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(54) **Silver halide color photographic lightsensitive materials.**

(57) A silver halide color photographic material is disclosed. The photographic material comprises a support having thereon a red-sensitive silver halide emulsion layer, a green-sensitive silver halide emulsion layer and a blue-sensitive silver halide emulsion layer. The blue-sensitive silver halide emulsion layer has the maximum spectral sensitivity at a wavelength within the range of from 415 nm to 470 nm, and the maximum spectral sensitivity is two or more times the spectral sensitivity of the blue-sensitive silver halide emulsion layer at 480 nm, provided that the spectral sensitivities are each determined based on the reciprocal of exposure amount necessary for forming a density of 0.1 on the minimum density of the light-sensitive material, and the blue-sensitive silver halide emulsion layer contains a DIR compound capable of releasing a development inhibiting group or a precursor thereof each having a diffusibility of not less than 0.34 upon reaction with the oxidation product of a color developing agent.

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FIELD OF THE INVENTION

The present invention relates to a color photographic light-sensitive material and more particularly to a color photographic light-sensitive material having a high hue reproducibility.

BACKGROUND OF THE INVENTION

In recent years, the image quality of silver halide multilayer color photographic light-sensitive materials has been noticeably improved. And each of the three key factors of image quality, namely, graininess, sharpness and hue reproducibility, is on a considerably high level at present. In color photographs for popular use, for example, customers seem not to be particularly dissatisfied with color prints or slide photographs they usually receive.

Among the above three key factors, however, the hue reproducibility is not so much improved in colors which have been regarded to be difficult to reproduce in photography, though color purity has been upgraded. That is to say, the hue reproducibility has several problems left unsolved still now. For example, purple colors including purple and royal purple which reflect rays having wavelengths longer than 600 nm, or greenish colors such as blueish green and yellowish green, are frequently reproduced in colors quite different from originals, disappointing users in their expectations.

There are important factors which greatly affect the hue reproducibility; namely, a spectral sensitivity distribution and an inter-layer effect or inter-image effect.

With respect to the inter-image effect, it is known to add, in a silver halide multilayer color photographic light-sensitive material, a compound capable of forming a developing inhibitor or precursor thereof upon coupling with an oxidation product of a color developing agent. And the developing inhibitor released from this so-called DIR compound inhibits development in other color-forming layers, and thereby an inter-image effect is generated to improve the hue reproducibility.

In color negative film, an effect similar to the inter-image effect can be obtained by adding a colored coupler in an amount more than that required to offset a useless absorption.

However, use of a colored coupler in a large amount raises the minimum density of the film and hinders making an appropriate judgement in correcting the color and density of prints. As a result, the image quality of finished prints is often impaired.

These techniques contribute particularly to the improvement in color purity of the hue reproducibility. And the so-called diffusible DIR compound, which contains an inhibiting group or its precursor with a large mobility in the photographic layers, has come to be widely used and greatly contributes to a better color purity. However, it is not easy to control the direction of the inter-image effect to be exerted, and therefore use of the diffusible DIR compound, though improves the color purity, may cause a trouble of changing a hue, U.S. Pat. No. 4,725,529 describes a method for controlling the direction of the inter-image effect.

With regard to the spectral sensitivity distribution, U.S. Pat. No. 3,672,898 discloses a spectral sensitivity distribution for minimizing fluctuation in the hue reproducibility when photographing under different light sources. But this method is of little use in improving the foregoing poor-reproducible colors.

Japanese Pat. O.P.I. Pub. No. 34541/1986, in which a technique to combine the spectral sensitivity distribution and the inter-image effect is disclosed, tries to improve the foregoing poor-reproducible colors and seems to be effective to some extent. The typical embodiment of this technique is to exert the inter-image effect not only from the respective principal wavelengths of blue-sensitive, green-sensitive and red-sensitive layers as in conventional methods, but also from wavelengths other than the principal wavelengths of the respective light-sensitive layers.

This technique is effective to some extent in improving the hue reproducibility of specific colors, but it has a disadvantage of raising the manufacturing cost because of a high silver consumption and increase in number of processes attributable to the necessity of an inter-image effect exerting layer in addition to the original blue-sensitive, green-sensitive and red-sensitive layers as well as the necessity of a light-sensitive silver halide emulsion of a different type. And the effect of this method is not good enough to offset such a disadvantage.

As stated above, conventional silver halide color photographic light-sensitive materials are still insufficient in the hue reproducibility. Blueish green color is particularly difficult to reproduce with high fidelity and reproduced, at times, in a color quite different from the actual color.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a color photographic light-sensitive material capable of,

in the hue reproducibility of subjects, reproducing blueish green and green colors with high fidelity as well as green and yellow colors with high brightness.

The above object of the invention is attained by a silver halide color photographic light-sensitive material comprising a support having thereon a red-sensitive silver halide emulsion layer, a green-sensitive silver halide emulsion layer and a blue-sensitive silver halide emulsion layer (hereinafter occasionally referred as red-sensitive layer, green-sensitive layer and blue-sensitive layer, respectively) wherein

the blue-sensitive layer has a wavelength giving the maximum spectral sensitivity in a spectral sensitivity distribution of the blue-sensitive layer within the range of from 415 nm to 470 nm, and the maximum spectral sensitivity is two or more times the spectral sensitivity of the blue-sensitive layer at 480 nm, provided that the spectral sensitivities are each determined based on the reciprocal of exposure amount necessary for forming a density of 0.1 on the minimum density of the light-sensitive material, and

the blue-sensitive layer contains a DIR compound capable of releasing a development inhibiting moiety or a precursor thereof each having a diffusibility of not less than 0.34 upon reaction with the oxidation product of a color developing agent.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a chromaticity diagram showing hue reproducibilities of the samples in Example 2.

DETAILED DESCRIPTION OF THE INVENTION

The color photographic light-sensitive material of the present invention comprises a support and provided thereon a blue-sensitive silver halide emulsion layer containing a color coupler which generally forms a yellow color, at least one green-sensitive silver halide emulsion layer containing a color coupler which generally forms a magenta color, and at least one red-sensitive silver halide emulsion layer containing a color coupler which generally forms a cyan color.

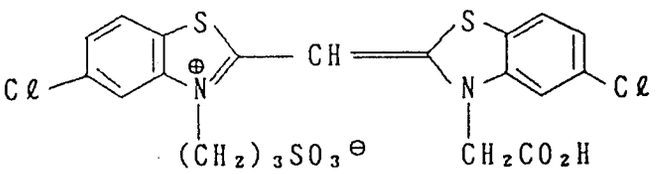
In the light-sensitive material of the invention, the spectral sensitivity distribution of the blue-sensitive silver halide emulsion layer has a maximum sensitivity in a wavelength region of 415 to 470 nm in a spectral sensitivity distribution to give a density of the blue-sensitive layer's minimum density + 0.1, and the maximum sensitivity in this spectral sensitivity distribution is 2 or more times the sensitivity at 480 nm.

In the invention , the spectral sensitivity distribution is to express a sensitivity as a function of wavelength by defining the reciprocal of exposure to give the prescribed density at a certain wavelength as a sensitivity at said wavelength, when a light-sensitive material is exposed to spectral light at intervals of several nanometers in a wavelength region of 400 to 700 nm.

There may be employed several means to give the spectral sensitivity distribution of the blue-sensitive silver halide emulsion layer in a shape which follows the invention: one means is to sensitize spectrally a silver halide with a sensitizing dye having an absorption spectrum in an objective wavelength region, another means is to give an objective spectral sensitivity to a silver halide by optimizing its halogen composition and distribution thereof using no sensitizing dye, a third means is to adjust the spectral sensitivity distribution to an objective one by employing a light absorbent in a light-sensitive material, of course, these means may also be combined.

The following are typical examples of the sensitizing dye used in the blue-sensitive silver halide emulsion layer of a light-sensitive material of the invention to give the foregoing spectral sensitivity.

A − 1



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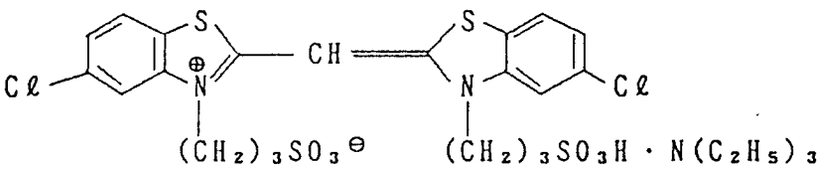

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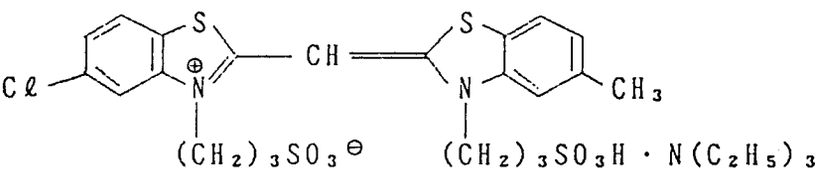

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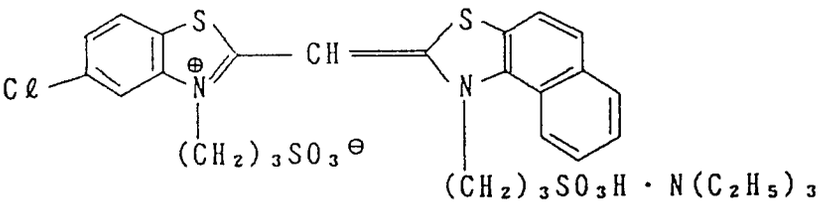

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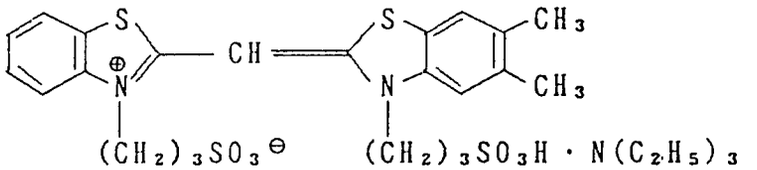

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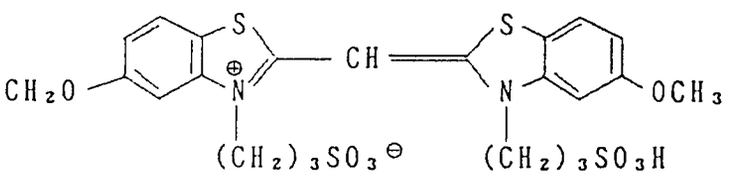

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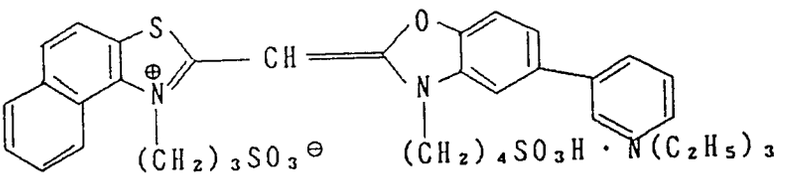

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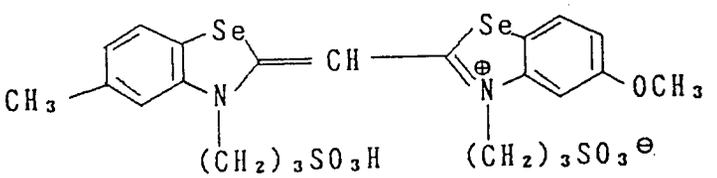

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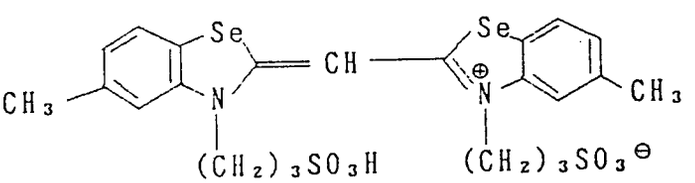

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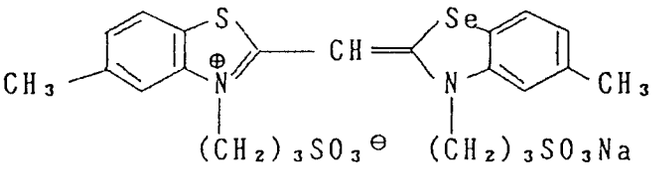

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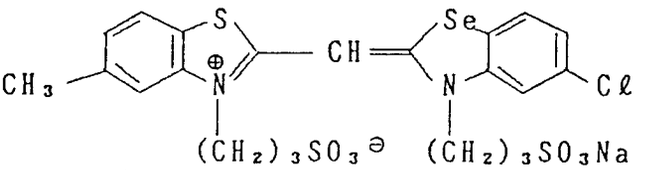
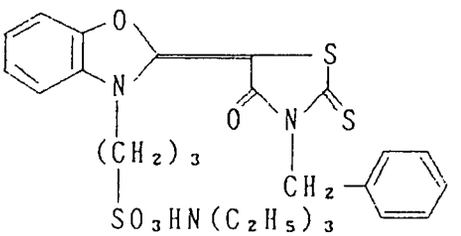


A－12



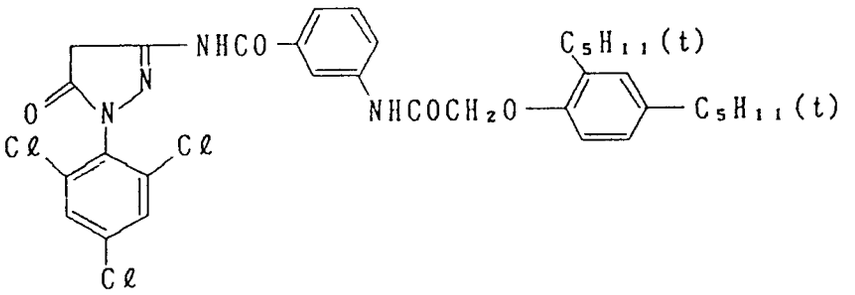
The blue-sensitive layer of a color light-sensitive material of the invention contains a compound (hereinafter occasionally referred to as a DIR compound) capable of releasing a developing inhibitor or a precursor thereof upon reaction with an oxidation product of a color developing agent, where the developing inhibitor or precursor thereof is a diffusible compound (hereinafter occasionally referred to as a diffusible DIR compound) having a diffusibility of 0.34 or more when measured by the following method. The diffusibility of diffusible DIR compounds is preferably 0.34 or more and 0.6 or less, especially 0.40 or more and 0.6 or less, in order to enhance the inter-image effect from blue-sensitive layer to green-sensitive layer and not to make the inter-image effect from blue-sensitive layer to red-sensitive layer larger than it is required.

The diffusibility is determined in the following procedure.

First, there are prepared light-sensitive material samples (I) and (II) each having the following layers on a transparent support.

Sample (I): sample having a green-sensitive silver halide emulsion layer

A gelatin coating solution containing silver iodobromide spectrally sensitized to green-sensitivity (silver iodide content: 6 mol%, average grain size: 0.48 μm) and 0.07 mol/mol silver of the following coupler is coated on a support so as to give a silver coating amount of 1.1 g/m^2 and a gelatin coating weight of 3.0 g/m^2, and then a gelatin coating solution containing silver iodobromide (silver iodide content: 2 mol%, average grain size: 0.08 μm), which is not subjected to chemical and spectral sensitizations, is coated thereon as a protective layer so as to give a silver coating amount of 0.1 g/m^2 and a gelatin coating weight of 0.8 g/m^2.



Sample (II): similar to sample (I) except that silver iodobromide is not used in the protective layer

In addition to the above components, a gelatin hardener and surfactant are contained in each layer.

Samples (I) and (II) are each exposed to white light through an optical wedge and processed in the following procedure. In developing, two types of developers are used: one containing various developing inhibitors in amounts to regulate the sensitivity of sample (II) to 60% (- ΔlogE = 0.22, in logarithm expression) and the other containing no developing inhibitors.

Processing (at 38 ° C)	
Color developing	2 min and 40 sec
Bleaching	6 min and 30 sec
Washing	3 min and 15 sec
Fixing	6 min and 30 sec
Washing	3 min and 15 sec
Stabilizing	1 min and 30 sec
Drying	

Compositions of the processing solutions used in the above processes are as follows:

(Color developer)	
4-Amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)-aniline sulfate	4.75 g
Anhydrous sodium sulfite	4.25 g
Hydroxylamine 1/2 sulfate	2.0 g
Anhydrous potassium carbonate	37.5 g
Sodium bromide	1.3 g
Trisodium nitrilotriacetate monohydrate	2.5 g
Potassium hydroxide	1.0 g

Water is added to make 1 liter.

(Bleaching solution)	
Ammonium ferric ethylenediaminetetracetate	100.0 g
Diammonium ethylenediaminetetracetate	10.0 g
Ammonium bromide	150.0 g
Glacial acetic acid	10.0 mℓ

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with an aqueous ammonia.

(Fixer)	
Ammonium thiosulfate	175.0 g
Anhydrous sodium sulfite	8.5 g
Sodium metasulfite	2.3 g

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with acetic acid.

(Stabilizer)	
Formalin (37% solution)	1.5 mℓ
Konidax (product of Konica Corp.)	7.5 mℓ

Water is added to make up to 1 liter.

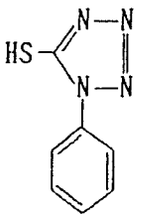
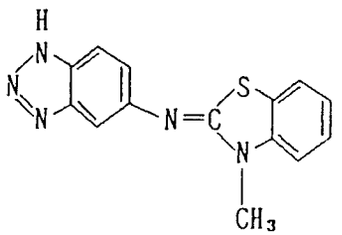
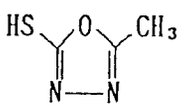
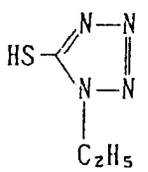
When the sensitivity of sample (I) processed with the developer containing no developing inhibitors is denoted by S_0, the sensitivity of sample(II) processed with the same developer by S_0', the sensitivity of sample (I) processed with the developer containing developing inhibitors by S_I and the sensitivity of sample-(II) processed with the same developer by S_{II}, the diffusivity is expressed as follows:

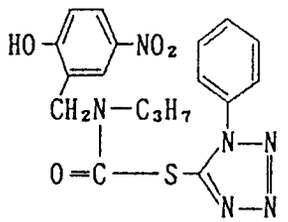
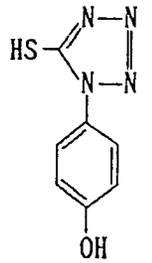
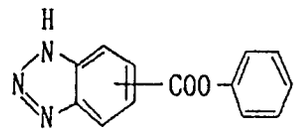
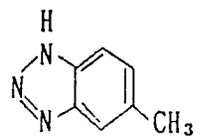
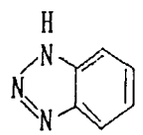
Desensitized degree of sample (I) $\Delta S = S_0 - S_I$
Desensitized degree of sample (II) $\Delta S_0 = S_0' - S_{II}$
Diffusivity $= \Delta S / \Delta S_0$

where all the sensitivities are each shown in a logarithm of a reciprocal of the exposure to give a density of fog density + 0.3 (-logE).

The diffusibilities of several developing inhibitors determined by this method are shown in the following table.

Table

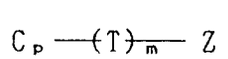
Structure	Addition amount	Degree of desensitization		Diffusibility
	(mol/ℓ)	ΔS_0	ΔS	$\Delta S / \Delta S_0$
	1.3×10^{-5}	0.22	0.05	0.23
	1.3×10^{-5}	0.23	0.03	0.34
	2.5×10^{-5}	0.22	0.10	0.45
	3.0×10^{-5}	0.21	0.10	0.48

Structure	Addition amount	Degree of desensitization		Diffusibility
	(mol/ℓ)	ΔS_0	ΔS	$\Delta S/\Delta S_0$
	1.4×10^{-5}	0.23	0.11	0.48
	2.5×10^{-5}	0.22	0.13	0.59
	3.5×10^{-5}	0.23	0.15	0.65
	4.3×10^{-5}	0.22	0.16	0.73
	1.7×10^{-4}	0.21	0.20	0.95

In the invention, there may be employed any DIR compound irrespective of the chemical structure, as far as it releases a compound having a diffusibility within the above limits.

The following is the typical structural Formula DIR-I of the compounds of this type usable in the invention:

Formula DIR-I



In Formula DIR-I, Cp is a coupler moiety; T is an interlinking group of which T to Z bond is cleaved after the Cp to T bond is cleaved by the reaction with an oxidation product of a developing agent, T is preferably linked to a coupling position of the coupler moiety; Z is a developing inhibitor moiety; and m is 0, 1 or 2, preferably 0 or 1.

The coupler moiety represented by Cp includes a yellow dye image forming coupler residue, a magenta dye image forming coupler residue, a cyan dye image forming coupler residue, and a residue of coupler which does not make an image forming dye substantially.

Preferable examples of the yellow dye image forming coupler moiety represented by Cp include coupler residues of acylacetanilide type e.g., pivaloylacetanilide type and benzolylacetanilide type, malonic diester type, malonic diamide type, dibenzolymethane type, benzothiazolylacetamide type, malonic ester monoamide type, benzothiazolylacetate type, benzoxazolylacetamide type, benzoxazolylacetate type, benzimidazolylacetamide type, benzimidazolylacetate type; coupler residues derived from heterocycle-substituted acetamides or heterocycle-substituted acetates contained in U.S. Pat. No. 3,841,880; coupler residues derived from acylacetamides described in U.S. Pat. No. 3,770,446, British Pat. No. 1,459,171, German Pat. 2,503,099, Japanese Pat. O.P.I. Pub. No. 139738/1975 and Research Disclosure No. 15737; and heterocyclic coupler residues described in U.S. Pat. No. 4,046,574.

Preferable examples of the magenta dye image forming coupler moiety represented by Cp are coupler residues having a 5-oxo-2-pyrazoline nucleus or a pyrazoloazole nucleus e.g., 5-oxo-2-pyrazoline nucleus or pyrazolotriazole nucleus, and cyanoacetophenone type coupler residues.

Preferable examples of the cyan dye image forming coupler moiety represented by Cp are coupler residues having a phenol nucleus or a α-naphthol nucleus.

Further, even when a coupler does not produce an image forming dye after releasing a developing inhibitor upon coupling with an oxidation product of a developing agent, the effect caused this coupler is the same as that of a DIR coupler. Coupler residues of this type represented by Cp are those described, for example, in U.S. Pat. Nos. 4,052,213, 4,088,491, 3,632,345, 3,958,993 and 3,961,959; coupler residues of this type include ones which yield no color forming dyes, so-called soluble-dye-forming coupler residues which form dyes effusing from a light-sensitive material into a processing solution, and so-called bleachable-dye-forming coupler residues which yield dyes bleached by reaction with a component in a processing solution.

Preferable examples of such coupler residues represented by Cp include pivaloylacetanilide type and benzoylacetanilide type yellow dye forming coupler residues, 5-oxo-2-pyrazoline nuclear magenta dye forming coupler residues, α-naphthol nuclear cyan dye forming coupler residues, and α-naphthol nuclear soluble-dye-forming coupler residues having a hydrophilic substituent.

The group represented by T includes, for example, (1) a group which causes a cleavage reaction by utilizing an electron-transfer reaction along a conjugated system, (2) a group which causes a cleavage reaction by utilizing an inter-molecular nucleophilic substitution, (3) a group which utilizes a cleavage reaction of a hemiacetal, (4) a group which utilizes a cleavage reaction of an iminoketal and (5) a group which utilizes a hydrolytic cleavage reaction of an ester.

The group of (1) is described in detail, for example, in Japanese Pat. O.P.I. Pub. Nos. 114946/1981, 154234/1982, 188035/1982, 98728/1983, 160954/1983, 209736/1983, 209737/1983, 209738/1983, 209739/1983, 209740/1983, 86361/1987 and 87958/1987.

The group of (2) is described, for example, in Japanese Pat. O.P.I. Pub. No. 56837/1982 and U.S. Pat. 4,248,962.

The group of (3) is described, for example, in Japanese Pat. O.P.I. Pub. Nos. 249148/1985, 249149/1985 and U.S. Pat. 4,146,396.

The group of (4) is described, for example, in U.S. Pat. 4,546,073.

The group of (5) is described, for example, in German Offenlegungshrift 2,626,315.

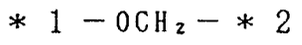
In the group represented by T, the T to Z bond may be further severed by reaction with an oxidation product of a developing agent after the Cp to T bond has been severed. Examples of such a group include a coupling component which couples with an oxidation product of a developing agent and a redox component which undergoes a redox reaction with an oxidation product of a developing agent.

When T is a coupler component, examples thereof are those coupler residues shown with respect to Cp.

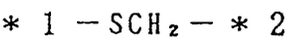
When T is a redox component, examples of such a redox component include hydroquinones, catechols, pyrogallols, aminophenols e.g., p-aminophenol, o-aminophenol, naphthalene diols e.g., 1,2-naphthalene diols, 1,4-naphthalene diols, 2,6-naphthalene diols and aminonaphthols e.g., 1,2-aminonaphthols, 1,4-aminonaphthols, 2,6-aminonaphthols.

Among the groups represented by T, the following ones are preferred. In these chemical structures, *1 is a position to bind with Cp and *2 is a position to bind with Z.

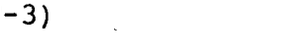
(T-1)



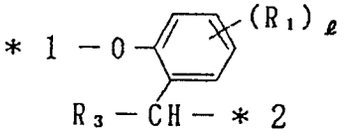
(T-2)



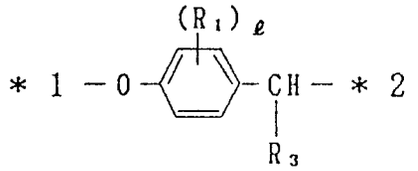
(T-3)



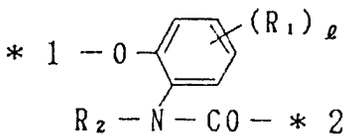
(T-4)



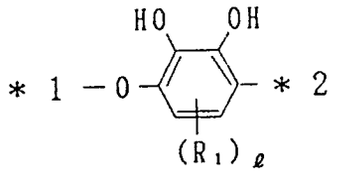
(T-5)



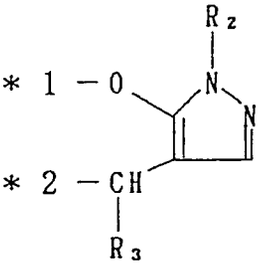
(T-6)



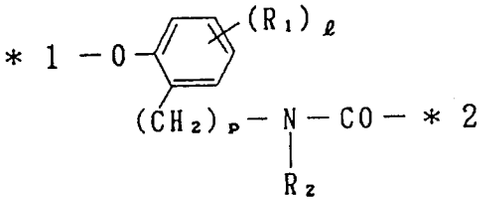
(T-7)



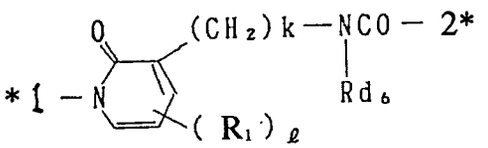
(T-8)



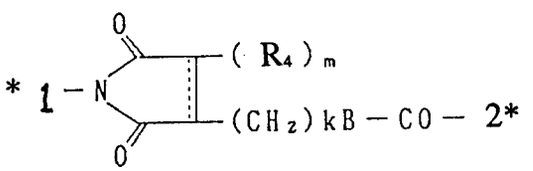
(T-9)



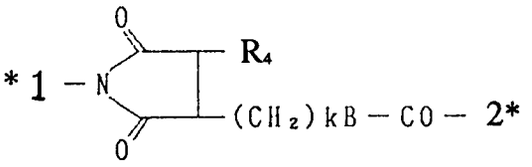
(T-10)



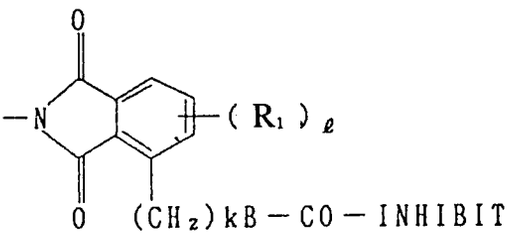
(T-11)



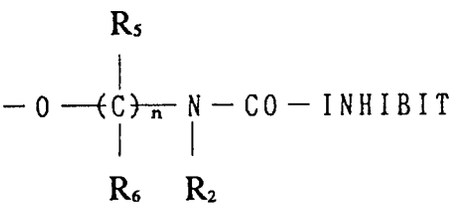
(T-12)



(T-13)



(T-14)

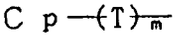


In the above formulas, R_1 is a hydrogen or halogen atom, or an alkyl, cycloalkyl, alkenyl, aralkyl, alkoxy, alkoxycarbonyl, anilino, acylamino, ureido, cyano, nitro, sulfonamido, sulfamoyl, carbamoyl, aryl, carboxy, sulfo, hydroxy or alkanesulfonyl group. In Formulas (T-9), (T-4), (T-5), (T-10) and (T-13), R_1's may be linked to each other to form a condensed ring. In Formulas (T-9), (T-8), (T-10) and (T-14), R_2 represents an alkyl, alkenyl, aralkyl, cycloalkyl, heterocyclic or aryl group. In Formulas (T-11) and (T-12), R_3 represents a hydrogen atom, or an alkyl, alkenyl, aralkyl, cycloalkyl, heterocyclic or aryl group. In Formula (T-14), R_4 and R_5 each represent a hydrogen atom or an alkyl group preferably, one having 1 to 4 carbon atoms. In Formulas (T-9) to (T-13), k is an integer of 0, 1 or 2. In Formulas (T-9), (T-4), (T-5), (T-10) and (T-13), ℓ is an integer of 1 to 4. In Formula (T-11), m is an integer of 1 or 2; R_4's may be the same or different, provided that m is 2. In Formula (T-14), n is an integer of 2 to 4; n groups each of R_5's and R_6's may be the same or different. In Formulas (T-11) to (T-14), B is an oxygen atom or a

group, in which R_2 is the same as the above. In Formula (T-11), — means that the bonding may be either a double bond or a single bond; m is 2 in case of a single bond, and m is 1 in case of a double bond.

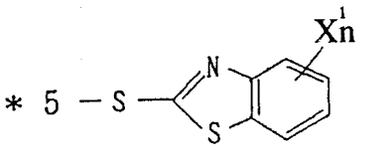
Z in Formula DIR-I is, for example, a divalent nitrogen-containing heterocyclic group or a nitrogen-containing heterocyclic thio group; such a heterocyclic thio group is a tetrazolylthio, benzothiazolylthio, benzimidazolylthio, triazolylthio or imidazolylthio group.

Typical examples of Z in Formula DIR-I are illustrated below. In these structures, *5 indicates a position to bind with a

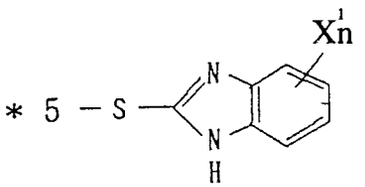


group.

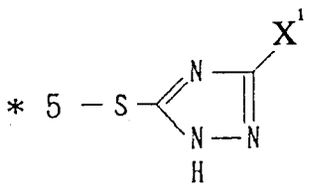
(1)



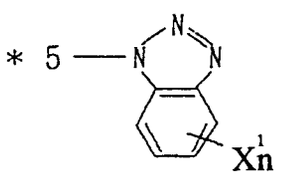
(2)



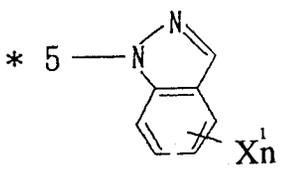
(3)



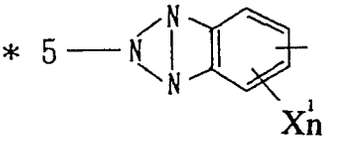
(4)



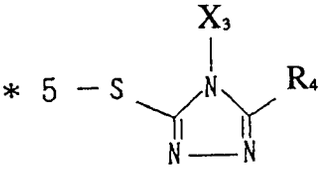
(5)



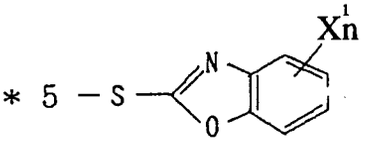
(6)



(7)



(8)



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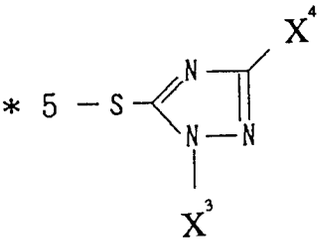
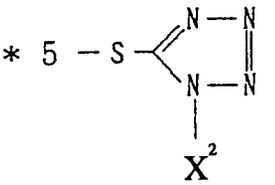
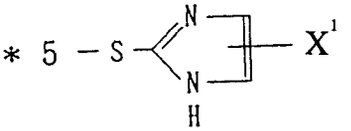


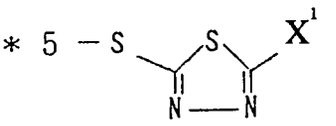
(10)



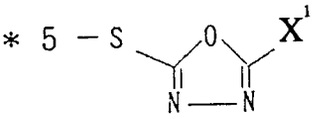
(11)



(12)



(13)



In the above formulas, X^1 is a hydrogen or halogen atom, or an alkyl, alkoxy, acylamino, alkoxycarbonyl, thiazolylideneamino, aryloxycarbonyl, acyloxy, carbamoyl, N-alkylcarbamoyl, N,N-dialkylcarbamoyl, nitro,

amino, N-arylcarbamoyloxy, sulfamoyl, N-alkylcarbamoyloxy, hydroxy, alkoxycarbonylamino, alkylthio, arylthio, aryl, heterocyclic, cyano, alkylsulfonyl or aryloxycarbonylamino group, or a group represented by L described later. n is 0, 1 or 2; and Rd_1's may be the same or different, provided that n is 2.

The total number of carbon atoms contained in n Rd_1's is preferably 0 to 10. The number of carbon atoms contained in X^1 of Formulas (13) and (14) is preferably 0 to 15. X^2 in Formula (11) represents an alkyl, aryl or heterocyclic group, or a group expressed by L described later. X^3 in Formulas (8) and (10) represents a hydrogen atom, or an alkyl, cycloalkyl, aryl or heterocyclic group, or a group expressed by L described later. X^4 represents a hydrogen atom, or an alkyl, cycloalkyl, aryl, acylamino, alkoxycarbonylamino, aryloxycarbonylamino, alkanesulfonamido, cyano, heterocyclic, alkylthio or amino group, or a group expressed by L described later.

When X^1 , X^2, X^3 and X^4 each represent an alkyl group, said alkyl group may have a substituent and may be straight-chained or branched.

When X^1 , X^2, X^3 and X^4 each represent an aryl group, said aryl group may have a substituent.

When X^1 , X^2, X^3 and X^4 each represent an heterocyclic group, said heterocyclic group may have a substituent. The heterocyclic group is preferably a 5-membered or 6 membered single or condensed ring having at least one heteroatom selected from nitrogen, oxygen and sulfur atoms; examples thereof include pyridyl, quinolyl, furyl, benzothiazolyl, oxazolyl, imidazolyl, thiazolyl, triazolyl, benzotriazolyl, imido and oxazino groups.

The number of carbon atoms contained in X^2 of Formula (11) is preferably 0 to 15. The total number of carbon atoms contained in X^3 and X^4 of Formula (7) or (9) is preferably 0 to 15.

In the invention, the diffusible DIR coupler releases a developing inhibitor, namely a moiety expressed by Z in Formula I, in the developing process, and it is preferable that after the developing inhibitor diffuses into the developer, its development-inhibiting property decrease with time and be virtually lost in the end. Use of such a DIR coupler prevents a developing inhibitor from accumulating in a developer while a light-sensitive material is precessed continuously, and thereby the developing can be stably continued.

As such a DIR coupler, one expressed by the following Formula DIR-II is preferred.

C_p-$(T)_m$-Z'-(L-Y)p (DIR-II)

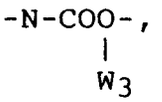
In the above Formula DIR-II, Cp, T, Z and m are the same as those defined for Formula DIR-I. Z'-(L-Y)p is a moiety of development inhibited. L is an interlinking group capable of being cleaved by a component in developer after the compound containing Z'-(L-Y)p performs a development-inhibiting function. Y is a substituent. p is 1 or 2; Y's may be the same or different when p is 2.

As moieties represented by Z' groups the same as that represented by Z in Formula DIR-I may be used.

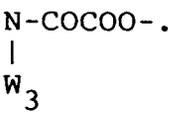
The group represented by L is converted by the cleavage into a group which inactivates the development-inhibiting activity of Z'-(L-Y)p, and the developing inhibitor Z'-(L-Y)p released from a DIR coupler virtually loses its development-inhibiting function when L is cleaved.

L in Formula DIR-II is a divalent interlinking group and contains a chemical bond which is cleaved by a nucleophilic reagent being a developer component such as hydroxy ion or hydroxylamine.

As such a chemical bond, there can be illustrated, for example, -COO-,



$-SO_2O-$, $-OCH_2CH_2SO_2-$, -OCOO- and

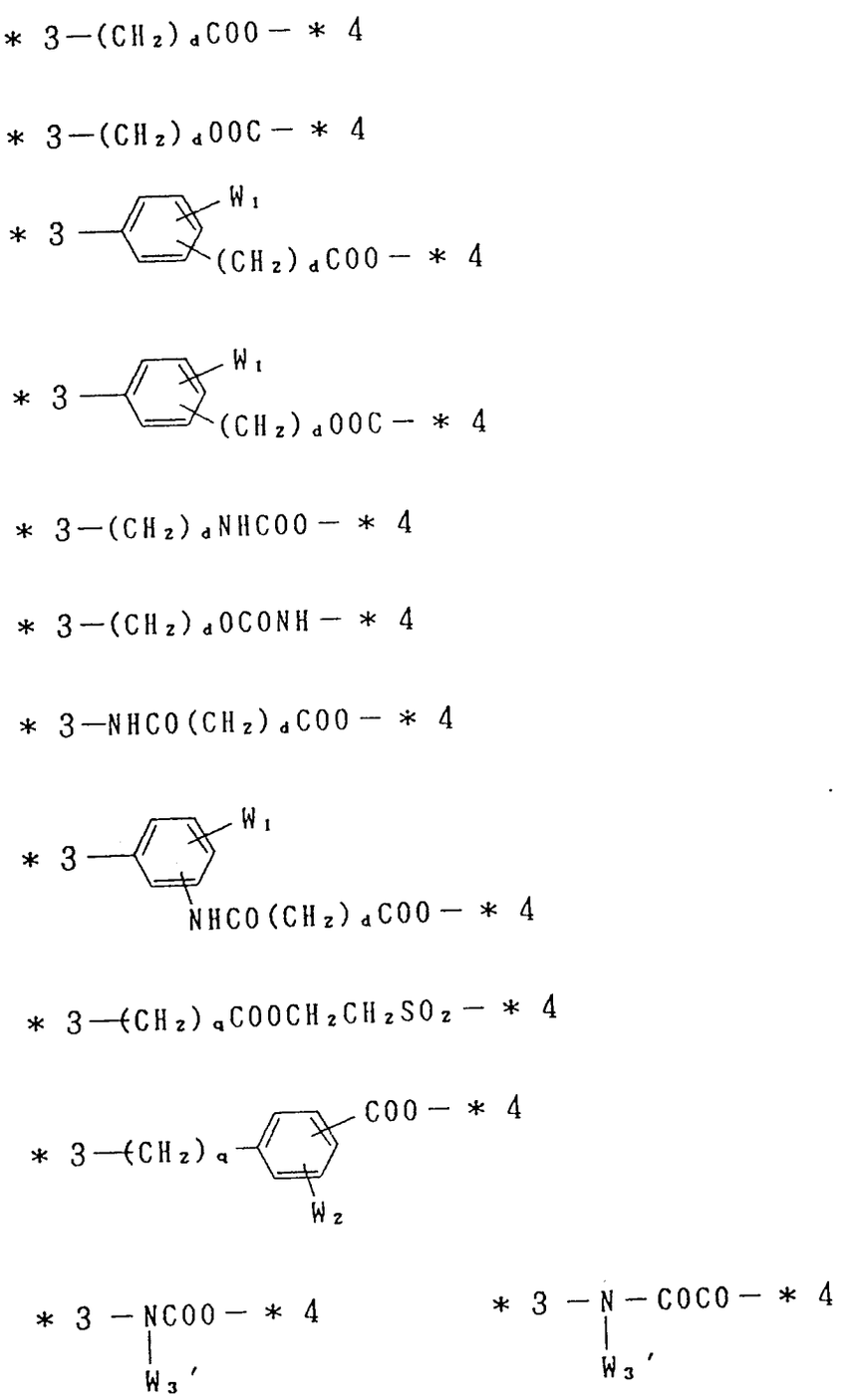


These chemical bonds are linked with Z directly or via an alkylene group and/or a phenylene group at one end and with Y directly at the other end. When the bond is formed via an alkylene or phenylene group,

there may be contained, in a portion of such an interposed divalent group, an ether bond, amide bond, carbonyl group, thioether bond, sulfo group, sulfonamide bond or urea bond.

W_3 is a hydrogen atom or a substituent such as halogen atom or nitro, alkoxy or alkyl group.

Preferred examples of the interlinking group expressed by L are illustrated below. In these structures, *3 is a position to bind with Z and *4 is a position to bind with Y.



wherein W_1, W_2 and W_3 each represent a hydrogen atom or a substituent. d is an integer of 0 to 10, preferably 0 to 5.

Examples of the substituent expressed by W_1 include halogen atoms, alkyl groups having 1 to 10, preferably 1 to 5, carbon atoms and alkaneamido, alkoxy, alkoxycarbonyl, alkanesulfonamido, alkylcarbamoyl, aryloxycarbonyl, aryl, carbamoyl, nitro, cyano, arylsulfonamido, sulfamoyl and imido groups.

Examples of the substituent expressed by W_2 include alkyl, aryl, and alkenyl groups. W_3' is the same

as W_3, and the same substituent is exemplified. q expresses an integer of 0 to 6.

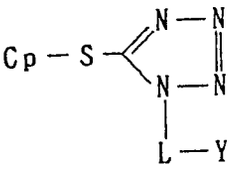
In Formula DIR-II, the substituent represented by Y is an alkyl, cycloalkyl, alkenyl, cycloalkenyl, aryl or heterocyclic group, each of which may further have a substituent.

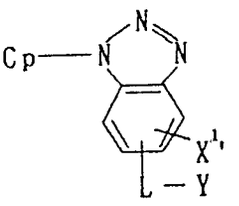
The alkyl, cycloalkyl or alkenyl group represented by Y has 1 to 10, preferably 1 to 5 carbon atoms and may be straight-chained or branched. These groups preferably have a substituent selected from halogen atoms, nitro group, alkoxy group having 1 to 4 carbon atoms, aryloxy group having 6 to 10 carbon atoms, alkanesulfonyl group having 1 to 4 carbon atoms, arylsulfonyl group having 6 to 10 carbon atoms, alkaneamido group having 2 to 5 carbon atoms, anilide group, benzamido group, alkylcarbamoyl group having 2 to 6 carbon atoms, carbamoyl group, arylcarbamoyl group having 7 to 10 carbon atoms, alkylsulfonamido group having 1 to 4 carbon atoms, arylsulfonamido group having 6 to 10 carbon atoms, alkylthio group having 1 to 4 carbon atoms, arylthio group having 6 to 10 carbon atoms, phthalimido group, succinimido group, imidazolyl group, 1,2,4-triazolyl group, pyrazolyl group, benzotriazolyl group, furyl group, benzothiazolyl group, alkylamino group having 1 to 4 carbon atoms, alkanoyl group having 2 to 4 carbon atoms, benzoyl group, alkanoyloxy group having 2 to 4 carbon atoms, benzoyloxy group, perfluoroalkyl group having 1 to 4 carbon atoms, cyano group, tetrazolyl group, hydroxyl group, carboxyl group, mercapto group, sulfo group, amino group, alkylsulfamoyl group having 1 to 4 carbon atoms, arylsulfamoyl group having 6 to 10 carbon atoms, morpholinogroup, aryl group having 6 to 10 carbon atoms, pyrrolidinyl group, ureido group, oxyamide group, alkoxycarbonyl group having 2 to 6 carbon atoms, aryloxycarbonyl group having 7 to 10 carbon atoms, imidazolidinyl group and alkylideneamino group having 1 to 6 carbon atoms.

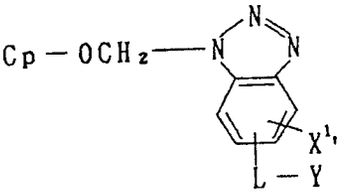
The aryl group represented by Y is a phenyl group or naphthyl group, each of which may have a substituent selected from substituents defined for the foregoing alkyl group and alkenyl group, or from alkyl groups having 1 to 4 carbon atoms.

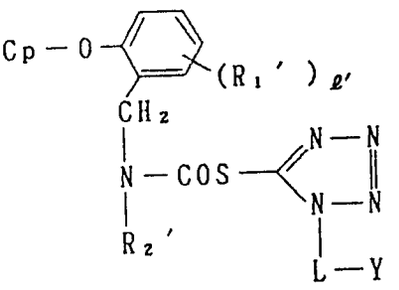
The heterocyclic group represented by Y is selected from diazolyl group such as 2-imidazolyl and 4-pyrazolyl, triazolyl group such as 1,2,4-triazole-3-yl, thiazolyl group such as 2-benzothiazolyl, oxazolyl group such as 1,3-oxazole-2-yl, pyrrolyl group, pyridinyl group, diazinyl group such as 1,4-diazine-2-yl, triazinyl group such as 1,2,4-triazine-5-yl, furyl group, diazolyl group such as imidazoline-2-yl, pyrrolinyl group and thienyl group.

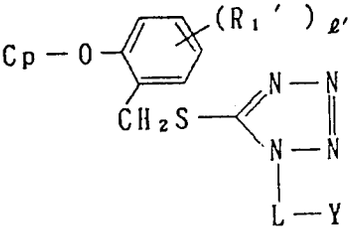
Preferred examples of the DIR compounds of the invention represented by Formula DIR-II are as follows:

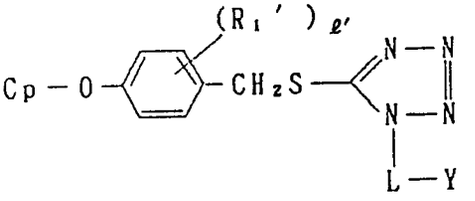


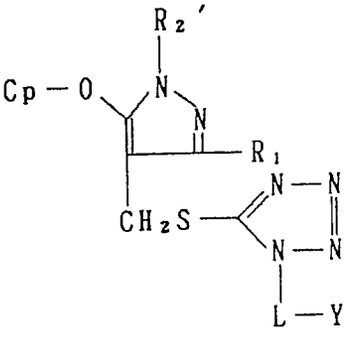


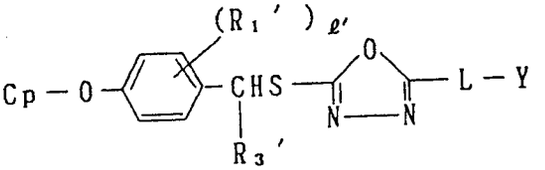


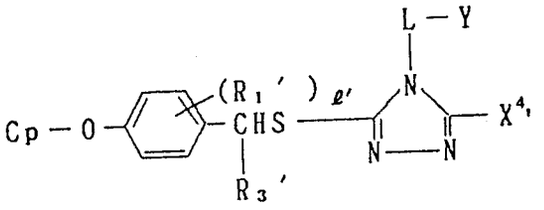










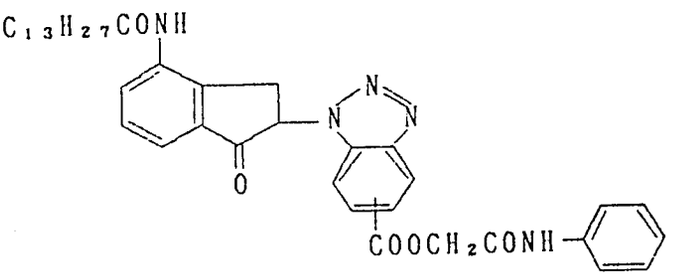


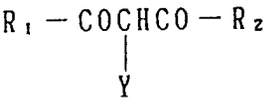
where, R_1' and R_1, R_2' and R_2, and R_3' and R_3 are the same with each other; ℓ' is the same as ℓ; $X^{1'}$ and $X^{4'}$ are the same as X^1 and X^4, respectively; and Cp and -L-Y are the same as Cp and -L-Y in Formula DIR-II, respectively.

Typical examples of the DIR compounds of the invention are illustrated below.

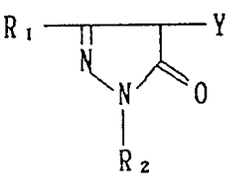
Illustrated compound

D-1

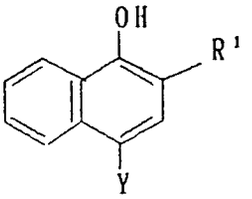




Illustrated compound No.	R_1	R_2	Y
D − 2	(1)	(1)	(30)
D − 3	(2)	(3)	(30)
D − 4	(2)	(4)	(30)
D − 5	(5)	(6)	(31)
D − 6	(2)	(4)	(32)
D − 7	(2)	(3)	(32)
D − 8	(7)	(8)	(33)
D −33	(2)	(4)	(55)



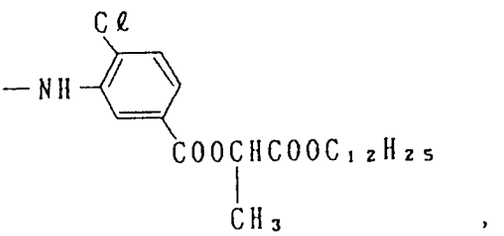
Illustrated compound No.	R_1	R_2	Y
D − 9	(9)	(10)	(30)
D −10	(11)	(10)	(30)
D −11	(12)	(7)	(34)
D −12	(12)	(13)	(35)
D −13	(9)	(14)	(36)
D −14	(15)	(16)	(37)
D −35	(56)	(24)	(23)



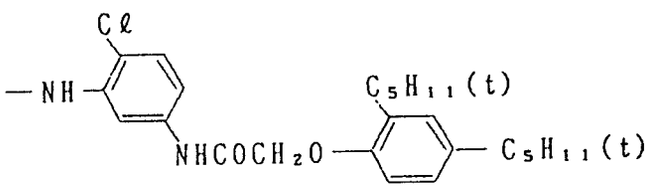
Illustrated compound No.	R_1	Y
D－15	(17)	(38)
D－16	(17)	(39)
D－17	(18)	(40)
D－18	(19)	(41)
D－19	(18)	(42)
D－20	(18)	(43)
D－21	(18)	(44)
D－22	(18)	(45)
D－23	(18)	(46)
D－24	(20)	(47)
D－25	(20)	(48)
D－26	(21)	(49)
D－27	(21)	(50)

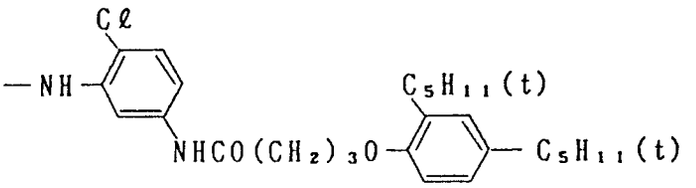
Illustrated compound No.	R_1	Y
D－28	(21)	(51)
D－29	(22)	(52)
D－30	(18)	(53)
D－31	(18)	(54)
D－32	(22)	(49)
D－34	(18)	(56)

In the above table, numbers in the column of R_1 R_2 or Y indicate numbers of the following groups, respectively.

1 

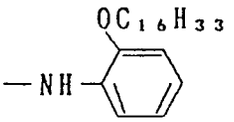
2 $-C(CH_3)_3$,

3 

4 

,

5 —OCH3 ,

6 

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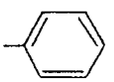
7 
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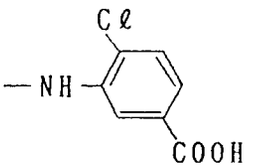
8 

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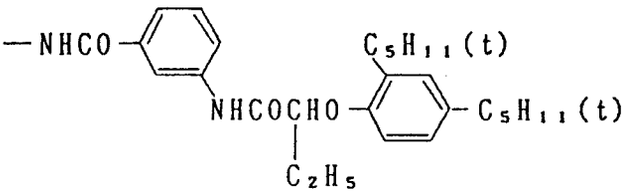
9 

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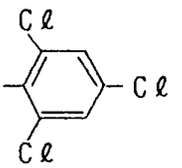
10 

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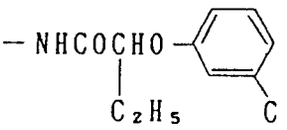
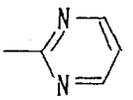
11 

,

12 —$C_{17}H_{35}$,

13 

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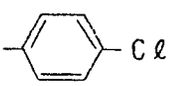
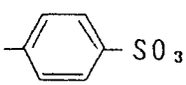
14 

,

15 —CH_3 ,

16 

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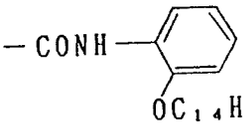
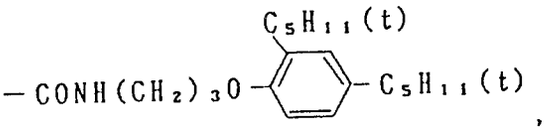
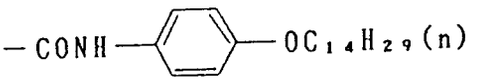
17 —$CONHC_{18}H_{37}$,

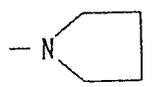
18 

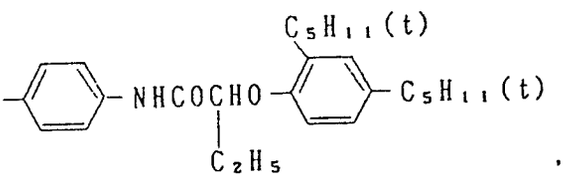
19 

20 

21 $-CONHCH_2CH_2COOH$,

22 $-CONHCH_2CH_2COOCH_3$,

23 

24 

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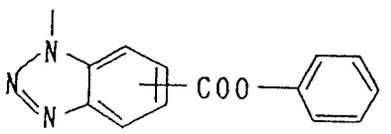

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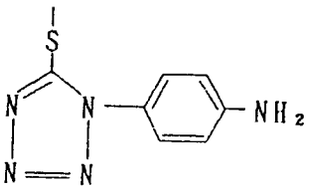

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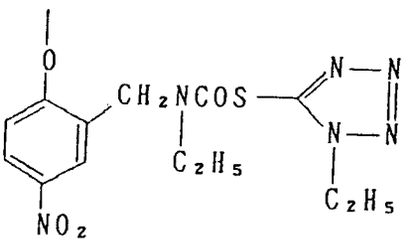

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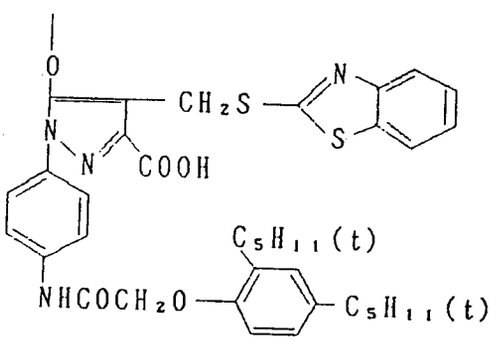

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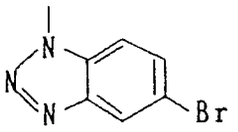

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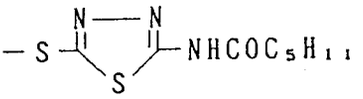

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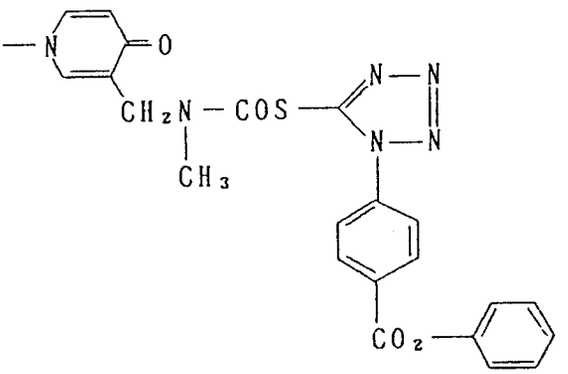

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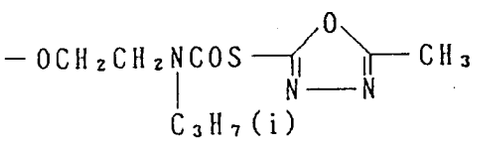

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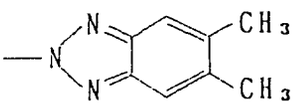

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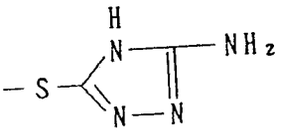

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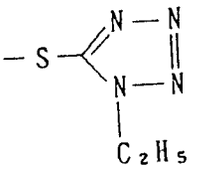

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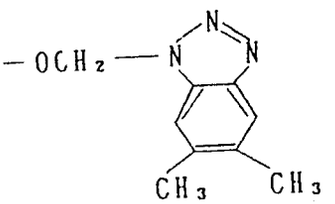

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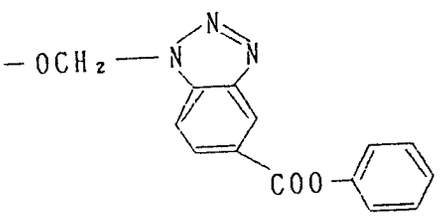

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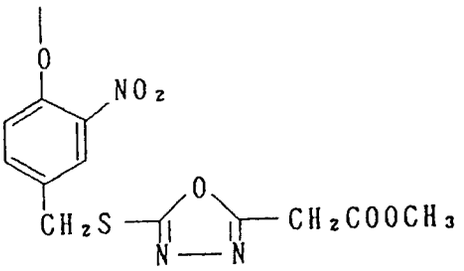

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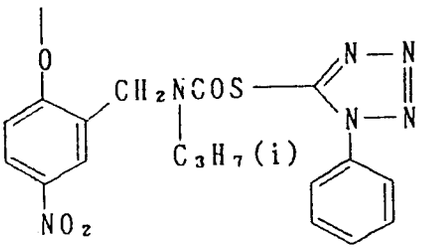

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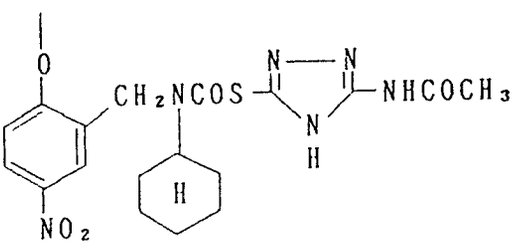

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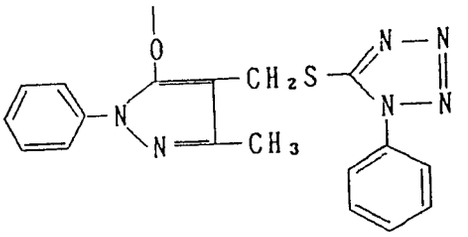

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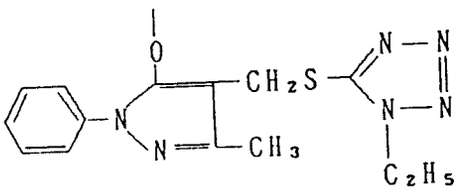

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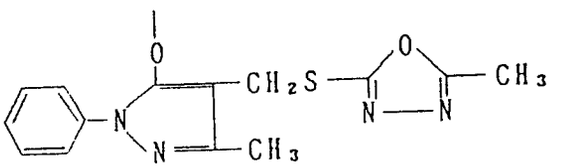

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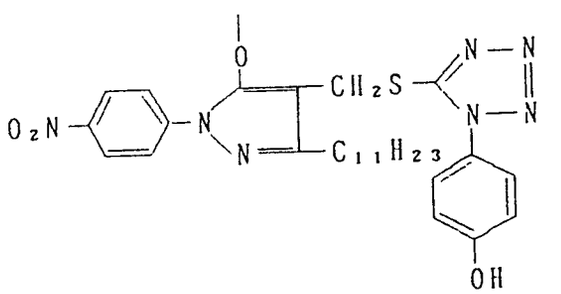

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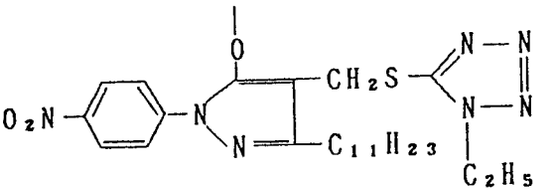

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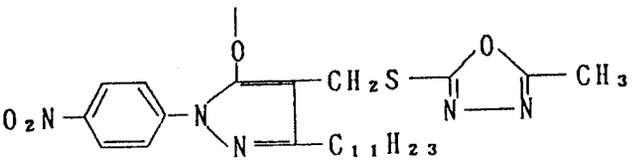

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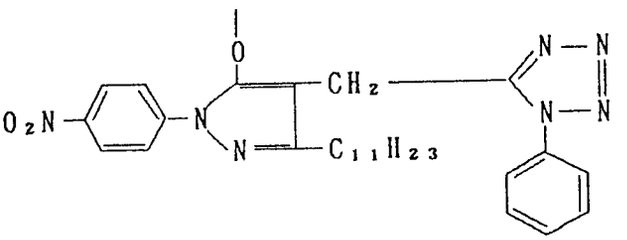

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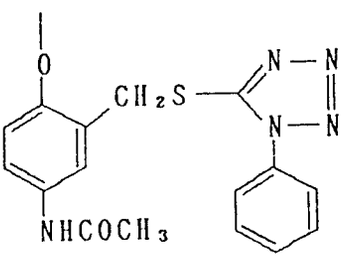

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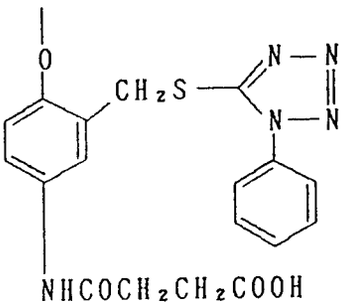

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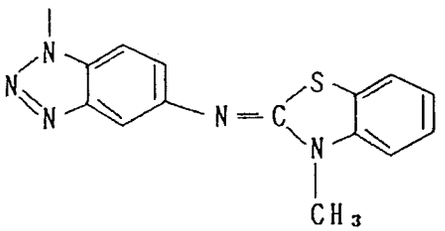

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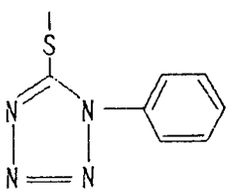
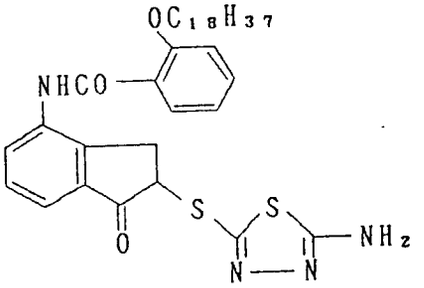
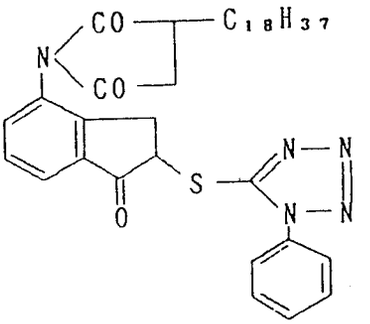


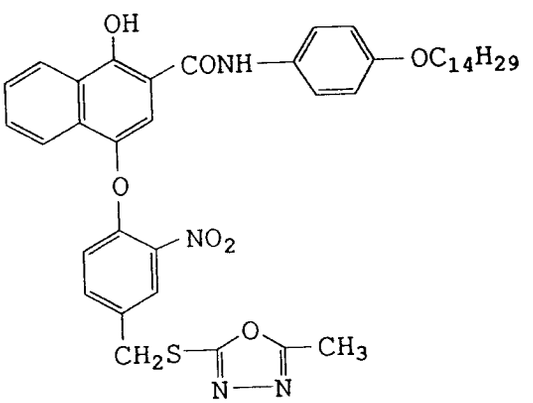
D-36



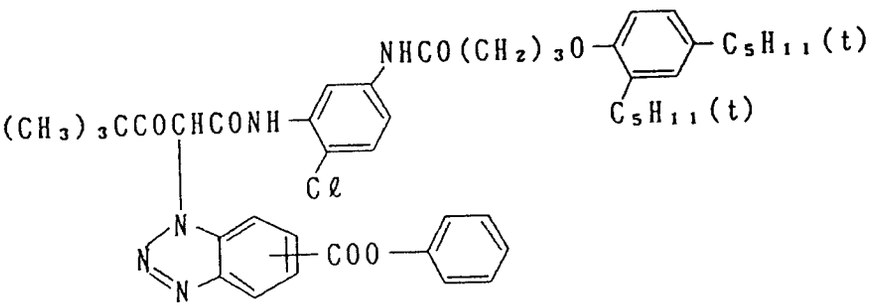
D-37



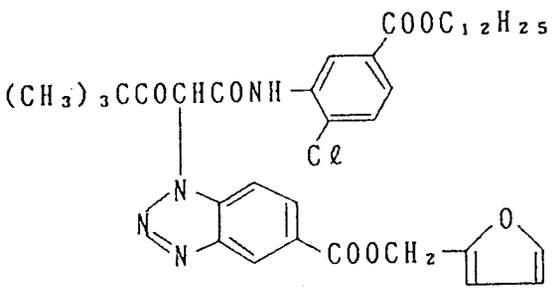
D-38



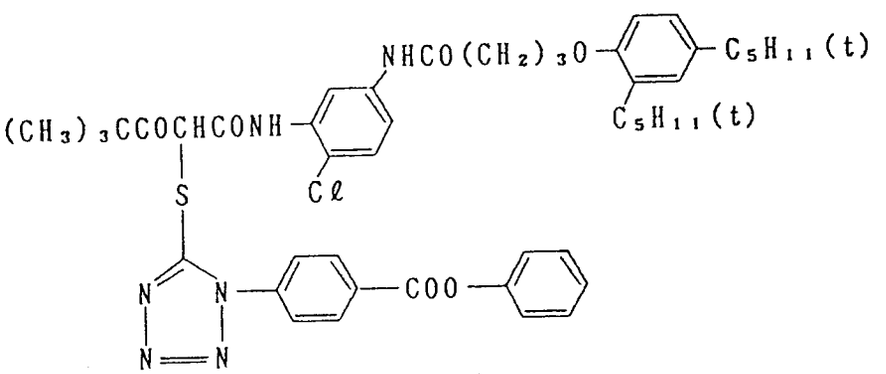
D-39



D-40



D-41



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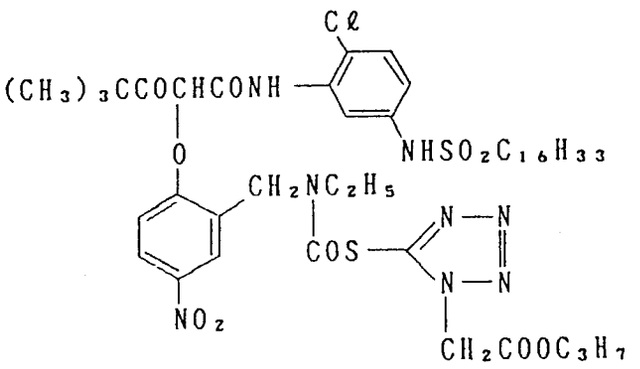

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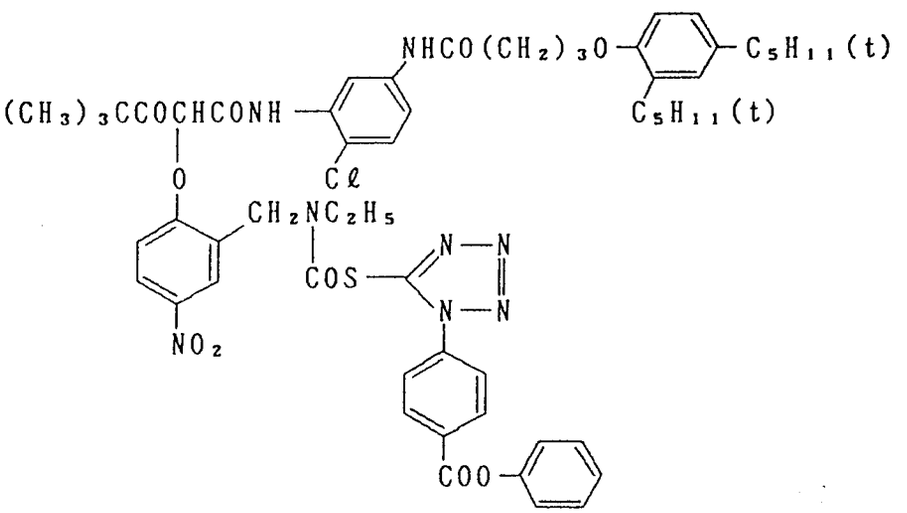

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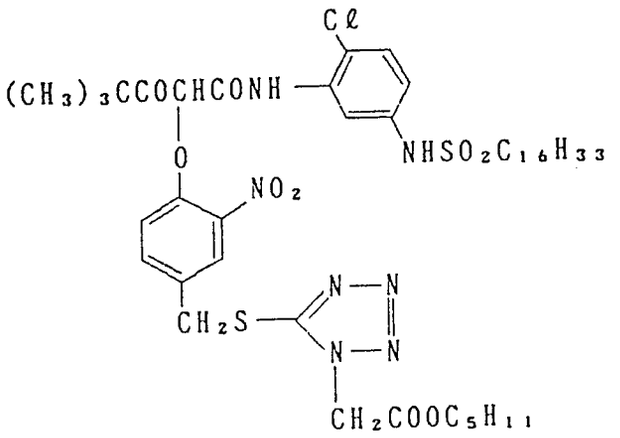

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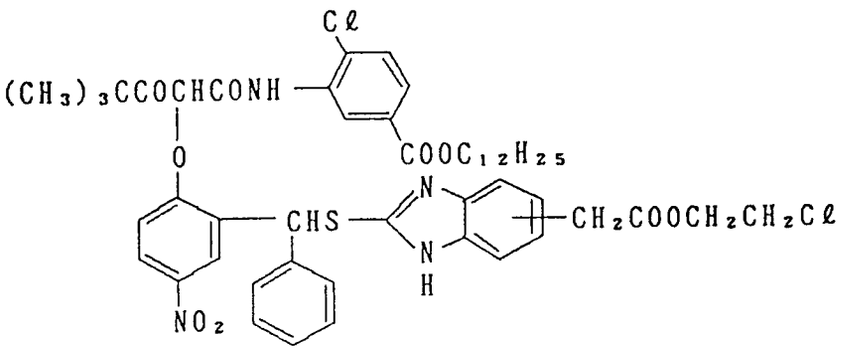

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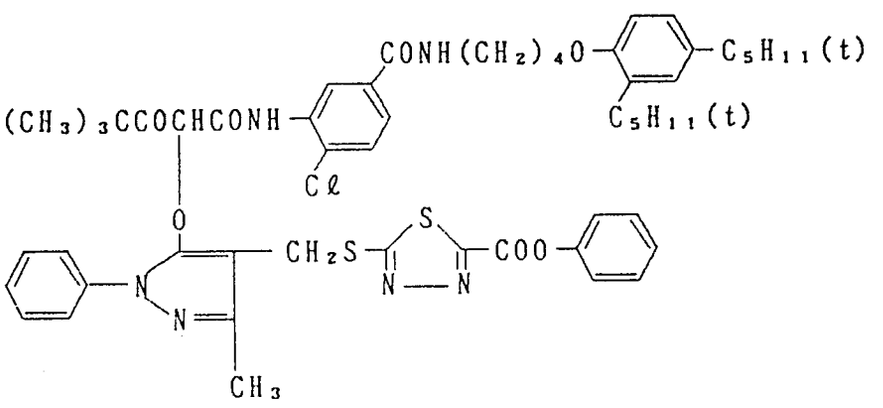

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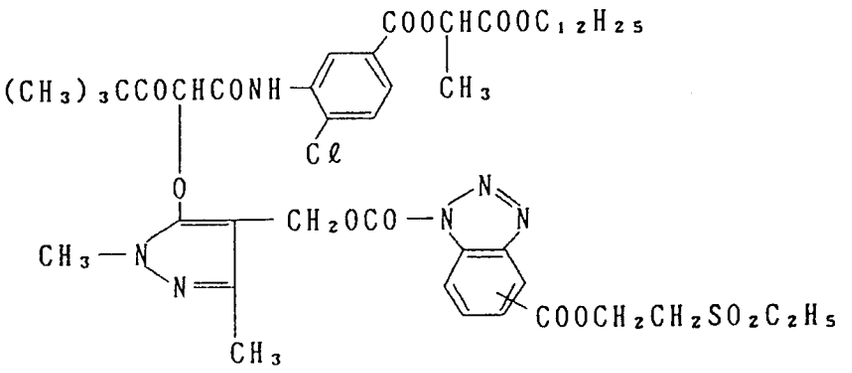

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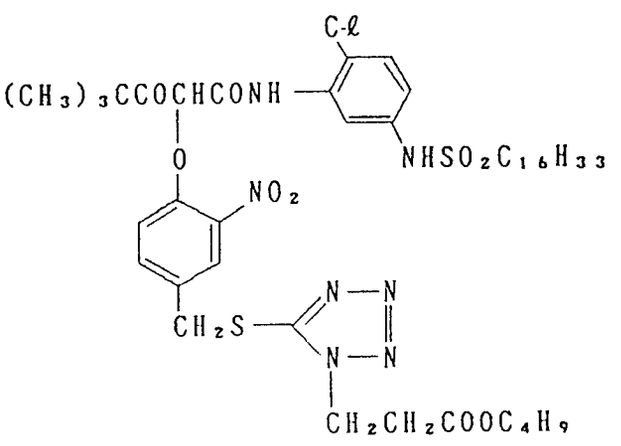

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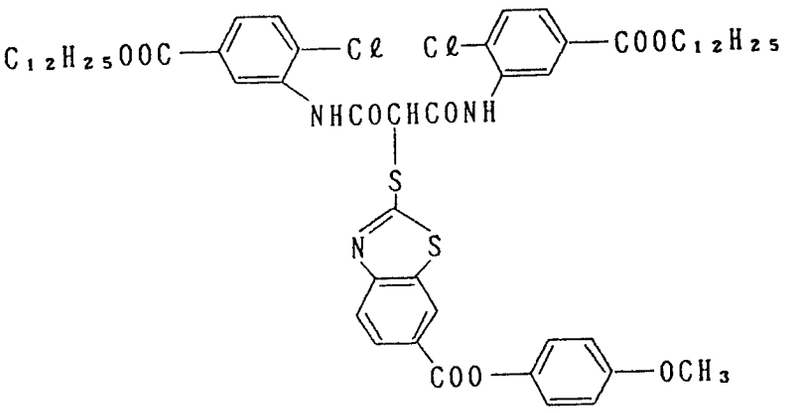

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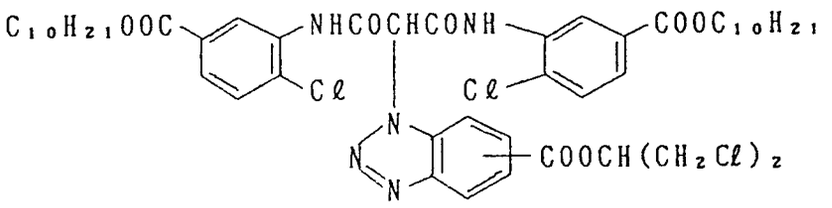

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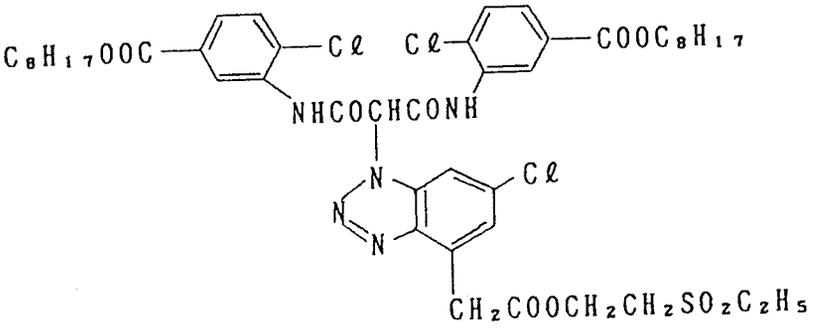

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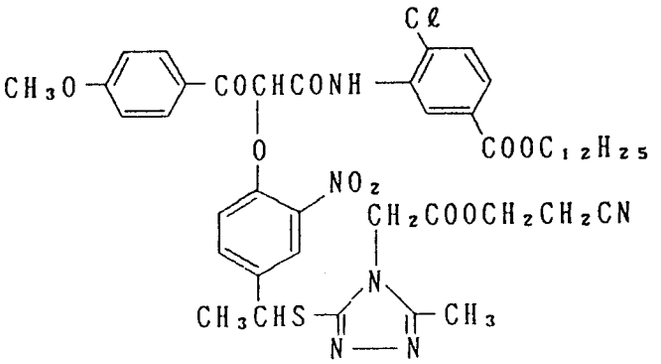

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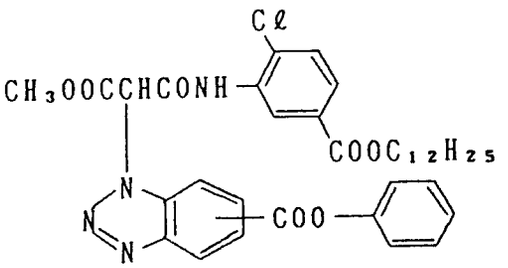

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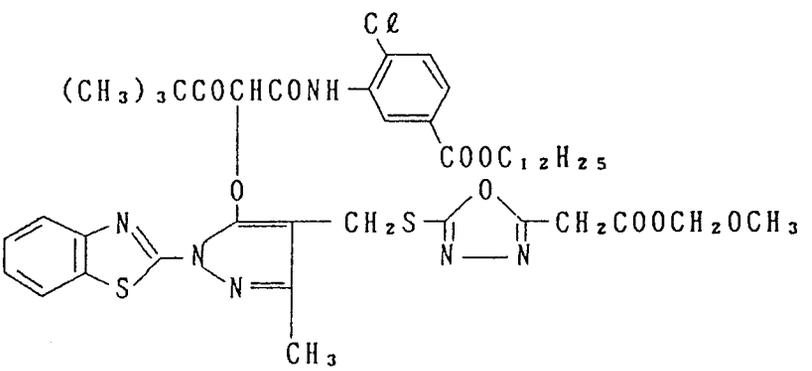

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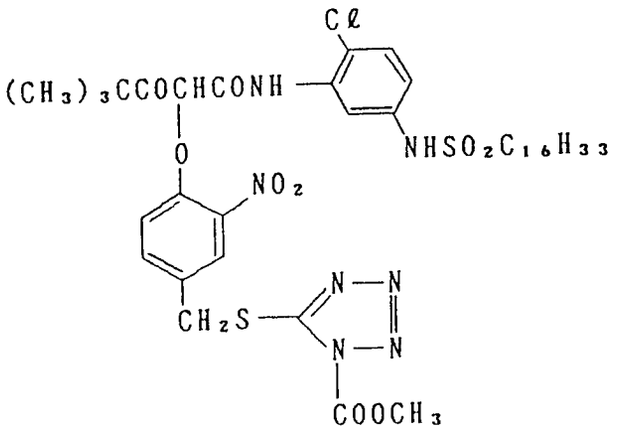

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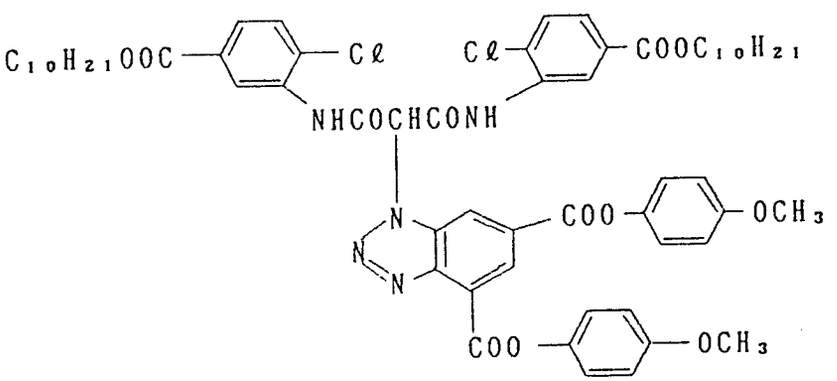

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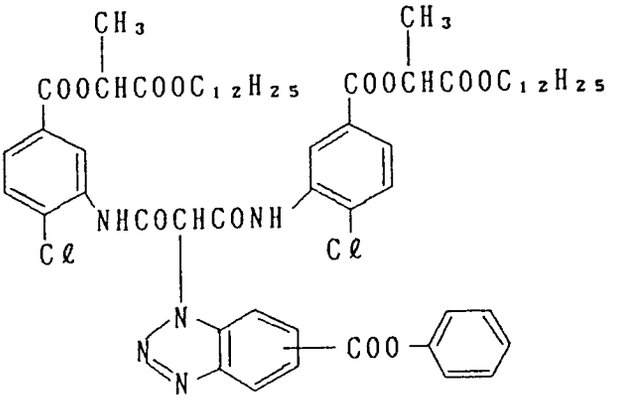

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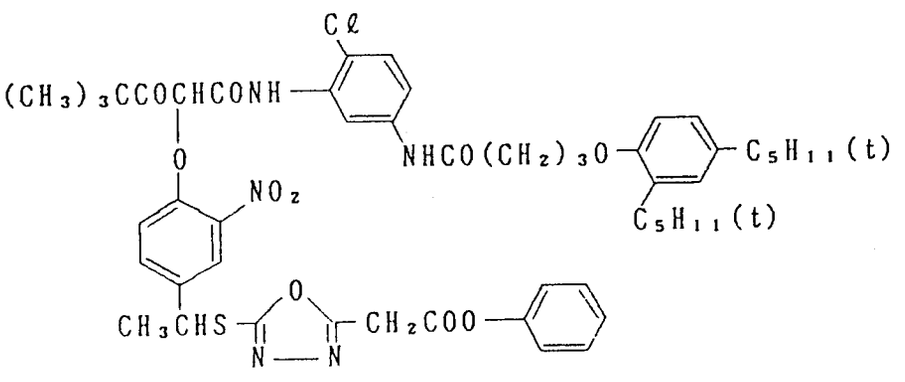

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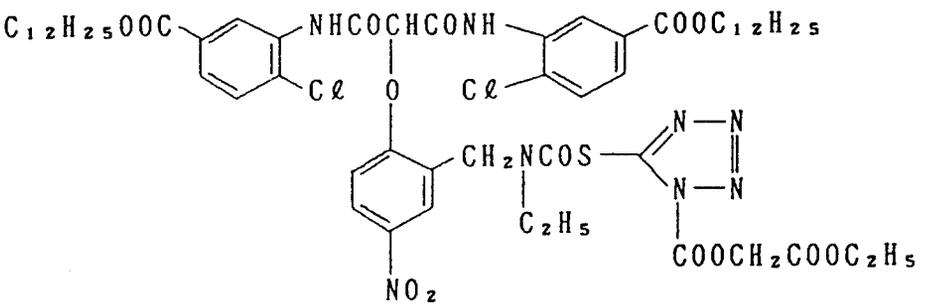

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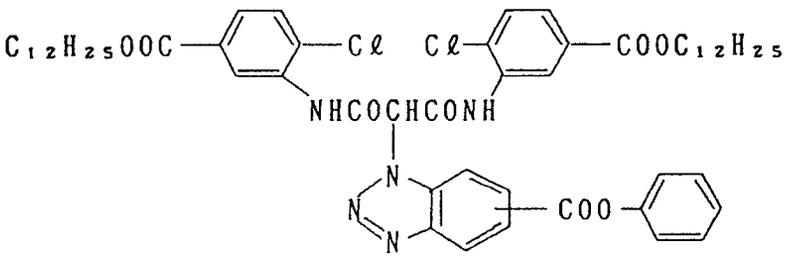

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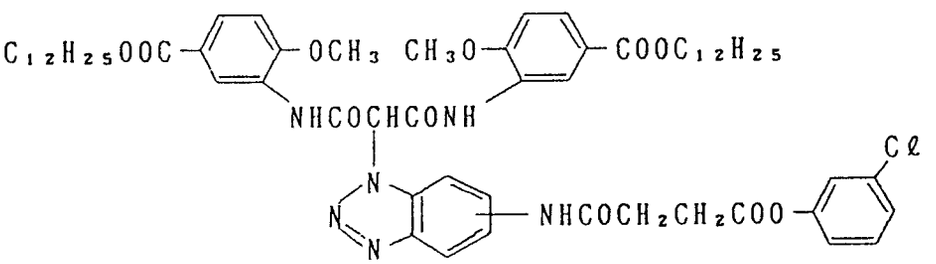

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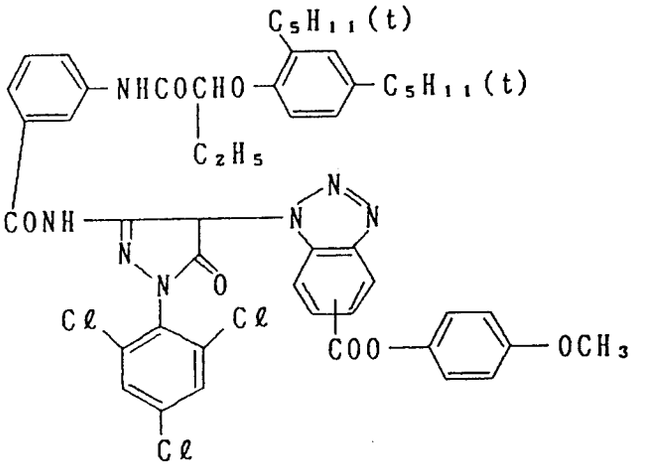

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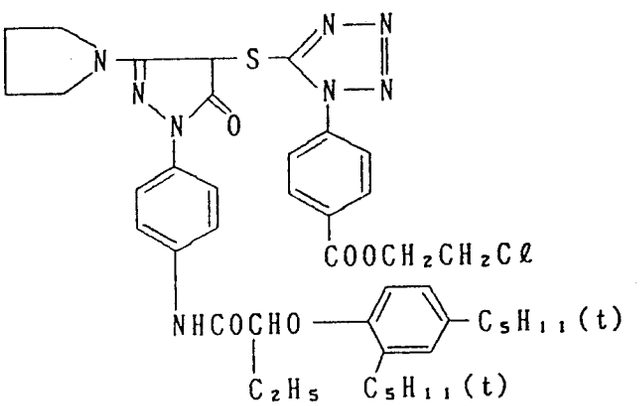

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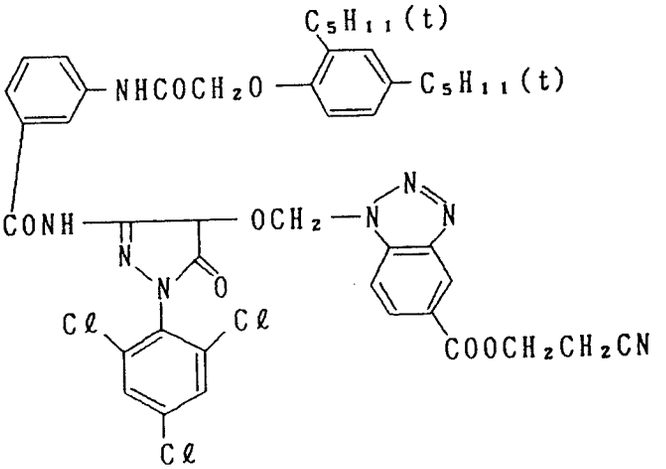

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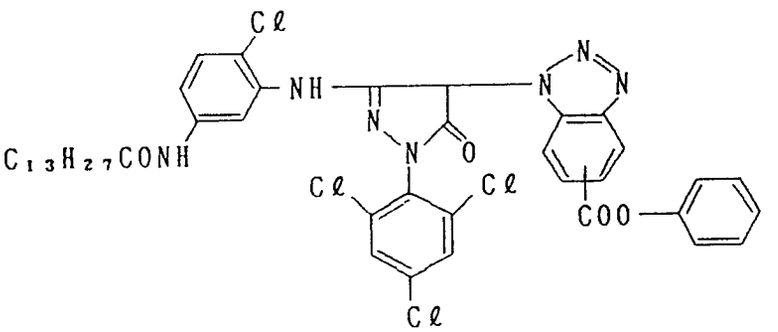

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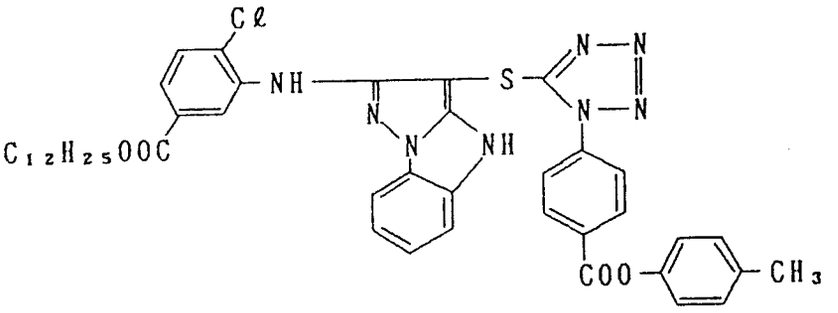

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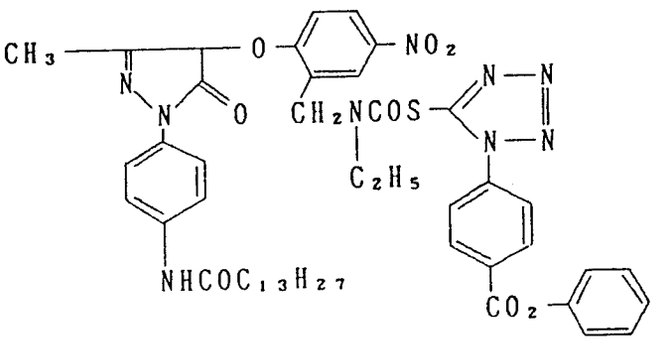

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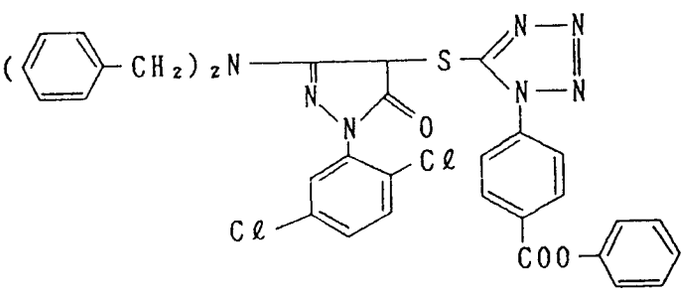

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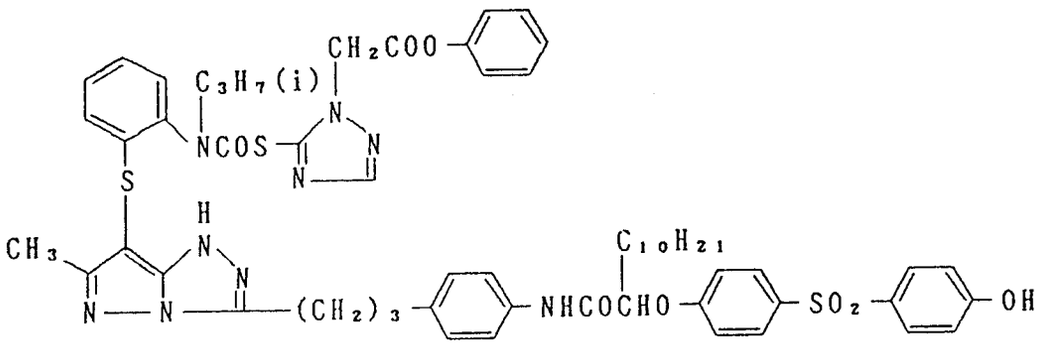

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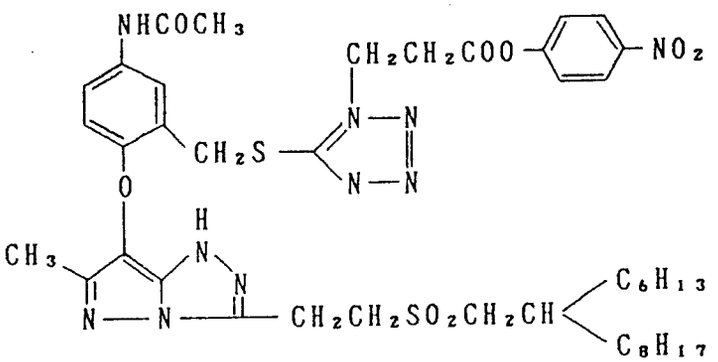

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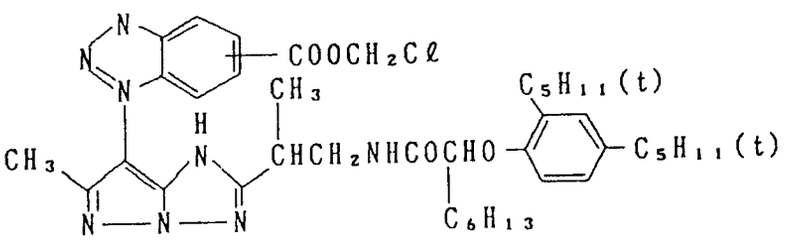

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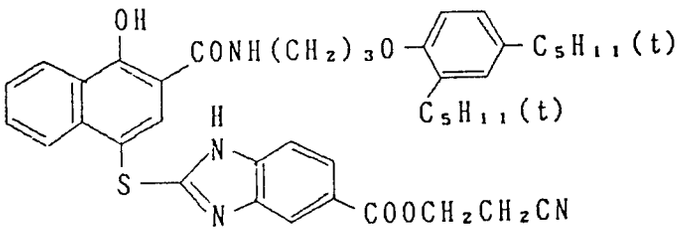

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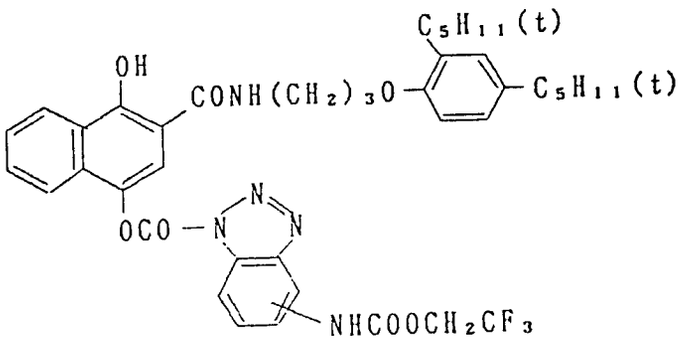

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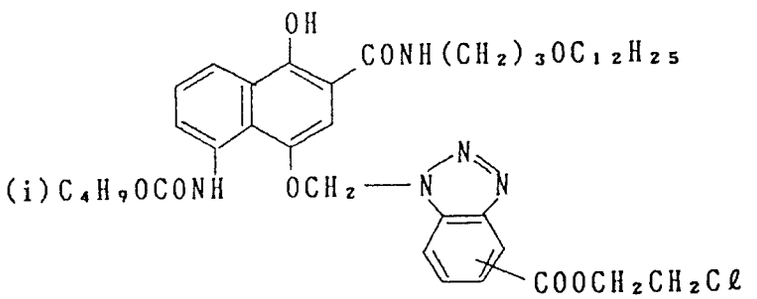

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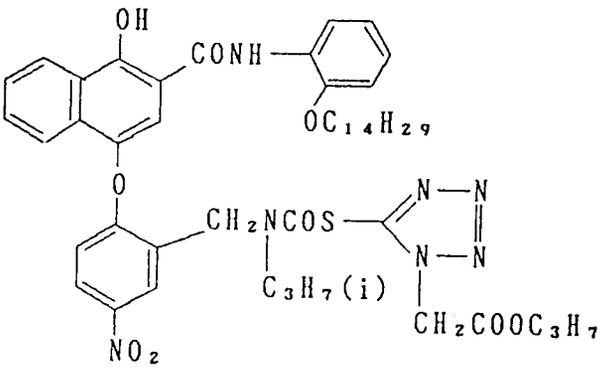

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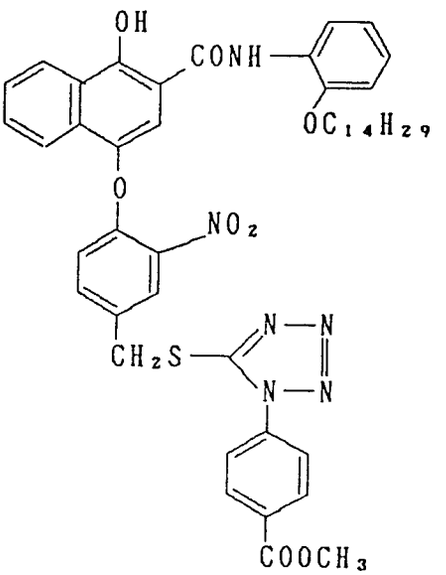

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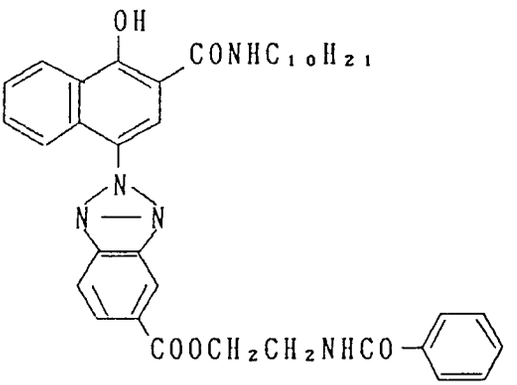

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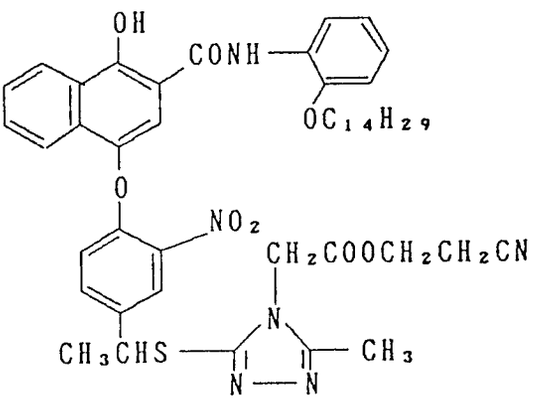

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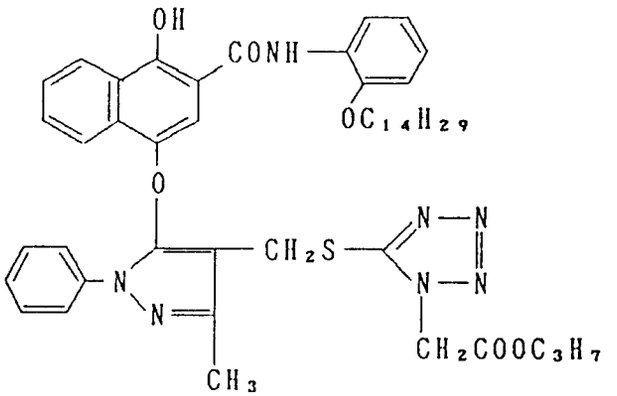

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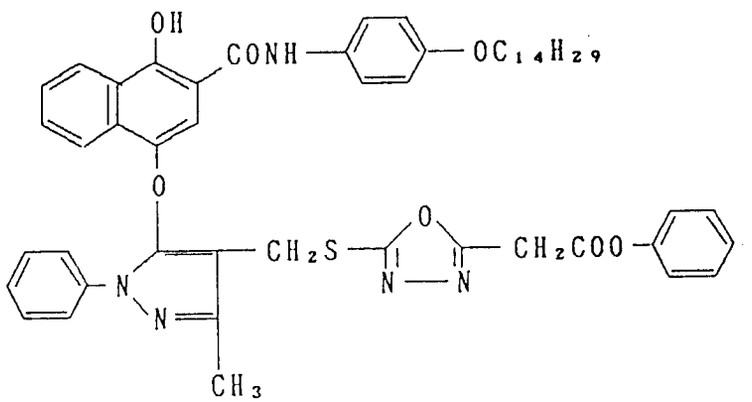

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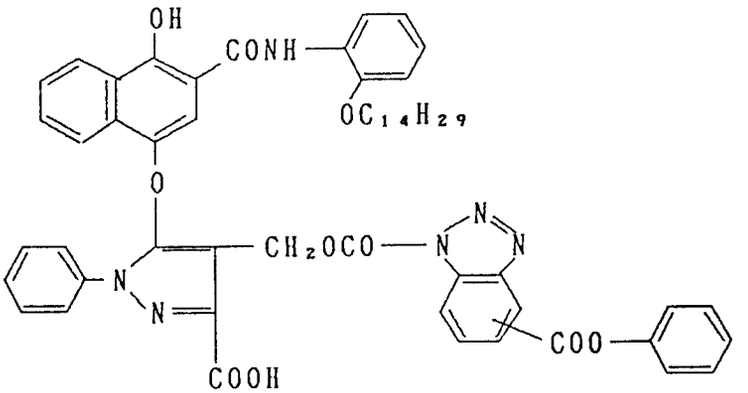

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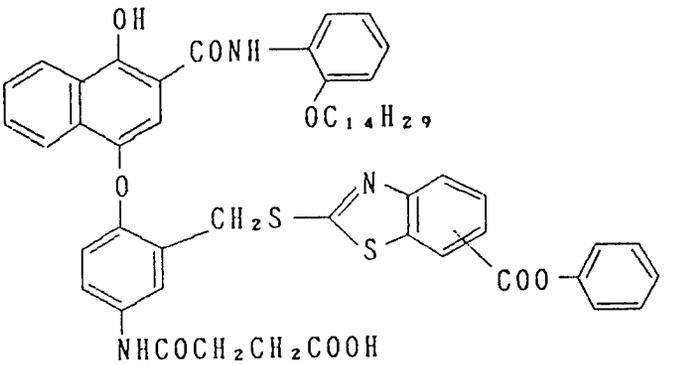

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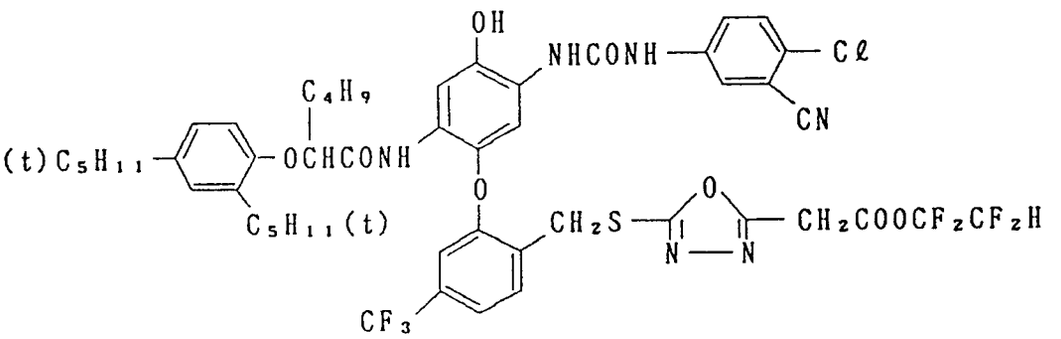

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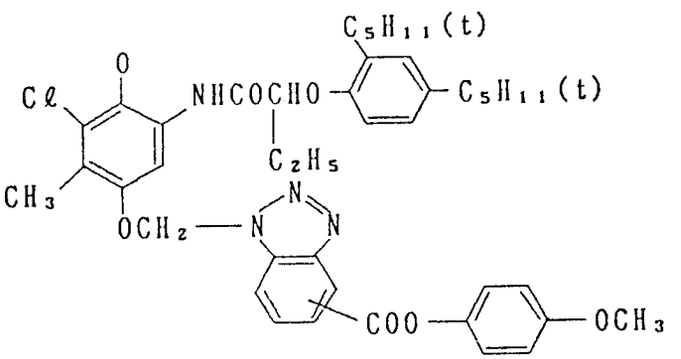

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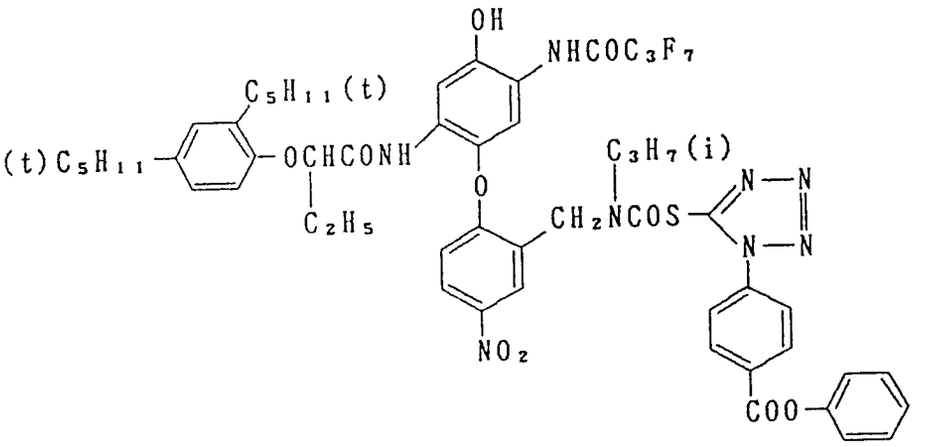

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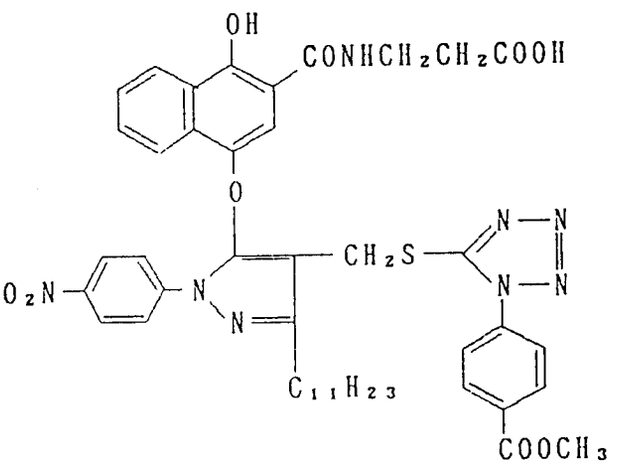

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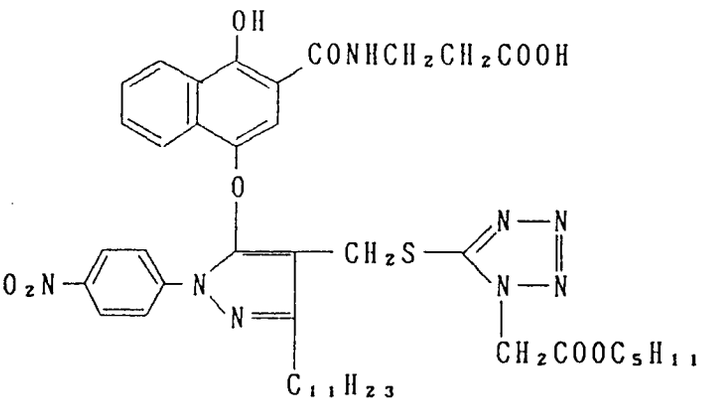

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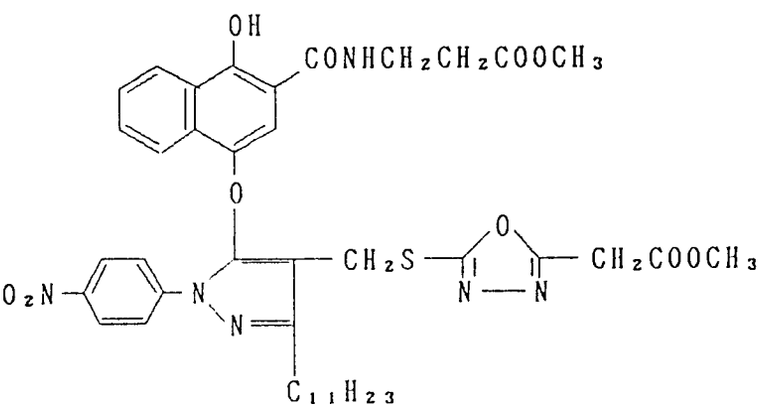

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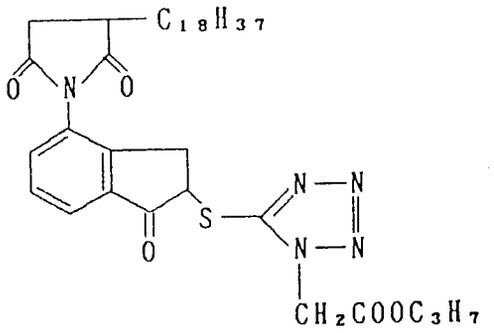

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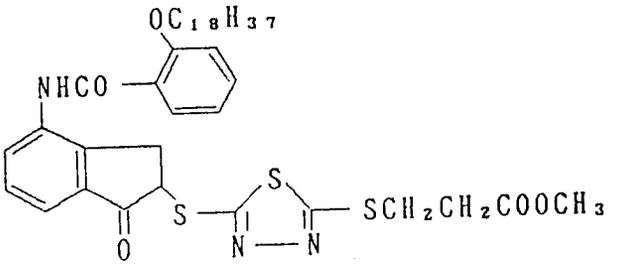

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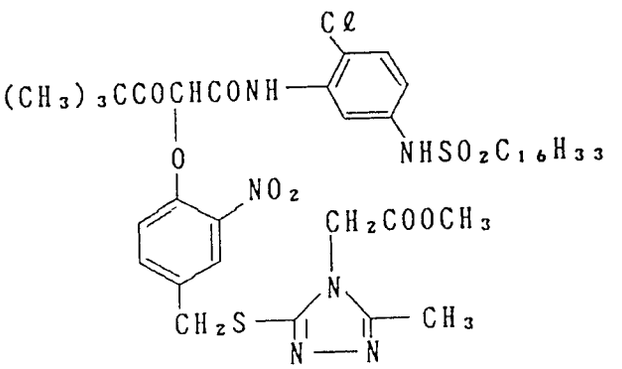

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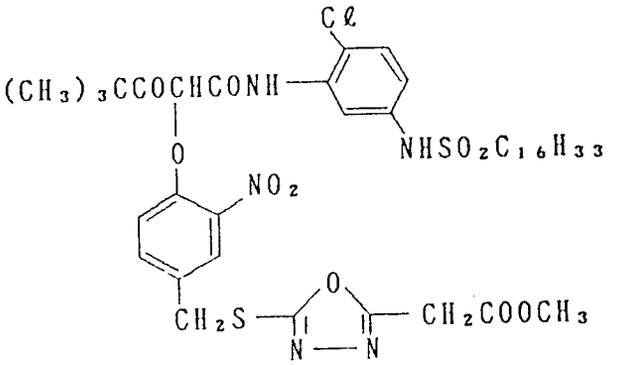

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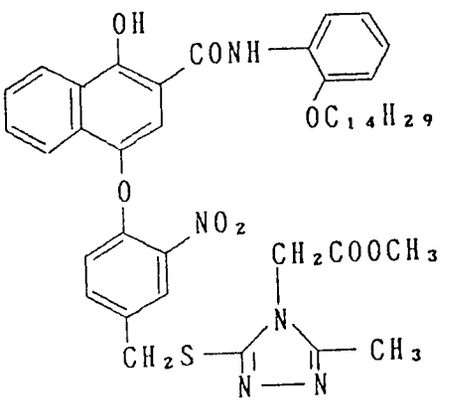

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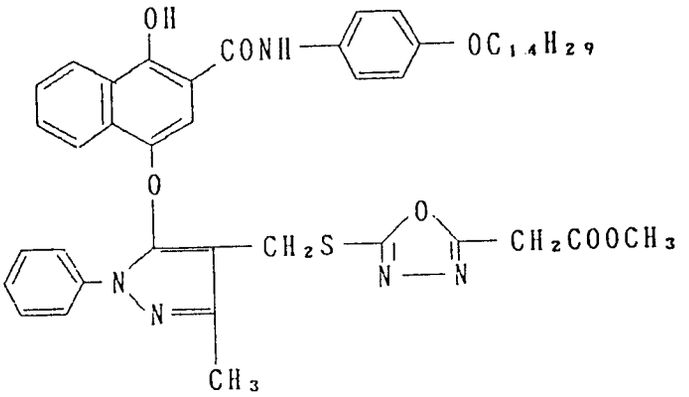

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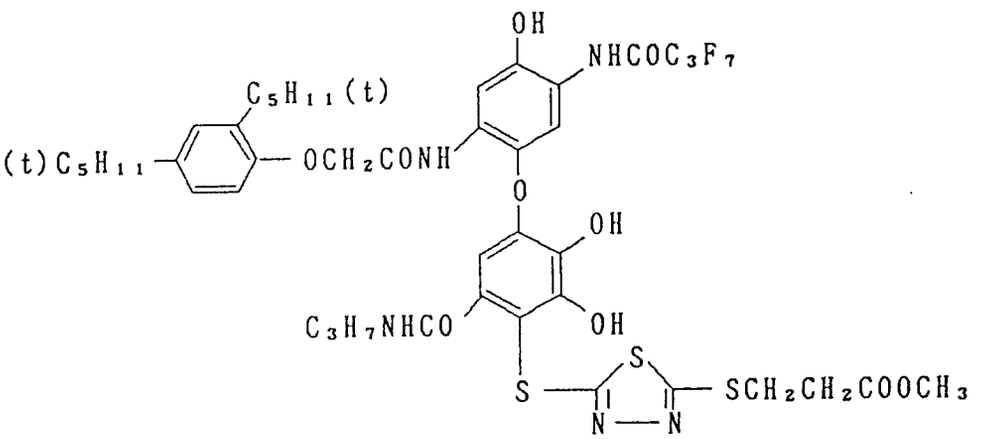


It is preferable that the developing inhibitor released from the DIR compound of the invention loses its development-inhibiting capability with a specific constant of rate. That is to say, the half-life period of the developing inhibitor at pH 10.0 is desirably less than 4 hours, more desirably less than 2 hours, and most desirably less than 1 hour.

In the invention, measurement of the half-life period of a developing inhibitor can be easily made according to the following method.

A developing inhibitor is added to a developer of the following composition to give a concentration of 1 X 10^{-4} mol/ℓ, and while maintaining the developer at 38°C, the concentration of residual developing inhibitor is determined by liquid chromatography.

Diethylenetriaminepentacetic acid	0.8 g
1-Hydroxyethylidene-1,1-diphosphonic acid	3.3 g
Sodium sulfite	4.0 g
Potassium carbonate	30.0 g
Potassium bromide	1.4 g
Potassium iodide	1.3 mg
Hydroxylamine sulfate	2.4 g
4-(N-ethyl-N-β-hydroxyethylamino) -2-methylaniline sulfate	4.5 g

Water is added to make to 1 liter, and the pH is adjusted to 10.0.

The DIR couplers of the invention are known compounds and can be easily synthesized by methods described, for example, in Japanese Pat. O.P.I. Pub. Nos. 151944/1982, 205150/1983, 218644/1985, 221750/1985, 233650/1985 and 11743/1986.

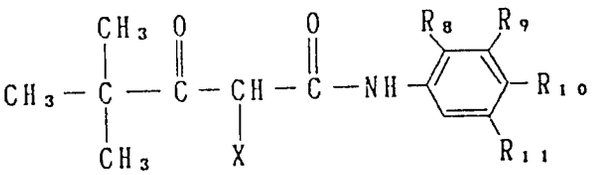
Including the above compounds, examples of the diffusible DIR coupler usable in the invention can be seen, for example, in U.S. Pat. Nos. 4,234,678, 3,227,554, 3,617,291, 3,958,993, 4,149,886, 3,933,500, 2,072,363, 2,070,266, Japanese Pat. O.P.I. Pub. Nos. 56837/1982, 13239/1976 and Research Disclosure No. 21,228 (Dec., 1981).

One or more kinds of these DIR couplers are added to a blue-sensitive emulsion layer of the light-sensitive material of the invention. The preferable amount of the DIR coupler or couplers added in the blue-sensitive emulsion layer is 0.01 to 50 mol%, more preferably 0.1 to 5 mol%, in total, per mol of silver halide contained in the emulsion layer.

In order to keep the inter-image effect on red-sensitivity within the limit of necessity, it is preferable that the DIR coupler used in the invention be one capable of coupling, as a moiety of Cd in Formula DIR-I, with an oxidation product of a color developing agent to form a cyan color.

In the invention, it is preferable that the yellow coupler used in the blue-sensitive layer contain 50% or more of the compound expressed by the following Formula [YP], for preventing a sensitivity drop of said layer caused by addition of a DIR compound.

Formula [YP]

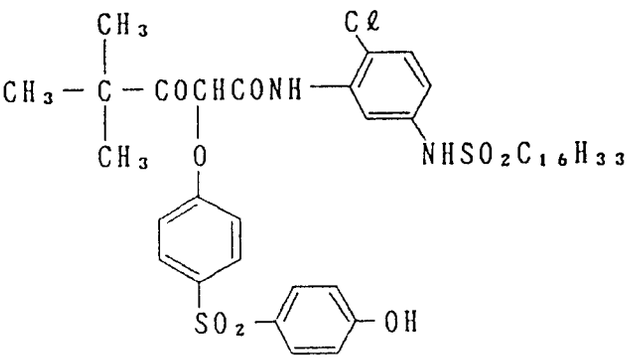


In Formula [YP], R_8 is a hydrogen or halogen atom, or an alkoxy group, and preferably a halogen atom. R_9, R_{10} and R_{11} each represent a hydrogen or halogen atom, or an alkyl, alkenyl, alkoxy, aryl, carboxyl, alkoxycarbonyl, carbamoyl, sulfone, sulfamoyl, alkylsulfonamido, acylamido, ureido or amino group; and it is preferable that R_9 and R_{10} be each a hydrogen atom and R_{11} be an alkoxycarbonyl, acylamido or alkylsulfonamido group. X represents a hydrogen atom or a substituent capable of spliting off upon reaction with an oxidation product of a color developing agent.

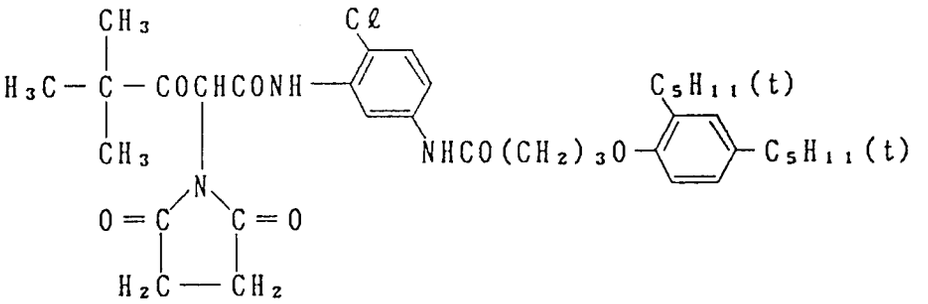
Typical examples of the compound are illustrated below, but useful examples are not limited to them.

(Y P − 1)

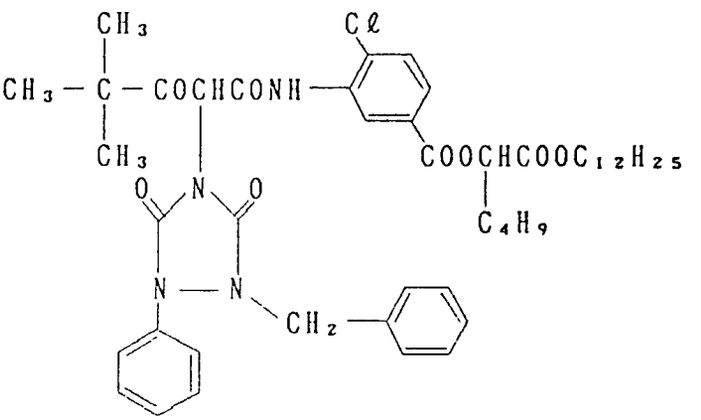
(Y P − 2)



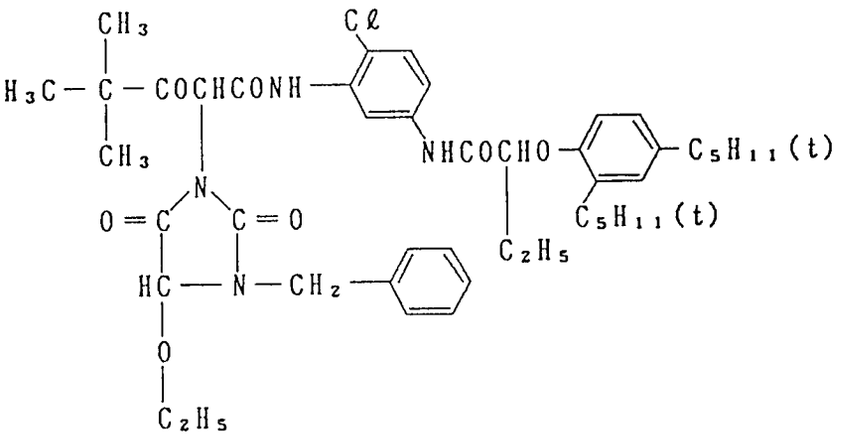
(Y P − 3)



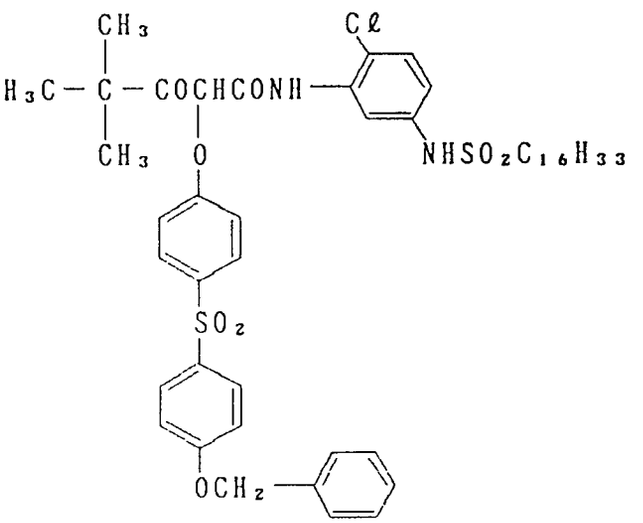
(Y P − 4)



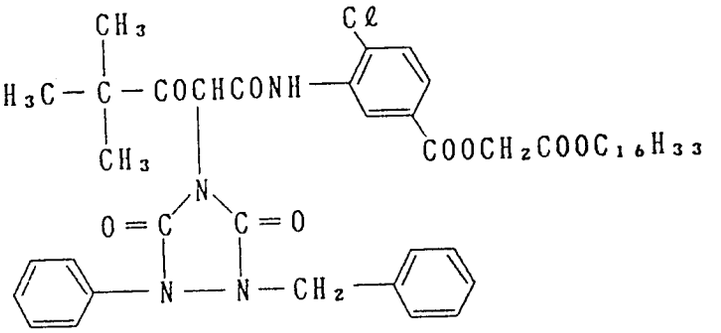
(Y P − 5)



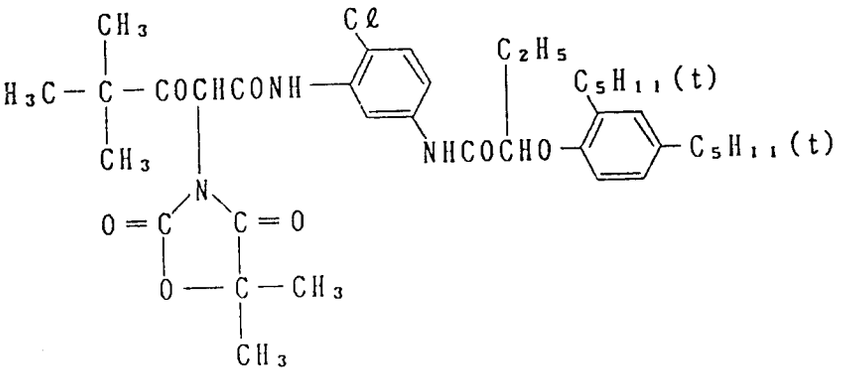
(Y P − 6)



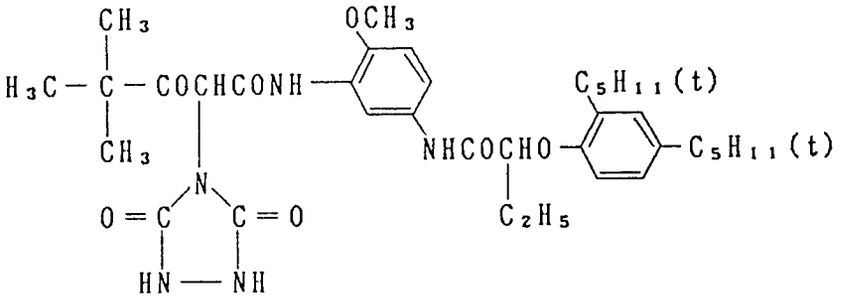
(YP－7)



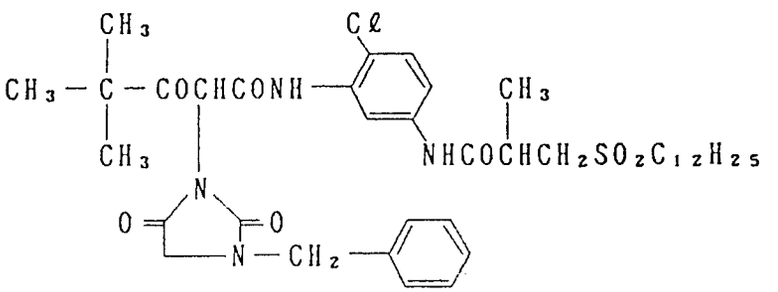
(YP－8)



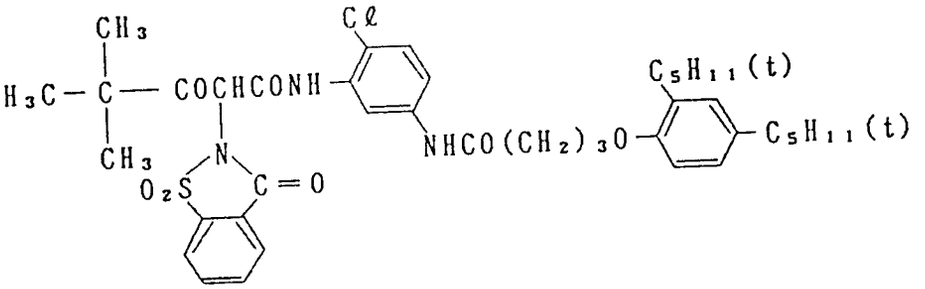
(YP-9)



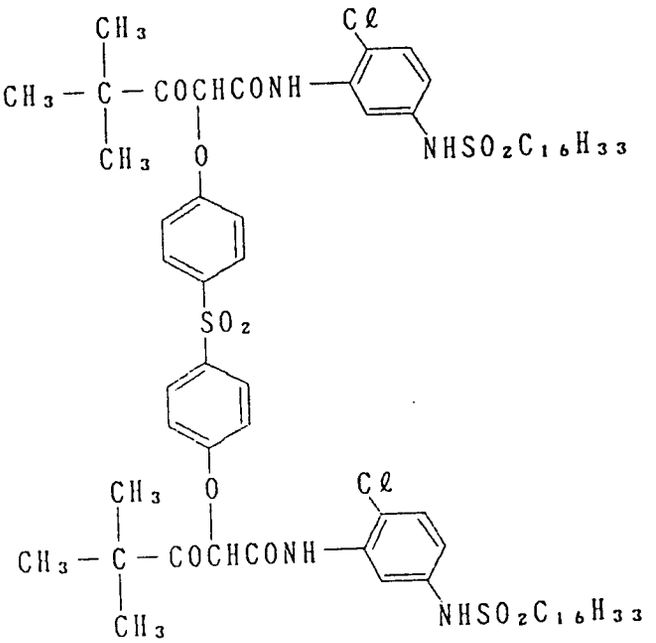
(YP-10)



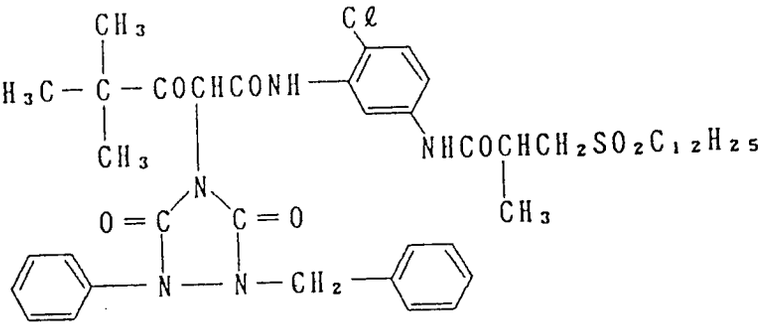
(YP-11)



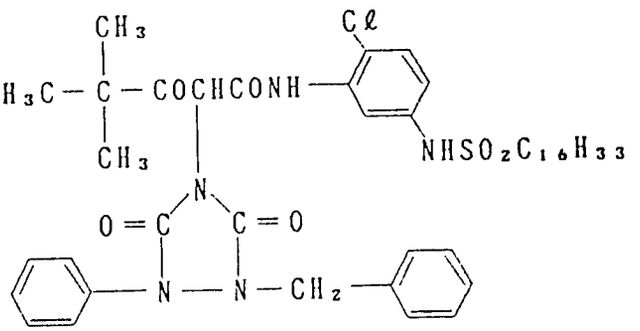
(YP-12)



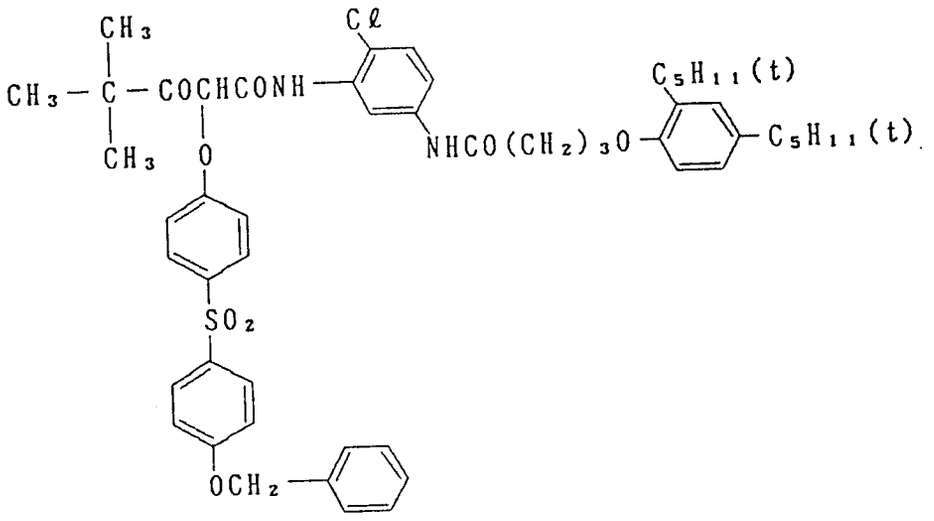
(YP-13)



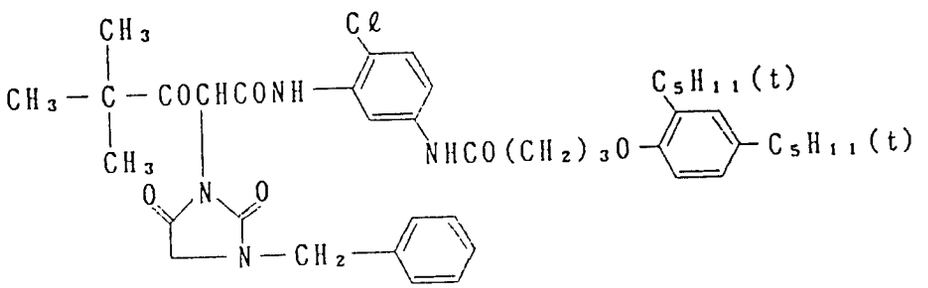
(YP-14)



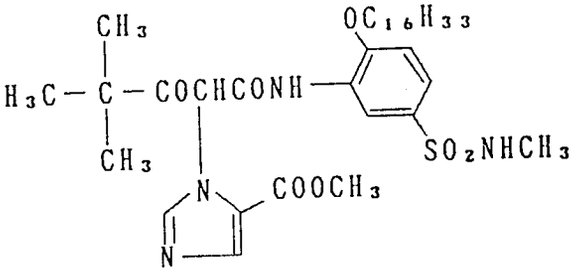
(YP-15)



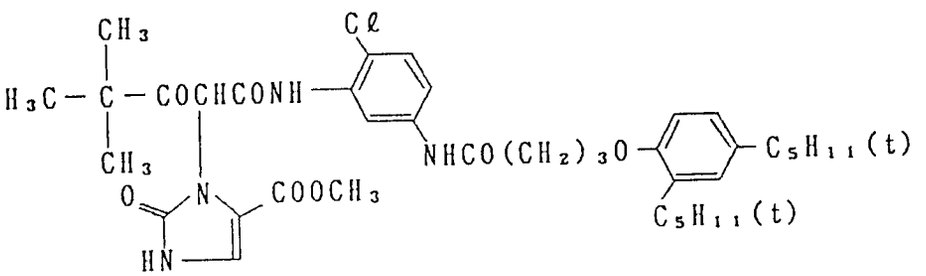
(YP-16)



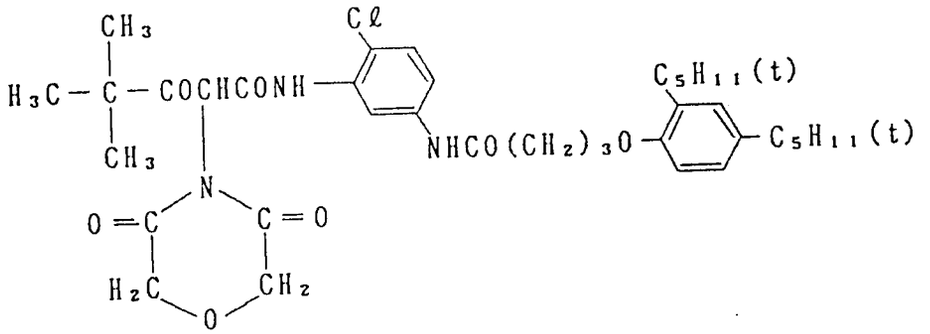
(YP-17)



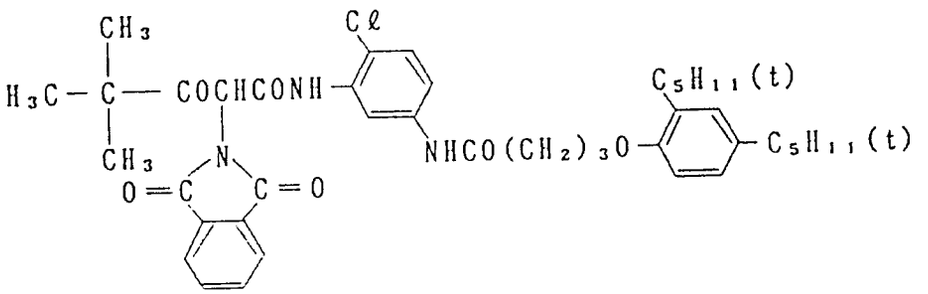
(YP-18)



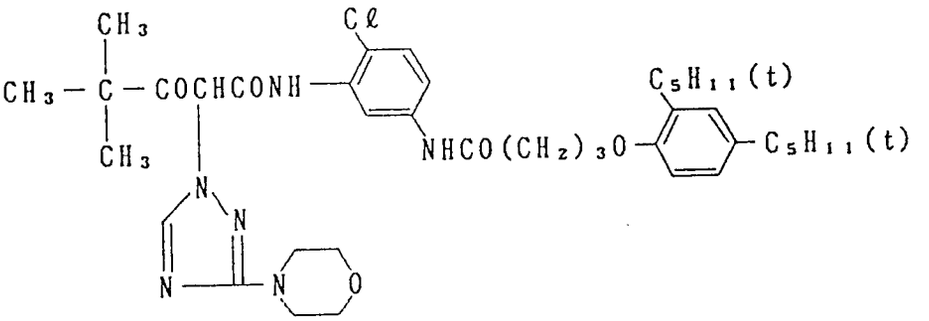
(YP-19)



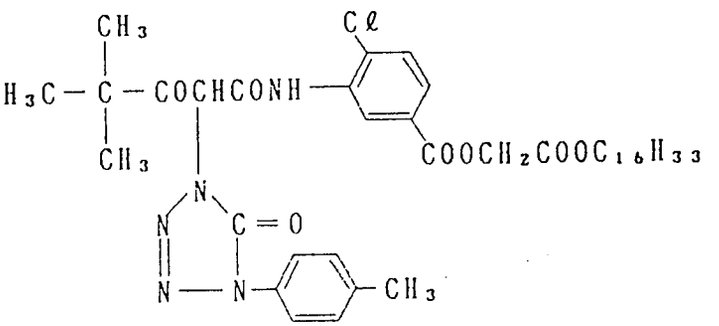
(YP-20)



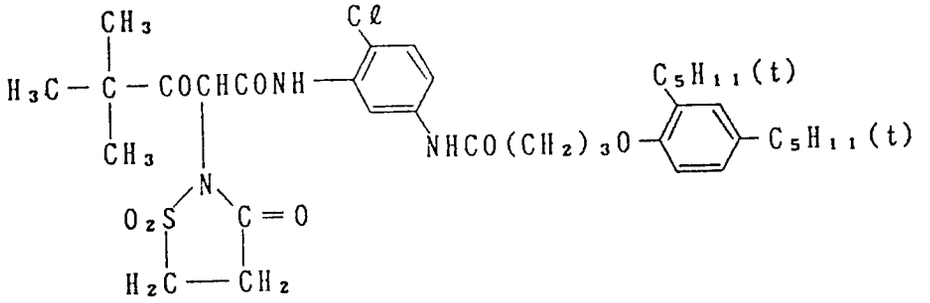
(YP-21)



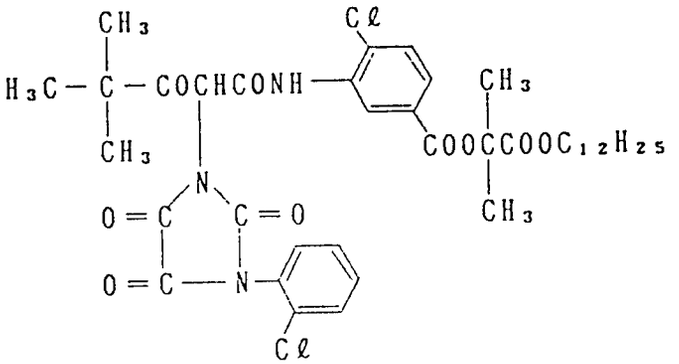
(YP-22)



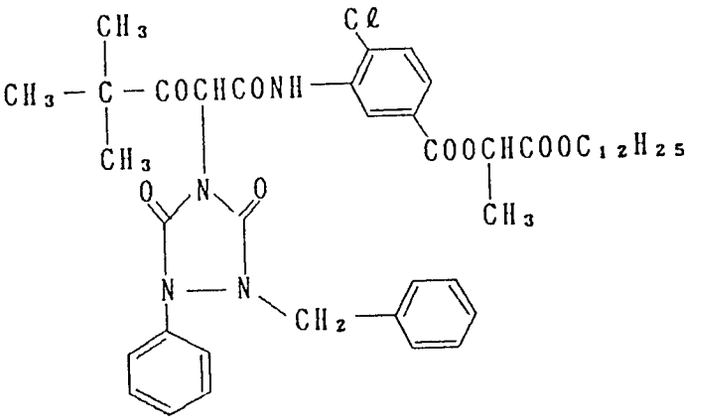
(YP-23)



(YP-24)



(YP-25)



In addition to the foregoing, there may also be utilized the couplers described in British Pat. No. 1,077,874, Japanese Pat. Exam. Pub. No. 40757/1970, Japanese Pat. O.P.I. Pub. Nos. 1031/1972, 26133/1972, 94432/1973, 87650/1975, 3631/1976, 115219/1977, 99433/1979, 133329/1979, 30127/1981 and

U.S. Pat. Nos. 2,875,057, 3,253,924, 3,265,506, 3,408,194, 3,551,155, 3,551,156, 3,664,841, 3,725,072, 3,730,722, 3,891,445, 3,900,483, 3,929,484, 3,933,500, 3,973,968, 3,990,896, 4,012,259, 4,022,620, 4,029,508, 4,057,432, 4,106,942, 4,133,958, 4,269,936, 4,286,053, 4,304,845, 4,314,023, 4,336,327, 4,356,258, 4,386,155 and 4,401,752.

To incorporate the compound represented by Formula [YP] and a jointly usable coupler in a silver halide emulsion layer, there may be used conventional methods, for example, one described in U.S. Pat. No. 2,322,027. Further, there may also be employed a dispersing method with aid of a polymer described in Japanese Pat. Exam. Pub. No. 39853/1976 and Japanese Pat. O.P.I. Pub. No. 59943/1976.

Silver halide emulsions used in the invention may have any of silver halide compositions used in ordinary silver halide emulsions, but silver bromide, silver iodobromide and silver chloroiodobromide are preferred.

Silver halide grains contained in the silver halide emulsion may be prepared by any of the acid method, neutral method and ammonia method. Said grains may be grown at a time, or may be grown after preparing seed grains. The method of preparing seed grains and that of growing seed grains may be the same or different.

Silver halide emulsions used in the color photographic light-sensitive material of the invention may be chemically sensitized by a conventional method.

The silver halide emulsion may use an antifoggant, stabilizer, etc. Gelatin is preferably used as a binder of said emulsion, but not limited to it.

Emulsion layers and other hydrophilic colloid layers may be hardened, or may contain a plasticizer and a dispersion or latex of water-insoluble or slightly water-soluble synthetic polymer.

The present invention is favorably applied to color negative film and color reversal film.

In general, a color-forming coupler is used in the emulsion layer of a color photographic light-sensitive material according to the invention.

Moreover, there may be arbitrarily used a colored coupler having a correction function, a competitive coupler, and a chemical substance capable of releasing, on coupling with an oxidation product of a developing agent, a photographically useful fragment such as developing accelerator, bleaching accelerator, developer, silver halide solvent, toning agent, hardener, fogging agent, antifoggant, chemical sensitizer, spectral sensitizer or desensitizer.

The light-sensitive material may have auxiliary layers such as a filter layer, antihalation layer and anti-irradiation layer. In these auxiliary layers and/or in emulsion layers, there may be contained a dye capable of being washed away or bleached in the course of development.

The light-sensitive material may contain a formalin scavenger, fluorescent brightening agent, matting agent, rublicant, image stabilizer, surfactant, antistain agent, developing accelerator, developing retardant and bleaching accelerator.

As a support, there may be used any of polyethylene-laminated paper, polyethylene terephthalate film, baryta paper and triacetyl cellulose film.

The color photographic light-sensitive material of the invention forms dye images thereon by being subjected to conventional color photographic processing after exposure.

EXAMPLES

In all the following examples, the addition amounts in silver halide light-sensitive materials are given in grams per square meter, unless otherwise specified. The amounts of silver halides or colloidal silvers are shown in amounts of silver present. The amounts of sensitizing dyes are in mol per mol of silver halide in the same layer. Sample 101 of multilayer color photographic light-sensitive material was prepared by forming the following layers in sequence on a triacethyl cellulose film support. Sample 101

1st layer: antihalation layer	
Black colloidal silver	0.20
UV absorbent (UV-1)	0.20
High boiling solvent (Oil-1)	0.20
Gelatin	1.40

2nd layer: intermediate layer	
Gelatin	1.30

3rd layer: low-speed red-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm, average silver iodide content: 7 mol%)	0.80
Sensitizing dye (SD-1)	3.0×10^{-4}
Sensitizing dye (SP-2)	4.0×10^{-4}
Cyan coupler (C-1)	0.45
Colored cyan coupler (CC-1)	0.06
DIR compound (DD-1)	0.05
High boiling solvent (Oil-1)	0.50
Gelatin	0.90

4th layer: intermediate layer	
Gelatin	1.00

5th layer: high-speed red-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm, average silver iodide content: 7 mol%)	1.20
Sensitizing dye (SD-1)	2.5×10^{-4}
Sensitizing dye (SD-2)	3.5×10^{-4}
Cyan coupler (C-1)	0.15
Colored cyan coupler (CC-1)	0.02
DIR compound (DD-1)	0.08
High boiling solvent (Oil-1)	0.25
Gelatin	0.90

6th layer: intermediate layer	
Antistain agent (SC-1)	0.10
High boiling agent (Oil-2)	0.10
Gelatin	1.00

7th layer: low-speed green-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm, average silver iodide content: 7 mol%)	0.80
Sensitizing dye (SD-2)	1.0×10^{-4}
Sensitizing dye (SD-3)	9.0×10^{-4}
Magenta coupler (M-1)	0.53
Colored magenta coupler (CM-1)	0.09
DIR compound (DD-2)	0.01
DIR compound (DD-3)	0.03
High boiling solvent (Oil-2)	0.70
Gelatin	1.30

8th layer: high-speed green-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm, average silver iodide content: 7 mol%)	0.90
Sensitizing dye (SD-4)	3.5×10^{-4}
Sensitizing dye (SD-5)	2.0×10^{-4}
Magenta coupler (M-1)	0.17
Colored magenta coupler (CM-1)	0.06
DIR compound (DD-2)	0.04
DIR compound (DD-3)	0.01
High boiling solvent (Oil-2)	0.40
Gelatin	0.80

9th layer: yellow filter layer	
Yellow colloidal silver	0.10
Antistain agent (SC-1)	0.10
High boiling solvent (Oil-2)	0.10
Gelatin	1.00

10th layer: low-speed blue-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm, average silver iodide content: 7 mol%)	0.50
Sensitizing dye (SD-6)	8.0×10^{-4}
Yellow coupler (YP-4)	0.95
DIR compound (DD-4)	0.05
High boiling solvent (Oil-2)	0.10
Gelatin	0.50

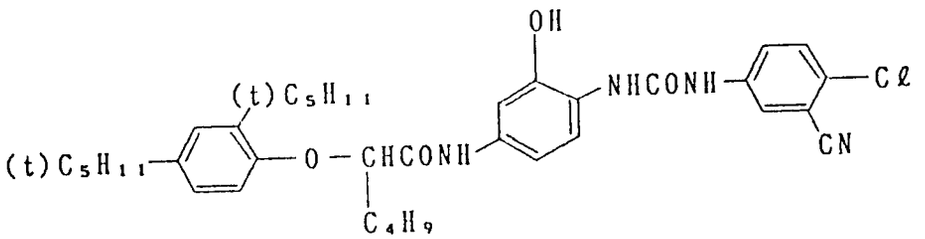
11th layer: high-speed blue-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm, average silver iodide content: 7 mol%)	0.50
Sensitizing dye (SD-6)	6.0×10^{-4}
Yellow coupler (YP-4)	0.20
DIR compound (DD-4)	0.01
High boiling solvent (Oil-2)	0.02
Gelatin	0.40

12th layer: 1st protective layer	
Fine grain silver iodobromide emulsion (average grain size: 0.08 μm)	0.20
UV absorbent (UV-1)	0.07
UV absorbent (UV-2)	0.10
High boiling solvent (Oil-1)	0.07
High boiling solvent (Oil-3)	0.07
Gelatin	0.60

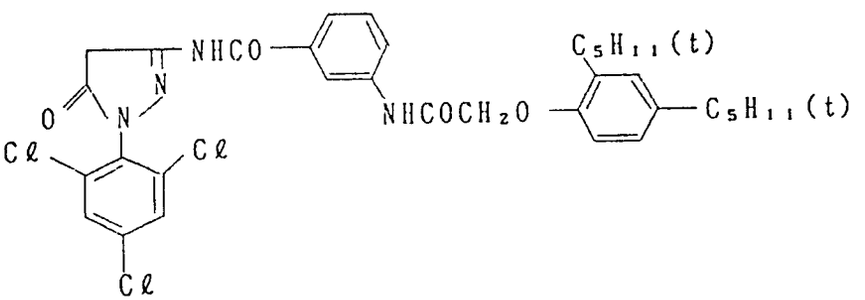
13th layer: 2nd protective layer	
Alkali-soluble matting agent (average grain size: 2 μm)	0.15
Polymethylmethacrylate (average grain size: 3 μm)	0.04
Slipping agent (Wax-1)	0.04
Gelatin	0.60

The materials used in the preparation of the above sample were as follows:

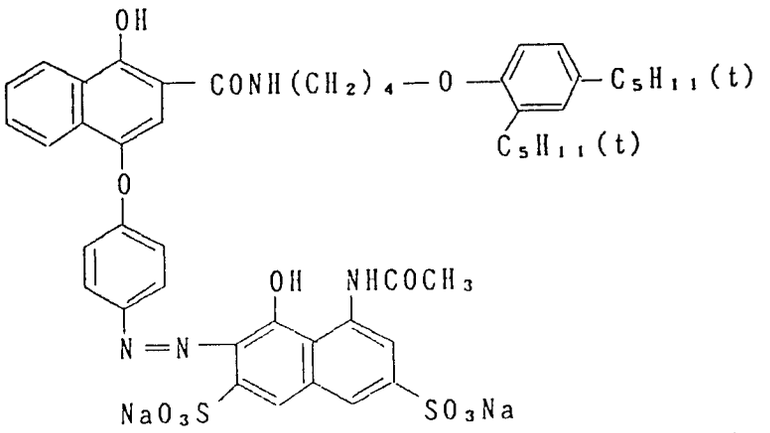
C-1



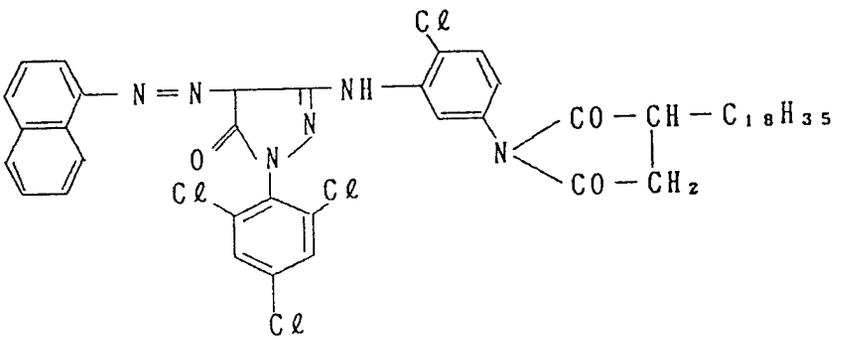
M-1



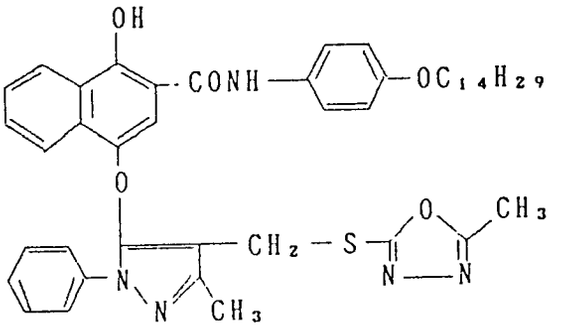
CC-1



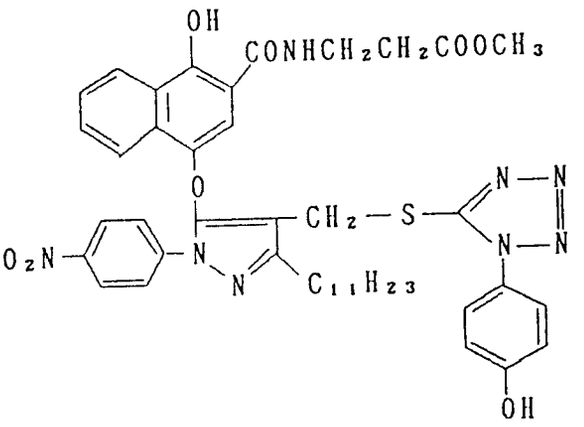
CM-1



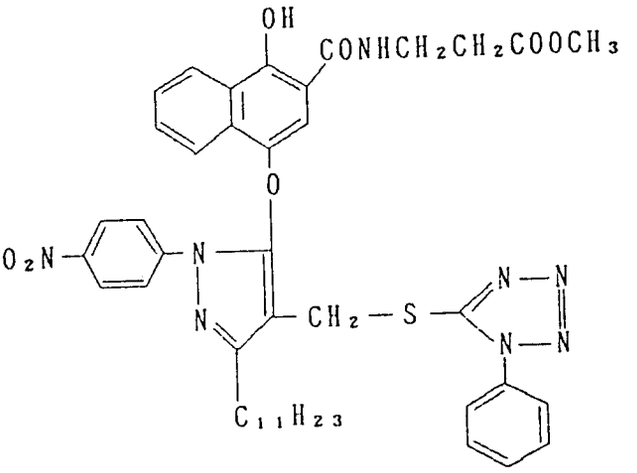
DD-1



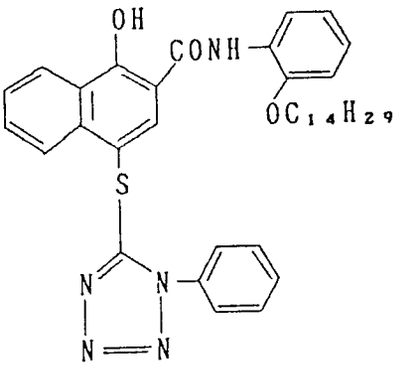
DD-2



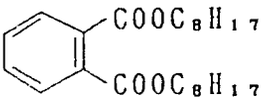
DD-3



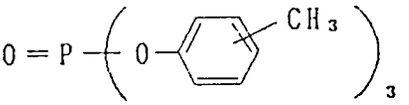
DD-4



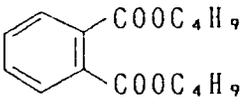
Oil-1



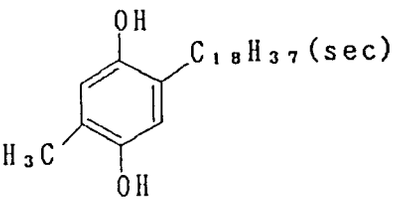
Oil-2



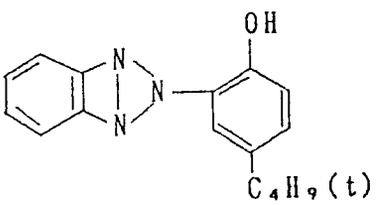
Oil-3



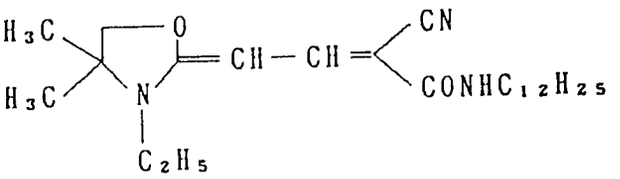
SC-1



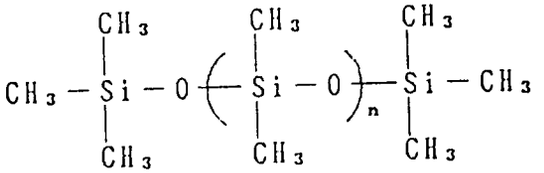
UV-1



UV-2

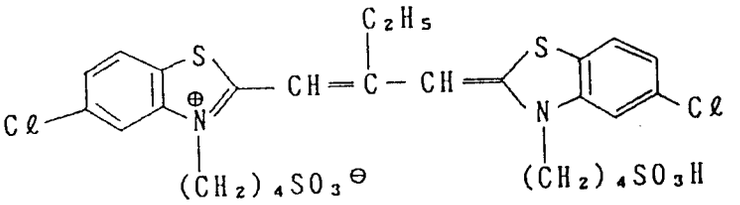


WAX-1

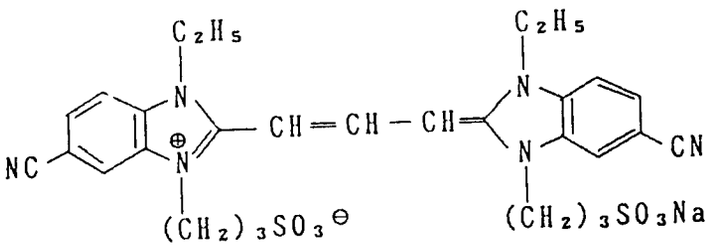


weight average molecular weight = 3,000

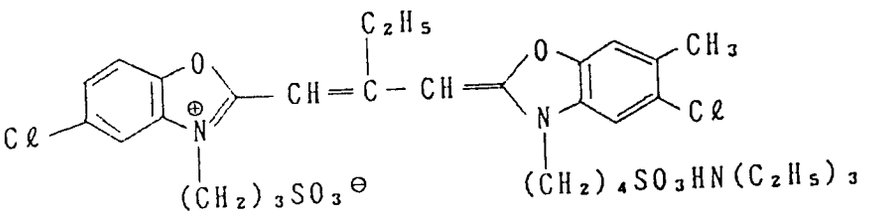
S D − 1



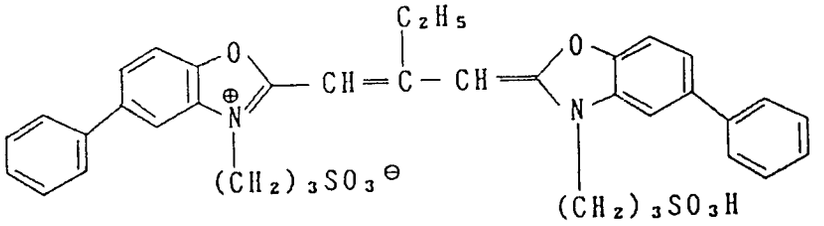
S D − 2



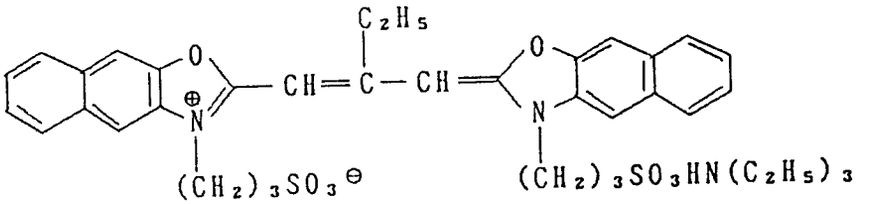
S D − 3



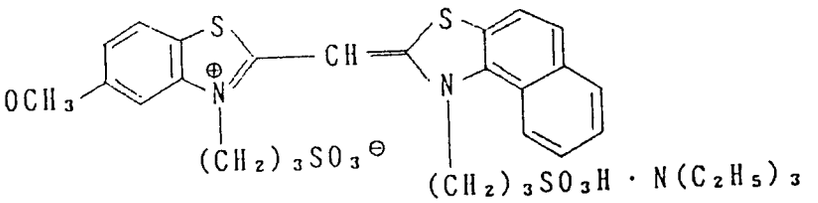
S D − 4



S D − 5

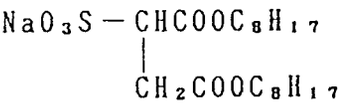


S D − 6

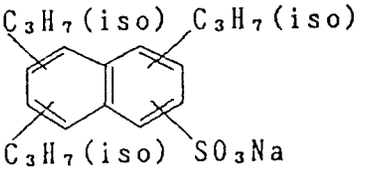


In addition to the above compounds, coating aid (Su-1), dispersant (Su-2), viscosity regulator, hardeners (H-1, H-2), stabilizer (ST-1) and antifoggants (AF-1, $\overline{Mw}$: 100,000; AF-2, $\overline{Mw}$: 1,100,000) were added.

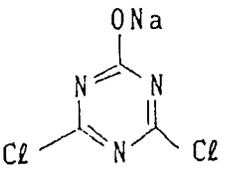
Su－1



Su－2



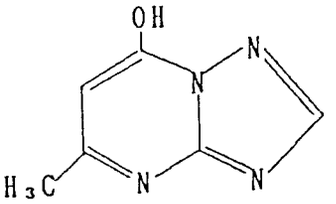
H－1



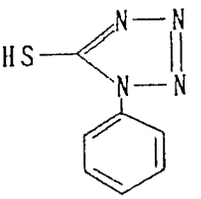
H－2

$(CH_2=CHSO_2CH_2)_2O$

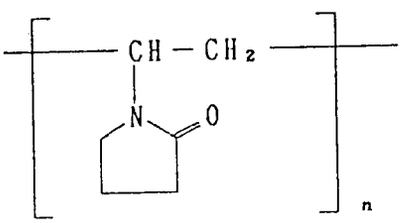
S T − 1



A F − 1



A F − 2



n = degree of polymerization

Samples 102 to 107 were prepared in the same manner as in sample 101, except that sensitizing dyes and DIR compounds used in the blue sensitive layers were changed as shown in Table 1.

After photographing a color rendition chart made by Macbeth company using samples 101 to 107, color development was performed under the following processing condition 1. Processing condition 1

Processing (at 38 ° C)	
Color developing	3 min and 10 sec
Bleaching	6 min and 30 sec
Washing	3 min and 15 sec
Fixing	6 min and 30 sec
Washing	3 min and 15 sec
Stabilizing	1 min and 30 sec
Drying	

Compositions of processing solutions used are as follows:

(Color developer)	
4-Amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)anilinesulfate	4.75 g
Anhydrous sodium sulfite	4.25 g
Hydroxylaminel/2sulfate	2.0 g
Anhydrous potassium carbonate	37.5 g
Sodium bromide	1.3 g
Trisodium nitrilotriacetate (monohydrate)	2.5 g
Potassium hydroxide	1.0

Water is added to make up to 1 liter (pH = 10.1).

(Bleaching solution)	
Ammonium ferric ethylenediaminetetracetate	100.0 g
Diammonium ethylenediaminetetracetate	10.0 g
Ammonium bromide	150.0 g
Glacial acetic acid	10.0 mℓ

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with an aqueous ammonia.

(Fixer)	
Ammonium thiosulfate	175.0 g
Anhydrous sodium sulfite	8.5 g
Sodium metasulfite	2.3 g

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with acetic acid.

(Stabilizer)	
Formalin (37% aqueous solution)	1.5 mℓ
Konidax (product of Konica Corp.)	7.5 mℓ

Water is added to make up to 1 liter.

Using color paper (Konica Color PC Paper Type SR), prints were made from respective developed sample films so as to make gray of optical density 0.7 give the same density. Then, the hue reproducibility was evaluated on each sample.

On the other hand, spectral sensitivity distribution of blue-sensitive layer was measured in the goregoing method in which the spectral sensitivity was determined based on the exposure amount necessary for forming a density of the minimum density plus 0.1. And the maximum value of the spectral sensitivity, hereunder referred to as a maximum sensitivity, and the sensitivity for light of 480 nm, hereunder referred to as a sensitivity at 480 nm, were compared in the spectral sensitivity distribution with respect to each sample. The comparison of the sensitivities was expressed by a value calculated by the following equation.

$$\frac{\text{Maximum sensitivity}}{\text{Sensitivity at 480 nm}} \times 100\ (\%)$$

The evaluation results on these two items are shown in Table 1. In the column of maximum sensitivity wavelength of the table, a wavelength to give a maximum sensitivity an a spectral sensitivity distribution of blue-sensitive layer's minimum density + 0.1 is recorded.

Table 1

Sample No.	Contents of blue-sensitive layer		Evaluation results			
	Sensitizing dye	DIR compound	Maximum sensitivity wavelength (nm)	Maximum sensitivity / Sensitivity at 480 nm	Yellow reproducibility	Green reproducibility
101	SD-6	DD-4	476	1.2	D	D
102	SD-6	D-25	476	1.2	C	C
103	A-7	DD-4	455	2.3	C	B
104	A-7	No addition	455	2.3	C	B
105	A-7	D-26	455	2.3	B	B
106	A-7	D-25	455	2.3	B	A
107	A-7	D-20	455	2.3	A	A

A: very good B: good
C: insufficient D: poor

The diffusivities of compounds D-26, D-25 and D-20 of the invention are 0.52, 0.36 and 0.48, respectively. D-20 is a compound represented by General Formula DIR-II and has a half-life period of 60 seconds.

Example 2

Sample 201 of multilayer color photographic light-sensitive material was prepared by forming the following layers in sequence on a triacethyl cellulose film support. In sample 201, the compositions of the 1st, 2nd, 4th, 6th, 12th and 13th layers were the same as those in Example 1.

3rd layer: low-speed red-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm)	0.80
Sensitizing dye SD-7	3.0×10^{-4}
Sensitizing dye SD-8	4.0×10^{-4}
Cyan coupler C-1	0.45
Colored cyan coupler CC-1	0.06
High boiling solvent Oil-1	0.50
Gelatin	0.90

5th layer: high-speed red-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm)	1.20
Sensitizing dye SD-7	2.5×10^{-4}
Sensitizing dye SD-8	3.5×10^{-4}
Cyan coupler C-1	0.15
Colored cyan coupler CC-1	0.02
DIR compound D-20	0.17
High boiling solvent Oil-1	0.25
Gelatin	0.90

7th layer: low-speed green-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm)	0.80
Sensitizing dye SD-2	1.0×10^{-4}
Sensitizing dye SD-3	9.0×10^{-4}
Magenta coupler M-1	0.53
Colored magenta coupler CM-1	0.09
DIR compound DD-3	0.01
DIR compound DD-2	0.03
High boiling solvent Oil-2	0.70
Gelatin	1.30

8th layer: high-speed green-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm)	0.90
Sensitizing dye SD-4	3.5×10^{-4}
Sensitizing dye SD-5	2.0×10^{-4}
Magenta coupler M-1	0.17
Colored magenta coupler CM-1	0.06
DIR compound DD-3	0.04
DIR compound DD-2	0.01
High boiling solvent Oil-2	0.40
Gelatin	0.80

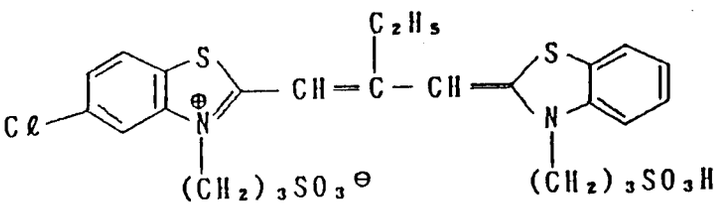
10th layer: low-speed blue-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.27 μm)	0.50
Sensitizing dye A-7	8.0×10^{-4}
Yellow coupler YP-4	0.95
DIR compound D-20	0.07
High boiling solvent Oil-2	0.10
Gelatin	0.50

11th layer: high-speed blue-sensitive emulsion layer	
Silver iodobromide (average grain size: 0.38 μm)	0.50
Sensitizing dye A-7	6.0×10^{-4}
Yellow coupler YP-4	0.20
High boiling solvent Oil-2	0.02
Gelatin	0.40

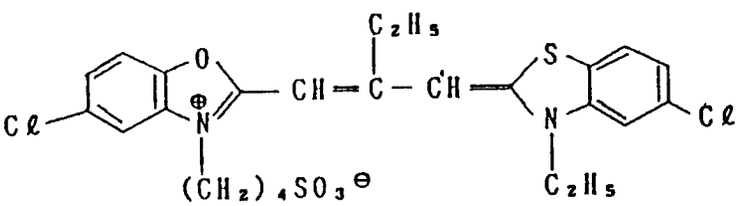
Samples 202 to 208 were prepared in the same manner as in sample 201, except that DIR compounds in the 5th and 10th layers as well as sensitizing dyes in the 10th and 11th layers were changed as shown in Table 2.

Materials used in these samples were the same as those used in Example 1, except the following sensitizing dyes SD-7 and SD-8.

SD-7



SD-8



Besides the above compounds, there were also added in these samples coating aid Su-1, dispersant Su-2, viscosity regulator, hardeners H-1 and H-2, stabilizer ST-1 and antifoggants AF-1 ($\overline{Mw}$: 100,000) and AF-2 ($\overline{Mw}$: 1,100,000).

Table 2

Sample No.	DIR compound (5th layer)	DIR compound (10th layer)	Sensitizing dye (10th and 11th layers)
201	D-20	D-20	A-7
202	-	D-20	A-7
203	D-38	D-38	A-7
204	-	D-38	A-7
205	D-20	D-20	SD-6
206	-	D-20	SD-6
207	-	-	A-7
208	-	-	SD-6

The wavelength to give a maximum spectral sensitivity to blue sensitive layers sensitized with sensitizing dye A-7 according to the invention, namely the 10th and 11th layers, was 435 nm, and the spectral sensitivity at a density higher than the blue-sensitive layer's minimum density by 0.1 at 480 nm was 40% of the maximum sensitivity of the blue-sensitive layer. Further, a maximum spectral sensitivity of a blue-sensitive layer sensitized with SD-6 was at 480 nm.

Using each of the samples 201 to 208 prepared as above, a color rendition chart made by Macbeth Company was photographed. Then, the samples were processed under the following processing condition 2.

Processing condition 2

Processing (at 38 ° C)	
Color developing	3 min and 15 sec
Bleaching	6 min and 30 sec
Washing	3 min and 15 sec
Fixing	6 min and 30 sec
Washing	3 min and 15 sec
Stabilizing	1 min and 30 sec

Compositions of processing solutions used are as follows:

(Color developer)	
4-Amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)anilineüEsulfate	4.8 g
Anhydrous sodium sulfite	0.14 g
HydroxylamineüE1/2sulfate	1.98 g
Sulfuric acid	0.74 g
Anhydrous potassium carbonate	28.35g
Anhydrous potassium hydrogencarbonate	3.46 g
Anhydrous potassium sulfite	5.10 g
Potassium bromide	1.16 g
Sodium chloride	0.14 g
Trisodium nitrilotriacetate (monohydrate)	1.20 g
Potassium hydroxide	1.48 g

Water is added to make up to 1 liter.

(Bleaching solution)	
Ammonium ferric ethylenediamine tetracetate	100.0 g
Diammonium ferric ethylenediamine tetracetate	10.0 g
Ammonium bromide	150.0 g
Glacial acetic acid	10.0 mℓ

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with an aqueous ammonia.

(Fixer)	
Ammonium thiosulfate	175.0 g
Anhydrous sodium sulfite	8.6 g
Sodium metasulfite	2.3 g

Water is added to make up to 1 liter, and the pH is adjusted to 6.0 with acetic acid.

(Stabilizer)	
Formalin (37% aqueous solution)	1.5 mℓ
Konidax (product of Konica Corp.)	7.5 mℓ

Water is added to make up to 1 liter.

Using color paper (Konica Color PC Paper Type SR), prints were made from respective developed sample films so as to make gray of optical density 0.7 give the same density. Then, the reproduced color of each print was measured with a color analyzer (Model CWS-1200 made by Murakami Shikisai), the results are shown in Fig. 1 in the L* a* b* color system.

Further, there was examined, using samples 201 to 208, the influence exerted on developing properties of a developer in continuous processing with an automatic developing machine. The examination was conducted under processing condition 3 shown below.

Processing condition 3

Processing (at 38 ° C)	
Color developing	3 min and 15 sec
Bleaching	45 sec
Fixing	1 min and 45 sec
Stabilizing	1 min and 30 sec

Compositions of processing solutions used are as follows:

(Color developer)	
Potassium carbonate	30 g
Sodium hydrogencarbonate	2.7 g
Potassium sulfite	2.8 g
Sodium bromide	1.3 g
Hydroxylamine sulfate	3.2 g
Sodium chloride	0.6 g
4-Amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)anilinesulfate	4.6 g
Diethylenetriamine pentacetic acid	3.0 g
Potassium hydroxide	1.3 g

Water is added to make up to 1 liter, and the pH is adjusted to 10.01 with potassium hydroxide or a

20% sulfuric acid.

(Color developer replenisher)	
Potassium carbonate	40 g
Sodium hydrogencarbonate	3 g
Potassium sulfite	7 g
Sodium bromide	0.5 g
Hydroxylamine sulfate	3.2 g
4-Amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)anilinesulfate	6.0 g
Diethylenetriamine pentacetic acid	3.0 g
Potassium hydroxide	2 g

Water is added to make up to 1 liter, and the pH is adjusted to 10.12 with potassium hydroxide or a 20% sulfuric acid.

(Bleaching solution)	
Ammonium ferric 1,3-diaminopropanetetracetate	0.35 mol
Diammonium ethylenediaminetetracetate	2 g
Ammonium bromide	150 g
Glacial acetic acid	40 mℓ
Ammonium nitrate	40 g

Water is added to make up to 1 liter, and the pH is adjusted to 4.5 with an aqueous ammonia or glacial acetic acid.

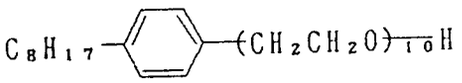
(Bleaching solution replenisher)	
Ammonium ferric 1,3-diaminopropane tetracetate	0.40 mol
Diammonium ethylenediamine tetracetate	2 g
Ammonium bromide	170 g
Ammonium nitrate	50 g
Glacial acetic acid	61 mℓ

Water is added to make up to 1 liter, and the pH is made 3.5 with an aqueous ammonia or glacial acetic acid, if necessary, adjustment is made to keep the pH of the bleacher tank solution constant.

(Fixer and fixer replenisher)	
Ammonium thiosulfate	100 g
Ammonium thiocyanate	150 g
Anhydrous sodium bisulfite	20 g
Sodium metasulfite	4.0 g
Disodium ethylenediaminetetracetate	1.0 g

Water is added to make up to 700 mℓ, and the pH is adjusted to 6.5 with glacial acetic acid and an aqueous ammonia.

(Stabilizer and stabilizer replenisher)

1,2-Benzoisothiazoline-3-one	0.1 g
	(50% solution) 2.0 mℓ
Hexamethylenetetramine	0.2 g
Hexahydro-1,3,5-tris(2-hydroxyethyl)-5-triazine	0.3 g

Water is added to make up to 1 liter, and the pH is adjusted to 7.0 with a 50% sulfuric acid.

After being exposed via an optical wedge, a test piece of sample 201 was continuously processed in an automatic processor charged with the above processing solutions. In the processing, the developer replenisher was added to the developing bath at a rate of 20 mℓ/dm^2 of the sample. When the addition amount of replenisher came to 90% of the initial developer amount at the start of processing, the processing was stopped, and the developer was then allowed to stand for 30 minutes at 38°C. The used developer thus obtained was named developer sample 201. The same procedures were repeated with samples 202 to 208 to obtain developer samples 202 to 208.

Separately, test pieces of color negative film Super DD-100 (product of Konica Corp.) were prepared by exposing said negative film via an optical wedge fitted with a green filter ribbon. They were processed with the above developer samples 201 to 208 according to the processing condition 3. The bleaching solution, fixer and stabilizer used were fresh ones. Then, green light sensitivities of these developed samples were determined as shown in Table 3.

Table 3

Sample No.	Green sensitivity
201	98
202	103
203	30
204	50
205	89
206	93
207	100
208	102

* The sensitivity is given as a reciprocal of the exposure to obtain a minimum density + 0.3, and expressed by a value relative to the sensitivity of sample 207 which is set at 100.

It is understood from Fig. 1 and Table 3 that samples 201 to 204 are silver halide light-sensitive materials excellent in reproduction of blueish green and that samples 201 and 202 are less liable to deteriorate developer quality in continuous processing.

Claims

1. A silver halide color photographic light-sensitive material comprising a support having thereon a red-sensitive silver halide emulsion layer, a green-sensitive silver halide emulsion layer and a blue-sensitive silver halide emulsion layer, wherein

said blue-sensitive silver halide emulsion layer has the maximum spectral sensitivity at a wavelength within the range of from 415 nm to 470 nm, and said maximum spectral sensitivity is two or more times the spectral sensitivity of said blue-sensitive silver halide emulsion layer at 480 nm, provided that said spectral sensitivities are each determined based on the reciprocal of exposure amount necessary for forming a density of 0.1 on the minimum density of said light-sensitive material, and

said blue-sensitive silver halide emulsion layer contains a DIR compound capable of releasing a development inhibitor or a precursor thereof each having a diffusibility of not less than 0.34 upon reaction with the oxidation product of a color developing agent.

2. A light-sensitive material of claim 1, wherein said diffusibility is within the range of from 0.34 to 0.60.

3. A light-sensitive material of claim 2, wherein said diffusibility is within the range of from 0.40 to 0.60.

4. A light-sensitive material of claim 1, wherein said DIR compound is a compound represented by formula DIR-I;

$Cp\text{-}(T)_m\text{-}Z$ (DIR-I)

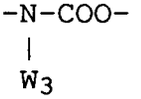
wherein Cp is a coupler moiety; T is a linking group; Z is a moiety of development inhibitor; and m is an integer of 0, 1 or 2, in which the bond between said Cp and said T is cleaved upon reaction of said Cp and the oxidation product of a color developing agent and the bond between said T and said Z is cleaved after said cleavage of the bond between said Cp and said T.

5. A light-sensitive material of claim 4, wherein said DIR compound is a compound represented by formula DIR-II;

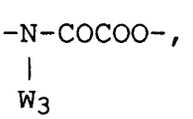
$Cp\text{-}(T)_m\text{-}Z'\text{-}(L\text{-}Y)_p$ (DIR-II)

wherein Cp, T and m are the same as those defined in formula DIR-I, respectively, $Z'\text{-}(L\text{-}T)_p$ is a moiety of development inhibitor; L is a linking group capable of being cleaved in a developer to form a group which inactivates the development inhibiting activity of said moiety of $Z'\text{-}(L\text{-}Y)_p$; and Y is a substituent; and p is an integer of 1 or 2.

6. A light-sensitive material of claim 5, wherein said group represented by L is -COO-, $-SO_2O-$, $-OCH_2CH_2SO_2-$, -OCOO-



or



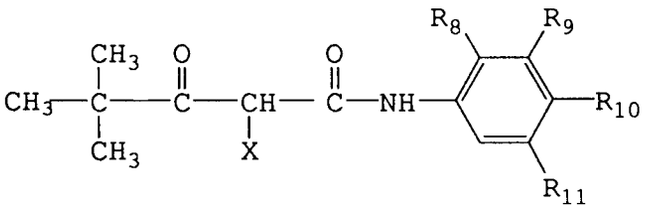
wherein W_3 is a hydrogen atom or a substituent.

7. A light-sensitive material of claim 5, wherein the development activity of said moiety of $Z'\text{-}(L\text{-}Y)_p$ has a half-life period of not longer than 1 hour at pH 10.0.

8. A light-sensitive material of claim 1, wherein said DIR compound is contained in an amount of 0.1 mol % to 5 mol % per mol of silver halide contained in said blue-sensitive emulsion layer.

9. S light-sensitive material of claim 1, wherein said DIR compound is a cyan dye-forming DIR coupler.

10. A light-sensitive material of claim 1, said blue-sensitive emulsion layer contains a yellow coupler represented by formula YP in an amount of not less than 50 mole % of the total amount of yellow coupler contained in said blue-sensitive emulsion layer;



(YP)

wherein R_8 is a hydrogen atom, a halogen atom or an alkoxy group; R_9, R_{10} and R_{11} are each a hydrogen atom, a halogen atom, an alkyl group, an alkenyl group, an alkoxy group, a carboxy group, an alkoxycarbonyl group, a carbamoyl group, a sulfon group, a sulfamoyl group, an alkylsulfonamido group, an acylamido group, a ureido group or an amino group; and X is a hydrogen atom or a substituent capable of releasing upon reaction with the oxidation product of a color developing agent.

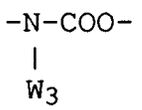
11. A silver halide color photographic light-sensitive material comprising a support having thereon a red-sensitive silver halide emulsion layer, a green-sensitive silver halide emulsion layer and a blue-sensitive silver halide emulsion layer, wherein

said blue-sensitive silver halide emulsion layer has the maximum spectral sensitivity at a wavelength within the range of from 415 nm to 470 nm, and said maximum spectral sensitivity is two or more times the spectral sensitivity of said blue-sensitive silver halide emulsion layer at 480 nm, provided that said spectral sensitivities are each determined based on the reciprocal of exposure amount necessary for forming a density of 0.1 on the minimum density of said light-sensitive material, and

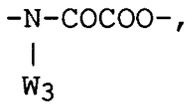
said blue-sensitive silver halide emulsion layer contains a DIR compound represented by the following formula DIR-II capable of releasing a development inhibiting moiety or a precursor thereof each having a diffusibility of from 0.40 to 0.60 upon reaction with the oxidation product of a color developing agent in which the developing inhibiting activity of said developing inhibiting moiety has a half-life period of not longer than 1 hour at pH 10.0; and a yellow coupler represented by the following formula YP in an amount of not less than 50 mol % of the total amount of yellow couplers contained in said blue-sensitive emulsion layer;

$$Cp\text{-}(T)_m\text{-}Z'\text{-}(L\text{-}Y)_p \qquad \text{(DIR-II)}$$

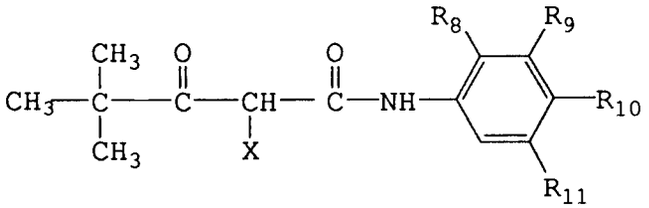
wherein Cp is a cyan dye-forming coupler moiety; T is a linking group; $Z'\text{-}(L\text{-}T)_p$ is a development inhibiting moiety in which L is -COO-, $-SO_2O-$, $-OCH_2CH_2SO_2-$, -OCOO-



or



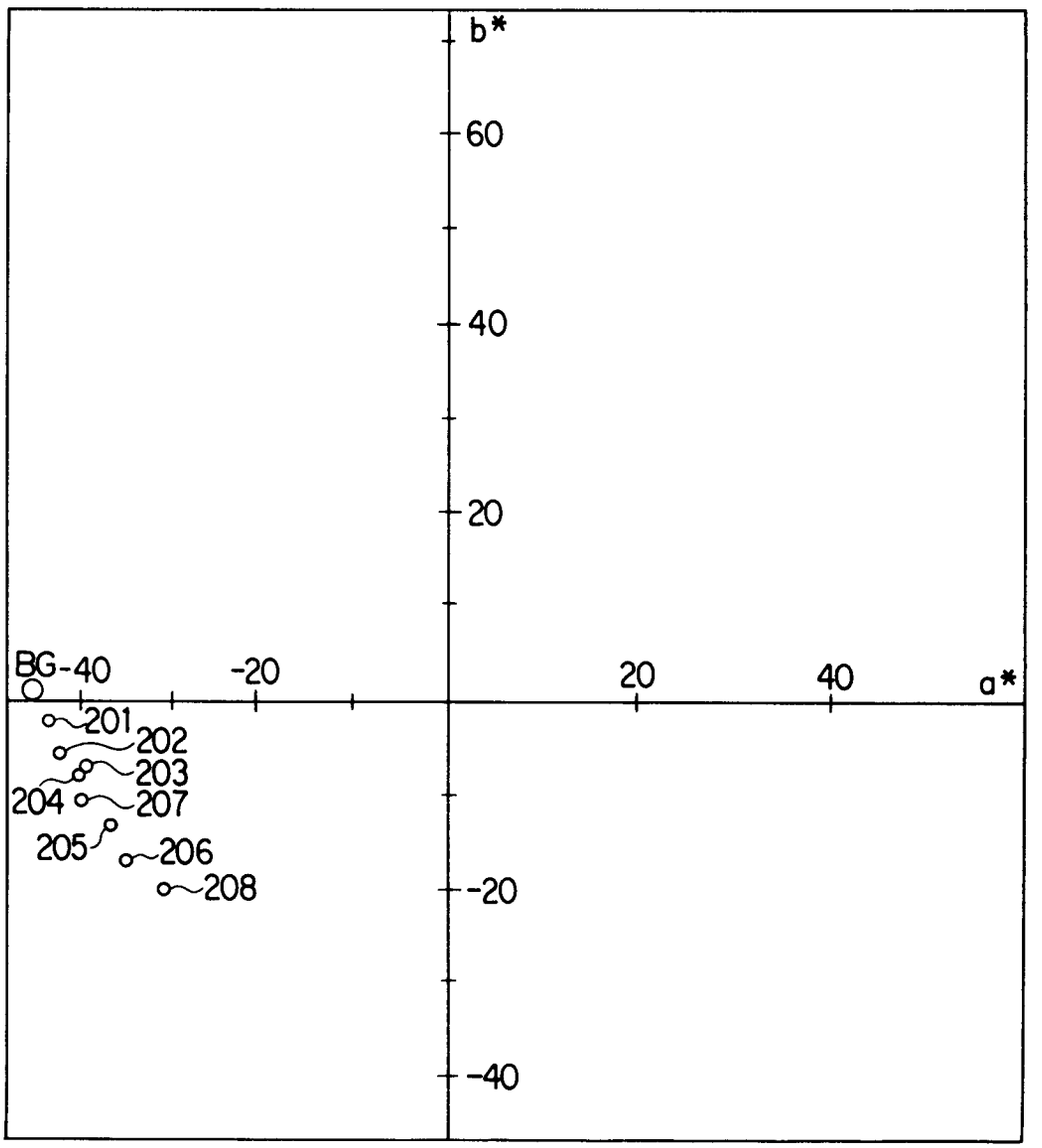
wherein W_3 is a hydrogen atom or a substituent; and Y is a substituent; m is an integer of 0, 1 or 2 and p is an integer of 1 or 2;



(YP)

wherein R_8 is a hydrogen atom, a halogen atom or an alkoxy group; R_9, R_{10} and R_{11} are each a hydrogen atom, a halogen atom, an alkyl group, an alkenyl group, an alkoxy group, a carboxy group, an alkoxycarbonyl group, a carbamoyl group, a sulfon group, a sulfamoyl group, an alkylsulfonamido group, an acylamido group, a ureido group or an amino group; and X is a hydrogen atom or a substituent capable of releasing upon reaction with the oxidation product of a color developing agent.

FIG. 1



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 7570

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	JP-A-62 160 449 (FUJI) * page 25; table * * page 31; example D2 * * page 37; example D34 * * page 45, left column, line 16 - line 29 * * abstract * *	1,4-9	G 03 C 7/30
Y		1-11	
	– – –		
D,Y	EP-A-0 200 502 (KONISHIROKU) * page 13 * * page 18 - page 18A * * page 36; example D3 * * page 54; example D58 * * page 60; example Y4 * * page 87, line 20 - line 28 * * page 88A * *	1-11	
	– – – – –		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G 03 C

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	09 January 92	MAGRIZOS S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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