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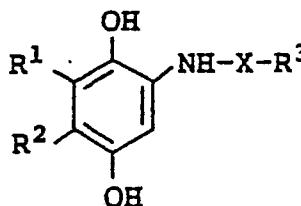
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(54) Heat-developable color photographic material and method for forming image using same.

(57) A heat-developable color photographic material and a method for forming an image using the same. The material comprises a support having thereon a light-sensitive silver halide, a binder, a diffusive reducing agent and a dye donor compound capable of releasing or forming a diffusive dye in correspondence or reverse correspondence with the reaction of reducing the silver ion into silver, wherein said material comprises at least two light-sensitive layers each having a different color sensitivity and at least one layer containing at least one compound represented by formula (I) between the two light-sensitive layers:

(I)



wherein R¹ and R² each represents a hydrogen atom, a halogen atom, or a substituted or unsubstituted alkyl, acylamino, alkoxy, aryloxy, alkylthio, arylthio, sulfonyl, acyl, carbamoyl or sulfamoyl group; or R¹ and R² may together form a carbon ring;

X represents -CO- or -SO₂-; and

R³ represents a substituted or unsubstituted alkyl, aryl, heterocyclic, alkoxy, aryloxy or amino group; provided that the total of the carbon atoms in R¹, R², and R³ is 10 or more, and the compound of the formula (I) is substantially insoluble in water.

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HEAT-DEVELOPABLE COLOR PHOTOGRAPHIC MATERIAL AND METHOD FOR FORMING IMAGE USING SAME

FIELD OF THE INVENTION

The present invention relates to a heat-developable photographic material and to a method for forming
 5 an image using the same.

BACKGROUND OF THE INVENTION

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Various heat-developable photographic materials are known, and for example, such materials and photographic process thereof are described in Bases of Photographic Engineering, Edition of Nonsilver Photography (published by Corona Publishing Co., 1982), pages 242 to 255.

Various methods have been proposed for forming color images by heat-development.

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For instance, U.S. Patents 3,531,286, 3,761,270 and 4,021,240, Belgian Patent 802,519 and Research Disclosure (hereinafter referred to as "RD"), September 1975, pages 31 to 32 have proposed methods of forming a color image by bonding of the oxidation product of a developing agent and a coupler.

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However, as the heat-developable photographic materials to be used in the said methods for forming color images are of a non-fixable type, the silver halide would still remain in the material even after formation of images. Accordingly, such materials have a serious problem that the white portion in the material is gradually colored after it has been exposed to a strong light or has been stored for a long period of time. In addition, the known methods generally require a relatively long period of time for development, and these have an additional drawback that the image formed is noticeably fogged and has a low image density.

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In order to overcome such drawbacks, a method has been proposed where a diffusive dye is imagewise formed or released under heat and the diffusive dye is transferred to an image-receiving material. (Refer to U.S. Patents 4,500,626, 4,483,914, 4,503,137, 4,559,290; European Patent 220,746A; Kokai Giho (Disclosure Bulletin) 87-6199 (vol. 12, No. 22); JP-A-59-165054, JP-A-59-218443, JP-A-61-238059 (the term "JP-A" as used herein means an "unexamined published Japanese patent application"); and European Patent
 30 210,660A2.)

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In order to obtain a multicolor image, combination of plural dye donor compounds each forming a different color dye and the corresponding plural silver halide emulsion layers each having a different color-sensitivity and provision of the plural layers with such combination on a support are necessary. For instance, in order to obtain various colors of a broad range in the chromatic diagram by the use of three primary colors of yellow, magenta and cyan, at least three light-sensitive layers each containing a silver halide emulsion having a different color-sensitivity are necessary.

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In the case, where a highly diffusive color developing agent and an electron-transferring agent which will be mentioned below are used as reducing agent, the oxidation product of the color developing agent or that of the electron-transferring agent to be formed as a result of development would diffuse into other light-sensitive layers to cause color mixing or to lower the color density. In order to prevent this, provision of an interlayer containing a non-diffusive reducing compound which may reduce the oxidation product of the diffusive reducing agent has been proposed (JP-A-60-119555 and JP-A-1-120553).

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In the heat-developable diffusion transfer-type color photographic material, however, it is desired that the amount of the binder in the interlayer is less than that in the conventional wet-type photographic material in view of the image-forming speed, the diffusive dye-transferring speed and the resolving power, and accordingly, it is also desired that the reducing compound to be added to the interlayer is one capable of displaying high effect even when used in a small amount.

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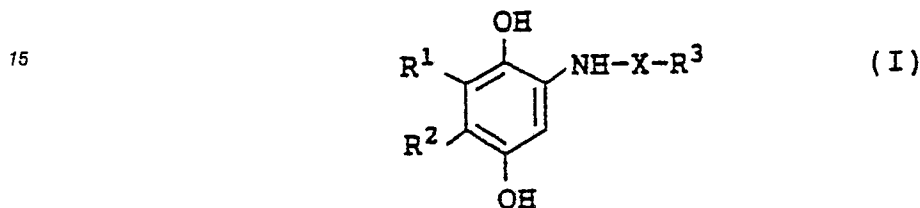
SUMMARY OF THE INVENTION

An object of the present invention is to provide a heat-developable color photographic material which has an excellent color reproducibility and which may form an image with high image density and low stain.

Another object of the present invention is to provide a heat-developable color photographic material which is thin and which has an improved sharpness.

The above and other objects and effects of the present invention will be more apparent from the following description.

5 The above objects of the present invention have been attained by a heat-developable color photographic material comprising a support having thereon a light-sensitive silver halide, a binder, a diffusive reducing agent and a dye donor compound capable of releasing or forming a diffusive dye in correspondence or reverse correspondence with the reaction of reducing the silver ion into silver, wherein the material comprises at least two light-sensitive layers each having a different color sensitivity and at least one layer
10 containing at least one compound represented by the following formula (I) between the two light-sensitive layers, and by a method of forming a color image by heat-developing the material after simultaneously with imagewise exposure thereof or simultaneously with imagewise exposure thereof.



where R¹ and R² each represents a hydrogen atom, a halogen atom, or a substituted or unsubstituted alkyl, acylamino, alkoxy, aryloxy, alkylthio, arylthio, sulfonyl, acyl, carbamoyl or sulfamoyl group; or R¹ and R² may together form a carbon ring; X represents -CO- or -SO₂-; R³ represents a substituted or unsubstituted
25 alkyl, aryl, heterocyclic, alkoxy, aryloxy or amino group; provided that the total of the carbon atoms in R¹, R², and R³ is 10 or more, and the compound of the formula (I) is substantially insoluble in water.

30 DETAILED DESCRIPTION OF THE INVENTION

Specifically, R¹ and R² in the formula (I) each represents a hydrogen atom, a halogen atom (e.g., chlorine, bromine), a substituted or unsubstituted alkyl group (preferably having from 1 to 60 carbon atoms e.g., methyl, pentadecyl, t-hexyl), a substituted or unsubstituted acylamino group (preferably having from 2
35 to 60 carbon atoms e.g., acetyl, benzoyl), a substituted or unsubstituted alkoxy group (preferably having from 1 to 60 carbon atoms e.g., methoxy, butoxy), a substituted or unsubstituted aryloxy group (preferably having from 6 to 60 carbon atoms e.g., phenoxy), a substituted or unsubstituted alkylthio group (preferably having from 1 to 60 carbon atoms e.g., octylthio, hexadecylthio), a substituted or unsubstituted arylthio group (preferably having from 6 to 60 carbon atoms e.g., phenylthio), a substituted or
40 unsubstituted sulfonyl group (preferably having from 1 to 60 carbon atoms e.g., dodecanesulfonyl, p-toluenesulfonyl), a substituted or unsubstituted acyl group (preferably having from 2 to 60 carbon atoms e.g., acetyl, benzoyl), a substituted or unsubstituted carbamoyl group (preferably having from 1 to 60 carbon atoms e.g., N,N-dibutylcarbamoyl) or a substituted or unsubstituted sulfamoyl group (preferably having from 0 to 60 carbon atoms e.g., N,N-diethylsulfamoyl). R¹ and R² may together form a carbon ring,
45 preferably a 5- to 7-membered carbon ring. X represents -CO- or -SO₂-. R³ represents a substituted or unsubstituted alkyl group (preferably having from 1 to 60 carbon atoms e.g., heptadecyl, 1-hexylnonyl, 1-(2,4-di-t-amylphenoxy)propyl; additionally, a substituted or unsubstituted cycloalkyl group such as 3-decanamidocyclohexyl or 2-[(2,4-di-t-amylphenoxy)butanamido]cyclohexyl group is also preferred), a substituted or unsubstituted aryl group (preferably having from 6 to 60 carbon atoms e.g., phenyl, 3,5-bis(2-hexyldecanamido)phenyl, 3,4-bis(hexadecyloxy)phenyl, 2,4-bis(tetradecyloxy)phenyl), a substituted
50 or unsubstituted heterocyclic group (preferably having from 2 to 60 carbon atoms and from 5- to 7-membered e.g., 2,6-dihexyloxypyridin-4-yl, N-tetradecylpyrrolidin-2-yl, N-octadecylpiperidin-3-yl), a substituted or unsubstituted alkoxy group (preferably having from 5 to 60 carbon atoms e.g., hexadecyloxy), a substituted or unsubstituted aryloxy group (preferably having from 6 to 60 carbon atoms e.g., 4-t-octylphenoxy), or a substituted or unsubstituted amino group (preferably having from 2 to 60 carbon atoms e.g., octadecylamino). The total of the carbon atoms in R¹, R², and R³ is 10 or more, and the compound of the formula (I) is substantially insoluble in water. Preferably, the solubility in water of the compound of the formula (I) is 0.1 g/l or less.

R¹ to R³ in the formula (I) may have further substituents. As the substituents, there are mentioned generally known organic groups (e.g., alkyl, alkoxy, alkylthio, acylamino, alkoxycarbonyl), halogen atoms and a hydroxyl group, but the compound does not contain a sulfo group and a carboxyl group as the substituent. This is because introduction of sulfo group or carboxyl group into the compound of the
 5 invention would make the compound soluble in water and, as a result, the water-soluble compound would easily diffuse in the photographic layer so that not only the compound-containing layer itself is thereby deteriorated but also the compound would further diffuse into other layers to thereby vary the photographic property of the layers.

Accordingly, the compound of the formula (I) for use in the present invention does not have sulfo group
 10 and carboxyl group as the substituent and the compound is substantially insoluble in water.

The compound of the formula (I) may form a bis-form, a tris-form or a polymer.

Preferably, R¹ and R² in the formula (I) each represents a hydrogen atom, a halogen atom, an alkyl group, an alkoxy group or an alkylthio group; and most preferably they each represents a hydrogen atom, a
 15 halogen atom or an alkyl group.

In the formula (I) X is preferably -CO-.

In the formula (I), R³ is preferably an alkyl group or an aryl group, most preferably it is an aryl group.

Where R³ in the formula (I) represents an aryl group, the substituents on the group are not specifically
 20 limitative, provided that they are generally known substituents substitutable on an aryl ring. However, as relatively preferable substituents, there are mentioned a halogen atom, an alkyl group, an amido group, a sulfonamido group, an alkoxy group, an alkoxycarbonyl group and a carbamoyl group.

In the formula (I), the total of the carbon atoms in R¹, R² and R³ is preferably from 10 to 60, more preferably from 15 to 50.

The compounds of the formula (I) can be prepared by the methods described in JP-B-59-37497 (the
 25 term "JP-B" as used herein means an "examined Japanese patent publication") and JP-A-62-103053 and in accordance with the methods.

Specific examples of the compounds of the formula (I) which are employable in the present invention are mentioned below, which, however, are not limitative.

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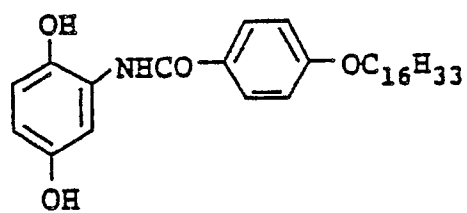
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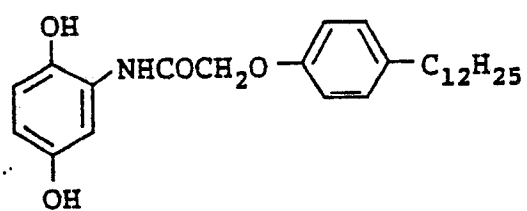
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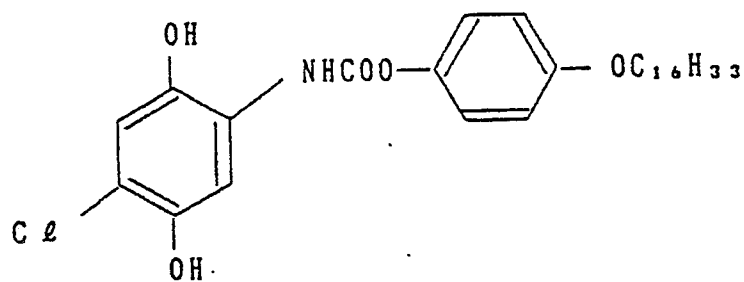
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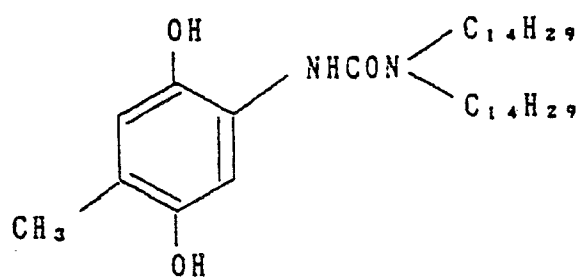
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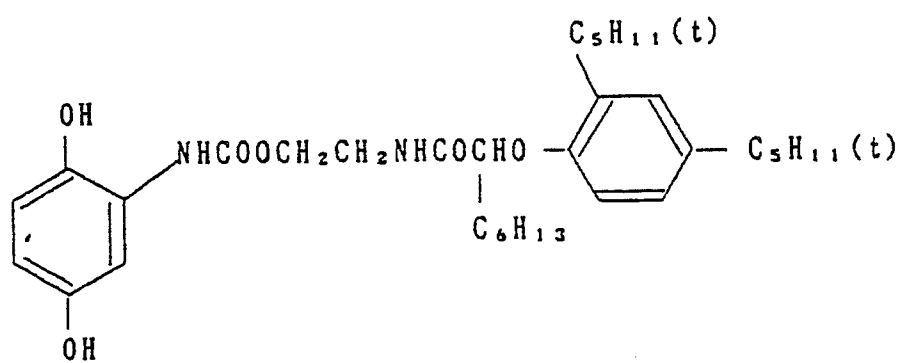
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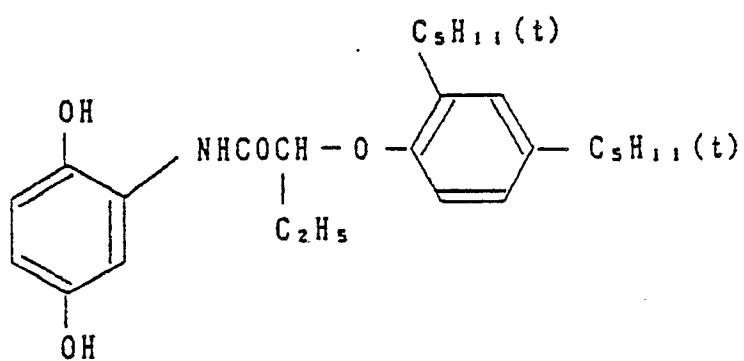


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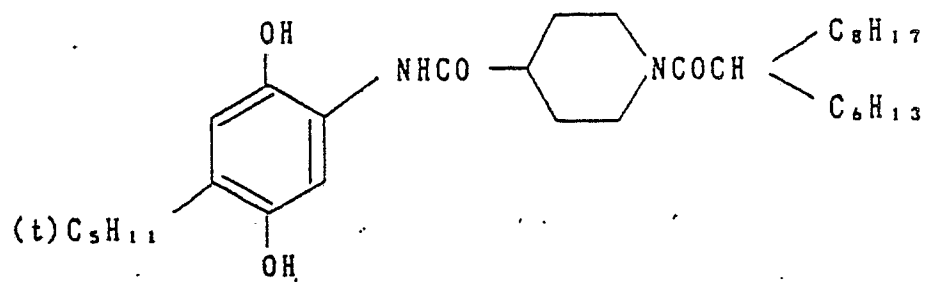
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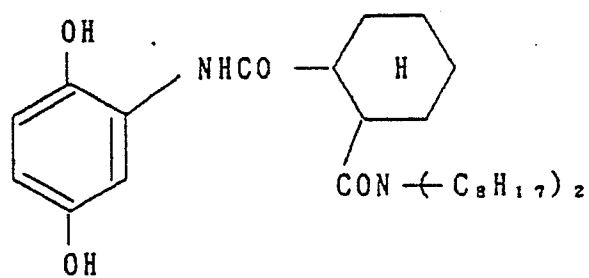
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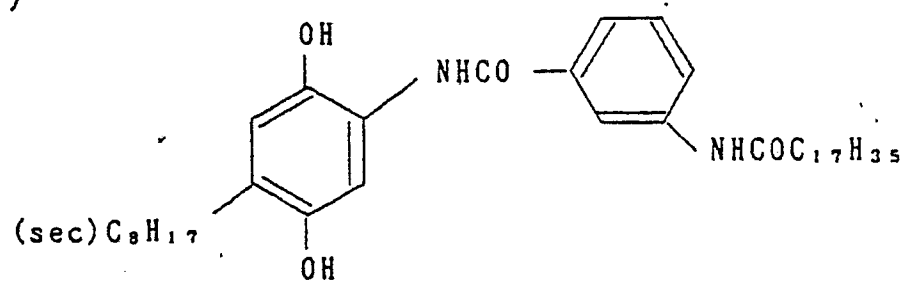
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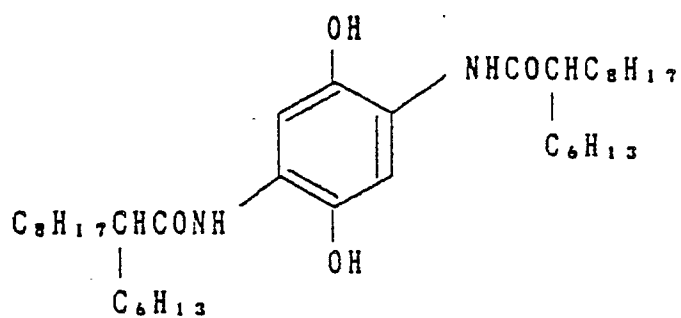
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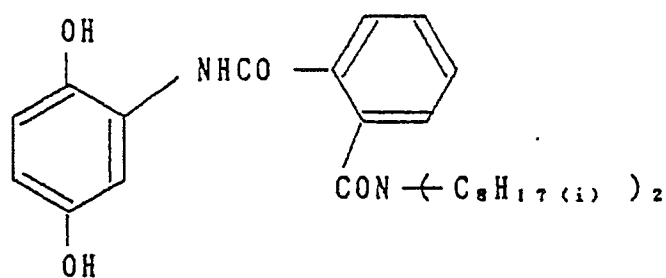
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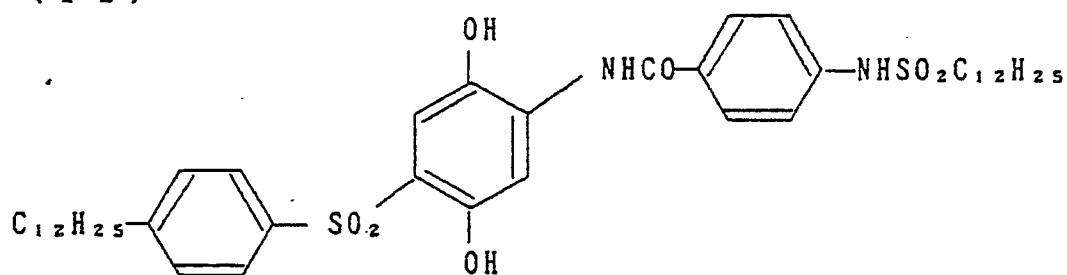
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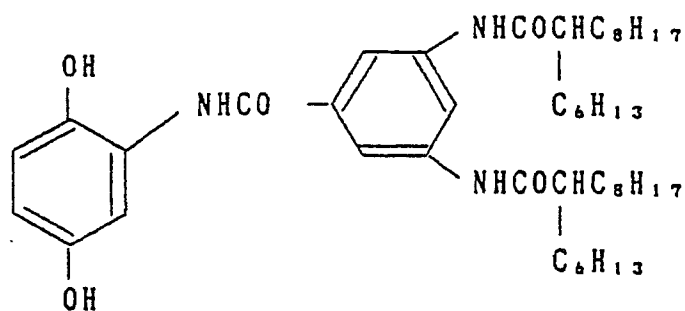
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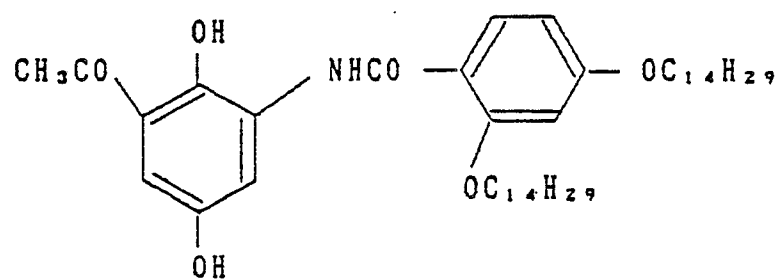
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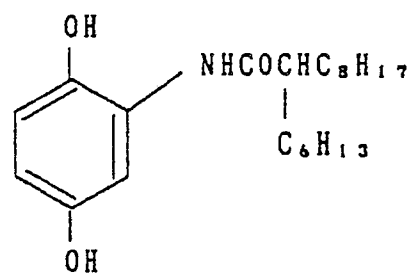
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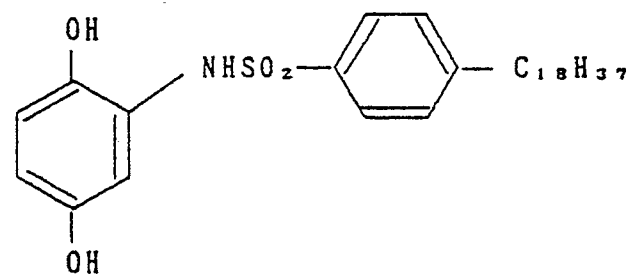
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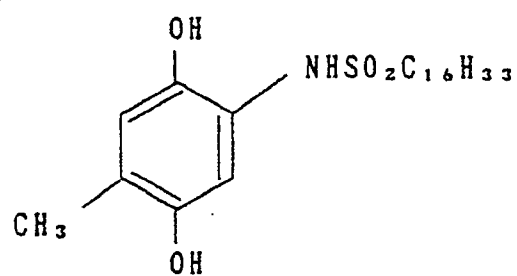
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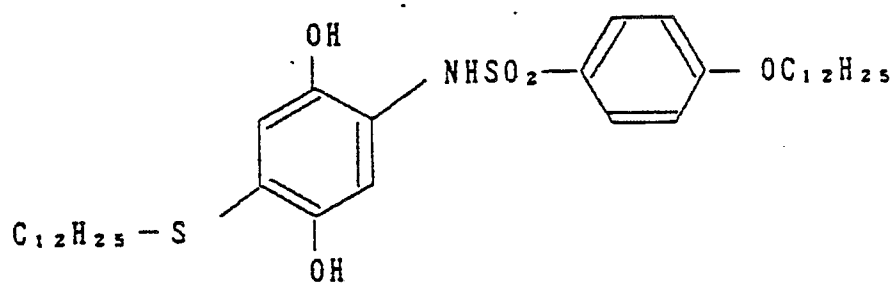
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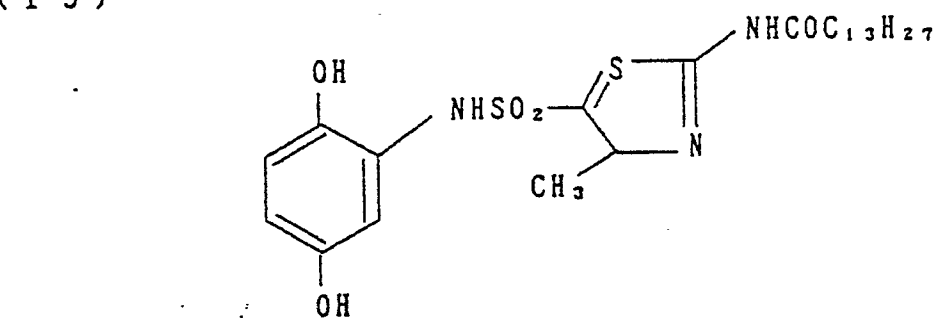
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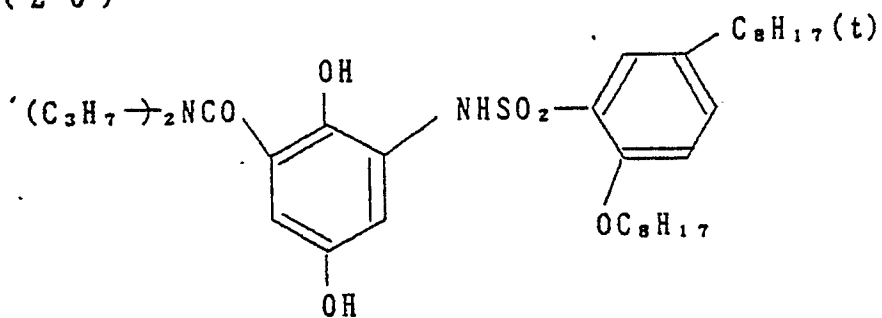
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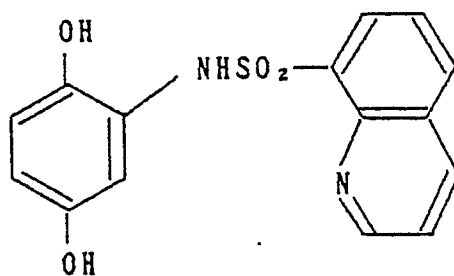
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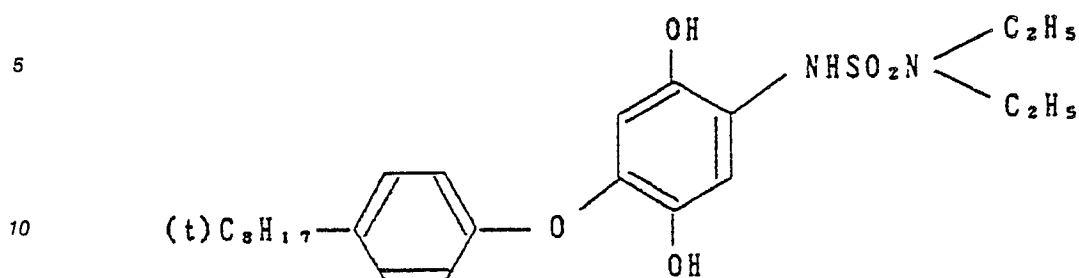
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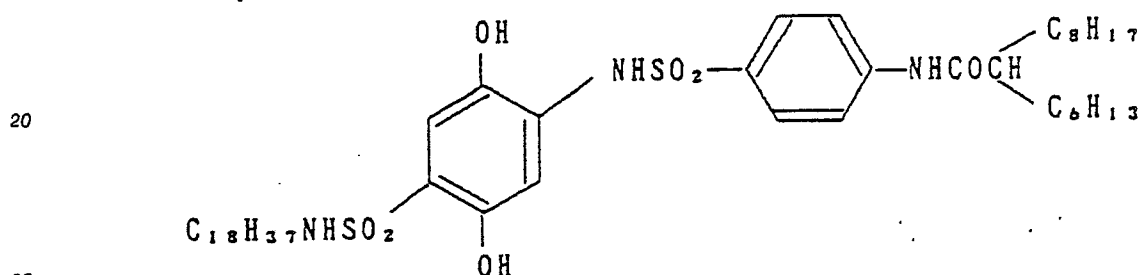
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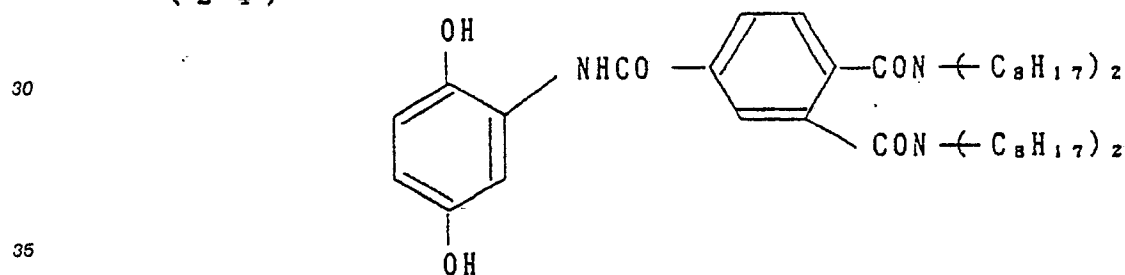
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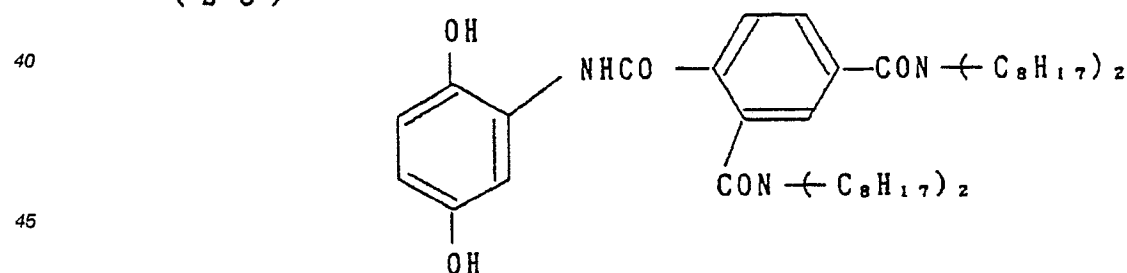
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50 The compound of the formula (I) is added to a non-light-sensitive layer (interlayer) to be provided between two silver halide emulsion layers each having a different color sensitivity. In addition, the compound may further be added to any other non-light-sensitive layer (protective layer) or emulsion layer. The same compound may be added to two or more different layers, or two or more different kinds of the compounds of the formula (I) may be added to one and the same layer. The interlayer containing the compound of the formula (I) may have a function as yellow filter layer. The amount of the compound of the formula (I) to be added is preferably from 1×10^{-6} to 1×10^{-2} mol/m², and more preferably from 10^{-5} to 2×10^{-3} mol/m².

55 The compound of the formula (I) may be incorporated into the photographic material by various known dispersion methods. As typical examples, there are mentioned a solid dispersion method, an alkali

dispersion method, preferably a latex dispersion method, more preferably an oil-in-water dispersion method. In the oil-in-water dispersion method, the compound is first dissolved in a single solvent which is a high boiling point organic solvent having a boiling point of 175° C or higher or a so-called auxiliary solvent having a low boiling point or in a mixed solvent of the two and then the resulting solution is finely dispersed in an aqueous medium such as water or an aqueous gelatin solution in the presence of a surfactant. Examples of the high boiling point organic solvent are described in U.S. Patent 2,322,027. The dispersion may be accompanied by phase conversion. If desired, the auxiliary solvent used may be removed or reduced by distillation, noodle washing or ultrafiltration before coating the dispersion.

As specific examples of high boiling point organic solvents, there are mentioned phthalic acid esters (e.g., dibutyl phthalate, dicyclohexyl phthalate, di-2-ethylhexyl phthalate, didodecyl phthalate), phosphoric acid or phosphonic acid esters (e.g., triphenyl phosphate, tricresyl phosphate, 2-ethylhexyldiphenyl phosphate, tricyclohexyl phosphate, tri-2-ethylhexyl phosphate, tridodecyl phosphate, tributoxyethyl phosphate, trichloropropyl phosphate, di-2-ethylhexylphenyl phosphate), benzoic acid esters (e.g., 2-ethylhexyl benzoate, dodecyl benzoate, 2-ethylhexyl p-hydroxybenzoate), amides (e.g., diethyldodecanamide, N-tetradecylpyrrolidone), alcohols or phenols (e.g., isostearyl alcohol, 2,4-di-tert-amylphenol), aliphatic carboxylic acid esters (e.g., dioctyl azelate, glycerol tributyrates, isostearyl lactate, trioctyl citrate), aniline derivatives (e.g., N,N-dibutyl-2-butoxy-5-tert-octylaniline), hydrocarbons (e.g., paraffin, dodecylbenzene, diisopropylnaphthalene). As the auxiliary solvent, that having a boiling point of from about 30° C to about 160° C is employed. Specific examples of such solvent include ethyl acetate, butyl acetate, ethyl propionate, methyl ethyl ketone, cyclohexanone, 2-ethoxyethyl acetate and dimethylformamide.

A latex dispersion method may be applied to dispersion of the compound of the formula (I) of the invention, and the procedure and effect of the process as well as latexes usable in the process are described in U.S. Patent No. 2,541,274 and West German Patent OLS No. 2,541,230.

In order to obtain colors of a broad range within the chromatic diagram by the use of three primary colors of yellow, magenta and cyan, at least three silver halide emulsion layers each having a different light-sensitivity in a different spectral range are combined. For instance, there are mentioned a combination of three layers of a blue-sensitive layer, a green-sensitive layer and a red-sensitive layer and a combination of three layers of a green-sensitive layer, a red-sensitive layer and an infrared-sensitive layer. The light-sensitive layers may be positioned in various sequences known for conventional color photographic materials. The light-sensitive layer may be composed of two or more layers having the same color-sensitivity but each having a different sensitivity degree.

The heat-developing photographic material of the present invention may have, in addition to the interlayer containing the compound of the formula (I) of the invention to be provided between two light-sensitive layers each having a different color-sensitivity, various auxiliary layers such as protective layer, subbing layer, yellow filter layer, antihalation layer and backing layer.

The silver halide which is employable in the present invention may be any of silver chloride, silver bromide, silver iodobromide, silver chlorobromide, silver chloriodide and silver chloriodobromide.

The silver halide emulsion for use in the present invention may be either a surface latent image-type emulsion or an internal latent image-type emulsion. The internal latent image-type emulsion is used as a direct reversal emulsion in combination with a nucleating agent or with light-fogging. The emulsion may be a so-called core/shell emulsion having different phases in the inside of the grain (core) and the surface layer thereof (shell). The silver halide emulsion may be either monodispersed or polydispersed, and plural monodispersed emulsions can be used in combination. The grain size of the emulsion grains is preferably from 0.1 to 2 µm, especially from 0.2 to 1.5 µm. Regarding the crystal habit of the silver halide grains, the grains may be any of cubic, octahedral or tetradecahedral grains or tabular grains with high aspect ratio or others.

Specifically, all the silver halide emulsions described in U.S. Patent 4,500,626 and 4,628,021, Research Disclosure (RD) Item No. 17029 (1978) and JP-A-62-253159 can be employed in the present invention.

Although the silver halide emulsions can be used in the form not after-ripened, these are generally used after being chemically sensitized. For chemical sensitization of the emulsions for use in the present invention, any of sulfur sensitization method, reduction sensitization method and noble metal sensitization method which are known for emulsions of conventional photographic materials can be employed singly or in combination. Such chemical sensitization can be effected in the presence of a nitrogen-containing heterocyclic compound (as described in JP-A-62-253159).

The amount of the light-sensitive silver halide to be coated on the support for forming the photographic material of the present invention is from 1 mg/m² to 10 g/m² as silver.

In accordance with the present invention, an organic metal salt is employed as an oxidizing dye, together with the light-sensitive silver halide. For such organic metal salt, organic silver salts are especially

preferably used.

As the organic compound employable for forming the said organic silver salt oxidizing agent, there are mentioned benzotriazoles, fatty acids and other compounds described in U.S. Patent 4,500,626, columns 52 to 53. In addition, silver salts of alkynyl group-containing carboxylic acids, such as silver phenylpropiolate, described in JP-A-60-113235, as well as silver acetylene described in JP-A-61-249044 are also usable. Two or more kinds of such organic silver salts can be employed in combination.

The organic silver salt can be incorporated into the photographic material in an amount of from 0.01 to 10 mols, preferably from 0.01 to 1 mol, per mol of the light-sensitive silver halide. The total of the light-sensitive silver halide and the organic silver salt is suitably from 50 mg/m² to 10 g/m² as silver.

In accordance with the present invention, various antifoggants and photographic stabilizers can be employed. As examples of the agents, there are mentioned azoles and azaindenes described in RD Item No. 17643 (1978), pages 24 to 25; nitrogen-containing carboxylic acids and phosphoric acids described in JP-A-59-168442; mercapto compounds and metal salts thereof described in JP-A-59-111636; and acetylene compounds described in JP-A-62-87957.

The silver halides for use in the present invention can be color-sensitized with methine dyes or the like. Dyes usable for the purpose include cyanine dyes, merocyanine dyes, complex cyanine dyes, complex merocyanine dyes, holopolar cyanine dyes, hemicyanine dyes, styryl dyes and hemioxonole dyes.

Specifically, there are mentioned the sensitizing dyes described in U.S. Patent 4,617,257, JP-A-59-180550 and JP-A-60-140335 and RD Item No. 17029 (1978), pages 12 to 13.

The sensitizing dyes can be used singly or in combination. Combination of sensitizing dyes is often employed for the purpose of supersensitization.

The emulsions for use in the present invention can contain dyes which do not have color-sensitizing action by themselves or compounds which do not substantially absorb visible lights but have supersensitizing action, together with the sensitizing dyes. (For instance, such dyes or compounds are described in U.S. Patent 3,615,641 and JP-A-63-23145).

The sensitizing dyes can be added to the emulsions at any time of during chemical ripening of the emulsion or before or after chemical ripening thereof. Further, they may also be added before or after formation of nuclei of silver halide grains, in accordance with U.S. Patents 4,183,756 and 4,225,666. The amount of the dye to be added to the emulsion is generally about from 10⁻⁸ to 10⁻² mol per mol of silver halide.

As the binder for the layers constituting the photographic material and the dye fixing material, hydrophilic substances are preferably employed. As examples thereof, the substances described in JP-A-62-253159, pages 26 to 28 are referred to. Specifically, transparent or semi-transparent binders are preferred, and for example, there are mentioned natural compounds including proteins such as gelatin and gelatin derivatives as well as polysaccharides such as cellulose derivatives, starch, gum arabic, dextran and pullulane; and synthetic high polymer compounds such as polyvinyl alcohol, polyvinyl pyrrolidone, acrylamide polymer and others. In addition, the high water-absorbing polymers described in JP-A-62-245260 can also be used, which are homopolymers of vinyl monomers having -COOM or -SO₃M (where M means a hydrogen atom or an alkali metal atom) or copolymers of the said vinyl monomers or of the said vinyl monomer(s) and other vinyl monomer(s) (e.g., sodium methacrylate, ammonium methacrylate, Sumicagel L-5H manufactured by Sumitomo Chemical Co.). Two or more kinds of such binders can be used in combination.

Where a system of heat-developing the photographic material with applying a slight amount of water thereto is employed, the photographic material is desired to contain the said high water-absorbing polymer whereby absorption of water may be effected rapidly. It is also preferred to incorporate the said high water-absorbing polymer into the dye-fixing layer and the protective layer therefor, whereby re-transferring of the once transferred dye to any other material from the dye-fixing material may be prevented.

In accordance with the present invention, the amount of the binder to be coated is preferably 20 g or less, especially 10 g or less, more preferably 7 g or less, per m² of the photographic material.

The layers (including backing layer) constituting the light-sensitive photographic materials and the dye-fixing materials of the present invention can contain various polymer latexes for the purpose of improving the film property of the material, for example, for the purpose of dimension stabilization, curling prevention, blocking prevention, film cracking prevention and prevention of pressure sensitization and desensitization (pressure marks). For instance, anyone of the polymer latexes described in JP-A-62-245258, JP-A-62-136648 and JP-A-62-110066 can be employed for such a purpose. In particular, when a polymer latex having a low glass-transition temperature (40°C or lower) is incorporated into the mordant layer, cracking of the mordant layer may be prevented; or when a polymer latex having a high glass-transition temperature is incorporated into the backing layer, curling preventing effect can be attained.

The photographic material of the present invention contains a compound which can form or release a diffusive dye in correspondence or reverse correspondence with the reaction of reducing silver ion into silver under high temperature condition, or a dye donor compound.

As examples of the dye donor compounds to be employed in the present invention, there are mentioned compounds (couplers) capable of forming a dye by oxidation-coupling reaction. The coupler may be either 4-equivalent or 2-equivalent. 2-Equivalent couplers which have a non-diffusive group as the releasing group and which form a diffusive dye by oxidation-coupling reaction are also preferred. The non-diffusive group may be in the form of a polymer chain. Examples of such dye-forming couplers are described in detail in T.H. James, *The Theory of the Photographic Process*, pages 291 to 334 and 354 to 361 and in JP-A-58-123533, JP-A-58-149046, JP-A-58-149047, JP-A-59-111148, JP-A-59-124399, JP-A-59-174835, JP-A-59-231539, JP-A-59-231540, JP-A-60-2950, JP-A-60-2951, JP-A-60-14242, JP-A-60-23474 and JP-A-60-66249.

A further example of the dye donor compound includes a compound adapted to imagewise release or spread of a diffusive dye. Compounds of such type can be represented by formula (LI)

(Dye-Y)_n-Z (LI)

wherein Dye represents a dye group or a dye precursor group whose absorption wavelength has been shortened temporarily; Y represents a chemical bond or a lining group; and Z represents a group which either causes an imagewise differential in the diffusibility of the compound (Dye-Y)_n-Z in correspondence or reverse correspondence with the photosensitive silver salt carrying a latent image or releases the Dye and causes a differential in diffusibility between the released Dye and (Dye-Y)_n-Z; n represents 1 or 2 and when n is 2, the two Dye-Y groups may be the same or different.

As specific examples of the dye donor compounds of the formula (LI), the following compounds (1) through (5) are mentioned. The compounds (1) through (3) are those of forming a diffusive color image in reverse correspondence with development of silver halide (positive color image); and the compounds (4) and (5) are those of forming a diffusive color image in correspondence with development of silver halide (negative color image).

(1) Color-developing agents comprising a combination of a hydroquinone developing agent and a dye component, described in U.S. Patents 2,134,764, 3,362,819, 3,597,200, 3,544,545 and 3,482,972. The color-developing agents are diffusive under an alkaline condition but become non-diffusive after reacted with a silver halide.

(2) Non-diffusive compounds which may release a diffusive dye under an alkaline condition but which lose their capacity when reacted with a silver halide can also be used, as so described in U.S. Patent 4,503,137. As examples of such compounds, there are mentioned the compounds of releasing a diffusive dye by intramolecular nucleophilic substitution reaction described in U.S. Patent 3,980,479 and the compounds of releasing a diffusive dye by intramolecular rearrangement reaction of the isoxazolone ring described in U.S. Patent 4,199,354.

(3) Non-diffusive compounds capable of reacting with a reducing agent which had remained without being oxidized by development to release a diffusive dye can also be used, as so described in U.S. Patent 4,559,290, European Patent 220,746A2 and Kokai Giho (Disclosure Bulletin) 87-6199.

As examples of such compounds, there are mentioned the compounds of releasing a diffusive dye by intramolecular nucleophilic substitution reaction after reduction described in U.S. Patents 4,139,389 and 4,139,379 and JP-A-59-185333 and JP-A-57-84453; the compounds of releasing a diffusive dye by intramolecular electron-migrating reaction after reduction described in U.S. Patent 4,232,107, JP-A-59-101649 and JP-A-61-88257 and RD Item No. 24025 (1984); the compounds of releasing a diffusive dye by cleavage of the single bond after reduction described in West German Patent 3,003,588A, JP-A-56-142530 and U.S. Patents 4,343,893 and 4,619,887; the nitro compounds of releasing a diffusive dye after electron reception described in U.S. Patent 4,450,223; and the compounds of releasing a diffusive dye after electron reception described in U.S. Patent 4,609,610.

More preferably, there are mentioned the compounds having an N-X bond (where X means an oxygen sulfur or nitrogen atom) and an electron-attracting group in one molecule described in European Patent 220,746A2, Kokai Giho (Disclosure Bulletin) 87-6199, JP-A-63-201653 and JP-A-63-201654; the compounds having SO₂-X (where X has the same meaning as mentioned above) and an electron-attracting group in one molecule described in JP-A-1-26842; the compounds having a PO-X bond (where X has the same meaning as mentioned above) and an electron-attracting group in one molecule described in JP-A-63-271344; the compounds having a C-X' bond (where X' has the same meaning as mentioned above or means -SO₂-) and an electron-attracting group in one molecule described in JP-A-63-271341; and the compounds of releasing a photographically useful group by cleavage of the single bond, after reduced, by the π -bond as conjugating with the electron-accepting group described in JP-A-1-161239 and JP-A-1-161342.

Above all especially preferred are the compounds having an N-X bond and an electron-attracting group in one molecule. Specific examples of such compounds includes Compounds (1) to (3), (7) to (10), (12), (13), (15), (23) to (26), (31), (32), (35), (36), (40), (41), (44), (53) to (59), (64) and (70) described in European Patent 220,746A2 and Compounds (11) to (23) described in Kokai Giho (Disclosure Bulletin) 87-6199.

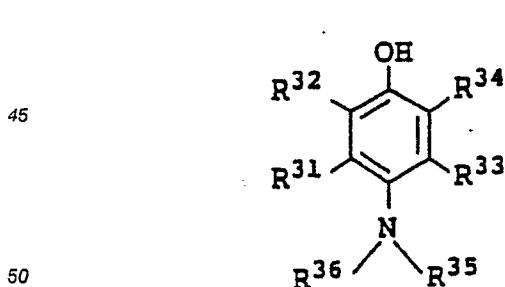
(4) Compounds (DDR couplers) which have a diffusive dye as the releasing and release the diffusive dye by reaction with the oxidation product of a reducing agent are also used. For instance, there are mentioned the compounds described in British Patent 1,330,524, JP-B-48-39165 and U.S. Patents 3,443,940, 4,474,867 and 4,483,914.

(5) Compounds (DRR compounds) which have a property of reducing silver halides and organic silver salts and which release a diffusive dye after having reduced the same can also be used. As the compounds of this type may function even in the absence of any other reducing agent, they are advantageously free from the problem of stain of images by the oxidized and decomposed product of a reducing agent. Specific examples of the compounds are described in U.S. Patents 3,928,312, 4,053,312, 4,055,423 and 4,336,322, JP-A-59-65839, JP-A-59-69839, JP-A-53-3819 and JP-A-51-104343, RD Item No. 17643, U.S. Patents 3,725,062, 3,728,113 and 3,443,939, JP-A-58-116537 and JP-A-57-179840 and U.S. Patent 4,500,626. As preferred examples of such DRR compounds, the compounds described in the above-mentioned U.S. Patent 4,500,626, columns 22 to 44 are referred to. Above all, Compounds (1) to (3), (10) to (13), (16) to (19), (28) to (30), (33) to (35), (38) to (40) and (42) to (64) described in U.S. Patent 4,500,626 are preferred. In addition, the compounds described in U.S. Patent 4,639,408, columns 37 to 39 are also useful.

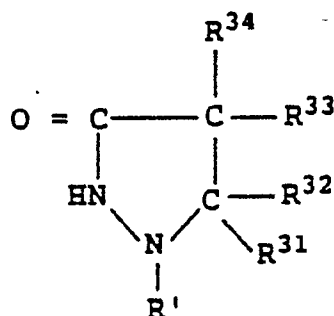
As other dye donor compounds than the above-mentioned couplers and the compounds of the formula (LI), dye-silver compounds comprising an organic silver salt and a dye as bonded to each other (RD of May 1978, pages 54 to 58), azo dyes to be employable in heat-developing silver dye bleaching method (U.S. Patent 4,235,957, RD of April 1976, pages 30 to 32) and leuco dyes (U.S. Patents 3,985,565 and 4,022,617) can also be employed in the present invention.

The diffusive reducing agent which is employable in the present invention is a compound having an ability of developing silver halides and having a possibility of moving in the coated layers. As such diffusive reducing agent, anyone of compounds capable of developing a silver halide to give an oxidation product which reacts with the dye donor compound by coupling reaction (color developing agents) or compounds capable of developing a silver halide to give an oxidation product which oxidizes the dye donor compound directly or via a non-diffusive reducing agent called an electron donor by cross-oxidation (electron-transmitting agents) can be employed in the present invention. As useful reducing agent, there are dihydroxybenzenes, catechols, pyrogallols, 3-pyrazolidones, p-phenylenediamines, p-aminophenols, sulfonamidophenols and hydrazones. As specific examples thereof, there are the reducing agents and reducing agent precursors described in U.S. Patents, 4,500,626 (columns 49 to 50), 4,483,914 (columns 30 to 31), 4,330,617 and 4,590,152, JP-A-60-140335 (pages 17 to 18), JP-A-57-40245, JP-A-56-138736, JP-A-59-178458, JP-A-59-53831, JP-A-59-182449, JP-A-59-182450, JP-A-60-119555, JP-A-60-128436 to JP-A-60-128439, JP-A-60-198540, JP-A-60-181742, JP-A-61-259253, JP-A-62-244044, JP-A-62-131253 to JP-A-62-131256 and European Patent 220,746A2 (pages 78 to 96).

Especially preferred diffusive reducing agents for use in the present inventions are compounds represented by the following formula (X-I) or (X-II):



(X-I)



(X-II)

wherein R' represents an aryl group; R³¹, R³², R³³, R³⁴, R³⁵ and R³⁶ each represents a hydrogen atom, a halogen atom, an acylamino group, an alkoxy group, an alkylthio group, an alkyl group or an aryl group and

these may be same or different.

The aryl group for R^1 in the formulae (X-I) and (X-II) includes, for example, a phenyl group, a naphthyl group, a tolyl group and a xylyl group. These groups may optionally be substituted. For instance, R^1 may be an aryl group optionally substituted by substituents selected from a halogen atom (e.g., chlorine, bromine), an amino group, an alkoxy group, an aryloxy group, a hydroxyl group, an aryl group, a carbonamido group, a sulfonamido group, an alkanoyloxy group, a benzoyloxy group, an ureido group, a carbamate group, a carbamoyloxy group, a carbonate group, a carboxyl group, a sulfo group and an alkyl group (e.g., methyl ethyl, propyl).

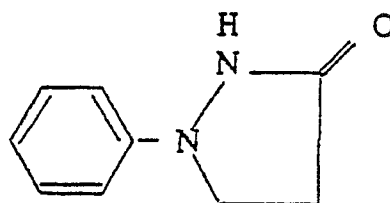
The alkyl group for R^{31} , R^{32} , R^{33} , R^{34} , R^{35} and R^{36} in the formulae (X-I) and (X-II) is an alkyl group having from 1 to 10 carbon atoms (e.g., methyl, ethyl, propyl, butyl), and the alkyl group may optionally be substituted by a hydroxyl group, an amino group, a sulfo group and/or a carboxyl group. As the aryl group, there are phenyl group, naphthyl group, xylyl group and tolyl group. The aryl group may be substituted by substituent(s) selected from a halogen atom (e.g., chlorine, bromine), an alkyl group (e.g., methyl ethyl, propyl), a hydroxyl group, an alkoxy group (e.g., methoxy, ethoxy), a sulfo group and a carboxyl group.

In the present invention, the compounds of the formula (X-II) are especially effective. In the formula (X-II), R^{31} , R^{32} , R^{33} , and R^{34} each are preferably a hydrogen atom, a substituted alkyl group having from 1 to 10 carbon atoms or a substituted or unsubstituted aryl group, more preferably a hydrogen atom, a methyl group, a hydroxymethyl group, a phenyl group or hydroxyl group or a phenyl group substituted by hydrophilic group(s) of an alkoxy group, a sulfo group and a carboxyl group.

Specific examples of the compounds of the formula (X-II) are mentioned below.

(X - 1)

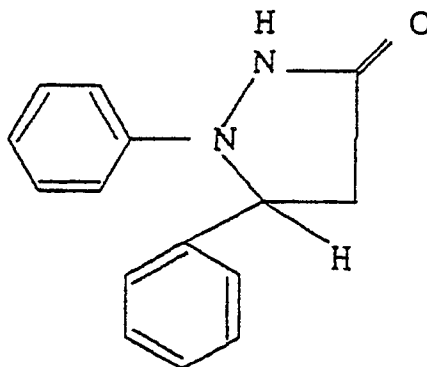
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(X - 2)

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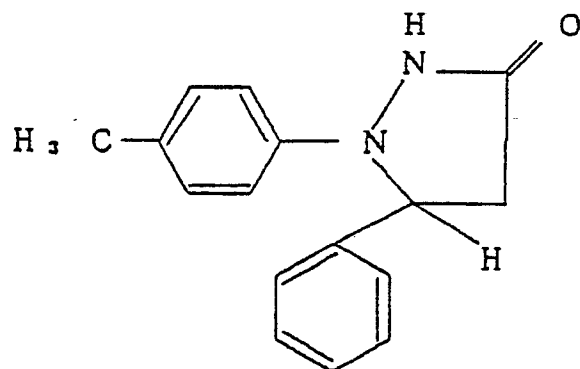


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(X - 3)

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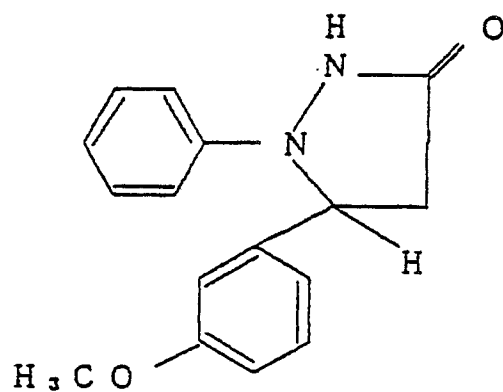
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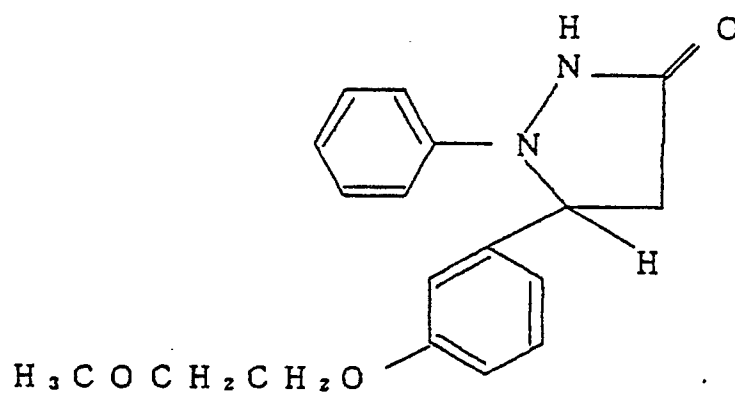
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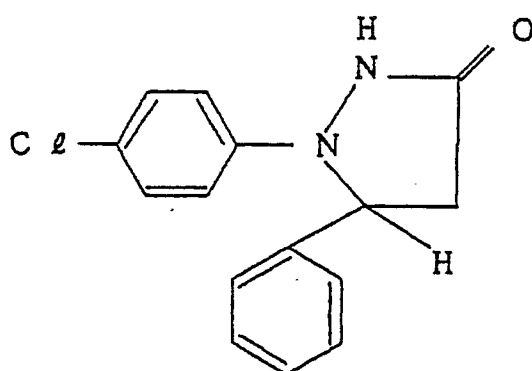
(X - 4)



(X - 5)



(X - 6)

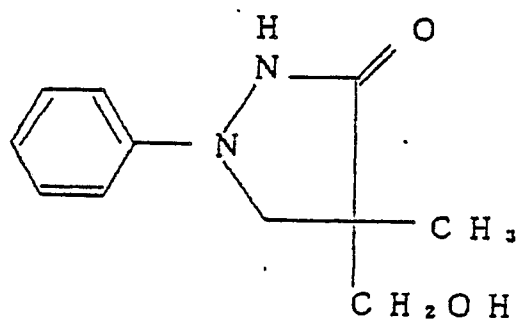


(X - 7)

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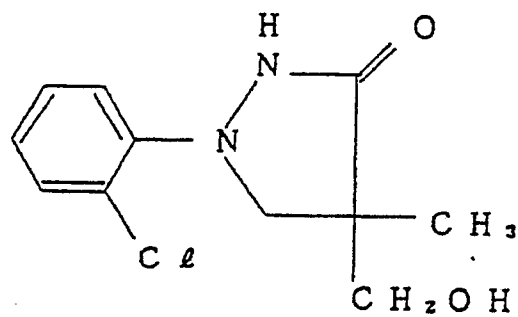


(X - 8)

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(X - 9)

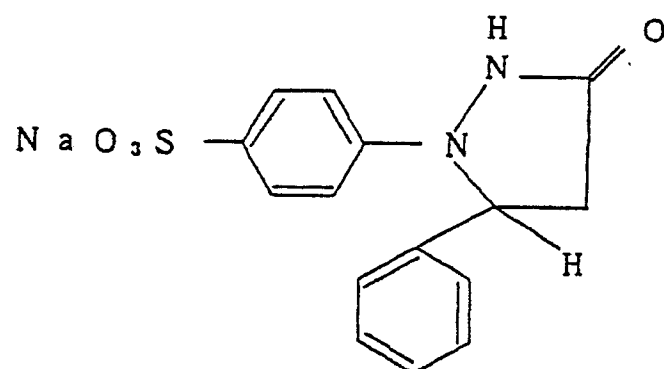
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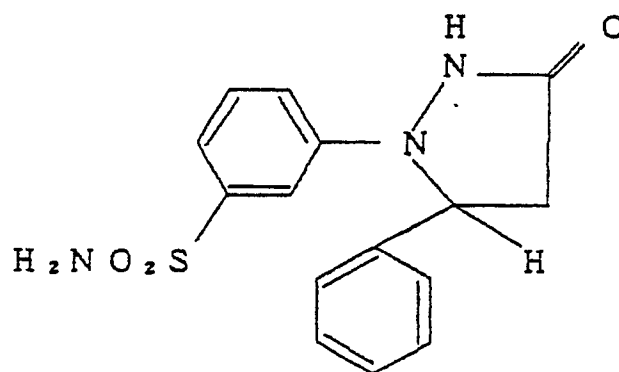
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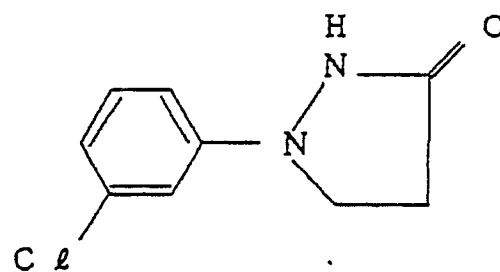
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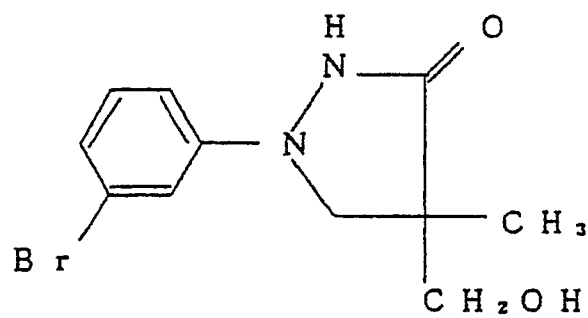
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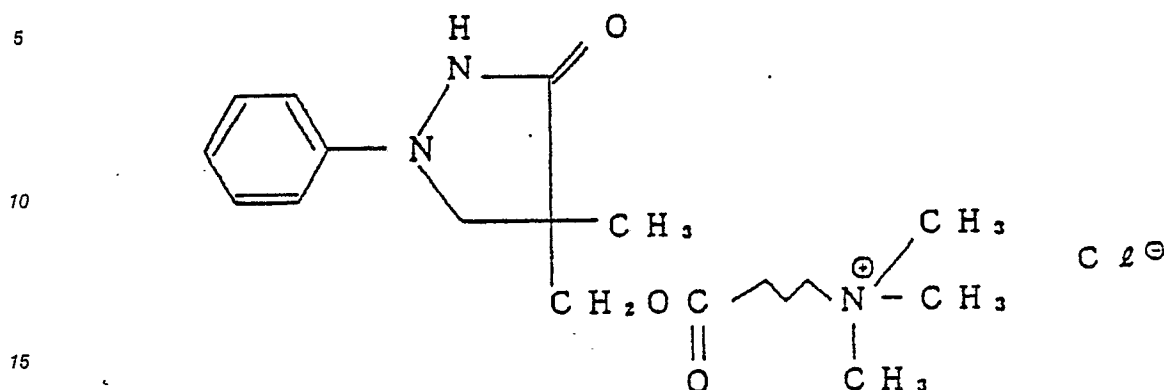
(X - 1 1)



(X - 1 2)



(X-13)



Precursors of the above-mentioned diffusive reducing agents are also applicable to the photographic materials of the present invention having the compound of the formula (I).

Precursors of diffusive reducing agents indicate such compounds that do not have a developing action in storage of the photographic material before use but may release a reducing agent only by the action of a pertinent activating agent (for example, bases, nucleophilic agents) or by the action of heat.

In particular, as the reactive functional group in the reducing agent precursor for use in the present invention is blocked with a blocking group, the precursor does not have a function as a reducing agent before development but may function as a reducing agent under an alkaline condition or under heat because of the cleavage and removal of the blocking group.

As the reducing agent precursors for use in the present invention, there are mentioned, for example, 2- and 3-acyl derivatives or 2-aminoalkyl or hydroxyalkyl derivatives of 1-phenyl-3-pyrazolidinone, metal salts (e.g., cadmium, calcium or barium salt) of hydroquinone or catechol, halogenated acyl derivatives of hydroquinone, oxazine or bisoxazine derivatives of hydroquinone, lactone-type ETA (electron transferring agent) precursors, quaternary ammonium group containing hydroquinone derivatives, cyclohexakis-2-ene-1,4-dione type compounds; as well as compounds of releasing a reducing agent by electron transfer reaction, compounds of releasing a reducing agent by intramolecular nucleophilic substitution reaction, reducing precursors blocked with phthalide group, and reducing agent precursors blocked with indomethyl group.

The reducing agent precursors for use in the present invention are known compounds; and developing agent precursors described in, for example, U.S. Patents 767,704, 3,241,967, 3,246,988, 3,295,978, 3,462,266, 3,586,506, 3,615,439, 3,650,749, 4,209,580, 4,330,617 and 4,310,612, British Patents 1,023,701, 1,231,830, 1,258,924 and 1,346,920, JP-A-57-40245, JP-A-58-1139, JP-A-58-1140, JP-A-59-178458, JP-A-59-183449 and JP-A-59-182450 can be employed.

In particular, precursors of 1-phenyl-3-pyrazolidinones described in JP-A-59-178458, JP-A-59-182449 and JP-A-59-182450 are preferred.

The amount of the diffusive reducing agent and/or the diffusive reducing agent precursor for use in the present invention may vary in a broad range, but preferably, it is from 0.001 mol to 5 mols, more preferably from 0.01 mol to 1.5 mols, per mol of silver halide.

As mentioned above, a non-diffusive reducing agent which is called an electron donor can be employed together with the diffusive reducing agent in the present invention. Combination use of such non-diffusive reducing agent is preferred when the compounds belonging to the above mentioned group (3) are employed as the color donor compounds. The electron donor is preferably incorporated into the photographic material in the vicinity of the dye donor compound and therefore it is added to the layer containing the dye donor compound. More preferably, it is added to the same phase as that containing the dye donor compound. As the electron donors for use in the present invention, there are mentioned non-diffusive group-containing dihydroxy benzenes, catechols, pyrogallols, sulfonamidophenols and sulfonamidonaphthols, as well as the reducing agents and/or precursors thereof described in European Patent Application 220746A (pages 84 to 95), JP-A-63-262647 and JP-A-1-142631. In addition, compounds of the same kind as the compounds of the formula (I) can also be used as the electron donor.

The hydrophobic additives such as dye donor compounds and electron donors can be introduced into

the layers of the photographic materials by the same dispersion method as that for the compounds of the formula (I) mentioned above.

The photographic material of the present invention can contain a compound having a function of activating the developability thereof and of stabilizing the image formed. Examples of such compounds which can preferably be employed in the present invention are described in U.S. Patent 4,500,626, columns 51 to 52.

In the system of forming an image by diffusion and transfer of the dye, a dye-fixing material is employed together with the light-sensitive photographic material. The system may be classified into two major categories, an embodiment in which the light-sensitive element and the dye-fixing element are respectively disposed on two independent supports and another embodiment in which the two elements are provided as coating layers on one and same support. As regards the relation between the light-sensitive photographic material and the dye-fixing material, the relation thereof to the support and the relation thereof to the white reflective layer, those described in U.S. Patent 4,500,626, column 57 are applicable to the present invention.

The dye-fixing material which is preferably used in the present invention has at least one layer containing a mordant agent and a binder. As the mordant agent, anyone known in the photographic field can be employed, and specific examples thereof include the mordant compounds described in U.S. Patent 4,500,626, columns 58 to 59 and JP A-61-88256, pages 32 to 41; and those described in JP-A-62-244043 and JP-A-62-244036. In addition, dye-receiving high polymer compounds for example those described in U.S. Patent 4,463,079 can also be employed.

The dye-fixing material may optionally have, if desired, auxiliary layers such as protective layers, peeling layers and curling preventing layers. In particular, provision of the protective layer on the material is helpful.

The layers constituting the light-sensitive photographic material and dye-fixing material can contain a high boiling point organic solvent as the plasticizer, sliding agent or agent of improving peeling of the photographic material and the dye-fixing material from each other. Concretely, the compounds described in JP-A-62-253159, page 25 and JP-A-62-245253 are referred to.

In addition, for the above purpose, various kinds of silicone oils (which may be all silicone oils including dimethylsilicone oil and modified silicone oils formed by introducing various organic groups into dimethylsiloxane) can also be used. As examples of such silicone oils, there are mentioned various modified silicone oils described in Modified Silicone Oils (technical data published by Shin-Etsu Silicone Co.), pages 6 to 18B. Above all, carboxy-modified silicone oil (trade name: X-22-3701 made by Shin-Etsu Silicone Co.) is effective.

Further, the silicone oils described in JP-A-62-215958 and JP-A-63-46449 are also useful.

The light-sensitive photographic material and the dye-fixing material can contain an anti-fading agent. Such anti-fading agent includes an antioxidant, an ultraviolet absorbent as well as various kinds of metal complexes.

As examples of the antioxidant, there are chroman compounds, coumaran compounds, phenol compounds (e.g., hindered phenols), hydroquinone derivatives, hindered amine derivatives and spiroindane compounds. The compounds described in JP-A-159644 are also effective.

As examples of the ultraviolet absorbent, there are benzotriazole compounds (U.S. Patent 3,533,796), 4-thiazolidone compounds (U.S. Patent 3,352,681), benzophenone compounds (JP-A-46-2784) and other compounds described in JP-A-54-48535, JP-A-62-136641 and JP-A-61-38256. Further, the ultraviolet-absorbing polymers described in JP-A-62-260152 are also effective.

As examples of the metal complexes, there are mentioned the compounds described in U.S. Patents 2,241,155, 4,245,013 (columns 3 to 36) and 4,254,195 (columns 3 to 8), JP-A-62-174741, JP-A-61-88256 (pages 27 to 29), JP-A-1-75568 and JP-A-63-199248.

Examples of the useful anti-fading agent are described in JP-A-62-215272 (pages 125 to 137).

The anti-fading agent for preventing the dye as transferred to the dye-fixing material from fading may previously be incorporated into the dye-fixing material or, alternatively, it may be supplied to the dye-fixing material from an external source of the agent-containing light-sensitive photographic material.

The above-mentioned antioxidant, ultraviolet absorbent and metal complex can be employed in the present invention in the form of a combination thereof.

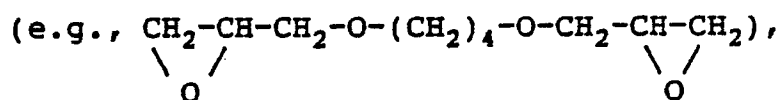
The light-sensitive photographic material and the dye-fixing material can contain a brightening agent. In particular, it is preferred to incorporate a brightening agent in the dye-fixing material or to supply the same to the said material from an external source of the agent-containing light-sensitive photographic material. As examples of the agent, the compounds described in K. Venkataraman, The Chemistry of Synthetic Dyes, Vol. V, Chap. 8, and JP-A-61-143752 are referred to. Specifically, there are mentioned stilbene compounds

coumarin compounds, biphenyl compounds, benzo xazolyl compounds, naphthalimide compounds, pyrazoline compounds and carbostyryl compounds.

A fluorescent whitening agent can be employed in combination with the anti-fading agent.

The layers constituting the light-sensitive photographic material and dye-fixing material can contain a hardening agent. As examples thereof, the hardening agents described in U.S. Patent 4,678,739 (column 41) and JP-A-59-116655, JP-A-62-245261 and JP-A-61-18942 are mentioned. Specifically, there are mentioned aldehyde hardening agents (e.g., formaldehyde), aziridine hardening agents, epoxy hardening agents,

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15 vinylsulfone hardening agents (e.g., N,N'-ethylene-bis(vinylsulfonylacetamido)ethane), N-methylol hardening agents (e.g., dimethylolurea) and high polymer hardening agents (e.g., compounds described in JP-A-62-234157).

The layers constituting the light-sensitive photographic material and dye-fixing material can contain various surfactants for various purposes of coating aid, improvement of peeling property, improvement of slide property, prevention of static charges and enhancement of developability. Specific examples of such surfactants are described in JP-A-62-173463 and JP-A-62-183457.

The layers constituting the light-sensitive photographic material and dye-fixing material can contain organic fluoro compounds for the purposes of improvement of slide property, prevention of static charges and improvement of peeling property. As specific examples of such organic fluoro compounds, there are mentioned fluorine surfactants described in JP-B-57-9053 (columns 8 to 17) and JP-A-61-20944 and JP-A-62-135826, as well as hydrophobic fluorine compounds such as fluorine oils and the like oily fluorine compounds and ethylene tetrafluoride resins and the like solid fluorine compound resins.

The light-sensitive photographic material and dye-fixing material can contain a mat agent. As the mat agent, there are mentioned silicone dioxide and the compounds described in JP-A-61-88256 (page 29) such as olefins or polymethacrylates, as well as the compounds described JP-A-63-274944 and JP-A-63-274952 such as benzoguanamine resin beads, polycarbonate resin beads and AS (acrylonitrile-styrene) resin beads.

In addition, the layers constituting the light-sensitive photographic material and dye-fixing material may further contain a thermal solvent, a defoaming agent, a microbicidal and fungicidal agent, a colloidal silica and other additives. Examples of such additives are described in JP-A-61-88256 (pages 26 to 32).

35 In accordance with the present invention, the light-sensitive photographic material and/or the dye-fixing material can contain an image formation accelerator. The image formation accelerators include those which promote the redox reaction between the silver salt oxidizing agent and the reducing agent, those which promote the reactions of forming a dye from a dye donor substance or decomposing a dye or releasing a diffusive dye, and those which promote the migration of the dye from the photosensitive layer to the dye-fixing layer. Classified by physicochemical function, the image formation accelerators can be classified into bases or base precursors, nucleophilic compounds, high boiling point organic solvents (oils), hot-melting solvents, surfactants and compounds which interact with silver or silver ions, for instance. However, each of these substances generally has plural functions and provides several of the above-mentioned effects. A detailed discussion on these substances can be found in U.S. Patent 4,678,739, columns 38 to 40.

45 As the base precursor, there are mentioned salts of an organic acid which may be decarboxylated under heat and a base, as well as compounds capable of releasing an amine by intramolecular nucleophilic substitution reaction, Rossen rearrangement or Backmann rearrangement. Specific examples thereof are described in U.S. Patent 4,511,493 and JP-A-62-65038.

In the system where heat-development and dye transfer are effected simultaneously in the presence of a small amount of water, it is preferred to incorporate the base and/or base precursor in the dye-fixing material for the purpose of improving the storage stability of the light-sensitive photographic material.

In addition, the combination of a hardly soluble metal compound and a compound capable of complexing with the metal ion which constitutes the said hardly soluble metal compound (hereinafter referred to as "complex-forming compound") described in European Patent Application 210,660A as well as the compounds of giving a base by electrolysis described in JP-A-61-232451 can also be used as the base precursor. Use of the former is especially effective. The hardly soluble metal compound and the complex-forming compound are advantageously separately added to different light-sensitive photographic material and dye-fixing material.

The light-sensitive photographic material and/or the dye-fixing material of the present invention can contain various development stopping agents for the purpose of always obtaining constant images despite fluctuation of the development temperature and processing time in development.

The terminology "development stopping agent" as used herein means a compound which, after proper development, quickly neutralizes the base or reacts with the base to lower the base concentration in the layer and thereby terminates the development or a compound which interacts with silver and silver salt to arrest development. Specifically, there are mentioned acid precursors which releases an acid under heat, electrophilic compounds which react with the existing base by substitution reaction under heat, as well as nitrogen-containing heterocyclic compounds, mercapto compounds and precursors thereof. More precisely, the compounds are described in JP-A-62-253159 (pages 31 to 32).

The support which is employable in the light-sensitive photographic material and dye-fixing material may be any support that withstands the processing temperature. In general, paper and synthetic high polymer films are used as the support. Specifically, the support includes films of polyethylene terephthalate, polycarbonate, polyvinyl chloride, polystyrene, polypropylene, polyimide, celluloses (e.g., triacetyl cellulose) and those films containing a pigment such as titanium oxide; synthetic paper made of polypropylene by filming method; mixed paper made of a synthetic resin pulp (e.g., polyethylene) and a natural pulp; as well as Yankee paper, baryta paper, coated paper (especially cast-coated paper), metals, cloth and glass.

These supports may be used directly as they are or may be used in the form as coated with a synthetic high polymer substance (e.g., polyethylene) on one surface or both surfaces thereof.

In addition, the supports described in JP-A-62-25319, pages 29 to 31 can also be employed in the present invention.

The surface of the support may be coated with a hydrophilic binder and a semiconductive metal oxide (e.g., alumina sol or tin oxide) or an antistatic agent such as carbon black.

For imagewise exposing and recording the photographic material of the present invention, various methods can be employed, which include, for example, a method of directly photographic scene or portrait with a camera; a method of exposing through a reversal film or negative film by the use of a printer or an enlarger; a method of scanning and exposing an original through a slit by the use of an exposing device of a duplicator; a method of exposing an image information via the corresponding electric signal by emitting the same with a light emitting diode or various lasers; and a method of outputting an image information with an image display device such as CRT (cathode-ray tube), liquid crystal display, electroluminescence display or plasma display and then exposing the same directly or via some optical system.

As the light source to be used for recording an image on the photographic material, those described in U.S. Patent 4,500,626 (column 56), such as natural light, tungsten lamp, light-emitting diode, laser rays and CRT rays can be employed, as mentioned above.

A wavelength converting element comprising a combination of a non-linear optical material and a coherent light source such as laser rays can also be used for image exposure. The terminology "non-linear optical material" as used herein means a material capable of expressing non-linear property between the polarization to be caused by some strong photoelectric field such as laser rays and the electric field. As such material, inorganic compounds such as lithium niobate, potassium dihydrogenphosphate (KDP), lithium iodate and BaB_2O_4 , as well as urea derivatives, nitro aniline derivatives, nitropyridine-N-oxide derivatives (e.g., 3-methyl-4-nitropyridine-N-oxide (POM)) and the compounds described in JP-A-61-54362 and JP-A-62-210432 are preferably employed in the present invention. As the form of the wavelength converting element, single crystal optical wave guide type and fiber type are known, both of which are employable in the present invention.

As the image information to be applicable to the photographic material of the present invention, anyone of the image signal to be obtained from video camera or electronic still camera; the television signal as standardized by Japan Television Signal Standard (NTSC); the image signal obtained by dividing the original into plural elements with scanner; and the image signal formed by the use of computer such as CG (computer graphics) or CAD (computer assisted drawing), can be employed.

The light-sensitive photographic material and/or the dye-fixing material may be in such form that has an electroconductive heating element layer as the heating means for heat development and diffusion and transfer of the formed dyes. In this case, the heating element may be either transparent or opaque, and the elements described in JP-A-61-145544 can be employed. The electroconductive layer acts also as an antistatic layer.

The heating temperature in the heat-development step may be from about 50°C to about 250°C . Especially preferably, the temperature is from about 80°C to about 180°C . The step of diffusing and transferring the dye formed by the development may be effected simultaneously with the heat-development step or after the same. In the latter case, the heating temperature in the transfer step may be from the

temperature in the previous heat-development step to room temperature. Preferably, it is from 50° C to a temperature lower than the temperature in the heat-development step by about 10° C.

Migration of the dye formed may be effected only by heat, but a solvent may be used for the purpose of accelerating the migration of the dye.

5 Further, as described in detail in JP-A-59-213443 and JP-A-61-238056, the method where development and transfer are carried out in the presence of a small amount of a solvent, especially water, either at the same time or in a continuous sequence can be advantageously utilized. In this method, the heating temperature is preferably higher than 50° C and lower than the boiling point of the solvent used. For instance, where the solvent is water, the temperature is desirably from 50° C to 100° C.

10 As examples of the solvents to be used for acceleration of development and/or migration of the diffusive dye formed to the dye-fixing material, there are mentioned water and an aqueous basic solution containing an inorganic alkali metal salt or an organic base. As the bases, those mentioned hereinbefore for the image formation accelerators can be employed. In addition, a low boiling point solvent or a mixed solvent comprising a low boiling point and water or an aqueous basic solution can also be used. Further, 15 surfactants, antifoggant as well as hardly soluble metals and complex-forming compounds can be incorporated into the solvents.

The solvent can be used by applying the same to either the dye-fixing material or the light-sensitive photographic material or to both of them. The amount thereof to be used may be a small amount of less than the weight of the solvent corresponding to the maximum swollen volume of the total coated layers 20 (especially less than the amount obtained by subtracting the weight of the total coated layers from the weight of the solvent corresponding to the maximum swollen volume of the total coated layers).

As a method of applying the solvent to the light-sensitive layer or the dye-fixing layer, for example, the method described in JP-A-61-147244 (page 26) can be employed. Apart from this, the solvent can be incorporated into either the light-sensitive photographic material or the dye-fixing material or into both of 25 them in the form of solvent-containing microcapsules.

In order to accelerate migration of the dye formed, a system of incorporating a hydrophilic thermal solvent which is solid at room temperature but may melt at a high temperature into the light-sensitive photographic material or into the dye-fixing material may also be employed in the present invention. In the system, the hydrophilic thermal solvent may be incorporated in either the light-sensitive photographic 30 material or the dye-fixing material or in both of them. The layer to which the solvent is added may be any of the emulsion layer, interlayer, protective layer and dye-fixing layer, but the solvent is preferably added to the dye-fixing layer and/or the adjacent layer(s).

As examples of the thermal solvent to be employed in the system, there are mentioned ureas, pyridine, amides, sulfonamides, imides, oximes, alcohols and other heterocyclic compounds.

35 Also for accelerating migration of the dye formed, a high boiling point organic solvent may be incorporated into the light-sensitive photographic material and/or the dye-fixing material.

For heating the material in the development step and/or the transfer step, the material may be contacted with a heated block or plate, or with a hot plate, hot presser, hot roller, halogen lamp heater or infrared or far-infrared lamp heater or is passed through a high temperature atmosphere.

40 Where the light-sensitive photographic material is attached to the dye-fixing material and combined together under pressure, the method described in JP-A-61-147244 (page 27) is applicable to the present case with respect to the pressure condition and the means of pressing the combined materials.

For processing the photographic elements of the present invention, anyone of general heat-developing apparatus can be utilized. For instance, the apparatus described in JP-A-59-75247, JP-A-59-177547, JP-A-59-181353 and JP-A-60-18951 and JP-A-U-62-25944 are preferably employed. (The term "JP-A-U" as used 45 herein means an "unexamined published Japanese utility model application".) The present invention will be explained in more detail with reference to the following examples, which, however, are not intended to restrict the scope of the present invention.

50

EXAMPLE 1

Emulsion (I) for the first layer was prepared as mentioned below.

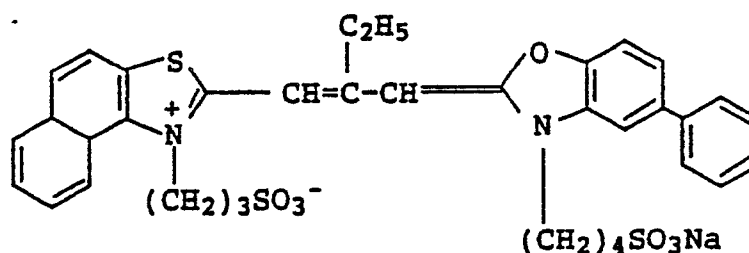
55 The following Solution (I), Solution (II) and Solution (III) were simultaneously added to a well stirred aqueous gelatin solution (prepared by adding 20 g of gelatin, 1 g of potassium bromide and 0.5 g of OH-(CH₂)₂S(CH₂)₂OH to 800 ml of water and heated at 50° C), all at the same flow rate over a period of 30 minutes. Accordingly, a dye-adsorbed monodispersed silver bromide emulsion having mean grain size of

0.42 μm was prepared.

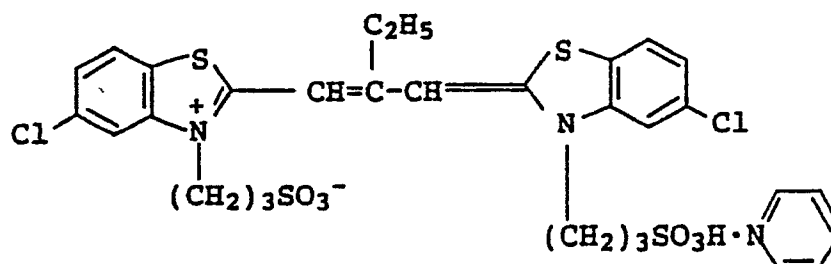
After rinsed with water and desalted, 20 g of lime-processed ossein gelatin was added and the resulting emulsion was adjusted to pH of 6.4 and pAg of 8.2. Afterwards, this was heated at 60 °C, and 9 mg of sodium thiosulfate, 6 ml of 0.01% aqueous solution of chloroauric acid and 190 mg of 4-hydroxy-6-methyl-1,3,3a,7-tetraazaindene were added thereto and chemical sensitization of the emulsion was effected for 45 minutes. The yield of the emulsion was 635 g.

	Solution (I) (Water to make 450 ml)	Solution (II) (Water to make 400 ml)	Solution (III) (Methanol to make 60 ml)
AgNO ₃	100 g	-	-
KBr	-	70 g	-
Dye (a)	-	-	40 mg
Dye (b)	-	-	80 mg

Dye (a):



Dye (b):



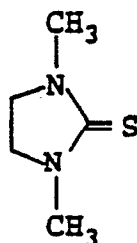
Emulsion (II) for the third layer was prepared as mentioned below.

The following Solution (I) and Solution (II) were simultaneously added to a well stirred aqueous gelatin solution (prepared by adding 20 g of gelatin, 0.30 g of potassium bromide, 6 g of sodium chloride and 0.015 g of the following Compound (A) to 730 ml of water and heated at 60.0 °C), all at the same flow rate over a period of 60 minutes. After addition of the Solution (I), the following Solution (III) (sensitizing dye-containing methanol solution) was added. Accordingly, a dye-adsorbed monodispersed cubic emulsion having a mean grain size of 0.45 μm was prepared.

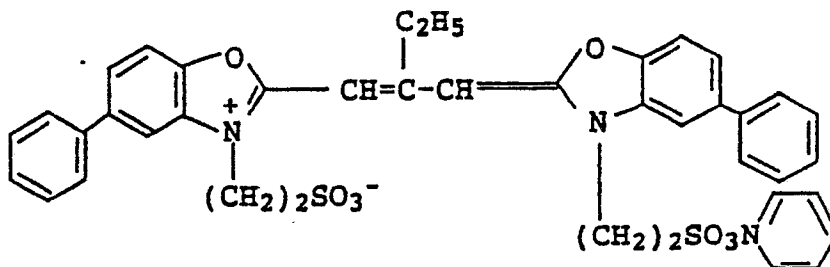
After rinsed with water and desalted, 20 g of gelatin was added and the resulting emulsion was adjusted to pH of 6.4 and pAg of 7.8. Afterwards, this was chemically sensitized at 60 °C. The reagents used for the

chemical sensitization were 1.6 mg of triethylthiourea and 100 mg of 4-hydroxy-6-methyl-1,3,3a,7-tetraazaindene, and the ripening time was 55 minutes. The yield of the emulsion was 635 g.

Compound (A):



Sensitizing Dye (C):



	Solution (I) (Water to make 400 ml)	Solution (II) (Water to make 400 ml)	Solution (III) (Methanol to make 77 ml)
AgNO ₃	100.0 g	-	-
KBr	-	56.0 g	-
NaCl	-	7.2 g	-
Dye (c)	-	-	0.23 mg

Emulsion (III) for the fifth layer was prepared as mentioned below.

The following Solution (I) and Solution (II) were simultaneously added to a well stirred aqueous gelatin solution (prepared by adding 30 g of gelatin, 3 g of potassium bromide, and 0.5 g of HO(CH₂)₂S(CH₂)₂S-(CH₂)₂OH to 600 ml of water and heated at 65°C) over a period of 20 minutes. Afterwards, the following Solution (III) and Solution (IV) were simultaneously added thereto over a period of 30 minutes. After rinsed with water and desalted, 20 g of lime-processed ossein gelatin was added and the resulting emulsion was adjusted to pH of 6.2 and pAg of 8.5. Afterwards, this was chemically sensitized to its optimum state with sodium thiosulfate, chloroauric acid and 4-hydroxy-6-methyl-1,3,3a,7-tetraazaindene. Accordingly, 600 g of monodispersed octahedral silver iodide emulsion having a mean grain size of 0.50 μm was obtained.

	Solution (I) (Water to make 200 ml)	Solution (II) (water to make 200 ml)	Solution (III) (Water to make 400 ml)	Solution (IV) (Water to make 400 ml)
AgNO ₃	30 g	-	70 g	-
KBr	-	19 g	-	49 g
KI	-	1.5 g	-	-

In the following, the asterisked compounds are defined hereinunder.

The dye donor substance-containing gelatin dispersion was prepared as follows:

18 g of Yellow Dye Donor Substance (1)*, 12 g of Electron Donor (1)* and 9 g of tricyclohexyl phosphate were weighed, and 46 ml of ethyl acetate was added thereto and heated at about 60 °C to give a uniform solution. The resulting solution was stirred together with 100 g of 10% solution of lime-processed gelatin, 60cc of water and 1.5 g of sodium dodecylbenzene-sulfonate and blended, and the resulting mixture was dispersed in a homogenizer at 10,000 rpm for 10 minutes. The resulting dispersion is called "yellow dye donor substance dispersion".

Magenta dye donor substance dispersion and cyan dye donor substance dispersion were also prepared in the same manner as the yellow dye donor substance dispersion, but using Magenta Dye Donor Substance (2)* and Cyan Dye Donor Substance (3)*, respectively.

Using the above-prepared emulsions and dispersions, a multilayer color photographic material (Sample No. 101) having the layers mentioned below was prepared.

Sixth Layer : Protective Layer	
Gelatin	0.90 g/m ²
Mat agent (silica)	0.03 g/m ²
Water-soluble polymer (1)*	0.02 g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (2)*	0.13 g/m ²
Hardening agent (1)*	8×10 ⁻³ g/m ²
Zn(OH) ₂	0.45 g/m ²

Fifth Layer : Blue Light-sensitive Layer	
Emulsion (III)	0.33 g/m ² as Ag
Gelatin	0.56 g/m ²
Antifoggant (2)*	5.0×10 ⁻⁴ g/m ²
Yellow dye donor substance (1)*	0.40 g/m ²
High boiling point organic solvent (1)*	0.20 g/m ²
Electron donor (1)*	0.27 g/m ²
Surfactant (3)*	0.05 g/m ²
Hardening agent (1)*	8×10 ⁻³ g/m ²
Water-soluble polymer (1)*	0.02 g/m ²

Fourth Layer : Interlayer	
Gelatin	0.70 g/m ²
Reducing agent (1)*	0.10 g/m ²
High boiling point organic solvent (1)*	0.05g/m ²
Surfactant (3)*	4.2×10^{-3} g/m ²
Surfactant (1)*	0.02 g/m ²
Surfactant (4)*	0.07 g/m ²
Electron-transmitting agent precursor (1)*	0.05 g/m ²
Electron-transferring agent (1)*	0.11 g/m ²
Water-soluble polymer (1)*	0.02 g/m ²
Hardening agent (1)*	8×10^{-3} g/m ²

Third Layer : Green Light-sensitive Layer	
Emulsion (II)	0.21 g/m ² as Ag
Gelatin	0.29 g/m ²
Antifoggant	6.0×10^{-4} g/m ²
Magenta dye donor substance (2)*	0.31 g/m ²
High boiling point organic solvent (1)*	0.16 g/m ²
Electron donor (1)*	0.16 g/m ²
Surfactant (3)*	0.04 g/m ²
Hardening agent (1)*	8×10^{-3} g/m ²
Water-soluble polymer (1)*	0.02 g/m ²

Second Layer : Interlayer	
Gelatin	0.80 g/m ²
Zn(OH) ₂	0.45 g/m ²
Reducing agent (1)*	0.10 g/m ²
High boiling point organic solvent (1)*	0.05 g/m ²
Surfactant (3)*	4.2×10^{-2} g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (4)*	0.10 g/m ²
Electron-transferring agent precursor (1)*	0.05 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Hardening agent (1)*	8×10^{-3} g/m ²

First Layer : Red Light-sensitive Layer	
Emulsion (I)	0.22 g/m ² as Ag
Gelatin	0.30 g/m ²
Antifoggant (1)*	6.0×10 ⁻⁴ g/m ²
Cyan dye donor substance (3)*	0.28 g/m ²
High boiling point organic solvent (1)*	0.14 g/m ²
Electron donor (1)*	0.16 g/m ²
Surfactant (3)*	0.04 g/m ²
Hardening agent (1)*	8×10 ⁻³ g/m ²
Water-soluble polymer (1)*	0.02 g/m ²

Support:

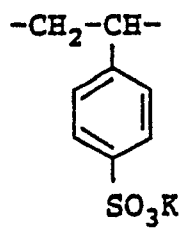
Polyethylene terephthalate (thickness: 100 μm)

Backing Layer :	
Carbon black	0.44 g/m ²
Polyester	0.30 g/m ²
Polyvinyl chloride	0.30 g/m ²

The compounds used above were as follows:

Water-soluble Polymer (1)*

5



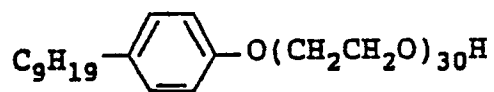
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Surfactant (1)* Aerosol OT

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Surfactant (2)*

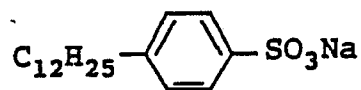
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Surfactant (3)*

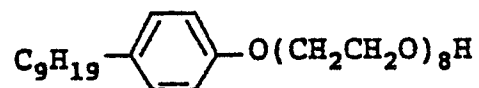
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Surfactant (4)*

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High Boiling Point Organic Solvent (1)*

Tricyclohexyl Phosphate

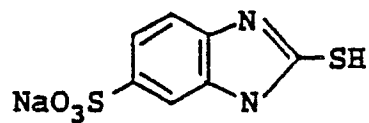
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Hardening Agent (1)*

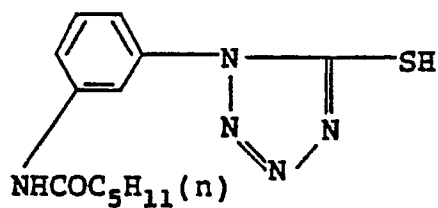
1,2-Bis(vinylsulfonylacetamido)ethane

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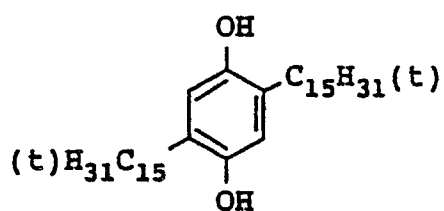
Antifoggant (1)*



Antifoggant (2)*



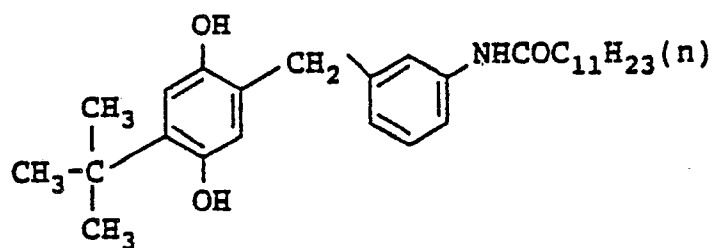
Reducing Agent (1)*



Electron Donor (1)*

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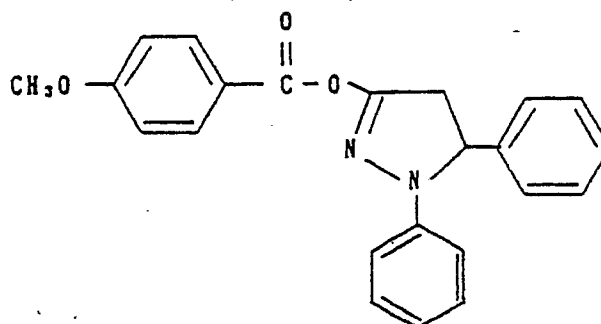


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Electron-transferring Agent Precursor (1)*

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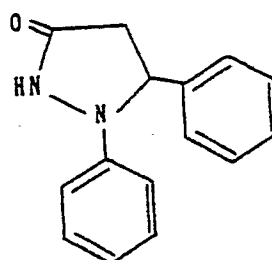
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Electron-transferring Agent (1)*

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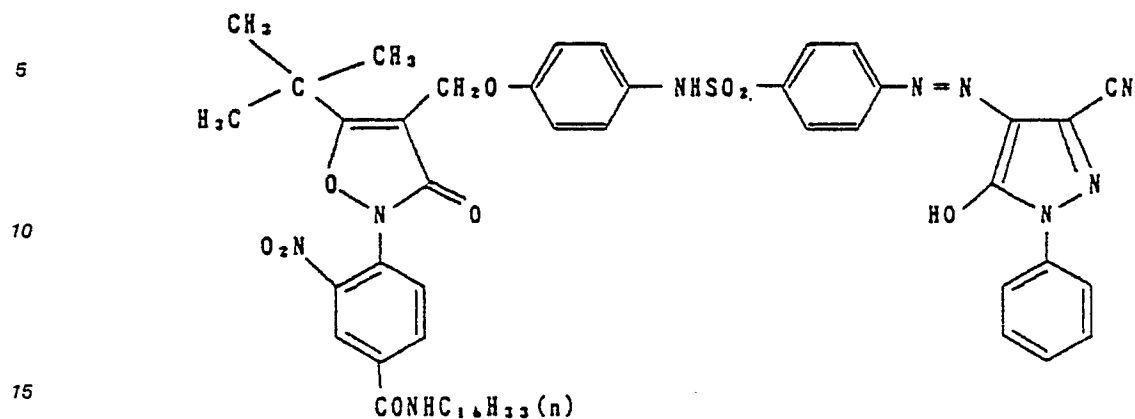
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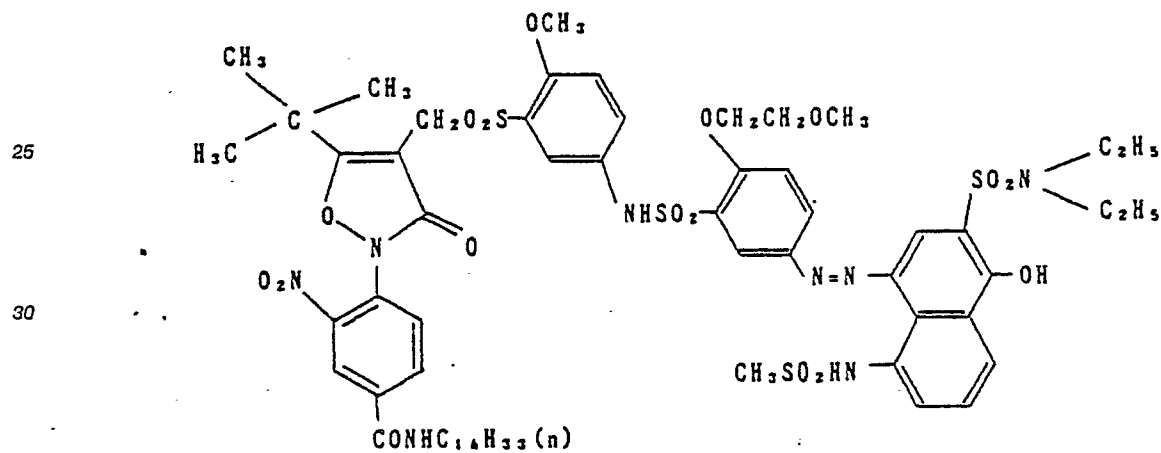
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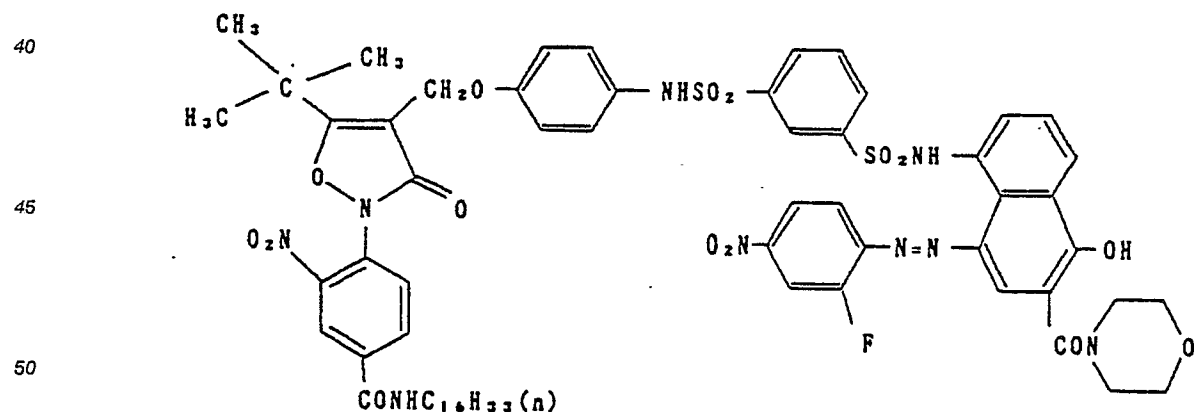
Yellow Dye Donor Substance (1)*



Magenta Dye Donor Substance (2)*



Cyan Dye Donor Substance (3)*



55 The reducing agent (1)* was dispersed in the high boiling point organic solvent (1)* as mentioned below and added to the layers.

15 g of the reducing agent (1)* and 7.5 g of the high boiling point organic solvent (1)* were dissolved in 40 ml of ethyl acetate at 60° C to form a uniform solution. The resulting solution was blended with 100 g of 10% aqueous solution of lime-processed gelatin and 12.6 ml of 5% aqueous solution of the surfactant (3)*

with stirring and then dispersed in a homogenizer at 10,000 rpm for 10 minutes.

Samples Nos. 102 to 105 were prepared in the same manner as Sample No. 101, except that the reducing agent (1)* in the second layer and the fourth layer was replaced by the same molar amount of the compound of the present invention as indicated in Table 1 below. Sample No. 106 was prepared also in the same manner as Sample No. 101, except that the amount of the reducing agent (1)* in the second layer and the fourth layer was increased twice.

Next, a dye-fixing material sample was prepared as mentioned below.

The layers each having the composition mentioned below were coated on a polyethylene-laminated paper support to prepare Dye-Fixing Material Sample (R-1).

Constitution of Dye-Fixing Material (R-1):

Third Layer :	
Gelatin	0.05 g/m ²
Silicone oil (*1)	0.04 g/m ²
Surfactant (*2)	0.001 g/m ²
Surfactant (*3)	0.02 g/m ²
Surfactant (*4)	0.10 g/m ²
Guanidine picolinate	0.45 g/m ²
Polymer (*5)	0.24 g/m ²

Second Layer :	
Mordant agent (*6)	2.35 g/m ²
Polymer (*7)	0.60 g/m ²
Gelatin	1.40 g/m ²
Polymer (*5)	0.21 g/m ²
High boiling point solvent (*8)	1.40 g/m ²
Guanidine picolinate	1.80 g/m ²
Surfactant (*2)	0.02 g/m ²

First Layer :	
Gelatin	0.45 g/m ²
Surfactant (*4)	0.01 g/m ²
Polymer (*5)	0.04 g/m ²
Hardening agent (*9)	0.30 g/m ²

Support:

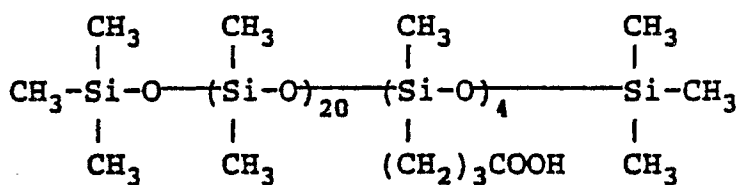
Polyethylene-laminated paper (thickness: 170 μ m) support

First Baking Layer :	
Gelatin	3.25 g/m ²
Hardening agent (*9)	0.23 g/m ²

Second Backing Layer	
Gelatin	0.44 g/m ²
Silicone oil (*1)	0.08 g/m ²
Surfactant (*2)	0.002 g/m ²
Mat agent (*10)	0.09 g/m ²

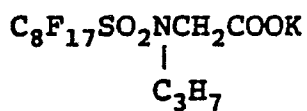
The compounds used above were as follows:

Silicone oil (*1):

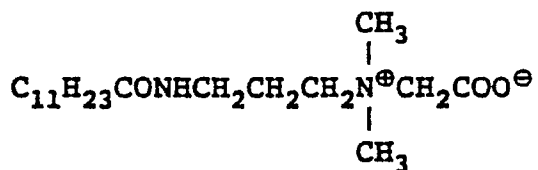


Surfactant (*2): Aerosol OT

Surfactant (*3):



Surfactant (*4):

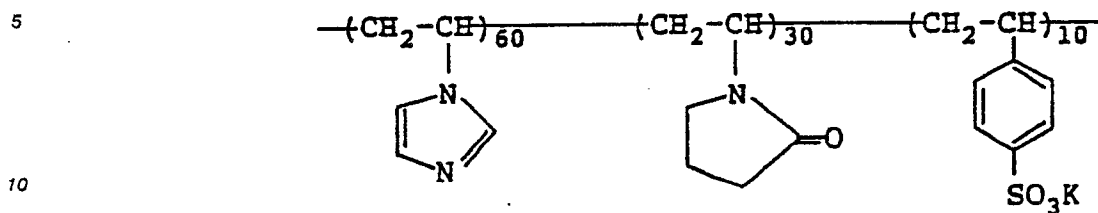


Polymer (*5):

Vinyl Alcohol-Sodium Acrylate (75/25 by mol) Copolymer

Polymer (*7):

Dextran (molecular weight: 70,000)

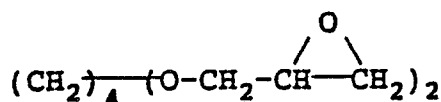
Mordant agent (*6):

15 High Boiling Point Organic Solvent (*8):

Reofos 95 (made by Ajinomoto Co.)

Hardening Agent (*9):

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Mat Agent (*10):

Benzoguanimie Resin (mean grain size: 10 μm)

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The thus prepared multilayer-structural color photographic Samples Nos. 101 to 106 were exposed with a spectrographic camera through a wedge where the density varied continuously in the direction perpendicular to the wavelength.

15 ml/m² of water was applied to the emulsion surface of each of the thus exposed samples with a wire bar and then attached to the image-receiving material sample with the coated surfaces facing to each other.

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The combined sample was heated with a heat roller whose temperature was so adjusted that the temperature of the water-absorbed surface could be 80°C, for 15 seconds. Next, the image-receiving material was peeled off from the light-sensitive material, and a spectrogram of blue, green and red corresponding to the wavelength was formed on the dye-fixing material.

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The color density of cyan and magenta in the blue light portion, that of cyan and yellow in the green light portion and that of magenta and yellow in the red light portion were measured with an X-Rite 310 TR densitometer. The results are shown in Table 1 below. On the other hand, the samples were exposed with a tungsten lamp of 4,000 luxes for 1/10 second and then processed in the same manner as above. The lowest density (Dmin portion) was measured and the results were also shown in the same Table 1.

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Table 1

Sample No.	Compound of Formula (I)	Blue Area		Green Area		Red Area		Dmin		
		Cyan	Magenta	Cyan	Yellow	Magenta	Yellow	Cyan	Magenta	Yellow
101 (comparison)	-	1.8	1.6	1.8	1.7	1.7	1.8	0.17	0.16	0.17
102	(13)	2.1	2.0	2.1	2.0	2.0	2.0	0.16	0.15	0.16
103	(15)	2.2	2.0	2.1	2.1	2.1	2.0	0.15	0.15	0.16
104	(17)	2.2	2.1	2.2	2.0	2.0	2.0	0.16	0.15	0.17
105	(22)	2.1	2.0	2.0	2.1	2.0	2.1	0.15	0.16	0.17
106 (comparison)	-	2.1	2.0	2.1	2.0	2.0	2.0	0.18	0.19	0.19

As is obvious from the results in Table 1 above, the compounds of the formula (I) are superior to the comparative reducing agent, as giving a higher color reproducibility and lower Dmin values. With respect to Sample No. 106 where the comparative reducing agent was added twice, although the color reproducibility was improved, the Dmin values increased and the film quality lowered so that the coated layer peeled off.

EXAMPLE 2

Using the same emulsions as those in Sample No. 101, a multilayer-structural color photographic material (Sample No. 201) having the constitution as shown below was prepared.

Unless otherwise specifically indicated, the additives were same as those in Sample No. 101.

The organic silver salt emulsion was prepared as mentioned below.

20 g of gelatin and 5.9 g of 4-acetylamino-phenylpropionic acid were dissolved in 1,000 ml of 0.1% aqueous sodium hydroxide solution and 200 ml of ethanol. The resulting solution was stirred at 40° C. To the solution was added a solution of 4.5 g of silver nitrate dissolved in 200 ml of water over a period of 5 minutes. Next, the excess salts were removed by sedimentation method. Afterwards, the pH was adjusted to 6.3, and 300 g of an organic silver salt dispersion was obtained.

Layer Constitution of Sample No. 201:

Sixth Layer : Protective Layer	
Gelatin	0.91 g/m ²
Mat agent (silica)	0.03 g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (2)*	0.13 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.30 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

Fifth Layer : Blue-sensitive Layer	
Emulsion (III)	0.30 g/m ² as Ag
Organic silver salt emulsion	0.25 g/m ² as Ag
Gelatin	1.00 g/m ²
Antifoggant (3)*	1.6×10^{-2} g/m ²
Yellow dye donor compound (4)*	0.30 g/m ²
High boiling point organic solvent (1)*	0.75 g/m ²
Surfactant (3)*	0.05 g/m ²
Developing agent precursor (1)*	0.10 g/m ²
Thermal solvent (1)*	0.20 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.27 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

Fourth Layer : Interlayer	
Gelatin	0.75 g/m ²
Reducing agent (2)*	0.12 g/m ²
High boiling point organic solvent (1)*	0.06 g/m ²
Surfactant (1)*	0.02 g/m ²
Surfactant (4)*	0.07 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.25 g/m ²

Third Layer : Green-sensitive Layer	
Emulsion (II)	0.20 g/m ² as Ag
Organic silver salt emulsion	0.20 g/m ² as Ag
Gelatin	0.85 g/m ²
Antifoggant (3)*	1.2×10^{-2} g/m ²
Magenta dye donor substance (5)*	0.37 g/m ²
High boiling point organic solvent (1)*	0.55 g/m ²
Surfactant (3)*	0.04 g/m ²
Developing agent precursor (1)*	0.08 g/m ²
Thermal solvent (1)*	0.16 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.25 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

Second Layer : Interlayer	
Gelatin	0.80 g/m ²
Reducing agent (2)*	0.12 g/m ²
High boiling point organic solvent (1)*	0.06 g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (4)*	0.10 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Base precursor (1)*	0.25 g/m ²
Hardening agent (1)*	0.01 g/m ²

First Layer : Red-sensitive Layer	
Emulsion (I)	0.20 g/m ² as Ag
Organic silver salt emulsion	0.20 g/m ² as Ag
Gelatin	0.85 g/m ²
Antifoggant (3)*	1.2×10^{-2} g/m ²
Thermal solvent (1)*	0.16 g/m ²
Base precursor (1)*	0.25 g/m ²
Cyan dye donor substance (6)*	0.40 g/m ²
High boiling point organic solvent (1)*	0.60 g/m ²
Surfactant (3)*	0.04 g/m ²
Developing agent precursor (1)*	0.07 g/m ²
Hardening agent (1)*	0.01 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

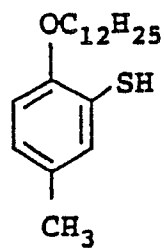
Support:

Polyethylene terephthalate (thickness: 100 μ m)

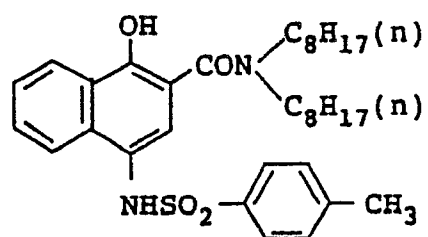
Backing Layer :	
Carbon black	0.44 g/m ²
Polyester	0.30 g/m ²
Polyvinyl chloride	0.30 g/m ²

The compounds used above were as follows:

Antifoggant (3)*:



Reducing Agent (2)*:



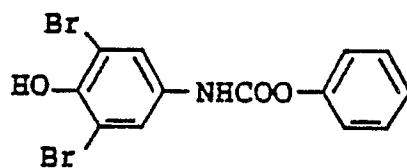
Thermal Solvent (1)*:

Benzenesulfonamide

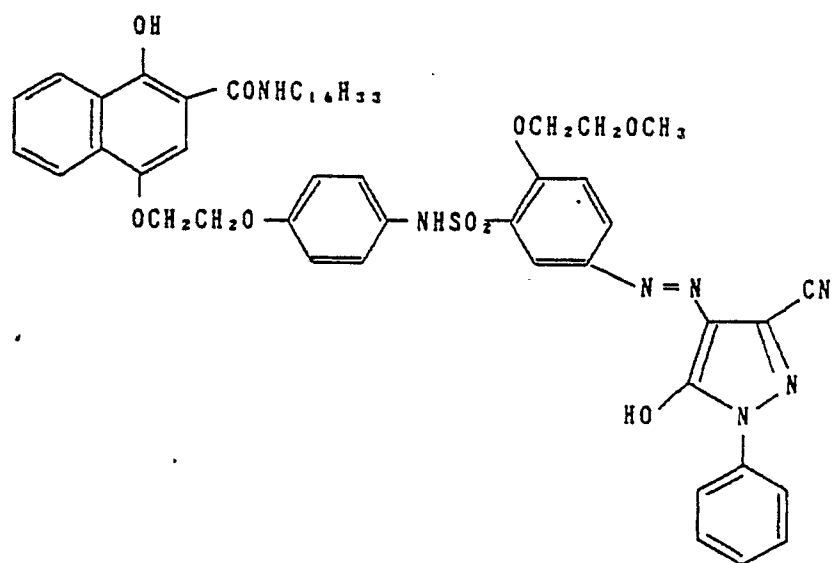
Base Precursor (1):

Guanidine 4-Chlorophenylsulfonylacetate

Developing Agent Precursor (1)*:



Yellow Dye Donor Substance (4)*:



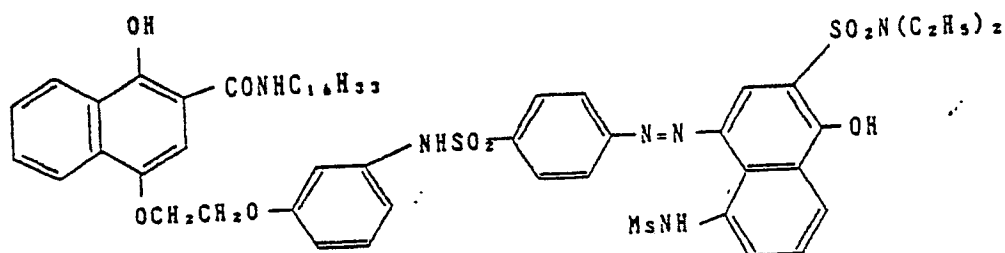
Magenta Dye Donor Substance (5)*:

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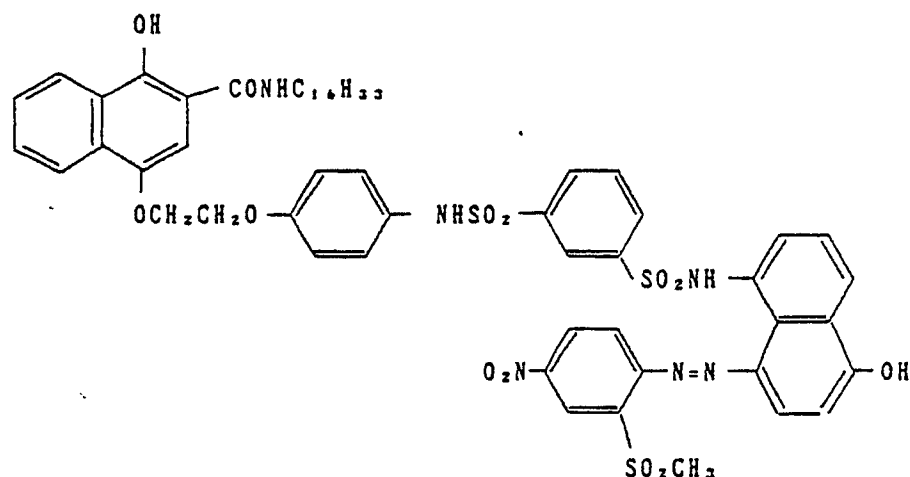
Cyan Dye Donor Substance (6)*:

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Samples Nos. 202 to 205 were prepared in the same manner as Sample No. 201, except that the reducing agent (2)* in the second layer and fourth layer was replaced by the same molar amount of the same compound of the present invention as that in Example 1, respectively.

Next, a dye-fixing material (Sample R-2) was prepared as follows:

10 g of poly(methyl acrylate-co-N,N,N-trimethyl-N-vinylbenzylammonium chloride) (ratio of methyl acrylate/vinylbenzylammonium chloride = 1/1) was dissolved in 200 ml of water and then uniformly blended with 100 g of 10% lime-processed gelatin. To the resulting mixture was added a hardening agent. The thus prepared composition was coated on a paper support as laminated with polyethylene containing a dispersion of titanium dioxide to form a wet film having a thickness of 90 μm . This was dried and was used as the dye-fixing material sample (R-2) having a mordant layer.

The previously prepared photographic material samples were exposed in the same manner as Example 1 and then uniformly heated on a heat block heated at 150° C for 30 seconds.

Water was applied on the coated surface of the dye-fixing material sample (R-2) in an amount of 20 ml/m², and then the heated photographic material sample was attached thereto with the coated surfaces facing to each other.

Next, the thus combined sample was passed through a laminater heated at 80° C at a linear velocity of

12 mm/sec and then the both materials were peeled off from each other. As a result, the dye-fixing material sample had a negative image thereon.

The color density of cyan and magenta in the blue light portion, that of cyan and yellow in the green light portion and that of magenta and yellow in the red light portion were measured with an X-Rite 310 TR densitometer and the results were shown in Table 2 below. In all the samples, the yellow density in the blue light portion was from 1.9 to 2.0, the magenta density of the green light portion was from 2.0 to 2.1 and the cyan density in the red light portion was from 2.0 to 2.1.

Sample No.	Compound of Formula (I)	Blue Area		Green Area		Red Area	
		Cyan	Magenta	Cyan	Yellow	Magenta	Yellow
201	-	0.20	0.50	0.35	0.75	0.83	0.41
202	(13)	0.15	0.45	0.28	0.67	0.72	0.34
203	(15)	0.14	0.44	0.27	0.66	0.70	0.33
204	(17)	0.14	0.45	0.28	0.66	0.72	0.34
205	(22)	0.15	0.46	0.29	0.68	0.73	0.35

It is noted from the results in Table 2 above that the Samples Nos. 202 to 205 each containing the compound of the present invention of the formula (I) were superior to the comparative Sample No. 201 as color mixing in the former was less than the latter.

EXAMPLE 3

Using the same emulsions, dye donor substances and electron donor reducing agents as those in Samples Nos. 101 to 105 in Example 1, multilayer-structural color photographic materials (Sample Nos. 301 to 305, respectively) each having the layer constitution mentioned below were prepared.

Unless otherwise specifically indicated, the additives were same as those used in Example 1.

The organic silver salt emulsion used was same as that used in Example 2.

The antifoggant precursor (1)* having the structure mentioned below was added to the dye donor substance in an amount of 0.2 mol times that of the substance and was formed into an oil dispersion together with the dye donor substance and electron donor, like the method of Example 1.

Layer Constitution of Sample Nos. 301 to 305:

Sixth Layer : Protective Layer	
Gelatin	0.91 g/m ²
Mat agent (silica)	0.03 g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (2)*	0.13 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.30 g/m ²

Fifth Layer : Blue-sensitive Layer	
Emulsion (III)	0.30 g/m ² as Ag
Organic silver salt emulsion	0.25 g/m ² as Ag
Gelatin	1.00 g/m ²
Antifoggant precursor (1)*	0.07 g/m ²
Yellow dye donor substance (4)*	0.50 g/m ²
High boiling point organic solvent (1)*	0.75 g/m ²
Electron donor (1)*	0.47 g/m ²
Surfactant (3)*	0.05 g/m ²
Electron-transmitting agent (2)*	0.04 g/m ²
Thermal solvent (1)*	0.20 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.27 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

Fourth Layer : Interlayer	
Gelatin	0.75 g/m ²
Reducing agent (1)*	0.24 g/m ²
High boiling point organic solvent (1)*	0.12 g/m ²²
Surfactant (1)*	0.02 g/m ²
Surfactant (4)*	0.07 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.25 g/m ²

Third Layer : Green-sensitive Layer	
Emulsion (II)	0.20 g/m ² as Ag
Organic silver salt emulsion	0.20 g/m ² as Ag
Gelatin	0.85 g/m ²
Antifoggant precursor (1)*	0.04 g/m ²
Magenta dye donor substance (2)*	0.37 g/m ²
High boiling point organic solvent (1)*	0.55 g/m ²
Electron donor (1)*	0.27 g/m ²
Surfactant (3)*	0.04 g/m ²
Electron-transferring agent (2)*	0.04 g/m ²
Thermal solvent (1)*	0.16 g/m ²
Hardening agent (1)*	0.01 g/m ²
Base precursor (1)*	0.25 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

Second Layer : Interlayer	
Gelatin	0.80 g/m ²
Reducing agent (2)*	0.24 g/m ²
High boiling point organic solvent (1)*	0.12 g/m ²
Surfactant (1)*	0.06 g/m ²
Surfactant (4)*	0.10 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²
Base precursor (1)*	0.25 g/m ²
Hardening agent (1)*	0.01 g/m ²

First Layer : Red-sensitive Layer	
Emulsion (I)	0.20 g/m ² as Ag
Organic silver salt emulsion	0.20 g/m ² as Ag
Gelatin	0.85 g/m ²
Antifoggant precursor (1)*	0.04 g/m ²
Thermal solvent (1)*	0.16 g/m ²
Base precursor (1)*	0.25 g/m ²
Cyan dye donor substance (3)*	0.35 g/m ²
High boiling point organic solvent (1)*	0.60 g/m ²
Electron donor (1)*	0.27 g/m ²
Surfactant (3)*	0.04 g/m ²
Electron-transferring agent (2)*	0.04 g/m ²
Hardening agent (1)*	0.01 g/m ²
Water-soluble polymer (1)*	0.03 g/m ²

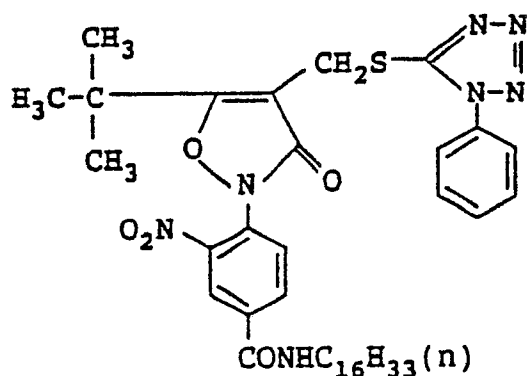
Support:

Polyethylene terephthalate (thickness: 100 μ m)

Backing Layer :	
Carbon black	0.44 g/m ²
Polyester	0.30 g/m ²
Polyvinyl chloride	0.30 g/m ²

The compounds used above were as follows:

Antifoggant precursor (1)*:



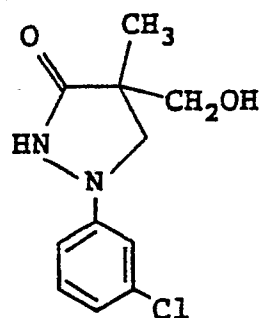
Thermal Solvent (1)*:

Benzenesulfonamide

Base Precursor (1)*

Guanidine 4-Chlorophenylsulfonylacetate

Electron-transferring Agent (2)*:



The same dye-fixing material (R-2) as that used in Example 2 was used.

The samples prepared above were exposed in the same manner as in Example 1 and then uniformly heated on a heat block heated at 140°C for 30 seconds.

20 ml/m² of water was applied to the coated surface of the dye-fixing material (R-2) and the heated light-sensitive material was attached to the wetted dye-fixing material with the coated surfaces facing to each other.

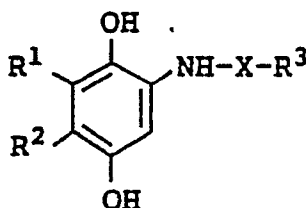
The thus combined material was passed through a laminator as heated at 80°C at a linear velocity of 12 mm/sec and then the both materials were peeled off from each other. As a result, a positive image was formed on the dye-fixing material. It was noted that the Sample Nos. 302 to 305 each containing the compound of the present invention of the formula (I) in the interlayers had a better color-reproducibility than the Comparative Sample No. 301.

While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

Claims

1. A heat-developable color photographic material comprising a support having thereon a light-sensitive silver halide, a binder, a diffusive reducing agent and a dye donor compound capable of releasing or forming a diffusive dye in correspondence or reverse correspondence with the reaction of reducing the silver ion into silver, wherein said material comprises at least two light-sensitive layers each having a different color sensitivity and at least one layer containing at least one compound represented by formula (I) between said two light-sensitive layers:

(I)



wherein R¹ and R² each represents a hydrogen atom, a halogen atom, or a substituted or unsubstituted alkyl, acylamino, alkoxy, aryloxy, alkylthio, arylthio, sulfonyl, acyl, carbamoyl or sulfamoyl group; or R¹ and R² may together form a carbon ring;

X represents -CO- or -SO₂-; and

R³ represents a substituted or unsubstituted alkyl, aryl, heterocyclic, alkoxy, aryloxy or amino group; provided that the total of the carbon atoms in R¹, R², and R³ is 10 or more, and the compound of the formula (I) is substantially insoluble in water.

2. A heat-developable color photographic material as in claim 1, in which the compound of formula (I) has neither sulfo group nor carboxyl group.

3. A heat-developable color photographic material as in claim 1, in which R¹ and R² in formula (I) each represents a hydrogen atom, a halogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted alkoxy group or a substituted or unsubstituted alkylthio group.

4. A heat-developable color photographic material as in claim 1, in which X in formula (I) represents -CO-.

5. A heat-developable color photographic material as in claim 1, in which R³ in formula (I) represents a substituted or unsubstituted alkyl group or a substituted or unsubstituted aryl group.

6. A heat-developable color photographic material as in claim 1, in which the total of the carbon atoms in R¹, R² and R³ in the formula is from 10 to 60.

7. A heat-developable color photographic material as in claim 6, in which the total of the carbon atoms in R¹, R² and R³ in the formula is from 15 to 50.

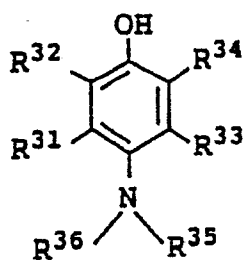
8. A heat-developable color photographic material as in claim 1, in which the compound of formula (I) is added to a non-light-sensitive interlayer between two silver halide emulsion layers each having a different color sensitivity.

9. A heat-developable color photographic material as in claim 8, in which the compound of formula (I) is additionally added to at least one of a non-light-sensitive protective layer and an emulsion layer.

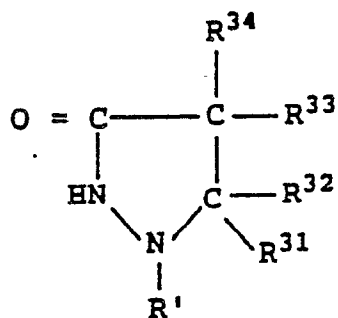
10. A heat-developable color photographic material as in claim 1, in which the amount of the compound of formula (I) added is from 1×10^{-6} to 1×10^{-2} mol/m².

11. A heat-developable color photographic material as in claim 10, in which the amount of the compound of formula (I) added is from 10^{-5} to 10^{-3} mol/m².

12. A heat-developable color photographic material as in claim 1, in which the diffusive reducing agent is a compound of formula (X-I) or (X-II):



(X-I)



(X-II)

wherein R' represents an aryl group;

R³¹, R³², R³³, R³⁴, R³⁵ and R³⁶ may be same or different and each represents a hydrogen atom, a halogen atom, an acylamino group, an alkoxy group, an alkylthio group, an alkyl group or an aryl group.

13. A method for forming a color image by heat-developing the heat-developable color photographic material as set forth in claim 1 after or simultaneously with imagewise exposure thereof.



DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)												
X,Y	EP-A-0 218 385 (KONISHIROKU) * Page 40, formula (III-15); page 105, line 8 *	1-13	G 03 C 8/40												
Y	EP-A-0 123 904 (FUJI) * Claim 1 *	1-13													
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)												
			G 03 C 8 G 03 C 1												
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 19-10-1989	Examiner MAGRIZOS S.												
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS</td><td>T : theory or principle underlying the invention</td></tr><tr><td>X : particularly relevant if taken alone</td><td>E : earlier patent document, but published on, or after the filing date</td></tr><tr><td>Y : particularly relevant if combined with another document of the same category</td><td>D : document cited in the application</td></tr><tr><td>A : technological background</td><td>L : document cited for other reasons</td></tr><tr><td>O : non-written disclosure</td><td>& : member of the same patent family, corresponding document</td></tr><tr><td>P : intermediate document</td><td></td></tr></table>				CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention	X : particularly relevant if taken alone	E : earlier patent document, but published on, or after the filing date	Y : particularly relevant if combined with another document of the same category	D : document cited in the application	A : technological background	L : document cited for other reasons	O : non-written disclosure	& : member of the same patent family, corresponding document	P : intermediate document	
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P : intermediate document															