



(12)

EUROPEAN PATENT APPLICATION

(21) Application number : **94306599.5**

(51) Int. Cl.⁶ : **G03C 1/26, G03C 1/10,
G03C 5/31**

(22) Date of filing : **08.09.94**

(30) Priority : **08.09.93 JP 223558/93**

(43) Date of publication of application :
08.03.95 Bulletin 95/10

(84) Designated Contracting States :
DE FR GB IT

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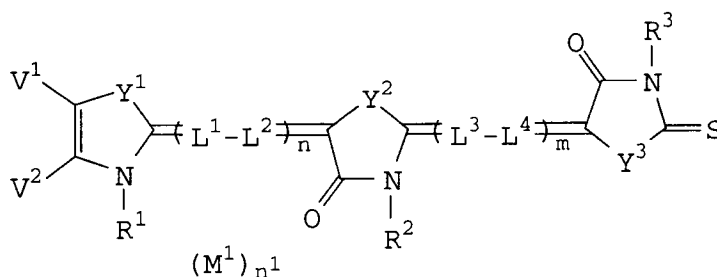
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(54) **A method of forming an image.**

(57) A method of forming an image is disclosed, comprising imagewise-exposing a silver halide photographic light sensitive material and developing the exposed photographic material to form a high contrast image, wherein said silver halide photographic material contains a spectral sensitizing dye represented by the following formula [S], and wherein said photographic material is developed with a developer having a pH of 10.9 or less, said developer being replenished by a developer-replenishing solution having a pH value of 10.9 or less in an amount of 300 ml or less per m² of the photographic material. The photographic material further contains a hydrazine compound and a nucleation-accelerating agent.

formula [S]



Field of the Invention

The present invention relates to an image forming method which is stable and free from residual color stains.

Background of the Invention

In recent years, development of a laser light source emitting a light of a red wavelength region has made the use of a silver halide photographic light-sensitive material recorded by the laser source active in the printing or medical fields. Particularly in the printing field a large amount of facsimile films or scanner films are used, and a helium-neon laser having an output wavelength of 632.8, a semiconductor laser having an output wavelength of 650-700 nm and a light emitting diode (LEWD) are used.

However, a dye having a high spectral sensitivity in a red-light wavelength region is difficult to dissolve out on development, and the elimination of the residual color stains is insufficient when rapid processing or a small amount of replenishing is conducted as in recent years. As a result, a serious problem occurs in view of photographic properties or commercial value.

The prior art improving such residual color stains of the light sensitive material is disclosed in U.S. Patent Nos. 2,493,747 and 2,526,632 incorporating a water solubilizing group to a cyanine dye. Further, there are proposed methods that use a three nuclear merocyanine dye disclosed in Japanese Patent Publication Open to Public Inspection No.2-143242 and a three nuclear merocyanine dye having two water solubilizing groups disclosed in Japanese Patent Publication Open to Public Inspection No.3-171135.

However, when the replenishing amount of a developer replenisher is small as not more than 300ml/m² of a light sensitive material and the pH of a developer is not more than 10.9, these sensitizing dyes had problems in that the dyes dissolved out the light sensitive material or decomposition products thereof accumulated in the developer and had an adverse effect on photographic properties, and in that the developer was dyed resulting in dyeing the light sensitive material. Particularly, the problems are remarkable in a hybrid light sensitive material containing a tetrazolium salt likely to be influenced by development conditions, a hydrazine compound or a pyridium salt as a contrast increasing agent. Therefore, a new development technique has been demanded on small amounts of replenishing.

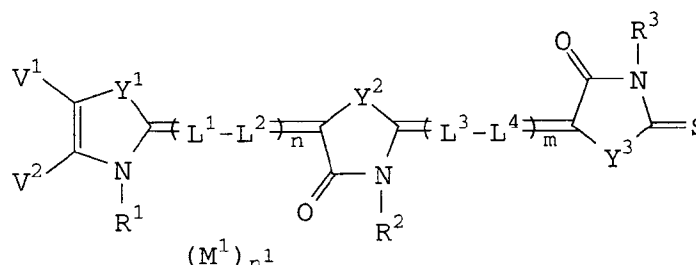
Summary of the Invention

An objective of the invention is to provide an image forming method which is improved in fog and black spot, furthermore, stable and free from residual color stains in the case of small amounts of replenishing.

The above problems can be solved by an image forming method of processing a silver halide photographic light sensitive material spectrally sensitized by a sensitizing dye represented by the following Formula (S) with a developer having a pH of not more than 10.9, the developer being replenished with a replenisher having a pH of not more than 10.9 in an amount of 300 ml/m² of the material.

Formula (S)

[S-I]



wherein Y¹, Y² and Y³ independently represent an -N(R)- group, an oxygen atom, a sulfur atom or a selenium atom, except that Y¹, Y² and Y³ are each a sulfur or selenium atom; R, R¹, R² and R³ independently represent an aliphatic group, an aryl group or a heterocyclic group, provided that at least one of R, R¹, R² and R³ is substituted with a water-solubilizing group; V¹ and V² independently represent a hydrogen atom, an alkyl group, an alkoxy group or an aryl group, provided that V¹ and V² combine with each other to form a ring; and L¹, L², L³ and L⁴ independently represent a substituted or unsubstituted methine carbon; n represents 1 or 2; m rep-

resents 0 or 1; M¹ represents an ion necessary for compensating the total charge of the molecule; and n¹ is a number necessary for neutralizing the charge of the molecules.

Detailed Description of the Invention

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In formula [S] of the present invention, Y¹, Y² and Y³ represent independently -N(R)-, or a oxygen, sulfur or selenium atom, except that Y¹, Y² and Y³ each are a sulfur or selenium atom. Y¹ represents preferably a group except a sulfur atom and a selenium atom and more preferably, an oxygen atom. At least one of Y² and Y³ is preferably a sulfur atom.

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In the compound represented by Formula (S) used in the invention, the water-solubilizing group substituted on R, R¹, R² and R³ includes an acid group such as a sulfo group, a carboxy group, a phosphono group, a sulfate group, a sulfino group, a sulfonamido group or a sulfamoyl group.

The aliphatic group represented by R, R¹, R² and R³ includes a branched or straight-chained alkyl group having 1 to 10 carbon atoms (for example, a methyl, ethyl, n-propyl, n-pentyl or isobutyl group), an alkenyl group having 3 to 10 carbon atoms (for example, a 3-butenyl or 2-propenyl group) or an aralkyl group having 3 to 10 carbon atoms (for example, a benzyl or phenetyl group).

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The aryl group represented by R, R¹, R² and R³ includes, for example, a phenyl group. The heterocyclic group includes, for example, a pyridyl group (2-, 4-), a furyl group (2-), a thienyl group (2-), a sulfolanyl group, a tetrahydrofuryl group or a piperidinyl group.

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Each of the groups represented by R, R¹, R² and R³ may have a substituent, for example, a halogen atom (a fluorine atom, a chlorine atom or a bromine atom), an alkoxy group (a methoxy group or an ethoxy group), an aryloxy group (a phenoxy group or a p-tolyloxy group), a cyano group, a carbamoyl group (a carbamoyl group, an N-methylcarbamoyl group or an N,N-tetramethylenecarbamoyl group), a sulfamoyl group (a sulfamoyl group or an N,N-3-oxapentamethyleneaminosulfonyl group), a methanesulfonyl group, an alkoxycarbonyl group (an ethoxycarbonyl group or a butoxycarbonyl group), an aryl group (a phenyl group or a carboxyphenyl group), or an acyl group (an acetyl group or a benzoyl group).

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The typical examples of aliphatic groups substituted with a water-solubilizing group include a carboxymethyl group, a sulfoethyl group, a sulfopropyl group, a sulfobutyl group, a sulfopentyl group, a 3-sulfobutyl group, a 6-sulfo-3-oxahexyl group, a ω -sulfopropoxycarbonylmethyl group, a ω -sulfopropylaminocarbonylmethyl group, a 3-sulfinoethyl group, a 3-phosphonopropyl, a 4-sulfo-3-butenyl group, a 2-carboxy-2-propenyl group, an o-sulfobenzyl group, a p-sulfophenethyl group or a p-carboxybenzyl group. The typical examples of aryl groups substituted with a water-solubilizing group include a p-sulfophenyl group or a p-carboxyphenyl group. The typical examples of heterocyclic groups substituted with a water-solubilizing group include a 4-sulfothienyl group or a 5-carboxypyridyl group.

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The alkyl group represented by V¹ and V² includes a straight-chained or branched group (such as a methyl, ethyl, iso-propyl, t-butyl, iso-butyl, t-pentyl or hexyl group). The alkoxy group represented by V¹ and V² includes a methoxy group, an ethoxy group, a propoxy group, a 2-methoxyethoxy group or a benzyloxy group.

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The aryl group represented by V¹ and V² may have a substituent in any position, and the aryl group includes a phenyl group, a tolyl, a p-hydroxyphenyl group or a p-methoxyphenyl group. The condensed ring which V¹ and V² combine each other and form together with an azole ring includes a condensed ring such as benzoxazole, 4,5,6,7-tetrahydrobenzoxazole, naphtho[1,2-d]oxazole, naphtho[2,3-d]oxazole, benzothiazole, 4,5,6,7-tetrahydrobenzothiazole, naphtho[1,2-d]thiazole, naphtho[2,3-d]thiazole, benzoselenazole or naphtho[1,2-d]selenazole.

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In the above-mentioned substituent represented by V¹ or V² and the condensed ring formed, there may be a substituent in any position. The substituent includes a halogen atom (a fluorine atom, a chlorine atom, a bromine atom or an iodine atom), a trifluoromethyl group, an alkoxy group (an unsubstituted alkyl group, e.g., a methoxy, ethoxy or butoxy group, or a substituted alkoxy group, e.g., a 2-methoxyethoxy or benzyloxy group), an alkylthio group (a substituted or unsubstituted alkyl group such as a methylthio or ethoxyethylthio group), a hydroxy group, a cyano group, an aryloxy group (a substituted or unsubstituted group, e.g., a phenoxy or tolyloxy group), or an aryl group (a substituted or unsubstituted group, e.g., a phenyl and p-chlorophenyl group), a styryl group, a heterocyclic group (a furyl or thienyl group), a carbamoyl group (a carbamoyl or N-ethylcarbamoyl group), a sulfamoyl group (a sulfamoyl and N,N-dimethylsulfamoyl group), an acylamino group (an acetylamino, propionylamino or benzoylamino group), an acyl group (an acetyl or benzoyl group), an alkoxycarbonyl group (an ethoxycarbonyl group), a sulfonamido group (a methanesulfonylamido or benzenesulfonamido group), a sulfonyl group (a methanesulfonyl and p-toluenesulfonyl group) or a carboxy group.

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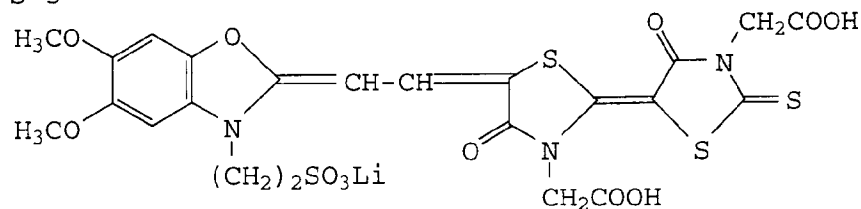
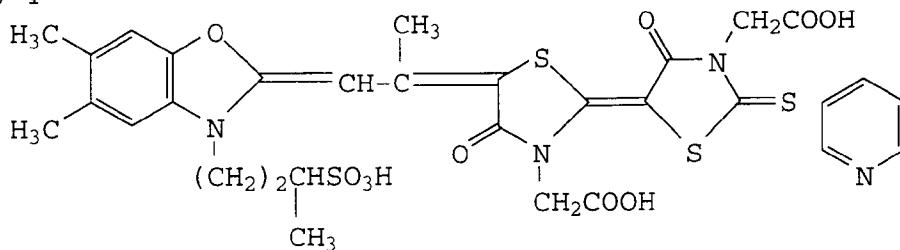
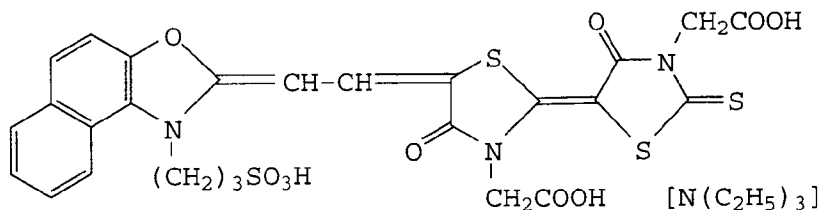
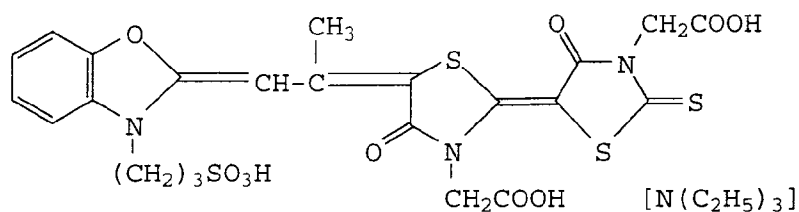
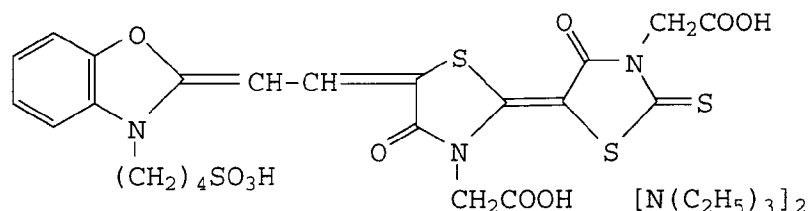
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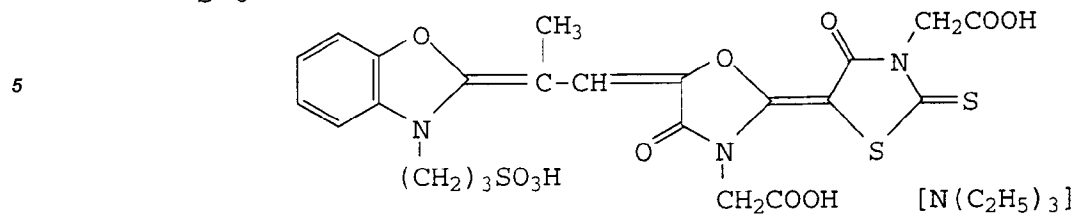
The substituent the methine carbon represented by L¹, L², L³ and L⁴ may have includes a lower alkyl group (a methyl or ethyl group), a phenyl group (a phenyl or carboxyphenyl group) or an alkoxy group (a methoxy or ethoxy group). n represents 1 or 2, and m represents 0 or 1. M¹ represents a cation or an acid anion. The typical

In the above Formula (S), it is preferable that R¹ represents an alkyl group having a sulfo group and at least two of R, R² and R³ represent carboxy groups.

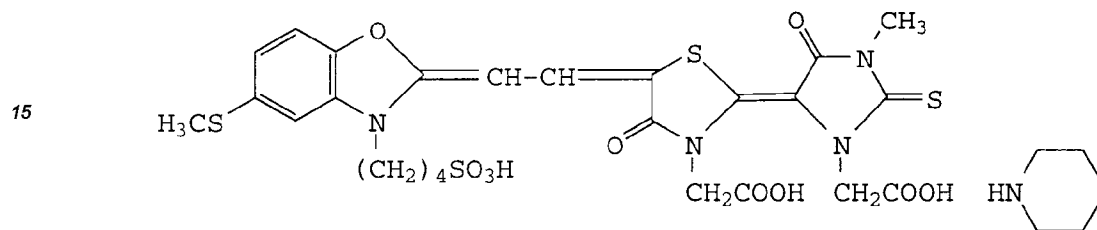
The typical example of a sensitizing dye represented by Formula (S) will be given below.



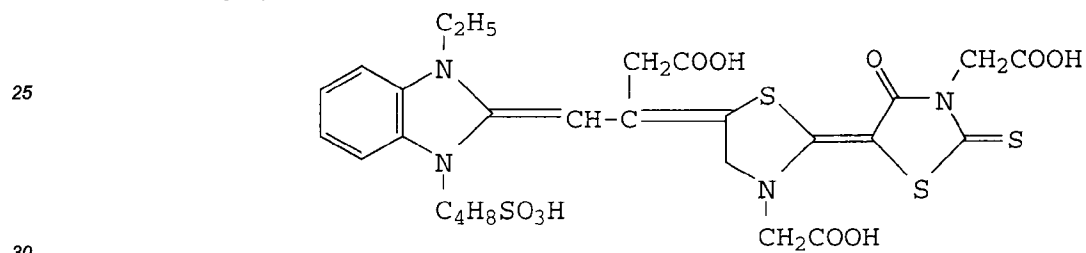
S-6



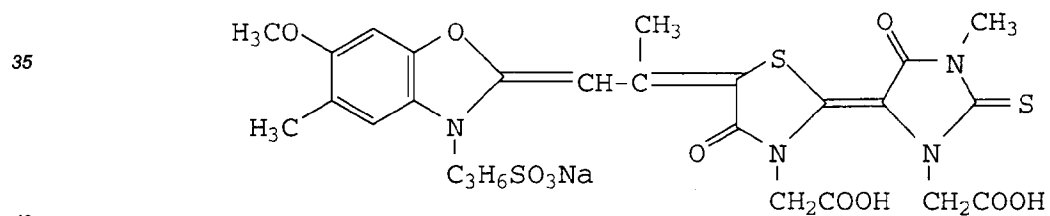
S-7



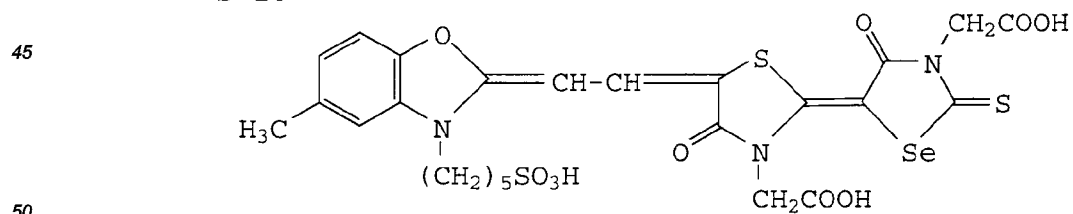
S-8



S-9



S-10



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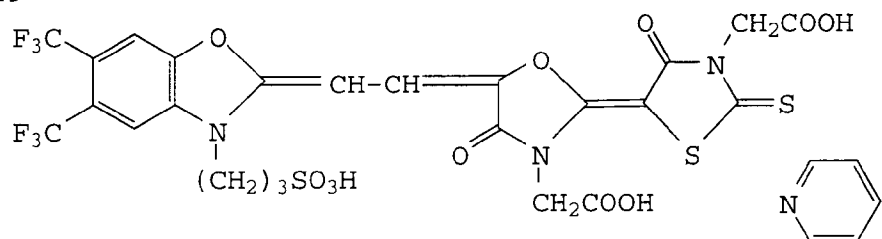
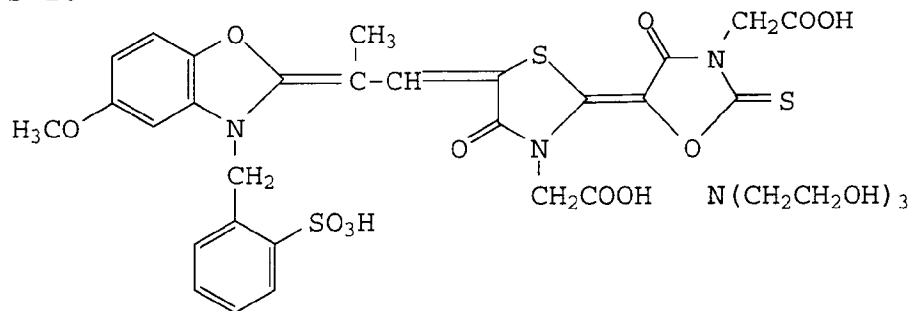
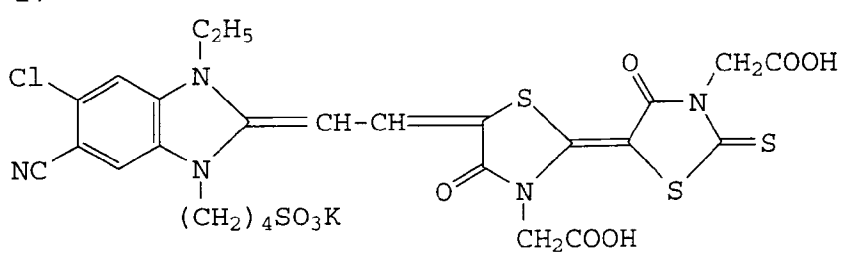
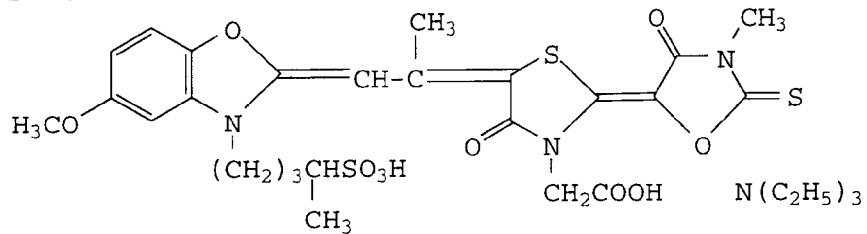
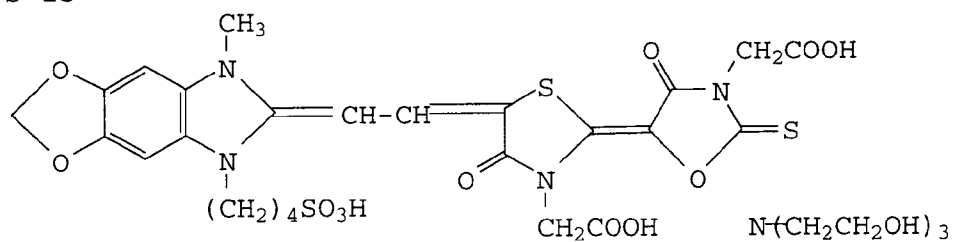


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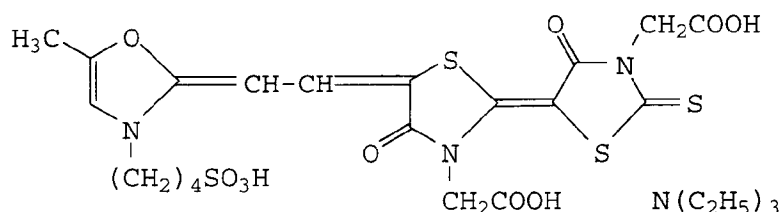


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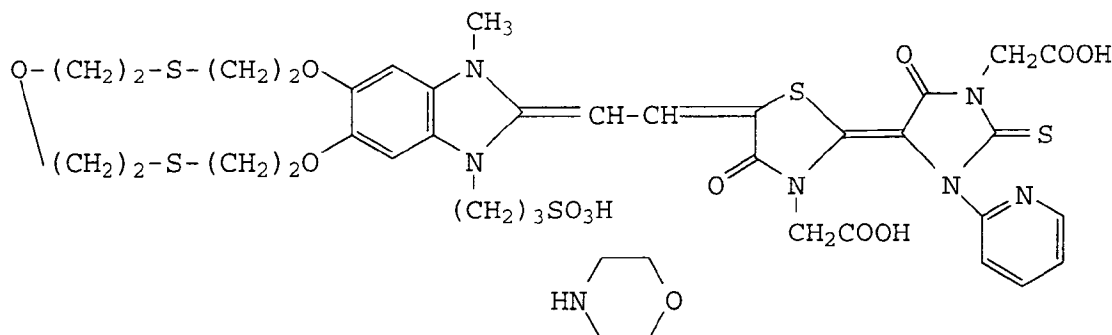




S-20

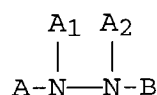


S-21



Next, as a contrast-increasing agent used in the present invention, a hydrazine derivative, pyridinium salt, or tetrazolium salt is employed singly or in combination thereof. Hydrazine compound represented by the following formula [H] is preferably used.

Formula [H]



Formula [H] is explained in detail as below.

A represents an aliphatic, aryl or heterocyclic group. In the formula, the aliphatic group represented by A preferably has 1-30 carbon atoms. Especially, it is a straight-chain, branched or cyclic alkyl group which has 1-20 carbons, such as methyl group, ethyl group, t-butyl group, octyl group, cyclohexyl group, and benzyl group. These groups may further be substituted by a suitable substituent, for example, an aryl group, alkoxy group, aryloxy group, alkyl thio group, aryl thio group, sulfoxy group, sulfonamide group, acylamino group, or ureide group.

The aryl group represented by A in Formula [H] is preferably a single condensed ring of an aryl group. For example, benzene ring and naphthalene ring can be mentioned.

In formula [H], the heterocyclic group represented by A is preferably a single or condensed ring containing one hetero atom selected from nitrogen, sulfur, and oxygen. For example, pyrrolidine ring, imidazole ring, tetrahydrofuran ring, morpholine ring, pyridine ring, pyrimidine ring, quinoline ring, thiazole ring, benz-thiazole ring, thiophene ring, and furan ring can be mentioned.

As A, an aryl group and a heterocyclic group are especially preferable.

The aryl group or the heterocyclic group represented by A may have a substituent. As typical substituents, an alkyl group, preferably, one having 1-20 carbon atoms, an aralkyl group, preferably, of single or fused ring of which alkyl part contains one to three carbon atoms, an alkoxy group, preferably, one having 1-20 carbon atoms in an alkyl part, a substituted amino group, preferably, amino group substituted by an alkyl or alkylidene group having 1-20 carbon atoms, an acylamino group, preferably, the one having 1-40 carbon atoms, a sulfonamide group, preferably, the one having 1-40 carbon atoms, an ureide group, preferably, the one having 1-40 carbon atoms, a hydrazinocarbonylamino group, preferably, the one having 1-40 carbon atoms, a hydroxyl group and a phosphonoamide group, preferably, the one having 1-40 carbon atoms can be mentioned.

Moreover, it is preferable for A to contain a diffusion inhibiting group or an adsorption promoting group on

the silver halide. As for the diffusion inhibiting group, so-called a ballast group, which is usually used in non-diffusible photographic additives such as a coupler. As examples of the ballast group, a photographically inactive organic group, such as alkyl group, alkenyl group, alkynyl group, alkoxy group, phenyl group, phenoxy group, or alkyl phenoxy group containing eight or more carbon atoms can be mentioned.

Examples of the adsorption promoting group on the silver halide grain, for example, include thiourea, a thio urethane group, a mercapto group, a thio ether group, a thione group, a heterocyclic group, a thio amide heterocyclic group, a mercapto heterocyclic group, or groups disclosed in Japanese Patent O.P.I. Publication No. 64-90439/1989.

B is a univalent blocking group. More precisely, B is an univalent group represented by $-G-R^6$.

In $-G-R^6$, G represents a carbonyl group, a sulfonyl group, a sulfoxy group, a phosphonyl group or an iminomethylene group. G is preferably a carbonyl group.

In formula Ha, R^6 is a hydrogen atom or a blocking group such as an aliphatic group such as methyl, ethyl, benzyl, methoxymethyl, trifluoromethyl, phenoxyethyl, 4-methoxybenzenesulfonylmethyl, 1-pyridiniumethyl, hydroxymethyl, methylthiomethyl, or phenylthiomethyl; an aromatic group such as phenyl, hydroxymethylphenyl, or chlorophenyl; a heterocyclic group such as pyridyl, thienyl, furyl, or N-methylpyridinium; an amino group such as methylamino, dimethylamino, or phenylamino; an alkoxy group such as methoxy, ethoxy, or butoxy; an aryloxy group such as phenoxy; a group represented by $-COOR_8$ and a group represented by $-CON(R_9)(R_{10})$, wherein R_8 is a hydrogen atom, an alkyl group such as methyl, ethyl, benzyl, or hydroxyethyl; an alkenyl group such as allyl, or butenyl; an alkynyl group such as propargyl, or butynyl; an aryl group such as phenyl, or naphthyl; and a heterocyclic group, for example, a saturated heterocyclic group such as 2,2,6,6-tetramethylpiperidinyl, N-ethylpiperidinyl, tetrahydrofuryl, or sulfolane and an unsaturated heterocyclic group such as pyridyl, pyrimidyl, thienyl, or furyl; and R_9 and R_{10} independently represent a hydrogen atom, an alkyl group such as methyl, ethyl, benzyl, or hydroxyethyl; an alkenyl group such as allyl, or butenyl; an alkynyl group such as propargyl, or butynyl; an aryl group such as phenyl, or naphthyl; a heterocyclic group, for example, a saturated heterocyclic group such as 2,2,6,6-tetramethylpiperidinyl, N,N'-diethylpyrazolinyl, quinuclidinyl, N-ethylpiperidinyl, N-benzylpiperidinyl, N-benzylpyrrolidinyl, tetrahydrofuryl, or sulfolane; an unsaturated heterocyclic group such as pyridyl, pyrimidinyl, thienyl, or furyl; a hydroxyl group, an alkoxy group such as methoxy, ethoxy, benzyloxy, or cyanomethoxy; an alkenyloxy group such as allyloxy, or butenyloxy; an alkynyloxy group such as propargyloxy, or butynyloxy; an aryloxy group such as phenoxy, or naphthoxy; a heterocycloxy group such as pyridyloxy, or pyrimidyloxy; an amino group such as amino, methylamino, dimethylamino, dibenzylamino, or phenylamino.

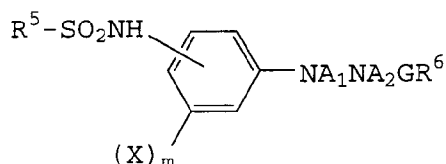
R^6 is preferably a hydrogen atom, an aliphatic group, an aromatic group, and groups represented by $-COOR_8$ and $-CON(R_9)(R_{10})$. And $-COOR_8$ and $-CON(R_9)(R_{10})$ groups are most preferable.

The most preferable R_8 is a $-COOR_8'$ group or $-CON(R_9')(R_{10}')$, wherein R_8' represents an alkynyl group or a saturated heterocyclic group; R_9' represents a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group, an aryl group or a heterocyclic group; and R_{10}' represents an alkenyl group, an alkynyl group, a saturated heterocyclic group, a hydroxyl group or an alkoxy group.

A_1 and A_2 both represent hydrogen atoms, or one of them represents a hydrogen atom while the other is an acyl group such as acetyl, trifluoroacetyl, or benzoyl; a sulfonyl group such as methanesulfonyl, toluenesulfonyl or an oxalyl group such as ethoxyoxalyl.

Among hydrazine compounds used in the present invention, preferable one is represented by formula [Ha] as below:

Formula [Ha]



wherein R^5 represents an aliphatic group such as octyl, or decyl; an aromatic group such as phenyl, 2-hydroxyphenyl, chlorophenyl, and a heterocyclic group such as pyridyl, thienyl or furyl. These groups may further be substituted by a suitable substituent. X represents a group capable of substituting and m represents an integer of 0-4. When m is two or more, X may be either the same or different. A_1 , A_2 and $-G-R^6$ are the same as defined in formula [H] aforementioned. It is preferable that R^5 contains at least one ballast group or a group for acceleration adsorption on silver halide. As the ballast group, one which is usually used in a non-diffusible photo-

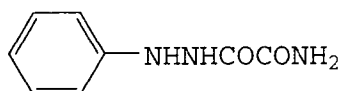
graphic additives such as coupler is preferable. As for the ballast group, a photographically inactive organic group, such as an alkyl group, an alkenyl group, an alkynyl group, an alkoxy group, a phenyl group, a phenoxy group, or an alkyl-phenoxy group containing eight or more carbon atoms can be mentioned. Also, one which contains repetition structure of alkyleneoxy unit disclosed in Japanese Patent O.P.I. Publication 5-61143/1993 or structure containing quaternary ammonium salt may be used.

As a group for accelerating adsorption on silver halide, for example, thiourea, a thio urethane group, a mercapto group, a thioether group, a thione group, a heterocyclic group, a thio amide heterocyclic group, a mercapto heterocyclic group, or adsorption groups disclosed in Japanese Patent O.P.I. Publication No. 64-90439/1989 is cited.

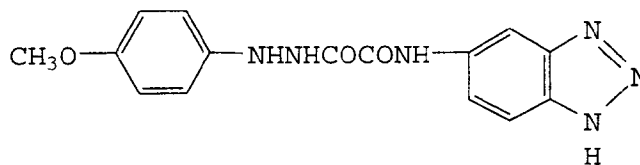
A substituting includes group represented by X in formula [Ha], straight chain, branched or cyclic alkyl group, preferably having 1-20 carbon atoms, alkenyl group or alkynyl group, preferably having 2-20 carbon atoms; aryl group such as phenyl; an alkoxy group such as one having 1-20 carbon atoms in the alkyl portion thereof, or one having alkyleneoxy repeating unit, alkenyloxy group such as allyloxy, butenyloxy; an alkynyloxy group such as propargyloxy or butynyloxy; aryloxy group such as phenoxy; acyloxy group such as acetyloxy, propionyloxy or benzoyloxy; an acylamino group such as acetamino, propionylamino, butanoylamino, octanoylamino or benzoylamino; a sulfonamide group such as methanesulfonamide, ethanesulfonamide, propanesulfonamide, butanesulfonamide, hexanesulfonamide, octanesulfonamide, dodecanesulfonamide or benzenesulfonamide; a ureido group such as methylureido, ethylureido, propylureido, butylureido or hexylureido group, cyclohexylureido, octylureido, dodecylureido, octadecylureido, phenylureido or naphthylureido group; a hydrazinocarbonylamino group such as methylhydrazinocarbonylamino, ethylhydrazinocarbonylamino, dimethylhydrazinocarbonylamino, diphenylhydrazinocarbonylamino or phenylhydrazinocarbonylamino; an alkylamino group such as methylamino, ethylamino, butylamino, octylamino or dodecylamino; a dialkylamino group such as dimethylamino, diethyl amino, dibutylamino or methyloctylamino; an amino group, a hydroxy group; a halogen atom; an alkylthio group, preferably, having 1-20 carbon atoms; an alkenylthio group such as allylthio or butenylthio; a mercapto group, sulfo group; a carboxyl group; a thioureido group such as methylthioureide, ethylthioureide, butylthioureide, cyclohexylthioureide, octylthioureide, dodecylthioureide or phenyl-thioureide; a cyano group; a sulfonyl group such as methanesulfonyl; a sulfamoyl group such as methylsulfamoyl, ethylsulfamoyl, butylsulfamoyl or phenylsulfamoyl; a carbamoyl group such as methylcarbamoyl, ethylcarbamoyl, butylcarbamoyl, octylcarbamoyl or phenylcarbamoyl. These groups can further be substituted by a suitable substituent.

Specific examples of the compounds represented by formulae [H] and [Ha] are given below: However, the scope of the the present invention is not limited by these.

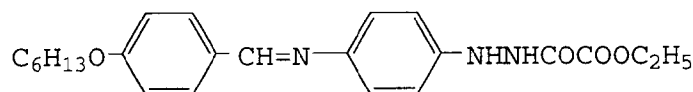
H-1



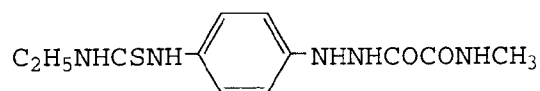
H-2



H-3

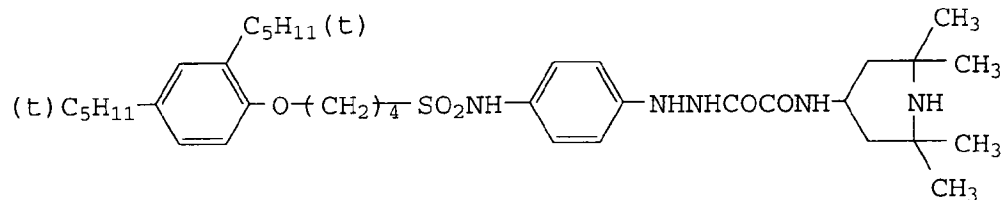


H-4



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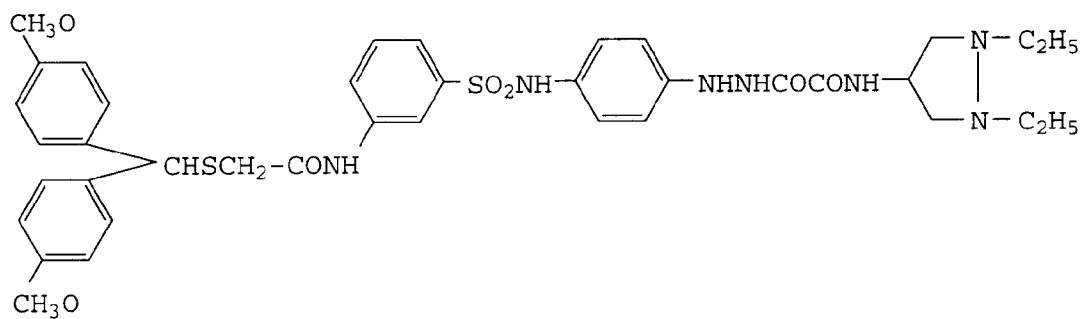
H-5



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H-6

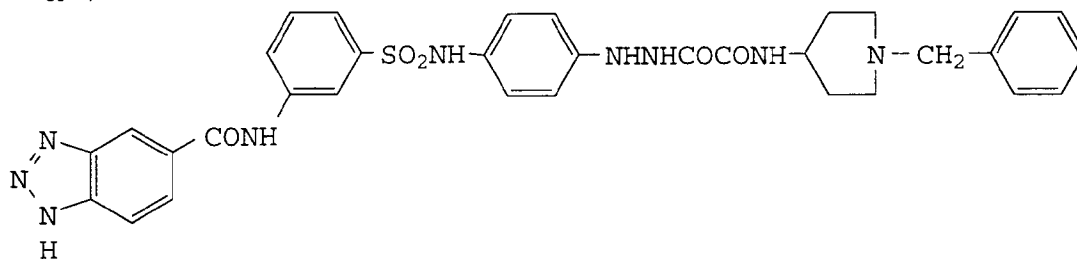


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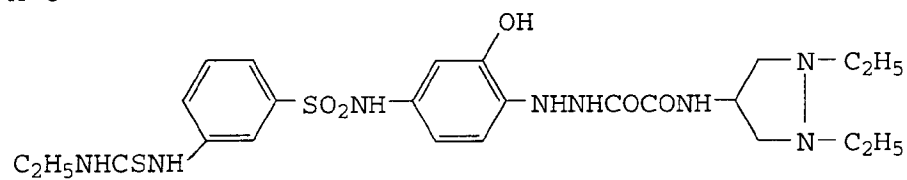
H-7



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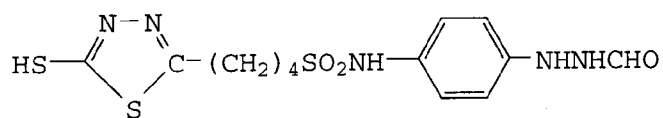
H-8



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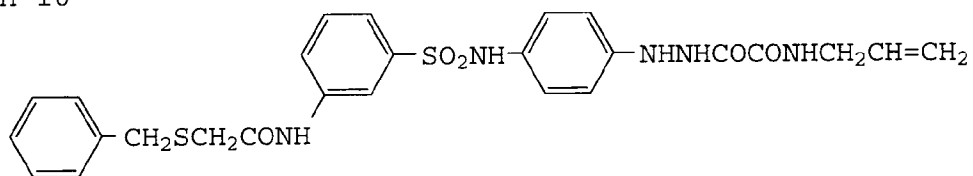
H-9



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H-10

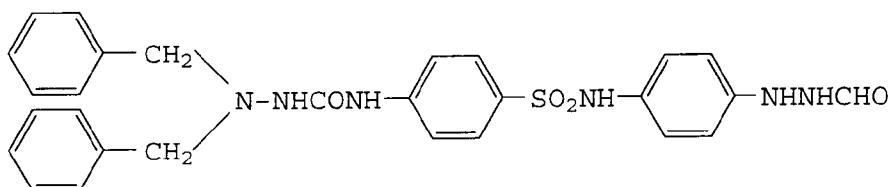
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H-11

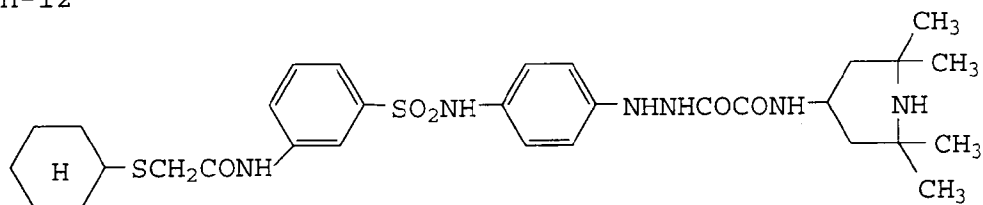
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H-12

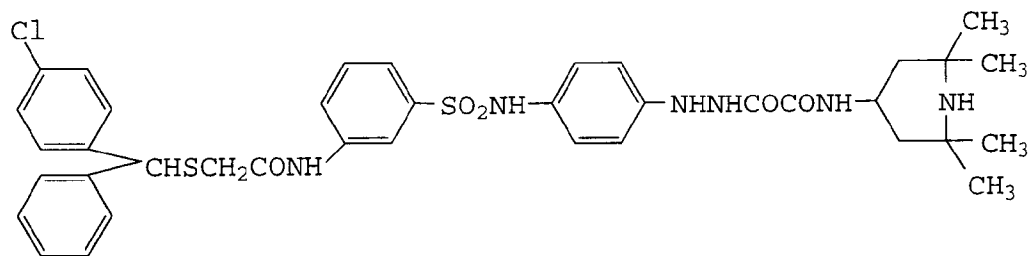
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H-13

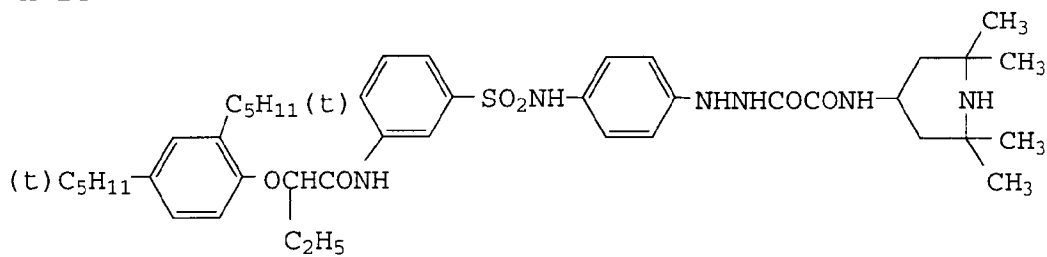
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H-14

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O=C1N=NN=C1C(=O)OCCc2ccc(O)cc2N=NN=O

10

$$\text{C}_2\text{H}_5-(\text{OCH}_2\text{CH}_2)_8-\text{O}-\text{C}_6\text{H}_4-\text{SO}_2\text{NH}-\text{C}_6\text{H}_4-\text{NHNHCOCOOCH}_2\text{CH}=\text{CH}_2$$

15

$$(t)C_5H_{11}-\text{C}_6\text{H}_3(C_5H_{11}(t))-\text{O}-(CH_2)_4-\text{SO}_2\text{NH}-\text{C}_6\text{H}_4-\text{NHNHCOCONHN} \begin{matrix} \diagup \text{CH}_3 \\ \diagdown \text{CH}_3 \end{matrix}$$

25

$$\text{(t) C}_5\text{H}_{11} \text{---} \text{C}_6\text{H}_3 \text{(C}_5\text{H}_{11} \text{---}) \text{---} \text{O} \text{(CH}_2\text{)}_4 \text{NHCONH} \text{---} \text{C}_6\text{H}_4 \text{---} \text{NHNHCOCOOCH}_2\text{C}\equiv\text{CH}$$

35

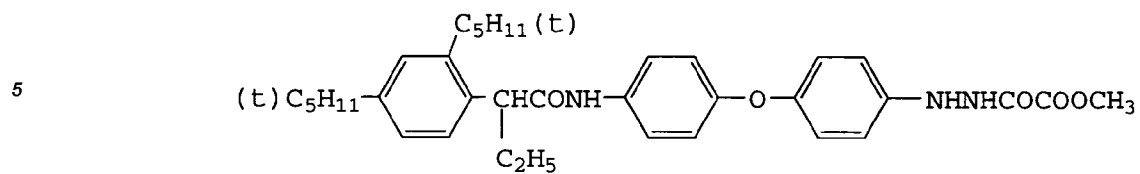
Nc1ncnc2cc(ccc12)C(=O)Nc3ccccc3S(=O)(=O)Nc4ccccc4NNC(=O)OC(=O)c5ccccc5

45

CCCCCc1ccc(cc1)OC(=O)Nc2ccc(cc2)NN=O

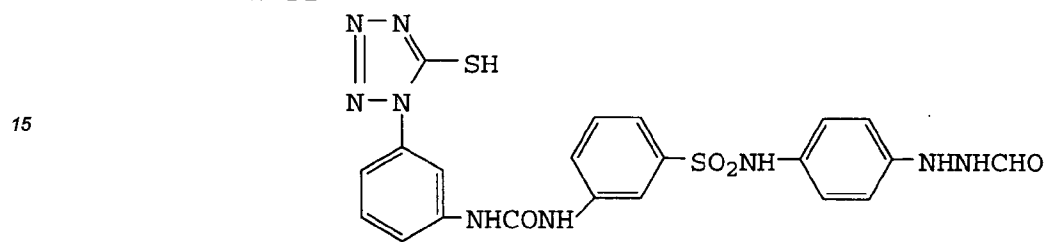
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H-21



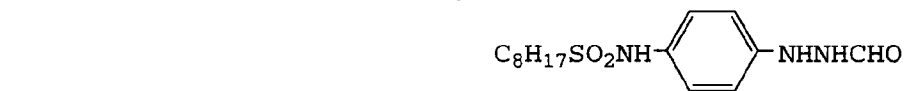
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H-22



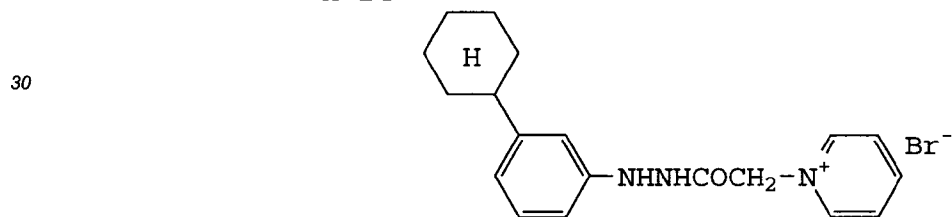
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H-23



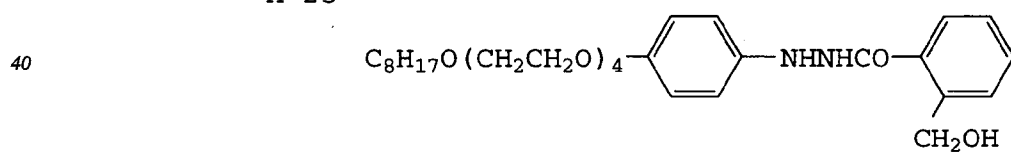
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H-24



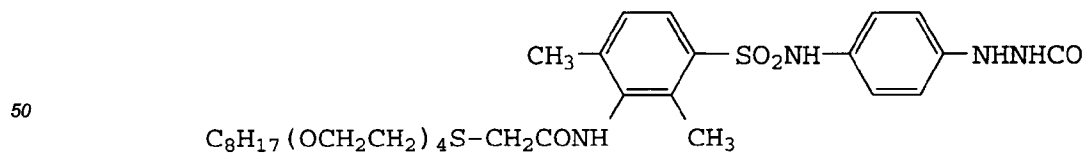
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H-25



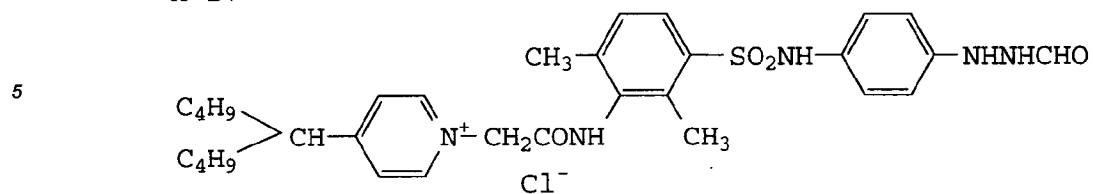
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H-26

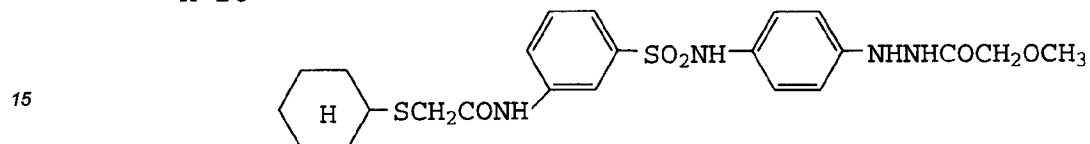


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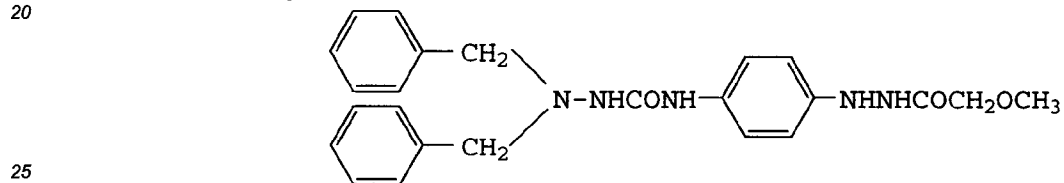
H-27



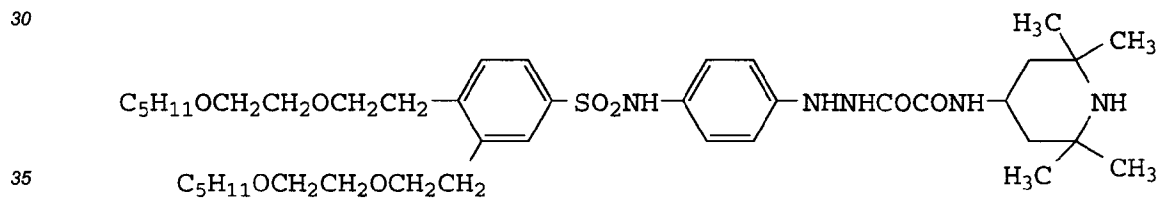
H-28



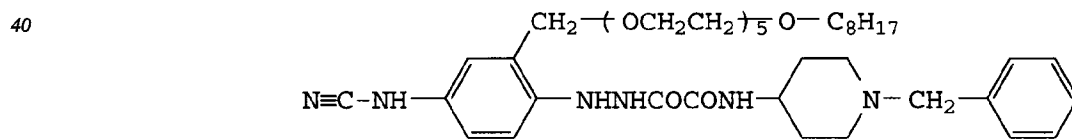
H-29



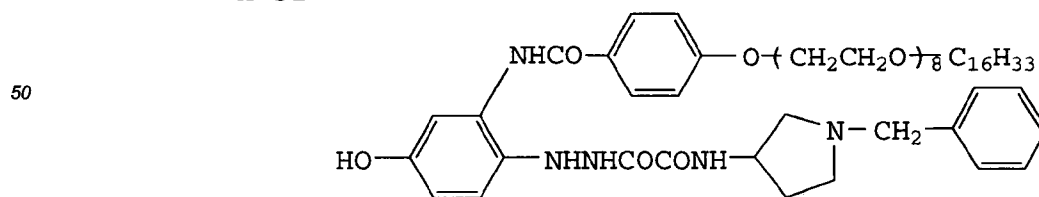
H-30



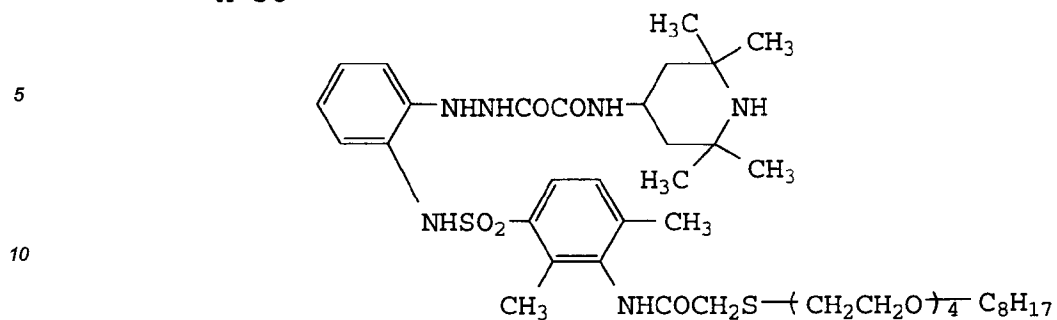
H-31



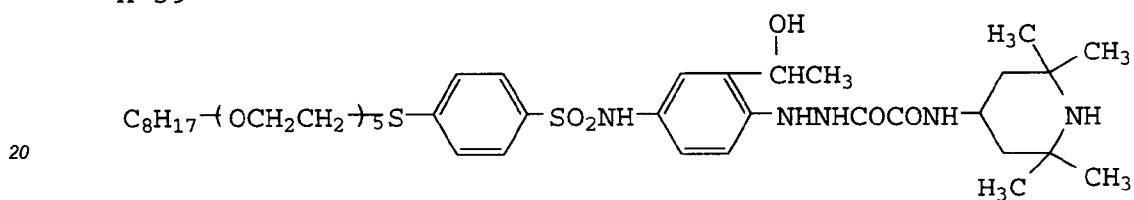
H-32



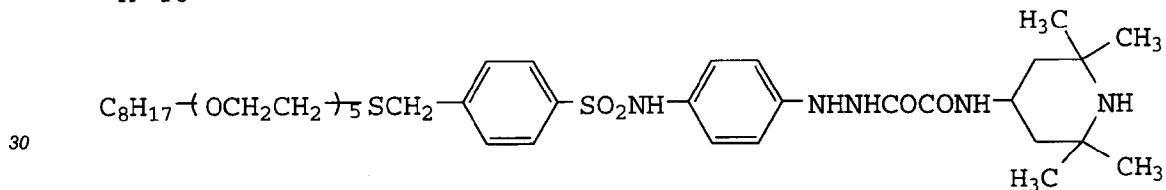
H-38



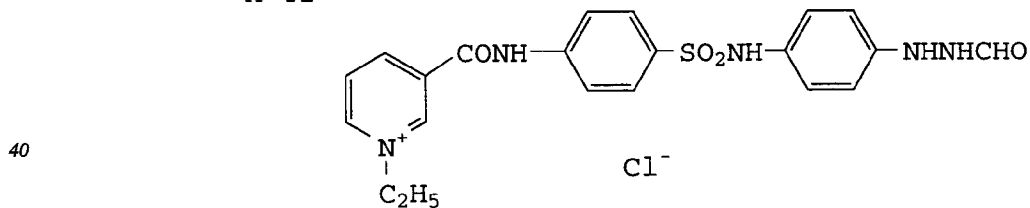
H-39



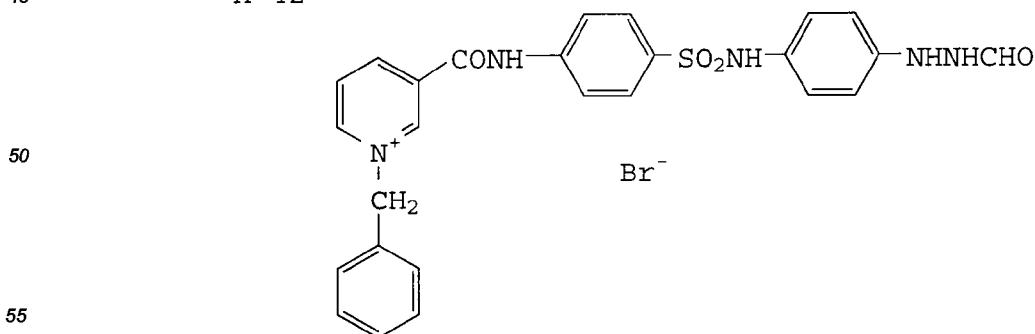
H-40



H-41



H-42

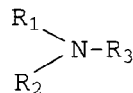


When the hydrazine derivative is incorporated in the light-sensitive photographic material of the present

invention, it is usually added to a silver halide emulsion layer or a hydrophilic colloidal layer which is adjacent to the silver halide emulsion layer.

In order to promote nucleation reaction by the hydrazine derivative effectively, it is preferable to use a nucleation accelerating agent represented by the following formula [Na] or [Nb].

Formula [Na]



In formula [Na], R_1 , R_2 , and R_3 independently represent a hydrogen atom, an alkyl group, a substituted alkyl group, an alkenyl group, a substituted alkenyl group, an alkynyl group, an aryl group, and a substituted aryl group, provided that a ring can be formed by combining at least two of R_1 , R_2 , and R_3 with each other.

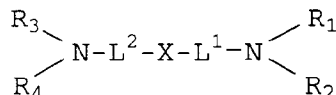
Among the compounds represented by [Na] is preferably a tertiary Amine compound, which, more preferably, contains a diffusion-proof group or a group for promoting adsorption on silver halide group.

In order for the compound to be diffusion-proof, the compound preferably have a molecular weight of not less than 100 and, more preferably, not less than 300.

A preferable adsorption promoting group is, for example, a heterocyclic ring group, mercapto group, thio ether group, chione group or thiourea group.

A more preferable type among the compounds represented by formula [Na] is a compound represented by the formula [Na2].

Formula [Na2]



In formula [Na2], R_1 , R_2 , R_3 and R_4 independently represent a hydrogen atom an alkyl group, a substituted alkyl group, an alkenyl group, a substituted alkenyl group, an alkynyl group, a substituted alkynyl group, an aryl group, a substituted aryl group and a saturated or unsaturated heterocyclic group, provided that they can form a ring by combining with each other, and that combinations of R^1 and R^2 , and R^3 and R^4 are not hydrogen atoms at the same time.

X represents a sulfur atom, selenium atom or tellurium atom.

L_1 and L_2 independently represent a divalent linkage group. Specifically, the divalent group is selected from the group consisting of the following groups or those substituted with a group such as a alkylene group, an alkenylene group, an arylene group, an acylamino group, a sulfonamido group:

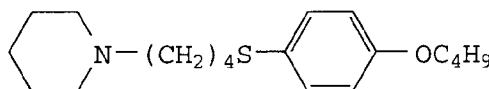
$-\text{CH}_2-$, $-\text{CH}=\text{CH}-$, pyridine-di-yl, $-\text{N}(\text{Z}_1)-$ group, $-\text{O}-$, $-\text{S}-$, $-(\text{CO})-$, $-(\text{SO}_2)-$, $-\text{CH}_2\text{N}-$, wherein Z_1 represents a hydrogen atom, an alkyl group, an aryl group.

Further, it is preferable that the linkage group comprises at least one of the following structures:

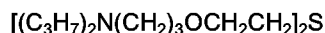
$-(\text{CH}_2\text{CH}_2\text{O})-$, $-(\text{C}(\text{CH}_3)\text{HCH}_2\text{O})-$, $-(\text{OC}(\text{CH}_3)\text{HCH}_2\text{O})-$ and $-(\text{OCH}_2\text{C}(\text{OH})\text{HCH}_2)-$.

Specific examples of the nucleation accelerating compounds represented by [Na] are shown below:

Na-1

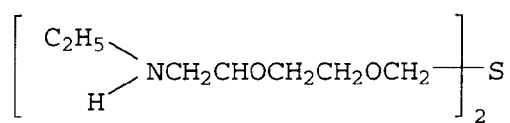


Na-2



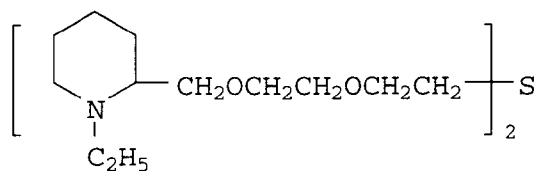
Na-3

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Na-4

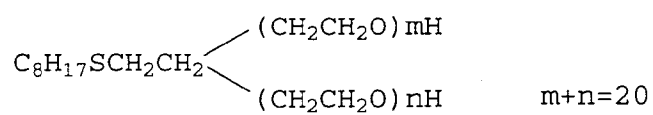
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Na-5

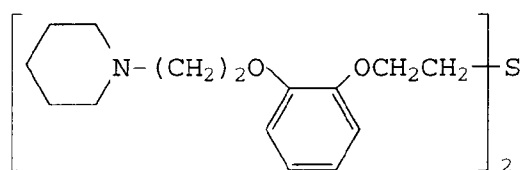
20



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Na-6

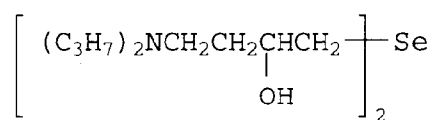
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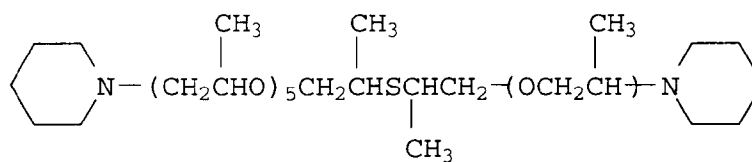
Na-7

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Na-8

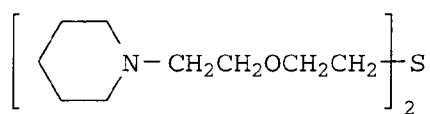
45



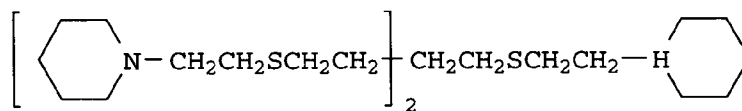
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Na-9

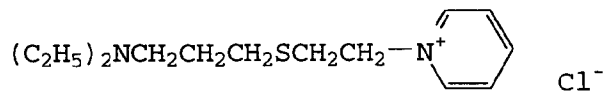
55



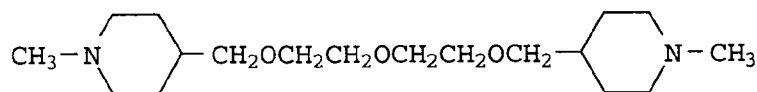
Na-10



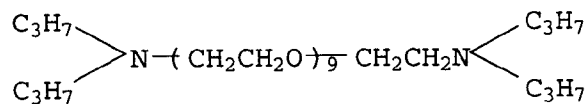
Na-11



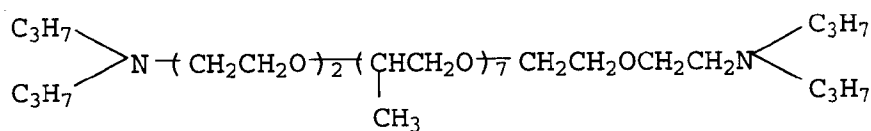
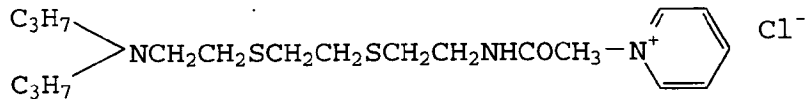
Na-12



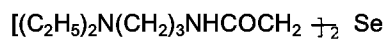
Na-13



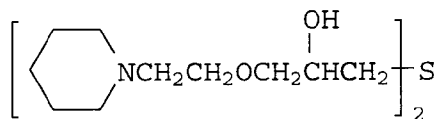
Na-14



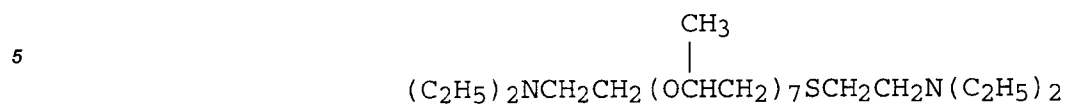
Na-16



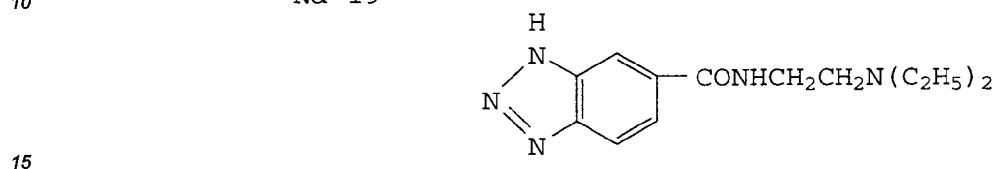
Na-17



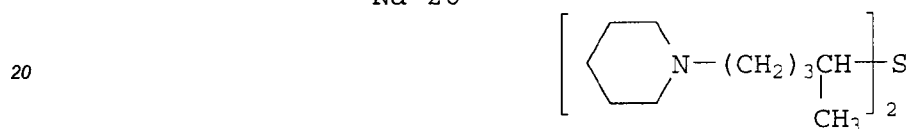
Na-18



10 Na-19



Na-20



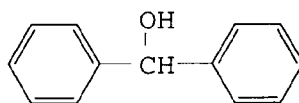
25 Formula [Nb]



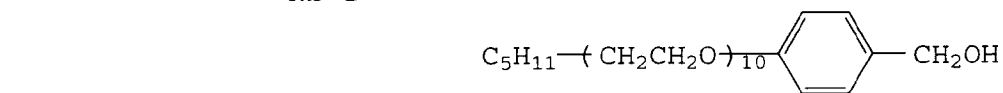
35 In the formula, Ar represents a substituted or unsubstituted aryl or heterocyclic group. R is a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group or an aryl group, which may be substituted. Ar and R may combine with each other to form a ring. These compounds each preferably contain a ballast group or a adsorption group onto silver halide. A preferable ballast group has a molecular weight of not less than 120, more preferably, not less than 300. The adsorption group is preferably the same as one defined in formula [H].

Specific examples of the compound represented by formula [Hb] are as follows:

40 Nb-1



45 Nb-2



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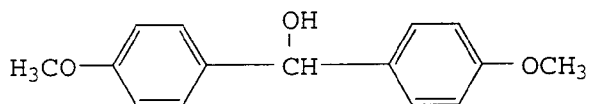
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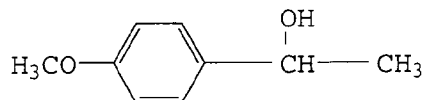
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Cc1nc2c(c1)ccc3ccccc3c2O

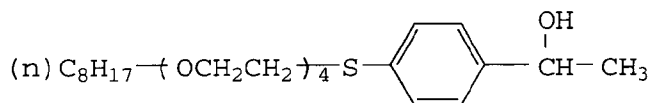
Nb-10



Nb-11



Nb-12



Further, as an image-hardening agent, a tetrazolium compounds and a pyridinium compound may preferably be used, as disclosed Japanese Patent Application Nos. 6-33827/1994, 5-217657/1993, 6-161009/1994, 5-53231/1993, 2-2543/1990 and 1-287557/1989.

In the present invention, a nucleation-accelerating agent may be contained in a silver halide emulsion layer or a hydrophilic colloidal layer adjacent thereto.

Although there is no specific limitation concerning the composition of the silver halide used in the silver halide emulsion layer, silver chloride or silver chlorobromide containing silver bromide is preferable.

Average grain size of the silver halide is preferably not more than 0.7 microns, and more preferably, between 0.1 and 0.5 microns. Herein the term "average grain size" is a terminology commonly used among photographic scientist and engineers and will be easily understood.

Grain size is defined as a diameter of a sphere when the grain can be approximated to have a spherical shape or a shape.

When the grain is a cubic shape, the grain size (d) is given in terms of the following equation:

$$\text{edge length} \times \sqrt{\frac{4}{\pi}}$$

The average diameter is obtained from algebraic average or from geometric average based on the average projection area of the grain.

For detailed method of obtaining the average grain diameter, "The Theory of the Photographic process" edited by C.E. Mees & T.H. James, 3rd edition, pp 36 through 43, published in 1966 by Mcmillan Ltd. can be referred.

There is no specific limitation with respect to the shape of the silver halide grain, and it may be anyone of tabular, spheric, cubic, tetradecahedral, octahedral or any other shape. And as regards grain size distribution, the narrower is the distribution, the more preferable.

Especially, a so-called mono-dispersion emulsion, in which at least 90 %, and, morepreferably more than 95 % by number of the total silver halide grains are within 40 % by size around the the average grain diameter, is preferable.

As for the manner of reacting aqueous silver salt with aqueous halide salt in the present invention, any conventionally known method, including the single mixing process, the simultaneous mixing process and any combination thereof can be employed.

It is also possible to employ a method, in which formation of the silver halide grain is carried out in excess amount of silver ion, which is so-called a reverse mixing process. As one mode of the simultaneous mixing process, a method in which pAg in the liquid phase where silver halide grain is formed is controlled at a constant level, so-called "controlled double-jet process", may also be used; and by this method a silver halide emulsion containing silverhalide grains with regular shape and narrow grain size distribution can be obtained.

The silver halide grain used in the silver halide emulsion is preferably incorporated during at least one step of nuclear formation or growth thereof with a cadmium salt, zinc salt, lead salt thallium salt, iridium salt, rhodium salt or any other complex salt containing these elements.

As regards these silver halide emulsions and the method for the preparation thereof, Research Disclosure

Vol. 176, No. 17643, pages 22 and 23, (December 1973) can be referred.

Silver halide emulsion used in the present invention may or may not be subjected to chemical sensitization. As for the manner of chemical sensitization, sulfur sensitization, reduction sensitization and noble metal sensitization are well known. These are each used either singly or in combination. As for sulfur sensitizing agent
 5 besides various sulfur compounds contained in gelatin, various sulfur compounds such as thiosulfides, thiour-
 eas, rhodanine compounds polysulfide compounds, etc. can be used.

Among well-known noble metal sensitization processes, gold sensitization is a representative process, and gold compound, mainly gold complex salt is usually used. Besides gold compounds, other noble metal com-
 pounds, for example, complex salts of platinum, palladium or rhodium may also be incorporated.

10 As a reduction sensitizing agent, tin (II) salts, amine compounds, formaminedisulfinate, silane compounds, etc. can be used.

In the light-sensitive material used in the present invention, various photographic additives can be incor-
 porated for the purposes of, for example, preventing fog from taking place during manufacture, storage or proc-
 essing thereof, or stabilizing photographic properties.

15 Such photographic additives include, for example, azole compounds such as benzthiazolium compounds, nitroindazole compounds, nitrobenzimidazole compounds, chlorobenzimidazole compounds, bromobenzimi-
 dazole compounds, mercaptothiazole compounds, mercaptobenzothiazole compounds, mercaptobenzimida-
 zole compounds, mercaptobenzothiadiazole compounds, aminotriazole compounds, benztriazole compounds,
 20 nitrobenzotriazole compounds, mercaptotetrazole compounds such as 1-phenyl-5-mercaptotetrazole, mer-
 captopyrimidine compounds, mercaptotriazine compounds such as oxazolinethione, azaindene compounds
 such as 4-hydroxy substituted 1,3,3a,7-tetrazaindene compounds, pentazaindene compounds benzenesulfon-
 ates, benzenesulfonates, benzenesulfonatezmidates and various other compounds which are known as anti-
 foggants or stabilizers.

The silver halide light-sensitive photographic layer and other non-light-sensitive hydrophilic colloidal layers
 25 may contain an inorganic or organic hardener. For example chromium salts such as chromium alum, or chro-
 mium acetate, aldehyde compounds such as formaldehyde, glyoxale, or glutaric aldehyde, N-methylol com-
 pounds such as dimethylolurea, methyloldimethylhydantoin, dioxane derivatives such as 2,3-dihydroxydioxane,
 active vinyl compounds such as 1,3,5-triacryloyl-hexahydro-s-triazine,
 bis(vinylsulfonyl)methylether, or N,N'-methylenebis-(β -(vinylsulfonyl)propionamide), active halide compounds
 30 such as 2,4-dichloro-6-hydroxy-s-triazine, mocoaldehyde compounds such as mocoalchloric acid, or phenoxymu-
 cochloric acid, isoxazole compounds, dialdehyde starch, and 2-chloro-6-hydroxytriazinylated gelatin, etc. can
 be used either singly or in combination.

Further in the silver halide light-sensitive photographic layer and/or other non-light-sensitive hydrophilic
 colloidal layers of the present invention, various other photographic additives such as coating aids, anti-static
 35 agents, lubricants, emulsification dispersion aids, adhesive agents and other photographic property-improving
 agents may also be used in accordance with various purposes.

As for a binder or protective colloid for the photographic emulsion, use of gelatin is usually advantageous,
 however, other hydrophilic colloids can also be used and they include, for example, gelatin derivatives, graft
 polymers of gelatin and other synthetic polymers, proteins such as albumin, casein, etc.; sulfuric acid esters of
 40 cellulose, etc.; sugar derivatives such as sodium alginate, starch derivatives, etc.; polyvinylalcohol, partially
 acetated polyvinylalcohol, poly-N-pyrrolidone, polyacrylic acid, polymethacrylic acid, polyacrylamide, polyvi-
 nylimidazole, polyvinylpyrazole, etc. cellulose derivatives such as hydroxyethylcellulose, carboxymethylcellu-
 lose, cellulose sulfate, etc.; sugar derivatives such as sodium alginate and starch derivatives; synthetic hydro-
 philic polymeric materials such as polyvinyl alcohol, a partial acetal thereof, poly-N-vinyl pyrrolidone, polyacrylic
 45 acid, polymethacrylic acid, polyacrylamide, polyvinyl imidazole, polyvinyl pyrazole and a copolymer thereof.

Gelatins such as lime-treated gelatin and acid-treated gelatin, and hydrolyzed or enzymatic process ge-
 latin thereof can be used in the present invention.

A silver halide of the present invention may contain a dispersion of water-insoluble or sparingly water-soluble
 polymer for the purpose of improving dimensional stability, i.e., an alkyl (meta)acrylate, an alkoxyacryl(met-
 50 a)acrylate, a glycidyl (meta)acrylate, (meta)acrylamide, vinyl ether (e.g., vinyl acetate), an acrylonitrile, an ole-
 fin, styrene, and a combination thereof or a copolymer thereof with acrylic acid, metaacrylic acid, α,β -unsat-
 ured dicarboxylic acid, hydroxyalkyl (meta)acrylate, sulfoalkyl (meta)acrylate and styrene sulfonate.

A silver halide emulsion of the invention may contain various sensitizing dye(s), besides the inventive dye.
 A preferred sensitizing dye is referred to Research Disclosures Vol.176, 17643 pp23-24 (1978), and Vol.346,
 55 34685 (1993).

A photographic light-sensitive material used in the present invention may contain other various kinds of
 additives such as a desensitizer, a plasticizer, a sliding agent, a development-accelerating agent, an oil and
 a dye.

These additives including afore-mentioned ones are referred to Research Disclosure Vol.176 (afore-cited) pp 22-31.

A light sensitive material of the invention comprises single or multi-layered emulsion layer and protective layer. In the case of multi-layers, an interlayer may be provided therebetween.

In the light sensitive material of the invention, a photographic emulsion layer and another layer may be provided on one side or both sides of a flexible support conventionally used. an usable flexible support is a synthetic polymer film comprising cellulose acetate, cellulose actate propionate, polystyrene or polyethylen terephthalate.

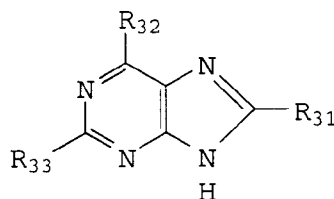
Developing agents which can be used in present invention include dihydroxy benzenes, for example, hydroquinone, chlorohydroquinone, bromohydroquinone, 2,3-dichlorochlorohydroquinone, methylhydroquinone, iso-propyl hydroquinone, 2,5-dimethylhydroquinone etc.; 3-pyrazolidone compounds such as 1-phenyl-3-pyrazolidone, 1-phenyl-4-methyl-3-pyrazolidone, 1-phenyl-4,4-dimethyl-3-pyrazolidone; 1-phenyl-4-ethyl-3-pyrazolidone, 1-phenyl-5-methyl-3-pyrazolidone, etc.; aminophenol compounds, such as o-aminophenol, p-aminophenol, N-methyl-o-aminophenol, N-methyl-p-aminophenol, 2,4-diaminophenol, etc.; pyrogallol, ascorbinic acid, 1-aryl-3-pyrazoline compounds, such as, 1-(p-hydroxyphenyl)-3-aminopyrazoline, 1-(p-methylamino-phenyl)-3-aminopyrazoline, 1-(p-amino phenyl)-3-aminopyrazoline, 1-(p-amino-N-methylphenyl)-3-pyrazolidone, etc. which can be used either singly or in combination. A combined used of a 3-pyrazolidone and a dihydroxybenzene, or an aminophenol and a dihydroxybenzene is preferable.

It is preferable that the developing agent is usually used in an amount of 0.01 to 1.4 mols/liter.

In the present invention, as anti silver-sludging agent, compounds disclosed in Japanese Patent Publication No. 62-4702/1987, Japanese Patent O.P.I. Publications Nos. 3-51844/1991, 4-26838/1992, 4-362942/1992 and 1-319031/1989 can be mentioned.

Especially, a compound represented by the following formula [P] is preferable.

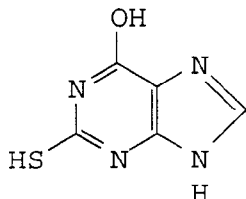
Formula [P]



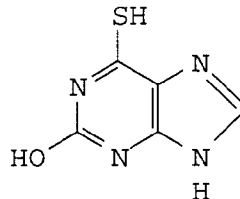
In the formula, R_{31} and R_{32} independently represent a hydrogen atom, a halogen atom, an alkyl group, an alkoxy group, an aryl group, an aralkyl group, a hydroxyl group, a mercapto group, a carboxyl group, a sulfo group, a phosphono group, an amino group, a nitro group, a cyano group, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl group, and a sulfamoyl group, provided that R_{31} and R_{32} may be bonded with each other to form a ring. R_{33} represents a hydrogen atom, a mercapto group or a hydroxyl group.

Representative examples of the compound represented by formula [P] are given below:

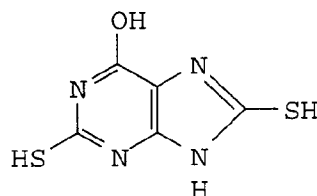
P-1



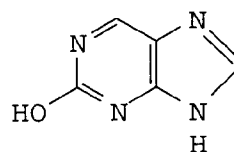
P-2



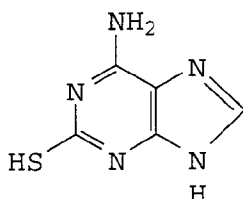
P-3



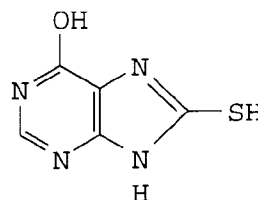
P-4



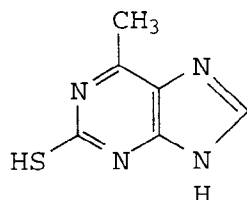
P-5



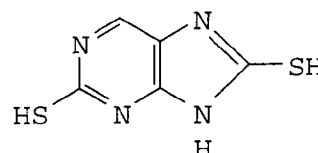
P-6



P-7



P-8



It is preferable that the anti-sludging agent be added to the developing solution. However, it can also be incorporated into the light-sensitive material.

In the present invention, as preservatives, a sulfite, metabisulfite such as sodium sulfite, potassium sulfite, ammonium sulfate and ammonium metabisulfite, etc. can be used. It is preferable that these sulfites are used in an amount of not less than 0.25 mol/liter and, more preferably, not less than 0.4 mol/liter.

In the developing solution, if necessary, there can be added other photographic additive, for example, Alkali agent such as sodium hydroxide, potassium hydroxide, etc.; pH buffer such as carbonate, phosphate, borate, acetate, alkanol amine, etc.; dissolution aid, for example, polyethylene glycol, esters thereof, alkanol amine, etc; sensitizer, for example, nonionic surface active agent which contains polyoxy ethylene, quaternary ammonium compound, etc.; surfactant, anti-foaming agent; antifoggant, for example, halides such as potassium bromide and sodium bromide, nitrobenzindazole, benzotriazole, benz-thiazole, tetrazoles, thiazoles, etc; chelating agent, such as ethylenediaminetetraacetic acid or alkali metal salt thereof, nitrilotriacetate, poly phosphate, etc.; development accelerator, for example, compounds disclosed in U.S. Patent No. 2,304,025, Japanese Patent Publication No. 47-45541/1972, etc.; gelatin hardeners such as glutal aldehyde or bisulfite addition product thereof, etc.. It is preferable that pH of the developing solution is adjusted to between 9.5 and 10.5.

As a special manner of photographic developing process, a light-sensitive material which contains a developing agent in the emulsion layer can be processed in an activator processing solution such as an aqueous alkaline solution. This photographic processing, which is further combined with the stabilization processing by use of a thiocyanate is often used as one of methods of processing rapidly the light-sensitive material. When the present invention is applied to such rapid processing, the effect thereof is especially large.

A fixer containing a conventional composition can be used. The fixer is aqueous solution which consists of a fixing agent and others, in general. pH thereof is usually 3.8-5.8. As fixing agent, there can be used sodium thiosulfates such as sodium thiosulfate, potassium thiosulfate and ammonium thiosulfates, thio cyanates such as sodium thiocyanate, potassium thiocyanate and ammonium thiocyanate, and an organic sulfur compound capable of forming soluble stable silver complex salt, which is known as a fixing agent.

A water soluble aluminium salt such as aluminium chloride, aluminium sulfate or potassium alum, which is capable of acting as a hardener can be added to the fixing solution.

The fixing solution may contain a preservative (e.g., a sulfite or a bisulfite), a pH buffer (e.g., acetic acid), a pH adjuster (e.g., sulfuric acid) and a chelating agent capable of softening hard water.

A developer may be a mixture of fixed compositions, an organic aqueous solution containing a glycol or amine, or a viscous solution in the form of half degumming. Each of these can be used on dilution or as it is.

When processed in the present invention, a developing temperature can be set to be a conventional range of 20 to 30°C. When processed at a high temperature, it can be set to a range of 30 to 40°C.

In the present invention, a black and white photographic material is preferably processed by use of an automatic processor. The photographic material is processed by replenishing a developer at a given rate in proportion to the area of the photographic material. The replenishing rate is 300 ml or less, preferably, 75 to 200 ml per m² of the material so as to reduce the amount of waste liquor.

When processed with a automatic processor in the present invention, a total processing time which is the time from the insertion of a leading end of the film to the processor to a point of going-out from a drying zone is preferably 20 to 60 seconds from demand for shortening a processing time. The total processing time refers a time taken in the overall process necessary for processing the black and white photographic material, i.e., a time taken for a total process including, for example, developing, fixing, bleach, washing, stabilizing and drying and so-called, Dry to Dry time. In the case when a total processing time is 20 seconds or less, satisfactory photographic performance cannot be achieved due to desensitizing or contrast-decreasing thereof. The total processing time (Dry to Dry time) is preferably 30 to 60 seconds.

Examples

The present invention is further illustrated by the example.

Example 1

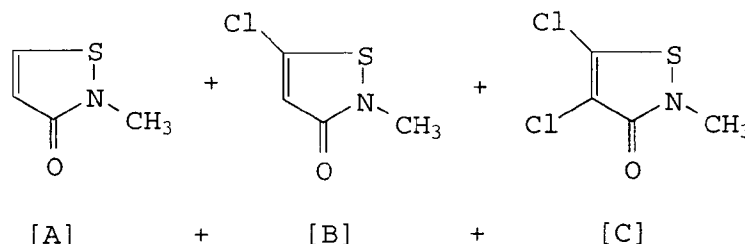
(Preparation of silver halide emulsion)

Silver iodobromochloride (Silver chloride 62 mol %, silver iodide 0.5 mol%) emulsion was prepared by the use of double-jet precipitation process.

8×10^{-8} mol/mol Ag of potassium hexabromorhodate and 8×10^{-7} mol/mol Ag of potassium hexachloroiridate were added during the mixing process after 5% of the final average grain size to be attained had been formed and up to the final average grain size.

Silver halide emulsion thus obtained was desalted by conventional floccuration process using the a gelatin which was modified by phenylisocyanate, and then dispersed in an aqueous gelatin solution, to which Compounds (A), (B) and (C) were added as anti-molds, to obtain a mono disperse silver halide emulsion containing cubic silver halide grains having an average grain size of 0.30 μm and a coefficient of variation of 10%.

[A]:[B]:[C] = 46:50:4 (molar ratio)



After adding citric acid and potassium bromide to the emulsion, chloraurate and sodium thiosulfate were further added to carry out chemical ripening at 60°C, and after reaching the maximum sensitivity, 50 mg of 1-phenyl-5-mercaptotetrazole and 1 g of a mol of silver were added thereto to stop the chemical ripening.

(Preparation of coating solution)

2×10^{-4} mols per a mol of silver halide of the exemplified compound of the present invention and those for comparison as shown in Table 1 were added to the emulsion thus obtained. Then, after adding adequate amount of sodium dodecyl benzene sulfonate as a surfactant and sodium 2,4-dichloro-6-hydroxytriazine as a hardener to the emulsion, the emulsion was coated uniformly on a subbed polyethylene terephthalate film so

that the coated amount of silver and gelatin per 1m² of the film were 4 g and 3g, respectively.

The coated samples were exposed through an optical wedge to He-Ne laser light for a period of 10⁻⁶ seconds processed with a developer and a fixer as described below by using a automatic processor, provided that as a developer was used a fresh solution or a running solution in which 20 m² of 50% exposed film was processed. The sample was sensitometrically measured by using an optical densitometer Konica PDA-65, a product of Konica Corporation. Sensitivity in the table was defined as the reciprocal of the exposure amount necessary for obtaining optical density of 3, which was represented by a relative value when the sensitivity of comparative sample No.1 was set to be 100. A fog density was represented as a density of non-light-exposed film (including a base density) which was previously held under irradiation from a UV-radiating fluorescent lamp to remove effects of dye-color. Moreover, the sample was evaluated as follows.

Residual color of the film

After an unexposed film was processed, the film was evaluated by visual observation in five piece piling.

The samples were classified into five grades. The level at which the residual color was hardly visible was made "5", the level at which practical use was possible was made "3" and the level at which practical use was impossible was made "1".

Degree of residual color in the developing solution

The developer after running was taken in a 200 ml flask to determine the level of coloring by the residual dye in the solution.

A level at which coloring of the developing solution by the sensitizing dye was assumed to be "G" (good) and the level at which coloring is clearly observable was "F" (Fair) and the level at which the coloring is remarkable was assumed to be "P" (Poor).

<Processing Conditions>

The processing conditions are as follows:

Composition of the developing solution		
(Composition A)		
5	Water (deionized water)	150 ml
	Disodium ethylenediaminetetraacetate	2 g
	Diethylene glycol	50 g
10	Potassium sulfite (55% W/V aqueous solution)	100 ml
	Potassium carbonate	50 g
	Hydroquinone	15 g
15	5-methylbenztriazole	200 ml
	1-phenyl-5-mercaptotetrazole	30 mg
	Potassium hydroxide	Amount necessary to adjust pH of the solution at 10.4.
20	Potassium bromide	4.5 g
(Composition B)		
25	Water (deionized water)	3 ml
	Diethylene glycol	50 g
	Disodium ethylenediaminetetraacetate	25 mg
30	Acetic acid (90% aqueous solution)	0.3 ml
	5-Nitroindazole	110 mg
	1-phenyl-3-pyrazolidone	500 mg

35 Compositions A and B were respectively dissolved in 500 ml of water 500ml in this order and finished at one liter when the developer is used.

Compositions of fixing solution		
(Composition A)		
40	Ammonium thiosulfate (72.5% W/V aqueous solution)	230 ml
	Sodium sulfite	9.5 g
45	Sodium acetate trihydrate	15.9 g
	Boric acid	6.7 g
	Sodium citrate dihydrate	2 g
50	Acetic acid (90%W/W aqueous solution)	8.1 ml
(Composition B)		
	Water (deionized water)	17 ml
55	Sulfuric acid (50% W/W aqueous solution)	5.8 g
	Aluminium sulfate (8.1% W/W aqueous solution)	26.5 g

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Compositions A and B were respectively dissolved in 500 ml of water in this order and finished at one liter when the solution was used. pH of this fixer was approximately 4 and the replenishing amount was 400 ml/m².

Processing condition:

5

	Step	Temperature	Time	Tank capacity
	Development	34 °C	15 sec	3 liter
10	Fixing	34 °C	15 sec	2 liter
	Washing	Normal	10 sec	2 liter
15	Drying	40 °C	10 sec	

Time of each process contains so-called cross-over time to the next step.
The results are shown in Table 1.

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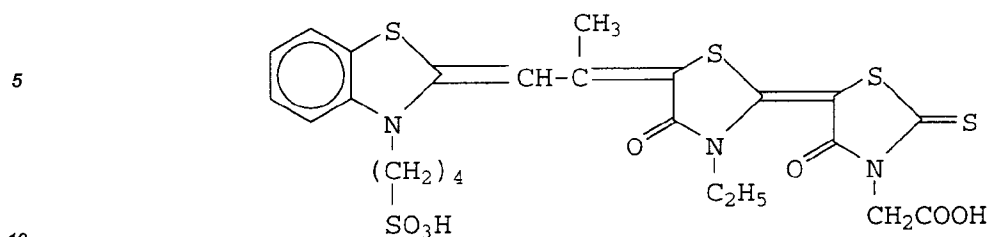
50

55

Table 1

Sample No.	Dye	Fresh solution processing			Developer replenishing rate	Running solution processing			Developer residual color	Remarks
		Sensi-tivity	Residual color	Fog		Sensi-tivity	Residual color	Fog		
1	Comp.	100	4	0.04	400 (ml/m ²)	98	3	0.07	F	Comp.
2	Comp.	100	4	0.04	300	97	2	0.06	P	Comp.
3	Comp.	100	4	0.04	200	70	2	0.04	P	Comp.
4	S-2	95	4	0.04	400	95	4	0.06	G	Comp.
5	S-2	95	4	0.04	300	95	4	0.05	G	Inv.
6	S-2	95	4	0.04	200	94	4	0.04	F	Inv.
7	S-5	105	5	0.04	400	105	5	0.05	G	Comp.
8	S-5	105	5	0.04	300	105	4	0.04	G	Inv.
9	S-5	105	5	0.04	200	103	4	0.04	G	Inv.
10	S-14	130	5	0.04	400	130	5	0.05	G	Comp.
11	S-14	130	5	0.04	300	128	5	0.04	G	Inv.
12	S-14	130	5	0.04	200	125	4	0.04	G	Inv.

Comparative sensitizing dye (Comp.)



It is shown from Table 1 that the samples prepared according to the present invention exhibit improved residual color of a film and coloring in the developing solution at a small amount of replenishing and that this property remains after continuous running process.

Example 2

Preparation for silver halide photographic emulsion

Silver chlorobromide emulsion, of which silver chloride content was 70 % and silver bromide content was 30 %, was prepared by the use of simultaneous controlled double-jet precipitation process. pAg and pHg of the mixed solution was adjusted at 7.8 and 3.0, respectively, and 2×10^{-7} mols/mol of silver of potassium hexabromorhodate was added during grain formation.

Silver halide emulsion thus obtained was desalted by conventional floccuration process using the a gelatin which was modified by phenylisocyanate, and then re-dispersed in an aqueous gelatin solution, to which the same anti-molds as Example 1 were added to obtain a monodisperse silver halide emulsion containing cubic silver halide grains having an average grain size of 0.25 μm and a coefficient of variation of 10%, respectively.

After adding 3 mg of chloroaurate and 0.5 g of elemental sulfur per mol of silver to the emulsion, the emulsion was subjected to chemical ripening at 60°C for 40 minutes, and at the time of completion of chemical ripening, 500 mg of 1-phenyl-5-mercaptotetrazole and 900 mg of 4-methyl-6-hydroxy-1,3,3a,7-tetrazaindene per one mol of silver were added. Preparation of silver halide light-sensitive photographic material.

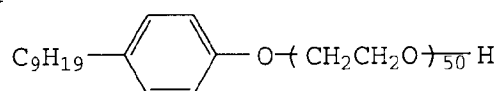
On one side of a 100 μm -thick polyethyleneterephthalate support, both surfaces of which are provided with a 0.1 μm -thick subbing layer formed with reference to the disclosure in Japanese Patent O.P.I. Publication No. 59-19941/1983, a silver halide light-sensitive emulsion layer was coated so that the coated amount of silver and gelatin per 1 m^2 of the film were 3.2 g and 2.6 g, respectively. Then on the emulsion layer, a protective layer, and on another side, a backing layer and a protective layer for the backing protective layer were coated to obtain a sample.

Composition for silver halide light-sensitive emulsion layer

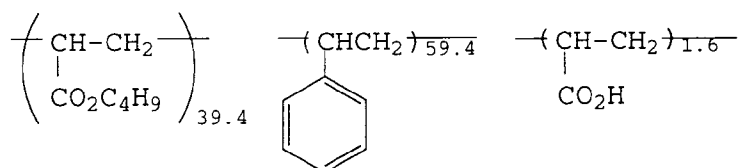
Gelatin	1.8 g/m ²
Silver halide emulsion A	3.5 g/m ²
Sensitizing dyes as shown in Table 2	2×10 ⁻⁵ mol/m ²
Antifoggant: 5-nitroindazole	10 mg/m ²

	2-mercaptohypoxanthine	2 mg/m ²
	Surfactant: Saponin	0.1 g/m ²
5	Sodium sulfosuccinate iso pentyl-n-decyl ester	8.0 g/m ²
	Compound K	30 mg/m ²
10	Hydrazine derivative (shown in Table 2)	3×10 ⁻⁵ mol/m ²
	Nucleation accelerator (shown in Table 2)	1.6×10 ⁻⁴ mol/m ²
15		
	Polymer latex P	0.5 g/m ²
	Hardener H-1	60 mg/m ²

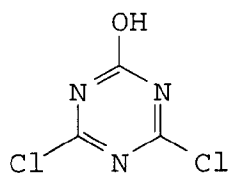
Compound K



Polymer latex



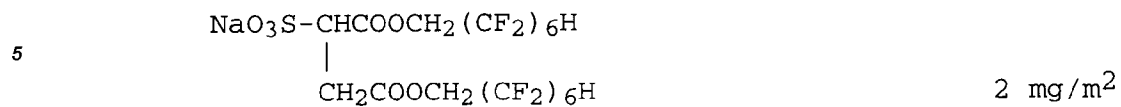
Hardener H-1



(Composition of protective layer)

45	Gelatin	1.5 g/m ²
	Surfactant: S-3	
50	Sodium sulfosuccinic acid di(2-ethylhexyl)ester	10 g/m ²

Surfactant: S-3

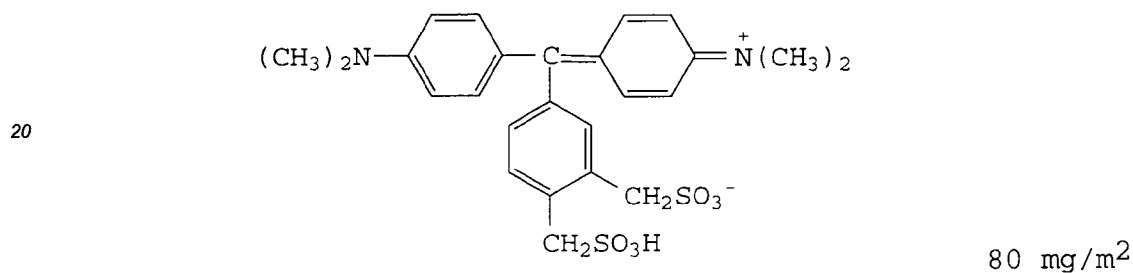


Matting agent: Silica, 3.5 μm 20 mg/m²

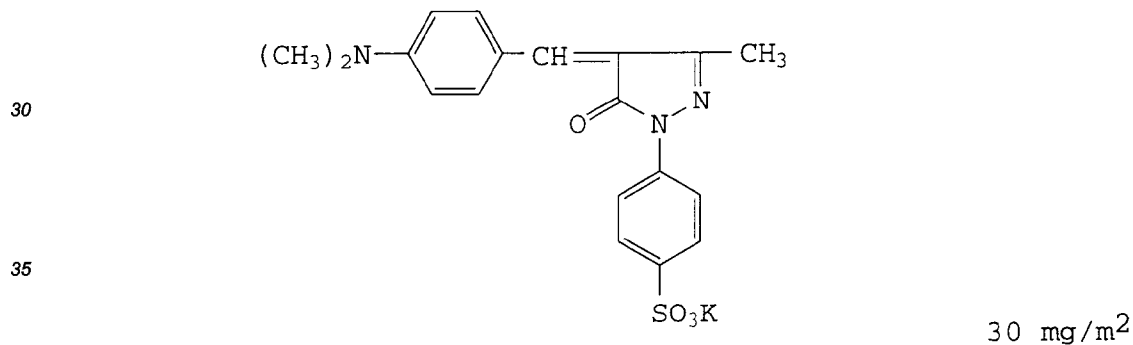
10 Hardener: Formalin 30 mg/m²

Composition of Backing Layer

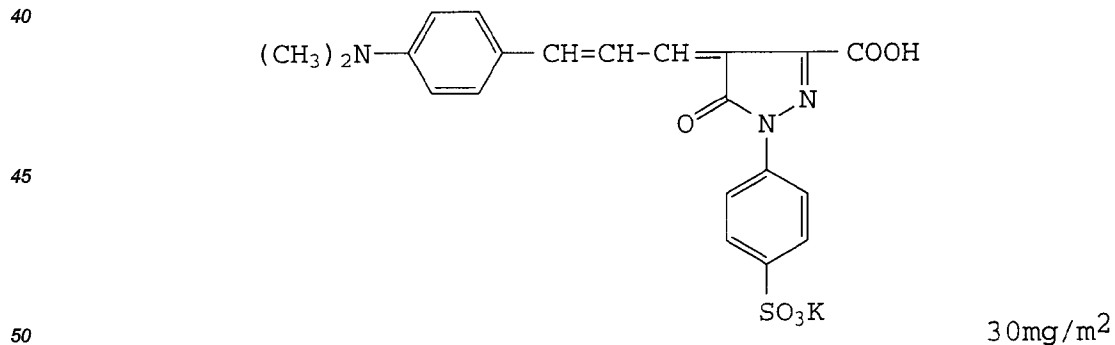
15 (a)



25 (b)



40 (c)



50 Gelatin 2.4 g/m²

55 Surfactant: Sodium dodecyl benzene sulfonate 50 mg/m²

Composition of the protective layer for the backing layer

5	Gelatin	1 g/m ²
	Matting agent: Polymethylmethacrylate having average grain size of 5.0 microns	50 mg/m ²
10	Surfactant: Sodium sulfosuccinic acid	
	Di(2-ethylhexyl) ester	10 mg/m ²
	Hardener: Glyoxal	25 mg/m ²
15	Hardener: 2-hydroxy-4,6-dichlorotriazine	35 g/m ²

20 The samples were exposed to light, processed using processing solutions as below and running solutions thereof as Example 1 and evaluated with respect to sensitivity and residual color in the same manner as Example 1. The developing solution was replenished as shown in Table 2. The number of black spots produced in a 2 mm-square of unexposed portion was counted by magnifying them with a 50 times loupe.

(Photographic processing condition)

25	Step	Temperature	Time
	Development	35°C	30
30	Fixing	33°C	20
	Washing	normal temperature	20
	Drying	40°C	40
35	Developer:		
	Sodium sulfite		55 g
40	Potassium carbonate		40 g
	Hydro quinone		24 g
45	1-Phenyl-4-dimethyl-3-pyrazolidone (dimezone)		0.9 g
	Potassium bromide		5 g
	5-Methylbenzotriazole		0.13 g
50	1-Phenyl-5-mercaptotetrazole		0.02 g
	Boric acid		2.2 g
55	2-Mercaptohypoxanthine		100 mg
	Diethylene glycol		40 g

Water was added to make 1 liter and pH was adjusted with the sodium hydroxide, as shown in Table 2.

	Fixer:	
5	(Composition A)	
	Ammonium thiosulfate (72.5W/V% aqueous solution)	240 cc
	Sodium sulfite	17 g
10	Sodium acetate trihydrate	6.5 g
	Boric acid	6.0 g
	Sodium citrate dihydrate	2.0 g
15	(Composition B)	
	Water (deionized water)	17 cc
	Boric acid (50W/V% aqueous solution)	4.7 g
20	Aluminum borate (aqueous solution of Al_2O_3 conversion content 8.1W/V%)	26.5 g

Composition A and composition B was dissolved in the water 500 cc, when using, in this order and made up to one liter. pH was adjusted by the acetic acid to 4.8.

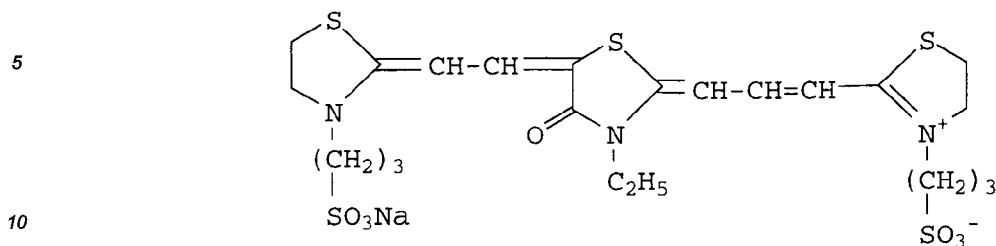
The result is shown in Table 2.

Table 2

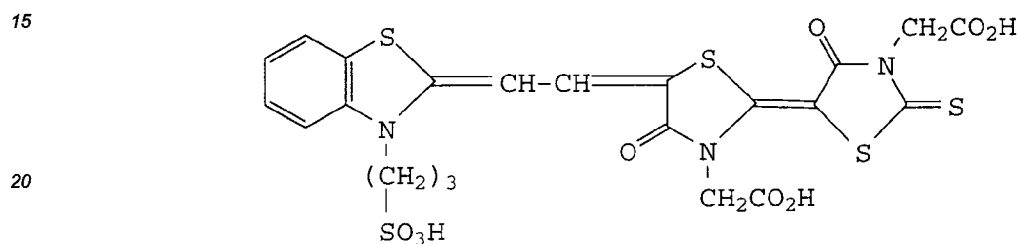
Sample No.	Dye	Hydra-zine	Nucleation accelerator	Fresh solution processing			Running solution processing			Replen- ing amount (ml/m ²)	Re- marks
				pH	Sensi- tivity	black spot	Residual color	Sensi- tivity	black spot	Residual color	
1	Comp. 1	H-13	-	11.5	100	10	4	80	12	4	Comp.
2	Comp. 1	H-13	-	11.0	80	2	3	70	5	3	Comp.
3	Comp. 1	H-13	-	10.5	60	1	3	55	2	2	Comp.
4	S-14	H-13	-	11.5	120	12	4	100	14	4	Comp.
5	S-14	H-13	-	11.0	90	3	4	85	5	3	Comp.
6	S-14	H-13	-	10.5	80	1	4	75	1	3	Inv.
7	S-14	H-13	Na-9	10.5	200	2	4	190	2	3	Inv.
8	Comp. 1	H-13	Na-9	10.5	180	1	3	160	30	2	Comp.
9	Comp. 2	H-13	Na-9	10.5	170	5	3	180	*1	*1	Comp.
10	S-15	H-13	Na-9	10.5	170	2	5	160	3	4	Inv.
11	S-19	H-13	Na-9	10.5	220	3	5	200	4	5	Inv.
12	S-20	H-13	Na-9	10.5	180	2	5	160	2	5	Inv.
13	S-20	H-13	Na-9	10.5	180	2	5	160	3	5	Inv.
14	S-20	H-13	Na-9	10.5	180	2	5	165	6	5	Inv.
15	S-15	H-6	Na-9	10.5	240	3	5	230	2	4	Inv.
16	S-14	H-6	Nb-4	10.5	240	2	5	235	3	4	Inv.

*1 non-measurable

Comparative dye (Comp. 1)



Comparative dye (Comp. 2)

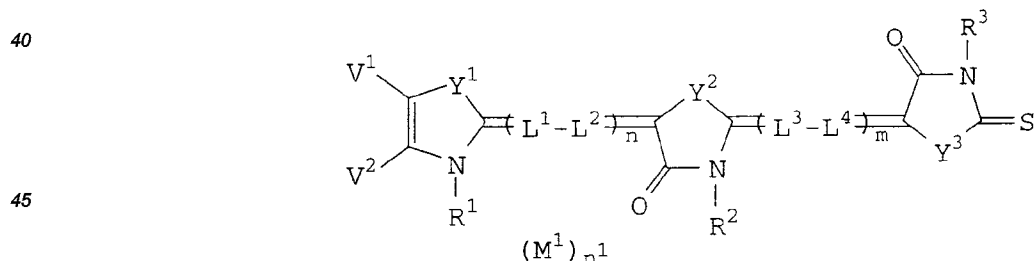


25 As can be seen from the results in Table 2, the inventive samples exhibited lowering in residual color and prevention of occurrence of black spot, and led excellent results even when running-processed.

Claims

- 30 1. A method of forming an image comprising imagewise-exposing a silver halide photographic light sensitive material and developing the exposed photographic material with a developer to form the image, wherein said silver halide photographic material contains a spectral sensitizing dye represented by the following formula [S], and wherein said photographic material is developed with a developer having a pH of 10.9 or less, said developer being replenished by a developer-replenishing solution having a pH value of 10.9 or less in an amount of 300 ml or less per m² of the photographic material,
- 35

formula [S]



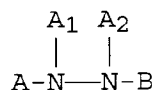
50 wherein Y¹, Y² and Y³ independently represent -N(R)- group, an oxygen atom, a sulfur atom or a selenium atom, provided that at least one of Y¹, Y² and Y³ is other than sulfur or selenium; R, R¹, R² and R³ independently represent an aliphatic group, an aryl group or a heterocyclic group, provided that at least one of R, R¹, R² and R³ has a water-solubilizing group as a substituent; V¹ and V² independently represent a hydrogen atom, an alkyl group, an alkoxy group or an aryl group, and V¹ and V² may combine with each other to form a ring; L¹, L², L³ and L⁴ independently represent a substituted or unsubstituted methine group; n is 1 or 2; m is 0 or 1; M¹ is an ion necessary for neutralizing a charge of a molecule; and n¹ is a number necessary for neutralizing a total charge of the molecule.

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2. The method of claim 1, wherein said silver halide photographic material contains a hydrazine compound

represented by the following formula [H],

formula [H]

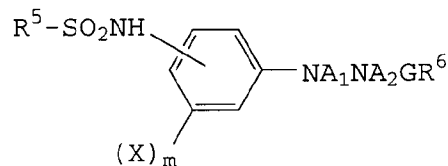


wherein A represents an aliphatic group, an aryl group or a heterocyclic group; B represents a blocking group; A₁ and A₂ are both hydrogen atoms, or one of them is a hydrogen atom and the other one is an acyl group, a sulfonyl group or an oxalyl group.

3. The method of claim 2, wherein B of formula [H] is -G- R⁶, wherein G represents a carbonyl group, a sulfonyl group, a sulfoxy group, a phosphoryl group or iminomethylene group; R⁶ represents a hydrogen atom, an aliphatic group, an aryl group, a heterocyclic group, an amino group, an alkoxy group, an aryloxy group, -COOR₈, or -CON(R₉)(R₁₀), in which R₈ represents a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group, an aryl group or a heterocyclic group; and R₉ and R₁₀ represents each a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group, an aryl group or a heterocyclic group, hydroxy, an alkoxy group, an alkenyloxy group, an alkynyloxy group, an aryloxy group, a heterocycloxy group or an amino group.

4. The method of claim 3, wherein said silver halide photographic material contains a hydrazine compound represented by the following formula [Ha],

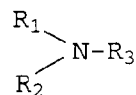
formula [Ha]



wherein R⁵ represents an aliphatic group, an aryl group or a heterocyclic group; R⁶, G, A₁ and A₂ each have the same definition as in claim 3.

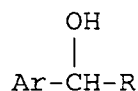
5. The method of claim 2, wherein said silver halide photographic material further contains a nucleation-accelerating compound represented by formula [Na] or formula [Nb],

Formula [Na]



wherein R₁, R₂ and R₃ independently represent a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group or an aryl group, and R₁, R₂ and R₃ may combine with each other to form a ring,

formula [Nb]



wherein Ar represents an aryl group or a heterocyclic group; R represents a hydrogen atom, an alkyl group, an alkenyl group, an alkynyl group or an aryl group; and Ar and R may combine through a linkage group to form a ring.



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 94306599.5

DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
D, A	EP - A - 0 363 104 (EASTMAN KODAK COMPANY) * Totality * & JP-A-02 143 242 -----	1-5
		CLASSIFICATION OF THE APPLICATION (Int. Cl.) G 03 C 1/26 G 03 C 1/10 G 03 C 5/31
		TECHNICAL FIELDS SEARCHED (Int. Cl.) G 03 C
The present search report has been drawn up for all claims		
Place of search	Date of completion of the search	Examiner
VIENNA	06-12-1994	BECK
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		

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