July 3, 1951 E. H. LAND 2,558,856

PHOTOGRAPHIC DEVELOPER DISPENSING ELEMENT

Filed July 8, 1946 2 Sheets-Sheet 1

FIG. 1

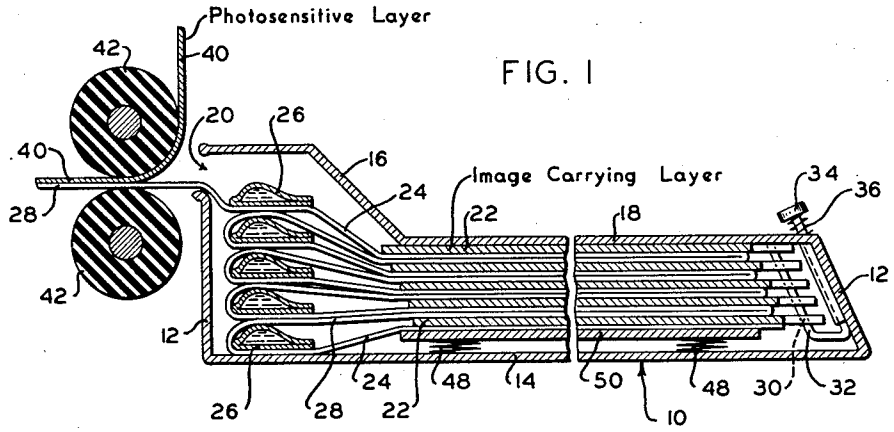


FIG. 2

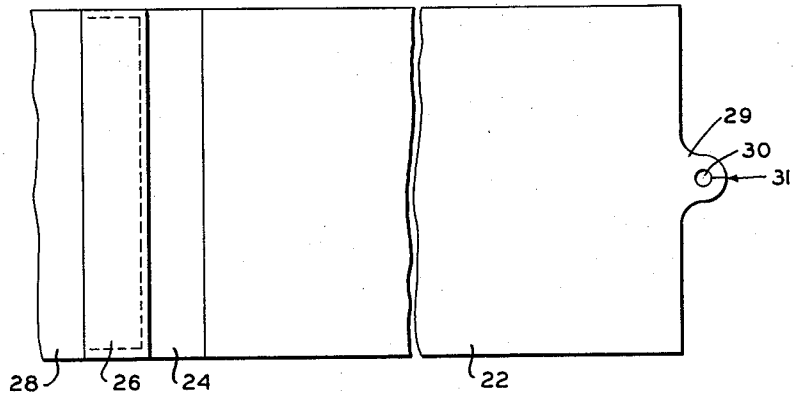
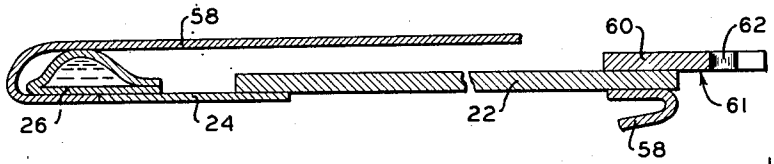


FIG. 3



INVENTOR
Edwin H. Land
BY
Donald K. Brown
Attorney

July 3, 1951 E. H. LAND 2,558,856

PHOTOGRAPHIC DEVELOPER DISPENSING ELEMENT

Filed July 8, 1946 2 Sheets-Sheet 2

FIG. 4

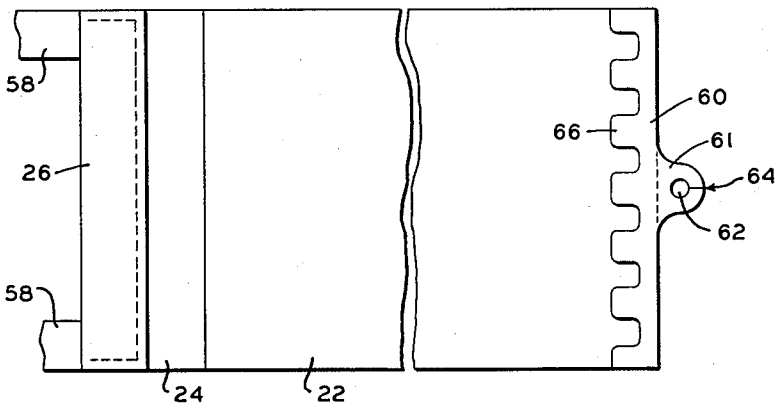


FIG. 5

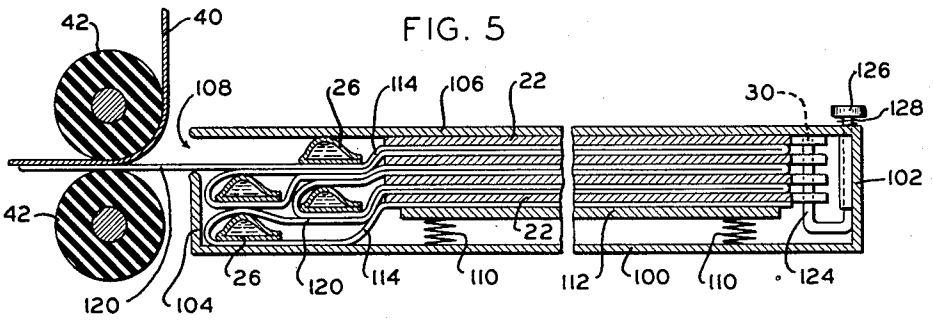
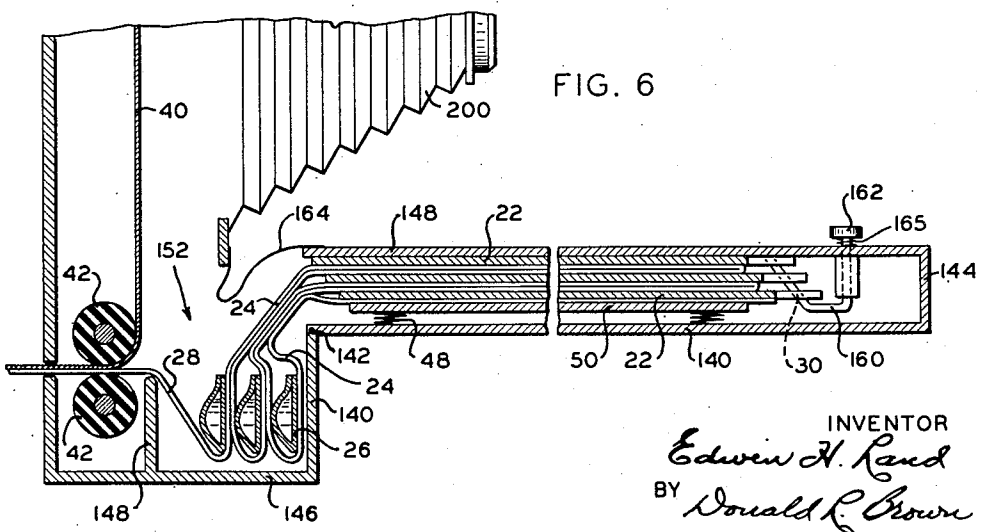


FIG. 6



INVENTOR
Edwin H. Land
BY Donald L. Brown
Attorney

Patented July 3, 1951

2,558,856

UNITED STATES PATENT OFFICE

2,558,856

PHOTOGRAPHIC DEVELOPER DISPENSING ELEMENT

Edwin H. Land, Cambridge, Mass., assignor to Polaroid Corporation, Cambridge, Mass., a corporation of Delaware

Application July 8, 1946, Serial No. 682,001

27 Claims. (Cl. 95—88)

1

This invention relates to photography and more particularly to novel photographic elements and magazines therefor.

A principal object of the present invention is to provide a novel photographic element including a relatively stiff layer of material and a container for a liquid composition, the element being so designed that a plurality thereof can be arranged in a magazine occupying a minimum of space and may be removed sequentially from said magazine.

Another object of the invention is to provide, in combination with elements of the above type, means for assuring registration of said elements with another layer of material which may be a photosensitive layer or an image-carrying layer.

Other objects of the invention are to provide elements of the above character which may be stored in a magazine having minimum dimensions throughout the major portion thereof, there being an enlarged portion of said magazine for holding the containers; wherein there is provided a flexible member for joining the container to the layers; wherein means are provided for positively holding each element in the magazine until released so as to assure registry of said element with an exposed frame of photosensitive material where said layers are image-carrying layers, or for proper framing where said layers are photosensitive layers; wherein said member is sufficiently impermeable to the liquid composition to assist in spreading said liquid composition thereacross; and wherein said member is sufficiently flexible to permit a magazine holding a plurality of the elements to be hinged and bent at some portion thereof.

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

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

Figure 1 is a diagrammatic exaggerated sectional view of a novel magazine containing a plurality of the novel photographic elements embodying the preferred modification of the present invention;

Fig. 2 is a diagrammatic exaggerated plan view of a single element of the type shown in Fig. 1;

Fig. 3 is a diagrammatic exaggerated sectional view of another modification of the novel photographic element of the present invention;

Fig. 4 is a diagrammatic exaggerated plan view of the modification of the invention shown in Fig. 3;

2

Fig. 5 is a diagrammatic exaggerated sectional view of still another modification of the invention; and

Fig. 6 is a diagrammatic exaggerated sectional view of a modified form of a magazine for use with the present invention.

In general this application relates to improvements in a novel product for use in novel photographic processes. Broadly, this product, in a preferred embodiment, comprises the combination of a layer of photosensitive material capable of being exposed to actinic light to create therein a latent negative image, an image-carrying layer adapted to have produced on its surface a positive image of the subject matter of said latent negative image, and a container having therein a liquid composition comprising a developer, a silver halide solvent and an alkali.

In the use of such a product the photosensitive layer is exposed to actinic light, such as in a camera. This exposure produces a latent negative image of a subject image in the photosensitive layer. The photosensitive layer is next brought into face-to-face relationship with the image-carrying layer. The container is preferably carried by the image-carrying layer and is accordingly positioned between the photosensitive layer and the image-carrying layer. This composite structure is next passed through a pair of pressure rollers, or other pressure applying means, to release the liquid composition from the container and to spread it in a uniform thin layer between the photosensitive layer and the image-carrying layer. The developer in the liquid composition develops the latent negative image and the silver halide solvent forms soluble positive image-forming complexes with undeveloped portions of the photosensitive material. The soluble complexes are transferred to the surface of the image-carrying layer where they are converted to insoluble, visible, colloidal particles constituting the positive image by the reaction therewith of unused portions of the developer. While the above described silver halide complex transfer is preferred, other transfer processes and other positive image-forming processes are equally usable.

With such a product and process it is sometimes desirable to so mount the various elements of the combination in the camera that the image-carrying layer is not joined to the photosensitive layer. Such an arrangement permits many modifications of camera construction and permits the use of standard roll films or standard film packs for the photosensitive layer, thus considerably simplifying the design of the camera and

simplifying conversion of standard cameras for use with the present invention, and also simplifying the packaging of the image-carrying layers and the containers. It also obviates the necessity of separating any image-carrying layer from the photosensitive layer to permit exposure of the latter, since these layers are not brought into contact with each other until after the photosensitive layer is exposed. The present invention, accordingly, relates primarily to novel film elements and a magazine containing a plurality of these novel elements. While the present invention is primarily useful in connection with the above-identified process wherein a positive image is obtained from a latent negative image, it may be equally applied to other photographic processes such as those involving only the development and fixing of a negative.

More specifically, the present invention deals with an improvement in the construction of image-carrying layers, means for mounting the containers in operative relationship to these image-carrying layers, a magazine for holding a plurality of these image-carrying layers, and connecting means for permitting sequential withdrawal of the image-carrying layers from the magazine.

In one modification of the present invention a plurality of image-carrying layers and their associated containers, having therein a liquid composition, are positioned within a magazine so that they may be withdrawn in succession. In order to save space, these elements are so arranged that the magazine has a large end and a relatively narrow body portion. The large end portion of the magazine holds the containers while the image-carrying layers occupy the main body portion of the magazine. Joining each of the image-carrying layers to its respective container is a flexible strip, and in a preferred modification of the invention this strip is continued from the container to the trailing edge of the preceding image-carrying layer. When one image-carrying layer is removed, the strip attached to the trailing edge thereof is positioned so as to permit withdrawal of the next succeeding image-carrying layer with its associated container. These connecting strips, in a preferred form, are made of a solid sheet of material and act to form a leader permitting withdrawal of the film unit, and which may act to form part of a light seal to permit the above described photographic reaction to take place in the absence of actinic light. These connecting strips may additionally act as means for trapping any liquid composition which may be spread past the end of the preceding image-carrying layer.

In another modification of the invention the image-carrying layer is provided with a liquid trap at the end thereof opposite from the container end, thus obviating the necessity for a solid connecting strip running between the various image-carrying layers.

In order to assist in the withdrawal of only one image-carrying layer at a time and to assist in the positioning of this image-carrying layer with respect to an exposed frame on the photosensitive layer against which the image-carrying layer is to be positioned, means are preferably included in the magazine, in a preferred modification of the invention, for preventing the withdrawal of one image-carrying layer from moving the next image-carrying layer until such time as the next image-carrying layer is needed for forming a positive print.

In another modification of the invention there are provided means which, while not preventing the movement of the second image-carrying layer, greatly resist such movement and thus call to the attention of the user of the camera the fact that he is trying to pull the first image-carrying layer too far from the camera.

Still another modification of the invention contemplates the use of photosensitive layers in place of the above-described image-carrying layers and in this modification the photosensitive layers, with their associated containers, are brought, after exposure, into contact with a suitable continuous strip of image-carrying material.

A prefrered form of the invention is shown in Fig. 1 wherein there is provided a magazine **10** having end walls **12** and a bottom wall **14**. There is also provided a top wall **18** having an upwardly extending portion **16** and a suitable opening **20** in one of the end walls through which the leader for the first image-carrying layer may run. These portions of the magazine are preferably formed of metal or stiff paper. This type of magazine is preferably sold in the form shown and is packed in the factory. However, it is readily apparent that the bottom wall **14** may be hinged to either of the end walls **12** so that a pack of the novel photographic elements may be inserted therein and the leader therefor threaded through the opening **20**.

Within the magazine there are providd a plurality of photographic elements which are shown in section in Fig. 1 and in plan in Fig. 2. Like numbers in Fig. 2 correspond to like members of Fig. 1. Each element comprises an image-carrying layer **22** which, in a preferred form of the invention, is formed of a relatively stiff, white opaque paper such as that known in the art as double-weight baryta paper. Associated with the leading edge of each image-carrying layer **22** there is provided a flexible joining strip **24** adapted to carrying on its surface a liquid container **26**, this container **26** being preferably adhesively secured to the surface of the joining strip **24**. Connecting container **26** with the trailing edge of the preceding image-carrying layer there is provided a leader **28**. In a preferred modification of the invention this leader **28** is integral with the joining strip **24** and is a continuous strip of paper upon which the image-carrying layers and containers are adhesively secured at proper intervals.

For the purpose of positively holding each image-carrying layer in the magazine until such time as it is needed, there is provided a pin **32**. In the modification of the invention shown in Fig. 1 and Fig. 2 the trailing edge of the image-carrying layer **22** is provided with a trailing portion **29** having a hole **30** therein through which can be inserted the pin **32**. The pin is released from the hole **30** to permit the image-carrying layer to be withdrawn from the magazine at the appropriate time. For releasing the pin from the hole **30**, by moving the pin in a downwardly direction, there is provided a button **34** which may be depressed by the operator to release the topmost image-carrying layer in the pack. In order that the pin **32** may be normally held in a position preventing the removal of an image-carrying layer, there is provided a spring, which is shown schematically at **36** and is adapted to keep the pin **32** in a raised position until it is pushed down by the user of the camera.

As can be seen in the left-hand portion of Fig. 1, there is provided a pair of pressure rollers **42**

through which the image-carrying layer and the container are passed in contact with a layer of exposed photosensitive material 40. In this figure, a portion of the connecting strip 28 is passing through the pressure rollers 42 and the remainder thereof is being fed out of the magazine.

In a preferred embodiment of the invention, the image-carrying layer 22 is formed of a piece of relatively stiff opaque white paper known in the art as double-weight baryta paper. Such a paper is supplied by Eastman Kodak Company under the designation Commercial Glossy double weight baryta coated paper. This layer, however, may be formed of many other substances such as gelatin or paper. It may also be made of regenerated cellulose, polyhydroxy alkanes such as polyvinyl alcohol, sodium alginate, certain of the cellulose ethers such as methyl cellulose, and their derivatives such as sodium carboxymethyl cellulose or hydroxyethyl cellulose, carbohydrates such as gums or starch, and mixtures of these materials where the latter are compatible. It may also be made of relatively impermeable materials such as Celluloid and other materials commonly used in the photographic arts.

The liquid composition in container 26, in its preferred embodiment, is composed of a developer such as hydroquinone, a film-forming substance such as sodium carboxymethyl cellulose, and a substance adapted to form from a latent photographic image a positive image-forming component. This latter substance in a preferred form of the invention is a silver halide solvent such as sodium thiosulfate. There are also preferably included other substances to aid the photographic reaction, such as a preservative, i. e., sodium sulfite, and an alkali, i. e., sodium hydroxide, plus water to carry the above-mentioned substances in solution. Suitable liquid compositions may comprise the approximate proportions of materials shown in the following nonlimiting example:

	Grams
Sodium carboxymethyl cellulose	116
Water	1860
Sodium sulfite	78
Sodium hydroxide	74.6
Citric acid	38.5
Hydroquinone	52.0
Sodium thiosulphate	14.5

Container 26 for the liquid composition is preferably formed of an elongated, water vapor-impervious and oxygen-impervious material such as a wax-coated metal foil or a metal foil coated with a resin, such as polyvinyl butyral, which is inert to alkalis. This container is so formed that the application of a suitable mechanical stress thereto as, for example, the squeezing together of the faces of the container will release the liquid composition from said contanier in only one direction, longitudinally of the member 24 so as to spread said liquid composition between the photosensitive layer 40 and the layers 24 and 22.

The joining member 24 and the connecting means 28 are preferably formed from a continuous strip of flexible black paper such as that sold by Knowlton Brothers, Watertown, New York, under the designation 604–L. This strip of black paper serves several functions. In the first place it adhesively carries the container 26 and acts to allow the spreading of the liquid composition thereacross to the image-carrying layer. In order to serve this function the paper must be sufficiently impermeable to the viscous liquid so as not to absorb too great a quantity of the liquid and thus prevent its reaching the image-carrying layer 22. The black paper strip also forms a flexible junction between the container 26 and the image-carrying layer 22, which permits relative movement between these two. This paper strip will also serve as a light seal to prevent the entrance of actinic light to the laminate formed by the photosensitive layer 40, the image-carrying layer 22 and the strip 24, 28. This is particularly desirable when the photosensitive layer is backed with a light-proof backing and permits discharge of the laminate directly from the camera into daylight.

The black paper strip additionally acts to connect the trailing edge (i. e., the right-hand edge in Fig. 1) of the first image-carrying layer with the container associated with the succeeding image-carrying layer. This portion of the strip may also act as a trap for any excess liquid composition which is spread past the trailing edge of the image-carrying layer. For this function the area of the connecting strip is utilized primarily for trapping and the trapping is additionally aided by the porosity of the paper strip which assists in drying the liquid and thus hindering its further spreading. The connecting strip of black paper 24, 28 should thus have some permeability to the liquid composition, but it should not be so permeable that it interferes with the spreading of a considerable quantity of the liquid composition thereacross.

The black paper strip 24, 28 should also have a sufficiently high wet strength so that it may serve to pull the image-carrying layer through the pressure rollers even after it has been wetted by the liquid composition.

The photosensitive layer 40 is preferably of the type that is rendered developable by exposure to actinic light, such as a noble metal halide, and in particular is preferably formed of an emulsion of a silver halide, a mixed silver halide, or a silver mixed halide. This photosensitive layer 40 may be a standard photosensitive emulsion carried on either a paper base or a cellulosic base such as a cellulose acetate or cellulose nitrate.

In the use of the invention a predetermined portion of the photosensitive layer 40 is exposed to actinic light. This predetermined portion, or frame, is then brought into face-to-face contact with a predetermined portion of the image-carrying layer 22. This portion of the image-carrying layer is hereinafter referred to as an image area. In order to accomplish the step of bringing the exposed frame of photosensitive material into contact with the image area on the image-carrying layer, a portion of the photosensitive layer is positioned between the pressure rollers 42. Connecting strip 28 leading from the first image-carrying layer is also placed between these pressure rollers. The photosensitive layer is then exposed to light to create therein a latent negative image. The user of the camera then depresses the button 34 which lowers the pin 32 from the hole 30 in the trailing edge of the first image-carrying layer. The leader 28 and the portion of the layer 40 extending through the pressure rollers are then grasped and pulled with an even pull through the pressure rollers. This pulling operation withdraws the container 26 and the first image-carrying layer 22 from the magazine 10. As the container 26 passes through the pressure rollers, the liquid composition is re-

leased from the container and is spread across the joining strip 24 and across the surface of the image-carrying layer 22, this spreading being accomplished as the photosensitive layer 40 is brought into contact with the image-carrying layer. This spreading operation creates a uniform layer of the liquid composition between the image-carrying layer 22 and the photosensitive layer 40. In view of the fact that the pin 32 positively positions the image-carrying layer with respect to a known distance from the pressure rollers, coincidence of the exposed frame on the photosensitive layer and the image area on the image-carrying layer is obtained if the leading edge of the image area is spaced the same distance from the bite of the pressure rollers as is the leading edge of the exposed frame. Thus, as these two layers are advanced together at the same speed to and through the pressure rollers, coincidence of these two areas is assured.

When the liquid composition of the type described above is spread between the image-carrying layer 22 and the photosensitive layer 40, the following reaction takes place. The developer develops the latent negative image in the photosensitive layer 40, the silver halide solvent forms soluble silver complexes with the undeveloped photosensitive material and transfers these soluble complexes to the layer of film-forming material spread in contact with the image-carrying layer 22. These soluble complexes are converted within this film to insoluble colloidal particles comprising silver and forming a positive image in this formed film. The image-carrying layer, carrying on its surface the formed film containing the positive image, is next separated from the photosensitive layer to permit viewing of the positive image.

As the first image-carrying layer is withdrawn from the magazine 10, the connecting means 28 attached to the trailing edge of this image-carrying layer is also withdrawn and is drawn through the pressure rollers following the image-carrying layer. As the liquid composition is spread across the image-carrying layer it forms a film of a thickness determined by the viscosity of the liquid, the speed of pulling, and the pressure exerted by the pressure rollers. Since one or more of these factors are variable due to temperature ranges and the conditions of use of such an apparatus, it is rather difficult to provide just a sufficient quantity of liquid composition to form a layer covering only the image-carrying layer, and in fact it is desirable, in order to assure complete coverage of the image-carrying layer, to provide an excess of liquid over that normally required. Therefore, a certain amount of the liquid composition is spread past the trailing edge of the image-carrying layer and is spread between the connecting means 28 and the photosensitive layer 40. Since this is a relatively small portion of the liquid composition, it finally reaches a point where no further spreading occurs. Thus the connecting means 28 serves to trap the excess of the liquid composition. This trapping, as previously mentioned, is aided by the fact that the connecting strip, which is preferably formed of paper, acts to absorb a certain amount of the water from the liquid composition, thereby increasing its viscosity and preventing further spreading.

As the connecting means 28 passes through the pressure rollers, it will reach a point where further travel is prevented due to the fact that it is connected to the succeeding image-carrying layer, which image-carrying layer is held by means of the pin 32 extending through a hole in the trailing edge thereof. The operator can immediately and readily ascertain when he has pulled the first image-carrying layer sufficiently far and he knows that the second image-carrying layer is in position for proper registry with the next frame of photosensitive material. It should be noted that the springs 48 in the bottom of the magazine 10 act to move succeeding image-carrying layers to the top of the magazine, thereby properly positioning them for release from the pin 32 when the button 34 is depressed.

While the above-described modification of the invention shows a preferred form thereof, many changes may be made without departing from the scope of the invention. In particular, it may be desirable, in certain cases, to provide a means for resisting the movement of an image-carrying layer from the magazine and to so construct said means or said image-carrying layer that said means does not positively prevent such movement. This modification of the invention contemplates a feature of construction of the image-carrying layer shown in Fig. 2, wherein there is provided adjacent the hole 30 a weakened portion 31 in the trailing portion 29 of the image-carrying layer 22. With such a modification of the invention it is not necessary to depress pin 32, shown in Fig. 1, to release the image-carrying layer. It is only necessary to increase the pull on the leader 28. This increased pull is sufficient to allow the image-carrying layer 22 to be pulled away from the pin by rupturing the weakened portion 31 on the trailing end of the image-carrying layer. In this modification of the invention, the user of the camera can tell when he has pulled the preceding layer 28 sufficiently far since the image-carrying layer is prevented from movement by means of the pin. The user of the camera exposes the next frame of photosensitive material and then, by a relatively strong pull, can release the image-carrying layer for withdrawal from the magazine and passage through the pressure applying means.

In some cases it is desirable to provide a positive trapping element on the trailing edge of the image-carrying layer, thus permitting the use of narrow leaders connecting successive image-carrying layers and resulting in a saving of the amount of materials required for the production of a film pack. Such a modification of the invention is shown in section in Fig. 3 and in plan in Fig. 4 where like elements correspond to like numerals in Figs. 1 and 2. As shown in Figs. 3 and 4, there is provided the usual image-carrying layer 22 which may be formed of materials mentioned in connection with the discussion of the image-carrying layers of Figs. 1 and 2. There is also provided a container 26 which is joined to the image-carrying layer by means of a strip of paper 24, this strip 24 being adhesively secured to the leading edge of the image-carrying layer 22, and also being secured to the container 26 by suitable means such as an adhesive. Running from the container 26 to the trailing edge of the preceding image-carrying layer there is provided a pair of leaders, or connecting means 58. As shown in Fig. 4 these connecting leaders 58 can be positioned on the marginal portions of the film unit. On the trailing edge of the image-carrying layer 22 there is positioned a liquid trap 60 which has, as shown in Fig. 4, a number of teeth 66 defining shallow pockets in which the viscous liquid

composition from the container 26 may be trapped. On the trailing edge of this trap there is provided a trailing portion 61 having a hole 62 therethrough. There is also provided a weakened portion 64 for the trailing portion 61.

In the preferred modification of the invention discussed in connection with Figs. 3 and 4, the image-carrying layer 22 is formed of a white opaque paper known in the art as baryta paper which may, if desired, be backed with an additional layer of black paper to increase the opacity of the image-carrying layer to actinic light. The joining strip 24 is preferably formed of a black paper which is relatively impermeable to the liquid composition in the container 26. This liquid composition preferably comprises an alkaline aqueous solution of a developer, such as hydroquinone, a preservative such as sodium sulphite, a silver halide solvent such as sodium thiosulphate, an alkali such as sodium hydroxide, and a film-forming material such as sodium carboxymethyl cellulose. The connecting leaders 58 may be formed of suitable paper strips having sufficient tensile strength to permit the drawing of the assembly through the pressure rollers, or they may be formed of a plastic such as cellulose acetate, and other materials well known to those skilled in the art.

The container 26 is preferably formed of a paper-backed metal foil coated with a resin, such as polyvinyl butyral, which is inert to alkalis. The trap 60, in a preferred modification, is formed of a relatively incompressible cardboard, although it may be formed of a felt or many other materials. The photographic processing involved in the use of the invention shown in Figs. 3 and 4 is the same as that described in connection with the discussion of the invention of Figs. 1 and 2. There is a slight difference in operation, however, due to the presence of the trap 60 on the trailing edge of the image-carrying layer 22. When this trap portion passes through the pressure rollers, it acts to separate the pressure rollers, thereby relieving the pressure upon the liquid composition, which stops the further spreading of the liquid composition and the excess is trapped between the fingers 66 of trap 60. Some of the liquid composition may also be absorbed by the material of the trap, although such absorption is not essential if there is sufficient depth to the trap in relationship to the trapping area, whereby a considerable volume of the liquid composition may be trapped.

The hole 62 and weakened portion 64 serve the same functions as the hole 30 and weakened portion 31 shown in Fig. 2.

In the above modification of the invention the connecting leader 28 has been shown in the form of a flat fold in the right-hand portion of Fig. 1. This fold, in some cases, is preferably made with a larger radius of curvature to prevent the formation of a crease in the leader which might interfere with the feeding of one image-carrying layer from the top of the magazine. In such a case, the trailing portion 29 on the trailing edge of the image-carrying layer may be moved to the side in Fig. 2 to permit the leader 28 to be brought to the right-hand end of the magazine where it may be opened up to give a larger radius of curvature for the leader. This modification of the invention has not been shown in the drawings, since it is felt that the above description thereof will enable one skilled in the art to accomplish the purposes of this modification.

In some cases it is desirable to provide a magazine having minimum outside dimensions while retaining a rectangular shape. In Fig. 5 there is shown a modification of the invention which permits the use of the novel film elements of the present invention in such a magazine. As shown in Fig. 5 there is provided a magazine having a bottom wall 100, an end wall 102, a front wall 104, and a top wall 106. In the front wall 104 there is provided an opening 108. The novel film elements, as shown in Fig. 5, comprise an image-carrying layer 22 joined to a container 26 by means of a joining strip 114. Between each of the film elements there is provided a connecting strip 120 which runs from the trailing edge of the first element to the container associated with the succeeding element. In a preferred modification of the invention, strips 114 and 120 are formed of a continuous piece of black paper and the containers 26 and the image-carrying layers 22 are adhesively secured thereto at proper intervals. In the trailing edge of each image-carrying layer there is provided a hole 30, shown in dotted lines, through which is adapted to pass a pin 124. This pin is attached to the rear wall 102 of the magazine and is provided with a button 126, which, when depressed, releases the pin from the hole in the top image-carrying layer. Spring 128 normally holds the pin in its raised position. For moving the image-carrying layers to the top of the magazine there is provided a pressure plate 112 which is pressed upwardly by means of a spring shown schematically at 110.

As can be seen from an examination of Fig. 5, the containers 26 are arranged in staggered relationship with respect to each other, thereby permitting the insertion of a larger number of containers in a film pack having a predetermined thickness. This staggered spacing is accomplished by having alternately short and long joining portions 114 for joining the containers to their respective image-carrying layers.

There is also shown in the left-hand side of Fig. 5 a pair of pressure rollers 42 similar to those of Fig. 1. Passing through these pressure rollers there is shown a layer 40 of a photosensitive material.

In a preferred modification of the invention described in connection with Fig. 5, the elements thereof are made of the same materials as specified as being preferred in the discussion of the corresponding portions of the elements embodied in the invention of Figs. 1 and 2. The image-carrying layer 22 is, accordingly, preferably formed of a sheet of opaque white paper known in the art as bartya paper. Container 26 is preferably formed of a paper-backed metal foil coated with polyvinyl butyral, and the liquid composition carried by the container preferably comprises an aqueous solution of hydroquinone, sodium thiosulfate, sodium sulphite, sodium hydroxide, and sodium carboxymethyl cellulose. The paper strip 120, 114 is preferably formed of black paper which is opaque to actinic light and which is relatively impermeable to the liquid composition.

In the use of the modification of the invention shown in Fig. 5, the same operations are utilized as discussed in connection with the invention of Figs. 1 and 2. A predetermined portion of the photosensitive layer 40 is exposed. The pin 124 is depressed, releasing the top image-carrying layer, while the leader 120 and the photosensitive layer 40 are grasped by the operator and the topmost film element is pulled through the

pressure rollers in contact with the photosensitive layer 40. This pressure releases the liquid from the container 26 and spreads it in a uniform thin film between the surfaces of the photosensitive layer and the image-carrying layer. A positive image is produced on the image-carrying layer, as previously discussed, and the image-carrying layer, having this positive image on its surface, is next preferably separated from the photosensitive layer.

In some modifications of the camera in which the present invention is to be utilized, it is desirable to provide a magazine which may be hinged so as to permit the movement of one portion thereof with respect to another portion thereof. The present invention permits the use of photographic film elements with associated containers in such a magazine due to the flexible connection between the containers and the image-carrying layers. This modification of the invention is shown in Fig. 6 where like elements correspond to like elements of Figs. 1 and 2.

In this modification of the invention there are provided the usual image-carrying layer 22 and a container 26 which is joined to the image-carrying layer by means of the flexible joining strip 24. For connecting the trailing edge of each image-carrying layer with the container associated with the succeeding image-carrying layer there is provided a connecting leader 28. The magazine in which these film units are placed comprises a bottom wall 140 having a hinge point 142 near the left-hand end thereof. The magazine has two end walls 144 and 146 and a top wall 148 which is formed in two pieces to permit bending of the film unit from a straight line position to the position shown in Fig. 6. When the magazine is bent in the position shown, the two portions of the top wall 148 separate to provide an opening 152 through which the leader 28 from the topmost element may be passed and through which the elements may be withdrawn from the magazine. The magazine is provided with a pin 160 adapted to be passed through holes 30 in the trailing edges of the image-carrying layers. This pin is provided, on an end extending from the magazine, with a button 162 which enables the pin to be depressed for releasing the topmost element from the magazine. For holding the pin in a raised position there is provided a spring, which is shown schematically at 165. For moving the image-carrying layers upwardly within the magazine, there is provided a pressure plate 50 which is under spring pressure due to the presence of springs 48. A light seal may be provided between the top wall of the magazine and a portion of the camera to prevent entrance of actinic light to the photosensitive material carried by the camera 200. This light seal is shown schematically at 164 and is preferably made flexible to permit relative movement of a portion of the magazine with respect to the camera. There is also provided a pair of pressure applying means such as a pair of rollers 42 through which the leader 28 and a layer of photosensitive material 40 are adapted to be passed.

In the preferred modification of the invention shown in Fig. 6, the various portions of the novel film elements are formed of materials stated as being preferable in connection with the discussion of the previous figures. The image-carrying layer is preferably formed of baryta paper, strip 24, 28 is preferably formed of a continuous strip of black paper relatively impermeable to a viscous liquid composition, the container 26 is preferably formed of a paper-backed metal foil coated with polyvinyl butyral and contains an aqueous solution of hydroquinone, sodium sulphite, sodium thiosulfate, sodium hydroxide and sodium carboxymethyl cellulose. The modifications shown in Figs. 3 and 4 previously discussed can be also applied to the invention shown in Fig. 6.

The operation of this modification of the invention is like that described in connection with the discussion of the invention of Figs. 1 and 2. To commence the operation, the leader 28 and photosensitive layer 40 are pulled through the pressure rollers by hand until further movement is prevented due to the presence of the pin 160 extending through the hole 30 in the trailing edge of the topmost image-carrying layer. The frame of photosensitive material lying in the focal plane of the camera is then exposed to actinic light. The operator then grasps the leader 28 and the photosensitive layer and releases the topmost image-carrying layer by pressing down on the button 162. He then draws the topmost element through the pressure rollers in contact with the photosensitive layer to cause release of the liquid composition from the container 26 and thereby spreading it between the image-carrying layer 22 and the exposed frame of the photosensitive layer 40. The liquid composition, as previously discussed, develops the latent negative image in the photosensitive layer and produces a positive image on the surface of the image-carrying layer 22.

In the above discussion of the various modifications of the invention, preferred forms thereof have been described. The invention, however, is by no means limited to the specific materials or arrangements thereof which have been shown in the drawings and discussed in the specification. One modification of the invention which is contemplated is that wherein the image-carrying layer 22 of Figs. 1 through 6 may be replaced by a layer of photosensitive material. Considering this modification of the invention and its applicability to Fig. 1, it can be seen that by replacing the various image-carrying layers 22 with sheets of photosensitive material the sheets may be readily exposed to actinic light by providing an opening in the top wall 18 of the magazine. In this case the strip of material 40, instead of being a photosensitive material, comprises a sheet of baryta paper which can be fed through the pressure rollers in contact with the photosensitive layer and its associated container. The operation of this modification of the invention is similar to that discussed in connection with the operation of the modification shown in Fig. 1, i. e., the photosensitive layer is exposed, button 34 is depressed to allow the leader to pull container 26 and the photosensitive layer from the magazine and to pass these elements through the pressure rollers 42 in contact with a sheet of material capable of serving as an image-carrying layer.

It is also contemplated by the present invention to provide, in container 26, liquids other than those previously mentioned. In one modification of the invention the liquid in the container 26 may comprise only water or an aqueous solution of a film-forming material such as sodium carboxymethyl cellulose. In this modification, the various substances normally and preferably included in the container are coated upon the image-carrying layer. It is also possible to include portions of the liquid composition in solid

form on the image-carrying layer and other portions in the container. All of these modifications of the invention are within the scope thereof. It is also possible to coat some of these substances on the joining strip 24 so that they may be dissolved by the liquid composition in its passage thereacross.

The present invention also has considerable utility where it is desired to develop and fix a negative latent image without the production of a positive image. In this case the image-carrying layer 22 may act only as a backing layer to permit spreading of the viscous liquid composition in contact with the photosensitive layer and may have no image-carrying function. In some cases where the invention is to be utilized for this purpose, the image-carrying layer may preferably be formed of a porous black paper similar to a blotter paper. Of course, it is equally apparent, from the above discussion, that the layer 22 of Fig. 1 may be a sheet of photosensitive material, while the layer 40 may be a black strip of porous paper which is capable of acting as a backing layer in spreading a liquid composition across the surface of the photosensitive layer and absorbing the products of the developing and fixing reaction effected by the operation of the liquid composition upon the photosensitive layer.

While the above-described modifications of the invention have dealt with preferred forms thereof wherein the laminate formed by the image-carrying layer and the photosensitive layer is opaque to actinic light, the invention is not limited thereto. Either one or both of these two layers may be transparent. If such be the case, the above-described process is preferably carried out within a light-tight chamber mounted on the camera at the exit from the pressure rolls.

Since certain changes may be made in the above product and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine.

2. In combination, a magazine and a plurality of relatively stiff sheets of material capable of serving as image-carrying layers, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with said sheets, each said container having therein a liquid composition, a plurality of flexible members joining each of said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine.

3. In combination, a magazine and a plurality of relatively stiff sheets, each of said sheets including a layer of photosensitive material capable of being exposed to actinic light to have a latent image produced therein, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with said sheets, each said container having therein a liquid composition, a plurality of flexible members joining each of said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexble means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine.

4. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, and means in said magazine preventing withdrawal of said sheets therefrom.

5. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, means in said magazine preventing withdrawal

of said sheets therefrom, and means for mounting said preventing means for movement to inoperative position.

6. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, and means in said magazine preventing withdrawal of said sheets therefrom, a portion of the said trailing edge of each of said sheets defining a hole through which said preventing means passes.

7. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, and means in said magazine preventing withdrawal of said sheets therefrom, a portion of the said trailing edge of each of said sheets defining a hole through which said preventing means passes, said portion being weakened to permit the rupture thereof.

8. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, said connecting means being sufficiently permeable to portions of said liquid composition to have a drying effect on said liquid composition.

9. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, each said sheet having a liquid trap associated with the trailing edge thereof.

10. In combination, a magazine and a plurality of relatively stiff sheets of material, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, said sheet having a liquid trap associated with the trailing edge thereof, said connecting means comprising a pair of strips of flexible material.

11. In combination, a magazine and a plurality of relatively stiff sheets of material capable of serving as image-carrying layers, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, said connecting means being sufficiently permeable to portions of said liquid composition to having a drying effect on said liquid composition.

12. In combination, a magazine and a plurality of relatively stiff sheets, each of said sheets including a layer of photosensitive material capable of being exposed to actinic light to have a latent image produced therein, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated

with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, and flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, said connecting means being sufficiently permeable to portions of said liquid composition to have a drying effect on said liquid composition.

13. In combination, a magazine and a plurality of relatively stiff sheets of material capable of serving as image-carrying layers, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, and means in said magazine preventing withdrawal of said sheets therefrom.

14. In combination, a magazine and a plurality of relatively stiff sheets, each of said sheets including a layer of photosensitive material capable of being exposed to actinic light to have a latent image produced therein, each of said sheets having a leading edge and a trailing edge, a plurality of containers, there being a container associated with each of said sheets, each said container having therein a liquid composition, a plurality of flexible members joining said containers to said sheets, there being a joining member for joining each container to its associated sheet, each said joining member joining its container to said leading edge of its associated sheet, said members being sufficiently impermeable to said liquid composition to permit said liquid composition to be spread thereacross, flexible means connecting the trailing edge of the first of said sheets to said joining member associated with the second of said sheets, said leading edges being positioned adjacent each other and said trailing edges being positioned adjacent each other in said magazine, and means in said magazine preventing withdrawal of said sheets therefrom.

15. A photographic product comprising, in combination, an elongated liquid-dispensing container holding a liquid and capable of dispensing its liquid content in a direction substantially perpendicular to its length, a relatively stiff liquid-receiving element having one dimension thereof at least as long as the length of said container, and a connecting strip which mounts said container and said element so that the longitudinal axis of said container is substantially parallel to said dimension of said liquid-receiving element, the edge of said element nearest said container being spaced from said container by said connecting strip, said connecting strip providing a continuous liquid-transmitting surface between said container and said element which is at least as wide as the length of said container, said surface of said strip being sufficiently impermeable to the liquid in the container to permit the spreading of said liquid thereacross without appreciable liquid loss, said liquid-receiving element providing a sufficient surface area so that the contents of said container can be spread thereon in a thin layer, said connecting strip being substantially more flexible than said liquid-receiving element, whereby said container, during handling and packaging of said product, may be readily displaced relative to the plane of the liquid-receiving surface of said element and relative to the nearest edge of said element.

16. The product of claim 15 wherein the liquid in the container is an aqueous solution of a silver halide developer and has dissolved therein a plastic for increasing the viscosity thereof.

17. A photographic product comprising, in combination, an elongated rupturable container holding a liquid, portions of the walls of said container being secured together in face-to-face relation to provide a liquid-dispensing lip extending lengthwise of the container, the material of the container walls being stronger than the seal of the dispensing lip and said walls being, at least in part, deformable and flexible for transmitting to the container contents externally applied pressure of sufficient magnitude to open said lip, a relatively stiff liquid-receiving element having one dimension thereof at least as long as said liquid-dispensing lip, and a flexible strip which connects said container and said element so that said container has the liquid-dispensing lip thereof substantially parallel to said dimension of said liquid-receiving element, the edge of said liquid-receiving element nearest said container being spaced therefrom by said connecting strip, said connecting strip providing a continuous liquid-transmitting surface between said container and said element which is at least as wide as the length of said liquid-dispensing lip, said surface of said strip being sufficiently impermeable to the liquid in the container to permit the spreading of said liquid thereacross without appreciable liquid loss, said liquid-receiving element providing a sufficient surface area so that the contents of said container can be spread thereon in a thin layer, said connecting strip being substantially more flexible than said liquid-receiving element, whereby said container, during handling and packaging of said product, may be readily displaced relative to the plane of the liquid-receiving surface of said element and relative to the nearest edge of said element.

18. The product of claim 17 wherein the liquid in the container is an aqueous solution of a silver halide developer and has dissolved therein a plastic for increasing the viscosity thereof.

19. The product of claim 17 wherein the liquid-receiving element is substantially opaque and has a white surface and the liquid in the container is an aqueous solution of a silver halide developer, a silver halide solvent and a plastic.

20. The product of claim 17 wherein the liquid-receiving element includes a layer of silver halide emulsion.

21. The product of claim 20 wherein the liquid in the container includes a silver halide developer.

22. A photographic product comprising, in combination, at least two units, each unit comprising a liquid-dispensing container, a relatively stiff liquid-receiving element, and a connecting strip which connects said container and said element, the connecting strip of one of said units also connecting said unit to the other unit, the liquid-dispensing container of each said unit holding a liquid and having a sealed liquid-dispensing passage extending substantially the length thereof for dispensing the liquid contents of the container in a direction substantially perpendicular to its length for spreading over the surface of the liquid-receiving element of the said unit, the liquid-receiving element of each unit having one dimension thereof at least as long as the length of the container of the said unit and being so connected to said container as to have said dimension substantially parallel to the longitudinal axis of said container, the connecting strip of each unit providing a continuous liquid-transmitting surface beween the container and the element of the said unit, which surface is at least as wide as the length of said container and is sufficiently impermeable to the liquid in said container to permit the spreading of the liquid thereacross without appreciable liquid loss, the connecting strip of each unit being substantially more flexible than the liquid-receiving element of said unit, whereby each container, during handling and packaging of said product, may be readily displaced relative to the liquid-receiving element connected thereto.

23. The product of claim 22 wherein the liquid in each liquid-dispensing container is an aqueous solution of a silver halide developer and has dissolved therein a plastic for increasing the viscosity thereof.

24. The product of claim 22 wherein each liquid-receiving element is substantially opaque and has a white surface and the liquid in each container is an aqueous solution of a silver halide developer and a silver halide solvent.

25. The product of claim 22 wherein each liquid-receiving element includes a layer of a silver halide emulsion and wherein the liquid in each container includes a silver halide developer.

26. The product of claim 22 wherein the liquid-receiving elements of said units are separated by a length of connecting strip greater than the length of either of said liquid-receiving elements.

27. The product of claim 22 wherein the connecting strips of said units are integrally connected.

EDWIN H. LAND.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,592,379	Merle	July 13, 1926
1,592,584	Viegelmann	July 13, 1926
1,945,885	Darlington	Feb. 6, 1934
2,166,643	Salfisberg	July 18, 1939
2,214,446	Albers	Sept. 10, 1940
2,319,560	Salfisberg	May 18, 1943
2,324,541	Salfisberg	July 20, 1943
2,405,195	Duke	Aug. 6, 1946

FOREIGN PATENTS

Number	Country	Date
7,521	Great Britain	June 28, 1906
11,346	Great Britain	of 1906
369,146	Germany	Feb. 15, 1923
370,821	Germany	Mar. 8, 1923
567,011	Germany	July 22, 1931