosensitive and process elements, pods and traps.

Still another object is to provide a film unit of the above type wherein the carrier sheets further define leaders for transporting and interconnecting the film units.

Another object is to provide an assemblage of film units each including a pod and image-recording unit supported on a carrier, wherein the pod is permanently coupled to the carrier and the image-recording unit is strippably coupled to the pod and carrier, such that the image-recording unit easily can be separated from the carrier, and pod after processing has been initiated.

BRIEF DESCRIPTION OF THE DRAWING

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

FIG. **1** is a pictorial view of a film pack in accordance with the present invention, including a casing for containing a film assemblage in accordance with the present invention.

FIG. **2** is a pictorial view of a film assemblage in accordance with the present invention.

FIGS. **3** and **4** are top and side plan views, respectively, of the film unit depicted in FIG. **2**, but illustrating the unit in a laid-out or unstacked condition.

FIGS. **5 – 8** are schematic cross-sectional views of the film unit depicted in FIG. **2** and illustrating various stages in the operation of the film unit with an associated camera.

FIGS. **9, 10** and **11** correspond substantially to FIGS. **5, 3** and **4**, respectively, but illustrate a first alternative embodiment of the assemblage.

FIGS. **12 – 15** correspond substantially to FIGS. **5 – 8**, respectively, but illustrate yet another alternative embodiment of the assemblage and its method of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Because photographic film units are well known, the present description will be 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 as being selectable from those known to those skilled in the art.

Referring now to the drawings, and particularly to FIGS. **1** and **2**, a preferred embodiment of the present invention is illustrated comprising a pack **1** including a casing **3** for containing an assemblage **5** of integral self-processing photographic film units **7** and a dark slide **9**.

Preferred individual image-recording and film units for use in the assemblage are illustrated and described more fully in my previously mentioned U.S. Applications Ser. Nos. 70,836, entitled FILM UNIT, and 70,835, entitled PHOTOGRAPHIC FILM UNIT. Briefly, however, each film unit comprises a carrier sheet **11**; an image-recording portion or smaller unit **13**, including photosensitive and process elements **15** and **17**; a pod or container **19** for processing composition; and a trap or collector **21** for any excess processing composition. The assemblage may contain any number of film units, for example eight, but has been illustrated with only three such units to simplify

the description. Additionally, reference numerals generally are applied only to the central illustrated film unit, since the first and last units may have a slightly different construction, for purposes to become more fully apparent hereinafter.

The photosensitive and process elements **15** and **17** accurately are constructed to define sheets having straight edges, square corners and appropriate borders, and properly are registered during manufacture, to provide a uniformly flat, aesthetically pleasing structure that will maintain its integrity after processing. Except for a pod, trap, and carrying sheet, included in the more comprehensive structure to be described hereinafter, the image-recording unit **13** is intended to be supplied with all parts necessary for processing by the intended apparatus, and all such parts permanently are retained together without adversely effecting the finished print.

The carrier sheet **11** supports image-recording unit **13** with the pod **19** and trap **21** coupled to the recording unit for discharging a suitable processing composition between the elements at one end of the recording unit and for collecting any excess of the composition from between the elements at the opposite end thereof. The carrier is particularly adapted for convenient handling of the entire film unit **7** from the first stages of manufacture, to completion of the finished print and disposal of any processing waste material. For this purpose the carrier comprises an individual sheet that most closely is associated only with one film unit, although it is coupled to other similar units in the assemblage as described hereinafter.

The pod **19** and trap **21** permanently are secured to the carrier sheet, but only releasably are coupled to the image-recording unit **13**. Similarly, the image-recording unit is only releasably coupled to the carrier sheet **11**. As will be described more fully hereinafter, such an arrangement of permanent and releasable couplings permits stripping after processing of the image-recording unit (then defining the finished print) from the carrier, pod and trap. The latter three elements, then comprising processing waste material, may be rolled up and discarded in one packet, with the carrier sheet surrounding the pod and trap and protecting any sensitive environment (e.g. clothing and skin) from any remaining processing composition in the waste material.

IMAGE-RECORDING UNIT

(Photosensitive Element and Process Sheet)

In a preferred form, photosensitive element **15** comprises a substantially flat, resilient support of transparent cellulose triacetate film base defining a first or leading end, a second or trailing end, lateral edges and a central portion. At least the latter central portion supports respective layers of image-receiving material, opaque reflecting material, and silver-halide emulsion with associated dye image-providing material. Such layers preferably are arranged in the sequence given, with the support located near the bottom or outside face adjacent the carrier sheet, where it can protect that side of the unit, and the silver-halide emulsion located near the top or inside face adjacent the process sheet, where it is protected by the process sheet. As will become more apparent hereinafter, the silver-halide emulsion is adapted to be exposed through the process sheet, from the top side of the unit, and the developed print is adapted to be viewed through the transparent support, from the bottom side of the unit.

The process sheet or second element **17** also preferably is formed of a transparent material, such as cellulose triacetate film base, and defines a resilient, substantially flat sheet having leading and trailing ends, lateral edges, and a central portion corresponding to equivalent parts of the photosensitive element. In addition to its function in spreading the processing composition, to be described more fully hereinafter, the transparent process sheet protects the top side of the photosensitive element and film unit while permitting the above-mentioned exposure of the silver-halide emulsion.

Photosensitive element **15** and process sheet **17** preferably are rectangular and coextensive with one another, and may be maintained in registered or superposed facing relationship by any permanent seal or connection to define the image-recording unit **13**. Regardless of the particular type of seal or connection, or of its particular manner of application, the photosensitive and process elements are secured substantially in direct contacting relationship, or the equivalent thereof, at lateral marginal edge portions and in such a manner that the central portions of the elements are retained in registered overlying relationship, but may be resiliently spaced apart in their central portions to permit the spreading of a processing composition therebetween. Additionally, the leading and trailing ends of the recording unit are resiliently separable to permit the introduction of the processing composition between the elements at the leading end and the collection of any excess composition from the trailing end.

COMPREHENSIVE FILM UNIT

(Including Carrier, Pod and Trap)

The image-recording unit described above, comprising the photosensitive element **15** and process sheet or second element **17**, particularly is adapted to cooperate with various elements of the more comprehensive film unit **7** with which it has been illustrated. The latter unit includes the carrier sheet **11**, the container or pod **19**, and the excess fluid collector or trap **21**, all of which cooperate for recording and developing a latent image when used with the intended apparatus.

The trap or excess-fluid collector generally comprises one or more lifters **31** permanently mounted on a skirt **33** at the trailing end of the carrier sheet for collecting any excess fluid composition expelled from the trailing end of the image-recording unit **13**. The lifters are substantially incompressible and cooperate with the carrier to define appropriate surfaces preferably completely enclosing a chamber or void that is maintained even when between the pressure members. A more detailed description of the operation of such lifters is set forth in U.S. Pat. No. 2,686,717.

The container or pod **19** may include various cooperating parts, together defining a suitable processing-composition supplying mechanism, and preferably including a rupturable containing part generally comprising a rectangular blank of a vapor impervious material that is folded along a first side edge and is securely sealed or closed along its ends. A second side opposite from the folded side, is provided

along substantially its entire length with a rupturable seal adapted to release a fluid composition from the container upon the application of hydraulic forces generated by passing the container between a pair of juxtaposed pressure-applying members, such as rollers **34**. The containing part of the fluid supplying mechanism is coupled to or cooperates with a leading end of the recording unit in a suitable manner for discharging its fluid contents between the photosensitive element and process sheet, and for this purpose has been illustrated with a funnel inserted into a space or slot provided between the photosensitive element and process sheet at the leading end of the image-recording unit.

Carrier sheet **11** comprises an elongated web of flexible material defined by one or more sheets cut and joined to provide the desired configuration and length. As will be described more fully hereinafter, this carrier sheet, either alone, or in combination with various leaders, serves to interconnect various ones of a plurality of the film units in assemblage **5** or pack **1**, and also serves for transporting such units in photographic apparatus such as a cartridge **3** or a camera (represented as **35** in FIG. **5**). For this reason the carrier is adapted to be folded or rolled back in almost any desired manner at one or more locations along its leading end **37** for proper attachment to such other units, and to provide a more compact (shorter) assemblage. This same unit may be assembled in many different arrangements, both simple and complex, and with no significant change in the unit itself, except, perhaps in its manner of folding or in the attachment of one or more leaders as mentioned above.

The carrier comprises a first leading end portion **37**, a second trailing end portion **39** and a central supporting portion **41**. The length of leading end **37** depends on many factors, such as the manner in which the units are to be connected in a pack. The central supporting portion **41** of the carrier is provided with suitable connecting means, such as adhesives, cohesives or seals, for coupling the image-recording unit **13**, the pod **19** and trap **21**, to the carrier sheet in a manner described more fully in the abovementioned U.S. Patent Application Ser. No. 70,835, entitled PHOTOGRAPHIC FILM UNIT. Briefly, however, the image-recording unit is strippably attached to the carrier, while the pod and trap are permanently attached thereto, such that the carrier, pod and trap may be stripped from the recording unit, to leave an aesthetically unencumbered print, and for convenient discarding of the processing waste materials.

The pod **19** and trap **21** also are releasably coupled to the image-recording unit **13**. However, such coupling preferably is only functional. For example, lips of the pod, or its funnel, may be inserted between the photosensitive and process elements at the leading end thereof, and trailing ends of the photosensitive and process elements may be inserted between similar lips of the trap. Such arrangements are more fully illustrated and described in commonly assigned copending U.S. Application Ser. No. 33,677, entitled PHOTOGRAPHIC APPARATUS, and filed on May 1, 1970 in the name of D. M. Harvey.

The film unit may be used in photographic apparatus such as a camera having stepped pressure-applying members as illustrated and described in previously mentioned U.S. Application Ser. No. 70,836, entitled FILM UNIT. In operation, raised shoulder portions of the pressure members are adapted to ride on the marginal portions of the film unit as the unit is pulled between the members, while recessed central portions of the members simultaneously are adapted to rupture the container and spread the processing composition in a uniform layer.

As the fluid processing composition is expelled from the container and distributed between the photosensitive and process elements, hydraulic forces in the fluid composition will separate the resilient elements in their central portions and force them (with the carrier sheet) into engagement with the central portions of the pressure members.

As the processing composition is distributed, it immediately begins to permeate the various layers of the photosensitive element to initiate processing in a manner to be described more fully hereinafter. Additionally, various components of the processing composition, including water, begin to escape or dissipate entirely through or otherwise from between the photosensitive and process elements to the surrounding atmosphere, resulting eventually in a drying of the processing composition. The composition comprises only a very small percentage of solids (e.g. less than 5 percent), and most of the rest of the composition (essentially water) eventually escapes from between the elements (e.g. within a few hours). As a result, the forces holding the photosensitive and process elements apart are relieved and the resiliency of the elements effects their return to facing engagement. By this time the image-recording unit again has assumed its original uniformly flat configuration. Additionally, since the image-recording unit **13** is adapted to be stripped from the carrier sheet, the finished print will be presented in a form unencumbered by the various materials, such as the pod and trap, that are necessary only for processing.

While any number of different methods can be used for separating the image-recording unit from the carrier sheet, the most convenient is to bend the carrier sheet downwardly away from the plane defined by the recording unit. Preferably, the photosensitive and process elements have significantly more resiliency than the carrier sheet, and will tend to retain a substantially flat condition. The forces resulting from such bending of the carrier sheet will pull the pod from between the photosensitive and process elements, and similarly will pull such elements from the trap. Additionally, the image-recording unit will separate or be stripped from the carrier, as provided for by the releasable connection between the recording unit and the carrier.

The pod and trap remain with the carrier sheet after stripping and can be rolled up in the sheet to enclose any remaining processing composition and to protect the environment, e.g. clothing and person, from the composition. Preferably, this roll, including all processing waste material, is discarded immediately. However, it also may be deposited temporarily in a pocket or drawer without substantial risk of damage thereto.

ASSEMBLAGE AND PACK

(Leader Arrangement)

The preferred film assemblage, illustrated most clearly in FIGS. 1–5, comprises a plurality of film units 7 and a leader arrangement for coupling the leading end of one film unit to the trailing end of a next adjacent (preceeding) film unit. In most cases the following description will be set forth in connection with the middle film unit in the assemblage. However, where it is necessary to refer to a particular film unit, the units will be distinguished by *a*, *b* and *c* to represent the first, next, and last film units, respectively, it being understood that ordinarily the assemblage will contain 8 rather than 3 film units. As briefly mentioned above, the leader arrangement may be defined by extensions or leading ends of the carrier sheets themselves, or, preferably, by one or more additional or supplemental leaders coupled to the leading end of each of the carrier sheets. The coupling between the film units is such that the withdrawal of one of the film units from the assemblage automatically will effect both: (1) the withdrawal of a leading end portion of the leader of the next successive film unit from the assemblage; and (2) the automatic stripping or separation of that leading end portion from the preceeding withdrawn film unit. When used in photographic apparatus having juxtaposed pressure-applying members, the withdrawal of one unit between the members automatically threads the leader of the next successive film unit between the pressure members and leaves a portion of that leader in a position outside the apparatus where it may be grasped for pulling the next unit between the pressure members.

More specifically, and as illustrated in FIGS. 2–4, the preferred leader arrangement comprises the carrier sheet 11, or at least its leading end portion 37, and a supplemental leader 51 coupled at one end 53 to the trailing end 39 of the carrier sheet of one film unit, and at its other end 55 to the leading end 37 of the carrier sheet of the next adjacent (successive) film unit. While the supplemental leader can be considered as a part of either of the film units to which it is coupled, the following description will assume the leader is a part of that film unit to which it is most securely coupled, as will become more apparent hereinafter.

The coupling at the first end 53 of the leader may be effected in any suitable manner and preferably is non-releasable or strong enough so the leader remains attached to the carrier sheet as a permanent part thereof. The second end coupling 55, on the other hand, is designed to be released or stripped from the next successive carrier sheet at an appropriate time, and for this reason is provided with a reverse curl or is folded back upon itself adjacent the point of attachment to define a peel-apart connection. This connection, including an appropriate adhesive, is sufficiently strong in sheer to remain intact while transporting the leading end of the next successive carrier sheet within and from the assemblage. Assisting to this end is the compact condition of the film units in the pack, which does not provide the peel-joint with sufficient vertical space to separate in its usual manner, and also the excess material defined by the folded back leading end of the carrier sheet that can be moved from the assemblage without substantial frictional resistance. However, after that leading end is withdrawn and threaded between the pressure members of an associated photographic apparatus, the additional vertical space becomes available, the excess material is exhausted, and the suddenly increased resistance to movement of the leader, because it is coupled to the next successive film unit, all effect an increase in the tensil forces applied to the connection. The connection is relatively weak in tension, and will separate or peel apart as the tensil forces increase, thus depositing the leading end outside the apparatus in a position where it may be grasped for withdrawing the next successive unit from the assemblage and apparatus.

In the embodiment illustrated, the peel-apart connection is spaced lengthwise along the leader, from the trailing end of the preceeding image-recording unit, by an amount approximately equal to the length of the image-recording unit 13 and lies vertically below the leading end of the recording unit. Similarly, the connection is spaced from the leading end of the next successive recording unit by an amount approximately equal to twice the length of the fluid container 19 and its funnel. These lengths have been established first so the leader will not pass between the pressure members until after the preceeding film unit but will pass entirely between the pressure members (except for the carrier sheet parts thereof) before the next successive recording unit, and second, so only a relatively short leading end portion of the leader or carrier sheet of the next successive film unit will be left extending from the apparatus after separation of the peel-apart connection.

The leader 51 is somewhat narrower than the other elements of the film unit to facilitate its rolling upon itself as it is withdrawn from the assemblage and to reduce the frictional forces as it moves in the assemblage and between the pressure-applying members. While the exact width is not known to be critical, it preferably is narrower than the recessed portion of the pressure members and is sufficiently thin to pass between the members without rotating the members, in the case of rollers, or without significant frictional contact between the leader and the pressure members, in the case of non-rotating members. In this manner, and is described more fully in U.S. Pat. No. 3,161,122, issued to Polaroid on Dec. 15, 1964, the leader can move laterally while between the pressure members to permit proper alignment of the film unit immediately prior to its entry into the bite between the members.

A dark slide 9 is provided for protecting the film units from premature exposure. While this dark slide may be coupled to the first or uppermost film unit in any suitable manner, a strippable or peel-apart connection has been illustrated that is similar to the connections described above except for its location, which has been selected to reduce the waste material left over after withdrawal of the dark slide.

OPERATION OF PREFERRED EMBODIMENT

Referring now more specifically to FIGS. 5 – 8, the operation of the preferred embodiment is illustrated. In order to position the pack within the camera, the camera back or door 81 is pivoted about hinge 83 and away from front body portion 85. A parting line 87 is provided between the camera back and the front body

portion such that opening of the camera back will separate one of the pressure members from the other pressure member and from a stripping guide **89**. The pack then can be inserted into the camera with a leading end portion of the dark slide **9** projecting therefrom, and when the camera back **81** is closed the pressure members will be located on opposite sides of the dark slide and the leading end portion of the dark slide will project from a first exit channel **91** and to a position outside the camera where it is accessible for withdrawing the dark slide through exit channel **91** and from the camera. The function of the stripping guide **89** and channel **91** is more fully illustrated and described in my U.S. Application Ser. No. 77,515, entitled STRIPPING MECHANISM, filed on even date herewith, and will not be described in detail in the present application. However, it should be understood that other camera structures for guiding the film units from the camera may be utilized without departing from the present invention and as illustrated, for example, in my previously mentioned U.S. Application Ser. No. 70,835, entitled PHOTOGRAPHIC FILM UNIT.

The pack is prepared for a first exposure by grasping the leading end of the dark slide and withdrawing the dark slide between the pressure-applying members and from the camera. As the dark slide is withdrawn, the leading end portion of carrier sheet **11***a* will move with the dark slide and will be threaded between the pressure-applying members and through the first exit channel **91** to the position illustrated in FIG. **6**. In its folded condition (illustrated in FIG. **5**) the leading end of the carrier sheet **11***a* provides sufficient excess material to move freely to the position illustrated in FIG. **6** without substantial frictional resistance. However, after reaching such position, the excess material is used up and significant additional resistance to movement is presented by the first film unit **7***a*. This additional resistance may result inherently from the compact arrangement of the pack or may be supplemented by a frangible coupling between the trailing end of the film unit and the pack casing in a manner well known to those skilled in the art. In any event the increased resistance is sufficient to effect a peeling apart of the dark slide from the leading end of the carrier sheet, also as depicted in FIG. **6**.

The first film unit then is exposed, and is transported from the assemblage and between the pressure-applying members by grasping and pulling on the leading end of carrier sheet **11***a*. As that carrier sheet is withdrawn, the pod **19***a*, the trap **21***a*, the leader **51***a*, and the leading end of the next successive carrier sheet **11***b* all follow the first carrier sheet **11***a* between the rollers and through first exit channel **91**. The film unit, on the other hand, is stripped from these other various elements, in a manner briefly described above and more fully described in my U.S. Application Ser. No. 77,515, entitled STRIPPING MECHANISM, and filed on even date herewith, and is guided through a second exit channel **93** to the camera exterior. The image-recording unit may be expelled entirely from the camera, or it may be expelled only until its trailing end reaches the second exit channel at which point it may be releasably held by a holding spring **95** until it is convenient for the camera operator to retrieve the unit. The carrier sheet, pod, trap and leader then may be rolled up and discarded in any convenient manner. The print, on the other hand, is retained separate from this processing waste material and automatically will be processed to a finished print without further intervention by the camera operator.

DETAILED DESCRIPTION OF ALTERNATIVE EMBODIMENTS

FIRST ALTERNATIVE

An alternative embodiment of the present invention is illustrated in FIGS. **9 – 11**. This embodiment is substantially identical in many respects with the preferred embodiment described above. Those features which are the same as described above have been identified by the same reference characters with a prime superscript and will not be described in detail.

This alternative embodiment differs from the above described embodiment primarily in the elimination of separate leader **51** and the substitution therefore of an extended trailing end portion of the carrier sheet to provide a leader **97** for coupling the trailing end of one film unit to the leading end of the next successive film unit. In a manner similar to that described above, this extended trailing end or leader **97** is strippably coupled to the leading end portion of the next successive carrier sheet by a separable or peel-apart connection **99** that operates in the same manner as the peel-apart connection **55** described above. Also unlike the leader of the previous embodiment, this extended trailing end portion or leader **97** is substantially equal in width to the other portions of the carrier sheet and to the image-recording unit.

SECOND ALTERNATIVE

Yet another alternative of the present invention is illustrated in FIGS. **12 – 15**. Many features of this alternative are substantially identical to the preferred embodiment described above and have been identified by similar reference numerals in a **100** series. Unlike the previous described embodiments, however, the film units are coupled within the assemblage by an extended leading end or leader portion defined by the carrier sheet itself and coupled to the trailing end of the next preceeding film unit. Additionally, the strippable connection is located at the trailing end of the next preceeding film unit instead of being located vertically adjacent the leading end of the image-recording unit as described above. Similarly, the coupling **205** between the dark slide and the first film unit has been provided at the trailing end of the dark slide. In all other respects, however, these strippable connections **203** and **205** are intended to be substantially identical to those described above.

CHEMISTRY

The above-described film units can be used to produce positive images in single or multicolors. In a three-color system, the image-recording unit preferably is provided with three emulsion layers having predominant sensitivity ranges corresponding, respectively, to different ones of the primary colors, and further having associated dye image-providing materials possessing spectral absorption ranges substantially complementary to the predominant sensitivity ranges of the respective emulsion layers: i.e., a blue-sensitive silver-halide emulsion layer is provided with an associated yellow dye image-providing material, a green-sensitive silver-

halide emulsion layer is provided with an associated magenta dye image-providing material, and a red-sensitive silver-halide emulsion layer is provided with an associated cyan dye image-providing material.

In commonly assigned, copending U.S. Application Ser. No. 027,990, entitled PHOTOGRAPHIC FILM UNIT FOR DIFFUSION TRANSFER PROCESSING and filed on Apr. 13, 1970 in the name of H. E. Cole, the dye image-providing materials described are non-diffusible couplers capable of reacting with oxidized color developing agent to produce diffusible dyes. However, other dye image-providing materials can be employed in film units useful with the present invention, including dye developers, coupling dyes, etc. Also as described in said U.S. Application Ser. No. 027,990, such dye image-providing material, may be contained either in the silver-halide emulsion layers with which they are associated, or in layers contiguous thereto.

After exposure of the film unit through the transparent process sheet, an opacifying agent contained in the processing composition is distributed as described above in a layer over at least the exposure frame. Since the negative portion of the film unit is surrounded by opaque material and the emulsion layers now are covered by an opacifying agent, the unit is rendered light insensitive, and can be removed from the camera during processing. The processing composition then diffuses into the photosensitive element to effect an imagewise development of the silver-halide emulsion layers, and imagewise distributions of diffusible dye image-providing material (contained in the silver-halide emulsion layers or in layers contiguous thereto) are formed as a function of the imagewise exposure of the silver-halide emulsion layers. 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 that is viewable through the transparent support as 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 the image-recording unit described, generally is of the type illustrated in previously 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, or integral film units for obtaining black and white images, also can be employed with the present invention.

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), in a concentration of about 1 to about 5 percent by weight of the processing composition to 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 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).

The alkaline solution-permeable, substantially opaque, light-reflective layer in the above-described photographic film unit generally comprises any opacifier dispersed in a binder. Particularly desirable are white light-reflective layers, since they provide esthetically pleasing backgrounds on which to view a transferred dye image, and 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 (including, 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 the reflecting layer (comprising, e.g., carbon black, nigrosine dyes, etc., dispersed in an alkaline solution-permeable polymeric matrix including, for example, gelatin, polyvinyl alcohol, and the like). Such an opaque layer generally would have a density of at least four and preferably greater than seven and substantially would be opaque to actinic radiation.

The transparent process sheet and support for the photosensitive element described above can by any transparent material as long as it does not deleteriously effect 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. In this latter case only the photosensitive element would be sufficiently resilient to accommodate the layer of processing composition.

The respective elements of the film unit described above are selected 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 and any negative image remaining after processing permanently are hidden from the

top side by the opacifying agent and from the bottom side by the opaque reflecting layer.

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

I claim:

1. A film assemblage comprising:

a plurality of self-processing film units respectively arranged in adjacent overlying relationship to define a stack of said film units, said stack defining a front position in which each film unit sequentially is positionable for exposure and from which each film unit is removable for processing after its exposure;

said film units each having a preregistered, integral image-recording portion, container means for processing fluid, and a flexible carrier sheet, said image-recording portion including a substantially flat photosensitive element for recording a processable latent image and a process sheet permanently attached in superposition to said photosensitive element, said container means being disposed adjacent said image-recording portion and including means for directing the processing fluid to said image-recording portion between said photosensitive element and said process sheet, said carrier sheet being permanently attached to said container means and strippably coupled to said image-recording portion to permit separation of said image-recording portion from said carrier sheet and from said container means after their removal from said front position;

said plurality of film units including a first film unit and a second film unit adjacent to said first film unit, said carrier sheet of said second film unit including a leading end portion for pulling on said carrier sheet of said second film unit to remove said second film unit from said front position after exposure of said second film unit, said leading end portion of said second film unit being inaccessibly arranged within said assemblage prior to exposure and removal of said first film unit to prevent premature removal of said second film unit; and

means for releasably coupling said leading end portion of said second film unit to said carrier sheet of said first film unit, said coupling means including a peelable connection constructed to be strong in shear for threading said leading end portion of said second film unit to an accessible position extending from said assemblage, but weak in peel for then releasing said carrier sheet of said first film unit from said carrier sheet of said second film unit, said threading and releasing of said leading end portion being effected in response to removal of said first film unit from said front position.

2. A film pack for use in photographic apparatus having a pair of juxtaposed pressure-applying members, the pack comprising a casing and a film assemblage contained in said casing;

said film assemblage comprising a plurality of self-processing film units respectively arranged in adjacent over-lying relationship to define a stack of said film units, said stack defining a front portion in which each film unit sequentially is positionable for exposure and from which each film unit is removable for processing after its exposure;

said film units each having a preregistered, integral image-recording portion, container means for processing fluid, and a flexible carrier sheet, said image-recording portion including a substantially flat photosensitive element for recording a processable latent image and a process sheet permanently attached in superposition to said photosensitive element, said container means being disposed adjacent said image-recording portion and including means for directing the processing fluid to said image-recording portion between said photosensitive element and said process sheet, said carrier sheet being permanently attached to said container means and strippably coupled to said image-recording portion to permit separation of said image-recording portion from said carrier sheet and from said container means after their removal from said front portion;

said plurality of film units including a first film unit and a second film unit adjacent to said first film unit, said carrier sheet of said second film unit including a leading end portion for pulling on said carrier sheet of said second film unit to remove said second film unit from said front position and between the pressure-applying members after exposure of said second film unit, said leading end portion being inaccessibly arranged within said assemblage prior to exposure and removal of said first film unit to prevent premature removal of said second film unit; and

means for releasably coupling said leading end portion of said second film unit to said first film unit, said coupling means including a peelable connection constructed to be strong in shear for threading said leading end portion of said second film unit between the pressure-applying members to an accessible position extending from said assemblage, but weak in peel for releasing said leading end portion from said first film unit after said leading end portion is threaded between the pressure-applying members, said threading and releasing of said leading end portion being effected in response to removal of said first film unit from said front portion and between the pressure-applying members.

3. The film pack claimed in claim 2 wherein said first film unit defines a trailing end beyond its image-recording portion and said leading end portion of said second film unit is coupled to said trailing end of said first film unit so said leading end portion will be threaded between the pressure-applying members after at least said image-recording portion of said first film unit is removed entirely from between the pressure-applying members.

4. The film pack claimed in claim 2 wherein said image-recording portion defines an underside and said carrier sheet extends along substantially the entire underside of said image-recording portion.

5. The film pack claimed in claim 2 wherein said carrier sheet of each film unit is defined by a continuous single sheet of web material.

6. The film pack claimed in claim 2 wherein said carrier sheet is defined by a plurality of interconnected sheets of web material.

7. The film pack claimed in claim 2 wherein said image-recording portion defines a first width and said leading end portion defines a second width narrower than said first width.

8. The film pack claimed in claim 2 wherein each film unit includes a trap for collecting any excess processing fluid from said image-recording portion, said trap being strippably coupled to said image-recording portion and permanently attached to said carrier sheet for removal from said image-recording portion with said carrier sheet and said container.

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