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(54) **Silver halide photographic lightsensitive material.**

(57) A silver halide photographic light-sensitive material having at least one silver halide emulsion layer containing a dye-forming coupler wherein the emulsion contains an ester group and has the oxidation potential of not more than 1800 mV, is disclosed. The material is good in image storage stability and excellent in color development stability.

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FIELD OF THE INVENTION

The present invention relates to a silver halide photographic light-sensitive material, more specifically a silver halide photographic light-sensitive material which is good in image storage stability and excellent in color developability and color reproducibility and which undergoes little change in the photographic performance thereof in continuous processing.

BACKGROUND OF THE INVENTION

In silver halide photographic light-sensitive materials undergoing direct viewing, such as color printing paper, it is a common practice to use a yellow coupler, a magenta coupler and a cyan coupler in combination as dye-forming couplers. These couplers are required to offer the desired level of basic performance, including the color reproducibility, color developability and image storage stability in the dye image obtained. In recent years, there has been increasing demand from users for improved dye image storage stability and improved color reproducibility leading to exact reproduction of the original color of the subject.

For improving image storage stability, the use of a phenol or piperidine derivative with a particular structure is proposed in Japanese Patent Examined Publication Nos. 1420/1976 and 6623/1977 and Japanese Patent Publication Open to Public Inspection (hereinafter referred to as Japanese Patent O.P.I. Publication) Nos. 87456/1984 and 96944/1991. However, these methods often result in reduction in coloring density.

Also, since the absorption characteristic of the obtained dye image is very important in color reproduction; couplers with good absorption characteristic have recently been studied actively. For example, the pivaloylacetanilide yellow couplers described in Japanese Patent O.P.I. Publication No. 123047/1988, 9051/1992 and Japanese Patent Application No. 245949/1990, which have an alkoxy group in the anilide moiety thereof, were found useful for color printing paper because they form a dye with sharp absorption. However, various investigations of these yellow couplers revealed a drawback of insufficient stability to light, i.e., light fastness, of the dye image formed.

Also, in color photographic light-sensitive materials and light-sensitive materials for printing, there recently has been increasing demand for high sensitivity and stable processing with the trend toward time reduction in the printing and developing processes. Particularly the photographic performance change with change in processing solution component concentration in continuous processing has posed an increasingly difficult problem in rapid processing.

SUMMARY OF THE INVENTION

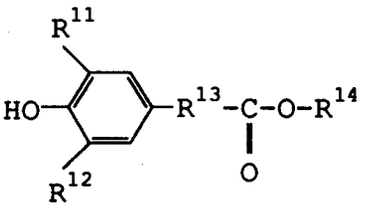
It is an object of the present invention to provide a silver halide photographic light-sensitive material excellent in storage stability to heat and light. It is another object of the present invention to provide a silver halide photographic light-sensitive material excellent in color developability. It is still another object of the present invention to provide a silver halide photographic light-sensitive material undergoing little change in the photographic performance thereof in continuous processing. It is yet another object of the present invention to provide a silver halide photographic light-sensitive material excellent in color reproduction.

The objects of the present invention described above are accomplished by the following constituents:

(1) A silver halide photographic light-sensitive material having at least one silver halide emulsion layer containing a dye-forming coupler on the support, wherein said silver halide emulsion layer contains at least one compound having an ester group and an oxidation potential of not more than 1800 mV.

(2) A silver halide photographic light-sensitive material as described in (1) above, wherein said compound having an ester group and an oxidation potential of not more than 1800 mV is a compound represented by the following formula I:

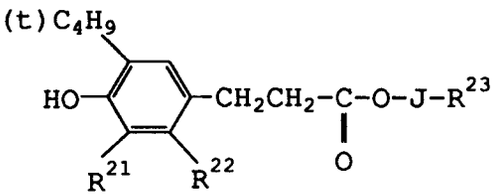
Formula I



(wherein R^{11} and R^{12} independently represent an alkyl group; R^{13} represents a divalent binding group; R^{14} represents a hydrogen atom or a substituent.)

(3) A silver halide photographic light-sensitive material as described in (1) above, wherein said compound having an ester group and an oxidation potential of not more than 1800 mV is a compound represented by the following formula II:

Formula II

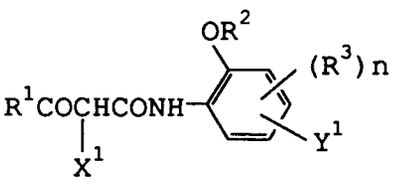


(wherein R^{21} and R^{22} independently represent a hydrogen atom or an alkyl group having 1 to 5 carbon atoms; J represents an alkylene group or a simple bond; R^{23} represents a heterocyclic residue.)

(4) A silver halide photographic light-sensitive material as described in (1), (2) or (3) above, wherein said dye-forming coupler is a yellow coupler.

(5) A silver halide photographic light-sensitive material as described in (1), (2), (3) or (4) above, wherein said dye-forming coupler is a yellow coupler represented by the following formula Y-I:

Formula Y-I



(wherein R^1 represents an alkyl group or a cycloalkyl group; R^2 represents an alkyl group, a cycloalkyl group, an aryl group or an acyl group; R^3 represents a group capable of substituting a benzene ring; n represents 0 or 1; X^1 represents a group capable of splitting off upon coupling with the oxidation product of a developing agent; Y^1 represents an organic group.)

(6) A silver halide photographic light-sensitive material as described in (1), (2), (3), (4) or (5) above, wherein said dye-forming coupler is a cyan coupler.

(7) A silver halide photographic light-sensitive material having photographic structural layers including a blue-sensitive silver halide emulsion layer, a green-sensitive silver halide emulsion layer and a red-sensitive silver halide emulsion layer on the support, wherein at least one of said blue-sensitive silver halide emulsion layers contains at least one kind of the yellow coupler represented by formula Y-I, described in (5) above, and one kind of the compound represented by formula II, described in (3) above.

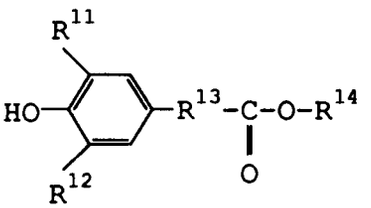
DETAILED DESCRIPTION OF THE INVENTION

First, the compound relating to the present invention (hereinafter referred to as the compound of the present invention), which has an ester group and an oxidation potential of not more than 1800 mV, is described below.

In the present invention, oxidation potential is defined to be obtained by cyclic voltammetry. Oxidation potential can be determined by taking a cyclic voltamogram at a sweeping speed of 50 mV/second in acetonitrile solvent at 20 °C, using platinum for a working electrode, an indicator electrode and saturated calomel for a reference electrode and tetra-n-butyl-ammonium perchlorate as a supporting electrolyte.

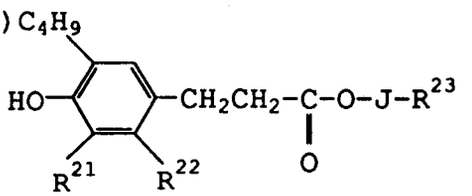
For the present invention, a compound represented by the following formula I or II is desirable.

Formula I



(wherein R^{11} and R^{12} independently represent an alkyl group; R^{13} represents a divalent binding group; R^{14} represents a hydrogen atom or a substituent.)

Formula II



wherein R^{21} and R^{22} independently represent a hydrogen atom or an alkyl group having 1 to 5 carbon atoms; J represents an alkylene group or a simple bond; R^{23} represents a heterocyclic residue.

Next, the compounds represented by formulas I and II are described below.

In formula I, R^{11} and R^{12} independently represent an alkyl group. Examples of preferable alkyl groups for R^{11} and R^{12} include linear or branched alkyl groups having 1 to 24 carbon atoms, such as a methyl group, an ethyl group, an isopropyl group, a t-butyl group, an octyl group, a 2-ethylhexyl group, a dodecyl group, a tetradecyl group, an eicosyl group and a benzyl group, with preference given to branched alkyl groups.

R^{13} represents a divalent binding group. Examples of groups for R^{13} include an alkylene group and a phenylene group, which groups may have a substituent. The group for R^{13} is preferably a linear alkylene group. Also, the number of carbons contained in R^{13} preferably ranges from 1 to 10, more preferably from 2 to 6.

R^{14} represents a hydrogen atom or a substituent. Examples of preferable substituents represented by R^{14} include alkyl groups, cycloalkyl groups, alkenyl groups, aryl groups, alkylamino groups, alkylthio groups, arylthio groups, alkoxycarbonyl groups and acyloxycarbonyl groups. R^{14} preferably has at least one branching point in the molecular structure thereof.

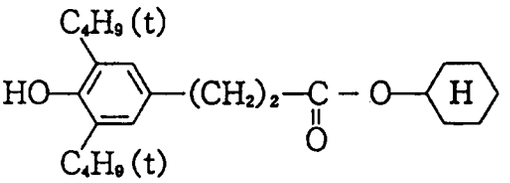
Examples of alkyl groups for R^{21} and R^{22} in formula II include a methyl group, an ethyl group, a propyl group, a butyl group and an amyl group, which alkyl groups may be branched. Examples of alkylene groups for J include alkylene groups having 1 to 20 carbon atoms, such as a methylene group, an ethylene group, a propylene group and a butylene group, which alkylene groups may be branched. Examples of heterocyclic residues for R^{23} include 5- or 6-membered ring residues containing a heteto atom such as of oxygen, sulfur or nitrogen, e.g., a thienyl group, a furyl group, a pyrrolyl group, a pyrrolidinyl group, a piperidyl group, a piperazinyl group, a morpholino group, a thiacyclohexyl group, a dithiacyclohexyl group, an oxacyclohexyl group and a dioxacyclohexyl group, which heterocyclic residues may have been condensed with another heterocyclic ring or a hydrocarbon ring and may have formed a spiro compound.

Also, the oxidation potential of the compound of the present invention is preferably in the range from

800 to 1800 mV, more preferably from 1200 to 1500 mV.

Examples of the compound of the present invention are given below, which are not to be construed as limitative on the invention.

I − 1



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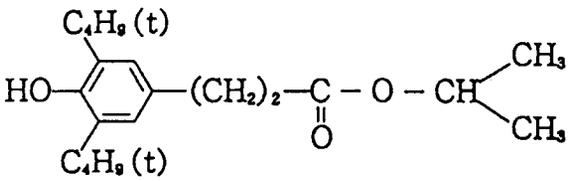

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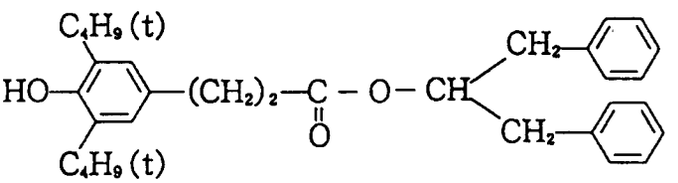

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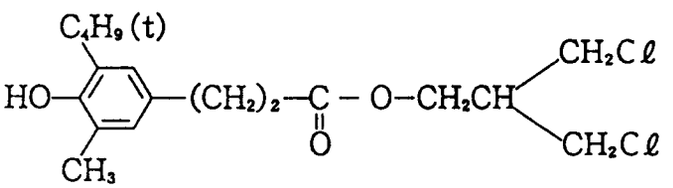

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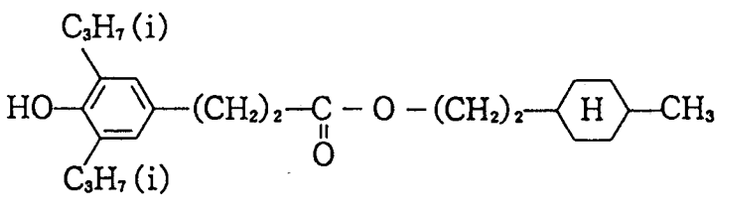

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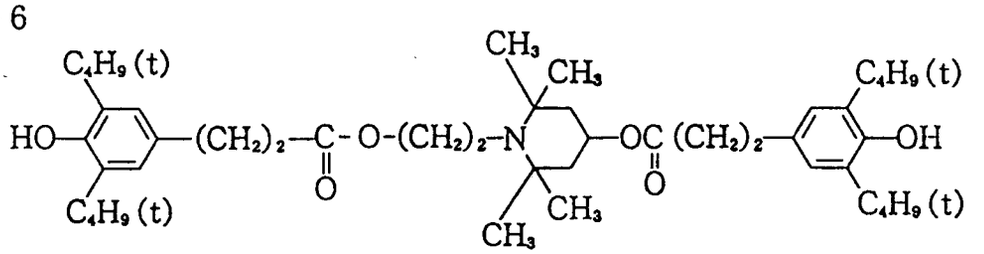

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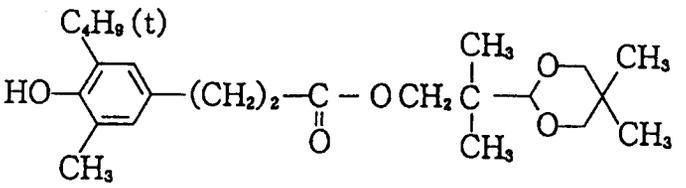

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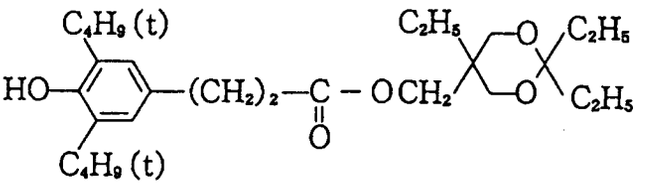

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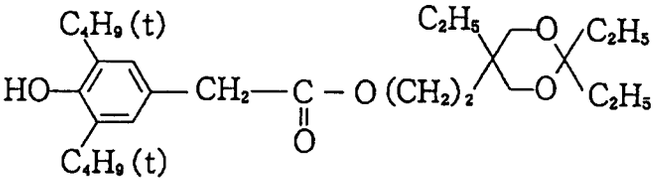

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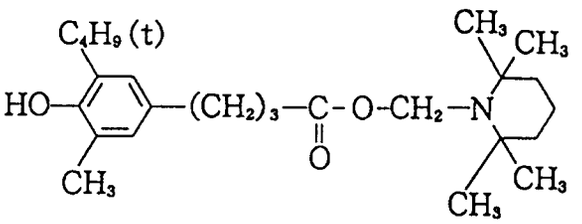

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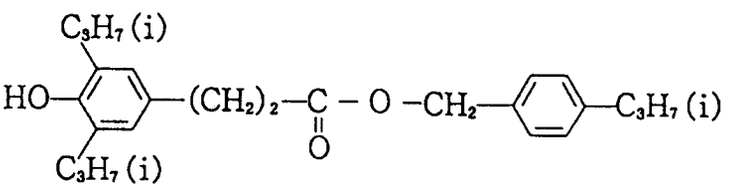

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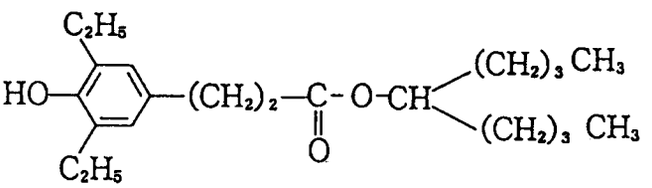

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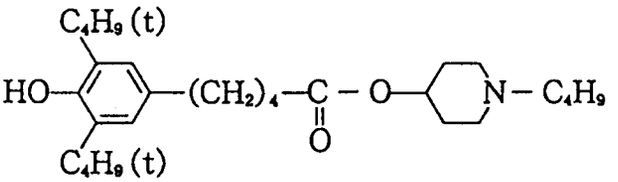

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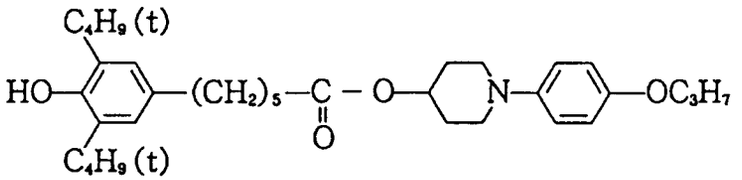

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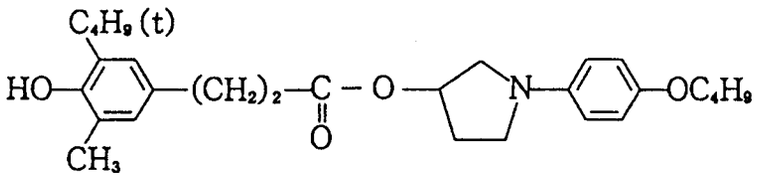

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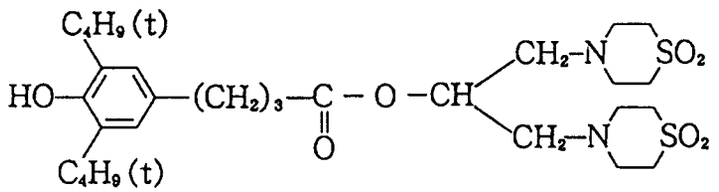

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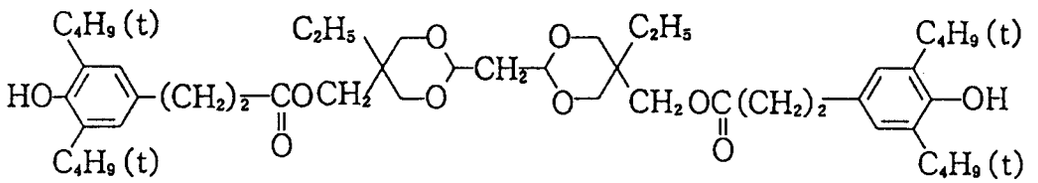

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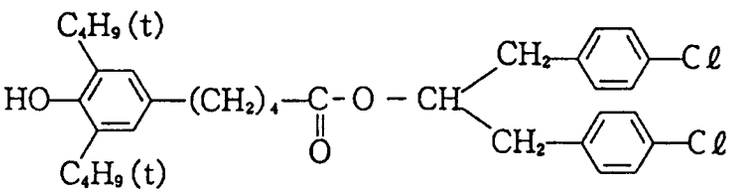

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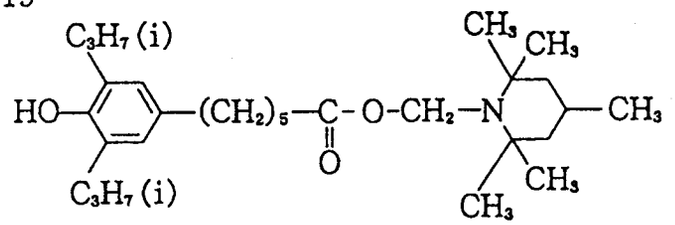

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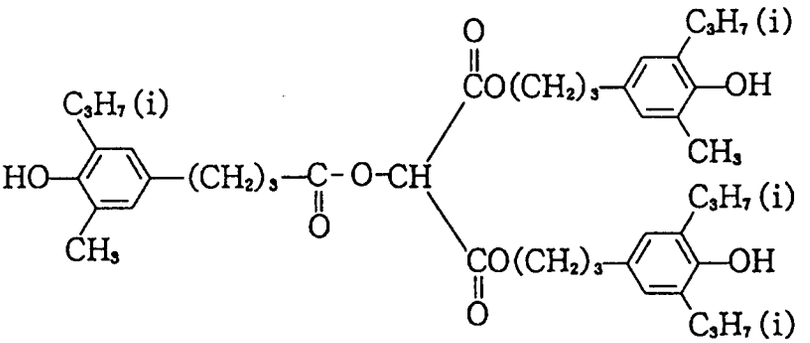

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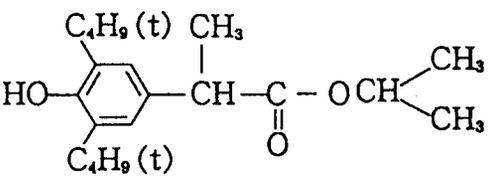

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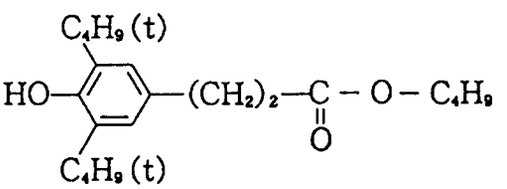

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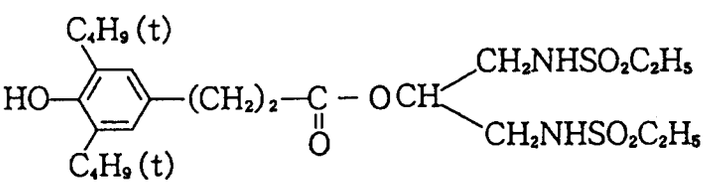

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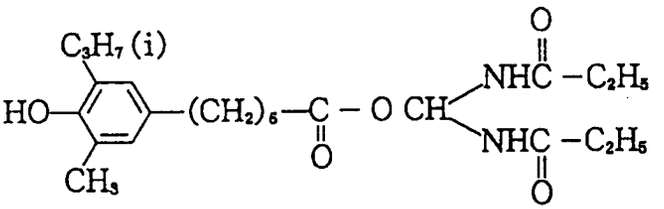

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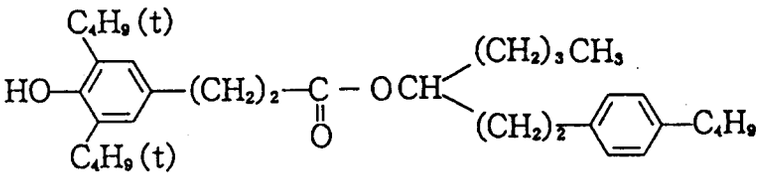

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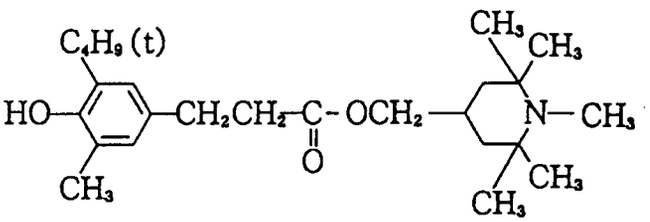

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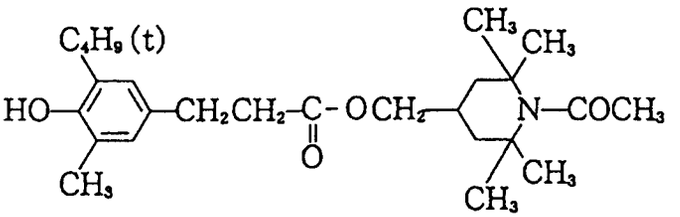

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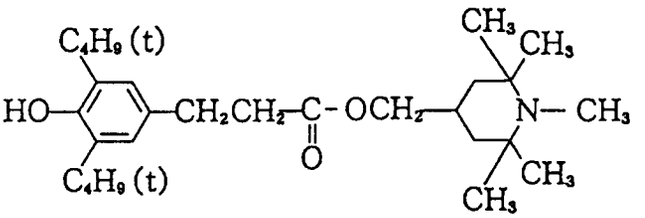

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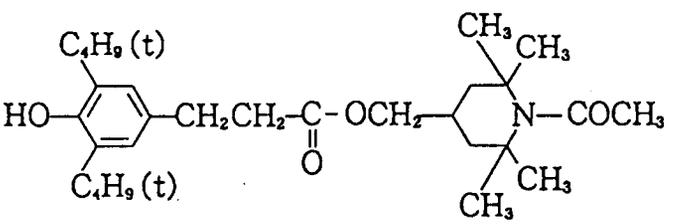

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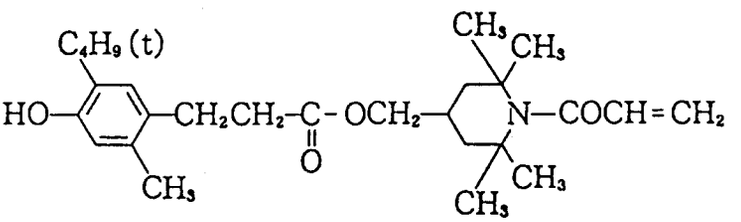

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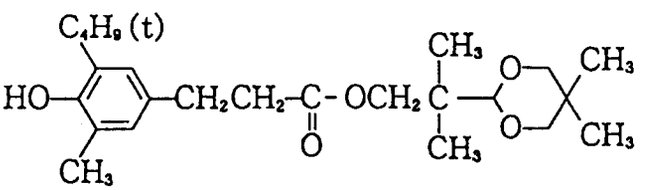

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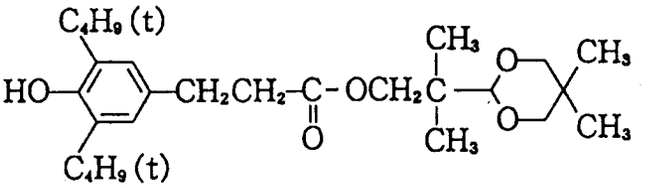

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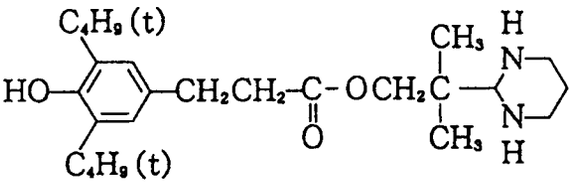

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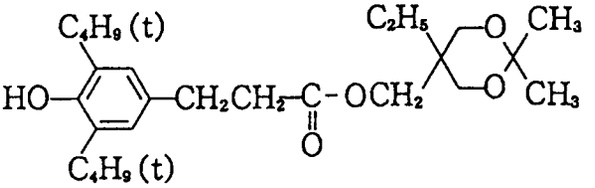

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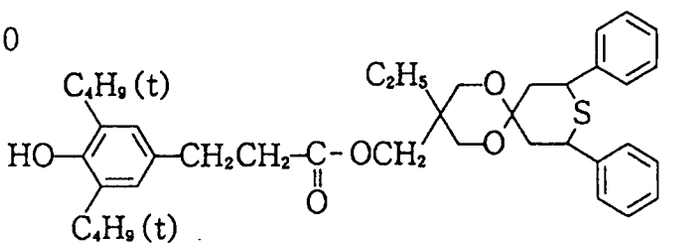

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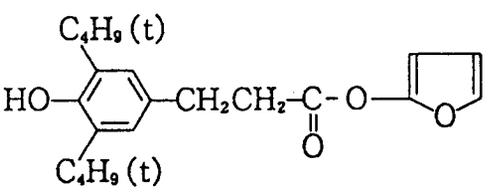
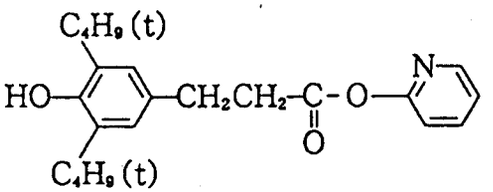


II－12



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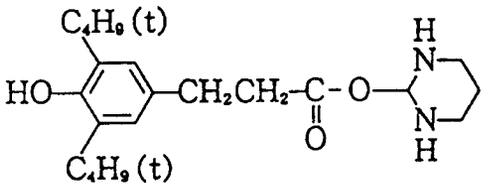

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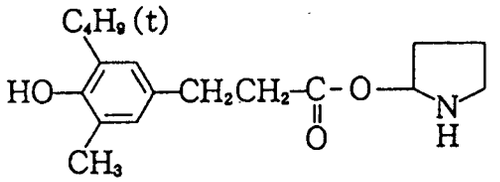
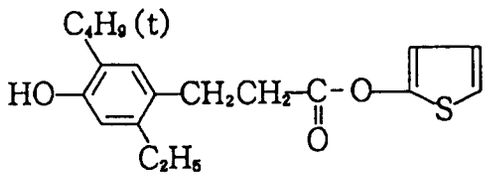
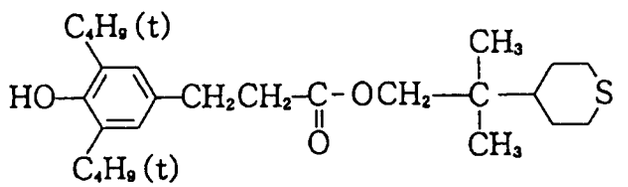


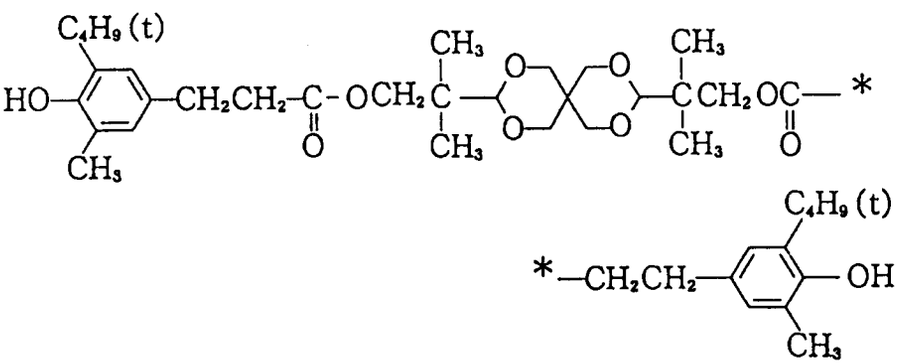
II − 15



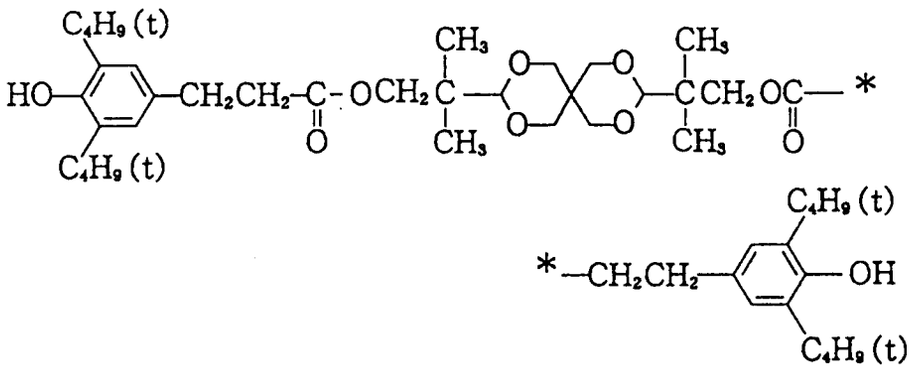
II − 16



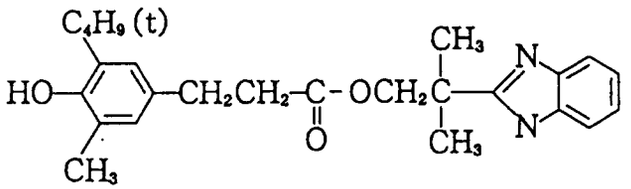
II − 17



II – 18



II – 19



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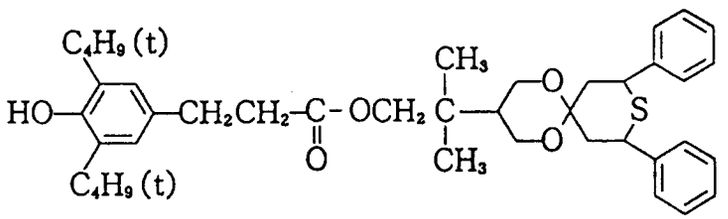
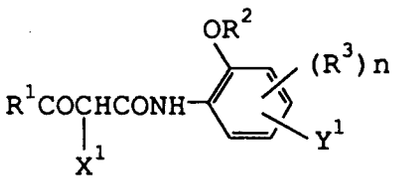


These compounds can easily be synthesized by the method described in European Patent No. 310,552. These compounds may be used singly or in combination. The amount of their addition is preferably 5 to 300 mol%, more preferably 10 to 200 mol% relative to the amount of couplers.

Next, the yellow couplers used for the present invention are described below. Although any yellow coupler can be used without limitation in the present invention, a yellow coupler represented by formula Y-I is preferred.

Formula Y-I



(wherein R^1 represents an alkyl group or a cycloalkyl group; R^2 represents an alkyl group, a cycloalkyl group, an aryl group or an acyl group; R^3 represents a group capable of substituting a benzene ring; n represents 0 or 1; X^1 represents a group capable of splitting off upon coupling with the oxidation product of a developing agent; Y^1 represents an organic group.)

Examples of the alkyl group for R^1 in formula Y-I include a methyl group, an ethyl group, an isopropyl group, a t-butyl group and a dodecyl group. These alkyl groups for R^1 may have a substituent. Examples of the substituent include a halogen atom, an aryl group, an alkoxy group, an aryloxy group, an alkylsulfonyl group, an acylamino group and a hydroxyl group.

Examples of the cycloalkyl group for R^1 include a cyclopropyl group, a cyclohexyl group and an adamantyl group, with preference given to a branched alkyl group, more specifically a t-butyl group.

Examples of the alkyl group or cycloalkyl group for R^2 in formula Y-I include the groups specified for R^1. Examples of the aryl group for R^2 include a phenyl group. These alkyl groups, cycloalkyl groups and aryl groups for R^2 include those having the same substituent as specified for R^1. Examples of the acyl group for R^2 include an acetyl group, a propionyl group, a butyryl group, a hexanoyl group and a benzoyl group. The group for R^2 is preferably an alkyl group or an aryl group, more preferably an alkyl group, and still more preferably a lower alkyl group having not more than 5 carbon atoms.

Examples of the group capable of substituting a benzene ring, represented by R^3 in formula Y-I, include halogen atoms such as a chlorine atom, alkyl groups such as an ethyl group, an isopropyl group and a t-butyl group, alkoxy groups such as a methoxy group, aryloxy groups such as a phenyloxy group, acyloxy groups such as a methylcarbonyloxy group and a benzoyloxy group, acylamino groups such as an acetamide group and a phenylcarbonylamino group, carbamoyl groups such as an N-methylcarbamoyl group and an N-phenylcarbamoyl group, alkylsulfonylamino groups such as an ethylsulfonylamino group, arylsulfonylamino groups such as a phenylsulfonylmaino group, sulfamoyl groups such as an N-propylsulfamoyl group and an N-phenylsulfamoyl group and imide groups such as a succinimide group and glutarimide group. n represents 0 or 1.

In formula Y-I, Y^1 represents an organic group without limitation, but it is preferably a group represented by the following formula Y-II:

Formula Y-II

$$-J-R^4$$

(wherein J represents $-N(R^5)-CO-$, $-CON(R^5)-$, $-COO-$, $-N(R^5)-SO_2-$ or $-SO_2-N(R^5)-$; R^4 and R^5 independently represent a hydrogen atom, an alkyl group, an aryl group or a heterocyclic group.)

Examples of alkyl groups for R^4 and R^5 include a methyl group, an ethyl group, an isopropyl group, a t-butyl group and a dodecyl group. Examples of aryl groups for R^4 and R^5 include a phenyl group and a naphthyl group. These alkyl groups or aryl groups for R^4 and R^5 include those having a substituent. The substituent is not subject to limitation; typical examples thereof include halogen atoms such as a chlorine atom, alkyl groups such as an ethyl group and a t-butyl group, aryl groups such as a phenyl group, a p-methoxyphenyl group and a naphthyl group, alkoxy groups such as an ethoxy group and a benzyloxy group, aryloxy groups such as a phenoxy group, alkylthio groups such as an ethylthio group, arylthio groups such as a phenylthio group, alkylsulfonyl groups such as a β-hydroxyethylsulfonyl group and arylsulfonyl groups such as a phenylsulfonyl group. Examples also include acylamino groups such as an alkylcarbonylamino group, specifically an acetamide group, and arylcarbonylamino groups, specifically a phenylcarbonylamino group, carbamoyl groups, including those substituted by an alkyl group, an aryl group (preferably a phenyl group) or another substituent, such as an N-methylcarbamoyl group and an N-phenylcarbamoyl group, acyl groups such as an alkylcarbonyl group, specifically an acetyl group and an arylcarbonyl group, specifically a benzoyl group, sulfonamide groups such as an alkylsulfonylamino group and an arylsulfonylamino group, specifically a methylsulfonylamino group and a benzenesulfonamide group, sulfamoyl groups, including those substituted by an alkyl group, an aryl group (preferably a phenyl group) or another substituent, specifically an N-propylsulfamoyl group and an N-phenylsulfamoyl group, a hydroxy group and a nitrile group.

The preferable group represented by $-J-R^4$ is $-NHCOR'^4$, wherein R'^4 represents an organic group, preferably a linear or branched alkyl group having 1 to 30 carbon atoms, such as a methyl group, an ethyl group, a n-propyl group, an isopropyl group, a t-butyl group, a n-pentyl group, a n-hexyl group, a 2-ethylhexyl group, a n-octyl group, a n-decyl group, a linear or branched dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, an octadecyl group, a nonadecyl group, an eicosyl group, a docosyl group, a tetracosyl group and a hexacosyl group. Of these alkyl groups, those having 8 to 20 carbon atoms are particularly preferable.

In formula Y-I, X^1 represents a group splitting off upon coupling reaction with the oxidation product of a developing agent. Examples of such groups include the group represented by the following formula Y-III or Y-IV, with preference given to the group represented by formula Y-IV.

Formula Y-III

$$-OR^6$$

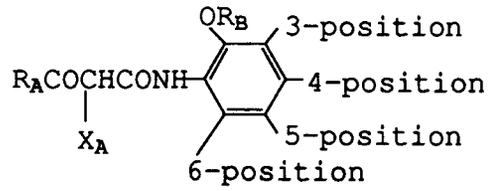
(wherein R^6 represents an aryl group which may have a substituent or a heterocyclic group.)

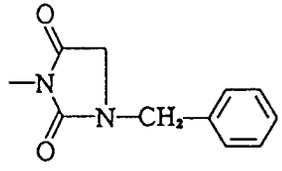
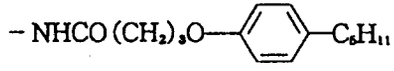
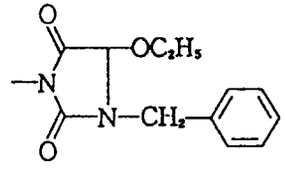
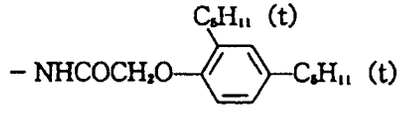
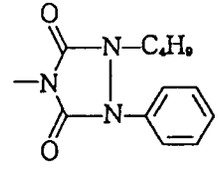
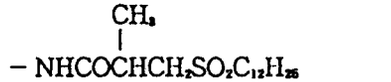
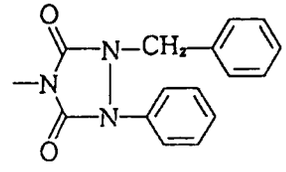
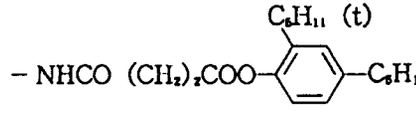
Formula Y-IV

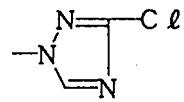
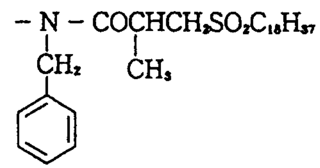
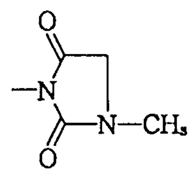
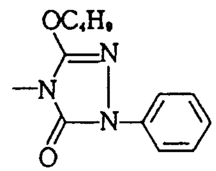
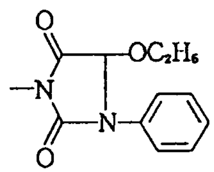
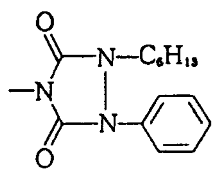
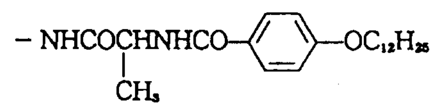
(wherein Z^1 represents a group of non-metallic atoms necessary to form a 5- or 6-membered ring in cooperation with the nitrogen atom. Examples of the group of non-metallic atoms necessary to form the 5- or 6-membered ring include a methylene group, a methine group, a substituted methine group, >C=O, >NR^7 (R^7 has the same definition as R^5 above), -N=, -O-, -S- and -SO_2-.)

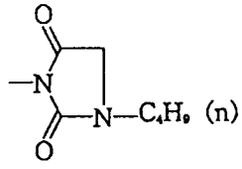
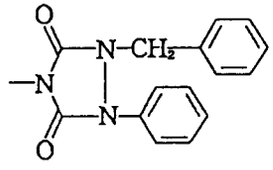
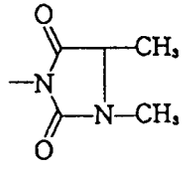
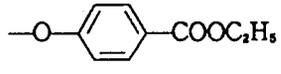
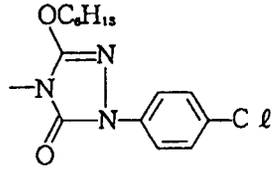
The yellow coupler represented by formula Y-I may bind at the R^1, R^3 or Y^1 moiety to form a bis configuration.

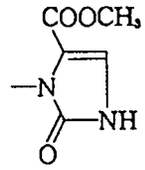
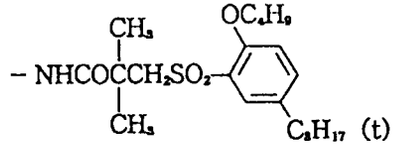
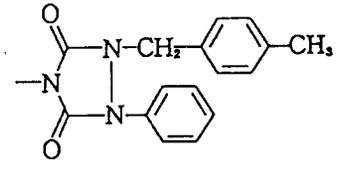
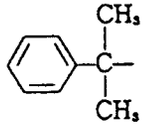
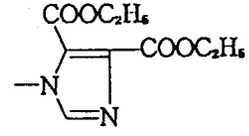
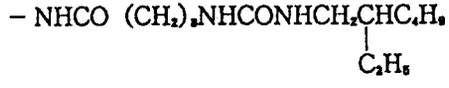
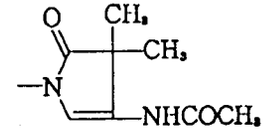
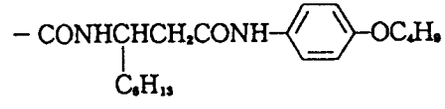
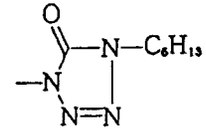
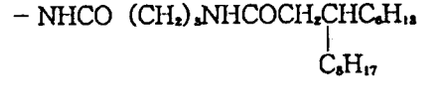
Next, examples of yellow couplers represented by formula Y-I are given below.



No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-1	(t) C_4H_9-	$-CH_3$		-H	-H		-H
Y-2	(t) C_4H_9-	$-CH_3$		-H	-H		-H
Y-3	(t) C_4H_9-	$-CH_3$		-H	-H		-H
Y-4	(t) C_4H_9-	$-CH_3$		-H	-H		-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-5	(t) C_4H_9-	$-CH_3$		-H	-H		-H
Y-6	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCH(CH_3)CH_2SO_2C_{12}H_{25}$	-H
Y-7	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCO(CH_2)_2CON(C_2H_5)C_{12}H_{25}$	-H
Y-8	(t) C_4H_9-	$-C_3H_7$ (iso)		-H	-H		-H
Y-9	(t) C_4H_9-	$-CH_3$		-H	-H		-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-10	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCHCH_2SO_2C_{12}H_{25}$ (CH$_3$ on CH)	-H
Y-11	(t) C_4H_9-	$-CH_3$		-H	-H	$-CONH(CH_2)_2NHSO_2C_{12}H_{25}$	-H
Y-12	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCHCH_2SO_2C_{12}H_{25}$ (CH$_3$ on CH)	-H
Y-13	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCHO$-(C$_{12}$H$_{25}$)-(OH)-(C_4H_9 (t))	-H
Y-14	(t) C_4H_9-	$-C_{12}H_{25}$		-H	-H	$-NHCO(CH_2)_2SO_2NHCH_2CHC_4H_9$ (C_2H_5 on CH)	-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-15	(t) C_4H_9-	$-C_2H_5$		-H	-H		-H
Y-16	(t) C_4H_9-	$-CH_3$		-H	-H	$-COOC_{12}H_{25}$	-H
Y-17		$-C_{12}H_{25}$		-H	-H		-H
Y-18	(t) C_5H_{11}-	$-CH_3$		-H	-H		-H
Y-19	(t) C_4H_9-	$-CH_3$		-H	-H		-H

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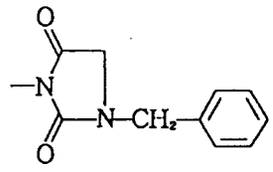
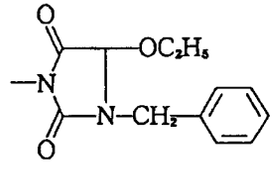
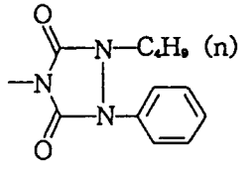
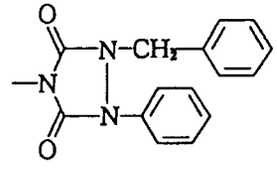
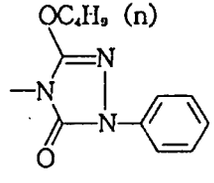
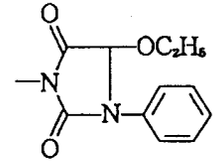
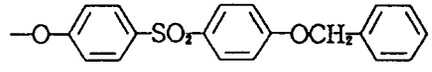
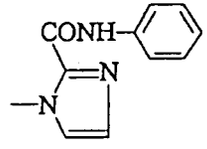
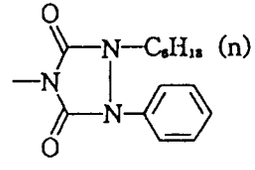
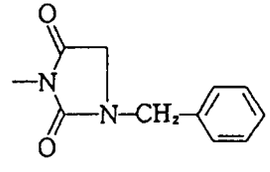
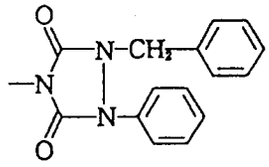
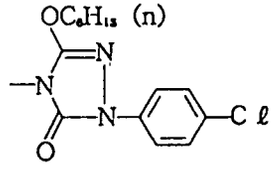
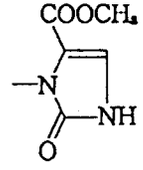
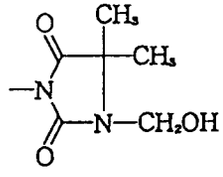
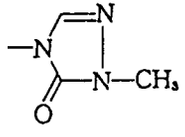
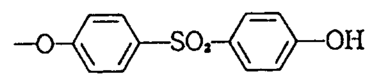
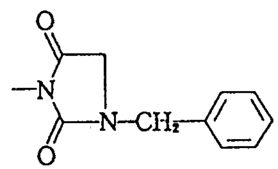
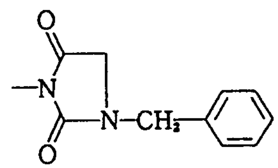
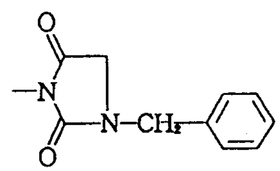
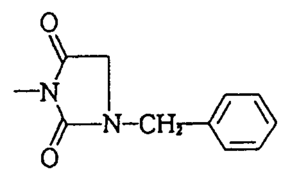
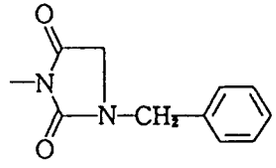
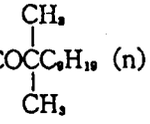
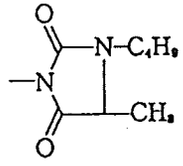
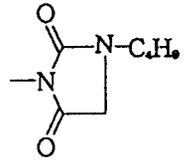
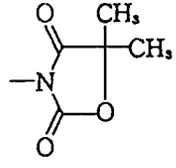
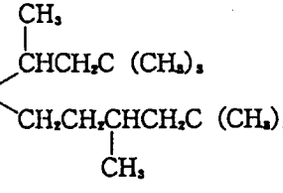
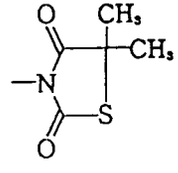
No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-20	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{15}H_{27}$ (n)	-H
Y-21	(t) C_4H_9-	$-CH_3$		-H	-H	$-CONHC_{14}H_{29}$ (n)	-H
Y-22	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{15}H_{27}$ (n)	-H
Y-23	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{15}H_{31}$ (n)	-H
Y-24	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{15}H_{27}$ (n)	-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y – 25	(t) C_4H_9 –	– C_3H_7 (iso)		– H	– H	– $CONHC_{14}H_{29}$ (n)	– H
Y – 26	(t) C_4H_9 –	– CH_3		– H	– H	– $CONHC_{14}H_{29}$ (n)	– H
Y – 27	(t) C_4H_9 –	– $C_{18}H_{37}$ (n)		– H	– H	– $NHCOCHCH_3$ | CH_3	– H
Y – 28	(t) C_4H_9 –	– CH_3		– H	– H	– $NHCOC_9H_{19}$ (n)	– H
Y – 29	(t) C_4H_9 –	– C_4H_9		– H	– H	– $NHCOC_{13}H_{27}$ (n)	– H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-30	(t) C_4H_9-	$-CH_3$		-H	-H	$-CONHC_{14}H_{29}$ (n)	-H
Y-31	(t) C_4H_9-	$-C_{12}H_{25}$ (n)		-H	-H	$-NHCOC_{13}H_{27}$ (n)	-H
Y-32	(t) C_4H_9-	$-C_2H_5$		-H	-H	$-NHCOC_{19}H_{39}$ (n)	-H
Y-33	(t) C_4H_9-	$-CH_3$		-H	-H	$-CONHC_{16}H_{33}$ (n)	-H
Y-34	(t) C_4H_9-	$-CH_3$		-H	-H	$-CONHC_{14}H_{29}$ (n)	-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-35	(t) C_4H_9-	$-CH_3$		-H	-Cℓ	$-NHCOC_{15}H_{31}$ (i)	-H
Y-36	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{15}H_{31}$ (n)	-H
Y-37	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOC_{17}H_{35}$ (n)	-H
Y-38	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCH(CH_3)C_{11}H_{23}$ (n)	-H
Y-39	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCH_2CH(C_6H_{13}\ (n))(C_8H_{17}\ (n))$	-H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y – 40	(t) C_4H_9 –	– CH_3		– H	– H	– NHCO  (n)	– H
Y – 41	(t) C_4H_9 –	– CH_3		– H	– H	– $NHCOC_{15}H_{31}$ (i)	– H
Y – 42	(t) C_4H_9 –	– CH_3		– H	– H	– $NHCOC_{15}H_{31}$ (i)	– H
Y – 43	(t) C_4H_9 –	– CH_3		– H	– H	– NHCOCH 	– H
Y – 44	(t) C_4H_9 –	– CH_3		– H	– H	– $NHSO_2C_{12}H_{25}$	– H

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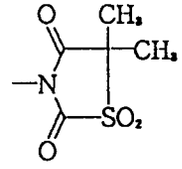
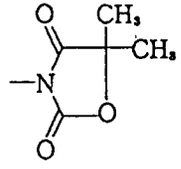
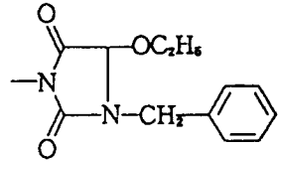
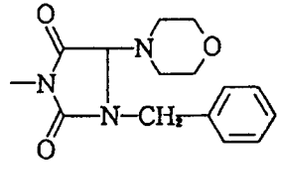
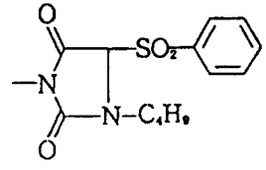
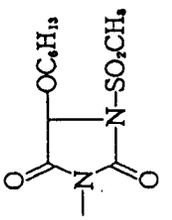
No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y – 45	(t) C_4H_9 –	– CH_3		– H	– Cℓ	– COC_9H_{19} (=O)	– H
Y – 46	(t) C_4H_9 –	– CH_3		– H	– H	– $COC_{14}H_{29}$ (=O)	– H
Y – 47	(t) C_4H_9 –	– CH_3		– H	– H	– $COC_{12}H_{25}$ (=O)	– H
Y – 48	(t) C_4H_9 –	– CH_3		– H	– H	– $COC_{14}H_{29}$ (=O)	– H
Y – 49	(t) C_4H_9 –	– CH_3		– H	– H	– NHCOCHO(–C_2H_5)–(–C_5H_{11} (t))–C_5H_{11} (t)	– H

No.	R_A	R_B	X_A	3-position	4-position	5-position	6-position
Y-50	(t) C_4H_9-	$-CH_3$		-H	-H	$-NHCOCHCH_2SO_2C_{12}H_{25}$ (with CH_3)	-H

These yellow couplers of the present invention, represented by formula Y-I, can easily be synthesized by the methods described in Japanese Patent O.P.I. Publication No. 123047/1988, Japanese Patent Application Nos. 245949/1990 and 96774/1990.

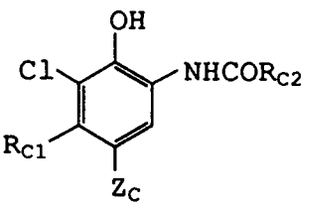
The yellow couplers represented by formula Y-I relating to the present invention may be used singly or in combination, and may be used in combination with other kinds of yellow couplers.

In the present invention, the yellow coupler can be used in the content ratio of about 1×10^{-3} to about

1 mol, preferably 1×10^{-2} mol to 8×10^{-1} mol per mol of silver halide.

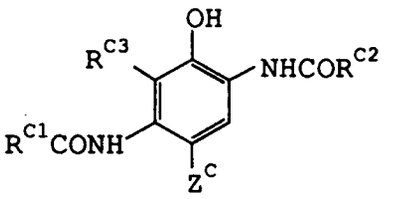
Next, the cyan couplers used for the present invention are described below. Although any cyan coupler may be used without limitation in the present invention, the cyan coupler for the present invention is preferably a naphthol cyan coupler, a phenol cyan coupler or an imidazole cyan coupler. More preferable cyan couplers are those represented by the following formulas C-I and C-II:

Formula C-I



(wherein R_{C1} represents an alkyl group having 2 to 6 carbon atoms; R_{C2} represents a ballast group; Z_C represents a hydrogen atom or a group capable of splitting off upon coupling with the oxidation product of a developing agent.)

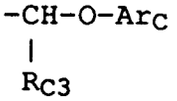
Formula C-II



(wherein R^{C1} represents an alkyl group or an aryl group; R^{C2} represents an alkyl group, a cycloalkyl group, an aryl group or a heterocyclic group; R^{C3} represents a hydrogen atom, a halogen atom, an alkyl group or an alkoxy group; R^{C1} and R^{C3} may cooperate to form a ring; Z^C represents a hydrogen atom or an atom or group capable of splitting off upon coupling with the oxidation product of a developing agent.)

With respect to formula C-I, the alkyl group represented by R_{C1}, whether linear or branched, includes those having a substituent.

The ballast group represented by R_{C2} is an organic group having a size and shape which provides the coupler molecule with sufficient bulkiness to make the coupler substantially incapable of diffusing from the layer to which it is applied to another layer. Said ballast group is preferably represented by the following formula:



(wherein R_{C3} represents an alkyl group having 1 to 12 carbon atoms; Ar_C represents an aryl group such as a phenyl group, which aryl group includes those having a substituent.)

Examples of cyan couplers represented by formula C-I include example compounds PC-1 through PC-19 given in the upper right column, page 30, through upper left column, page 31, Japanese Patent O.P.I. Publication No. 156748/1989, example compounds C-1 through C-28 given in Japanese Patent O.P.I. Publication No. 249151/1987, the cyan couplers described in Japanese Patent Examined Publication No. 11572/1974 and Japanese Patent O.P.I. Publication No. 3142/1986, 9652/1986, 9653/1986, 39045/1986, 50136/1986, 99141/1986 and 105545/1986 and the cyan couplers described below, which are not to be construed as limitative.

With respect to formula C-II, the alkyl group represented by R^{C1} preferably has 1 to 32 carbon atoms, which alkyl group may be linear or branched and includes those having a substituent.

The aryl group represented by R^{C1} is preferably a phenyl group, including those having a substituent.

The alkyl group represented by R^{C2} preferably has 1 to 32 carbon atoms, which alkyl group may be linear or branched and includes those having a substituent.

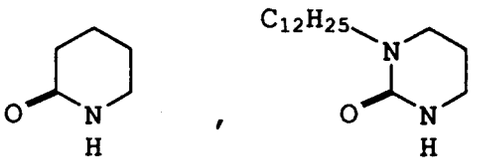
The cycloalkyl group represented by R^{C2} preferably has 3 to 12 carbon atoms, which cycloalkyl group may be linear or branched and includes those having a substituent.

The aryl group represented by R^{C2} is preferably a phenyl group, including those having a substituent.

The heterocyclic group represented by R^{C2} preferably has 5 to 7 members, including those having a substituent, and may have been condensed.

R^{C3} represents a hydrogen atom, a halogen atom, an alkyl group or an alkoxy group, which alkyl group and alkoxy group include those having a substituent, but R^{C3} is preferably a hydrogen atom.

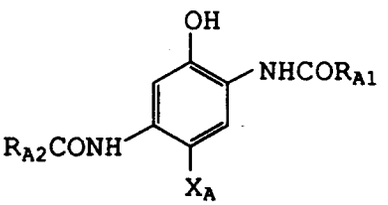
The ring formed by R^{C1} and R^{C3} in cooperation is preferably a 5- or 6-membered ring. Examples of such rings include the following:



With respect to formula C-II, examples of the group capable of splitting off upon reaction with the oxidation product of a color developing agent, represented by Z^C, include halogen atoms, alkoxy groups, aryloxy groups, acyloxy groups, sulfonyloxy groups, acylamino groups, sulfonylamino groups, alkoxycarbonyloxy groups, aryloxycarbonyloxy groups and imide groups, with preference given to halogen atoms, aryloxy groups and alkoxy groups.

Of the cyan couplers represented by formula C-II, those represented by the following formula C-II-A are preferred.

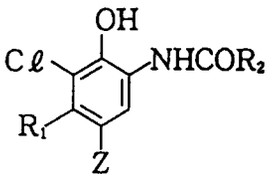
Formula C-II-A

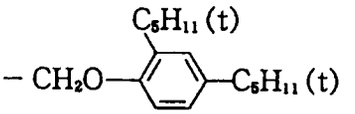
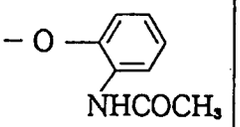
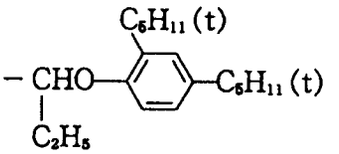
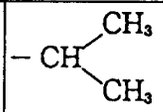
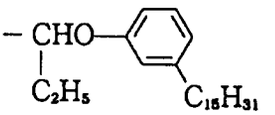
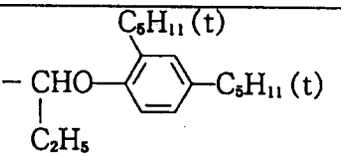
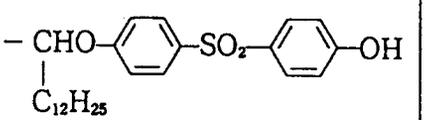
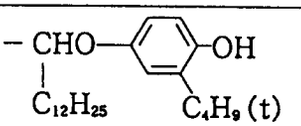
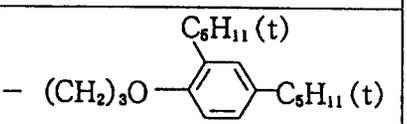
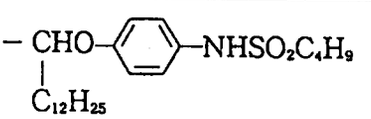


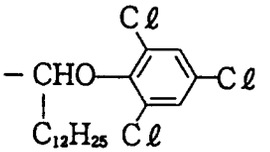
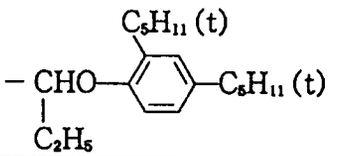
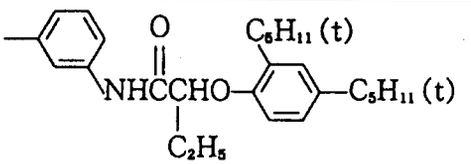
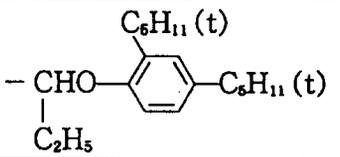
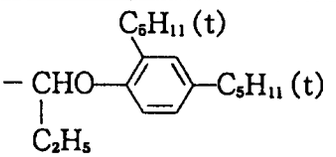
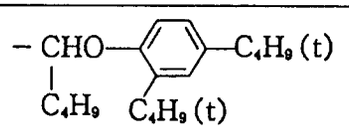
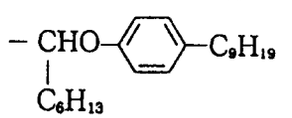
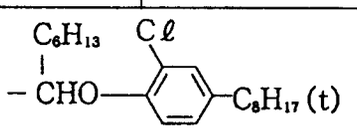
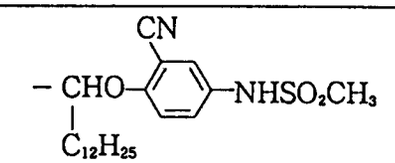
(wherein R_{A1} represents a phenyl group substituted by at least one halogen atom; such phenyl groups include those having a non-halogen substituent. R_{A2} has the same definition as R^{C1} in formula C-II. X_A represents a halogen atom, an aryloxy group or an alkoxy group, including those having a substituent.)

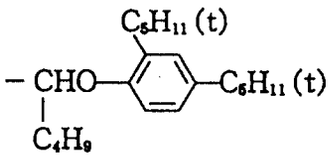
Examples of the cyan coupler represented by formula C-II include example compounds C-1 through C-25 given in Japanese Patent O.P.I. Publication No. 96656/1988, example compounds PC-II-1 through PC-II-31 given in lower left column, page 32, through upper left column, page 34, Japanese Patent O.P.I. Publication No. 156748/1989, the 2,5-diacylamino cyan couplers described in lower right column, page 7, through lower left column, page 9, Japanese Patent O.P.I. Publication No. 178962/1987, lower left column, page 7, through lower right column, page 10, Japanese Patent O.P.I. Publication No. 225155/1985, upper left column, page 6, through lower right column, page 8, Japanese Patent O.P.I. Publication No. 222853/1985 and lower left column, page 6, through upper left column, page 9, Japanese Patent O.P.I. Publication No. 185335/1984 and the cyan couplers described below, which can be synthesized in accordance with the methods described in these publications.

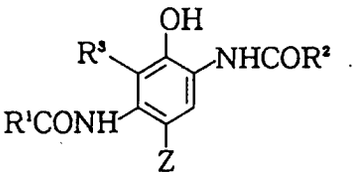
Examples of the cyan couplers represented by formulas C-I and C-II are given below.

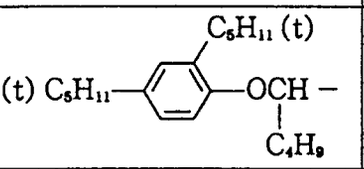
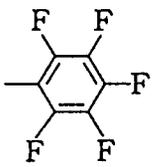
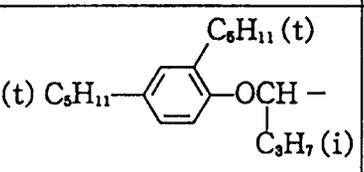
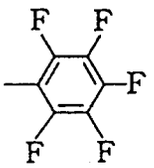
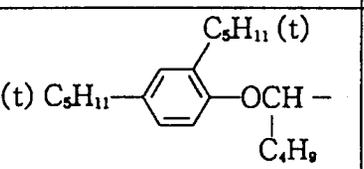
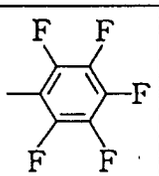
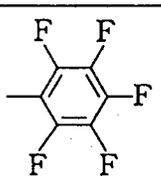
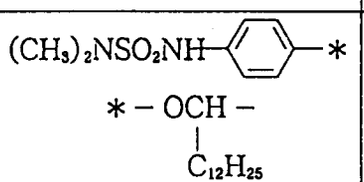
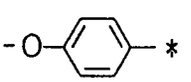
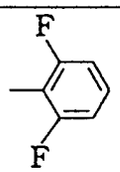
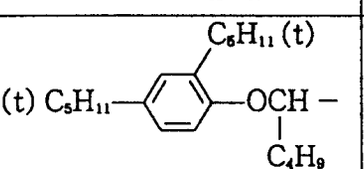
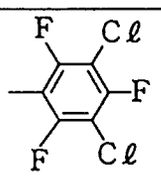
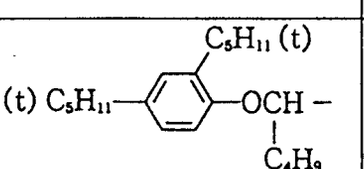


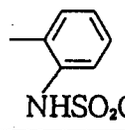
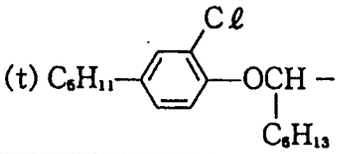
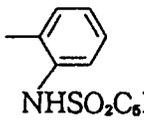
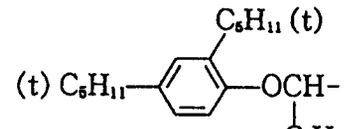
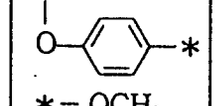
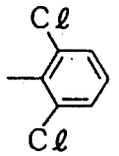
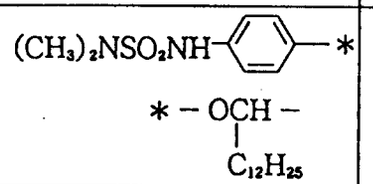
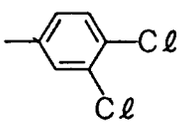
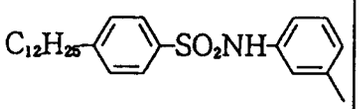
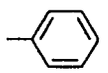
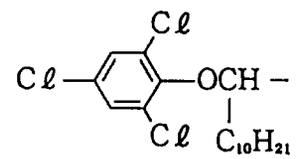
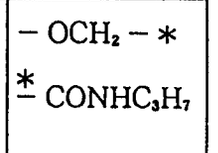
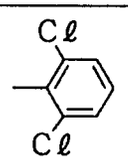
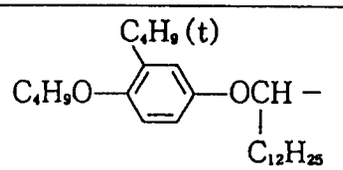
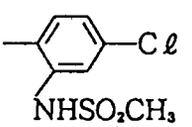
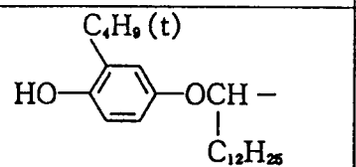
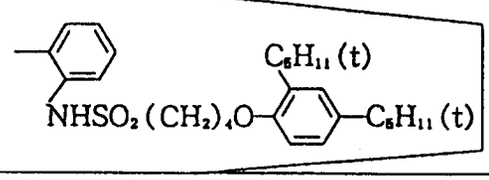
Couplers	R_1	Z	R_2
C – 1	$-C_2H_5$	$-C\ell$	
C – 2	$-C_2H_5$		
C – 3		$-C\ell$	
C – 4	$-C_2H_5$	$-C\ell$	
C – 5	$-C_4H_9$	$-F$	
C – 6	$-C_2H_5$	$-F$	
C – 7	$-C_2H_5$	$-C\ell$	
C – 8	$-C_2H_5$	$-C\ell$	

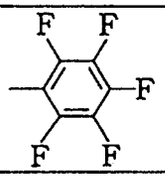
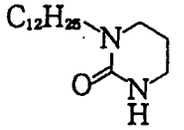
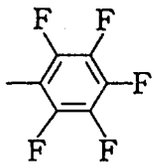
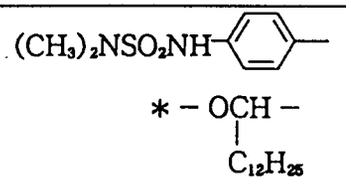
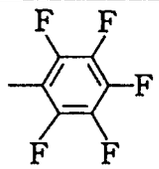
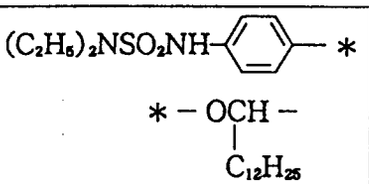
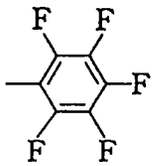
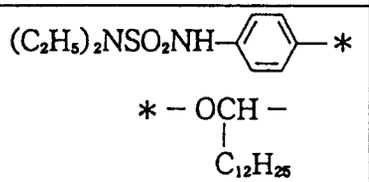
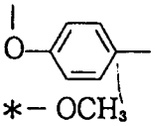
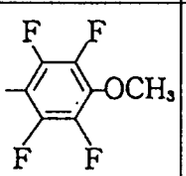
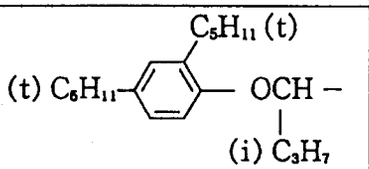
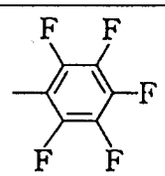
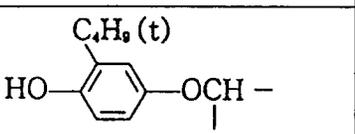
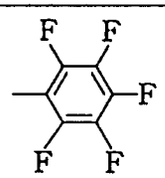
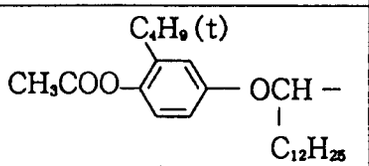
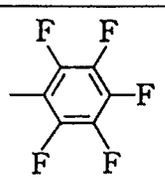
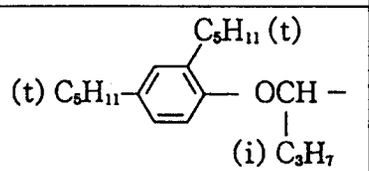
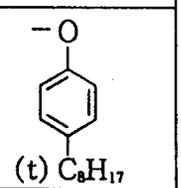
Couplers	R_1	Z	R_2
C – 9	$-C_2H_5$	$-C\ell$	
C – 10	$-CH(CH_3)_2$	$-C\ell$	$-C_{18}H_{37}$
C – 11	$-C_6H_{13}$	$-C\ell$	
C – 12	$-C_3H_7$	$-C\ell$	
C – 13	$-C_2H_4NHCCH_3$ (O)	$-C\ell$	
C – 14	$-C_2H_4OCH_3$	$-C\ell$	
C – 15	$-C_2H_5$	$-C\ell$	
C – 16	$-C_4H_9(t)$	$-OCH_2CH_2SO_2CH_3$	
C – 17	$-C_2H_5$	$-C\ell$	
C – 18	$-C_2H_5$	$-C\ell$	

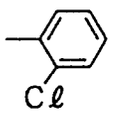
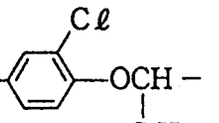
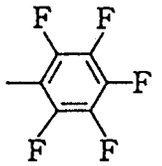
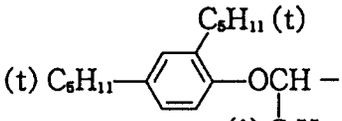
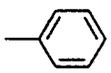
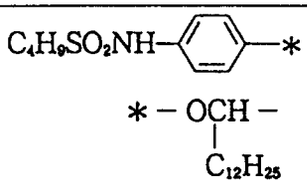
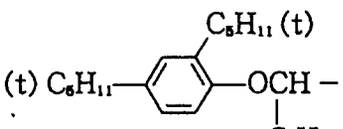
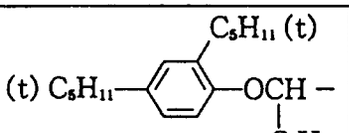
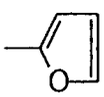
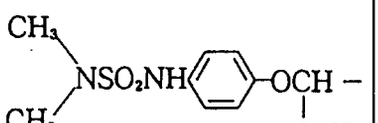
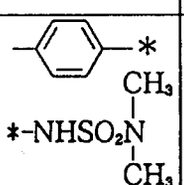
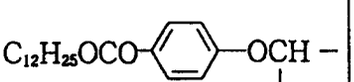
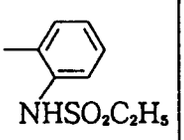
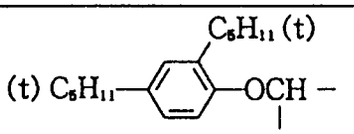
Couplers	R_1	Z	R_2
C – 19	$-C_2H_5$	$-C\ell$	
C – 20	$-C_2H_5$	$-C\ell$	$-C_{15}H_{31}$ (n)

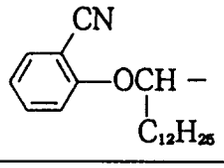


Couplers	R^2	R^1	R^3	Z
PC – 1	$-(CF_2)_4H$		H	$-C\ell$
PC – 2			H	$-C\ell$
PC – 3			H	$-C\ell$
PC – 4		$C_{16}H_{33}-$	$-C\ell$	$-C\ell$
PC – 5			H	 $*-C_8H_{17}(t)$
PC – 6			H	H
PC – 7			H	$-C\ell$

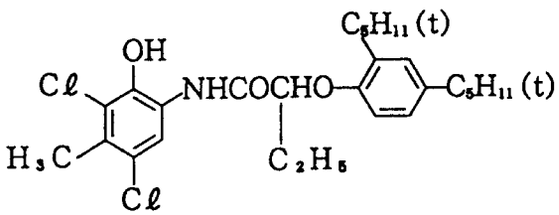
Couplers	R^2	R^1	R^3	Z
PC – 8			H	– Cℓ
PC – 9			H	
PC – 10			H	– Cℓ
PC – 11			H	– Cℓ
PC – 12			H	
PC – 13			H	– Cℓ
PC – 14			H	– Cℓ
PC – 15				– Cℓ

Couplers	R^2	R^1	R^3	Z
PC – 16				–Cℓ
PC – 17			H	–Cℓ
PC – 18			H	–Cℓ
PC – 19			H	
PC – 20			H	–Cℓ
PC – 21			H	–Cℓ
PC – 22			H	–Cℓ
PC – 23			H	

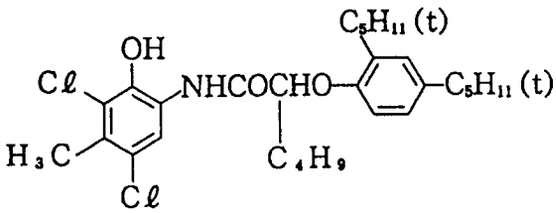
Couplers	R^2	R^1	R^3	Z
PC – 24			H	– Cℓ
PC – 25			H	-OCH_2CO-* *-$NH(CH_2)_2$-* *-OCH_3
PC – 26			H	– Cℓ
PC – 27	– C_3F_7		H	H
PC – 28	– C_3F_7		H	H
PC – 29			H	– Cℓ
PC – 30			– OCH_3	– Cℓ
PC – 31			H	– Cℓ

Couplers	R^2	R^1	R^3	Z
PC – 32	$-C_3F_7$		H	H

CA – 1



CA – 2



The cyan couplers can be used in the content range from 1×10^{-3} to 1 mol, preferably from 1×10^{-2} to 8×10^{-1} mol per mol of silver halide.

These cyan couplers may be used in combination with other kinds of cyan coupler.

In the present invention, known couplers can be used as magenta couplers, including 5-pyrazolone couplers, pyrazolobenzimidazole couplers, pyrazolotriazole couplers and chain-opened acylacetonitrile couplers.

Preferably the compound of the present invention and couplers are used in the same layer, but the compound may be used in a layer adjacent to a coupler-containing layer.

The compound of the present invention and couplers and other hydrophobic compounds can be added to the light-sensitive material by various methods, including solid dispersion, latex dispersion and oil-in-water emulsion dispersion. For example, the compound of the present invention, couplers and other substances are dissolved in a high boiling organic solvent having a boiling point of over about 150 °C or in a water-insoluble organic-solvent-soluble high molecular compound in the presence of a low boiling and/or water-soluble organic solvent used as necessary, the resulting solution is emulsified and dispersed in a hydrophilic binder such as an aqueous solution of gelatin using a means of dispersion such as a mechanical stirrer, a homogenizer, a colloid mill, a flow jet mixer or an ultrasonicator in the presence of a surfactant, and the resulting emulsion is added to the target hydrophilic colloid layer. Another process may be added wherein the low boiling organic solvent is removed after or simultaneously with dispersion.

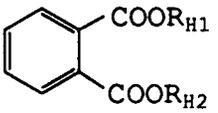
In the present invention, the high boiling organic solvent preferably has a dielectric constant of less than 6.0. Although the lower limit of dielectric constant is not subject to limitation, it is preferably not less than 1.9. Examples of such high boiling organic solvents include esters such as phthalates and phosphates, organic acid amides, ketones and hydrocarbon compounds, provided that they have a dielectric constant of less than 6.0. Also, in the present invention, high boiling organic solvents having a vapor pressure at 100 °C of not more than 0.5 mmHg are preferred.

The high boiling organic solvent may be a mixture of two or more kinds. In this case, the dielectric constant of the mixture is less than 6.0. Here, dielectric constant is as determined at 30 °C.

Preferably, the high boiling organic solvent is a phthalate or phosphate.

The phthalate advantageously used for the present invention is represented by the following formula HA:

Formula HA

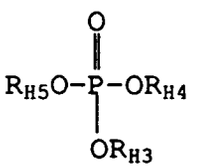


wherein R_{H1} and R_{H2} independently represent an alkyl group, an alkenyl group or an aryl group, provided that the total number of carbon atoms in the groups represented by R_{H1} and R_{H2} is 9 to 32, more preferably 16 to 24.

The alkyl groups for R_{H1} and R_{H2} in formula HA may be linear or branched. Examples of aryl groups for R_{H1} and R_{H2} include a phenyl group and a naphthyl group; examples of alkenyl groups for R_{H1} and R_{H2} include a hexenyl group, a heptenyl group and an octadecenyl group. These alkyl groups, alkenyl groups and aryl groups may have a substituent.

The phosphate advantageously used for the present invention is represented by the following formula HB:

Formula HB



wherein R_{H3}, R_{H4} and R_{H5} independently represent an alkyl group, an alkenyl group or an aryl group, provided that the total number of carbon atoms in the groups represented by R_{H3}, R_{H4} and R_{H5} is 24 to 54. These alkyl groups, alkenyl groups and aryl groups may have one or more substituents.

The preferable group for R_{H3}, R_{H4} and R_{H5} is an alkyl group, specifically a nonyl group, a n-decyl group, a sec-decyl group, a sec-dodecyl group and a t-octyl group.

Examples of the high boiling organic solvent described above include example organic solvents 1 through 22 given in page 41 of Japanese Patent O.P.I. Publication No. 166331/1987.

Examples of water-insoluble organic-solvent-soluble polymers used to disperse couplers etc. include the following:

(1) vinyl polymers and copolymers,
(2) condensation polymers of polyhydric alcohol and polybasic acid,
(3) polyesters obtained by ring-opening polymerization, and
(4) others, including polycarbonate resin, polyurethane resin and polyamide resin.

Although the number-average molecular weight of these polymers is not subject to limitation, it is preferably not more than 200000, more preferably 5000 to 100000. The ratio by weight of the polymer to the hydrophobic compounds is preferably 1:20 to 20:1, more preferably 1:10 to 10:1.

Examples of polymers which are preferably used for the present invention are given below. For copolymers, the ratio of monomer is given by weight.

PO-1: Poly(N-t-butyracrylamide)
PO-2: N-t-butyracrylamide-methyl methacrylate copolymer (60:40)
PO-3: Polybutyl methacrylate
PO-4: Methyl methacrylate-styrene copolymer (90:10)
PO-5: N-t-butyracrylamide-2-methoxyethyl acrylate copolymer (55:45)
PO-6: ω-methoxypolyethylene glycol acrylate (adduct molar number n = 9)-N-t-butyracrylamide copolymer (25:75)
PO-7: 1,4-butanediol-adipic acid polyester
PO-8: Polypropiolactam

The light-sensitive material of the present invention is applicable to color negative films, color positive films, color printing paper, etc., with the effect of the invention enhanced when the light-sensitive material is used for color printing paper undergoing direct viewing.

The silver halide for the present invention may be any silver halide, including silver chloride, silver

bromide, silver iodide, silver chlorobromide, silver iodobromide and silver chloroiodide. The silver halide grains preferably used for the present invention have a silver chloride content of not less than 90 mol%, a silver bromide content of not more than 10 mol% and a silver iodide content of not more than 0.5 mol%, with more preference given to a silver chlorobromide having a silver bromide content of 0.1 to 2 mol%. Said silver halide grains may be used singly or in combination with other kinds of silver halide grains with different composition, and may also be used in combination with silver halide grains having a silver chloride content of not more than 90 mol%. In the silver halide emulsion layers containing silver halide grains having a silver chloride content of not less than 90 mol%, the silver halide grains having a silver chloride content of not less than 90 mol% account for not less than 60% by weight, preferably not less than 80% by weight of the total silver halide grain content of said emulsion layers. The composition of the silver halide grains may be uniform from inside to outside, or may be different between inside and outside. In cases where there is a difference between inside and outside, the composition change may be continuous or not.

Although the grain size of silver halide grains is not subject to limitation, it is preferable in view of other photographic performance requirements such as rapid processing and sensitivity that the grain size be in the range from 0.2 to 1.6 μm, more preferably from 0.25 to 1.2 μm. The grain size can be determined by various methods in common use in the relevant field. Typical methods are described in "Particle-Size Measurement", ASTM Symposium on Light Microscopy, R.P. Loveland, pp. 94-122 (1955), or Chapter 2 of "The Theory of the Photographic Process", edited by Meath and James, 3rd edition, MacMillan (1966). The grain size can be determined on the basis of either the projected area of the grain or an approximated diameter.

When the grains have a substantially uniform shape, grain size distribution can be expressed with fair accuracy using the diameter or projected area. The grain size distribution of silver halide grains may be polydispersed or monodispersed. Preferred silver halide grains are monodispersed silver halide grains having a coefficient of variance of silver halide grain distribution of not more than 0.22, more preferably not more than 0.15. Here, the coefficient of variance is a coefficient indicating grain size distribution, as defined by the following equation:

$$\text{Coefficient of variance } (S/\bar{r}) = \frac{\text{grain size distribution standard deviation}}{\text{average grain size}}$$

$$\text{Grain size distribution standard deviation } (S) = \sqrt{\frac{\Sigma(\bar{r} - ri)^2 ni}{\Sigma ni}}$$

$$\text{Average grain size } (\bar{r}) = \frac{\Sigma niri}{\Sigma ni}$$

Here, ri represents the diameter of each grain; ni represents the number of grains. Grain size means the diameter of a grain, provided that the grain is a spherical silver halide grain, or the diameter of the circle with the same area converted from the projected area, provided that the grain is a cubic or otherwise non-spherical grain.

The silver halide grains used for the present invention may be prepared by any of the acidic method, the neutral method and the ammoniacal method. These grains may be grown at once or grown after seed grain formation. The method of preparing the seed grains and the method of growing them may be identical or not. As for the mode of reaction of a soluble silver salt and a soluble halide, any of the normal precipitation method, the reverse precipitation method, the double jet precipitation method and combinations thereof may be used, but the grains obtained by the simultaneous precipitation method are preferred. As a mode of the double jet precipitation method, the pAg controlled double jet method, which is described in Japanese Patent O.P.I. Publication No. 48521/1979, can also be used.

If necessary, a silver halide solvent such as thioether may be used. Also, a compound containing a mercapto group, a nitrogen-containing heterocyclic compound or a sensitizing dye compound may be

added at the time of silver halide emulsion formation or after completion of said grains.

The shape of the silver halide grains for the present invention may be any one. A preferred shape is a cube having (100) planes to form the crystal surface. It is also possible to use octahedral, tetradecahedral, dodecahedral or other forms of grains prepared by the methods described in US Patent Nos. 4,183,756 and 4,225,666, Japanese Patent O.P.I. Publication No. 26589/1980, Japanese Patent Examined Publication No. 42737/1980 and the Journal of Photographic Science, 21, 39 (1973). Grains having twin crystal planes may also be used. The silver halide grains for the present invention may be of a single shape or a combination of various shapes.

The silver halide grains used for the present invention may be supplemented with metal ions using a cadmium salt, a zinc salt, a lead salt, a thallium salt, an iridium salt or a complex salt thereof, a rhodium salt or a complex salt thereof or an iron salt or a complex salt thereof to contain such metal elements in and/or on the grains during formation and/or growth of silver halide grains. Also, reduction sensitization specks can be provided in and/or on the grains by bringing the grains in an appropriate reducing atmosphere.

The emulsion containing silver halide grains may be treated to remove the undesirable soluble salts after completion of growth of silver halide grains or may retain said soluble salts. Removal of said salts can be achieved in accordance with the method described in Research Disclosure No. 17643.

The silver halide grains used in the emulsion for the present invention may be grains wherein latent images are formed mainly on the surface thereof or grains wherein latent images are formed mainly therein, with preference given to grains wherein latent images are formed mainly on the surface thereof.

In the present invention, the emulsion is chemically sensitized by a conventional method. Specifically, sulfur sensitization, which uses either a compound containing sulfur capable of reacting with silver ion or active gelatin, selenium sensitization, which uses a selenium compound, reduction sensitization, which uses a reducing substance, noble metal sensitization, which uses gold or another noble metal, and other sensitizing methods can be used singly or in combination.

The emulsion can also be optically sensitized in the desired wavelength band using a sensitizing dye. Sensitizing dyes which can be used for the present invention include cyanine dyes, merocyanine dyes, complex cyanine dyes, complex merocyanine dyes, holopolar cyanine dyes, hemicyanine dyes, styryl dyes and hemioxanol dyes.

It is the common practice to select dye-forming couplers for use in the silver halide photographic light-sensitive material of the present invention so that a dye absorbing the sensitization spectral light for each emulsion layer is formed; a yellow coupler, a magenta coupler and a cyan coupler are used in the blue-, green-and red-sensitive emulsion layers, respectively. However, the silver halide photographic light-sensitive material may be prepared using these couplers in different combinations according to the purpose.

Although it is advantageous to use gelatin as a binder (or protective colloid) for the silver halide photographic light-sensitive material of the present invention, it is possible to use gelatin derivatives, graft polymers of gelatin and another polymer and other hydrophilic colloids such as proteins, sugar derivatives, cellulose derivatives and synthetic hydrophilic polymer substances in the form of homo- or copolymer.

The silver halide photographic light-sensitive material of the present invention may optionally incorporate other additives such as hardeners, antistaining agents, image stabilizer, UV absorbents, plasticizers, latices, surfactants, matting agents, lubricants and antistatic agents.

The total amount of gelatin coated on the support of the silver halide photographic light-sensitive material of the present invention is preferably less than 7 g/m^2. Although the lower limit is not subject to limitation, the total amount is generally preferably not less than 3 g/m^2 from the viewpoint of physical properties or photographic performance. The amount of gelatin is determined as the weight of gelatin containing 11.0% water as determined by the PAGI method.

The gelatin contained in the silver halide photographic light-sensitive material of the present invention is hardened with a hardener. Any hardener can be used without limitation, including hardeners known in the photographic industry, such as aldehyde hardeners, active vinyl hardeners, active halogen hardeners, epoxy hardeners, ethyleneimine hardeners, methanesulfonate hardeners, carbodiimide hardeners, isoxazole hardeners and high molecular hardeners.

The effect of the present invention is enhanced when the silver halide photographic light-sensitive material of the invention is a light-sensitive material undergoing direct viewing, such as color printing paper or a light-sensitive material for color copying, which are open to strict requirements for image storage stability.

The light-sensitive material of the present invention permits image formation by a color developing process known in the relevant field.

The color developing agent used in the color developer is a primary amine based color developing agent in wide use in various color photographic processes, such as an aminophenol or p-phenylenediamine

derivative.

In addition to the primary amine based color developing agent described above, known developer component compounds may be added to the color developer used to process the light-sensitive material of the present invention. The pH level of the color developer is normally not less than 9, preferably about 10 to 13. Color developing temperature is normally over 15 °C, specifically in the range from 20 to 50 °C. For rapid processing, it is preferable to carry out the color developing process at a temperature of over 30 °C.

Although developing time is normally 10 seconds to 4 minutes, it is preferable to carry out development in the range from 10 to 30 seconds when rapid processing is desired. When more speed-up is required, it is preferable to carry out development in the range from 10 to 30 seconds.

When the light-sensitive material of the present invention is subjected to running processing while continuously supplying a color developer replenisher, the amount of color developer replenisher is preferably 20 to 150 ml, more preferably 20 to 120 ml, and more preferably 20 to 100 ml per m^2 of light-sensitive material. The effect of the present invention is enhanced when the running processing is carried out using such a low level of replenishment.

The light-sensitive material of the present invention is subjected to bleach-fixation after color development.

Bleach-fixation is normally followed by washing or stabilization or a combination thereof.

EXAMPLES

The present invention is hereinafter described in more detail by means of the following examples, which are not to be construed as limitative on the embodiment of the invention.

Example 1

Preparation of silver halide emulsion

The three kinds of silver halide emulsion listed in Table 1 were prepared by a combination of the neutral method and the double jet precipitation method.

Table 1

Emulsion No.	AgCl (%)	AgBr (%)	Average grain size (μ)	Chemical sensitizers	Spectral sensitizing dye
Em-1	99.5	0.5	0.67	Sodium thiosulfate *1 Chloroauric acid *2	SD-1 *3
Em-2	99.5	0.5	0.46		SD-2 *4
Em-3	99.5	0.5	0.43		SD-3 *5

*1: 2 mg added per mol of silver halide.
*2: 5×10^{-5} mol added per mol of silver halide.
*3: 0.9 mmol added per mol of silver halide
*4: 0.7 mmol added per mol of silver halide.
*5: 0.2 mmol added per mol of silver halide.

Each silver halide emulsion was supplemented with the following emulsion stabilizer STB-1 in an amount of 5×10^{-4} mol per mol of silver halide after completion of chemical sensitization.

Preparation of silver halide color photographic light-sensitive material

Layers with the following compositions were coated on a paper support, laminated with polyethylene on one face and titanium oxide containing polyethylene on the first layer side of the other face, to yield multiple-layered photographic light-sensitive material No. 101. The coating solutions were prepared as follows.

First layer coating solution

26.7 g of a yellow coupler Y-51, 0.67 g of an antistaining agent HQ-1 and 6.7 g of a high boiling organic solvent DNP were dissolved in 60 ml of ethyl acetate. This solution was emulsified and dispersed in 200 ml of a 10% aqueous solution of gelatin containing 10 ml of 10% sodium triisopropylnaphthalenesulfonate SU-1 using a homogenizer to yield a yellow coupler dispersion.

This dispersion was mixed with a blue-sensitive silver chlorobromide emulsion Em-1 (containing 8.71 g of silver) and a gelatin solution for coating to yield a first layer coating solution.

Second through seventh layer coating solutions were prepared in the same manner as with the first layer coating solution. The hardeners added were H-1 for layers 2 and 4 and H-2 for layer 7. Surfactants SU-2 and SU-3, as coating aids, were added to adjust surface tension.

Table 2

Layer	Composition	Amount of addition (g/m^2)
Layer 7: Protective layer	Gelatin	1.00
Layer 6: Ultraviolet absorbing layer	Gelatin	0.40
	UV absorbent UV-1	0.10
	UV absorbent UV-2	0.04
	UV absorbent UV-3	0.16
	Antistaining agent HQ-1	0.01
	DNP	0.20
	PVP	0.03
Layer 5: Red-sensitive layer	Gelatin	1.30
	Red-sensitive silver chlorobromide emulsion Em-3	0.21
	Cyan coupler C-4	0.24
	Cyan coupler CC-2	0.08
	Dye image stabilizer ST-1	0.20
	Antistaining agent HQ-1	0.01
	HBS-1	0.20
	DOP	0.20

Table 2 (cont'd)

Layer	Composition	Amount of addition (g/m^2)
Layer 4: Ultraviolet absorbing layer	Gelatin	0.94
	UV absorbent UV-1	0.28
	UV absorbent UV-2	0.09
	UV absorbent UV-3	0.38
	Antistaining agent HQ-1	0.03
	DNP	0.40
Layer 3: Green-sensitive layer	Gelatin	1.40
	Green-sensitive silver chlorobromide emulsion Em-2	0.17
	Magenta coupler M-1	0.35
	Dye image stabilizer ST-2	0.20
	Dye image stabilizer ST-3	0.20
	DNP	0.20
Layer 2: Interlayer	Gelatin	1.20
	Antistaining agent HQ-2	0.12
	DIDP	0.15

Table 3

Layer 1: Blue-sensitive layer	Gelatin	1.20
	Blue-sensitive silver chlorobromide emulsion Em-1	0.26
	Yellow coupler Y-51	0.80
	Antistaining agent HQ-1	0.02
	DNP	0.20
Support	Polyethylene-laminated paper	

Figures for silver halide emulsions are expressed as silver.

DOP: Dioctyl phthalate DIDP: Diisodecyl phthalate

DNP: Dinonyl phthalate PVP: Polyvinylpyrrolidone

Next, sample Nos. 102 through 132 were prepared in the same manner as above except that yellow coupler Y-51 for layer 1 was replaced as shown in Tables 4 and 5 and 0.1 $mmol/m^2$ of each of the dye image stabilizer shown in Tables 4 and 5 were added to layer 1.

The samples thus obtained were subjected to blue light exposure through an optical wedge using the sensitometer KS-7 (produced by Konica Corporation) and then processed in the following procedures.

Processing procedures

	Temperature	Time
Color development	35.0 ± 0.3 °C	45 seconds
Bleach-fixation	35.0 ± 0.5 °C	45 seconds
Stabilization	30 to 34 °C	90 seconds
Drying	60 to 80 °C	60 seconds

Color developer

Water	800 ml
Triethanolamine	10 g
N,N-diethylhydroxylamine	5 g
Potassium bromide	0.02 g
Potassium chloride	2 g
Potassium sulfite	0.3 g
1-hydroxyethylidene-1,1-diphosphonic acid	1.0 g
Ethylenediaminetetraacetic acid	1.0 g
Disodium catechol-3,5-diphosphonate	1.0 g
N-ethyl-N-β-methanesulfonamidoethyl-3-methyl-4-aminoaniline sulfate	4.5 g
Brightening agent (4,4'-diaminostylbenedisulfonic acid derivative)	1.0 g
Potassium carbonate	27 g
Water was added to make a total quantity of 1 l, and the solution was adjusted to a pH of 10.10.	

Bleach-fixer

Ferric ammonium ethylenediaminetetraacetate dihydrate	60 g
Ethylenediaminetetraacetic acid	3 g
Ammonium thiosulfate (70% aqueous solution)	100 ml
Ammonium sulfite (40% aqueous solution)	27.5 ml
Water was added to make a total quantity of 1 l, and potassium carbonate or glacial acetic acid was added to obtain a pH of 5.7.	

Stabilizer

5-chloro-2-methyl--4-isothiazolin-3-one	1.0 g
Ethylene glycol	1.0 g
1-hydroxyethylidene-1,1-diphosphonic acid	2.0 g
Ethylenediaminetetraacetic acid	1.0 g
Ammonium hydroxide (20% aqueous solution)	3.0 g
Ammonium sulfite	3.0 g
Brightening agent (4,4'-diaminostylbenedisulfonic acid derivative)	1.5 g
Water was added to make a total quantity of 1 l, and sulfuric acid or potassium hydroxide was added to obtain a pH of 7.0.	

The samples thus processed were subjected to densitometry using a densitometer (PDA-65 model, produced by Konica Corporation) to determine their sensitivity. Sensitivity was obtained as the reciprocal of the exposure amount corresponding to a density of 0.5. Figures for sensitivity are expressed as percent ratio relative to the sensitivity of sample No. 101. Light fastness was also evaluated by determining the residual rate of density in a dye image with an initial density of 1.0 after 10 weeks of storage of each processed sample under direct sunlight (exposure table). Color reproducibility was evaluated by visual observation of the print samples. The results are shown in Tables 4 and 5.

Table 4 (1/2)

Sample No	Dye image stabilizer	Oxidation potential	Yellow coupler	Color reproduction	Relative sensitivity	Residual rate (%)
101 (comparative)	Not added		Example coupler Y-51	C	100	60
102 (comparative)	Comparative compound YST-1	2060	Example coupler Y-51	C	89	85
103 (comparative)	Comparative compound YST-2	1400	Example coupler Y-51	C	102	70
104 (inventive)	Example compound I-1	1420	Example coupler Y-51	C	97	80
105 (inventive)	Example compound I-6	1540	Example coupler Y-51	C	102	83
106 (inventive)	Example compound I-8	1510	Example coupler Y-51	C	102	81
107 (inventive)	Example compound I-17	1590	Example coupler Y-51	C	92	82
108 (inventive)	Example compound I-21	1200	Example coupler Y-51	C	97	83
109 (inventive)	Example compound I-22	1600	Example coupler Y-51	C	92	84
110 (inventive)	Example compound I-25	1580	Example coupler Y-51	C	102	83
111 (comparative)	Not added		Example coupler Y-3	B	111	52

Note: Color reproducibility increases in the order of A > B > C.

Table 4 (2/2)

Sample No	Dye image stabilizer	Oxidation potential	Yellow coupler	Color reproduction	Relative sensitivity	Residual rate (%)
112 (comparative)	Comparative compound YST-1	2060	Example coupler Y-3	B	68	82
113 (comparative)	Comparative compound YST-2	1400	Example coupler Y-3	B	102	60
114 (inventive)	Example compound I-1	1420	Example coupler Y-3	A	102	88
115 (inventive)	Example compound I-6	1540	Example coupler Y-3	A	97	90
116 (inventive)	Example compound I-8	1510	Example coupler Y-3	B	106	86
117 (inventive)	Example compound I-17	1590	Example coupler Y-3	A	102	92
118 (inventive)	Example compound I-21	1200	Example coupler Y-3	B	87	82
119 (inventive)	Example compound I-22	1600	Example coupler Y-3	B	92	80
120 (inventive)	Example compound I-25	1580	Example coupler Y-3	B	97	85
121 (comparative)	Comparative compound YST-1	2060	Example coupler Y-20	A	73	89

Note: Color reproducibility increases in the order of A > B > C.

Table 5

Sample No	Dye image stabilizer	Oxidation potential	Yellow coupler	Color reproduction	Relative sensitivity	Residual rate (%)
122 (inventive)	Example compound I-1	1420	Example coupler Y-20	B	106	91
123 (inventive)	Example compound I-6	1540	Example coupler Y-20	A	102	90
124 (inventive)	Example compound I-8	1510	Example coupler Y-20	A	106	88
125 (comparative)	Comparative compound YST-1	2060	Example coupler Y-36	A	68	89
126 (inventive)	Example compound I-1	1420	Example coupler Y-36	B	102	90
127 (inventive)	Example compound I-6	1540	Example coupler Y-36	A	102	91
128 (inventive)	Example compound I-8	1510	Example coupler Y-36	A	106	88
129 (comparative)	Comparative compound YST-1	2060	Example coupler Y-46	B	73	90
130 (inventive)	Example compound I-1	1420	Example coupler Y-46	A	106	89
131 (inventive)	Example compound I-6	1540	Example coupler Y-46	A	106	89
132 (inventive)	Example compound I-8	1510	Example coupler Y-46	A	102	90

Note: Color reproducibility increases in the order of A > B > C.

From Tables 4 and 5, it is evident that the samples incorporating comparative compound YST-1 as a dye image stabilizer, which has an ester group in the molecular structure thereof and an oxidation potential of 2060 mV (sample Nos. 102, 112, 121, 125 and 129), had reduced sensitivity, though the light fastness improved. Also, sample Nos. 103 and 113, which incorporated comparative compound YST-2 as a dye image stabilizer, which had no ester group in the molecular structure thereof, though the oxidation potential was 1400 mV, falling in the range of the present invention, had no sufficient light fastness, though the

sensitivity did not decrease. On the other hand, the use of a compound relating to the present invention offered sufficient sensitivity and excellent light fastness.

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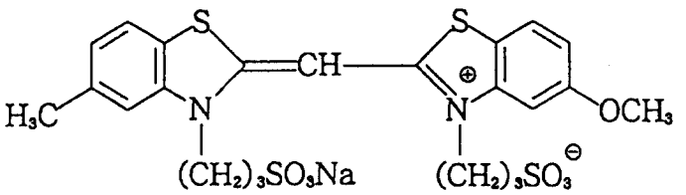

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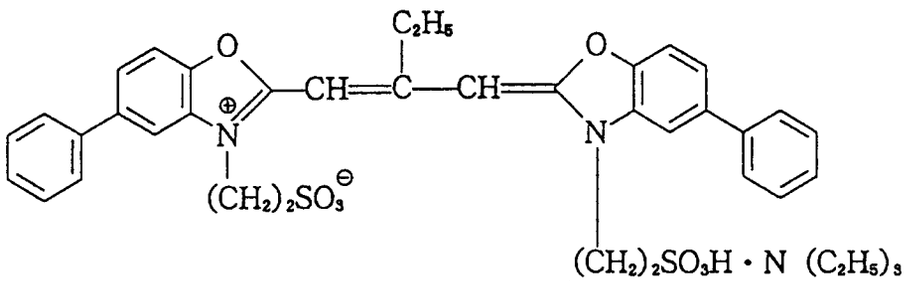

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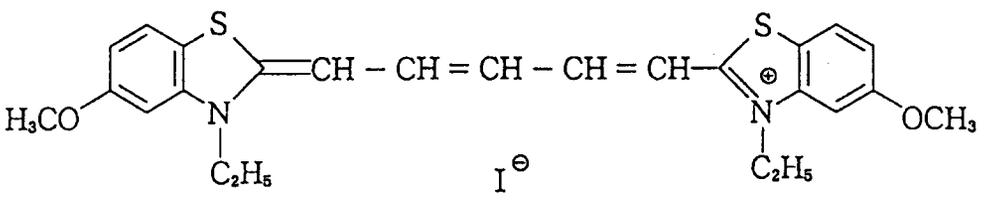
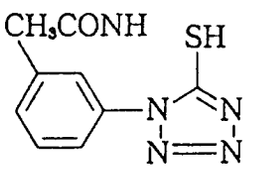
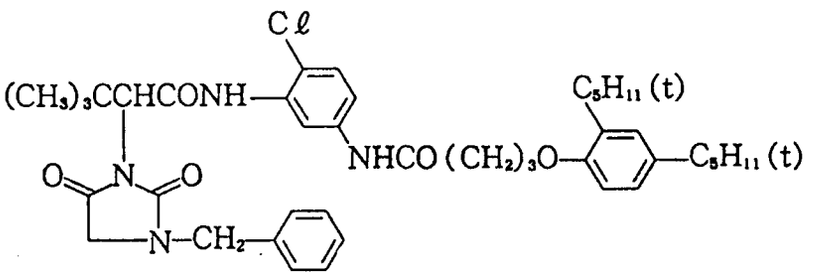


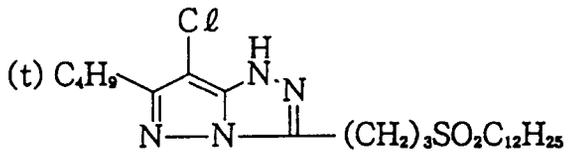
STB－1



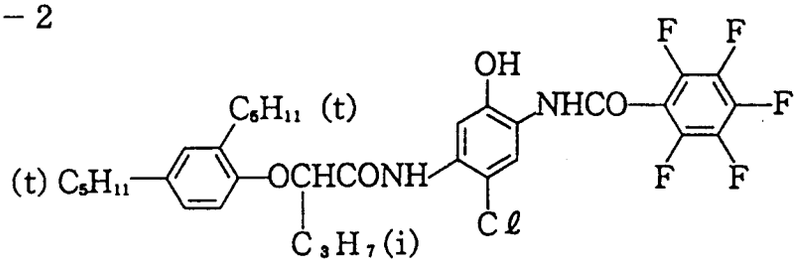
Y－51



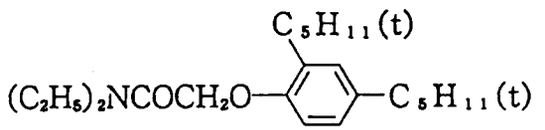
M－1



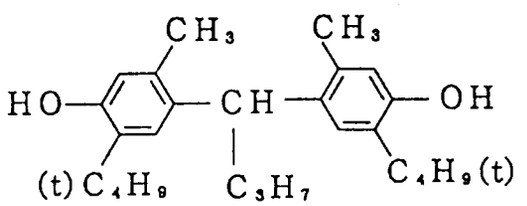
CC－2



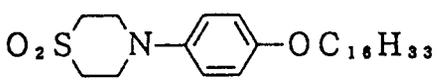
ST－1



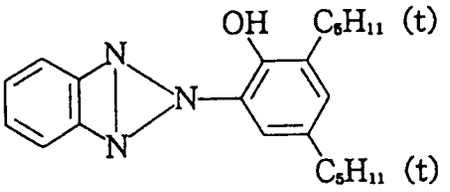
ST－2



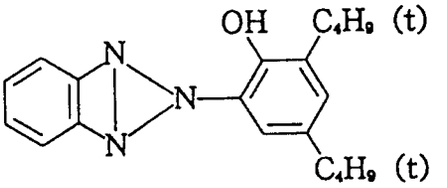
ST－3



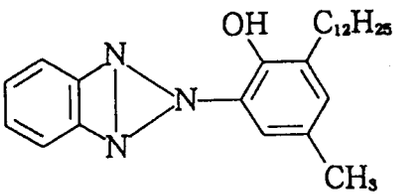
UV − 1



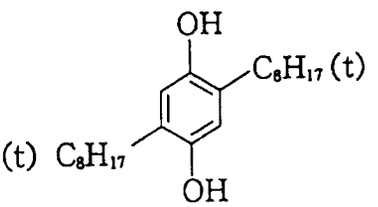
UV − 2



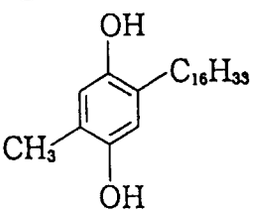
UV − 3



HQ − 1

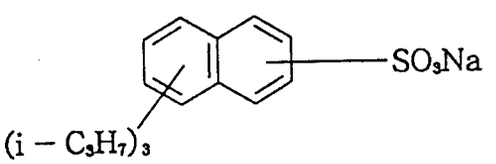


HQ − 2



HBS − 1

SU − 1



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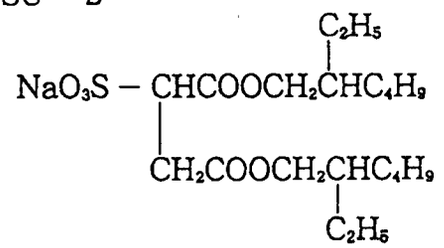

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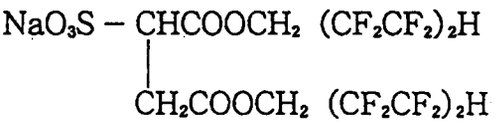
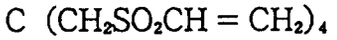
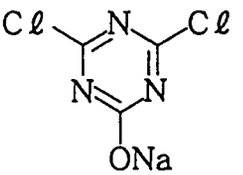


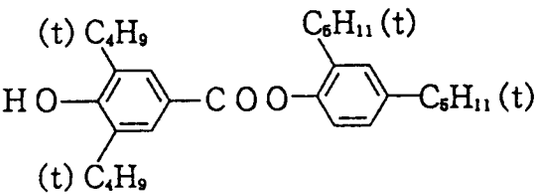
H – 1



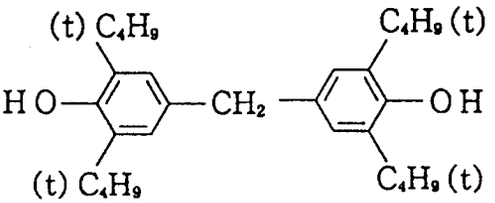
H – 2



Comparative compound YST-1



Comparative compound YST-2



Example 2

Sample Nos. 101 through 132, prepared in Example 1, were each subjected to exposure through an optical wedge and then continuously processed using a paper processor in the following procedures until the amount of replenisher became 2 times the capacity of the color developer tank. The finished samples thus obtained are referred to as sample Nos. 201 through 232. Developing procedures

	Temperature	Time	Amount of replenisher	Tank capacity
Color development	34.7 ± 0.3 ° C	45 seconds	160 ml/m^2	16 l
Bleach-fixation	34.7 ± 0.5 ° C	45 seconds	215 ml/m^2	16 l
Stabilization 1	30 to 34 ° C	30 seconds		10 l
Stabilization 2	30 to 34 ° C	30 seconds		10 l
Stabilization 3	30 to 34 ° C	30 seconds	245 ml/m^2	10 l
Drying	60 to 80 ° C	60 seconds		

Stabilization was conducted while supplying the replenisher in the direction from stabilization step 3 to 1 by the counter-current method. The processing solutions used in the respective processes had the following compositions.

Color developer

	Tank solution	Replenisher
Pure water	800 ml	800 ml
Triethanolamine	8 g	10 g
N,N-diethylhydroxylamine	5 g	7 g
Potassium chloride	2 g	1.1 g
N-ethyl-N-(β-methanesulfonamidoethyl-3-methyl-4-aminoaniline sulfate	5 g	7.4 g
Sodium tetrapolyphosphate	2 g	2.8 g
Potassium carbonate	30 g	30 g
Potassium sulfite	0.2 g	0.3 g
Brightening agent 4,4'-diaminostylbenedisulfonic acid derivative	1 g	1.2 g
Water was added to make a total quantity of 1 l, and pH was adjusted to 10.2.		

Bleach-fixer (tank solution and replenisher)

Water	800 ml
Iron (II) ammonium ethylenediaminetetraacetate	60 g
Ethylenediaminetetraacetic acid	3 g
Ammonium thiosulfate (70% aqueous solution)	100 ml
Ammonium sulfite (40% aqueous solution)	27.5 ml
Water was added to make a total quantity of 1 l, and potassium carbonate or glacial acetic acid was added to obtain a pH of 5.7.	

Stabilizer (tank solution and replenisher)

Water	800 ml
5-chloro-2-methyl-4-isothiazolin-3-one	1 g
1-hydroxyethylidene-1,1-diphosphonic acid	2 g
Water was added to make a total quantity of 1 l, and sulfuric acid or potassium hydroxide was added to obtain a pH of 7.0.	

Light fastness and sensitivity were evaluated in the same manner as in Example 1. Figures for sensitivity are expressed as percent sensitivity relative to the sensitivity of each sample at initiation of continuous processing. The results are shown in Tables 6 and 7.

Table 6 (1/2)

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Yellow coupler	Relative sensitivity	Residual rate (%)
201 (comparative)	Not added		Example coupler Y-51	89	53
202 (comparative)	Comparative compound YST-1	2060	Example coupler Y-51	84	72
203 (comparative)	Comparative compound YST-2	1400	Example coupler Y-51	90	62
204 (inventive)	Example compound I-1	1420	Example coupler Y-51	88	75
205 (inventive)	Example Compound I-6	1540	Example coupler Y-51	89	78
206 (inventive)	Example Compound I-8	1510	Example coupler Y-51	90	76
207 (inventive)	Example Compound I-17	1590	Example coupler Y-51	85	77
208 (inventive)	Example compound I-21	1200	Example coupler Y-51	88	78
209 (inventive)	Example compound I-22	1600	Example coupler Y-51	85	78
210 (inventive)	Example Compound I-25	1580	Example coupler Y-51	90	78
211 (comparative)	Not added		Example coupler Y-3	94	50

Table 6 (2/2)

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Yellow coupler	Relative sensitivity	Residual rate (%)
212 (comparative)	Comparative compound YST-1	2060	Example coupler Y-3	76	74
213 (comparative)	Comparative compound YST-2	1400	Example coupler Y-3	92	57
214 (inventive)	Example compound I-1	1420	Example coupler Y-3	93	84
215 (inventive)	Example Compound I-6	1540	Example coupler Y-3	90	86
216 (inventive)	Example Compound I-8	1510	Example coupler Y-3	94	82
217 (inventive)	Example Compound I-17	1590	Example coupler Y-3	92	88
218 (inventive)	Example compound I-21	1200	Example coupler Y-3	85	78
219 (inventive)	Example compound I-22	1600	Example coupler Y-3	88	76
220 (inventive)	Example Compound I-25	1580	Example coupler Y-3	90	81
221 (comparative)	Comparative compound YST-1	2060	Example coupler Y-20	78	82

Table 7

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Yellow coupler	Relative sensitivity	Residual rate (%)
222 (inventive)	Example compound I-1	1420	Example coupler Y-20	94	87
223 (inventive)	Example compound I-6	1540	Example coupler Y-20	92	86
224 (inventive)	Example compound I-8	1510	Example coupler Y-20	94	84
225 (comparative)	Comparative compound YST-1	2060	Example coupler Y-36	76	81
226 (inventive)	Example compound I-1	1420	Example coupler Y-36	93	86
227 (inventive)	Example compound I-6	1540	Example coupler Y-36	92	87
228 (inventive)	Example compound I-8	1510	Example coupler Y-36	94	84
229 (comparative)	Comparative compound YST-1	2060	Example coupler Y-46	78	82
230 (inventive)	Example compound I-1	1420	Example coupler Y-46	94	85
231 (inventive)	Example compound I-6	1540	Example coupler Y-46	94	85
232 (inventive)	Example compound I-8	1510	Example coupler Y-46	92	86

As is evident from Tables 6 and 7, the silver halide photographic light-sensitive material of the present invention undergoes little change in the sensitivity thereof between initiation and completion of continuous processing and has excellent light fastness.

Example 3

Sample No. 301 was prepared in the same manner as with sample No. 102 of Example 1 except that

layer 5 (red-sensitive layer) was replaced as described in Table 8 below.

Fifth layer coating solution

10.7 g of a cyan coupler (comparative coupler C-1), 0.33 g of an antistaining agent HQ-1, 6.7 g of a high boiling organic solvent DOP and 6.7 g of HBS-1 were dissolved in 60 ml of ethyl acetate. This solution was emulsified and dispersed in 215 ml of a 10% aqueous solution of gelatin containing 10 ml of 10% sodium triisopropylnaphthalenesulfonate SU-1 using a homogenizer to yield a cyan coupler dispersion.

This dispersion was mixed with a red-sensitive silver chlorobromide emulsion Em-3 (containing 7.0 g of silver) and a gelatin solution for coating to yield a fifth layer coating solution.

Table 8

Layer 5 (red-sensitive layer)	Gelatin Red-sensitive silver chlorobromide emulsion (Em-3)	1.30 0.21
	Cyan coupler (C-1) Antistaining agent (HQ-1) HBS-1 DOP	0.32 0.01 0.20 0.20

Next, sample Nos. 302 through 315 were prepared in the same manner as above except that the cyan coupler C-1 for layer 5 was replaced as shown in Tables 9 and 10 and 0.1 mmol/m^2 of each of the dye image stabilizers shown in Tables 9 and 10 was added to layer 5. The resulting samples were each subjected to red light exposure through an optical wedge using the sensitometer KS-7 (produced by Konica Corporation) and processed in accordance with the procedures described in Example 2, after which they were evaluated in the same manner as in Example 1. Figures for sensitivity are expressed as percent sensitivity relative to the sensitivity of sample No. 301. The results are shown in Tables 9 and 10.

Table 9 (1/2)

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Cyan coupler	Relative sensitivity	Residual rate (%)
301 (comparative)	Not added		Example coupler C-1	100	72
302 (comparative)	Comparative compound YST-1	2060	Example coupler C-1	82	80
303 (comparative)	Comparative compound YST-2	1400	Example coupler C-1	90	75
304 (inventive)	Example compound I-1	1420	Example coupler C-1	96	90
305 (inventive)	Example compound I-6	1540	Example coupler C-1	101	83
306 (inventive)	Example compound I-8	1510	Example coupler C-1	102	83
307 (inventive)	Example compound I-17	1590	Example coupler C-1	94	85
308 (inventive)	Example compound I-21	1200	Example coupler C-1	95	83
309 (inventive)	Example compound I-22	1600	Example coupler C-1	93	84
310 (inventive)	Example compound I-25	1580	Example coupler C-1	92	80

Table 9 (2/2)

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Cyan coupler	Relative sensitivity	Residual rate (%)
311 (comparative)	Not added		Example coupler C-4	98	74
312 (comparative)	Comparative compound YST-1	2060	Example coupler C-4	81	82
313 (comparative)	Comparative compound YST-2	1400	Example coupler C-4	88	75
314 (inventive)	Example compound I-1	1420	Example coupler C-4	87	90
315 (inventive)	Example compound I-6	1540	Example coupler C-4	99	92
316 (inventive)	Example compound I-8	1510	Example coupler C-4	101	92
317 (inventive)	Example compound I-17	1590	Example coupler C-4	90	90
318 (inventive)	Example compound I-21	1200	Example coupler C-4	91	90
319 (inventive)	Example compound I-22	1600	Example coupler C-4	92	88
320 (inventive)	Example compound I-25	1580	Example coupler C-4	93	89
321 (comparative)	Not added		Example coupler PC-1	94	42

Table 10

Sample No.	Dye image stabilizer	Oxidation potential (mV)	Cyan coupler	Relative sensitivity	Residual rate (%)
322 (comparative)	Comparative compound YST-1	2060	Example coupler PC-1	75	60
323 (comparative)	Comparative compound YST-2	1400	Example coupler PC-1	90	45
324 (inventive)	Example compound I-1	1420	Example coupler PC-1	91	84
325 (inventive)	Example compound I-6	1540	Example coupler PC-1	98	86
326 (inventive)	Example compound I-8	1510	Example coupler PC-1	99	82
327 (comparative)	Not added		Example coupler CA-1	102	74
328 (comparative)	Comparative compound YST-1	2060	Example coupler CA-1	85	82
329 (comparative)	Comparative compound YST-2	1400	Example coupler CA-1	100	75
330 (inventive)	Example compound I-1	1420	Example coupler CA-1	98	93
331 (inventive)	Example compound I-6	1540	Example coupler CA-1	103	85
332 (inventive)	Example compound I-8	1510	Example coupler CA-1	103	85

As is evident from Tables 9 and 10, the samples incorporating comparative compound YST-1 as a dye image stabilizer, which has an ester group in the molecular structure thereof and an oxidation potential of 2060 mV (sample Nos. 302, 312, 322 and 328), had reduced sensitivity, irrespective of which cyan coupler was used. Also, the samples incorporating comparative compound YST-2 as a dye image stabilizer, which had no ester group in the molecular structure thereof but had an oxidation potential of 1400 mV, falling in the range of the present invention (sample Nos. 303, 313, 323 and 329), had no sufficient light fastness, though the sensitivity did not decrease. On the other hand, the use of a compound relating to the present

invention offered sufficient sensitivity and excellent light fastness.

Example 4

Silver halide color photographic light-sensitive material sample No. 401 was prepared by coating the following layers from the support side on a polyethylene-laminated paper support (titanium oxide content 2.7 g/m^2).

Layer 1: A layer containing 1.2 g/m^2 of gelatin, 0.32 g/m^2 (as silver; the same applies below) of a blue-sensitive silver chlorobromide emulsion (silver chloride content 99.3 mol%) and 0.80 g/m^2 of a yellow coupler Y-51 dissolved in 0.3 g/m^2 of dioctyl phthalate (hereinafter referred to as DOP).

Layer 2: An interlayer comprising 0.7 g/m^2 of gelatin, 30 g/m^2 of an anti-irradiation dye AI-1 and 20 g/m^2 of another anti-irradiation dye AI-2.

Layer 3: A layer containing 1.25 g/m^2 of gelatin, 0.20 g/m^2 of a green-sensitive silver chlorobromide emulsion (silver chloride content 99.5 mol%) and 0.26 g/m^2 of a magenta coupler M-2 dissolved in 0.30 g/m^2 of DOP.

Layer 4: An interlayer comprising 1.2 g/m^2 of gelatin.

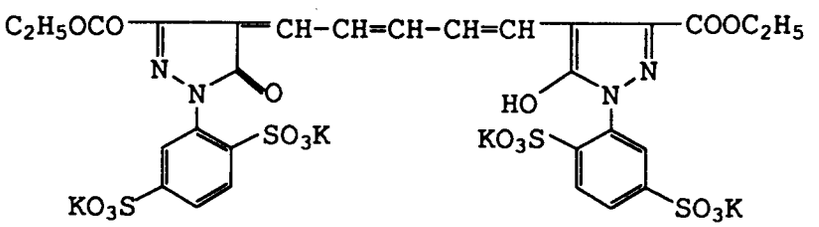
Layer 5: A layer containing 1.4 g/m^2 of gelatin, 0.20 g/m^2 of a red-sensitive silver chlorobromide emulsion (silver chloride content 99.7 mol%) and 0.40 g/m^2 of a cyan coupler C-4 dissolved in 0.20 g/m^2 of dibutyl phthalate (hereinafter referred to as DBP).

Layer 6: An interlayer comprising 1.0 g/m^2 of gelatin and 0.3 g/m^2 of a UV absorbent UV-1 dissolved in 0.2 g/m^2 of DOP.

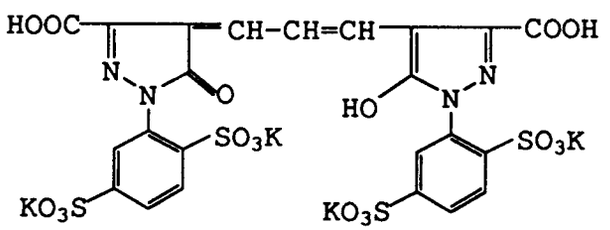
Layer 7: A layer containing 0.5 g/m^2 of gelatin.

As a hardener, 2,4-dichloro-6-hydroxy-s-triazine sodium was added to layers 2, 4 and 7 to 0.017 g per gram of gelatin.

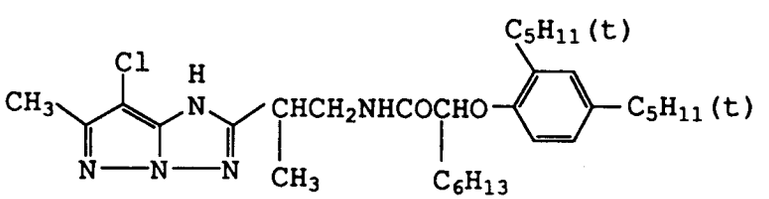
AI-1



AI-2



AI-3



Sample Nos. 402 through 422 were prepared in the same manner as with sample No. 401 except that yellow coupler Y-51 in layer 1 was replaced by each of the yellow couplers shown in Table 11 and each of the compounds of the present invention shown in Table 11 was added at 0.6 g/m^2.

For these samples, the yellow coupler was added in an amount equal to that of yellow coupler Y-51 in sample No. 401.

Samples Nos. 401 through 422 thus prepared were each subjected to blue light exposure through an optical wedge and then developed as follows.

Developing procedures

	Temperature	Time
Color development	34.7 ± 0.3 ° C	45 seconds
Bleach-fixation	34.7 ± 0.5 ° C	45 seconds
Stabilization	30 to 34 ° C	90 seconds
Drying	60 to 80 ° C	60 seconds

The processing solutions used in the respective processes had the following compositions.

Color developer

Water	800 ml
Triethanolamine	8 g
N,N-diethylhydroxylamine	5 g
Potassium chloride	2 g
N-ethyl-N-(β-methanesulfonamidoethyl-3-methyl-4-aminoaniline sulfate	5 g
Sodium tetrapolyphosphate	2 g
Potassium carbonate	30 g
Potassium sulfite	0.2 g
Water was added to make a total quantity of 1 l, and pH was adjusted to 10.05.	

Bleach-fixer

Iron (III) ammonium ethylenediaminetetraacetate	60 g
Ethylenediaminetetraacetic acid	3 g
Ammonium thiosulfate (70% aqueous solution)	100 ml
Ammonium sulfite (40% aqueous solution)	27.5 ml
Water was added to make a total quantity of 1 l, and potassium carbonate or glacial acetic acid was added to obtain a pH of 5.7.	

Stabilizer

5-chloro-2-methyl-4-isothiazolin-3-one	1 g
1-hydroxyethylidene-1,1-diphosphonic acid	2 g
Water was added to make a total quantity of 1 l, and sulfuric acid or potassium hydroxide was added to obtain a pH of 7.0.	

With respect to each sample after processing, the maximum density (D_{max}) of the blue-sensitive emulsion layer was determined. Also, light fastness was evaluated by calculating the dye image residual rate (%) at an initial density of 1.0 in a 10-day fading test using a fade-0-meter. Also, a negative film was obtained by photographing a color checker (produced by Macbeth Company) using the Konica Color GX-100 (produced by Konica Corporation) and developed. Then, after tone adjustment in the gray portion, this negative film was printed on the above sample Nos. 401 through 422 and processed in the same procedures as above, after which color reproduction for each hue was evaluated. The results are shown in Table 11.

Table 11

Sample. No	Yellow coupler in layer 1	Compound of the present invention	Maximum density	Light fastness (%)	Color reproduction*1			Remark
					Red	Green	Yellow	
401	Y-51	-	2.62	72	B	C	C	Comparative
402	Y-51	II-10	2.65	91	B	C	C	Comparative
403	Y-2	-	2.41	53	A	A	A	Comparative
404	Y-2	II-10	2.50	92	A	A	A	Inventive
405	Y-2	II-1	2.51	89	A	A	A	Inventive
406	Y-2	II-4	2.52	89	A	A	A	Inventive
407	Y-2	II-17	2.50	91	A	A	A	Inventive
408	Y-2	II-18	2.51	90	A	A	A	Inventive
409	Y-3	II-1	2.49	90	A	A	A	Inventive
410	Y-3	II-4	2.47	89	A	A	A	Inventive
411	Y-3	II-10	2.51	91	A	A	A	Inventive
412	Y-3	II-17	2.48	90	A	A	A	Inventive
413	Y-3	II-18	2.50	88	A	A	A	Inventive
414	Y-36	II-1	2.48	89	A	A	A	Inventive
415	Y-36	II-4	2.51	91	A	A	A	Inventive
416	Y-36	II-10	2.50	93	A	A	A	Inventive
417	Y-36	II-17	2.53	91	A	A	A	Inventive
418	Y-36	II-18	2.52	90	A	A	A	Inventive
419	Y-46	II-4	2.49	85	A	A	A	Inventive
420	Y-46	II-10	2.51	88	A	A	A	Inventive
421	Y-46	II-17	2.51	86	A	A	A	Inventive
422	Y-46	II-18	2.48	85	A	A	A	Inventive

*1: Color reproduction (hue, chromaticity) C = poor; B = slightly poor; A = good.

As is evident from Table 11, sample Nos. 401 and 402, which incorporated a yellow coupler not represented by formula Y-I, had a high maximum density but poor color reproducibility.

On the other hand, sample No. 403, which incorporated a yellow coupler represented by formula Y-I, cannot be said to be satisfactory as to maximum density and light fastness, though the color reproducibility improved. In contrast, sample Nos. 404 through 422 of the present invention all had a high maximum density, excellent light fastness and a sufficient level of color reproducibility.

ABSTRACT OF THE DISCLOSURE

The present invention offers a silver halide photographic light-sensitive material which is excellent in dye image storage stability, which undergoes little change in the photographic performance thereof between initiation and completion of continuous processing, which has excellent color reproducibility and sufficient color developability. The present invention comprises a silver halide photographic light-sensitive material having at least one silver halide emulsion layer containing a dye-forming coupler on the support, wherein said silver halide emulsion layer contains at least one compound having an ester group and an oxidation potential of not more than 1800 mV.

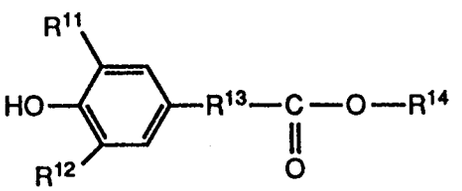
Claims

1. A silver halide photographic light-sensitive material comprising:

a support having provided thereon, a silver halide emulsion layer containing a dye-forming coupler, in which said emulsion contains a compound having an ester group and the compound having an oxidation potential of not more than 1800 mV.

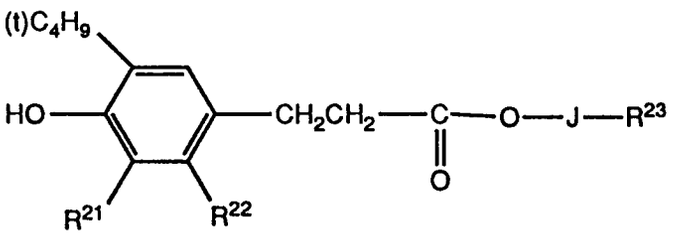
2. The material of claim 1 wherein the compound is selected from the group consisting of formulae I and II,

formula I,



wherein R^{11} and R^{12} independently represent an alkyl group; R^{13} represents a divalent binding group; R^{14} represents a hydrogen atom or a substituent,

formula II,



wherein R^{21} and R^{22} independently represent a hydrogen atom or an alkyl group having 1 to 5 carbon atoms; J represents an alkylene group or a simple bond; R^{23} represents a heterocyclic residue.

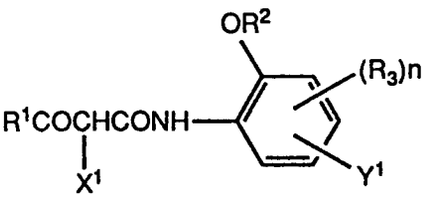
3. The material of claim 2 wherein the compound is represented by formula I.

4. The material of claim 2 wherein the compound is represented by formula II.

5. The material of claim 1 or 2 wherein the dye-forming coupler is a yellow coupler.

6. The material of claim 5 wherein the dye-forming coupler is the yellow coupler represented by the formula Y-I,

formula Y-I,

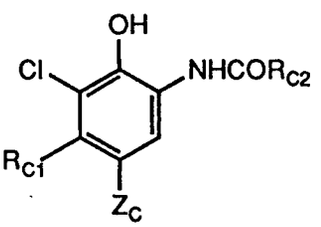


wherein R^1 represents an alkyl group or a cycloalkyl group; R^2 represents an alkyl group, a cycloalkyl group, an aryl group or an acyl group; R^3 represents a group capable of substituting a benzene ring; n represents 0 or 1; X^1 represents a group capable of splitting off upon coupling with the oxidation product of a developing agent; Y^1 represents an organic group.

7. The material of claim 1 or 2 wherein the dye-forming coupler is a cyan coupler.

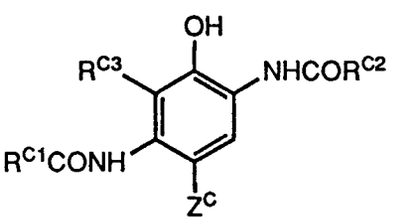
8. The material of claim 7 wherein the cyan coupler is represented by formula C-1 or C-II,

formula C-I



wherein R^{c1} represents an alkyl group having 2 to 6 carbon atoms; R^{c2} represents a ballast group; Z_c represents a hydrogen atom or a group capable of splitting off upon coupling with the oxidation product of a developing agent,

formula C-II



wherein R^{C1} represents an alkyl group, a cycloalkyl group, an aryl group or a heterocyclic group; R^{C3} represents a hydrogen atom, a halogen atom, an alkyl group or an alkoxy group; R^{C1} and R^{C3} may cooperate to form a ring; Z^C represents a hydrogen atom or an atom or group capable of splitting off upon coupling with the oxidation product of a developing agent.

9. The material of claims 1 or 2 to 8 wherein the silver halide emulsion layercontains a silver halide grain having a silver chloride content to total silver halide being not less than 90 mol %, a silver bromide content being not more than 10 mol %, and a silver iodide content being not more than 0.5 mol %.

10. The material of claim 9 wherein the silver bromide content is 0.1 to 2 mol %.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 11 0647

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	EP-A-0 393 718 (KONICA) * page 11; example T24 * * page 15; example Y14 * * page 41, line 4 - line 6 * * page 48; examples C1,C2 * ---	1,2,4-6, 9,10	G03C7/392
X	EP-A-0 159 912 (KONISHIROKU) * page 34; example III3 * * page 35; examples III4,III5 * * claim 1 * ---	1-3,7,8	
A	EP-A-0 111 448 (CIBA-GEIGY) * page 15; example 5 * -----	2,3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 AUGUST 1992	MAGRIZOS S.

CATEGORY OF CITED DOCUMENTS

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