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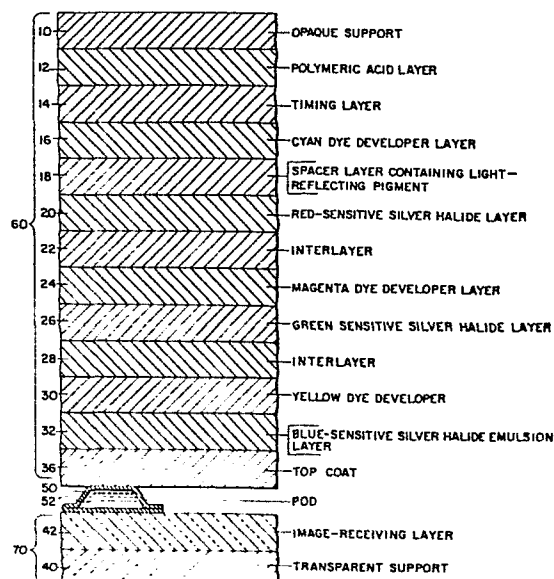
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54 Photosensitive element and photographic process.

57 Photosensitive elements are disclosed which employ a spacer layer between a silver halide emulsion layer and the adjacent layer of image-providing material, the spacer layer comprising a light-reflecting pigment in a dispersion of inert polymeric particles. The photosensitive elements are particularly useful in photographic films for forming multicolor diffusion transfer images.



Photosensitive element and photographic process.

This invention relates to photography and, more particularly, to diffusion transfer photography.

U. S. Patent No. 2,983,606, issued May 9, 1961 to Howard G. Rogers, a photosensitive element containing a dye developer and a silver halide emulsion is photoexposed and
5 a processing composition applied thereof, for example, by immersion, coating, spraying, flowing, etc., in the dark. The exposed photosensitive element superposed prior to, during, or after the processing composition is applied, on
10 a sheet-like support element which may be utilized as an image-receiving element. In a preferred embodiment, the processing composition is applied to the exposed photosensitive element in a substantially uniform layer as the photosensitive element is brought into superposed relationship with the
15 image-receiving layer. The processing composition, positioned intermediate the photosensitive element and the image-receiving layer, permeates the emulsion to initiate development of the latent image contained therein. The dye developer is immobilized or precipitated in exposed areas as a consequence of the
20 development. In unexposed and partially exposed areas of the emulsion, the dye developer is unreacted and diffusible and thus provides an imagewise distribution of unoxidized dye developer, diffusible in the processing composition, as a function of the point-to-point degree of exposure of
25 the silver halide emulsion. At least part of this imagewise distribution of unoxidized dye developer is transferred, by imbibition, to a superposed image-receiving layer or element, said transfer substantially excluding oxidized dye developer. The image-receiving layer receives a depthwise diffusion,

from the developed emulsion, of unoxidized dye developer without appreciably disturbing the imagewise distribution thereof to provide a reversed or positive color image of the developed image. The image-receiving element may contain agents adapted to mordant or otherwise fix the diffused, unoxidized dye developer. In a preferred embodiment of said U. S. Patent No. 2,983,606 and in certain commercial applications thereof, the desired positive image is revealed by separating the image-receiving layer from the photosensitive element at the end of a suitable imbibition period. Alternatively, as also disclosed in said U. S. Patent No. 2,983,606 and as embodied in certain other commercial applications thereof, the image-receiving layer need not be separated from its superposed contact with the photosensitive element, subsequent to transfer image formation, if the support for the image-receiving layer, as well as any other layers intermediate said support and image-receiving layer, is transparent and a processing composition containing a substance, e.g., a white pigment, effective to mask the developed silver halide emulsion or emulsions is applied between the image-receiving layer and said silver halide emulsion or emulsions.

Dye developers, as noted in said U. S. Patent No. 2,983,606, are compounds which contain, in the same molecule, both the chromophoric system of a dye and also a silver halide developing function. By "a silver halide developing function"

is meant a grouping adapted to develop exposed silver halide. A preferred silver halide development function is a hydroquinonyl group. In general, the development function includes a benzenoid developing function, that is, an aromatic
5 developing group which forms quinonoid or quinone substances when oxidized.

Multicolor images may be obtained using dye developers in diffusion transfer processes by several techniques. One such technique contemplates obtaining
10 multicolor transfer images utilizing dye developers by employment of an integral multilayer photosensitive element, such as is disclosed in the aforementioned U. S. Patent No. 2,983,606 and in U. S. Patent No. 3,345,163 issued October 3, 1967 to Edwin H. Land and Howard G. Rogers, wherein at least
15 two selectively sensitized photosensitive strata, superposed on a single support, are processed, simultaneously and without separation, with a single common image-receiving layer. A suitable arrangement of this type comprises a support carrying a red-sensitive silver halide emulsion stratum, a green-
20 sensitive silver halide emulsion stratum and a blue-sensitive silver halide emulsion stratum, said emulsions having associated therewith, respectively, for example, a cyan dye developer, a magenta dye developer and a yellow dye developer. The dye developer may be utilized in the silver halide emulsion
25 stratum, for example in the form of particles, or it may be disposed in a stratum behind the appropriate silver halide emulsion strata. Each set of silver halide emulsion and associated dye developer strata may be separated from other sets by suitable interlayers, for example, by a layer or
30 stratum of gelatin or polyvinyl alcohol. In certain

instances, it may be desirable to incorporate a yellow filter in front of the green-sensitive emulsion and such yellow filter may be incorporated in an interlayer. However, where desirable, a yellow dye developer of the appropriate spectral characteristics and present in a state capable of functioning as a yellow filter may be so employed and a separate yellow filter omitted.

Particularly useful products for obtaining multicolor dye developer images are disclosed in U. S. Patent No. 3,415,644 issued December 10, 1968 to Edwin H. Land. This patent discloses photographic products and processes wherein a photosensitive element and an image-receiving element are maintained in fixed relationship prior to exposure, and this relationship is maintained as a laminate after processing and image formation. In these products, the final image is viewed through a transparent (support) element against a light-reflecting, i.e., white background. Photoexposure is made through said transparent element and application of the processing composition provides a layer of light-reflecting material to provide a white background. The light-reflecting material (referred to in said patent as an "opacifying agent") is preferably titanium dioxide, and it also performs an opacifying function, i.e., it is effective to mask the developed silver halide emulsions so that the transfer image may be viewed without interference therefrom, and it also acts to protect the photoexposed silver halide emulsions from post-exposure fogging by light passing through said transparent layer if the photoexposed film unit is removed from the camera before image-formation is completed.

U. S. Patent No. 3,647,437, issued March 7, 1972 to Edwin H. Land, is concerned with improvements in products and processes disclosed in said U. S. Patent No. 3,415,644, and discloses the provision of light-absorbing materials to permit such processes to be performed, outside of the camera in which photoexposure is effected, under much more intense ambient light conditions. A light-absorbing material or reagent, preferably a pH-sensitive phthalein dye, is provided so positioned and/or constituted as not to interfere with photoexposure but so positioned between the photoexposed silver halide emulsions and the transparent support during processing after photoexposure as to absorb light which otherwise might fog the photoexposed emulsions. Furthermore, the light-absorbing material is so positioned and/or constituted after processing as not to interfere with viewing the desired image shortly after said image has been formed. In the preferred embodiments, the light-absorbing material, also sometimes referred to as an optical filter agent, is initially contained in the processing composition together with a light-reflecting material, e.g., titanium dioxide. The concentration of the light-absorbing dye is selected to provide the light transmission opacity required to perform the particular process under the selected light conditions.

In a particularly useful embodiment, the light-absorbing dye is highly colored at the pH of the processing composition, e.g., 13-14, but is substantially non-absorbing of visible light at a lower pH, e.g., less than 10-12. This pH reduction may be effected by an acid-reacting reagent appropriately positioned in the film unit, e.g., in a layer between the transparent support and the image-receiving layer.

U. S. Patent No. 3,594,165 issued July 20, 1971 to Howard G. Rogers discloses photographic products and processes wherein the image-receiving layer is part of the photosensitive element, and this element is maintained in fixed relationship with a transparent cover sheet prior to exposure, and this
5 relationship is maintained as a laminate after processing and image formation. In these products, the final image is viewed through the transparent support for the photosensitive element, photoexposure being effected through the transparent
10 cover sheet. The photosensitive element includes an opaque layer between the image-receiving layer (positioned adjacent the transparent support) and the photosensitive layers, and the processing composition includes an opacifying material, preferably carbon black, so that the exposed film unit may
15 be processed in ambient light.

As disclosed in said patents and in other publications, the image-forming material may be initially diffusible or initially non-diffusible and it may be an image dye or an image dye intermediate.

20 Canadian Patent No. 668,592 issued August 13, 1963 discloses the incorporation of a light-reflecting layer (titanium dioxide in gelatin) between a silver halide emulsion layer and the associated layer of image dye-providing material, e.g., a dye developer, to effectively increase the
25 speed of the silver halide layer. Such light-reflecting layers are indeed useful to increase the effective film speed as a result of the reflection of light back to the silver halide. However, such light-reflecting layers have been found to undesirably slow down the diffusion of the
30 underlying image dye-providing material and, in at least

some instances, reduce the maximum transfer density as a result of retention of the image dye in the light-reflecting layer.

In accordance with the present invention a spacer
5 layer is provided between a silver halide emulsion layer
and its associated, underlying layer of image dye-providing
material, the spacer layer comprising a light-reflecting
pigment dispersed in inert polymeric particles which are
substantially non-swelling in alkali and substantially
10 non-film-forming. These spacer layers have been found to
require lower coverages of the light-reflecting pigment
to achieve a given light reflectance, and to present
relatively little inhibition to the diffusion of the image
dye-providing material to the silver halide and to the
15 image-receiving layer.

The light-reflecting pigment may be any pigment
which is photographically inert in the particular photographic
process and which exhibits the desired reflectivity for the
silver halide emulsion with which it is to be associated.
20 The preferred light-reflecting pigment is titanium dioxide.
The pigment particle size most suitable for any particular
application may be determined by routine experimentation.
In the preferred embodiments of this invention the titanium
dioxide has a particle size of about 0,2 μ m.

25 The inert, non-swelling polymeric particles are
provided as a non-coalescing latex to provide minimum
inhibition of diffusing reagents. The polymer may have an
index of refraction which is higher, lower or about the
same as that of gelatin but the index should be less than
30 that of the light-reflecting pigment, thereby increasing

the reflectivity of a given coverage of the pigment. Suitable polymers include polymethylmethacrylate, polystyrene and polytetrafluoroethylene.

The spacer layer may include a minor portion of
5 another polymer, such as gelatin or polyacrylamide, to provide a binder for the pigment and inert polymeric particles, and to provide additional flexibility to the spacer layer.

For convenience, further description of this
10 invention will be in the context of the use of dye developers and positive transfer images.

The Figure illustrates in diagrammatic cross-section a film unit embodying the present invention, and adapted for use as an integral film unit of the type described in the
15 above-mentioned U. S. Patent No. 3,415,644. As shown in the Figure, a photosensitive element 60 is positioned in superposed relationship with a transparent image-receiving element 70 through which photoexposure of the photosensitive element is to be effected. Positioned between the
20 photosensitive and image-receiving elements 60 and 70 is a rupturable pod 50 releasably holding a processing composition 52. The photosensitive element 60 comprises an opaque support 10, a neutralizing layer 12 of a polymeric acid, a layer 14 adapted to "time" the availability of the
25 polymeric acid by preventing diffusion of the processing composition thereto for a predetermined time, a cyan dye developer layer 16, a spacer layer 18 in accordance with this invention, a red-sensitive silver halide emulsion layer 20, an interlayer 22, a magenta dye developer layer 24,
30 a green-sensitive silver halide emulsion layer 26, an

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interlayer 28, a yellow dye developer layer 30, a blue-sensitive silver halide emulsion layer 32, and a top coat 36. (The top coat serves as an anti-abrasion layer and also may carry a component of the photographic system, e.g., an auxiliary developing agent, an ultraviolet light absorber, etc., as is well known in the art.) The image-receiving layer 70 comprises a transparent support 40 and an image-receiving layer 42. Photoexposure of the silver halide emulsion layer is effected through the transparent support 40 and the layers carried thereon also are transparent, the film unit being so positioned within the camera that light admitted through the camera exposure or lens system is incident upon the outer or exposure surface of the transparent support 40. After exposure the film unit is advanced between suitable pressure-applying members (not shown), rupturing the container or pod 50, thereby releasing and distributing a layer of the opaque processing composition 52 and forming a laminate of the photosensitive element 60 and the image-receiving element 70 with their respective support members providing the outer layers of the laminate. The opaque processing composition contains a film-forming polymer, a white pigment and has an initial pH at which the optical filter agents contained therein are colored; the optical filter agents are selected to exhibit the appropriate light absorption, i.e., optical density, over the wavelength range of light actinic to the particular silver halide emulsions. As a result, ambient or environmental light within that wavelength range incident upon the surface of transparent support 40 and transmitted transversely through said transparent support and the transparent layers carried

thereon in the direction of the exposed silver halide emulsions is absorbed, thereby avoiding further exposure of the photoexposed and developing silver halide emulsions. In exposed and developed areas, the dye developer is oxidized as a function of the silver halide development and immobilized. Unoxidized dye developer associated with undeveloped and partially developed areas remains mobile and is transferred imagewise to the image-receiving layer 42 to provide the desired positive image therein. Permeation of the alkaline processing composition through the timing layer 14 to the neutralizing (polymeric acid) layer 12 is so controlled that the process pH is maintained at a high enough level to effect the requisite development and image transfer and to retain the optical filter agents in colored form within the processing composition layer and on the silver halide emulsion side of said layer, after which pH reduction effected as a result of alkali permeation into the polymeric acid layer 12 is effective to reduce the pH to a level which changes the optical filter agents to a colorless form. Absorption of the water from the applied layer of the processing composition results in a solidified film composed of the film-forming polymer and the white pigment dispersed therein, thus providing a light-reflecting layer which also serves to laminate together the photosensitive component 60 and the image-receiving component 70 to provide the final integral image. The positive transfer image in dye developer present in the image-receiving layer 42 is viewed through the transparent support 40 against the light-reflecting layer which provides an essentially white background for the dye image and also effectively masks from view the developed photosensitive element 60.

The spacer layer 18 in accordance with this invention comprises a light-reflecting pigment, e.g., titanium dioxide, dispersed in inert, substantially non-swelling and non-film forming, polymeric particles, e.g., an uncoalesced polymethylmethacrylate latex. Light passing through the red-sensitive emulsion layer 18 is reflected by the spacer layer 20 to the red-sensitive silver halide emulsion, thus effectively increasing the efficiency (speed) of the red-sensitive silver halide layer. The amount of light reflected by the spacer layer 18 may be adjusted in accordance with the needs of the particular photographic film by increasing or decreasing the coverage of the light-reflecting pigment.

In the film unit illustrated in the Figure the light-reflecting pigment-containing spacer layer is shown between the cyan dye developer layer and the red-sensitive silver halide emulsion layer. It will be understood that such spacer layers 20 also may be positioned between the magenta dye developer layer 24 and the green-sensitive silver halide emulsion layer 26, between the yellow dye developer layer 32 and the blue-sensitive silver halide emulsion layer 36, or in any combination of these three locations. Where the light-reflecting pigment-containing spacer layer is so positioned that there is another silver halide emulsion behind it, as in the two positions not illustrated but noted above, it will be understood that the coverage of the light-reflecting pigment may be reduced and the speed of the underlying silver halide emulsion(s) may be increased to adjust for any light loss and thus obtain proper exposure of the underlying silver halide emulsion(s).

The optical filter agent is retained within the final film unit laminate and is preferably colorless in its final form, i.e., exhibiting no visible absorption to degrade the transfer image or the white background therefor provided by the reflecting layer. The optical filter agent may be retained in the reflecting layer under these conditions, and it may contain a suitable "anchor" or "ballast" group to prevent its diffusion into adjacent layers. Some of the optical filter agent may diffuse into the photosensitive component and be mordanted by the gelatin or other material present on the silver halide emulsion side of the reflecting layer; optical filter mordanted in the photosensitive component may be colorless or colored in its final state so long as any color exhibited by it is effectively masked by the reflecting layer. In the preferred embodiment, the optical filter agents are pH-sensitive phthalein dyes.

The concentration of optical filter agent (indicator dye) is selected to provide the optical transmission density required, in combination with other layers intermediate the silver halide emulsion layers and the incident radiation, to prevent nonimagewise exposure, i.e., fogging, by incident actinic light during the performance of the particular photographic process. The transmission density and the optical filter agent concentration necessary to provide the requisite protection from incident light may be readily determined for any photographic process by routine experimentation, as a function of film speed or sensitivity, processing time, anticipated incident light intensity, etc., as described in said U. S. Patent No. 3,647,437. It will be recognized that a particular transmission density may not

be required for all portions of the spectrum, lesser density being sufficient in wavelength regions corresponding to lesser sensitivities of the particular photosensitive material.

5 In a particularly useful embodiment, the optical filter agent is a light absorbing dye which is highly colored at the pH of the processing composition, e.g., 13-14, but is substantially non-absorbing of visible light at a lower pH, e.g., less than 10-12. Particularly suitable are phthalein
10 dyes having a pKa of about 13 to 13.5; many such dyes are described in the aforementioned U. S. Patent No. 3,647,437. This pH reduction may be effected by an acid-reacting reagent appropriately positioned in the film unit, e.g., in a layer
15 of the photosensitive element as shown in the Figure or in a layer between the transparent support and the image-receiving layer or in other positions as known in the art.

 It will be understood that a mixture of light-absorbing materials may be used so as to obtain absorption in all critical areas of the visible and near-visible by
20 which the silver halide emulsions being used are exposable. Many dyes which change from colored to colorless as a function of pH reduction, e.g., phthalein dyes, are known (see, for example, the aforementioned U. S. Patent No. 3,647,437) and appropriate selection may be made by one
25 skilled in the art to meet the particular conditions of a given process and film unit.

 In those embodiments of this invention involving a film unit of the type shown in U. S. Patents No. 3,415,644 and 3,647,437 and in the Figure and having an optical filter
30 agent in the processing composition, it is advantageous to

utilize an image-receiving element having a surface layer adapted to decolorize the optical filter agent adjacent the interface. Suitable decolorizing layers are described in the copending applications of Edwin H. Land, Leon D.

5 Cerankowski and Neil C. Mattucci, Serial No. 143.293 filed April 24, 1980 (now US Patent No. 4.298.674 issued November 3, 1981), Irena Bronstein-Bonte, Edward P. Lindholm and Lloyd D. Taylor, Serial No. 143.281 filed April 24, 10 1980 (now U.S. Patent No. 4.294.907 issued October 13, 1981), and Charles K. Chiklis and Neil C. Mattucci, Serial No. 267.416 filed May 26, 1981.

Of the several "clearing coats" described in said copending applications, the unhardened gelatin clearing coat described and claimed in said application of Chiklis and Mattucci is 15 presently preferred.

Inert, non-swelling polymeric particles of the type herein contemplated for use in spacer layer 20 are described in the copending applications of Peter O. Kliem, Serial No. 38.533 filed May 14, 1979 and Serial No. 210.808 20 filed November 26, 1980. The following illustrative example of the preparation of a polymethylmethacrylate latex suitable for use in the practice of this invention is reproduced from said copending applications:

Example A

25	Water	118	l
	Methylmethacrylate	51	kg
	Potassium persulfate	0,15	kg
	Ascorbic Acid	0,01	kg
30	Dowfax 2A1 20% solution (dodecyldiphenyl oxide disulfonate sodium salt, sold by Dow Chemical Co., Midland, Michigan)	1,275	kg

A reactor was charged with 102 l of demineralized water and the Dowfax 2A1 and heated under nitrogen to 83°C whereupon 7,65 kg of methylmethacrylate was added and mixed until the temperature returned to 83°C. After 5 min. at 83°C, 5 4,93 kg of initiator solution (0,15 kg of potassium persulfate and 14,79 kg water) was added. After the exotherm the temperature was reduced to 85°C and the remaining methylmethacrylate was added at a rate of about 361 g/min. and the remaining initiator solution at a rate of about 10 111 g/min. At the end of the monomer and initiator solution, the temperature was maintained at 85°C for 10 min. and then the ascorbic acid was added. The resulting latex had a 30% solids and about a 0,125 μ m average particle size.

As noted above, the use of the inert polymeric 15 particles permits the use of lower coverages of the light-reflecting pigment to achieve a given reflection of light incident on the pigment-containing layer. Thus it has been found that a white light reflection density of about 1,0 may be obtained from a titanium dioxide coverage of about 20 1000 mg/m² by the use of a coating comprising, by weight, 8 parts titanium dioxide, 1 part gelatin and 3 parts polymethylmethacrylate. About 4000 mg/m² of titanium dioxide was found to be needed to give the same white reflection density when coated using an 8:1 by weight ratio 25 of titanium dioxide and gelatin. (The white reflection density was measured of the described titanium dioxide layers coated on opaque polyethylene terephthalate having a neutral density of 1,62.)

It will be readily apparent that the present 30 invention provides the ability to use less silver halide to

obtain a given film speed. This in turn may reduce the concentrations needed of other components of the system.

The following example of a film wherein the photosensitive element includes a spacer layer in accordance with this invention is intended to be illustrative and not limiting.

Example 1

A photosensitive element was prepared by coating, on a polyethylene glycol terephthalate base, the following layers:

(1) A neutralizing layer of a partial butyl ester of polyethylene/maleic anhydride copolymer at a coverage of about $23,700 \text{ mg/m}^2$ and polyvinylbutyral at a coverage of about $2,600 \text{ mg/m}^2$.

(2) A timing layer of a 60,6/29/6,3/3,7/0,4 pentapolymer of butylacrylate, diacetone acrylamide, styrene, methacrylic acid and acrylic acid at a coverage of about $3,500 \text{ mg/m}^2$ and about 524 mg/m^2 of gelatin.

(3) A layer of a gelatin dispersion of a cyan dye developer, 6-dodecylaminopurine, and 4'-methylphenylhydroquinone coated at a coverage of about 600 mg/m^2 of dye, 225 mg/m^2 of 6-dodecylaminopurine, 120 mg/m^2 of 4'-methylphenylhydroquinone, and 300 mg/m^2 of gelatin.

(4) A spacer layer of titanium dioxide, poly(methylmethacrylate), gelatin, the above pentapolymer, and polyacrylamide coated at a coverage of about $1,000 \text{ mg/m}^2$ of titanium dioxide, 375 mg/m^2 of poly(methylmethacrylate), 125 mg/m^2 of gelatin, 375 mg/m^2 of said pentapolymer, and 270 mg/m^2 of polyacrylamide.

(5) A red sensitive gelatino-silver iodobromide (1,8 μm) emulsion layer coated at a coverage of about 1,300 mg/m^2 of silver and 1,014 mg/m^2 of gelatin.

5 (6) An interlayer of the above pentapolymer coated at a coverage of about 3,000 mg/m^2 , about 158 mg/m^2 of polyacrylamide and about 32 mg/m^2 of succindialdehyde.

10 (7) A layer of gelatin dispersion of a magenta dye developer and 6-dodecylaminopurine coated at a coverage of about 575 mg/m^2 of dye, 280 mg/m^2 of gelatin and 23 mg/m^2 of 6-dodecylaminopurine.

15 (8) A green-sensitive gelatino-silver iodobromide emulsion layer comprising a blend of 1,1 μm grains coated at a coverage of about 373 mg/m^2 of silver and 60 mg/m^2 of gelatin and 1,8 μm grains coated at a coverage of about 1,027 mg/m^2 of silver and 504 mg/m^2 of gelatin.

20 (9) An interlayer of the above pentapolymer coated at a coverage of about 2,500 mg/m^2 , about 130 mg/m^2 of polyacrylamide, about 31 mg/m^2 of succindialdehyde and about 4 mg/m^2 of formaldehyde.

(10) A layer of 2-phenylbenzimidazole and gelatin coated at a coverage of about 250 mg/m^2 of 2-phenylbenzimidazole and 100 mg/m^2 of gelatin.

25 (11) A layer of a gelatin dispersion of a yellow dye developer coated at a coverage of about 800 mg/m^2 of dye and 320 mg/m^2 of gelatin.

30 (12) A spacer layer of titanium dioxide, poly(methylmethacrylate) and polyacrylamide coated at a coverage of about 200 mg/m^2 of titanium dioxide, 150 mg/m^2 of poly(methylmethacrylate) and 40 mg/m^2 of polyacrylamide.

(13) A blue-sensitive gelatino-silver iodobromide emulsion layer comprising 1,5 μ m grains coated at a coverage of about 950 mg/m² of silver, 456 mg/m² of gelatin, 250 mg/m² of 4'-methylphenylhydroquinone, and about 340 mg/m² of diethyldodecanamide.

(14) A top coat layer of gelatin coated at a coverage of about 484 mg/m².

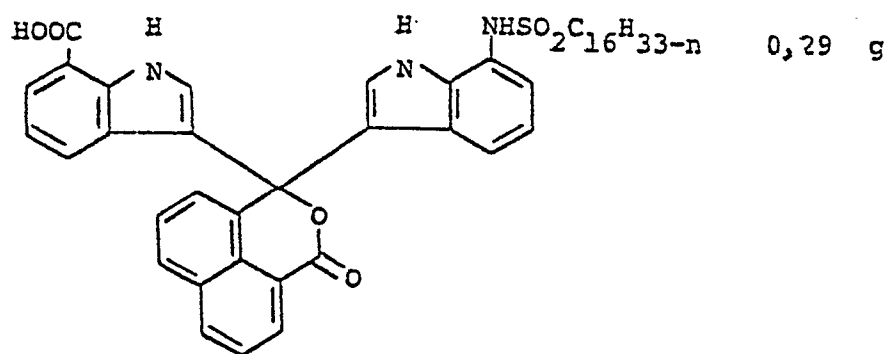
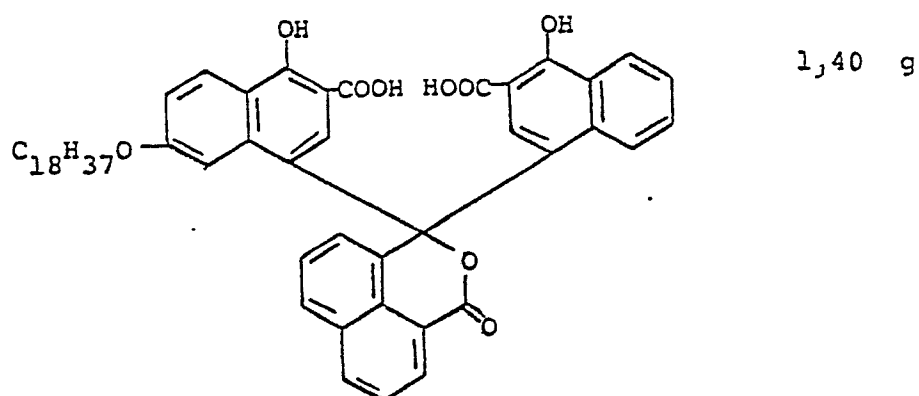
The thus-prepared photosensitive element was exposed and then processed by spreading a layer of alkaline processing composition approximately 0,076 mm thick between it and a superposed image-receiving element prepared by coating a transparent subcoated polyethylene terephthalate 0,1 mm support with the following layers:

1. an image-receiving layer coated at a coverage of about 3,330 mg/m² of a graft copolymer comprising 4-vinyl pyridine (4VP) and vinyl benzyl trimethyl ammonium chloride (TMQ) grafted onto hydroxyethyl cellulose (HEC) at a ratio HEC/4VP/TMQ of 2,2/2,2/1, and about 43 mg/m² of 1,4-butanediol diglycidyl ether cross-linking agent; and

2. a layer of unhardened inert bone gelatin coated at a coverage of about 1,076 mg/m²

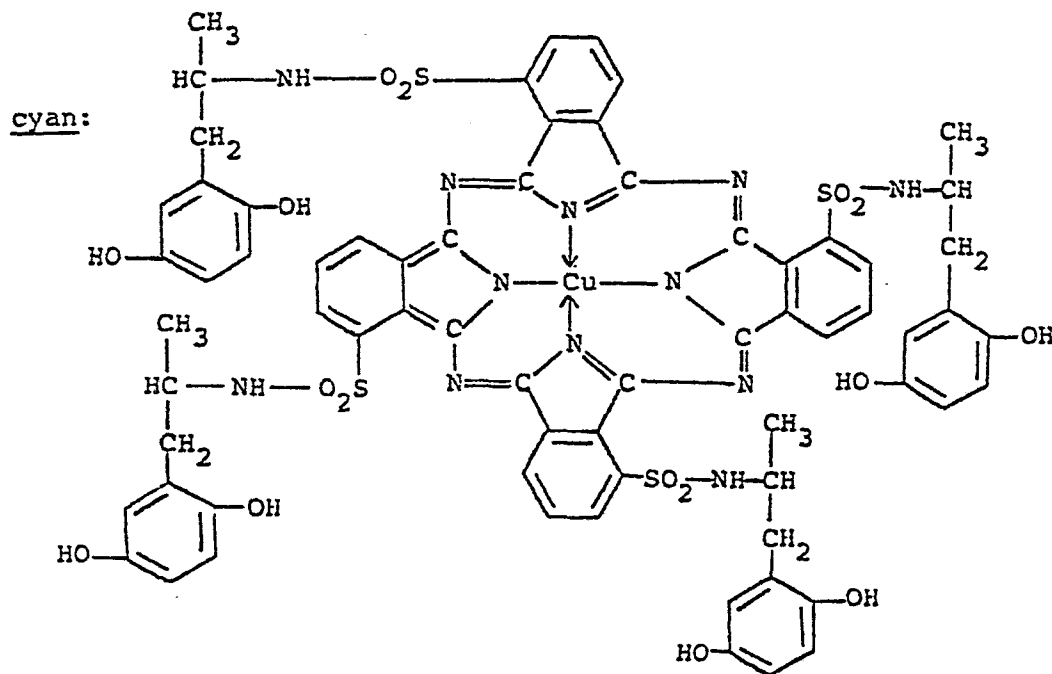
Water	41,0 g
Potassium hydroxide (100%)	4,40 g
Poly-diacetone acrylamide oxime	0,67 g
Titanium dioxide	48,0 g
Benzotriazole	0,456 g
4-aminopyrazolo-(3,4d)-pyrimidine	0,21 g
6-methyl uracil	0,25 g
N-2-hydroxyethyl-N,N',N'-tris-carboxymethyl-ethylene diamine	0,625 g

Polyethylene glycol (mol. wt. about 4000)	0,375 g
Colloidal silica (30% dispersion)	0,77 g
N-phenethyl- α -picolinium bromide	1,32 g
5 2-methyl imidazole	0,70 g
1-(4'-hydroxyphenyl)-5-mercaptopotetrazole	0,04 g
2,3-dimethyl pyrazole	0,167 g

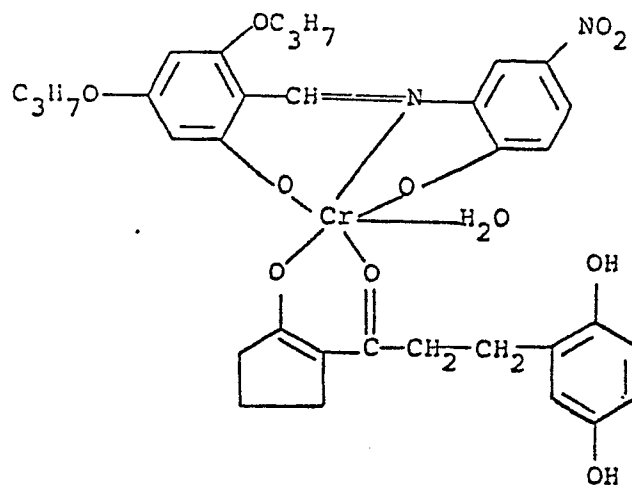
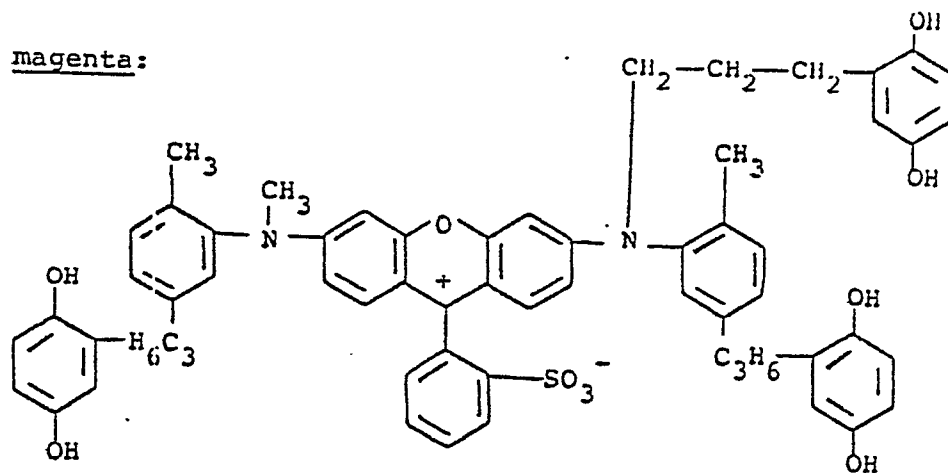


After about 90 seconds a well-developed multicolor transfer image was visible through the transparent support (40) of the laminate. Sensitometric evaluation showed that the presence of the titanium dioxide-containing spacer layer behind the red-sensitive silver halide emulsion resulted in an increase in red speed of about 0,5 stop as compared with a control which did not have this spacer layer. The titanium dioxide-containing spacer layer behind the blue-sensitive silver halide emulsion layer gave a little increase in blue speed without any significant loss in green and red light transmission to the underlying layers. The control of the yellow dye developer also was improved.

The cyan, magenta and yellow dye developers used in the above examples were:



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yellow:magenta:

The polymethylmethacrylate latex employed in the spacer layers of the above example had an average particle size of about 0.12 μm . The titanium dioxide had a particle size of about 0.2 μm .

It is well known in the art that for in camera processing the processing composition should include a viscosity-increasing polymer of the type which, when the composition is spread and dried, forms a relatively firm and stable film. High molecular weight polymers are preferred, and include cellulosic polymers such as sodium carboxymethyl cellulose, hydroxyethyl cellulose and hydroxyethyl carboxymethyl cellulose. Another class of useful viscosity-increasing polymers comprises the oxime polymers disclosed and claimed in U. S. Patent No. 4,202,694 issued May 13, 1980 to Lloyd D. Taylor. Suitable oxime polymers include polydiacetone acrylamide oxime as well as copolymers, e.g., oximated poly diacetone acrylamide/acrylic acid, and oximated graft copolymers, e.g., grafts of diacetone acrylamide oxime onto hydroxyethyl cellulose. The preferred concentration of such oxime polymers is about 1% by weight or less, e.g., about 0.8% by weight as in the above example.

It will be understood that the neutralizing layer 22 and timing layer 20 may be coated in the photosensitive element between the opaque support 10 and the cyan dye developer layer 16, as described in U. S. Patent No. 3,537,043 issued March 30, 1971 to Edwin H. Land or between the transparent support 40 and the image-receiving layer 42, as described in the above-mentioned U. S. Patent No. 3,415,644. Other techniques for controlling the pH known in the art also may be used.

The positive component 60 and the negative component 70 shown in the Figure may be secured to each other along their marginal edges as described in U. S. Patent No. 3,415,644. They may be temporarily laminated to each other

by a bond of such a nature that these elements may be readily separated by the distribution of the processing composition following rupture of the pod 50. A particularly useful method of providing such a temporary lamination is to apply an aqueous solution of a polyethylene glycol, e.g., a polyethylene glycol having a molecular weight of about 6000 such as that commercially available under the tradename "Carbowax 6000" from Union Carbide Corporation. Such uses of polyethylene glycols are disclosed in U. S. Patent No. 3,793,023 issued February 19, 1974 to Edwin H. Land and to which reference may be made.

It will be recognized that this invention also may be practiced employing film units wherein the image-receiving element is adapted to be separated from the developed photosensitive element after the transfer image has been formed.

Neutralizing layers such as the polymeric acid layer are well known in the art and are described in detail, for example, in the above-noted U. S. Patent Nos. 3,415,644, 3,573,043 and 3,647,437 to which patents reference may be made.

This invention is applicable to a wide variety of photographic processes as will be readily apparent to one skilled in the art. Dye developers are preferred image-providing substances, as indicated above, and constitute an example of initially diffusible dye image-providing substances. Other useful dye image-providing substances include initially diffusible dyes useful as image dyes per se and which couple with the oxidation product of a silver halide developing agent to provide a non-diffusible product, initially diffusible

color couplers which couple with the oxidation product of a silver halide developing agent to provide image dyes, initially non-diffusible compounds which react with the oxidation product of a silver halide developing agent, as by coupling or by cross-oxidation, to release a diffusible dye useful as an image dye per se. The final image may be formed as a result of the diffusion transfer of a soluble complex of undeveloped silver halide, in which event the image may be in silver as is well known. In another dye release system a soluble silver complex formed from undeveloped silver halide may be used to effect a cleavage reaction and release a dye or dye intermediate for transfer. Since these image-forming processes are well known and form no part per se of the present invention, it is not necessary to describe them in detail herein.

It will be understood that the transfer image may be positive or negative, with respect to the photographed subject matter, as a function of the particular image-forming system employed. The silver halide emulsion may be negative-working or positive-working (e.g., internal latent image) as appropriate for the particular imaging system.

For convenience, the disclosures of the aforementioned U. S. Patent Nos. 3,415,644, 3,573,043, 3,594,165 and 3,647,437 are expressly incorporated herein.

Since certain changes may be made in the above product and process without departing from the scope of the invention herein involved, the invention is not intended to be limited thereto but to include variations and modifications obvious to those skilled in the art and which are within the spirit of the invention and the scope of the appended claims.

CLAIMS:

1. A photosensitive element comprising a support carrying, in sequence, a layer of a silver halide emulsion, a spacer layer, and a layer of an image-providing material, said spacer layer comprising a light-reflecting pigment dispersed in inert polymeric particles which are substantially non-swelling in alkali and substantially non-film forming.

2. A photosensitive element as defined in claim 1 wherein said support is opaque and said layer of image-providing material is nearest to said support.

3. A photosensitive element as defined in claim 1 wherein said support is transparent and said silver halide emulsion layer is nearest to said support.

4. A photosensitive element as defined in claim 1 wherein said image-providing material is an image dye or an image dye intermediate.

5. A photosensitive element as defined in claim 4 wherein said image-providing material is a dye developer.

6. A photosensitive element as defined in claim 4 wherein said image-providing material is colored.

7. A photosensitive element as defined in claim 1 wherein said light-reflecting pigment is titanium dioxide.

8. A photosensitive element as defined in claim 1 wherein said inert polymeric particles are derived from a polymer latex.

9. A photosensitive element as defined in claim 8 wherein said polymer is polymethylmethacrylate.

10. A photosensitive element as defined in claim 8 wherein said polymer is polystyrene.

11. A photosensitive element as defined in claim 8 wherein said latex particles have a diameter of about 0,1 μ m.

12. A photosensitive element as defined in claim 1 wherein said spacer layer includes a minor proportion by weight of a film-forming polymer.

13. A photosensitive element as defined in claim 1 wherein said light-reflecting polymer in said spacer layer is present in a quantity by weight which is greater than said inert polymer particles.

14. A multicolor photosensitive element comprising a support carrying, in sequence, a layer of a cyan image dye-providing material, a layer of a red-sensitive silver halide emulsion, an interlayer, a layer of a magenta image dye-providing material, a layer of a green-sensitive silver halide emulsion, an interlayer, a layer of a yellow image dye-providing material and a layer of a blue-sensitive silver halide emulsion, at least one of said silver halide emulsion layers and its associated layer of image dye-providing material being separated by a spacer layer comprising a light-reflecting pigment dispersed in inert polymeric particles which are substantially non-swelling in alkali and substantially non-film forming.

15. A multicolor photosensitive element as defined in claim 14 wherein said spacer layer is positioned between said layer of cyan image dye-providing material and said red-sensitive silver halide emulsion layer.

16. A multicolor photosensitive element as defined in claim 14 wherein said spacer layer is positioned between said layer of magenta image dye-providing material and said green-sensitive silver halide emulsion layer.

17. A multicolor photosensitive element as defined in claim 14 wherein said spacer layer is positioned between said layer of yellow image dye-providing material and said blue-sensitive silver halide emulsion layer.

5 18. A multicolor photosensitive element as defined in claim 14 wherein each said image dye-providing material is a dye developer.

19. A multicolor photosensitive element as defined in claim 14 wherein said light-reflecting pigment
10 is titanium dioxide.

20. A photographic process comprising providing a layer of a viscous aqueous alkaline processing composition between a first sheet-like element and a second sheet-like element; said first sheet-like element comprising a support
15 carrying an exposed silver halide emulsion having an image-providing material in a layer behind said silver halide emulsion; said second sheet-like element comprising a transparent support; an image-receiving layer in one of said sheet-like elements, said application of said processing
20 composition being effective to develop said exposed silver halide emulsion and to form a visible image in said image-receiving layer; said silver halide emulsion layer being separated from said layer of image-providing material by a spacer layer comprising a light-reflecting pigment dispersed
25 in inert polymeric particles which are substantially non-swelling in alkali and substantially non-film forming.

21. A photographic process as defined in claim 20 wherein said first sheet-like element is a multicolor photosensitive element comprising a support carrying, in
30 sequence, a layer of a cyan image dye-providing material,

a layer of a red-sensitive silver halide emulsion, an interlayer, a layer of a magenta image dye-providing material, a layer of a green-sensitive silver halide emulsion, an interlayer, a layer of a yellow image dye-providing material and a layer of a blue-sensitive silver halide emulsion, at least one of said silver halide emulsion layers and its associated layer of image dye-providing material being separated by a spacer layer comprising a light-reflecting pigment dispersed in inert polymeric particles which are substantially non-swelling in alkali and substantially non-film forming.

22. A photographic process as defined in claim 20 wherein said light-reflecting pigment is titanium dioxide.

23. A photographic process as defined in claim 21 wherein said spacer layer is positioned between said layer of red-sensitive silver halide and said layer of cyan image dye-providing material.

24. A photographic process as defined in claim 20 wherein said image-providing material is a dye developer.

25. A photographic process as defined in claim 20 wherein said polymer is polymethylmethacrylate.

26. A photographic process as defined in claim 20 wherein said first sheet-like element includes a blue-sensitive silver halide emulsion, a green-sensitive silver halide emulsion, and a red-sensitive silver halide emulsion, said silver halide emulsions having associated therewith, respectively, a yellow dye developer, a magenta dye developer and a cyan dye developer.

27. A photographic process as defined in claim 20 wherein said image-receiving layer is positioned in said second sheet-like element.

28. A diffusion transfer process film unit including a first sheet-like element and a second sheet-like element, said first sheet-like element comprising a support carrying a silver halide emulsion layer; said second
5 sheet-like element comprising at least a support; an image-receiving layer carried on one of said sheet-like elements; a viscous aqueous alkaline processing composition releasably contained in a rupturable container positioned to release said composition for distribution between said first and
10 second sheet-like elements with said supports outermost; said first sheet-like element including a spacer layer between said silver halide emulsion layer and a layer of an image-providing material associated with said silver halide, said spacer layer comprising a light-reflecting pigment
15 dispersed in inert polymeric particles which are substantially non-swelling in alkali and substantially non-film forming.

29. A film unit as defined in claim 28 wherein said second sheet-like element is transparent.

30. A film unit as defined in claim 28 wherein
20 said image-receiving layer is positioned in said second sheet-like element.

31. A film unit as defined in claim 28 wherein said image-receiving layer is positioned in said first sheet-like element.

25 32. A film unit as defined in claim 28 wherein said light-reflecting pigment is titanium dioxide.

33. A film unit as defined in claim 28 wherein said first sheet-like element includes a blue-sensitive silver halide emulsion, a green-sensitive silver halide
30 emulsion, and a red-sensitive silver halide emulsion, said

silver halide emulsions having associated therewith,
respectively, a yellow dye developer, a magenta dye developer
and a cyan dye developer.

5 34. A film unit as defined in claim 33 wherein
said spacer layer is positioned between said red-sensitive
silver halide emulsion and said cyan dye developer.

 35. A film unit as defined in claim 33 wherein
said spacer layer is positioned between said blue-sensitive
silver halide and said yellow dye developer.

10 36. A film unit as defined in claim 28 wherein
said image-providing material is an initially diffusible
image dye or image dye intermediate.

 37. A film unit as defined in claim 28 wherein
said image-providing material is an initially non-diffusible
15 image dye or image dye intermediate.

 38. A film unit as defined in claim 32 wherein
said polymer is polymethylmethacrylate.

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