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Frost et al.

[11] **3,776,732**

[45] **Dec. 4, 1973**

[54] **LIQUID TRAPPING MEANS FOR IN-CAMERA PROCESSED PHOTOGRAPHIC PRODUCT**

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

[22] Filed: **July 15, 1969**

[21] Appl. No.: **841,865**

[52] **U.S. Cl.** ..... **96/76 C,** 96/29

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

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

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[57] **ABSTRACT**

For trapping and retaining the excess processing fluid distributed between an exposed photosensitive sheet and a second sheet superposed therewith when the two are moved longitudinally between a pair of pressure-applying members to rupture a pod containing an amount of processing fluid in excess of that required to process the exposed latent image, the trailing end of at least one of said sheets is embossed to provide a plurality of protuberances for separating the opposed surfaces of the trailing ends of said sheets as they pass through the pressure-applying members and provide a space for retaining the excess processing solution. While each individual protuberance might be readily compressible, the arrangement of protuberances is such that there is a sufficient number of them between the pressure-applying members at any one time to effect a significant separation of said pressure-applying members for maintaining a separation between the superposed surfaces of the trailing ends of said sheet elements as they pass between the pressure-applying members.

6 Claims, 13 Drawing Figures

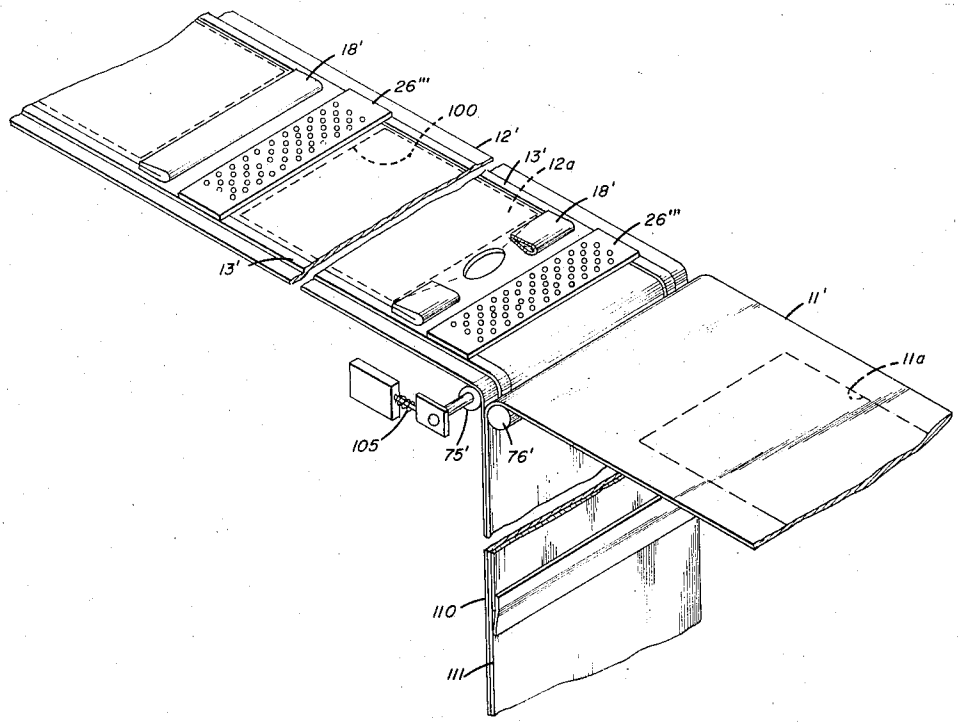


FIG. 1

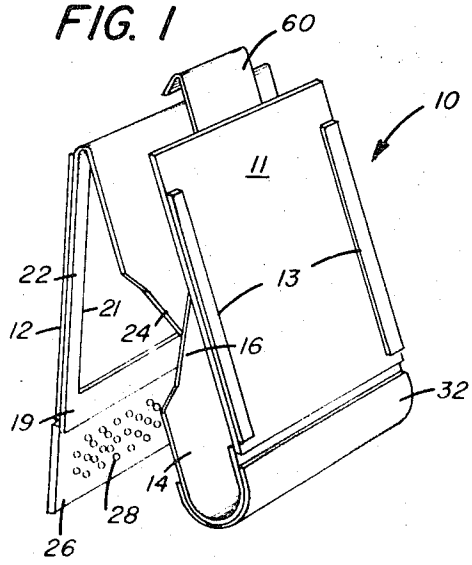


FIG. 5

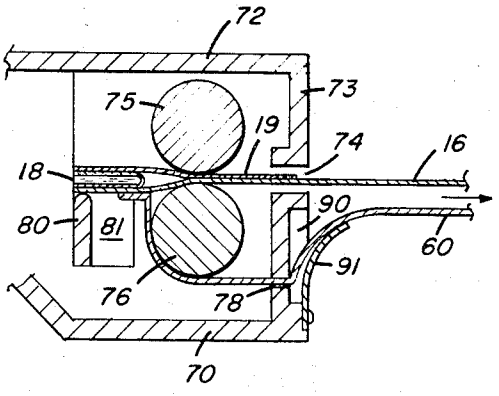


FIG. 6

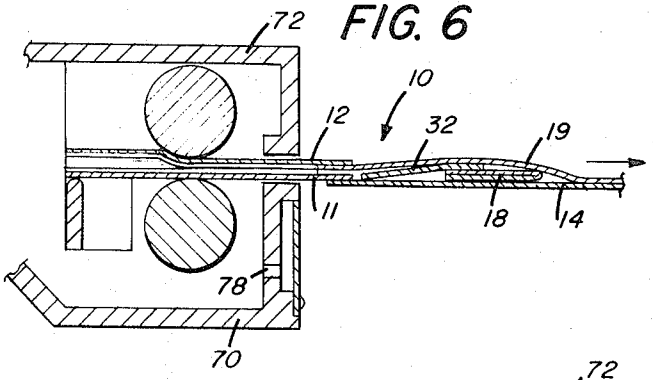
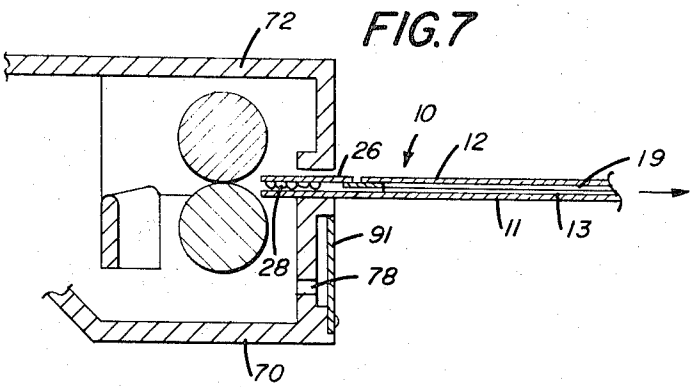


FIG. 7



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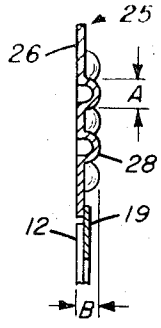

FIG. 2a

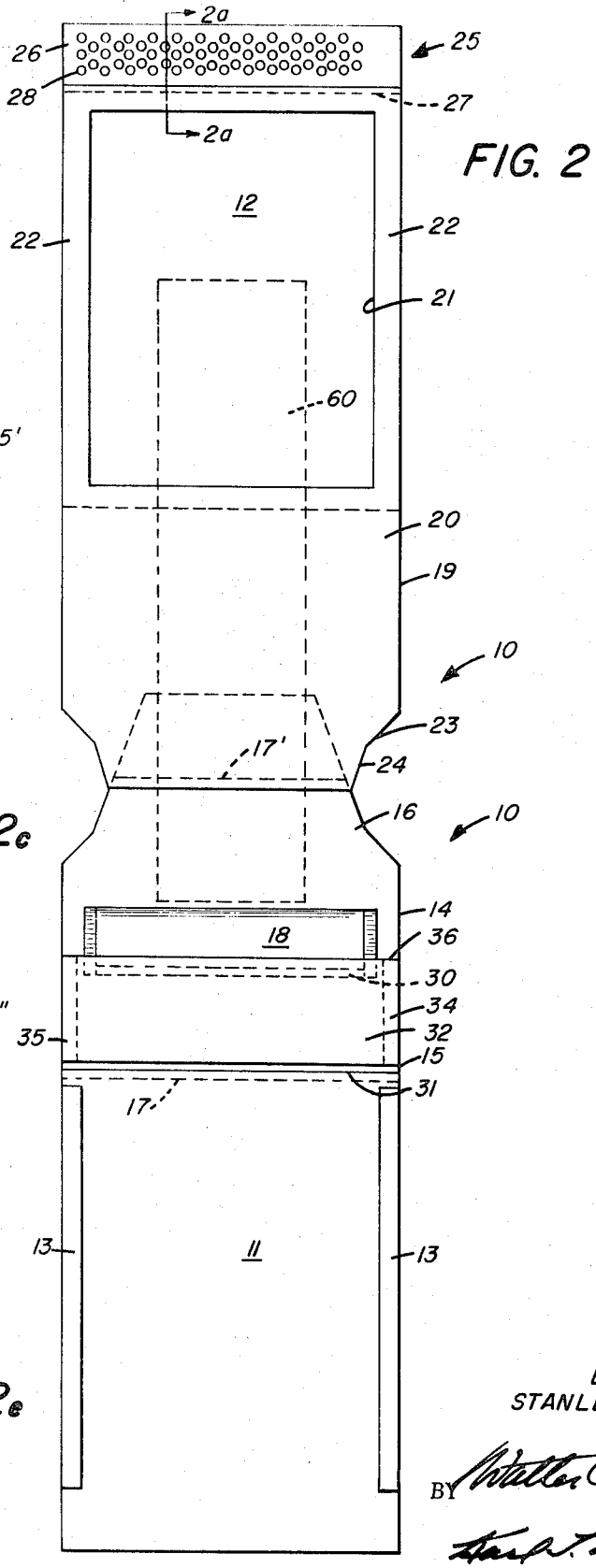

FIG. 2

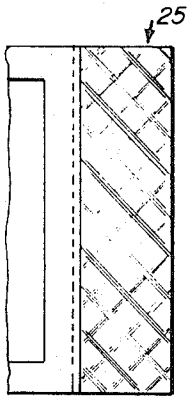

FIG. 2b

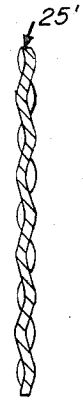

FIG. 2c

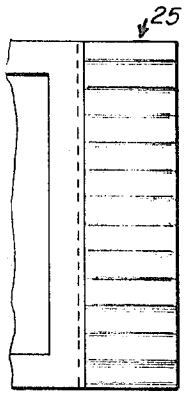

FIG. 2d

FIG. 2e

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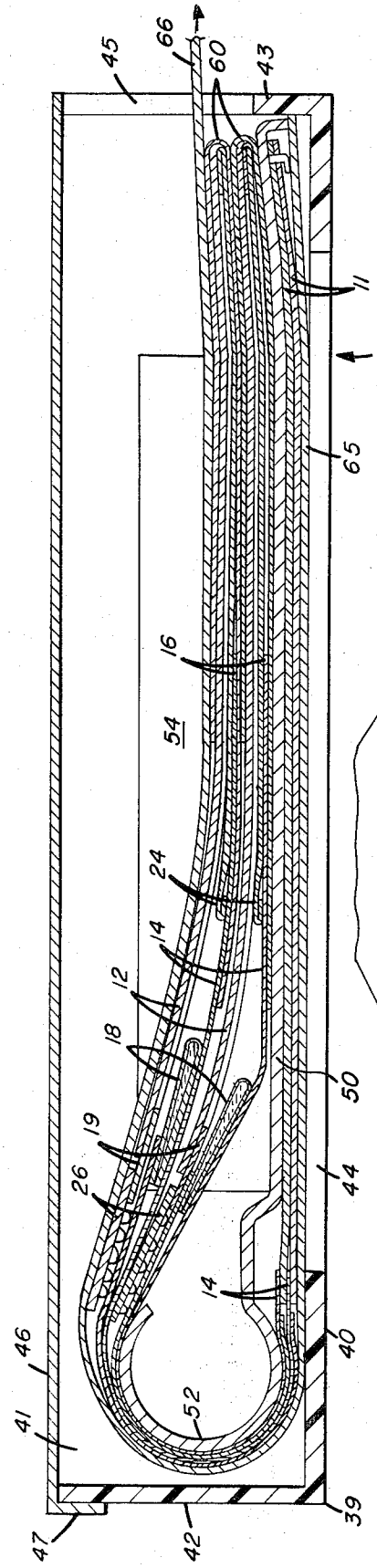

FIG. 4

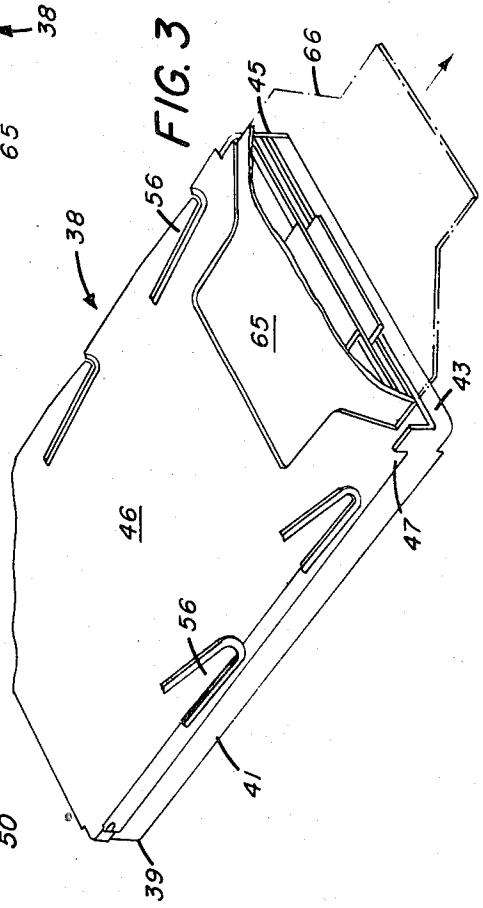

FIG. 3

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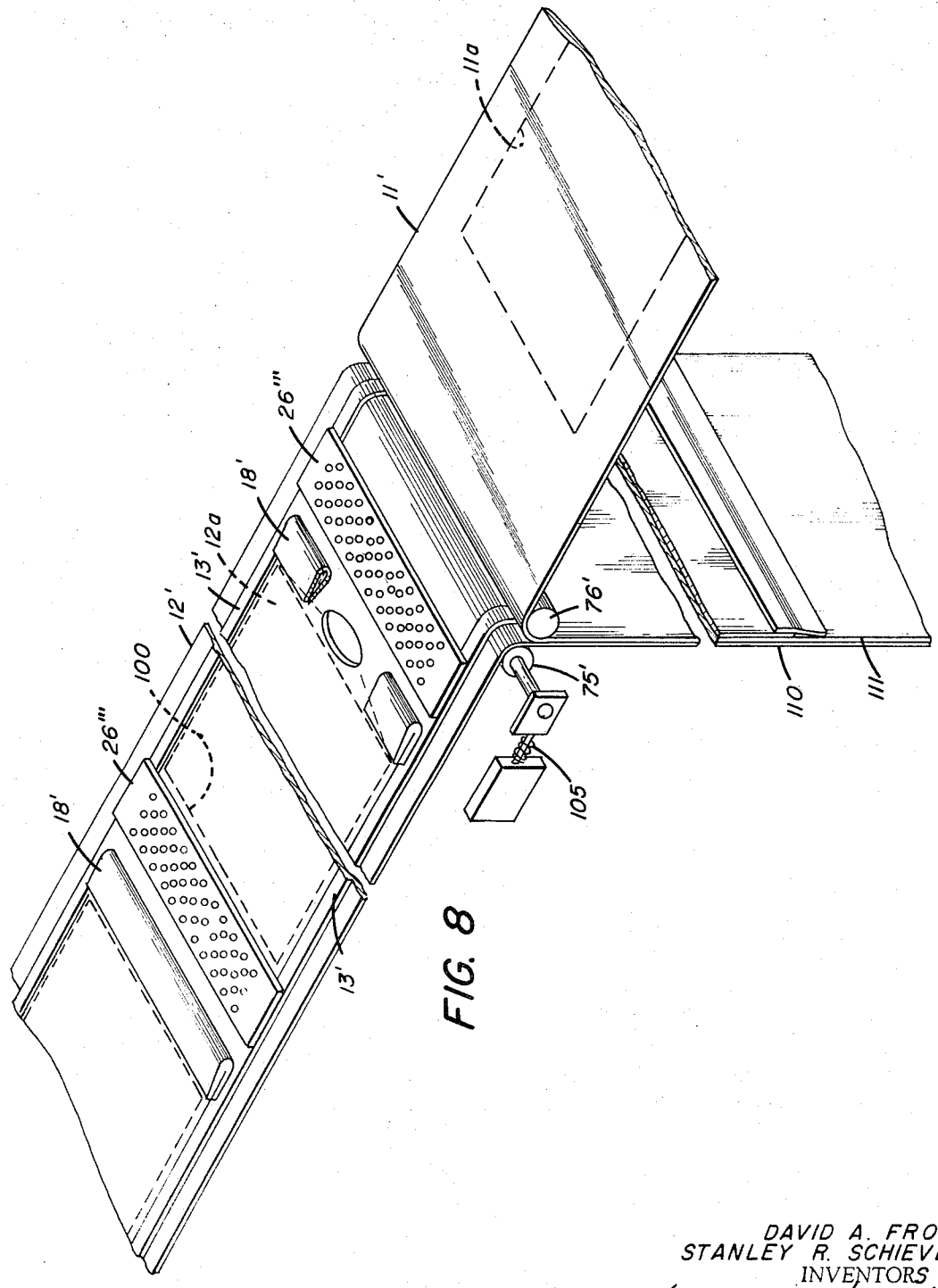

FIG. 8

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LIQUID TRAPPING MEANS FOR IN-CAMERA PROCESSED PHOTOGRAPHIC PRODUCT

This invention relates to photography, and more particularly to a novel photographic product for obtaining a positive print by an image-transfer process.

In photographic diffusion transfer processing, the photosensitive sheet element is normally first exposed and then biased into superposed relation with a second sheet element which is, in general, photographically inert and aids in the controlled distribution of the processing composition. The photosensitive element may contain an integral print-receiving stratum or, most preferably, the second sheet element comprises a transfer image-receiving element. After the photosensitive sheet element has been photographically exposed, the two sheet elements are biased into face-to-face relation and moved relative to, and between, a pair of opposed pressure-applying members, such as a pair of parallel rollers which are spring loaded into engagement with one another. Application of pressure to a frangible fluid retaining means situated between the sheet elements adjacent their leading edges effects controlled rupture thereof and a predetermined unidirectional distribution of its processing composition contents between, and in contact with, the opposed surfaces of the superposed sheet elements. Subsequent to transfer processing, the image-carrying area of the print-receiving sheet may be separated from the laminate.

In order to insure that the predetermined area to be processed is completely covered with a layer of processing fluid of the desired thickness, it is generally necessary to supply an amount of processing fluid in excess of the minimum amount required to provide these desired parameters. For this reason, and because this processing solution is highly caustic, some means must be provided to trap and retain the excess fluid which remains after distribution of the processing fluid in order to prevent its undesired escape from the lamination within and also outside of the camera apparatus.

In order to trap this excess processing fluid within the laminated photosensitive and image-receiving elements it has heretofore been taught, see U.S. Pat. Nos. 2,644,755 and 2,686,717, that the trailing portions of the respective sheet elements may have one or more spacing elements or lifters made of some rigid material, e.g., hard rubber, plastic, etc., adhered to the surface adjacent the trailing end of one of the sheet elements. As the trailing portions of the sheet elements are drawn between the pressure-applying members in superposed relation during the distribution of the processing fluid, the spacing elements, or lifters, force the pressure-applying members apart. The excess processing fluid, rather than being further advanced, is thus collected and retained in the space formed between the superposed trailing portions of the sheet elements. In an effort to reduce the size of the trap required with film units designed for use in film packs, U.S. Pat. No. 3,294,538 suggests forming a positive trap by folding the end of the receiving sheet upon itself and interposing a spring member between the folded over end of the sheet element and the main body of the sheet element to maintain the two separated so that the excess fluid can readily enter the trap.

As will be appreciated from the above description, the heretofore proposed excess fluid trapping means have required the attachment of lifters and/or springs to the film units. Such constructions not only complicate the fabrication and handling of a film product in a camera, but it has been found that these lifters have a tendency to become accidentally detached from their sheet element during handling of the film unit outside of the camera or during manipulation within the camera. If the lifters become detached before the film product is processed, then they are not available to serve their intended function in the trapping of the excess fluid. Furthermore, if these lifters become detached from their sheet element for any reason before the film product is processed they can shift from their intended position and even move up into the image area of the elements and prevent proper transfer of the image from the photosensitive sheet to the image receiving sheet.

The primary object of the present invention is to provide in a film unit comprising, in combination, a first photosensitive sheet element, a second sheet element, and a rupturable container adapted for unidirectional release of a retained fluid processing composition for selective distribution between and in contact with opposed surfaces of said first and second sheet elements, a new and novel trapping means on the trailing end of at least one of said sheet elements adapted to trap or retain any fluid processing composition which is in excess of that required to be spread between the sheet elements for transfer processing of the image exposed on the photosensitive sheet.

Another object of the invention is to provide a trapping means on the trailing end of one of said sheet elements of a film unit of the type above referred to which overcomes the shortcomings of known trapping means and comprises a plurality of protuberances embossed from the surface, and extending over a substantial area, of the trailing end of at least one of said sheet elements to separate the opposed surfaces of the trailing ends of said sheets when they are biased into superposed relation and maintain said trailing ends separated, to collect and retain excess processing fluid, as they are moved through the pressure-applying means.

Further objects of the invention are to provide a trapping means of the type referred to in which the means for spacing the trailing ends of the sheet elements are integral parts of one or both sheet elements, rather than separate elements which have to be adhered to the sheet elements and might become accidentally detached therefrom; in which the means for spacing the trailing ends of the sheet elements comprise a plurality of protuberances embossed from the face of one or both of the trailing ends of the sheet elements, or a part attached thereto, said protuberances being arranged so that there is a sufficient number of them between the pressure-applying members at any one time to effect a significant separation of the pressure-applying members for maintaining a separation between superposed surfaces of the trailing ends of the sheet elements as the film unit passes between said pressure-applying members.

A further object is to provide an excess fluid trapping means from which the excess fluid is less likely to be squeezed to contaminate the customer's hand should he grasp the product at the trap after processing.

And still another object of the present invention is to provide a novel excess fluid trapping means for film units of the type described which is adapted for use on film units of both the film pack type and the roll film

type and facilitates the manufacture and assembly of either of these types of film units.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its details of construction and its methods of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a photographic film unit of the film pack type embodying the present invention;

FIG. 2 is a plan view of the film unit of FIG. 1;

FIG. 2*a* is a sectional view, on an enlarged scale, taken substantially on lines 2*a*—2*a* of FIG. 2;

FIGS. 2*b* and 2*c* are plan and sectional views, respectively, of another embodiment of embossed pattern for the trap;

FIGS. 2*d* and 2*e* are plan and sectional views, respectively, of still another embodiment of embossed pattern for the trap;

FIG. 3 is a perspective view of a film pack comprising an assemblage of film units of the type shown in FIGS. 1 and 2;

FIG. 4 is a longitudinal section view taken substantially midway between the sides of the pack shown in FIG. 3;

FIG. 5 is a fragmentary sectional view illustrating the initiation of and initial passage of one film unit between a pair of opposed pressure-applying rollers during removal of the film unit from a camera apparatus subsequent to photographic exposure;

FIG. 6 is a fragmentary sectional view, similar to FIG. 5, illustrating further passage of the film unit between the pressure-applying rollers, rupture of the frangible pod and distribution of its fluid processing composition between, and in contact with, the opposed surfaces of the superposed sheet elements of the film unit;

FIG. 7 is a fragmentary sectional view, similar to FIGS. 5 and 6, illustrating completion of the passage of the film unit between the pressure rollers, the laminate formed by the distribution of the fluid processing composition between the superposed sheet elements, and trapping of the excess fluid processing composition passing within the confines of the trapping means; and

FIG. 8 is a schematic, fragmentary, isometric view showing excess fluid trapping means constructed according to the present invention applied to an image-transfer film product of the roll type.

Photographic products for obtaining a positive print by a one-step, image-transfer process can be made in two forms, individual film units for use in packs or a roll type product, and a novel liquid trapping means according to the present invention is adaptable to both of these forms of product. These two forms of product are alike in that in each the components for producing a positive image include a sheet of photosensitive material adapted to be photographically exposed to produce a latent photographic image; a second or print-receiving sheet for receiving a positive transfer image; a rupturable container or pod of a fluid agent for reacting with the photosensitive sheet after exposure to produce the positive image on the second sheet when distributed between the two sheets when they are moved between a pair of pressure-applying members in superposed relation; and trapping means at the trailing end of one of said two sheets for receiving and retaining any excess fluid agent reaching the trailing ends of the sheets as they are moved between the pressure-applying members. The film pack and roll type products differ from each other primarily in the physical arrangement of these noted individual components which affects the manner in which they are manipulated in a camera to bring the first and second sheets into superposed relation after photographic exposure of the first sheet before they are passed between the pressure-applying rollers to rupture the fluid containing pod and spread the processing fluid contained therein between the adjacent surfaces of the two sheets. For use in a film pack, the two sheets are arranged so that the photosensitive sheet may be photographically exposed and the two sheets are coupled by a leader means by which the sheets can be withdrawn from the pack in superposed relation and then through pressure-applying rollers of the camera to rupture the fluid container and spread the fluid unidirectionally between the sheets. A film pack may contain a plurality of these film units which can be individually exposed and processed in succession.

In the roll type product, on the other hand, a plurality of photosensitive areas are spaced along a continuous strip of material supplied in roll form. A like number of print-receiving areas are spaced along a strip of material also supplied in roll form. A rupturable container of processing fluid is fixed to one or the other of the strips, usually the one carrying the print-receiving areas, and ahead of each image-receiving area thereon. These two rolls of photosensitive and receiver sheets may be used in a camera of the type shown in U.S. Pat. No. 2,644,755 in which the strip of photosensitive material is moved into the focal plane to be photographically exposed and thereafter is superposed with a corresponding receiver sheet on the strip of receiver material before being passed between a pair of pressure-applying rollers to rupture the container of processing fluid associated with the leading end of that receiver sheet and to spread the fluid between the superposed photosensitive and receiver sheets.

It will be appreciated that in a photographic product of the type to which the novel trapping means of this invention relates, there are two sheets, a photosensitive sheet and an image-receiving sheet or a second sheet which serves only as a means of confining a layer of processing fluid on the photosensitive sheet. In use, a processing liquid is dispensed in some manner, e.g., from a rupturable container or pod adjacent the leading end of the image area, between the two sheets which are superposed before or just as the liquid is dispensed. After the liquid is dispensed between the two sheets, it is spread between them by pressure-applying means which are moved relative to the product from the end at which the liquid has been dispensed toward the opposite end. In order to insure proper coverage of the image area of these superposed sheets an excess of processing liquid is used. In order to prevent the excess liquid from contaminating the spreading means or the customer's hands, each of the sheets is extended beyond the desired image area thereof. According to the present invention, at least a portion of the area of one or both sheets extending beyond the image area is embossed or knurled to provide a raised pattern which in cross section will resemble mountains and valleys. This embossed pattern serves to spread the pressure-

applying means apart and provide a separation between the trailing ends of the sheets for collecting the excess liquid in a relatively small area. This patterned region is called the trap. Great variation is possible in the pattern used in the trap, and the number and height of the raised portions required to separate the pressure-applying means is related to the thickness and physical properties of the material used to form the trap, and the amount of excess fluid provided, as well as being related to the shape of the trap section. For example, while no single raised portion embossed in the trap, or two or three raised portions if widely spaced, might have sufficient rigidity to separate the pressure-applying means, a plurality of such raised portions may possess the necessary rigidity if they are simultaneously engaged by the pressure-applying means. Therefore, according to the present invention the embossed pattern of the trap is so arranged that there is a sufficient number of protuberances between the pressure-applying members at any one time to effect a significant separation of said pressure-applying members as the trap portion is moved between said members. The trap may be on the trailing end of either the photosensitive sheet, on the trailing end of the receiver sheet, or on the trailing end of both sheets. If it is to be carried on the trailing end of the receiver sheet which is generally covered with a masking sheet made of very thin paper, then the trap should consist of a short length of material capable of being embossed, e.g., a thin plastic sheet, which is connected to the trailing end of the receiver sheet or the mask adhered thereto. If the trap is to be carried by the trailing end of the photosensitive sheet, it can be formed by directly embossing the trailing end of the photosensitive sheet if this sheet is adequately thick and is made from a plastic film base material such as cellulose acetate, cellulose acetate butyrate, polyester, etc.

The pattern of embossing of the trap may take the form of simple mounds, ridges, or letters of the alphabet. Thus, it might be advantageous to emboss instructions, product identification or trade name into the trap. As mentioned above, the trap may be a separate piece attached to the trailing end of either of the photosensitive sheet or the receiver sheet, or both, or it may be embossed from the same sheet as either of these.

Trapping means formed in accordance with the present invention is not as subject to being accidentally torn off in the camera as are the trap spacers or lifters of known photographic products of this type. It is also possible to assemble the product using this type of trapping means more easily as this type of trap can be applied to the film units as a continuous web, or can be readily formed at selected points in a continuous web and subsequently chopped into individual traps for application to the film units.

Reference is now made to FIGS. 1–4 wherein there is illustrated a pack-type film unit having a trapping means constructed according to the present invention and an assemblage of such film units in the form of a film pack. Each film unit, designated **10**, comprises a generally rectangular photosensitive sheet **11** and a second or print-receiving sheet **12**. Both of these sheets comprise a support which is opaque to light actinic to the photosensitive material of the photosensitive sheet. The photosensitive material comprises a layer of any conventional photographic recording media, gelatino silver halide emulsions being preferred, coated on a light-opaque, flexible sheet such as paper, organic plastics, etc. Secured on the face of, and along each of the lateral edges of, the photosensitive sheet **11** is a narrow spacer rail **13** in the form of a strip of thin paper. As will be described hreinafter, these spacer rails cooperate with a part of the carrier sheet for the print-receiving sheet in spreading a controlled thickness of processing fluid between the sheets.

The second, or print-receiving sheet may merely serve to aid in the distribution of a processing fluid in contact with the photosensitive layer, or, in the preferred form of the film unit, comprises means for supporting a transfer image formed, for example, by a silver halide diffusion, transfer reversal process. Attached to the leading edge of the photosensitive sheet **11** is a leader sheet **14** having a first section **15** approximately equal in width to the photosensitive sheet and having a tapered end section **16**. The transverse edge of first section **15** is coupled to the leading edge of photosensitive sheet **11** as indicated at **17**, and a rupturable fluid containing pod **18** is mounted on leader sheet **14** ahead of the leading end of photosensitive sheet **11**. Second or print-receiving sheet **12** is mounted on a carrier sheet **19** having an intermediate section **20** approximately equal in width to second sheet **12** and having a generally rectangular opening **21** therein defining the area of the second sheet in which the image formation occurs. Those portions of the intermediate section **20** bordering on opening **21** provide a mask for defining the area of the image transferred from the photosensitive sheet to the print-receiving sheet. The narrow portions **22** of the carrier sheet extending along the lateral edges of the print receiver cooperate with the spacer rails **13** secured along the lateral edges of the photosensitive sheet in spreading a controlled thickness of a processing fluid between the two sheets. Carrier sheet **19** includes a leading end section **23** having a tapered end section **24** similar to tapered end section **16** and secured thereto behind the leading end of the tapered end section **16** as indicated at **17'**. Tapered end section **16** and end portion **24** cooperate to define the leading end section of the film unit which is advanced between pressure-applying members.

The length of leader sheet **14** between the leading edge of the photosensitive sheet **11** and the point of attachment of the leader sheet to carrier sheet **19** is substantially equal to the length of the carrier sheet **19** between its point of attachment to the leader sheet and the leading edge of print-receiving sheet **12**. It is by virtue of this arrangement that the photosensitive and print-receiving sheets are capable of being biased into superposed registered relation during the processing of the film unit.

In a preferred embodiment of the present invention the trapping means for the excess processing liquid is carried by the trailing end of the print-receiving sheet of the film unit and cooperates with the trailing end of the photosensitive sheet to provide a space for receiving and retaining the excess fluid. To this end the trap **25** is shown as comprising a trailer sheet **26** secured to the face of the trailing end of the carrier sheet **19** along a line as indicated at **27**. The width of the trailer sheet **26** is substantially equal to the width of the carrier sheet **19** and the photosensitive sheet **11** and is of such length as to increase the overall length of the carrier sheet **19** to equal that of the photosensitive sheet **11**. Consequently, when the print receiver portion of the

film unit is biased into superposed relation with the exposed photosensitive sheet for processing, the trailer sheet **26** is superposed with the trailing end of the photosensitive sheet, see FIG. **7.** This trailer sheet is embossed to provide a pattern of protuberances **28** which in section resemble mountains and valleys, see FIGS. **2***a* and **7.** The protuberances extend above the surface of the trailer sheet which will be in face-to-face contact with the photosensitive sheet **11** when the two are superposed for processing so that these protuberances will serve to space the valleys of the trailer sheet from the surface of the trailing end of the photosensitive sheet **11** and provide a space for collecting and retaining excess processing fluid.

In order to provide an effective trap the protuberances formed by the embossing operation which are between the pressure-applying means at any time must be able to effect a significant separation of the pressure-applying means or an effective trap will not be formed. In other words, the protuberances must be sufficiently resistant to compression so as not to be completely squashed down when the trap moves between the pressure-applying means. It is desirable to use the thinnest and least expensive material for the trap in order to keep the overall thickness of the film pack as low as possible and to keep its cost down. While there are undoubtedly many materials available which could be used as a suitable trap material and meet these specifications, it has been found that thin plastic sheeting such as 0.005 inch cellulose acetate sheeting, 0.0055 inch cellulose acetate butyrate sheeting or 0.005 inch – 0.007 inch polyester sheeting, are very satisfactory. Although no one protuberance embossed in the trailer sheet, or even a few which are widely separated across the trap, will serve to lift or separate the pressure-applying means, it has been found that if a plurality of these protuberances are simultaneously engaged by the pressure-applying means at any one time, then collectively these protuberances will be able to separate the pressure-applying means. Accordingly, the embossed protuberances are arranged in a pattern over the area of the trailer sheet or trap so that at any given time during the travel of the trap portion of the film unit through the pressure-applying means there will be sufficient number of protuberances engaged by the pressure-applying means to effect a significant separation of the pressure-applying means to form an effective liquid trapping means.

In FIGS. **2** and **2***a* there is shown an example of a trap made from 5½ mil polystyrene sheeting which has been shown to effectively separate the pressure-applying rollers of cameras now on the market which are adapted to expose and process film units of the type disclosed. The trap **25** is approximately 0.563 inch long and 3.375 inches wide. The embossed pattern thereon has an overall width of approximately .375 inch and an overall length of approximately 3.0 inches and consists of **60** protuberances each having a shape and size as illustrated on an enlarged scale in FIG. **2***a* and arranged in five rows across the width of the trap in staggered relation and twelve rows along the length of the trap in staggered relation. While the protuberances could be of any number of different shapes, ones of generally hump shape are preferred because such shapes have been found to have a strong resistance to crushing, hence fewer protuberances of such shape are required to separate the pressure-applying rollers. Protuberances of this shape in which the width dimension A is 0.09 inch – 0.100 inch and the height dimension B is 0.028 inch – .030 inch have been found to be sufficiently resistant to crushing to separate the pressure rollers. In the preferred embodiment shown in FIGS. **2** and **2***a* the trap is shown embossed so that all of the protuberances extend from one surface of the trap, that surface to be brought into face-to-face contact with the photosensitive sheet **11.** This arrangement is used to keep the thickness of each receiver component of the film unit as thin as possible so that when a group of as many as eight of them are stacked in a film pack, as will be hereinafter described, the container for housing them will be as thin as possible.

As mentioned above, great variation is possible in the pattern embossed in the trap and two other versions which have been successful are shown in FIGS. **2***b*, **2***c* and **2***d*, **2***e*. In the embodiment shown in FIGS. **2***b* and **2***c*, the trap **25'** is made from a 0.0055 inch thick acetate butyrate sheet having a diagonally knurled pattern, the overall depth of the knurling being approximately 0.037 inch. The ridges formed by the cross knurling forms a plurality of individual pockets for collecting the excess processing solution. One difficulty which might be encountered with an embossed pattern of this type is that the ridges combine with the trailing end of the photosensitive sheet **11** to form individual spaces from one to another of which the excess processing fluid can pass only with difficulty. This could result in the excess processing fluid building up in the spaces at the leading edge of the trap and being forced back onto the print-receiving sheet **12** as the pressure-applying members pass over the trap faster than the excess fluid can move ahead of them. This difficulty can be overcome if fluid communication between the individual spaces is increased by making the ridges discontinuous along their length or undulating the top of the ridges so that there will not be a continuous line of contact between the top of the ridges and the trailing end of the photosensitive sheet when the two are brought into face-to-face contact.

In the embodiment shown in FIGS. **2***d* and **2***e* the trap **25''** is made from a 0.007 inch thick polyester sheet having a sinusoidal embossed pattern whose overall depth is approximately 0.050 inch. In this pattern the ridges and valleys extend longitudinally of the film unit to form, in combination with the trailing end of the photosensitive sheet which it engages, fluid collecting and retaining cavities having openings arranged to readily receive the excess fluid forced to the end of the film unit. Also, since the ridges extend substantially parallel to the edges of the trap, they will effectively prevent any leakage from the edges of the trap.

While in the preferred embodiment of the invention the trap **25** is shown as comprising a trailer sheet **26** attached to the trailing end of the carrier sheet **19** for the print-receiving sheet **12,** the trap could be formed by embossing the trailing end of the photosensitive sheet **11** if such sheet is made of a film base material such as cellulose acetate, cellulose acetate butyrate or polyester sheeting. If the trap is embossed into the trailing end of the photosensitive sheet **11,** then the carrier sheet **19** must be extended to overlap the trap when the two sheets are biased into superposed relation for processing. Also, if the carrier sheet **19** is made of a material which can be embossed to form a satisfactory trap, then the trailing end of this sheet can be extended and di-

rectly embossed to provide the trap. Another alternative would be to provide an embossed pattern in both the trap 25 and the trailing end of the photosensitive sheet 11 which could combine to provide the desired separation of the pressure-applying rollers and the necessary separation between these parts for forming a cavity to collect and retain the excess processing fluid.

Distribution of the processing fluid is effected by advancing the photosensitive and second sheets and pod of processing fluid in superposition between a pair of juxtaposed pressure-applying members forming a part of the camera in which the film unit is to be exposed. The members apply compressive pressure to the sheets progressively, from the leading ends in the area of the pod to the trailing ends, to cause the ejection of the fluid contents of the pod between the sheets and the spreading of the fluid in a layer between and in contact with the sheets. The superposed spacer rails 13 and narrower portions 22 of the carrier sheet 19 keep the processing fluid from leaking out the edges of the film unit and their combined thickness determines the thickness of the layer of processing fluid which is spread between the image areas of the two sheets 11 and 12. The excess of processing fluid, which is always provided in the pod, is effectively collected and retained at the trailing end of the film unit by the trapping means 25 of the present invention, since the embossed pattern of the trap serves both as a means of lifting or separating the pressure-applying rollers and also, in combination with the trailing end of the sheet superposed therewith, provides a space or spaces in which the excess fluid is collected and retained.

The rupturable pod or container 18 may be of the type shown in U.S. Pat. No. 2,543,181 and comprises a rectangular blank of fluid and air-impervious sheet material folded longitudinally upon itself to form two walls which are sealed to one another along their longitudinal and end margins to form a cavity in which the processing fluid is contained. The longitudinal marginal seal 30 is made weaker than the end seals so as to become unsealed in response to hydraulic pressure generated within the fluid contents of the pod by the application of compressive pressure to the top and bottom walls of the pod. Pod 18 is mounted on first section 15 of leader sheet 14 with its longitudinal seal 30 directed toward the leading end 31 of the photosensitive sheet 11. Bib sheet 32 is secured to leader sheet 4 at lateral edges 34 and 35, with its trailing edge 36 in overlapping relation with the longitudinal seal 30 of pod 18, and facilitates restricted unidirectional flow of the fluid content of the pod upon compressive rupture thereof.

The fluid content of the pod 18 is preferably adapted to effect the formation of a transfer image on the print-receiving sheet 12 in the area thereof defined by the mask opening 21 in carrier sheet 19. For details concerning the composition of the processing fluid and materials useful for the photosensitive and print-receiving sheets as well as the process performed by such materials, reference may be had to U.S. Pat. Nos. 2,543,181, 2,662,822 and 2,983,606.

A film pack or assemblage of film units 10 is shown in FIGS. 3 and 4. This film pack, designated 38, comprises a generally parallelepiped-shaped container or box 39 for holding and enclosing a plurality of film units 10 when each is folded upon itself as generally indicated in FIG. 1. Container 39 comprises two sections, a forward section having forward wall 40, side walls 41, a trailing end wall 42 and a leading end wall 43. Forward wall 40 is provided with a generally rectangular exposure aperture 44 for exposing the photosensitve sheets 11 of the film units carried within the container. Leading end wall 43 extends only part way of the depth of the container to provide a passage 45 at the leading end of the container through which the film units within the container can be withdrawn one at a time. The rear section of the container comprises a metal cover 46 having flanges 47 turned down along its sides and rear end to slidably engage the side walls 41 and trailing end wall 42 of the container when the cover is slid endwise onto the container.

The arrangement of each film unit within the container 39 is illustrated in FIG. 1 and the arrangement of a plurality of film units (two being shown) is illustrated in FIG. 4. Each film unit is arranged with the photosensitive and receiver sheets in overlying relation with the photosensitive surface of the photosenstive sheet facing outward and with the surface of the print-receiving sheet which is superposed therewith, during processing, facing inwardly in the same direction. That portion of the leader sheet 14 between the leading edge of the photosensitive sheet 11 and the pod 18 is bent back upon itself, and carrier sheet 19 is similarly bent back upon itself adjacent the leading edge of receiver sheet 12 so that portions of the leader sheet and the carrier sheet lie between the two sheets 11 and 12, and the leading and trailing ends of the photosensitive sheet 11 are disposed adjacent, respectively, the trailing and leading ends of the receiver sheet 12. The film pack is provided with a generally flat, rectangular pressure plate 50 located intermediate photosensitive sheet 11 and the other portions of the film unit for supporting the photosensitive sheet 11 against the inner surface of the forward wall 40 in position for exposure through the aperture 44. Pressure plate 50 includes a rolled end section 52 around which extends the bent-back portion of the leader sheet 14, see FIG. 4. Rolled end section 52 is provided for guiding photosensitive sheet 11 around the end of the pressure plate and into superposed relation with its corresponding receiver sheet 12 in a manner to be hereinafter described. The major portion of first section 15 of the leader sheet 14, rupturable pod mounted thereon, tapered section 16, and the leading end section 23 of the carrier sheet 19 are located behind pressure plate 50 and between the latter and the receiver sheet 12. Pressure plate 50 is provided with lateral flanges 54 disposed adjacent side walls 41 of the container. The cover 46 of the container is provided with spring fingers 56 biased inwardly for engaging the top of lateral flanges 54 and biasing pressure plate 50 toward forward wall 40 to retain the photosensitive sheet 11 in a predetermined plane for exposure.

The means for withdrawing each film unit 10 from the pack 38 with the photosensitive and print-receiving sheets 11 and 12 in superposition and advancing tapered end section 16 between a pair of pressure rollers comprises a relatively narrow and elongated leader 60 adhesively secured at its trailing end to tapered end section 16 intermediate first section 15 and the point of attachment of the tapered end section to tapered end portion 24. The adhesive bond between the trailing end of leader 60 and tapered end section 16 is such that it will provide sufficient resistance to the application of tension, in a direction of the plane of the tapered end section 24 to prevent shearing, but tension applied to

the leader 60 in a direction at an angle from the plane of the tapered end section 16 will cause leader 60 to readily peel from contact with the tapered end section 16. By virtue of this construction, so long as the leader 60 and the film unit coupled therewith are being moved in approximately the same direction, then the leader 60 is in tension and the adhesive bond between it and the tapered end section 16 is subjected to a shear force and will not fail. However, when the direction of movement of the leader 60 diverges sufficiently from the end section 16 (as shown in FIG. 5) the adhesive bond between the trailing end of the leader 60 and the tapered end section 16 is subjected to a peeling force which causes the leader to separate from the tapered end section 16.

Leaders 60 are adapted to extend from the container 39 through opening 45 therein and, when drawn from the container, advances a photosensitive sheet 11 around rolled end section 52 of pressure plate 50 and into superposed relation with the print-receiver sheet 12 coupled thereto, and then advances the two sheets in superposed relation within the container 39 toward the opening 45 in the forward wall thereof. As the leader 60 commences to advance to the opening 45, tapered end section 24 of the carrier sheet 19 is required to commence rolling upon itself toward the opening in response to movement of tapered end section 16 of leader sheet 14 toward the same opening. It is for this reason that section 16 and portion 24 are tapered, since this provides the weakest portion of end portion 16 in the area where the end portion is required to commence rolling.

Film pack 38 is provided with means for initially sealing exposure aperture 44 against the admission of light until the pack has been loaded into the camera in which it is to be employed. This light-sealing means comprises a cover sheet 65 of a light-impervious material located between the foremost sensitive sheet 11 and the forward wall 40 and extending across exposure aperture 44. Cover sheet 65 extends around the curved end 52 of the pressure plate 50 and behind the same to a position against the cover 46. It has a tapered leading end 66 which extends through the opening 45 in the forward end of the pack and serves as means for withdrawing the cover sheet from the pack after the pack has been loaded into a camera.

The film units incorporating the invention and comprising film pack 38 are adapted to be employed in a hand-held camera of the type shown in U.S. Pat. No. 3,080,805. Inasmuch as the camera per se forms no part of the present invention, and is well known, we have shown in FIGS. 5–7 only so much of the camera as is necessary to an understanding as to how the film units of the present invention are processed after exposure when they are moved through the pressure-applying means incorporated in the camera. As clearly shown in the above-noted U.S. Pat. No. 3,080,805, the camera back is provided with a chamber at its rear end closed by a hinged cover to permit insertion of a film pack into the camera with its forward wall 40 abutting a wall in the chamber to position the foremost sensitive sheet 11 of the pack in the focal plane of the camera lens. In FIGs. 5–7 we have shown the lower end of the back chamber of the camera as comprising a front wall 70 which is fixed to the camera body and a rear wall 72 which is part of the hinged cover on the back of the camera. A film unit withdrawal passage 74 is provided in lower end wall 73 to permit withdrawal of a film unit 10 from a film pack located in the chamber. Suitable latch means, not shown, are provided at the lower end of the chamber for retaining the hinged cover in a closed or operative position relative to the camera back as shown in the drawings.

The camera includes a pair of juxtaposed pressure-applying rollers 75 and 76 mounted within the rear chamber adjacent the withdrawal passage 74. Pressure-applying rollers 75 and 76 are mounted for pivotal movement with their axes substantially in a common plane, and resilient means, not shown, are provided for biasing the rollers toward one another so as to apply a compressive pressure to a film unit during withdrawal thereof between the rollers. The pressure-applying rollers cooperate to form a convergent passage through which the film unit is moved for effecting a processing of the film unit, and this passage is located in substantial alignment with the withdrawal passage 74. In the arrangement of the pressure-applying rollers shown in the drawings, both rollers are mounted on the rear wall 72 which is hinged to the back of the camera so that when the hinged cover is opened, a pack of film units may be loaded into the camera with the leading end 66 of safety cover 65 extending from the camera past and to one side (forward) of the pressure rollers. Portions of the end wall 73 and front wall 70 cooperate to define an opening 78 between the hinged cover and the camera back through which safety cover 65 and the leaders of the film units can be pulled from the camera housing in sequence.

The camera includes suitable means for guiding the tapered end section 16 of a film unit 10 between the pressure-applying rollers 75 and 76 in response to withdrawal movement of its leader 60 past roller 6 to the front thereof and through passage 78. In the form shown in FIGS. 5-7 this guide means comprises a guide bar 80 and two guide members 81. Guide bar 80 and guide members 81 are mounted on the forward section of the back chamber fixed to the camera body and adjacent forward roller 76 with the rearmost surfaces of the guide members 81 disposed approximately in a plane divergent to the surfaces of the rollers at their point of engagement. The spacing between guide members 81 is slightly greater than the width of the leaders 60, but less than the narrowest portion of the tapered end section 16, so that leaders 60 may pass between the guide members 81 while tapered end section 16 is supported on and guided by members 81 between the pressure-applying rollers. The intermediate section of guide bar 80 and guide members 81 cooperate with one another and roller 76 to define what may be determined a passage through which leader 60 is guided to the front of roller 76 and through passage 78.

Film passage 74 in the end wall 73 of the hinged cover 72 is at least equal in width to the width of a film unit 10, whereas passage 78 need be only wide enough to allow passage of the narrow leader 60. It is desirable to allow only one leader 60 at a time to project from the camera where the leader may be grasped so as to prevent the operator from accidentally pulling the wrong leader or pulling more than one leader at a time. For this purpose, the leading ends of the leaders 60 of all film units of the present film pack are folded back on themselves and each has its end adhered to the leader 60 of the preceding film unit at a point behind the leading end thereof. The leading end of the leader of the

first film unit in the pack is folded back upon itself and is adhered to the cover sheet **65.** With such an arrangement, all of the leaders **60** lie within the pack itself and are pulled out of the passageway **78** in succession as the leader **60** of the preceding film unit is pulled to feed the tapered end section **16** of its unit between the pressure rollers **75** and **76.** If a film pack of the type shown in U.S. Pat. No. 3,294,538 is used, wherein the folded-back ends of the leaders of the film unit all extend outside of the pack, then the construction shown in FIGS. **5–7** can be used to prevent more than one leader at a time extending from the camera. As shown, the end wall of the back chamber is provided with a recess **90** adjacent leader passage **78** for holding the leading end sections of the film unit leaders. When the film pack is placed in a camera, the folded-back leading ends of the leaders are contained within the recess **90** which is provided with a resilient cover **91.** As the leading end of the leader **60** of one of the film units is pulled through the passage **78,** the leading end of the next leader **60** is unfolded and withdrawn through passage **78** where it may be grasped for pulling the leader from the camera.

When the film pack of the present invention is loaded into the camera only the leading end **66** of the cover sheet **65** extends through passage **78** and the folded leading ends of leaders **60** lie within the pack as shown in FIG. **4.** Now to ready the pack for the first exposure, the end **66** of the cover sheet **65** is grasped and pulled from the pack to uncover the exposure aperture **44** in the forward wall of the pack. This will also pull the leading end of the leader **60** of the first film unit (the outermost one in the pack) through the passage **78** where it can be grasped. After the light-sensitive sheet **11** of the first film unit in the pack is exposed, then the leader **60** thereof, which is extending outside of the camera, is grasped and pulled through passage **78** advancing tapered end section **16** and tapered end portion **24** between pressure-applying rollers **75** and **76** to the position shown in FIG. **5.** In this position the leader **60** extends from its point of attachment to the tapered end section **16** at almost a right angle from the plane of the tapered end section **16** which projects through passage **74** a sufficient distance to permit it to be grasped outside of the camera. The continued application of a pulling force to leader **60** results in the exertion of a peeling force to leader **60** at the point where it is attached to the tapered end section **16** and results in a separation of the leader from the tapered end section at this point. Also, at this time the exposed photosensitive sheet **11** is brought substantially into superposed relation with its print-receiving sheet **12.**

Now the end of the tapered end section **16** which is extending between the pressure roll **75, 76** is grasped and pulled to advance the exposed photosensitive sheet **11,** the print-receiving sheet **12** superimposed therewith, and pod **22** sandwiched between the two, between pressure-applying rollers **75** and **76.** When the film unit reaches the position, as shown in FIG. **6,** it will be seen that the pressure-applying rollers **75** and **76** have caused a rupture of the longitudinal marginal seal **30** of the pod **18** and a unidirectional feeding of the processing fluid between and in contact with the opposed surfaces of the photosensitive sheet **11** and the receiver sheet **12.**

Continued withdrawing force on tapered end section **16** to the position shown in FIG. **7** provides positive engagement between the processing fluid and the trapping means of the present invention which collects and retains the excess fluid reaching the trapping means. As the trap **25** passes between the pressure-applying rollers the embossed protuberances serve to separate or lift the rollers and also provide a separation between the bottom of the trap and the surface of the trailing end of the photosensitive sheet superposed therewith, this separation forming a space sufficiently large to collect all excess fluid which might reach the trap.

The liquid trapping means of the present invention is not limited to use on individual film units which are to be assembled in film packs, but is also adaptable for use in film products for carrying out a one-step photographic process of the roll type such as shown in U.S. Pat. No. 2,644,755. In this roll type product the photosensitive layer comprises a continuous sheet of photosensitive material and the print-receiving layer comprises a continuous sheet of material suitable for forming the background for a positive image comprising silver. The print-receiving sheet and the photosensitive sheet are coiled into separate rolls adapted to be arranged in a camera so that successive areas of the photosensitive sheet can be individually exposed and then be superposed with successive image areas on the print-receiving sheet before the two sheets are moved between pressure-applying rollers for processing of the film.

Referring now to FIG. **8,** there is shown a photographic product of the roll type incorporating a trap means constructed in accordance with the present invention and the manner in which this product is used. There is shown a photosensitive layer **11'** with its photosensitive surface facing upwardly with an exposure image area being indictated at **11***a*. This image area **11***a* is that area of the layer **11** which is in exposure position when a developer pod **18'** on the print-receiving layer **12'** is in a predetermined position with respect to the processing members of the camera. On that surface of the print-receiving layer **12'** which is brought into face-to-face contact with the image area **11***a*, there is shown a positive image area **12***a*, this area being roughly defined by the distance between a pair of developer pods **18'**. This image area **12***a* is completely defined by a series of perforations **100** extending around the periphery thereof. For the purpose of trapping excess spread developer there is provided a trap which, according to a preferred embodiment of the present invention, comprises an embossed strip **26'''** of thin plastic sheeting adhered to the print-receiving layer **12'** adjacent the trailing edge of each image area **12***a*. There are also provided leader portions **110** and **111** on the photosensitive and image-receiving layers, respectively.

Also, shown in FIG. **8** is a pair of processing members which are schematically indicated in the form of pressure-applying rollers **75'** and **76'**. In a preferred form of camera, one of the pressure rollers **76'** is fixedly mounted and the other is placed under a resilient load by means of a spring **105.** For controlling the thickness of spread of liquid issuing from a pod **18'** when it is ruptured there may be provided spacer strips **13'** secured to the marginal portions of the image-receiving layer **12'**.

In the use of this roll type product in a camera designed therefor, the photosensitive layer **11'** and the receiver layer **12'** may be advanced to the positions indicated by pulling on the leaders **110** and **111.** A known type of metering mechanism, not shown, within the

camera cooperating with the photosensitive and receiving layers, respectively, may be used to properly position the two layers in the position shown for making an exposure when the two layers are advanced by pulling on the leader portions **110** and **111**. After an exposure of the image area **11***a* is made, the two leader portions **110** and **111** are again pulled. During commencement of the pull, the passage of the pod **18'** between the pressure rollers **75'** and **76'** increases the hydraulic pressure within the pod to the point where the liquid is forced out of the trailing longitudinal edge of the pod. As the pull is continued, the liquid is spread between the two layers in a thin uniform layer having a thickness defined by that of the spacer strips **13'**, the liquid acting to bond the photosensitive and image-receiving layers together as a unit and to carry out the formation of the positive image on the area **12***a* which is in coincidence with the exposed area **11**a. As the embossed trap **26'''** passes between the rollers **75'** and **76'** a sufficient number of protuberances engage the roller **75'** at any given time to separate it from roller **76'**. These protuberances in addition to separating the roller **75'** from roller **76'** engage the surface of the photosensitive layer **11'** at the trailing end of the image area **11***a* to form a space for collecting and retaining any excess fluid and keeping it from being spread on the layers **11'** and **12'** beyond the trap. As mentioned above, the trap **26'** may be carried by the photosensitive layer **11'** rather than by the image-receiving layer **12'**, as shown, or coincident areas of both layers may carry embossed strips which cooperate to provide the trap. Also, if the image-receiving layer **12'** and/or the photosensitive layer **11'** comprises a material which can be embossed to provide protuberances having the necessary resistance to crushing, e.g., cellulose acetate, cellulose acetate butyrate, or polyester sheeting, the embossed trap pattern can be embossed directly in these layers rather than requiring a separate trap sheet to be adhered thereto as shown. The depth of the embossed protuberances may be adjusted so as to provide a space having the necessary volume to trap all excess fluid which might be encountered.

It will be apparent that this novel trapping means has several advantages over schemes previously used, particularly in connection with roll type products. If the embossing is made in one or the other, or in each, of the layers **11'** and **12'**, then there are no parts which can become accidentally disconnected from the layers during the handling thereof prior to or during the processing step. Even when the trap comprises an embossed strip which is attached to one or both of the layers, it is so flexible itself that it can be coiled with the layers and/or bent around guide rollers with the layers without subjecting the adhesive connection between the trap and the layers to a shearing force of such nature that the trap is apt to become accidentally separated from the layer to which it is adhered. Also, a trap constructed in accordance with the present invention facilitates the manufacture or assembly of a film product of the type disclosed because it can be applied to the respective layers of the product by a continuous or intermittent assembly line technique. Furthermore, if the embossed traps are made separately, they can be made by continuously passing a strip through an embossing roller and then chopping the individually formed traps from the strip.

While we have shown and described certain embodiments of our invention, we are fully aware of any modifications thereof that are possible. Our invention, therefore, is not to be limited to the precise details of construction shown and described, but is intended to cover all modifications coming within the scope of the appended claims.

We claim:

1. In a photographic film unit which is adapted to be processed by passing said unit between a pair of juxtaposed pressure-applying members which comprises, in combination,

a first photosensitive sheet element having a leading edge and a trailing end;

a second non-photosensitive sheet element having a leading edge and a trailing end;

a rupturable container retaining a fluid processing composition fixed to one of the sheet elements;

said sheet elements arranged for biasing into superposed relationship with said container positioned intermediate said sheet elements transversely of the leading edges thereof to effect unidirectional discharge of said container's contents between and in contact with opposed surfaces of said elements resulting from the application of compressive force to said container and said sheet elements upon movement of said film unit between and relative to said pressure-applying members; the improvement which consists of,

a plurality of protuberances, which are individually readily compressible, embossed from the surface of, and extending over a substantial area of, the trailing end of at least one of said sheet elements and extending toward the other of said sheet elements to separate the opposed surfaces of the trailing ends of said sheet elements when they are biased into superposed relation and provide a trap portion at the trailing end of said film unit for collecting any processing fluid in excess of that required to process the opposing surfaces of said sheet elements between the container and the trailing end of said film unit and reaching said trap portion,

the arrangement of said protuberances being such that there is a sufficient number of them between the pressure-applying members at any one time to effect a significant separation of said pressure-applying members for maintaining a separation between the superposed surfaces of the trailing ends of said sheet elements as the trailing end of the film unit passes between said pressure-applying members.

2. A photographic film unit as defined in claim **1**, wherein one of said sheet elements is made of a thin plastic sheet, and the trailing end thereof is embossed to provide said protuberances.

3. A photographic film unit as defined in claim **1**, wherein the trailing ends of each of said sheet elements are embossed to provide said protuberances.

4. A photographic film unit as defined in claim **1**, wherein one of said sheet elements is shorter than the other, and wherein said means for confining excess processing fluid comprises an embossed sheet of thin plastic material attached to and extending beyond the trailing end of said short sheet element.

5. A photographic film unit as defined in claim **1**, wherein the shape of the individual protuberances are

humps, said protuberances being arranged in rows extending transversely of said film unit.

6. A photographic film unit as defined in claim 1, wherein the sheet element having its trailing end embossed is longer than said other sheet element, the trailing end of said embossed sheet element being folded back on itself and over the protuberances to an extent to make the overall length of this sheet element substantially equal to that of the other sheet element and to form a pocket for collecting any excess processing fluid.

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