Sept. 26, 1972 R. B. DOWNEY 3,694,206

PHOTOGRAPHIC FILM UNIT

Filed Dec. 29, 1970

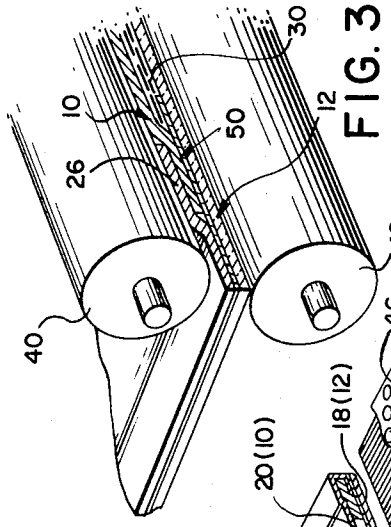

FIG. 3

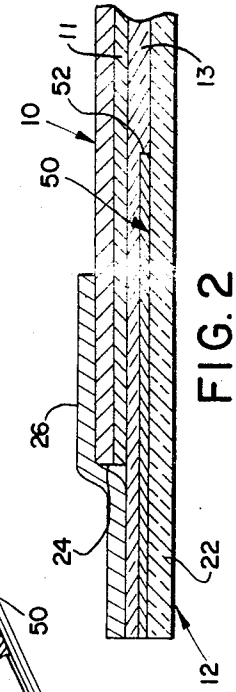

FIG. 2

FIG. 1

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3,694,206

PHOTOGRAPHIC FILM UNIT

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U.S. Cl. 96—29 R 27 Claims

ABSTRACT OF THE DISCLOSURE

A self-developing, photographic film unit including a pair of rectangular support sheets, one of which is transparent, secured in face-to-face relation at their lateral margins and at one end by binding strips. The margins of the transparent support sheet extend beyond the edges of the other sheet and the binding strips are secured to and overlap the lateral margins and one end margin of both sheets. A photosensitive image-recording layer and an image-receptive layer are sandwiched between the sheets, preferably with the image-receptive layer closest the transparent sheet. A container of a liquid processing agent adapted to initiate formation of a visible transfer image in the image-receptive layer when distributed between the sheets for permeation into the photosensitive layer following exposure thereof, is coupled to the sheets at the other end edge of the smaller sheet so as to dispense its liquid contents between the sheets in response to the application of compressive pressure. A masking layer including a reflective pigment carried in a binder is coated or the side of the transparent sheet facing the smaller sheet and extends to the edges of the transparent sheet. The masking layer is formed with a rectangular opening smaller than the smaller sheet and is located between the photosensitive and image-recording layers or between the latter and the transparent sheet to provide a reflective border surrounding the visible image formed in the image-recording layer. The sheets and layers of the film unit may be laminated to one another to form an integral unit or the two support sheets and the layers carried thereon may be secured to one another only at their margins.

BACKGROUND OF THE INVENTION

A number of U.S. patents disclose and/or claim the structure of self-developing film unit particularly adapted to the production of images in full color by processes involving diffusion transfer. Such patents include, for example, Nos. 3,415,644, 3,415,645, 3,415,646, and 3,460,452. Generally, film units of this type include a pair of rectangular support sheets, at least one of which is transparent, coated on their facing surfaces with a plurality of layers including a photo-sensitive image-recording layer and an image-receptive layer for supporting a visible transfer image. The two support sheets are of equal width and are secured in face-to-face relation with the photosensitive and image-receptive layers sandwiched therebetween, by binding means including a binding sheet secured around and to the outer surfaces of the support sheets at their lateral margins and at one end margin. The support sheets and the layers carried thereby also may be laminated to one another throughout the extent of their facing surfaces to form an integral unit. Attached to the other end of the support sheets is a container of a liquid processing composition adapted to form a transfer image visible through the transparent support sheet when distributed between the support sheets for permeation into the photoexposed photo-sensitive, image-recording layer. The binding sheets and/or binding strips are employed to form a seal between the container and

the support sheets for conducting the processing liquid from the container between the support sheets in response to the application of compressive pressure to the container.

Processing of such a film unit is accomplished by advancing the film unit, container foremost, between a pair of pressure applying members which dispense the processing liquid from the container and distribute it between the sheets toward the opposite or trailing ends thereof. The sheets of the film unit are retained in superposed relation following competion of processing and image formation so that the image formed between the sheets is protectively enclosed and is viewed through the transparent sheet. Among the advantages of this structure over the prior art is that the only processing step is distribution of the processing liquid within the film unit, and there is no necessity for subsequent processing and handling steps such as separation of the sheets nor are there any waste materials to be disposed of because all components of the film units remain together as a unit prior to, during and subsequent to processing.

In the preferred embodiment of such a film unit disclosed and claimed, for example, in the copending and commonly assigned U.S. patent application of Edwin H. Land et al., Ser. No. 5,799, filed Jan. 26, 1970 now U.S. Pat. No. 3,619,192, the transparent sheet is longer than the other sheet and the rupturable container of processing liquid is mounted on an extended end section of the transparent sheet adjacent an edge of the other sheet. To provide a more aesthetically pleasing product, i.e. a positive photographic print, as well as to aid in the distribution of the processing liquid, the binding means include an external binding sheet which is generally rectangular and has a rectangular exposure and viewing opening therein. This binding sheet is secured in covering relation to the entire outer surface of the transparent sheet, except of course in the region of the exposure and viewing opening, and the margins of the binding sheet are folded around at least the lateral edges and one (trailing) end edge of the support sheets and secured to the margins of the other support sheet. In this way the binding sheet performs a multiplicity of functions including retaining the support sheets in face-to-face relation; providing an attractive border or frame surrounding the image; assisting in the distribution of the processing liquid by controlling the spacing between the pressure-applying members which distribute the processing liquid; preventing admission of air between the sheets, at least at their lateral margins; and providing means for trapping and retaining excess processing liquid. This construction represents a substantial advance over prior art, self-developing film units particularly insofar as it results in a greatly improved and more pleasing product that is less expensive to produce and easier to utilize.

As previously noted, the binding sheet performs a number of functions as a part of the film structure including:

(1) Providing an attractive, well-defined border around the completed image which comprises the photographic print;

(2) Retaining the sheets together at their margins;

(3) Preventing admission of air between the sheets which might otherwise interfere with distribution of the processing liquid and/or become entrained in the liquid causing voids;

(4) Providing space for trapping and retaining excess processing liquid overrun; and

(5) Aiding in the distribution of a viscous processing liquid as a uniformly thin layer between the sheets to in-

sure the proper amount of liquid in all areas within the exposure opening in the binding sheet by:

(a) Spacing apart the pressure-applying members; and
(b) Permitting spreading of the liquid outwardly beyond the edges of the exposure aperture in regions underlying the binding sheets.

As is noted in the copending and commonly assigned U.S. patent application of Bachelder et al., Serial No. 744,912, filed July 15, 1968, the binding sheet performs still another important function in the film manufacturing and assembly process. According to this application, the binding sheet is supplied as an elongated web which functions as a carrier on which other components of the film unit are mounted and attached during the assembly process as the web moves through the assembly apparatus.

Because the functions performed by the binding sheet are important and often critical to assembly, processing and the appearance of the product, the physical specifications for this sheet are equally important and critical necessitating the use of a relatively expensive material representing a substantial fraction of the overall cost of each film unit. However, it will also be apparent that a major portion of this cost, e.g. 80%, represents waste, namely the material cut out of the binding sheet to form the relatively large exposure opening therein.

SUMMARY OF THE INVENTION

Objectives of the present invention include the provision of a novel and improved self-developing film of the general type described comprising structure for performing all of the functions of the binder sheet while eliminating the binder sheet itself. This film unit will function in essentially the same manner and can be processed by the same apparatus to produce a more pleasing product (photographic print) while offering a number of cost-saving advantages in manufacture and assembly.

The objective of cost saving is achieved not only by eliminating the binding sheet and employing less expensive means for securing the sheets to one another, but by utilizing improvements in manufacturing and assembly techniques made possible by the novel structure and by providing a structure in which one of the sheets is narrower as well as shorter than the other sheet. Heretofore, both support sheets and the layers carried thereon have been of unequal length and of equal width. However, in the preferred embodiment of the invention, the shorter sheet includes the photosensitive image-recording layer which, in the case of a film unit designed to produce color images such as described in the aforementioned patents, comprises a multiplicity of strata including differently sensitized silver halide strata and associated dye developer strata. Thus, the shorter sheet constitutes a relatively complex and expensive structure and its cost per unit area is large relative to the cost of the longer sheet so that the shorter sheet represents a large proportion of the total cost of each film unit. Accordingly, a substantial cost saving can be realized by further reducing the area of the more expensive sheet to a minimum, specifically, by making it as narrow as possible in addition to making it as short as possible. In the novel and improved structure of the invention, the sheet which costs the most per unit area is both narrower and shorter than the less expensive sheet which, in this case, is the transparent sheet. Alternatively, the transparent sheet may serve merely to aid in the distribution of the processing liquid in contact with another sheet carrying all of the layers involved in the image-forming process.

For practical as well as aesthetic reasons, photographic transfer prints are usually surrounded by an image-free border having sharply defined inner edges. This border is uniformly wide and in the case of prior art film units of the type described, is provided by marginal portions of the binding sheet; paper, polymers, or composites thereof being suitable for this purpose. The binding sheet providing the border is attached to the exterior of the transparent support sheet through which the image is viewed and accordingly, is subjected to physical damage as well as becoming marred or discolored. Another function of the border provided by the binding sheet is to mask any image formed between the sheets outside of the area in which the image-forming exposure is made.

The present invention contemplates an improvement over this structure in that the material which forms the combined mask and border is located within the film unit between the sheets so that the forward surface of the photographic print is a plain, smooth surface without attachments or discontinuities and the image is surrounded by a plain border which cannot be physically damaged or discolored. The improved structure for securing the sheets to one another at their margins makes this possible and the border or mask is formed as a layer on the inner surface of the transparent sheet so that there is no waste material as in the case where an exposure aperture is formed in a sheet by cutting out a relatively large section thereof.

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

The invention accordingly comprises the product possessing the features, properties and the relation of components which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

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

FIG. 1 is a perspective view, partially in section, illustrating a photographic film unit embodying the invention;

FIG. 2 is a fragmentary, sectional view taken along the line **2—2** of FIG. 1; and

FIG. 3 is a perspective view showing the film unit partially in section, illustrating the processing of the film unit.

DESCRIPTION OF PREFERRED EMBODIMENT

The present invention is primarily concerned with the physical aspects or structure of a photographic, self-developing film unit adapted to incorporate a variety of diffusion transfer systems for producing visible images. This film unit is particularly adapted for incorporating diffusion transfer systems capable of forming full color images which rely for color image formation upon a differential in mobility or solubility of a dye image-providing material achieved as a function of development of a photosensitive, image-recording material such as silver halide, so as to provide an imagewise distribution of the dye image-providing material which is diffusible and is selectively transferred, at least in part, by diffusion to a superposed dyeable, image-receptive stratum to impart thereto, the desired transfer image.

The basic components of a multicolor image-forming system of this type include a photosensitive layer comprising a plurality of selectively sensitized silver halide strata each having associated therewith a dye image-providing material exhibiting desired spectral absorption characteristics. Most commonly employed photosensitive layers of this type are the so-called tripack structures employing blue-, green- and red-sensitive silver halide emulsions having associated therewith, respectively, yellow, magenta and cyan dye image-providing materials. For a more detailed disclosure of a system of this type for forming color images by diffusion transfer, reference may be had to a number of U.S. patents including Pat. No. 2,983,606. Examples of specific dye image-providing materials of both the initially soluble or diffusible type and the initially non-diffusible type and their uses in color transfer systems are to be found in U.S. Pats. Nos. 2,647,049; 2,661,293; 2,698,244; 2,698,798; 2,802,735; 2,774,668;

2.983,606; 3,443,939; 3,443,940; 3,227,550; 3,227,551; 3,227,552; 3,227,554; 3,243,294; and 3,445,228.

Another essential component of the color image-forming system is a positive or image-receptive layer which is either initially superposed with the photosensitive layer or is adapted to be brought into superposition with the photosensitive layer after photoexposure and during processing. Generally, the image-receptive layer may comprise any of the dyeable materials heretofore known in the photographic art for supporting color transfer images including dyeable polymers such as gelatin, polyvinyl alcohol or gelatin containing a dye mordant. Such layers are designed to receive the imagewise distribution of diffused, dye image-providing material and are described in detail in many of the above-mentioned patents including 3,227,550.

The image-forming system will also contain additional layers or strata for performing a variety of functions including arresting or restraining development, particularly in the dyeable stratum or in an associated layer, and especially in integral or composite structures in which the layers including the photosensitive and image-receptive layers are retained together as a unit without separation. The film unit contains means for providing a reflecting layer between the photosensitive layer and the dyeable image-receptive layer so as to effectively mask the photosensitive layer and provide a background for viewing, by reflected light, the dye image formed on the overlying dyeable stratum. Such means for providing a reflecting layer between the overlying photosensitive and image-receptive layers may take a number of different forms. For example, a suitable reflecting agent may be incorporated in a liquid processing composition adapted to be distributed in a layer between the photosensitive and image-receptive layers to effectuate the image diffusion processing resulting in the positive image. Alternatively, the reflecting agent may be incorporated in a layer initally located between the photosensitive and image-receptive layers prior to exposure of the former or the reflective material which provides a background for the transfer image may be formed in situ during the image-forming processing.

Another component of the dye image-forming system incorporated in the film unit structure of the invention is a liquid processing composition adapted, when distributed within the film unit for permeation into the exposed photosensitive layer, to initiate and effectuate the diffusion transfer process resulting in the formation of a dye image in the image-receptive layer viewable by reflective light against a background formed between the image-receptive layer and the photosensitive layer. This processing liquid is usually aqueous, alkaline, and contains a viscosity adding agent such hydroxyethyl cellulose, to aid in the spreading of the liquid in a thin layer within the film unit. It may also contain a reflecting agent such as titanium dioxide. For examples of specific materials and compositions, reference may be made to many of the aforementioned patents, or U.S. Pats. Nos. 3,415,644; 3,415,645; 3,415,646; and 3,473,925.

The various layers constituting the image-forming diffusion transfer system are supported on and sandwiched between a pair of dimensionally stable and preferably liquid impermeable support layers or sheets. Each sheet and the layers coated thereon during the manufacturing of the film unit may be in the form of separate, individual elements which are laminated to one another by and during distribution of the processing liquid between the elements. In the alternative, the two elements comprising the support sheets and layers coated thereon may be laminated to one another prior to photoexposure to form an integral structure, in which case, the processing liquid is distributed between the layers of the integral structure simultaneously delaminating and laminating these layers to one another to form another integral structure containing an additional layer constituted by the processing liquid.

Reference is now made to the drawing wherein there is illustrated a self-developing photographic film unit embodying the invention. The basic components of the film unit include a first rectangular, sheet-like element designated **10** and a second rectangular, sheet-like element designated **12**. Each of these elements comprises a dimensionally stable support sheet coated thereon with some or all of the various layers and strata previously described and/or conventionally incorporated in photographic film units of this type. In the preferred embodiment shown and described, the first element **10** is preferably opaque to actinic light and includes a support sheet which, during the manufacturing process, is coated at least on one side with the photosensitive layer, generally designated **11** in FIG. 2, including the various photosensitive strata and associated dye image-forming materials. It also may be coated during the manufacturing process with auxiliary layers and strata including the image-receptive layer, a layer for arresting or inhibiting the development process and/or a reflective layer for providing a background for the dye image supported by the image-receptive layer. The layer (or strata) coated on the support sheet comprising second element **12** is generally designated **13** in FIG. 2.

In accordance with the invention, the first element is substantially smaller than the second element and, in order to realize the largest possible cost-saving, it should support as many of the various layers as is possible, consistent with the constraints imposed thereon by the manufacturing process, in order that the first element will have a higher cost per unit area than the larger second element. It should be realized, of course, that where additional expense may be incurred by incorporating a particular layer or stratum as a part of the first element will be more expensive than coating the same layer or stratum on the sceond element and such expense will outweigh any possible savings in material, then such a layer or stratum should be incorporated as part of the second element as layer **13**. All of those factors which dictate which particular layer will be initially incorporated as a part of element **10** or **12**, should be apparent to anyone skilled in the art, bearing in mind the cost-saving objective which is achieved by utilizing a minimum area of a relatively expensive sheet material and a relatively larger area of a less costly sheet material.

Each of sheet-like elements **10** and **12** comprises a dimensionally stable support sheet and the elements are secured to one another in face-to-face relation with the layers (**11** and **13**, respectively) coated thereon and comprising components of the dye image transfer system, e.g., the photosensitive and image-receptive layers, sandwiched between the support sheets. The layers **11** and **13** coated on the support sheets of elements **10** and **12** are designed to perform functions involved in the exposure and/or processing of the film unit to form a finished and attractive photographic print. In addition to the layers sandwiched between the supports, other layers may be coated on the outside of the supports for performing functions such as, for example, altering the optical properties of these supports, preventing abrasion, opacification, and the like. The support for element **10** is preferably opaque to actinic light to permit processing of the film unit in the light (as will be described hereinafter) as well as to permit a plurality of the film units to be arranged in stacked relation in a film container or cassette and exposure of the film unit at one end of the stack without exposure of underlying film units. The support sheet for second element **12** is preferably transparent to permit photoexposure of the photosensitive layer sandwiched between the support sheets and to permit viewing of the positive transfer image when image formation is completed. As examples of materials useful for the support sheets, mention may be

made of polymeric films derived from ethylene glycol terephthalic acid, vinyl chloride polymers, polyvinyl acetate, cellulose derivatives, and the like.

Element **12** is substantially longer and wider than element **10** and includes a leading end section **14** extending beyond the leading edge **16** of first element **10**; a trailing end section **18** extending beyond the trailing edge **20** of element **10** and lateral marginal sections **22** extending beyond the lateral edges **24** of element **10**. The two sheets are preferably arranged with respect to one another so that the lateral marginal sections **22** are of equal width while the leading end section **14** is substantially longer than trailing end section **18**.

The two elements are secured together at their lateral edges by a pair of binding strips **26**, each secured to the lateral margin of the outer surface of element **10** and to the adjacent lateral marginal section **22** of sheet **12**. Materials useful for the binding strips include paper, polymeric films or laminates composed of different materials including paper and polymers.

The processing liquid for each film unit is supplied in a rupturable container **28** of a type well-known in the art and described, for example, in U.S. Pat. No. 2,543,181. Container **28** is formed by folding a rectangular blank of a fluid and vapor impervious sheet material medially and sealing the marginal sections of the blank to one another to form a cavity for containing processing liquid designated **30**. The seal between the longitudinal marginal sections **32** is weaker than the seals at the ends of the container so that in response to the application of compressive pressure to the walls of the container in the region of the liquid-filled cavity, there will be generated within the liquid hydraulic pressure sufficient to separate longitudinal marginal sections **32** throughout the major portion of their length to form a discharge mouth which is preferably equal in length to the liquid-filled cavity. The latter is preferably at least substantially equal in length to the width of the exposed area of the photosensitive layer. Container **28** is mounted on leading end section **14** of element **12** with the edge of marginal sections **32** located closely adjacent the leading edge **16** of element **10**, and the opposite longitudinal edge of the container at which the blank is folded, is located closely adjacent and in parallel relation with the end edge of element **12**.

Means are provided for securing container **28** to elements **12** and **14** so as to retain the container in place and provide a passage for conducting the liquid contents of the container from the cavity within the container between layers of elements **10** and **12** as compressive pressure is applied to the container to eject its liquid contents therefrom.

These last-mentioned means include an elongated retaining strip **34** folded longitudinally to form two sections, one of which is adhered to element **10** adjacent the leading edge thereof between element **10** and a longitudinal edge portion of container **28**. The other section of retaining strip **34** is folded around the longitudinal edge portion of the container and is secured to the outer marginal surface of the container. The overall length of the container is approximately equal to the width of element **10** and retaining means in the form of relatively short retaining strips **36** are secured to the end margins of container **28** and lateral marginal sections **22** of element **12**. Retaining strips **36** are preferably equal in length to the width of the container and equal in width to retaining strips **26** so that one end edge of each retaining strip **36** abuts an end edge of one of the retaining strips **26** while the other end edge of each retaining strip **36** is aligned substantially with the leading edge of second element **12**. Means in the form of another retaining strip **38**, approximately equal in length to the width of element **12**, is secured to one marginal section **32** of continer **28** and the outer surface of the leading edge section of element **10** so as to bridge the gap between the container and element **10** and provide a passage for confining the processing liquid within the film unit as the liquid is ejected from the container. Retaining strips **34**, **36** and **38** may be formed of the same material as binding strips **26** and are adhered to the elements and the container in the same manner.

In the embodiment of the film unit in which first and second elements **10** and **12** are separate, individual elements secured together only at their margins, the liquid contents of container **28** will be spread between the elements as the film unit is moved, container foremost, between a pair of juxtaposed members which first apply compressive pressure to the container to rupture the seal between marginal sections **32**, ejecting the liquid from the container between the marginal sections so that it is forced to flow between elements **10** and **12**. In the alternative embodiment of the film unit in which elements **10** and **12** are laminated to one another to form an integral unit, the bond between a particular pair of adjacent layers or strata will be weaker than the physical bond between any other pair of adjacent layers or strata so that the hydraulic pressure of the liquid which is confined within the film unit, will rupture the laminate where the bond is weakest, permitting the liquid to spread between elements **10** and **12** toward the trailing end of the film unit.

Another function of lateral binding strips **26** is illustrated in FIG. 3 in which there is shown a typical pair of pressure-applying members in the form of rollers **40** and **42** mounted in juxtaposition for rotation about axes located in a common plane. Processing means including rollers are well-known in the art and the rollers are biased toward one another to apply compressive pressure to the film unit, progressing from the leading end toward the trailing end so as first to eject the liquid contents of the container and then distribute the liquid between elements **10** and **12** toward the trailing ends of the elements. Lateral binding strips **26** provide means for predeterminately spacing apart the pressure-applying rollers so as to provide a space between the medial portions of elements **10** and **12** in which the processing liquid can be spread in a layer of predetermined thickness. It will be apparent from FIG. 3 that the greatest cross-sectional thickness of a transverse section of a film unit in the region in which the photosensitive layer is exposed, occurs near the margins of the film unit where the lateral binding strips **26** are adhered to the outer surface of element **10**. This thickness includes a binding strip, elements **10** and **12**, and any additional layers or strata coated on the elements in this region. The aggregate cross-sectional thickness of the portion of the film unit intermediate binding strips **26** will be less so that during spreading of the processing liquid, the medial portions of elements **10** and **12** will be forced apart into engagement with rollers **40** and **42** providing a space between the elements in which the processing liquid is spread. The depth of this space is a function of the thickness of the binding strips.

Other functions performed by the binding strips are to prevent escape of the processing liquid from between the elements **10** and **12** at the margins thereof and prevent admission of air between the elements. Preventing escape of processing liquid at the margins of the film unit is obviously important, not only because such liquid may contaminate the processing apparatus, but the loss of liquid may mean that there will be insufficient liquid to complete image formation throughout the exposed area of the photosensitive layer. The exclusion of air from between elements **10** and **12** is important because such air tends to interfere with the spreading of the liquid since it must be advanced ahead of the advancing mass of liquid and/or may become entrained in the liquid to form voids in the layer of liquid which appear as defects in the visible image.

The first and second elements **10** and **12** are secured to one another at their trailing ends by retaining means in the form of a trailing end retaining strip **44**, equal in length to the width of element **12** and secured along one edge to

trailing end section **18** of second element **12** adjacent the trailing edge of the second element. End retaining strip **44** is folded upon itself and secured along its opposite longitudinal margin to the outer surface of first element **10** adjacent the trailing edge thereof and the trailing end portions of lateral binding strips **26**. The ends of retaining strip **44** are adhered to the lateral margins of the trailing end section of element **12**.

In order to insure the spreading of the processing liquid in a layer of predetermined uniform thickness throughout an area at least coextensive with the exposed area of the photosensitive layer, excess processing liquid is supplied within the container. Means are provided within the film unit for trapping and retaining any excess processing liquid that may be spread beyond the trailing edge of first element **12**. In the form shown, these liquid trapping and retaining means comprise a pocket formed by retaining strip **44** and a spacing element (or elements) **46** enclosed within the pocket by retaining strip **44** and the trailing end section **18** of element **12**. Spacing element **46** is designed to space apart the inner surfaces of retaining strip **44** and second element **12** as the pressure-applying members, e.g., rollers **40** and **42**, pass over the trailing end of the film unit so that a space remains within the film unit in which the excess processing liquid overrun is trapped and retained. Spacing elements suitable for this purpose are well-known in the art and in the form shown, spacing element **46** consists of a strip formed with openings in which the excess processing liquid can collect. Other forms of spacing elements find equal utility in the film unit of the invention and these include a spacing element of the type shown and described in the copending and commonly assigned U.S. patent application of Richard J. Chen, Ser. No. 726,252 now abandoned, filed May 2, 1968.

Provision is also made for releasing air from the liquid trapping and retaining space provided by spacing element **46** and retaining strip **44**. This may be accomplished in a number of different ways such as by providing slits or perforations in retaining strip **44**, or providing regions in which the retaining strip is not adhered to either the second element **12** adjacent the lateral edges thereof or to the first element **10** adjacent the trailing edge thereof, as suggested in the aforementioned Chen application.

As previously noted, the film unit includes a masking layer designated **50** designed to perform a number of functions and having as its basic function, the provision of a sharply defined image-free border surrounding a high quality transfer image extending to the edges of the border. Masking layer **50** is applied to the second element during manufacture, extends to the edges of the second element and is formed with a rectangular opening **52** having sharply defined edges. Opening **52** defines the extent of the visible image, is slightly smaller than first element **10** and is symmetrically located with respect to the first element with the edges of opening **52** parallel with and equally spaced from adjacent edges of the second element. The edges of the opening **52** are also spaced inwardly from the edges of the film unit so as to be located inwardly from the edges (inner) of binding strips **26** and retaining strips **38** and **44**, such that when viewed from the side of the transparent element, the edges of the strips underlie the masking layer. The binding and retaining strips limit and define the region in which the liquid is distributed. This construction in which the edges of the strips underlie the masking layer and are outside the image area is significant because it permits the processing liquid to be distributed laterally and lengthwise beyond the edges of the image area into regions underlying the masking layer. This is important because it has been found that the various layers near and particularly outside of the edges of the region in which the liquid is distributed, will absorb the processing liquid so that within this region at the edges thereof, there may be insufficient processing liquid to insure proper and complete transfer image formation. However if, as in the construction of the invention, the liquid is distributed outwardly beyond the edges of the region in which the visible portion of the transfer image is formed, that is, behind the masking layer, then the image will appear to be of uniform high quality at its edges defined by the edges of the opening in the masking layer.

Masking layer **50** may be of any desired color although white is, by custom and usage, the more preferred color; and comprises a pigment such as titanium dioxide carried in a suitable binder, preferably a polymer which is a liquid during formation of the masking layer and solidifies to form a stable adherent layer. The masking layer can be formed or applied to element **12** by a number of well-known systems including, for example, conventional printing methods such as the gravure process. The masking layer is located layerwise within the film unit such that the processing liquid will be distributed behind the masking layer, that is, to the side thereof opposite the transparent support. This is to insure that any diffusible, image-providing material (dye) formed outside (laterally and lengthwise) of the image area defined by opening **52**, will underlie the masking layer and will be hidden from view thereby. The preferred location of the masking layer is betweeen the image-receptive layer **13** and the layers or strata associated therewith as shown in FIG. 2 and may be located directly on the inner surface of support sheet **22**. However, depending on the nature and composition of the masking layer and particularly, the composition of the polymeric binder and the density of the reflecting agent, the masking layer may be disposed within the multilayer structure, for example, between the photosensitive layer designated **11** and the image-receptive layer.

In the preferred embodiment of the invention, the polymeric binder of the masking layer is insoluble in the aqueous alkaline processing liquid, is preferably hydrophobic and at most, very slightly permeable to water. The masking layer should be as thin as possible consistent with providing the requisite opacity and reflectance, a function of the density and distribution of the reflecting agent, preferably titanium dioxide. So-called acrylic latex base paints and similar compounds are considered especially suitable for forming a masking layer having the required characteristics mentioned above. An example of such a compound is given as follows:

	Grams
Water	17.0
Tamol 731 [1]	11.0
Antifoamer (e.g., tributyl phosphate)	2.0
Ethylene glycol	22.0
Preservative (sodium pentachlorophenate)	0.5
2% hydroxyethyl cellulose	84.0
Rutile titanium dioxide	400.0

[1] Trade name of sodium salt of polymeric carboxylic acid, sold by Rohm & Haas.

The above is ground at high speed and mixed with the following:

	Grams
Polymer binder [1]	600.0
Tributyl phosphate [2]	5.0
Antifoamer [2]	2.0
Ammonium hydroxide 28%.	

[1] Such as a 46% acrylic emulsion polymer sold by Rohm & Haas under the trade name Rhoplex MV–1.
[2] Premixed.

The effectiveness of masking layer **50** in covering or masking any transfer image formed therebehind is a function of two factors, namely, the permeability of the layer by the dye solvent, e.g., water, and the content or concentration of titanium dioxide. A masking layer having the requisite covering power and reflectance can be formed by coating the above composition on second element **12** to provide a minimum titanium dioxide concentration of the order of 600.0 milligrams per square foot. However, lower titanium dioxide concentration may provide covering power acceptable for any application depending upon the distribution of titanium dioxide and the location of other layers or strata with respect to the mask-

ing layer. Of course, higher concentration of titanium dioxide up to a maximum of about 2,500 milligrams per square foot will provide a whiter, higher reflectance border more capable of masking any image formed therebehind.

Masking layer **50** is illustrated in FIG. 2 as being coated between image-receptive layer **11** and support sheet **22**. This location is preferred for a number of reasons including the fact that the various strata which make up the film unit include an acid-containing or neutralizing layer for reducing the pH to arrest the development process as disclosed, for example, in the copending U.S. patent application of E. H. Land, Ser. No. 782,056, filed Dec. 9, 1968, now U.S. Pat. 3,573,043. This neutralizing layer generally has associated therewith a spacer or timing layer for delaying the neutralizing reaction and both of these layers are located between the image-receiving layer and the masking layer providing a barrier which aids in preventing permeation of the masking layer by image-forming dyes.

As noted in many of the aforementioned patents and applications, a masking layer including a reflecting pigment is formed between the photosensitive and image-receptive layers throughout the areas thereof in which an image is formed, to provide a reflective background for the transfer image formed in the image-receptive layer and to mask or cover the photosensitive layer and the image formed therewith. This masking and reflecting layer may be formed in a number of ways. For example, as noted in the copending U.S. patent application of Edwin H. Land, Ser. No. 43,782, filed June 5, 1970, an inorganic reflecting pigment such as titanium dioxide is dispersed in the processing liquid which is spread in a layer between the photosensitive layer and the image-receptive layer to provide a layer exhibiting the requisite optical transmission and reflection densities. Obviously, this second masking layer will extend from edge-to-edge of the area in which the processing liquid is distributed so that it will be located behind masking layer **50** where it will contribute further to the masking of any image formed behind masking layer **50**.

In an alternative embodiment of the film unit, the masking and reflecting layer located between the photosensitive and image-receptive layers to provide a background for viewing the color transfer image may be provided, in whole or in part, as a preformed layer of the film unit such as disclosed in the copending U.S. patent applications of Edwin H. Land, Ser. Nos. 846,441, filed July 31, 1965, now U.S. Pat. 3,615,421 and 3,645, filed Jan. 19, 1970, now U.S. Pat. 3,620,724; or the reflecting pigment may be generated in situ as is disclosed in the copending U.S. patent applications of Edwin H. Land, Ser. Nos. 43,741, now U.S. Pat. 3,647,434 and 43,742, now U.S. Pat. 3,647,435, both filed June 5, 1970. In these latter embodiments, the masking and reflecting layer will be located behind masking layer **50** so as to further contribute to the effectiveness thereof.

Masking layer **50** may be provided between the image-receptive layer and the photosensitive layer particularly when the binder for the pigment is a polymer that is insoluble in water and forms a layer which is at least poorly permeable and preferably impermeable to the solvent (i.e. water), of the processing composition or, as disclosed, is essentially hydrophobic. Such a masking layer **50** provides an effective barrier to the diffusion of the image-forming dyes while the masking and reflecting layer formed between the photosensitive and image-receptive layers and hence between the photosensitive layer and the masking layer **50**, will also contribute to the effectiveness of the latter. While in the preferred embodiment the masking layer **50** is described as including a polymeric binder which is water insoluble and preferably hyprophobic so that the masking layer is impermeable or at least poorly permeable, the masking layer may also be formed employing a binder which is soluble in water and hence more permeable to the diffusible image-forming dyes. Suitable polymeric binders of this type useful in masking layer **50** include, for example, gelatin and polyvinyl alcohol. Such layers prove very effective, particularly when located between the image-receptive layer and support layer **22** although such a masking layer may be located between the image-receptive layer and the photosensitive layer with the masking and reflecting layer which is formed therebetween, further contributing to the effectiveness of masking layer **50**.

It will be appreciated from the foregoing that the novel film unit structure, in achieving the objects of the invention, represents a substantial advance in the art particularly insofar as it constitutes a construction having fewer and more easily formed and assembled components, and utilizes less material while minimizing waste materials. To these advantages are added the achievement of a more esthetically pleasing product, i.e. a photographic print, which is less subject to damage.

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

What is claimed is:

1. In a photographic film unit adapted to be exposed to form an image and comprising first and second rectangular supports secured in face-to-face relation, a light-sensitive, image-recording layer and an image-receptive layer between said supports, at least said second support being substantially transparent to permit viewing of an image formed between said supports, and a rupturable container of liquid processing composition for forming a visible image in said image-receptive layer when distributed between said supports for permeation into said image-recording layer, the improvement comprising, in combination:

said second support being larger than said first support and said supports being arranged with margins of said second support extending beyond the edges of said first support;

first retaining means secured to the marginal surfaces of said supports facing in the same direction along these edges of said supports to retain the latter in face-to-face relation prior to, during and subsequent to exposure and processing;

second retaining means securing said rupturable container to said supports adjacent the fourth edge of said first support for conducting the liquid contents of said container between said supports in response to the application of compressive pressure to said container; and

a masking layer carried on said second support and located between the latter and said image-recording layer, said masking layer extending to the edges of said second support and having a rectangular medial opening with length and width dimensions smaller than the length and width of said first support and located with the edges of said first support underlying said masking layer.

2. A photographic film unit as defined in claim **1** wherein said first retaining means include an end and two lateral retaining strips secured to the outer surface of said first support and the inwardly facing surface of said second support at one end and two lateral, marginal portions thereof.

3. A photographic film unit as defined in claim **2** wherein the inner edges of said end and lateral retaining strips furthest from the outer edges of said second support underlie said masking layer.

4. A photographic film unit as defined in claim **2** wherein said container is rectangular and is mounted on the other end portion of said second support, and said other end portion extending beyond an end edge of said

first support has a length at least equal to the shorter dimension of said container.

5. A photographic film unit as defined in claim 4 wherein said second retaining means include a fourth retaining strip secured to a margin of said container and to the outer surface of said first support at the other end margin thereof.

6. A photographic film unit as defined in claim 5 wherein the edge of the portion of said fourth retaining strip secured to said first support underlies said masking layer.

7. A photographic film unit as defined in claim 5 wherein said container is secured to said other end marginal portion of said second support at least along three margins of said container.

8. A photographic film unit as defined in claim 7 wherein said second retaining means further include a fifth retaining strip secured to the surface of said second support underlying said container, folded around and secured to the outer surface of the margin of said container furthest from said fourth retaining strip.

9. A photographic film unit as defined in claim 2 further including liquid trapping and retaining means secured between said second support and said end retaining strip.

10. A photographic film unit as defined in claim 1 wherein said masking layer is located between said image-receptive layer and said second support and includes a light-reflecting agent for effectively masking said image-recording layer and any image formed in said image-receptive layer underlying said masking layer.

11. A photographic film unit as defined in claim 1 wherein said masking layer includes a light-reflecting agent suspended in a polymeric binder for effectively masking said image-recording layer.

12. A photographic film unit as defined in claim 11 wherein said supports and said layers are bonded together as an integral unit.

13. A photographic film unit as defined in claim 11 wherein said image-recording layer includes at least a light-sensitive silver halide stratum and an associated dye image-providing material and said image-receptive layer includes a dyeable stratum.

14. A photographic film unit as defined in claim 13 wherein said binder is at least poorly soluble in said liquid processing composition.

15. A photographic film unit as defined in claim 13 wherein said binder is substantially insoluble in said processing liquid.

16. A photographic film unit as defined in claim 14 wherein said masking layer is located between said image-recording layer and said image-receptive layer.

17. A photographic film unit as defined in claim 14 wherein said masking layer is located between said image-receptive layer and said second support.

18. A photographic film unit as defined in claim 13 wherein said liquid processing composition includes water and said binder is poorly soluble in water.

19. A photographic film unit as defined in claim 1 wherein said supports and said layers are bonded together as an integral unit.

20. In a self-developing photographic film unit including a pair of external support sheets, at least one of which is transparent, secured in face-to-face relation, an image-recording layer including at least a light-sensitive silver halide stratum and an associated dye image-providing material and an image-receiving layer including a dyeable stratum, located between said support sheets, and a rupturable container coupled with said support sheets and containing a liquid processing composition including a solvent for said dye image-providing material, adapted to be distributed between said support sheets for permeation into said image-recording layer to render said dye image-providing material transferable by diffusion to said dyeable stratum, the improvement comprising:

a masking layer between said one support sheet and at least said image-recording layer extending to the edges of said one support sheet and having a medial opening smaller than said image-recording layer;

said masking layer including a light reflecting agent suspended in a polymeric binder at least poorly soluble in said liquid processing composition for effectively masking from view, portions of said image-recording layer and any of said dye image-forming material rendered diffusible to said image-receptive layer and underlying said masking layer..

21. A photographic film unit as defined in claim 20 wherein said support sheets and said layers are bonded together as an integral unit.

22. A photographic film unit as defined in claim 20 wherein said masking layer is located between said image-recording layer and said image-receptive layer.

23. A photographic film unit as defined in claim 22 wherein said binder is insoluble in said liquid processing composition.

24. A photographic film unit as defined in claim 20 wherein said image-receptive layer is located between said image-recording layer and said one support sheet and said masking layer is located between said image-recording layer and said image-receptive layer.

25. A photographic film unit as defined in claim 20 wherein said image-receptive layer is located between said image-recording layer and said one support sheet and said masking layer is located between said image-receptive layer and said one support sheet.

26. A photographic film unit as defined in claim 20 wherein said liquid processing composition includes water and said binder is poorly permeable to water.

27. A photographic film unit as defined in claim 26 wherein said binder is hydrophobic.

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