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Description

RAPIDLY PROCESSABLE SILVER HALIDE PHOTOGRAPHIC LIGHT-SENSITIVE ELEMENT AND PROCESSING METHOD THEREFORE

The present invention relates to a silver halide photographic light-sensitive element which enables rapid processing and is characterized by sharpness of the dye images produced.

In recent years, there have been mounting needs, in the photographic art, for the rapidly processable silver halide light-sensitive elements capable of providing high-quality images.

The development of silver halide photographic light-sensitive elements is carried out ordinarily by a running process with an automatic developing machine. The developing service has been required to be finished within the same day, but now requests are mounting for the order to be finished and handed over to the customer within a matter of a few hours. This situation thus intensifies the need for a more rapid development process. The development of a more rapid process is also being urged from the viewpoint of productivity because a reduction in cost can be achieved by reducing the developing time,

Attempts to make the development process more rapid have been made in two ways, by altering the light-sensitive element as well as the processing solutions. With respect to the color developing, attempts have been made for example, to use a high temperature, higher pH level, or a high-concentration color developing agent. Additives such as development accelerator have also been used. Some examples of such development accelerators are 1-phenyl-3-pyrazolidone disclosed in British Patent No. 811,185, N-methyl-p-aminophenol in U.S. Patent No. 2,417,514, and N, N, N′, N′-tetramethyl-p-phenylenediamine in Japanese Patent Publication Open to Public Inspection (hereinafter referred to as Japanese Patent O.P.I. Publication) No. 15554/1975. Such accelerators, however, have been unable to achieve satisfactory results in speeding up the process and their use often incurs degradation in performance, such as fogging.

On the other hand, it is known that the developing speed is greatly influenced by the configuration, size, and composition of the silver halide grains which constitute the emulsion of a photographic light-sensitive element. The halogen composition, especially, has a significant influence. The use of a silver halide with a high content of chloride is known to show remarkable increases in developing speed.

In order to prevent halation and irradiation, to provide filtering, or to adjust the sensitivity of emulsions, dyes have been included in the hydrophilic colloidal layer which absorb light of a specific wavelength.

Prevention of halation or irradiation is often done in order to improve the sharpness of resulting images.

The dyes used for such purposes must satisfy various requirements, for example: the dye should have satisfactory spectral absorption characteristics depending on the intended purpose; the dye must be completely decolorized in the processing bath, and elute readily out of the photographic element so that no residual staining by the dye occurs after the developing process; the dye should not cause the emulsions to undergo fogging, desensitization, or like adverse influences; the dye is required to have a long shelf life while it is in solution as well as when it is in the photographic element, and should not undergo fading or discoloration.

There has hitherto been a great effort to discovery dyes which satisfy such requirements, and, as a result, a large number of dyes have been proposed for use. Some of such dyes are, for example, oxonol dyes disclosed in U.S. Patent Nos. 506,385 and 3,247,127, Japanese Patent Examined Publication Nos. 22069/1964 and 13168/1978; styryl dyes disclosed, for example, in U.S. Patent No. 1,845,404; merocyanine dyes disclosed, for example, in U.S. Patent Nos. 2,493,747, 3,148,187 and 3,282,699; cyanine dyes disclosed, for example, in U.S. Patent No. 2,843,486; and anthraquinone dyes disclosed, for example, in U.S. Patent No. 2,865,725.

The inventors, through their studies on dyes especially in pursuit of their satisfactory decolorization property in rapid processing, discovered that dyes with some specific structures satisfy the requirements when used in combination with a silver halide with a high content of chloride which, as mentioned before, has a high developing speed and suits rapid processing.

However, the above-mentioned dyes, which were intended to improve the sharpness of photographic images, were found to be unable to achieve the expected results in sharpness because of problems such as when a gelatin coating incorporates such a dye with an especially satisfactory decolorization property, there is the problem that the maximum absorption wavelength is on the short waveform side and the absorption waveform is broad.

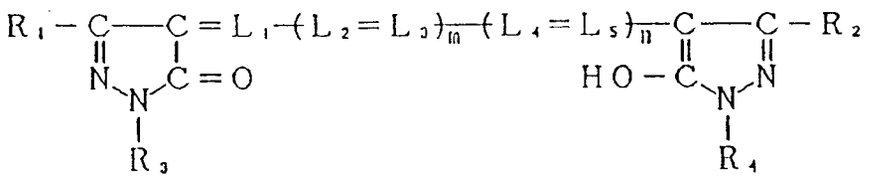
Further studies have focussed on the solution of the problems relating to the spectral absorption characteristic of the gelatin coating, that is, on control of the maximum absorption wavelength and on sharpening of the absorption wave form. The inventors, in their commitment to improvement of the sharpness of finished picture images, have discovered that by additionally incorporating a specific compound into the system of a silver halide with a high content of chloride combined with a specific dye having a good decolorization property, a distinct improvement in sharpness of a finished picture image is attainable. This occurs without impairing the

rapid processing ability or the decolorization property of the dye.

The object of the present invention is to provide a silver halide photographic light-sensitive element which has improved rapid processing ability and in decolorization property of the dye and produces a picture image with improved sharpness.

According to the present invention there is provided a silver halide photographic light-sensitive element comprising a support having thereon photographic component layers including at least one silver halide emulsion layer which contains silver halide grains comprising not less than 90 mol% of silver chloride, wherein the proportion of said silver halide grains in said silver halide emulsion layer is not less than 60% by weight of the total silver halide grains contained in said silver halide emulsion layer, and at least one layer among said photographic component layers contains a compound represented by the following formula [I] and a capturing material for fluorescent whitening agent:

Formula [I]



wherein R_1 and R_2 independently represent a -CN group, a $-CFR_5R_6$ group, a $-COR_7$ group, a $-COOR_7$ group or a $-CONHR_5$ group, in which R_5 and R_6 independently represent a hydrogen atom, a fluorinated alkyl group having one to four carbon atoms, and R_7 represents an alkyl group or an aryl group which may have a substituent; R_3 and R_4 independently represent a hydrogen atom, an aliphatic group, an alicyclic group, an aromatic group or a heterocyclic group, each of which is optionally substituted; L_1, L_2, L_3, L_4, and L_5 independently represent an optionally substituted methine group; and m and n independently represent an integer of 0 or 1.

At least one of the silver halide emulsion layers used in the invention contain silver halide grains comprising not less than 90 mol% of silver chloride grains.

These silver halide grains used in the invention comprise not less than 90 mol%, preferably not less than 95 mol% of silver chloride grains. The content of silver bromide grains is preferably 5 mol% or less and that of silver iodide is preferably 0.5 mol% or less.

The silver halide grains used in this invention can be used alone or in a mixture with another type of silver halide grains having a different composition. The silver halide grains according to the invention may be used also by mixing with another type of silver halide grains comprising a silver chloride content of less than 10 mol%.

In the silver halide emulsion layer used in the invention wherein the silver halide grains comprise not less than 90 mol% of silver chloride grains, the proportion of the silver halide grains comprising not less than 90 mol% of silver chloride grains per total silver halide grains in said emulsion layer is not less than 60 wt%, or, preferably, not less than 80 wt%.

The composition of the individual silver halide grains used in the present invention may be uniform or be different from the inner portion to the surface. Where the composition differs between the inner and outer portions, the composition may vary in a sequential order or in no sequence.

This invention does not restrict the grain size of the silver halide grains to any particular range. But, the preferred grain size is within the range from 0.2 to 1.6 μm, or more preferably, within the range from 0.25 to 1.2 μm, with the adaptability to rapid processing, sensitivity, and other photographic properties taken into consideration. The grain size can be measured by normal methods in general use. Methods most generally applicable are described in "Grain Size Analysis" by Labrand (A.S.T.M. Symposium on light Microscopy, 1955, pp. 94-122) and "Theory of Photographic Process" by Meas & James (3rd Ed. McMillan, 1966, Chapter 2).

The grain size can be measured by using the projected area of the grain or by using an approximate value of the diameter. When the grains are virtually uniform in shape, the grain size distribution can be determined fairly accurately in terms of diameter or projected area.

The grain size distribution of the silver halide grains used in this invention may be multi-dispersed or monodispersed. It is preferably for the distribution to be monodispersed with a variation coefficient of 0.22 or less, or more preferably 0.15 or less. This variation coefficient is a coefficient which indicates the extent of the grain size distribution, and can be defined by the following formulas:

$$\text{Variation coefficient } (S/\bar{r}) = \frac{\text{Standard deviation of grain size distribution}}{\text{Average grain size}}$$

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

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

wherein ri represents the grain size of the individual grains and ni their quantity. The term "grain size" herein used means the diameter when the silver halide grains are spherical. When the grains are cubic or of a shape other than spherical, it refers to the diameter obtained by converting the projected image into a corresponding circular area.

The silver halide grains may be formed in any desired configurations. One preferable configuration is a cube having the {100} face as a crystalline face. It is also possible to produce grains having octahedral, tetradecahedral or dodecahedral configuration by a method described, for example, in U.S. Patent Nos. 4,183,756 and 4,225,666, and Japanese Patent O.P.I. Publication No. 26589/1980 and Japanese Patent Examined Publication No. 42737/1980 and in literature such as The Journal of Photographic Science 21, 39(1973).

During the formation and/or growth of silver halide grains for the emulsion used in the present invention, a metal ion is optionally added and incorporated into the interior and/or the surface of the grains. For example, a cadmium salt, zinc salt, lead salt, thallium salt, iridium salt or iridium complex salt, rhodium salt or rhodium complex salt, and iron salt or iron complex salt, may be used. By placing the grains in a suitable reducing environment, reduction-sensitizing nuclei can be imparted to the grain at the interior and/or on the surface.

The silver halide grains used for the emulsion according to this invention are preferably grains wherein a latent image is primarily formed on the grains' surface.

The emulsion used in the invention is preferably chemically sensitized by a conventional method. Examples of such methods are a sulfur-sensitizing method using a sulfur compound which is reactive with silver ions or by using active gelatin; a selenium-sensitizing method using a selenium compound; a reduction-sensitizing method using a reducing substance; and a noble metal-sensitizing method using a noble metal compound such as gold. Such methods can be used individually or in combination.

Chalcogen sensitizers, for example, are useful for chemical sensitization. Among chalcogen sensitizers, sulfur sensitizers and selenium sensitizers are advantageous. The sulfur sensitizers useful for this purpose are, for example, thiosulfate, alkyl thiocarbazide, thiourea, aryl isothiocyanate, cystine, p-toluene thiosulfonate, and rhodanine. Sulfur sensitizers useful for this purpose are also found in the specifications of U.S. Patent Nos. 1,574,944, 2,410,689, 2,278,947, 2,728,668 3,501,131, and 3,656,955, West German OLS Patent No. 1,422,869, and Japanese Patent O.P.I. Publication Nos. 24937/1981 and 45016/1980. The quantity of the sulfur sensitizer added varies widely depending on various conditions such as pH, temperature, and size of the silver halide grains. Roughly, sulfur sensitizer is used in a range of 10^{-7} mol to 10^{-1} mol per mol silver halide.

The selenium sensitizers useful for the purpose are selenides such as aliphatic isoselenocyanates such as alkyl isoselenocyanate; selenoureas, selenoketones, selenoamides, selenocarboxylates and esters; selenophosphates; selenides such as diethylselenide, and diethyldiselenide. Examples of such sensitizers are described in U.S. Patent Nos. 1,574,944, 1,602,592, and 1,623,499.

Reduction sensitization can be used in combination with other sensitizing processes. The reducing agents useful for this purpose are stannous chloride, thiourea dioxide, hydrazine, and polyamide.

Noble metal compounds other than gold, such as a palladium compound, can also be used in combination.

It is preferable for the silver halide grains used in this invention to contain a gold compound. A gold compound suitable for use in the present invention may have a oxidation number of +1 or +3, whereby a wide variety of gold compounds are applicable. Some examples of such gold compounds are chloraurate, potassium chloraurate, auric trichloride, potassium auric thiocyanate, potassium iodine aurate, tetracyanoauric azide, ammonium aurothiocyanate, pyridyl trichlorogold, gold sulfide, and gold selenide.

A gold compound can be used either to sensitize the silver halide grains or in such a way not to contribute to sensitization totally.

The quantity of a gold compound used varies depending on various conditions. Roughly, a gold compound is preferably used in a quantity of a range of 10^{-8} mol to 10^{-1} mol, or, more preferably, 10^{-7} mol to 10^{-2} mol per mol silver halide. Such a gold compound can be added at any of the stages of formation of the silver halide grains, for example at physical ripening, chemical ripening, or after the chemical ripening.

The emulsion produced is preferably spectrally sensitized at a desired wavelength range by using a sensitizing dye. The sensitizing dyes can be used singly or in combination of two or more kinds.

In combination with a sensitizing dye in the emulsion a supersensitizing dye is more preferably used. This is a dye or compound not having the spectral sensitization function or not actually absorbing visible light, but such a dye or compound is capable of enhancing the sensitizing action of the sensitizing dyes.

No specific restriction applies to the silver halide grains used for the other emulsion layers. But, it is preferable for such silver halide grains to comprise not less than 90 mol% of silver chloride grains.

The photographic light-sensitive element according to the present invention contains a compound expressed by formula [I] and a capturing material for fluorescent whitening agent in at least one layer selected from among the photographic component layers, that is, the silver halide emulsion layers, or from among the non-light-sensitive layers, for example, the intermediate layer, protective layer, filter layer, or anti-halation layer.

A description will now be provided hereunder with respect to the compounds defined by formula [I] used in the present invention, said such compound(s) will hereinafter be referred to as "the dye(s) used in the invention".

In formula [I], R_1 and R_2 independently represent -CN, $-CFR_5R_6$, $-COR_7$, $-COOR_7$, or $-CONHR_5$, wherein R_5 and R_6 independently represent a hydrogen atom, a fluorinated alkyl group with 1 to 4 carbon atoms, for example, difluoromethyl group, trifluoromethyl group, 1,1,2,2-tetrafluoroethyl group, 1,1,2,2,3,3,4,4-octafluorobutyl group, and 1,1,2,2,3,3-hexafluoropropyl group.

R_7 in $-COR_7$ or $-COOR_7$ represented by R_1 or R_2 represents an optionally substituted alkyl group or aryl group.

R_3 and R_4 independently represent a hydrogen atom, or an optionally substituted aliphatic group, alicyclic group, aromatic group, or heterocyclic group, of which the aliphatic group is, for example, an alkyl group or alkenyl group; the alicyclic group is, for example, a cycloalkyl group; the aromatic group is, for example, an aryl group such as phenyl or naphthyl; the heterocyclic group is, for example, benzothiazolyl group or benzoxazolyl group.

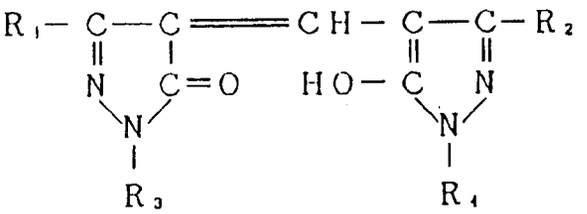
The methine group represented by each of L_1, L_2, L_3, L_4, and L_5 may be substituted by an alkyl or aryl group with 1 to 4 carbon atoms.

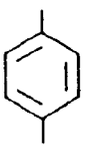
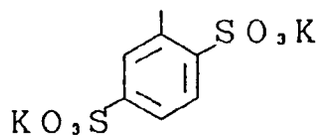
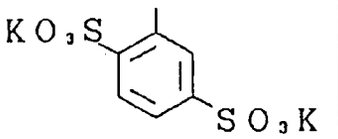
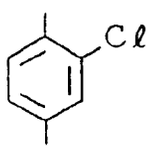
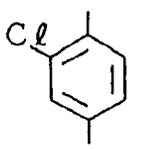
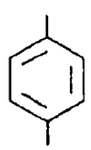
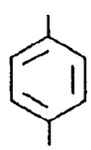
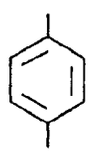
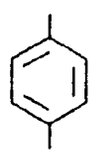
It is preferable for R_1 and R_2 to be -CN, $-CF_3$, $-CONH_2$, or $-COR_7$, and for R_7 to be alkyl . It is preferable for R_3 and R_4 to be an aromatic group, especially preferably to be 4-sulfophenyl group, 2,5-di-sulfophenyl group, or their salts.

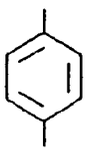
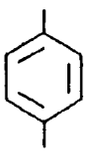
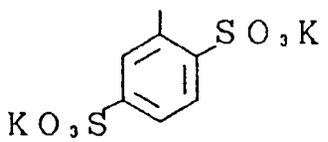
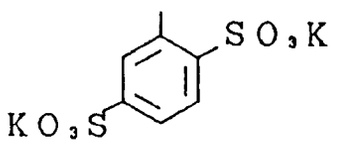
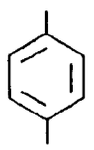
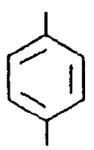
With respect to the dyes used according to the invention, it is preferable for such a dye to contain at least one water soluble group (such as sulfo group, carboxyl group, or their salts) in its molecular structure.

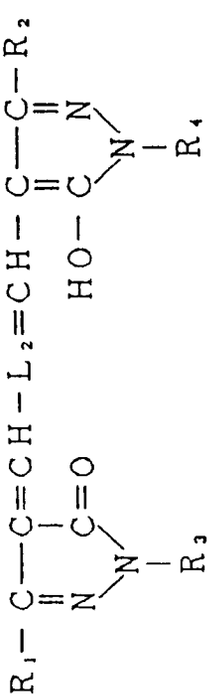
Typical examples of dyes used in the invention represented by formula [I] are hereinunder listed on the understanding that these examples in no way restrict the dyes used in the practice of the invention.

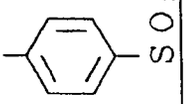
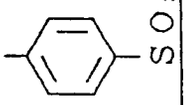
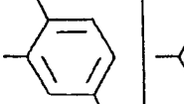
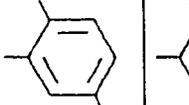
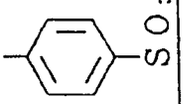
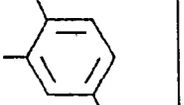
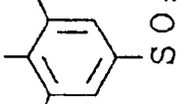
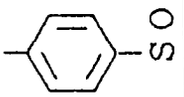
Example dye

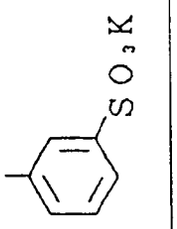
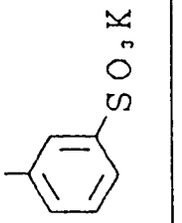
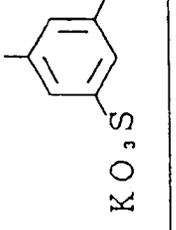
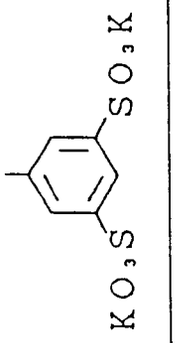
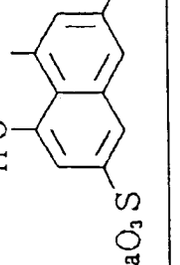
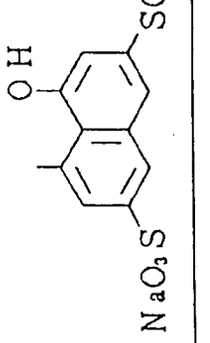
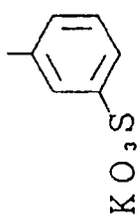
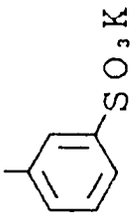


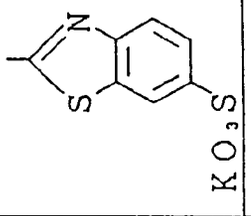
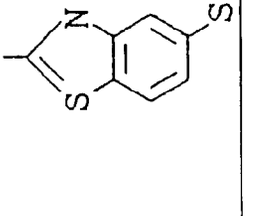
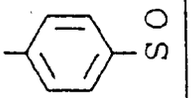
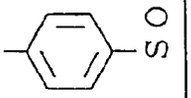
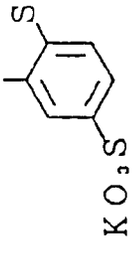
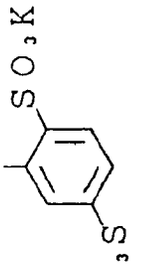
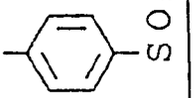
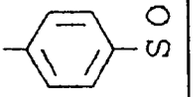
Example No.	R_1	R_2	R_3	R_4
1	$-CN$	$-CN$		
2	$-CN$	$-CN$		
3	$-CN$	$-CN$		
4	$-CF_3$	$-CF_3$		
5	$-COOC_4H_9$	$-COOC_4H_9$		

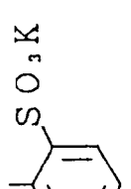
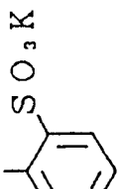
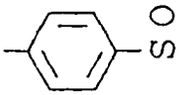
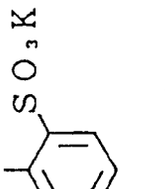
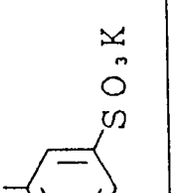
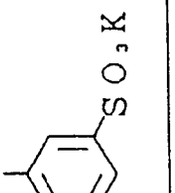
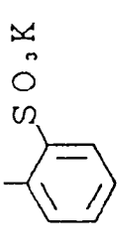
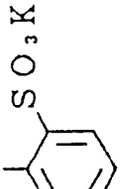
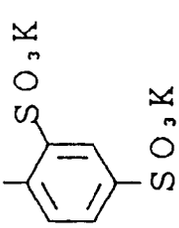
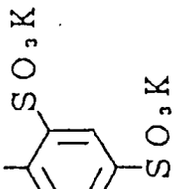
Example No.	R_1	R_2	R_3	R_4
6	$-COCH_3$	$-COCH_3$		
7	$-COCH_3$	$-COCH_3$		
8	$-CONHCF_3$	$-CONHCF_3$		

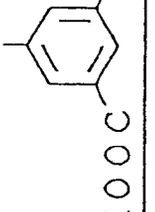
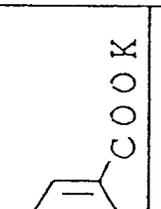
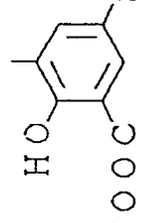
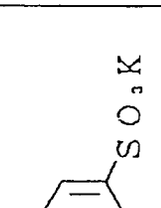
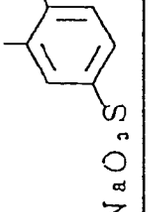
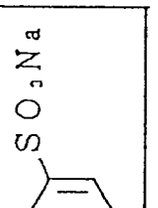


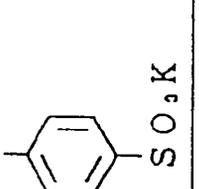
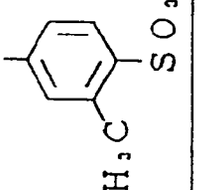
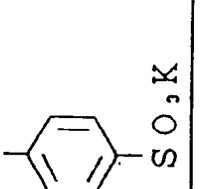
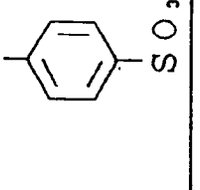
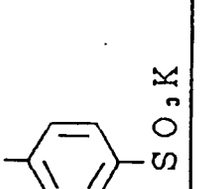
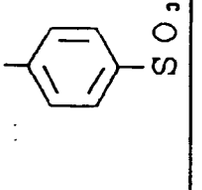
Example No.	R_1	R_2	L_2	R_3	R_4
9	-CN	-CN	-CH=		
10	-CN	-CN	-CH=		
11	-CN	-CN	-CH=		
12	-CN	-CN	-CH=		

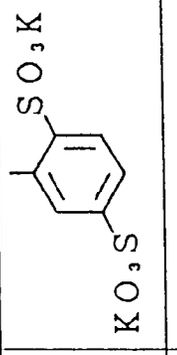
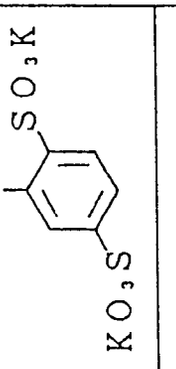
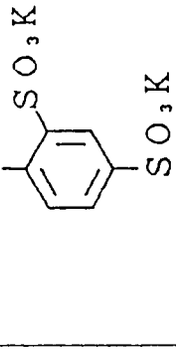
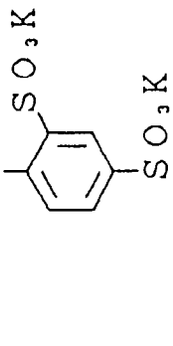
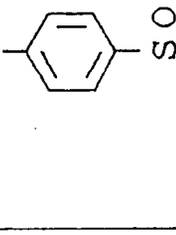
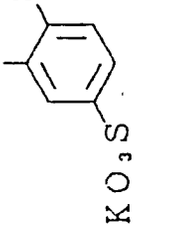
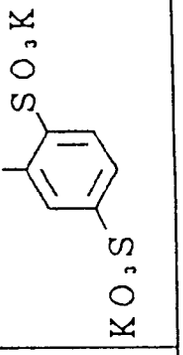
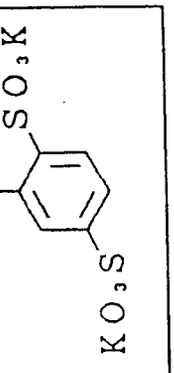
Example No.	R_1	R_2	L_2	R_3	R_4
13	$-CN$	$-CN$	$-CH=$		
14	$-CN$	$-CN$	$-CH=$		
15	$-CN$	$-CN$	$-CH=$		
16	$-CN$	$-CN$	$-\overset{C_2H_5}{\underset{\vert}{C}}=$		

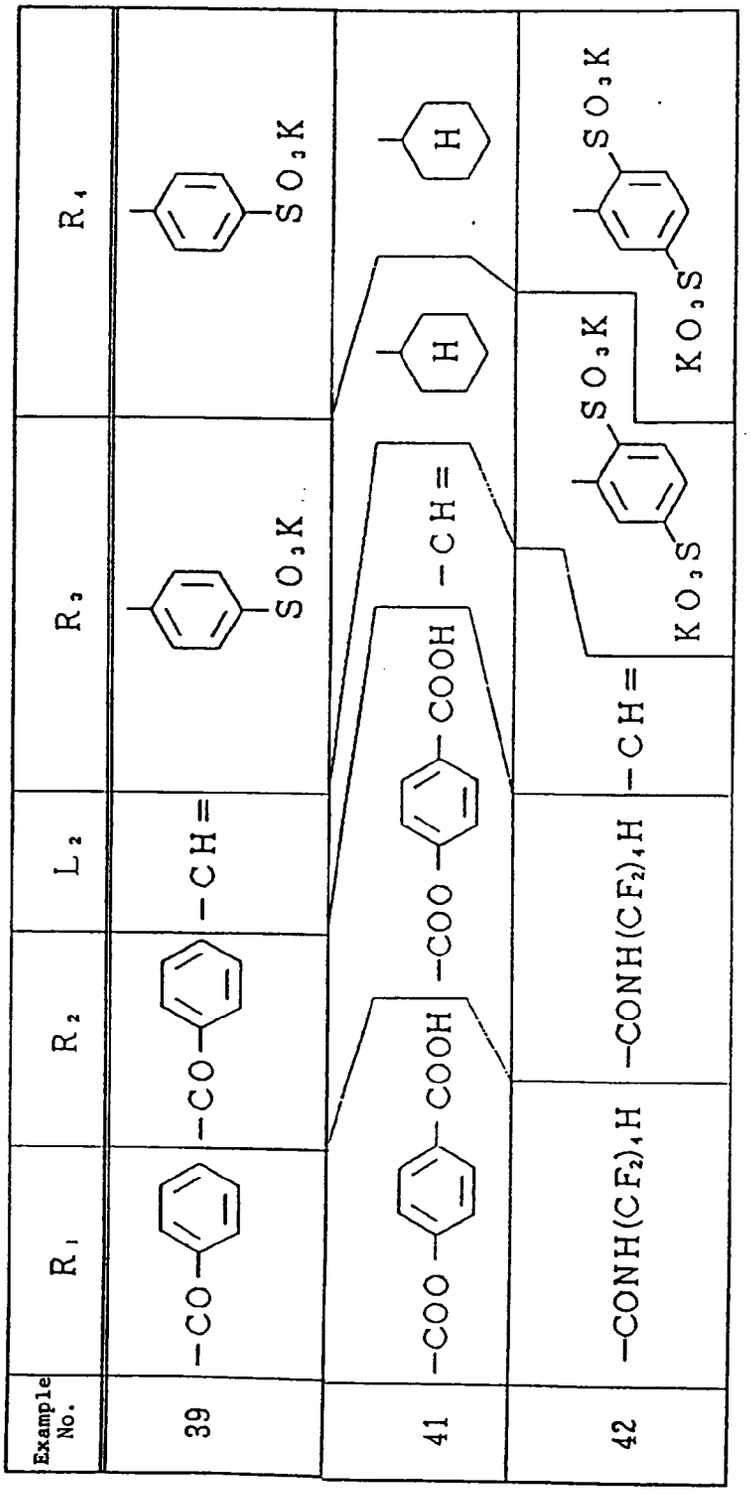
Example No.	R_1	R_2	L_2	R_3	R_4
17	$-CN$	$-CN$	$-CH=$		
18	$-CF_3$	$-CF_3$	$-CH=$		
19	$-CF_3$	$-CF_3$	$-CH=$		
20	$-CONH_2$	$-CONH_2$	$-CH=$		

Example No.	R_1	R_2	L_2	R_3	R_4
21	$-CONH_2$	$-CONH_2$	$-CH=$		
22	$-CONH_2$	$-CONH_2$	$-CH=$		
23	$-CONH_2$	$-CONH_2$	$-C(CH_3)=$		
24	$-CONH_2$	$-CONH_2$	$-CH=$		
25	$-CONH_2$	$-CONH_2$	$-CH=$		

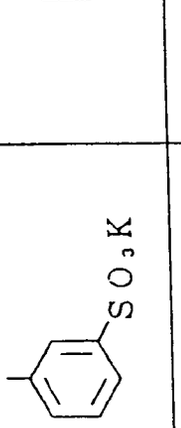
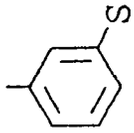
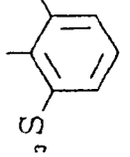
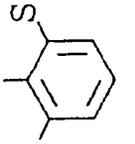
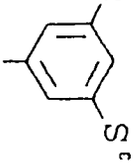
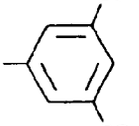
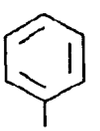
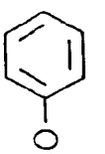
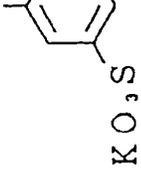
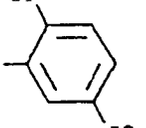
Example No.	R_1	R_2	L_2	R_3	R_4
26	$-CF_3$	$-CF_3$	$-CH=$		
27	$-CF_3$	$-CF_3$	$-CH=$		
28	$-CF_3$	$-CF_3$	$-CH=$		

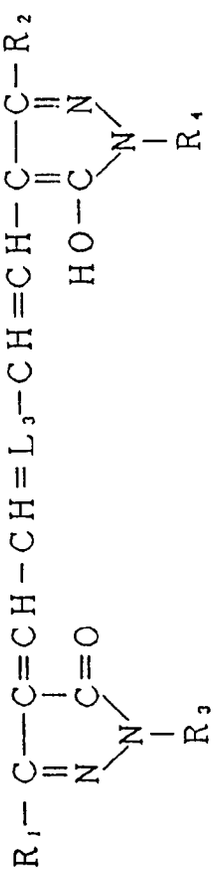
Example No.	R_1	R_2	L_2	R_3	R_4
32	$-COOC_2H_5$	$-COOC_2H_5$	$-CH=$		
33	$-COOC_2H_5$	$-COOC_2H_5$	$-CH=$		
34	$-COCH_3$	$-COCH_3$	$-CH=$		

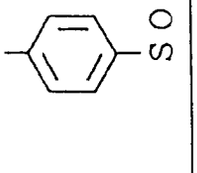
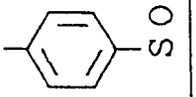
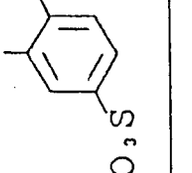
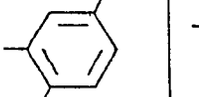
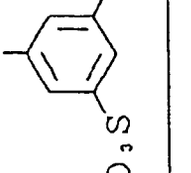
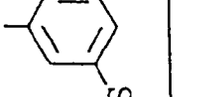
Example No.	R_1	R_2	L_2	R_3	R_4
35	$-COCH_3$	$-COCH_3$	$-CH=$		
36	$-COCH_3$	$-COCH_3$	C_2H_5 $-C=$		
37	$-COCH_3$	$-COCH_3$	$-CH=$		
38	$-COC_2H_5$	$-COC_2H_5$	$-CH=$		

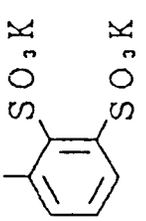
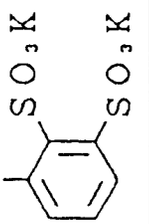
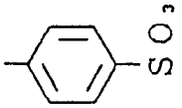
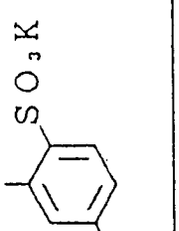
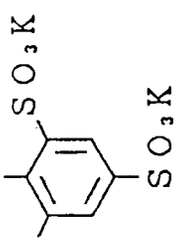
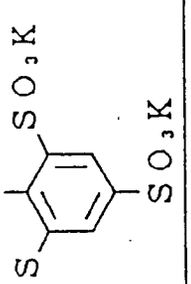
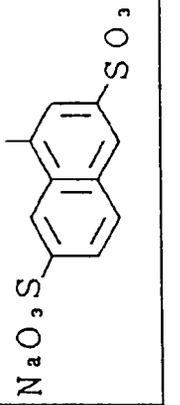
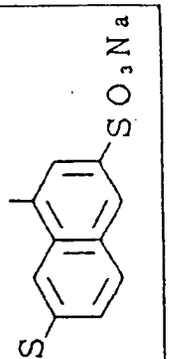


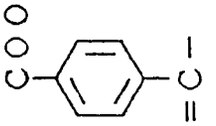
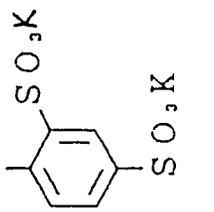
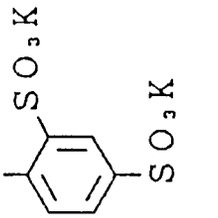
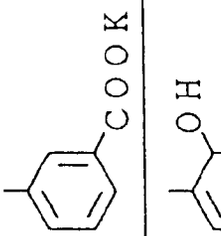
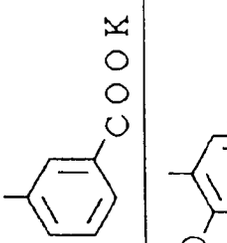
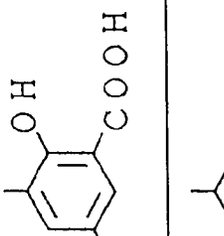
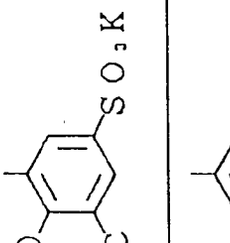
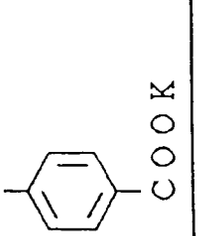
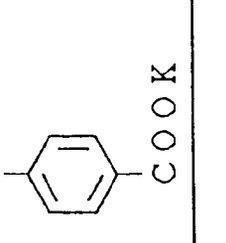
Example No.	R_1	R_2	L_2	R_3	R_4
39			$-CH=$		
41			$-COO-$ $-CH=$		
42	$-CONH(CF_2)_4H$	$-CONH(CF_2)_4H$	$-CH=$		

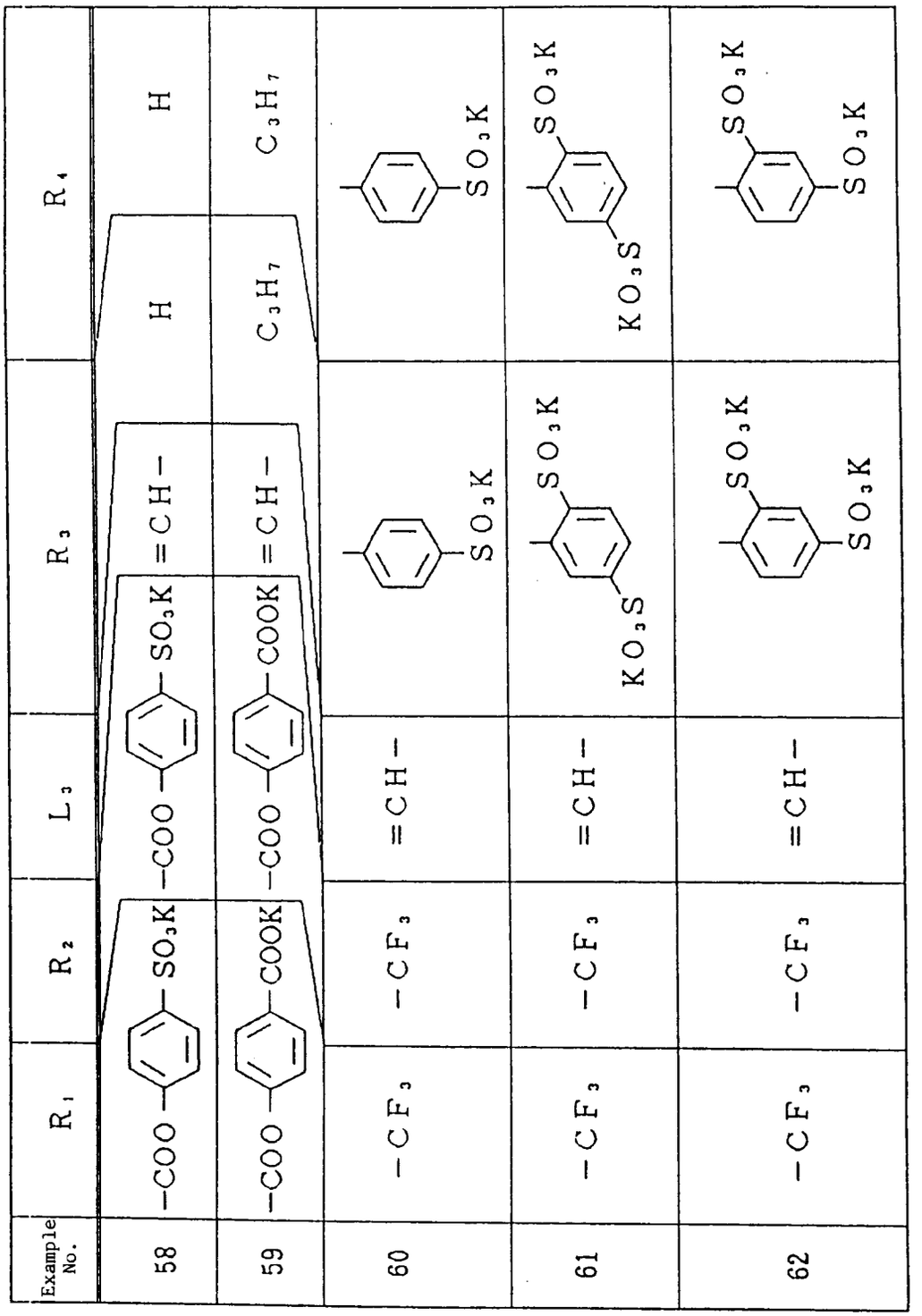
Example No.	R_1	R_2	L_2	R_3	R_4
43	$-COCH_3$	$-COCH_3$	$-CH=$		
44	$-COCH_3$	$-COCH_3$	C_2H_5 $-C=$		
45	$-COCH_3$	$-COCH_3$	$-CH=$		
46			$-CH=$		



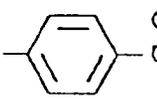
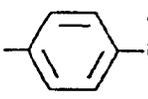
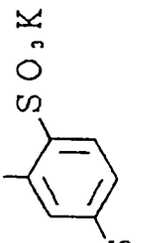
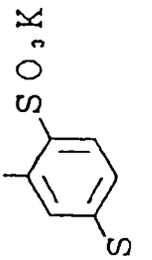
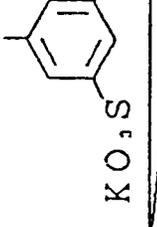
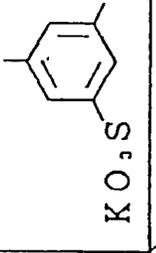
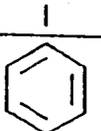
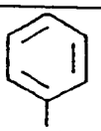
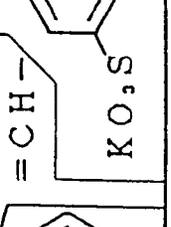
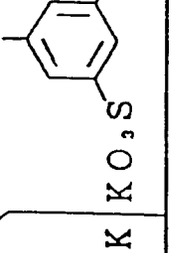
Example No.	R_1	R_2	L_3	R_3	R_4
47	$-CN$	$-CN$	$=CH-$		
48	$-CN$	$-CN$	$=CH-$		
49	$-CN$	$-CN$	$=CH-$		

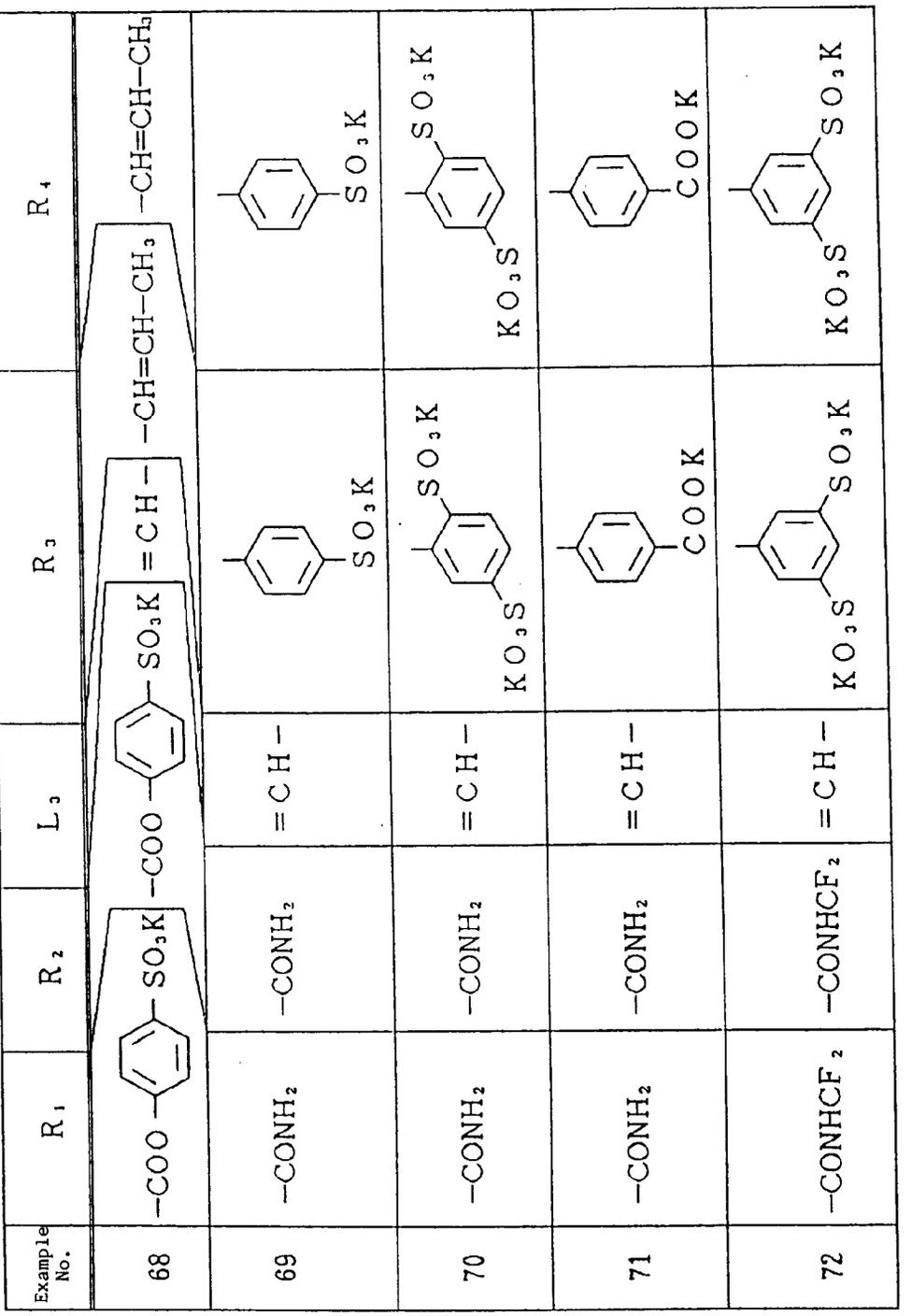
Example No.	R_1	R_2	L_3	R_3	R_4
50	$-CN$	$-CN$	$=CH-$		
51	$-CN$	$-CN$	$\begin{matrix} C_2H_5 \\ \vert \\ =C- \end{matrix}$		
52	$-CN$	$-CN$	$=CH-$		
53	$-CN$	$-CN$	$=CH-$		

Example No.	R_1	R_2	L_3	R_3	R_4
54	$-CN$	$-CN$			
55	$-CN$	$-CN$	$=CH-$		
56	$-CN$	$-CN$	$=CH-$		
57	$-CF_3$	$-CF_3$	$=CH-$		

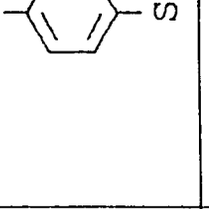
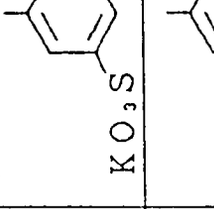
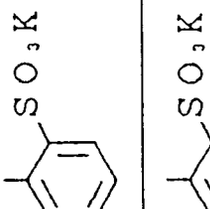
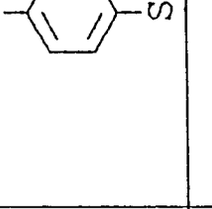
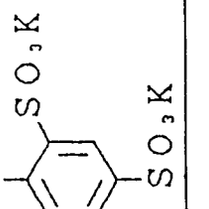
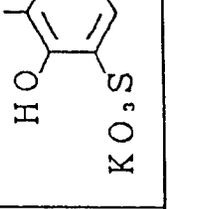
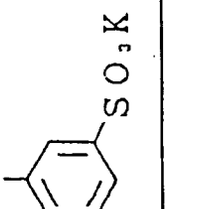


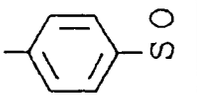
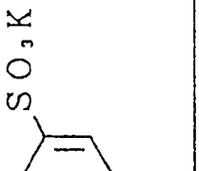
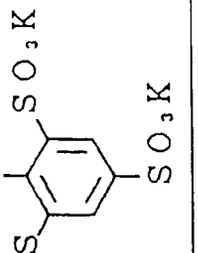
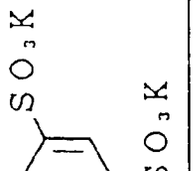
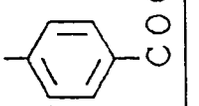
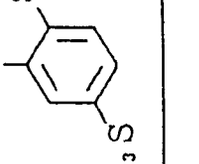
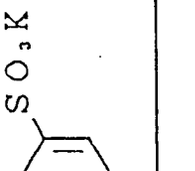
Example No.	R_1	R_2	L_3	R_3	R_4
58					H
59					C_3H_7
60	$-CF_3$	$-CF_3$	$=CH-$		
61	$-CF_3$	$-CF_3$	$=CH-$		
62	$-CF_3$	$-CF_3$	$=CH-$		

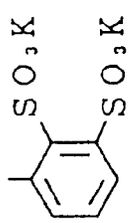
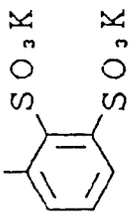
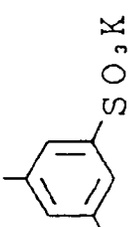
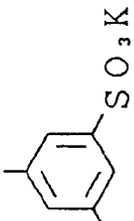
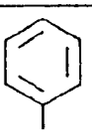
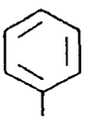
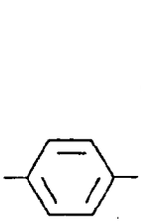
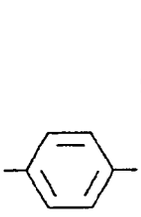
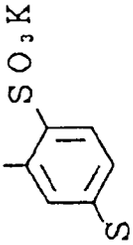
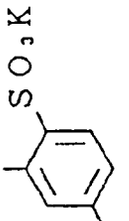
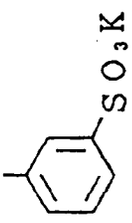
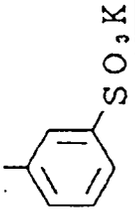
Example No.	R_1	R_2	L_3	R_3	R_4
64	$-COOC_2H_5$	$-COOC_2H_5$	$=CH-$		
65	$-COOC_2H_5$	$-COOC_2H_5$	$=CH-$		
66	$-COOC_2H_5$	$-COOC_2H_5$	$\begin{matrix} CH_3 \\ \vert \\ =C- \end{matrix}$		
67	$-COOCH_2-$ 	$-COOCH_2-$ 	$=CH-$		



Example No.	R_1	R_2	L_3	R_3	R_4
68					
69	$-CONH_2$	$=CH-$			
70	$-CONH_2$	$=CH-$			
71	$-CONH_2$	$=CH-$			
72	$-CONHCF_2$	$=CH-$			

Example No.	R_1	R_2	L_3	R_3	R_4
73	$-COCH_3$	$-COCH_3$	$=CH-$		
74	$-COCH_3$	$-COCH_3$	$=CH-$		
75	$-COCH_3$	$-COCH_3$	$=CH-$		
76	$-COCH_3$	$-COCH_3$	$=CH-$		

Example No.	R_1	R_2	L_3	R_3	R_4
77	$-COCH_3$	$-COCH_3$	$=CH-$		
78	$-COCH_3$	$-COCH_3$	$=CH-$		
79	$-COCH_3$	$-COCH_3$	$=CH-$		
80	$-COC_2H_5$	$-COC_2H_5$	$=CH-$		

Example No.	R_1	R_2	L_3	R_3	R_4
81	$-COCH_3$	$-COCH_3$	$=CH-$		
82	$-COCH_3$	$-COCH_3$	$=CH-$		
83			$=CH-$		
84			$=CH-$		
85	$-COCH_3$	$-COCH_3$	$C_3H_7(i)$ | $=C-$		

Besides the dyes shown as examples above, dyes applicable effectively to the practice of the present invention are shown in the specification of Japanese Application No. 8796/1986, pp. 179-199, which are Examples (2), (3), (7), (9), (15), (16), (18), (19), (21), (22), (24), (25), (27) , (33), (34), (35), (40) , (42) , (43), (44), (45), (46), (47), (48), (49), (50), (51), (52) , (53) , (54) , (55) , (58), (59) , (60), and (62).

These dyes which may be used in the present invention can be synthesized by the method described in the above-mentioned specification of Japanese Patent Application No. 8796/1986. The dyes according to the invention expressed by formula [I] can be used as anti-irradiation dyes by introducing them into a silver halide emulsion layer or as filter dyes or anti-halation dyes by introducing them into non-light-sensitive hydrophilic colloidal layers. Where a dye used in the invention is incorporated into a silver halide emulsion layer, it is pre-

ferable for the compound, if m = 0 and n = 0 in the formula [I], to be introduced into a blue-sensitive silver halide emulsion layer; into a green-sensitive silver halide emulsion layer if m = 1 and n = 0; and into a red-sensitive silver halide emulsion layer if m = 1 and n = 1.

The preferred compounds are those defined by m = 1 and n = 0; or m = 1 and n = 1. The particularly preferable compounds are those defined by m = 1 and n = 1, wherein one of such compounds is contained at least in a red-sensitive silver halide emulsion layer.

A dye used in the invention can be used in combination with another different dye not of formula (I) or in combination with a dye of formula [I], depending on the purpose of the use. A dye embodying the invention can be incorporated into a silver halide light-sensitive emulsion or other hydrophilic colloidal layer, usually by dissolving the dye or an organic/inorganic alkali salt of the dye in an aqueous solution or an organic solvent, such as alcohol, glycol, cellosolve, dimethylformaldehyde, dibutyl phthalate, and tricresylphosphate. Then dispersing it, if necessary, by emulsifying, adding it to a coating solution, and then by applying to and drying over the support. If the dye is diffusible, the dye can be added to a coating solution for a different layer rather than that of the capturing material so that the dye, once the solution is applied, is allowed to diffuse and eventually be incorporated, before the solution completely dries, into a layer which contains the capturing material for fluorescent whitening agent.

It is essential that the dye used in the invention is present in the layer containing a capturing material for fluorescent whitening agent. The quantities of the dyes used vary depending on the purpose of application and are not restricted to any specific amounts. But, generally, it is preferable for the dye to be applied at a rate of 0.01 - 1.0 mg/dm^2, or, more preferably, 0.03 - 0.4 mg/dm^2.

One of the effective means of improving the whiteness of a silver halide photographic light-sensitive element including particularly a photographic print paper, is the method of adding a water-soluble fluorescent whitening agent into the hydrophilic colloidal layer of a light-sensitive element. The fluorescent whitening agents include, for example, the compounds of a diaminostilbene, a benzidine, an imidazole, a triazole or an imidazolone, each having a hydrophilic group, as described in Japanese Patent O.P.I. No. 71049-1984.

A fluorescent whitening agent added into the hydrophilic colloidal layer of a light-sensitive element will be eluted from the hydrophilic colloidal layer into the processing solution during the course of processing the light-sensitive element. However, there are compounds capable of capturing a fluorescent whitening agent so as to prevent it from eluting out of the hydrophilic colloidal layer. These compounds have been widely used with the purpose of enhancing the effects of fluorescent whitening agents used in light-sensitive elements, as described in Japanese Patent O.P.I. Publication No. 71045-1984.

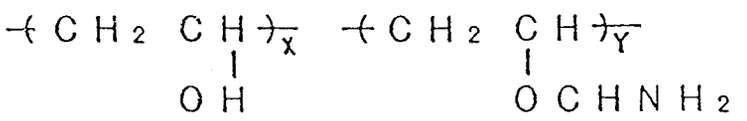
When a compound having such a fluorescent whitening agent capturing effect as mentioned above coexists, in a light-sensitive element, with a dye represented by the aforegiven Formula [I], the effect of improving the image sharpness of the light-sensitive element is remarkably increased.

Substances having such an effect of capturing a fluorescent whitening agent as mentioned above are called capturing materials for fluorescent whitening agents or simply capturing agents used in the invention.

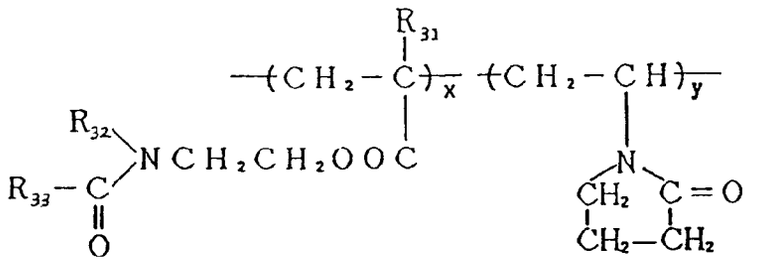
Any compound capable of capturing a fluorescent whitening agent may be used in the invention. It is, however, preferred that it is a non-color-developable hydrophilic synthetic macro-molecular polymer.

The typical examples of the hydrophilic polymers include polyvinyl pyrrolidone or copolymers having vinyl pyrrolidone as repeating units, wherein the examples of monomers capable of forming repeating units together with vinyl pyrrolidone include acrylic acid, methacrylate acid, amide compounds of acrylic acid and methacrylic acid, such as acrylamide, methacrylamide, N,N-dimethylacrylamide, N,N-diethylacrylamide, N-methyloylacrylamide, N-hydroxyethylacrylamide, N-tert-butylacrylamide, N-cyclohexylacrylamide, diacetoneacrylamide, N-(1,1-dimethyl-3-hydroxybutyl)acrylamide, N-(β-morpholino)ethylacrylamide, N-benzylacrylamide, N-acryloylmorpholine, N-methacryloylmorpholine, N-methyl-N-acryloylpiperazine, N-acryloylpiperazine, N-acryloylpiperidine, N-acryloylpyrrolidine, and N-acryloylhexamethyleneimine); alkyl esters of acrylic acid and methacrylic acid, such as methylmethacrylate, ethylacrylate, hydroxyethylacrylate, propylacrylate, cyclohexylacrylate, 2-ethylhexylacrylate, decylacrylate, β-cyanoethylacrylate, β-chloroethylacrylate, 2-ethoxyethylacrylate, and sulfopropylmethacrylate vinyl esters such as vinyl acetate, vinyl propionate, vinyl butyrate, and vinyl lactate; vinyl ethers, such as methylvinyl ether, butylvinyl ether, and oleylvinyl ether; vinyl ketones, such as methyl vinyl ketone and ethyl vinyl ketone; styrenes such as styrene, methyl styrene, dimethyl styrene, 2,4,6-trimethyl styrene, ethyl styrene, lauryl styrene, chlorostyrene, dichlorostyrene, methoxy styrene, cyanostyrene, dimethylamino styrene, chloromethyl styrene, vinyl benzoate, styrene sulfonate, and α-methyl styrene; vinyl heterocyclic compounds, such as vinyl pyridine, vinyl isooxazoline, and vinyl imidazole; acrylonitrile, vinyl chloride, vinylidene chloride, ethylene, propylene, butadiene, isoprene, chloroprene, maleic anhydride, itaconic anhydride, citraconic anhydride, and vinyl sulfonate; and poly-N-vinyl-5-methyl-2-oxazolidinone described in Japanese Patent Examined Publication No. 31842/1973, polymer of N-vinylamide compound expressed by a formula CH_2=CHNR^{1}COR^2, in which R^1 represents an alkyl group and R^2 represents a hydrogen atom or an alkyl

group; hydrophilic polymer including a cationic nitrogen-containing active group described in Japanese Patent O.P.I. Publication No. 42732/1973; polymers of morpholino alkylalkenoylamide described in Japanese Patent Examined Publication No. 2522/1969; copolymers of vinyl alcohol and vinyl-pyrrolidone described in Japanese Patent Examined Publication No. 20738/1972; polymers described in Japanese Patent Examined Publication No. 49028/1972 and represented by the following formula



wherein X + Y = 100 to 500, $\frac{Y}{X+Y}$ = 0.05 to 0.25; and polymers described in Japanese Patent Examined Publication No. 38417/1973 and expressed by the following formula



wherein R_{31} represents a hydrogen atom or methyl group; R_{32} and R_{33} individually represent a hydrogen atom and an alkyl group with 1 to 4 carbon atoms; X/Y = 95/5 to 20/80.

It is preferable to employ polyvinyl pyrrolidone or its copolymer as the capturing material used in the invention.

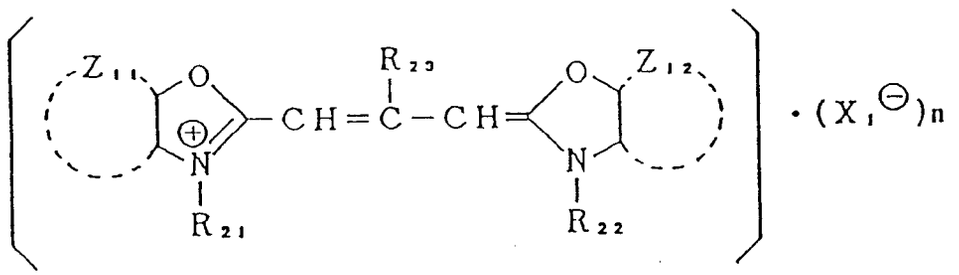
It is preferable for said hydrophilic polymers to have a molecular weight of not less than 1,000, in particular, a molecular weight of not less than 10,000, in terms of weight-average molecular weight. Still more advantageous is a molecular weight in the range of 50,000-1,000,000.

The capturing material used in the invention can be incorporated into any of the photographic structural layers, that is, in a light-sensitive layer or in a non-light-sensitive layer. It is preferable for the capturing material of the invention to be contained in a non-light-sensitive layer.

It is preferable for the capturing material of the invention to be used at a rate of 0.05 to 3.0 mg/dm^2, more preferably 0.1 to 20 mg/dm^2. It is also preferable for the capturing material of the invention to be used at a rate of 0.1 to 50 wt%, or, more preferably, at a rate of 1 to 30 wt% per amount of gelatin which is used as a binder in the photographic structural layer where the capturing material is contained.

It is preferable for a sensitizing dye used in the invention preferably in the green-sensitive silver halide emulsion layer to be one expressed by the following formula [B]:

Formula [B]



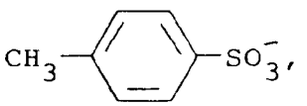
wherein Z_{11} and Z_{12} individually represent an optionally substituted group of atoms required to form a benzene ring or naphthalene ring condensed on the oxazole ring. The preferable substituents are halogen atoms, aryl group, alkyl group, or alkoxy group. Halogen atoms, phenyl group, and methoxy group are more preferable as substituents, and phenyl group is most preferable as a substituent.

Preferably, both Z_{11} and Z_{12} represent a benzene ring condensed on the oxazole ring, wherein at least one of these benzene rings has a substituent phenyl group in the 5-position, or one of these benzene ring has a substituent phenyl group in the 5-position, and the other benzene ring has in the 5-position a halogen atom as a substituent group.

R_{21} and R_{22} individually represent an alkyl group, alkenyl group, or aryl group, preferably an alkyl group. It is more preferable for R_{21} and R_{22} individually to be alkyl groups having a carboxyl or sulfo group as a substituent group. The more preferable example of R_{21} and R_{22} is a sulfoalkyl group having 1 to 4 carbon atoms, where the most preferable is a sulfoethyl group.

R_{23} represents a hydrogen atom, or an alkyl group having 1 to 3 carbon atoms, or, preferably, a hydrogen atom or ethyl group.

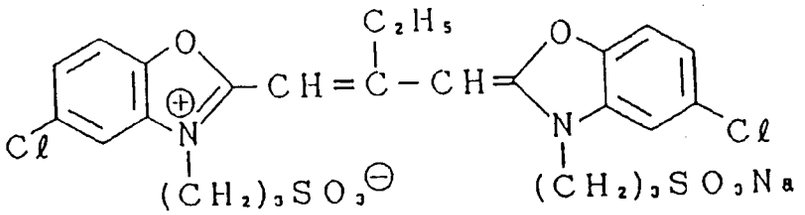
$X_1^{\ominus}$ represents an anion, such as a halogen ion of chloride, bromine, or iodine, or an anion such as



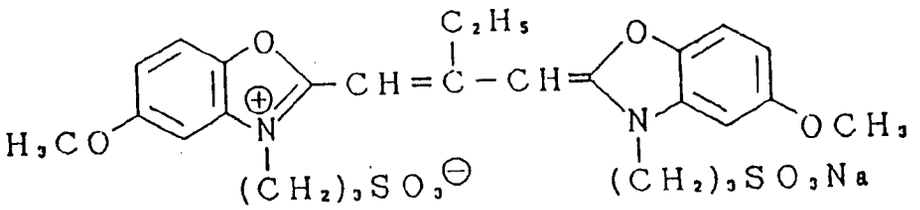
$CH_3SO_4^-$, or $C_2H_5SO_4^-$. n represents 1 or 0. When a compound forms an inner salt, however, n represents 0.

Examples of sensitizing dyes preferable in the practice of the present invention, expressed by the formula [B], will now be shown hereunder.

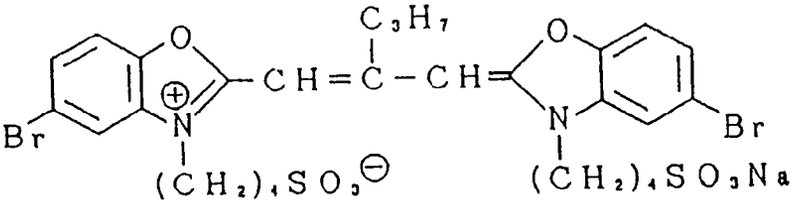
B − 1



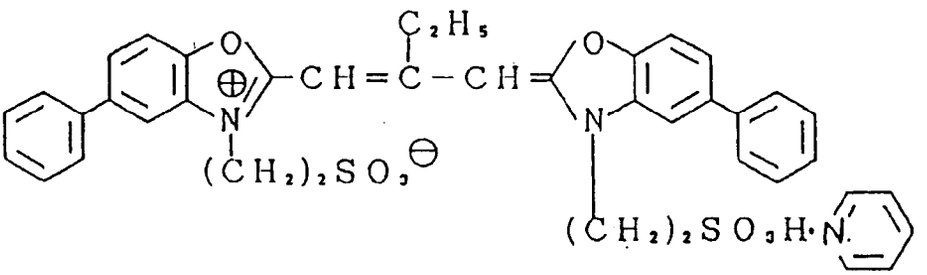
B − 2



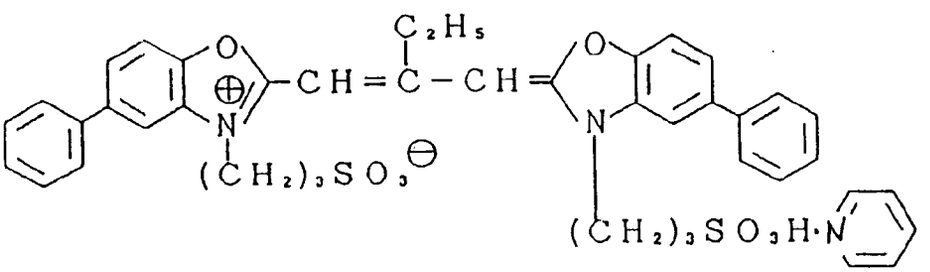
B − 3



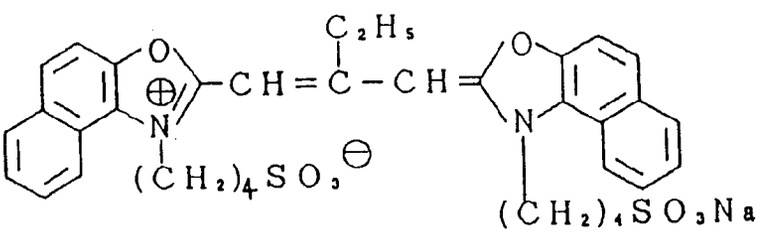
B − 4



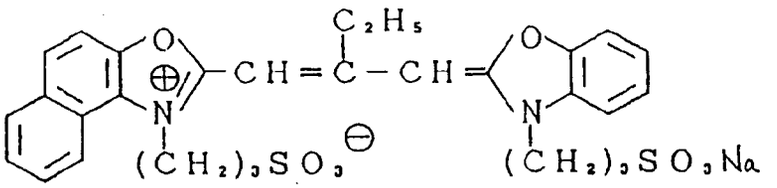
B − 5



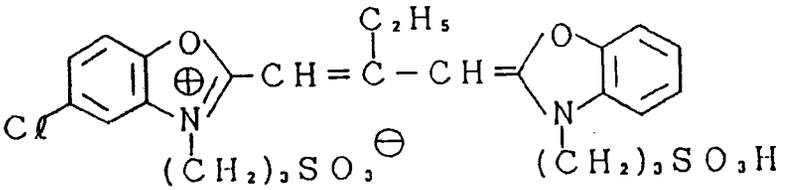
B − 6



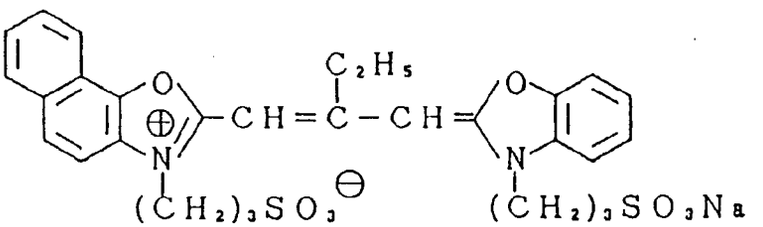
B - 7



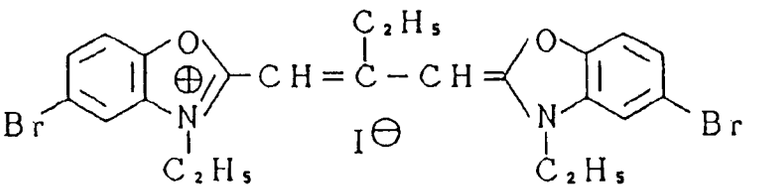
B - 8



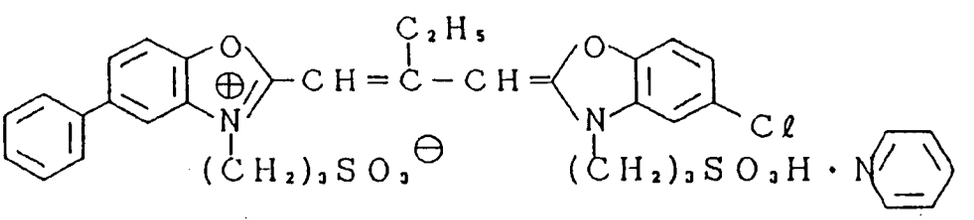
B - 9



B - 10

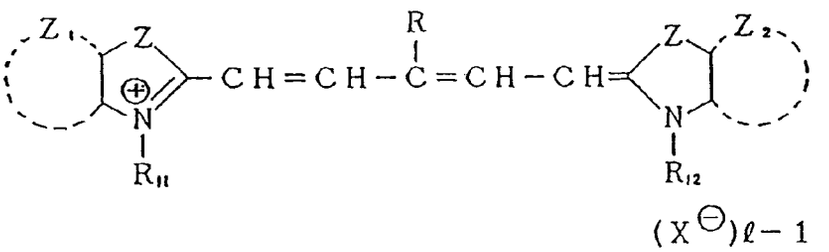


B - 11

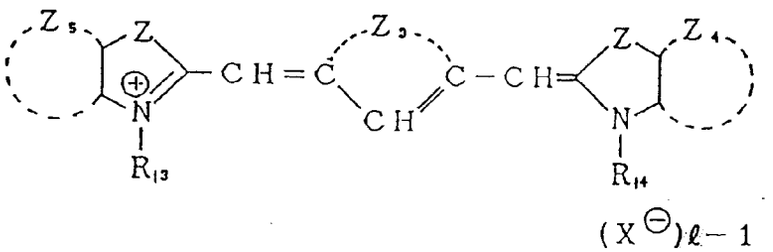


It is preferable for the sensitizing dye preferably used in the invention to be incorporated into the red-sensitive silver halide emulsion layer to be one expressed by the following formula [C] or another expressed by the following formula [D],

Formula [C]



Formula [D]



wherein R represents a hydrogen atom, or an optionally substituted alkyl group; R_{11} through R_{14} individually represent an optionally substituted alkyl group or aryl group; Z_1, Z_2, Z_4, and Z_5 individually represent a group of atoms required to form a benzene or naphthalene ring condensed into a thiazole or selenazole ring; Z_3 represents a group of hydrocarbon atoms required to form a six-membered ring; ℓ represents 1 or 2; Z represents a sulfur atom or selenium atom; $X^{\ominus}$ represents an anion.

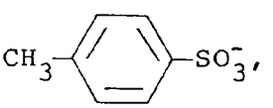
R in the formulas above represents preferably an hydrogen atom, methyl group or ethyl group. It is especially preferable for R to be a hydrogen atom or ethyl group.

R_{11}, R_{12}, R_{13}, and R_{14} individually represent an optionally substituted straight-chained or branched alkyl or aryl group.

The rings formed by Z_1, Z_2, Z_4, and Z_5 are optionally substituted. Preferred substituents are halogen atoms, aryl group, alkyl group, and alkoxy group. Particularly preferred substituents are halogen atoms such as chlorine atom, phenyl group, or methoxy group.

The ring formed by Z_3 is optionally substituted, for example, by an alkyl group.

X represents an anion (such as $C\ell^-$, Br^-, I^-,

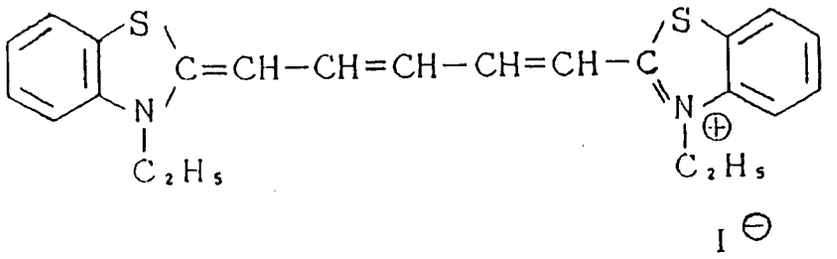


$CH_3SO_4^-$, and $C_2H_5SO_4^-$); and ℓ represents 1 or 2.

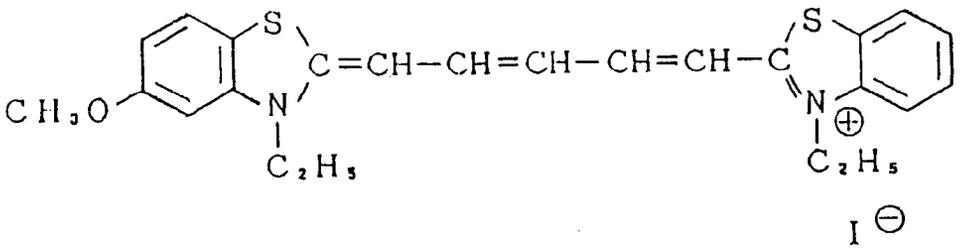
When a compound forms an inner salt, however, ℓ represents 1.

Typical examples of sensitizing dyes preferable in the practice of the present invention, expressed by the formulas [C] and [D], will now be shown hereunder.

C − 1



C − 2



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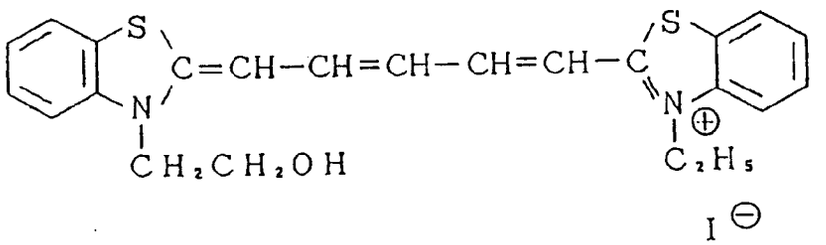

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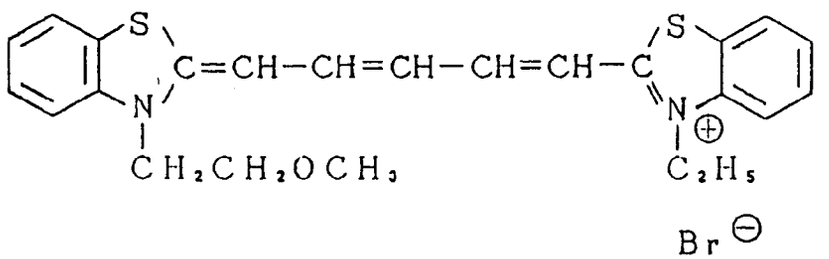

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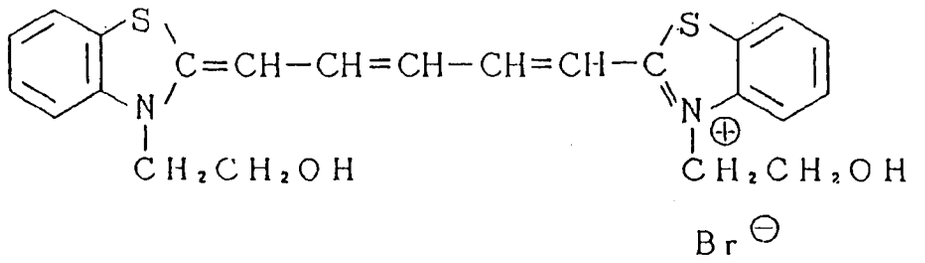

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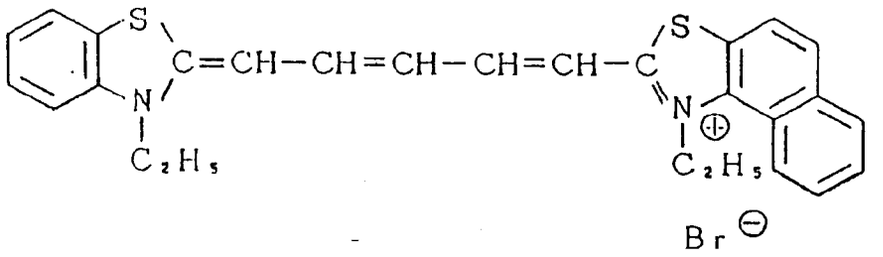
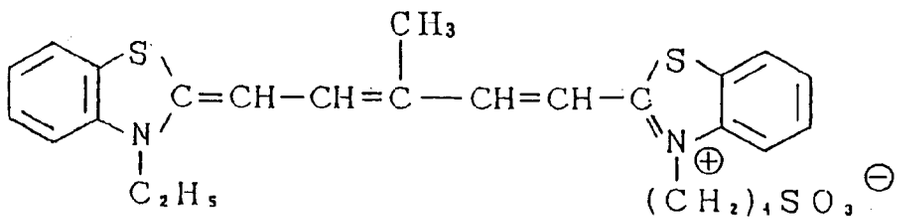
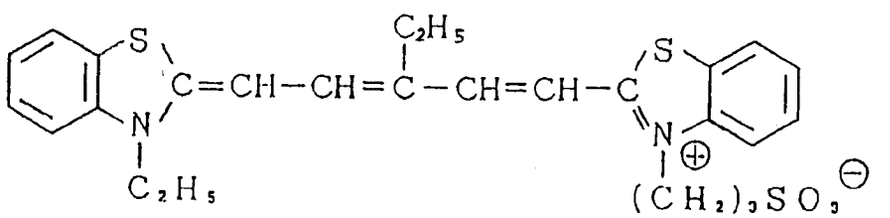


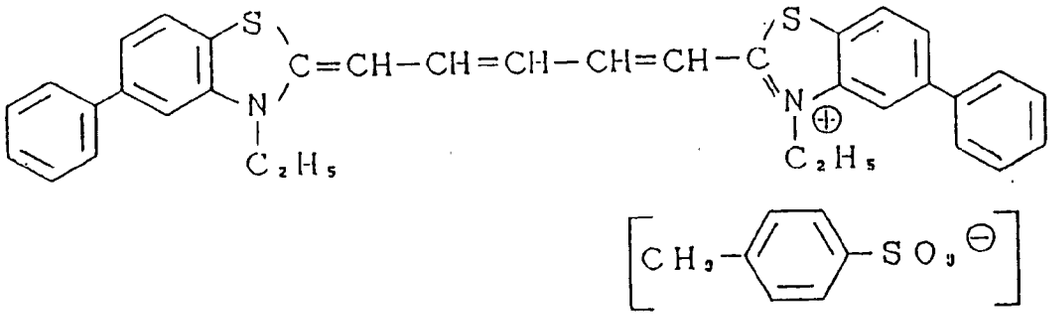
C - 7



C - 8



C - 9



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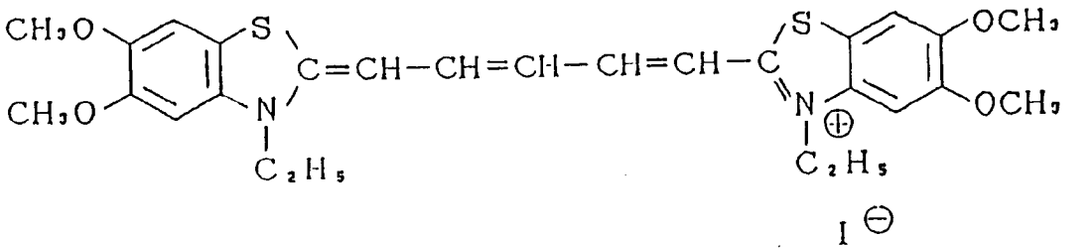

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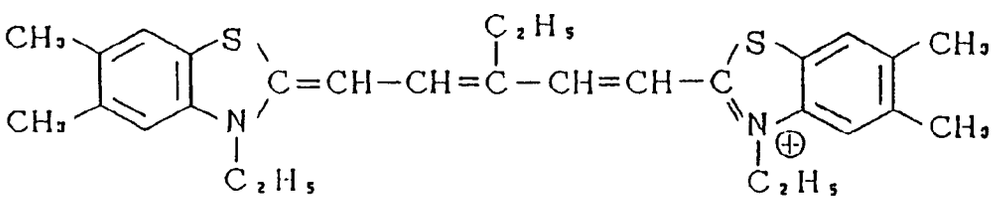

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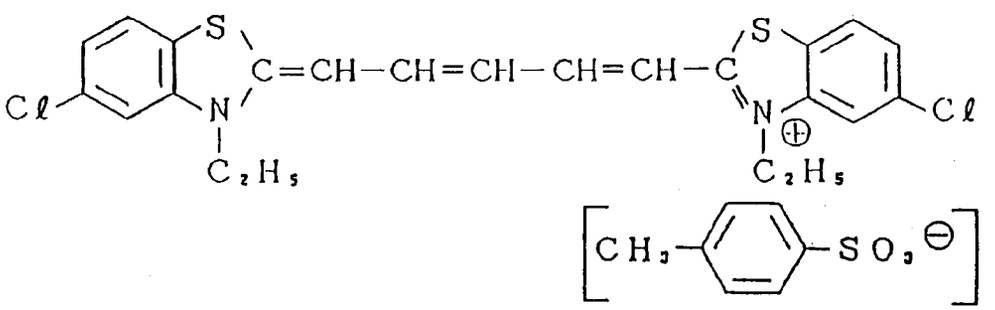
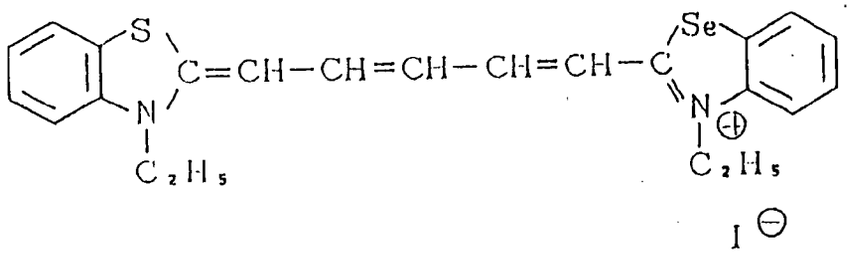


C − 1 3



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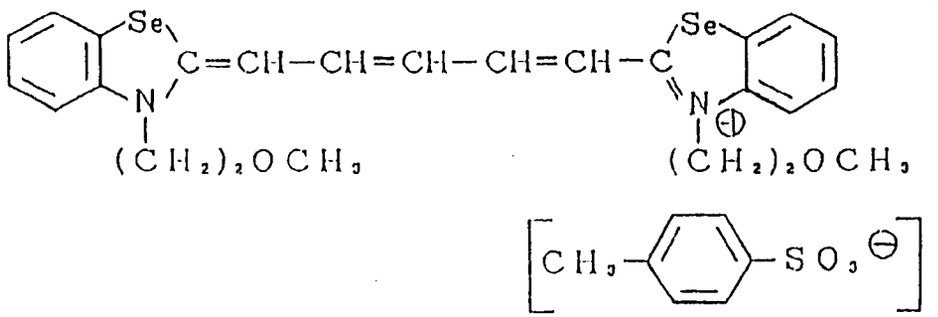

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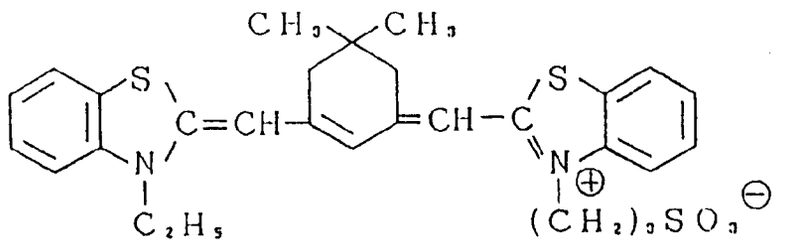

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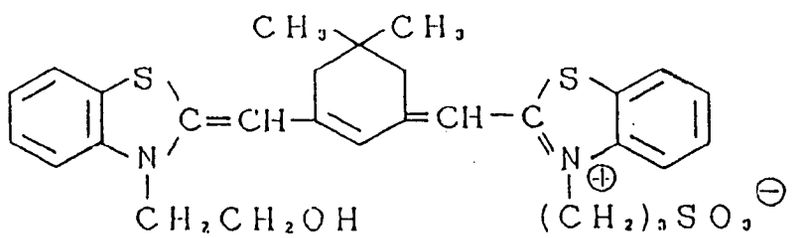

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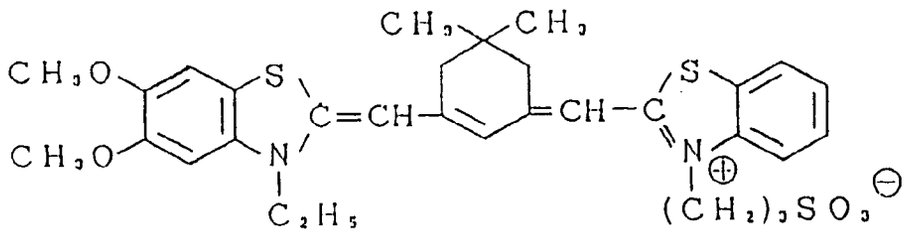

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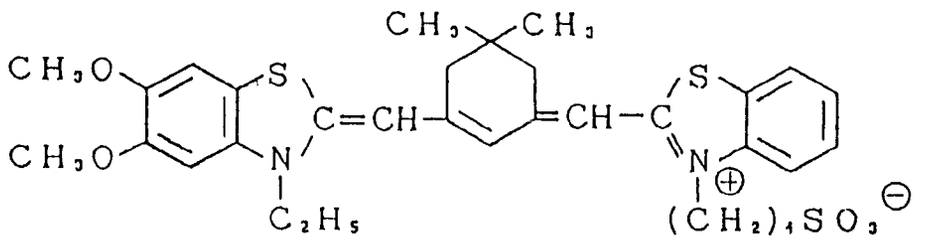

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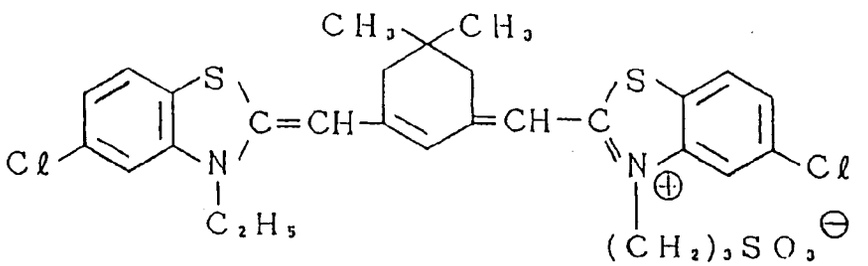
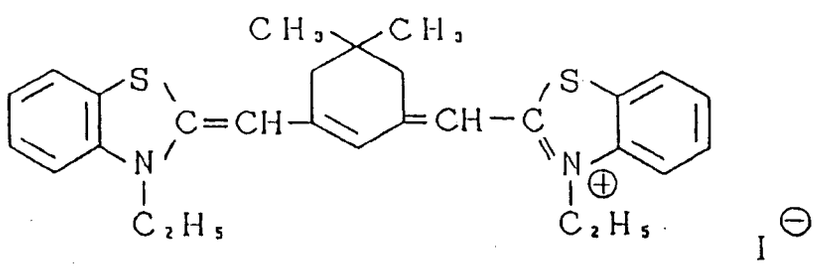
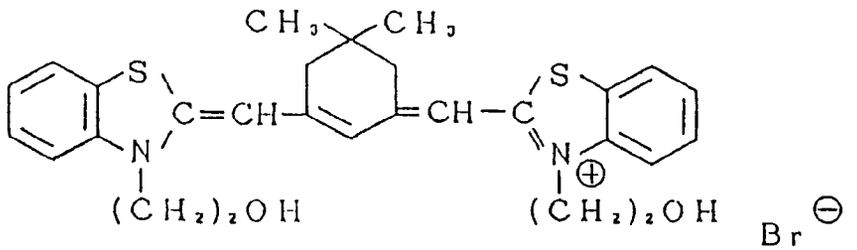


D − 6



D − 7



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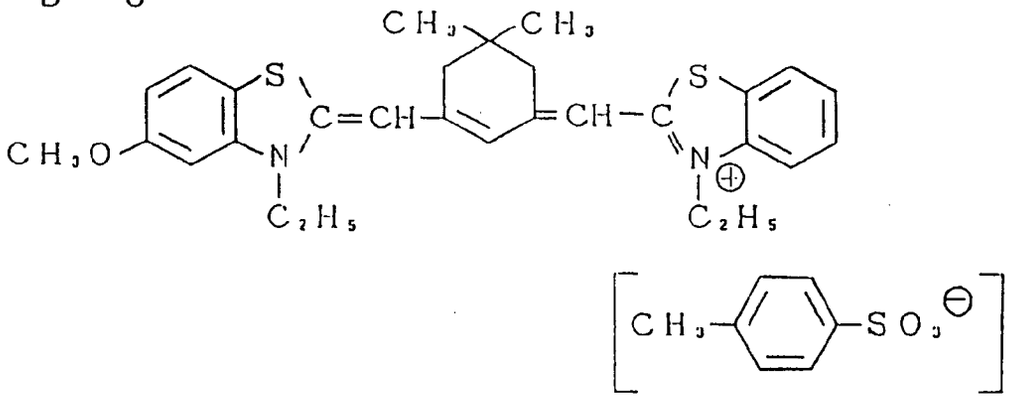
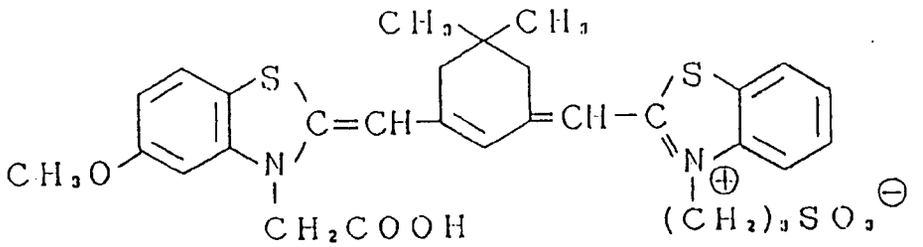
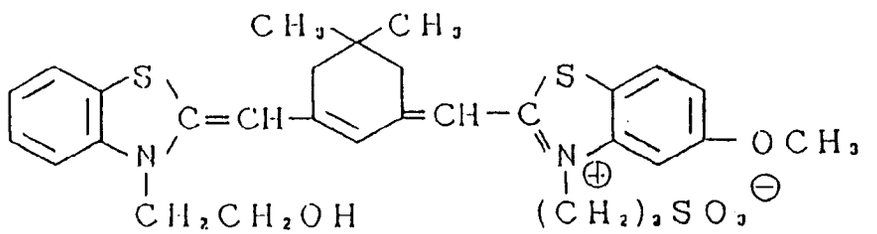


D − 9



D − 10



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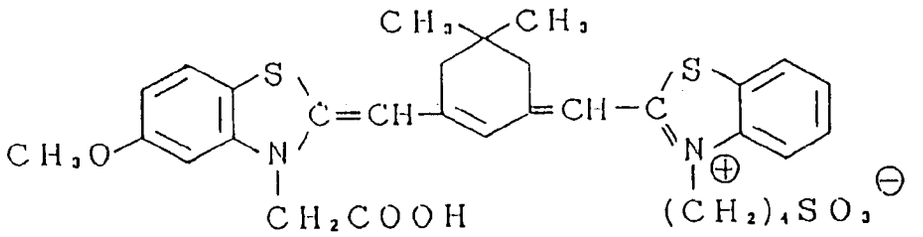
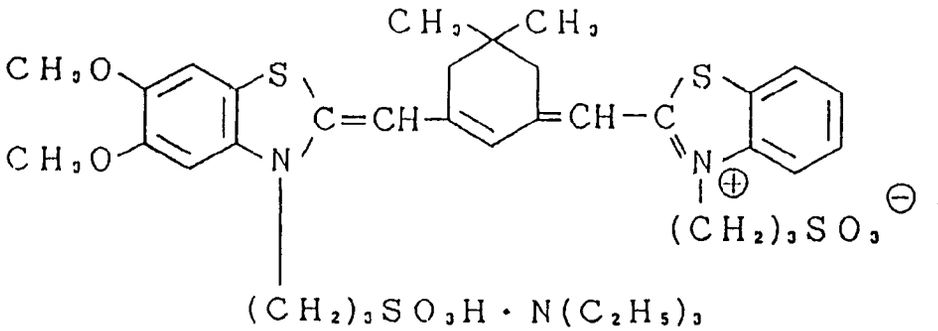
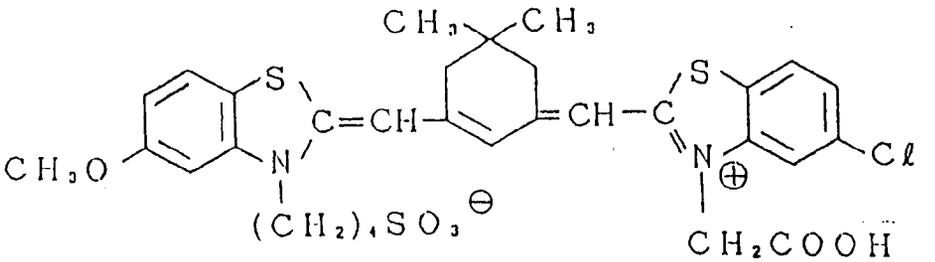


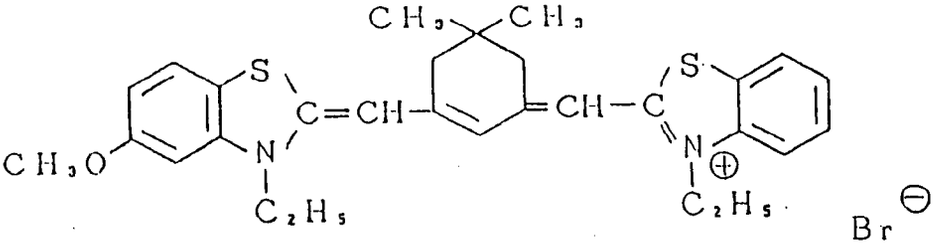
D - 12



D - 13



D - 14



Any of methods well known in the art may be used as a method for adding the sensitizing dyes.

For example, a method wherein the sensitizing dye is dissolved in a water soluble solvent such a pyridine, methyl alcohol ethyl alcohol, methyl Cellosolve and acetone (or the mixture of any of these solvents). The solution is then diluted with water to form a solution which may be added into a coating solution. Otherwise, any

of the sensitizing dyes may be dissolved in water to prepare a solution to be added into a coating solution.

The amount of sensitizing dye being added is not specifically limited. A preferred range of addition is 2 x 10^{-6} to 1 x 10^{-3} mol, in particular, 5 x 10^{-6} to 5 x 10^{-4} mol per mol silver halide.

The silver halide photographic light-sensitive element of the invention having the constitution described above may be, for example, a color negative film, color positive film, or color photographic paper. The effect of the invention is best demonstrated when the material takes the form of a color photographic paper, which will be directly appreciated by human vision.

The silver halide photographic light-sensitive elements of the invention, preferably color photographic paper, may be monochromatic or multi-color. To enable subtraction color reproduction, the multi-color silver halide photographic light-sensitive element usually comprises a support having thereon, in an appropriate order and number, silver halide emulsion layers containing as photographic couplers each of magenta, yellow and cyan couplers, as well as non-light-sensitive layers. The order and number of these layers may be deliberately changed in accordance with the target performance and intended application.

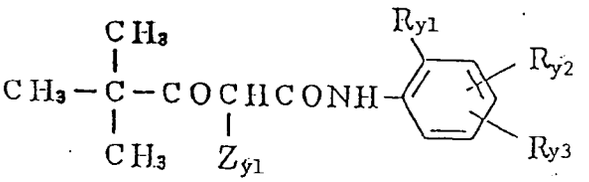
If the silver halide photographic light-sensitive element used in embodying the invention is the preferred multi-color light-sensitive element, the preferred layer configuration comprises a support provided sequentially thereon in the order of a yellow dye-image forming layer, intermediate layer, magenta dye-image forming layer, intermediate layer, cyan dye-image forming layer, intermediate layer, and protective layer.

Into the silver halide emulsion layers of the silver halide color photographic light-sensitive element according to the invention are incorporated dye-forming couplers.

These dye-forming couplers preferably contain within the molecular structure a group known as a "ballast group" which has not less than 8 carbon atoms and is capable of making the coupler non-diffusible.

The preferred yellow dye-forming couplers are acylacetanilide couplers. Among these couplers, benzoylacetanilide compounds and pyvaloylacetanilide compounds are particularly advantageous. The preferred compounds are those represented by the following formula [Y].

Formula [Y]

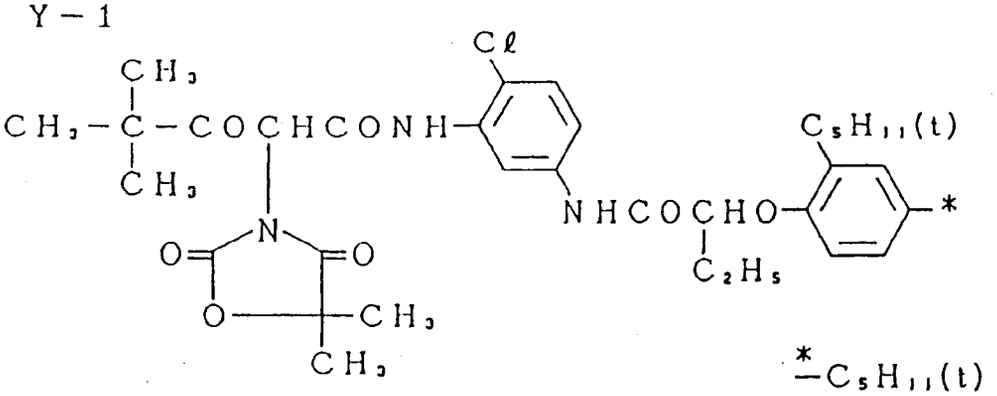


In this formula, R_{y1} represents a halogen atom, or an optionally substituted alkoxy group. R_{y2} represents a hydrogen atom, halogen atom, or an optionally substituted alkoxy group. R_{y3} represents an optionally substituted acylamino group, alkoxycarbonyl group, alkylsulfamoyl group, arylsulfamoyl group, alkylureide group, arylureide group, succinimide group, alkoxy group or aryloxy group. Z_{y1} represents a group being capable of split off by the reaction with an oxidation product of the color developing agent.

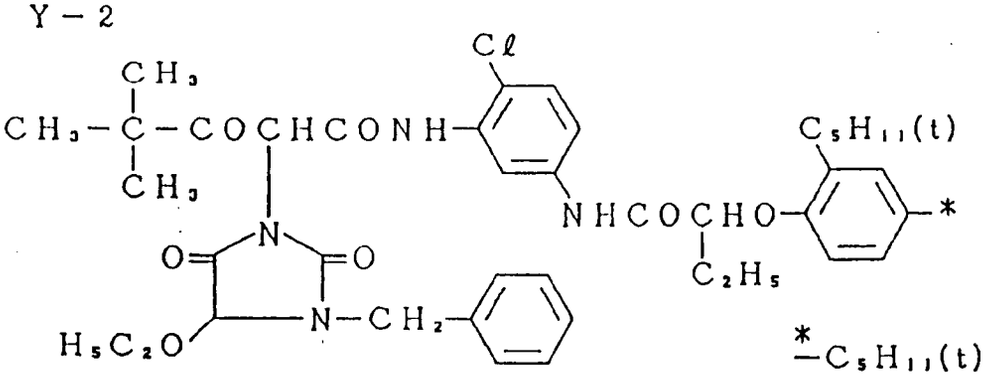
The examples of useful yellow coupler are those described, for example, in British Patent No. 1,077,874, Japanese Patent Examined Publication No. 40757/1970, Japanese Patent O.P.I. Publication Nos. 1031/1972, 26133/1972, 94432/1973, 87650/1975, 3631/1976, 115219/1977, 99433/1979, 133329/1979, and 30127/1981, U.S. Patent 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, 3,939,500, 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.

The typical examples are listed below.

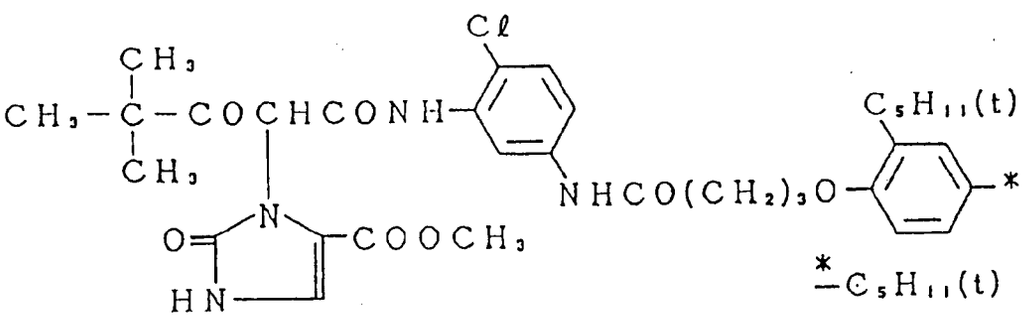
Y − 1



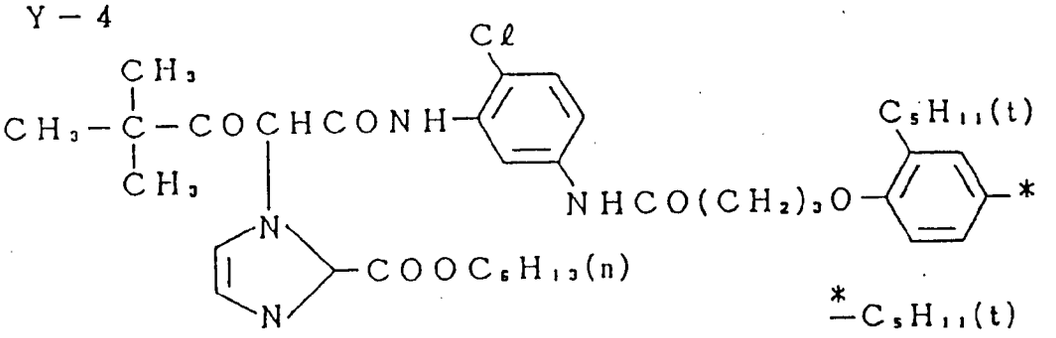
Y − 2



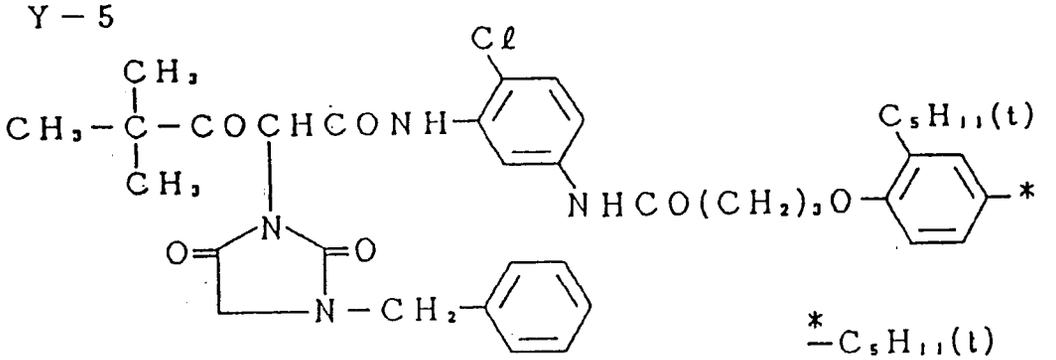
Y − 3



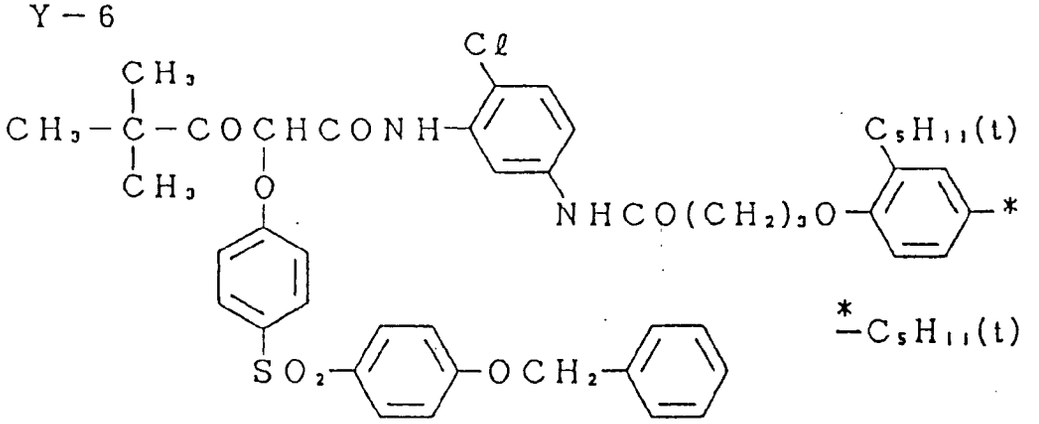
Y − 4



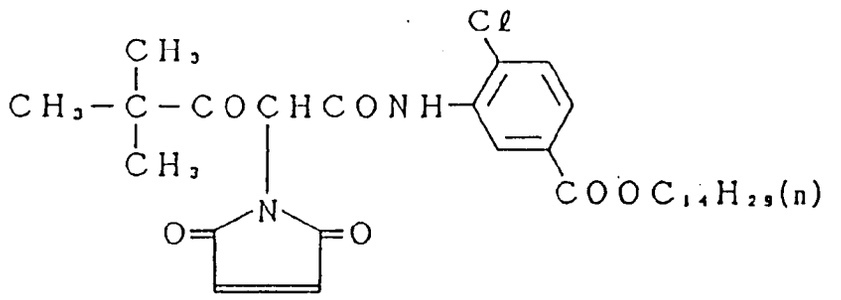
Y − 5



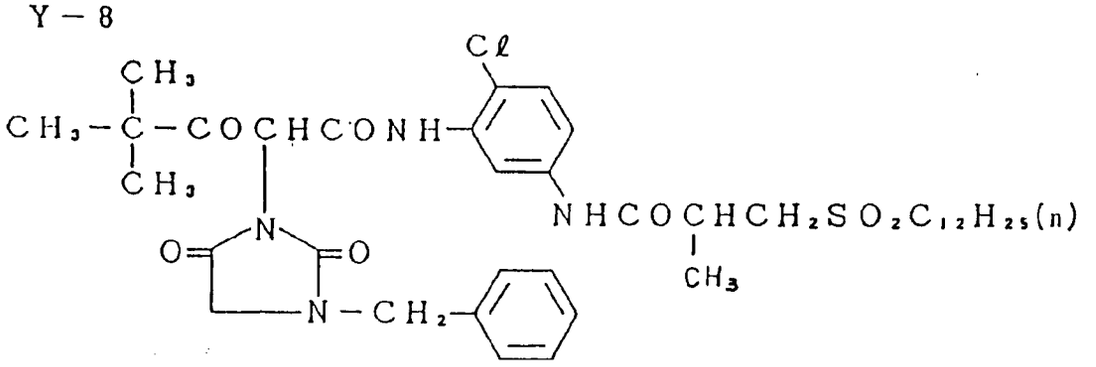
Y − 6



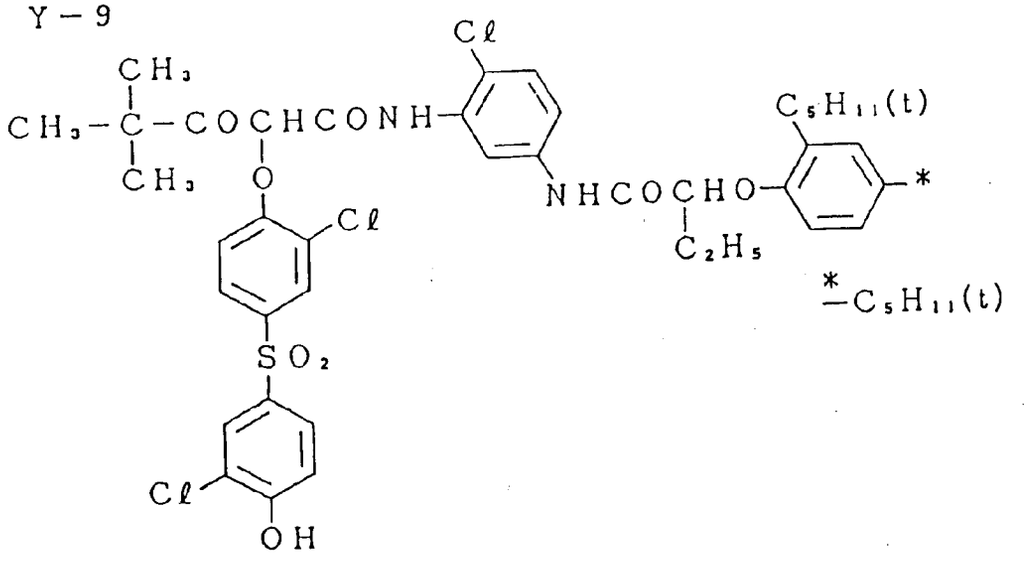
Y − 7



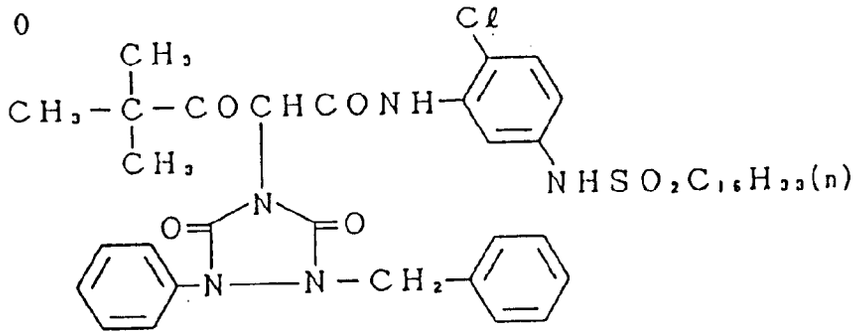
Y − 8



Y − 9

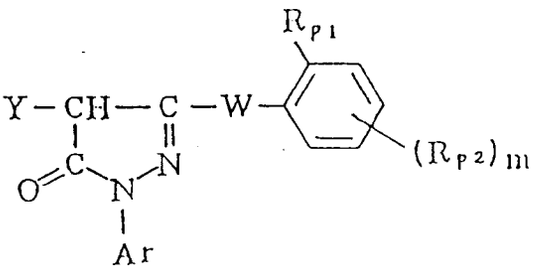


Y-10



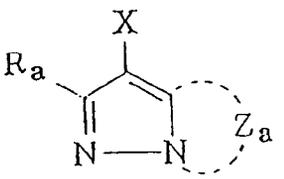
The preferred magenta dye-forming couplers are 5-pyrazolone couplers and pyrazoloazole couplers. Among these couplers, the particularly preferred couplers are those represented by the following formula [P] or [a].

Formula [P]



In this formula, Ar represents an aryl group. R_{p1} represents a hydrogen atom or a substituent group. R_{p2} represents a substituent group. Y represents a group capable of being split off by the reaction with an oxidation product of the color developing agent. W represents -NH-, -NHCO- (N atom being bonded to a carbon atom on the pyrazolone nuclei), or -NHCONH-. m represents an integer, 1 or 2.

Formula [a]



In this formula, Z_a represents a group of non-metal atoms required for forming a nitrogen-heterocycle. The heterocycle formed by this Z_a may have a substituent.

X represents a hydrogen atom, or a group capable of being split off by the reaction with an oxidation product of the color developing agent.

R_a represents a hydrogen atom, or a substituent group.

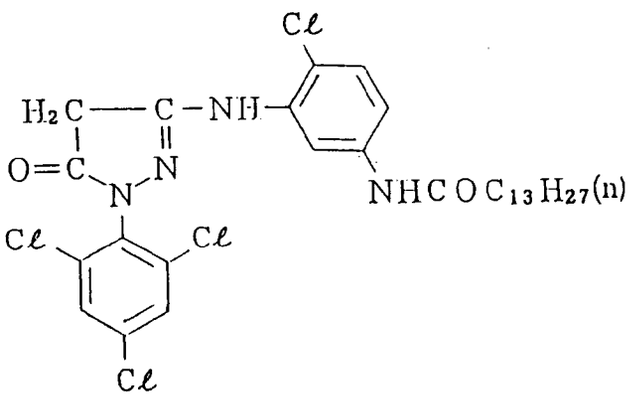
The examples of a substituent group represented by R_a include a halogen atom, alkyl group, cycloalkyl group, alkenyl group, cycloalkenyl group, alkinyl group, aryl group, heterocyclic group, acyl group, phosphonyl group, carbamoyl group, sulfamoyl group, cyano group, spiro compound residue group, bridged hydrocarbon

compound residue group, alkoxy group, aryloxy group, heterocyclic oxy group, siloxy group, acyloxy group, carbamoyloxy group, amino group, acylamino group, sulfonamide group, imide group, ureide group, sulfamoylamino group, alkoxycarbonylamino group, aryloxycarbonylamino group, alkoxycarbonyl group, aryloxycarbonyl group, alkylthio group, arylthio group, and heterocyclic thio group.

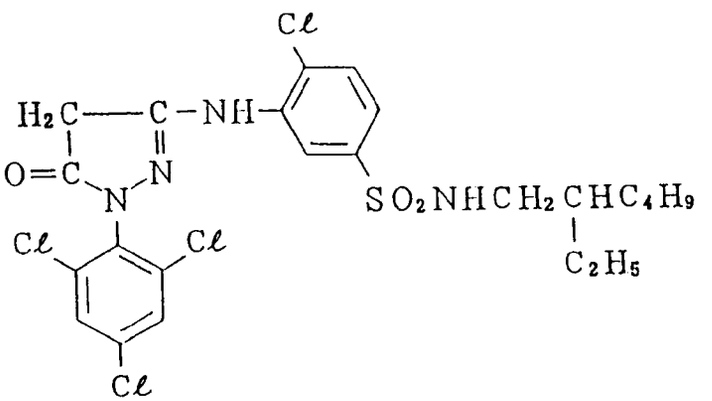
The examples of a magenta coupler are described, for example, in U.S. Patent Nos. 2,600,788, 3,061,432, 3,062,653, 3,127,269, 3,311,476, 3,152,896, 3,419,391, 3,519,429, 3,555,318, 3,684,514, 3,888,680, 3,907,571, 3,928,044 3,930,861, 3,930,866, and 3,933,500, Japanese Patent O.P.I. Publication Nos. 29639/1974, 111631/1974, 129538/1974, 58922/1977, 62454/1980, 118034/1980, 38043/1981, 35858/1982, and 23855/1985, British Patent No. 1,247,493, Belgium Patent Nos. 769,116 and 792,525, West German Patent No. 2,156,111, Japanese Patent Examined Publication No. 60479/1971, Japanese Patent O.P.I. Publication Nos. 125732/1984, 228252/1984, 162548/1984, 171956/1984, 33552/1985, and 43659/1985, West German Patent No. 3,725,067, and U.S. Patent No. 3,725,067.

The typical examples are listed below.

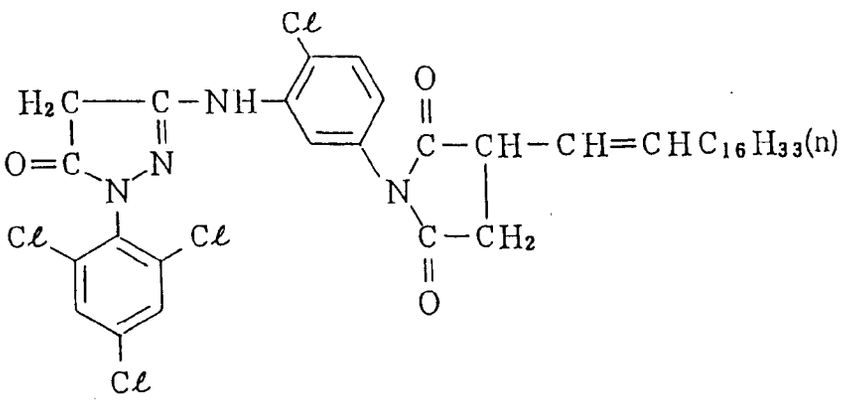
m − 1



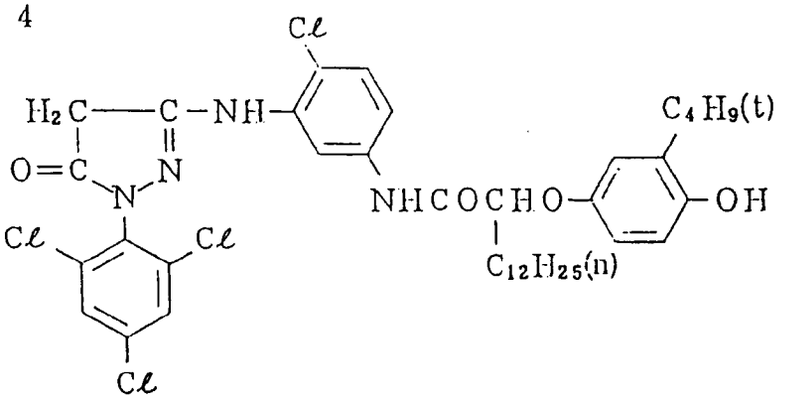
m − 2



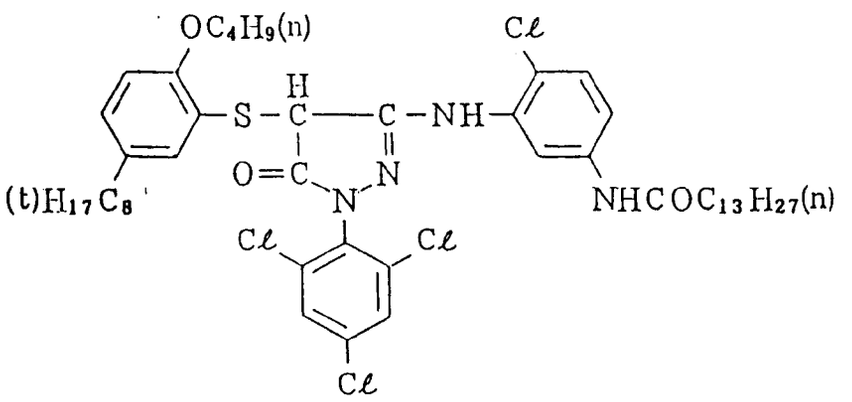
m – 3



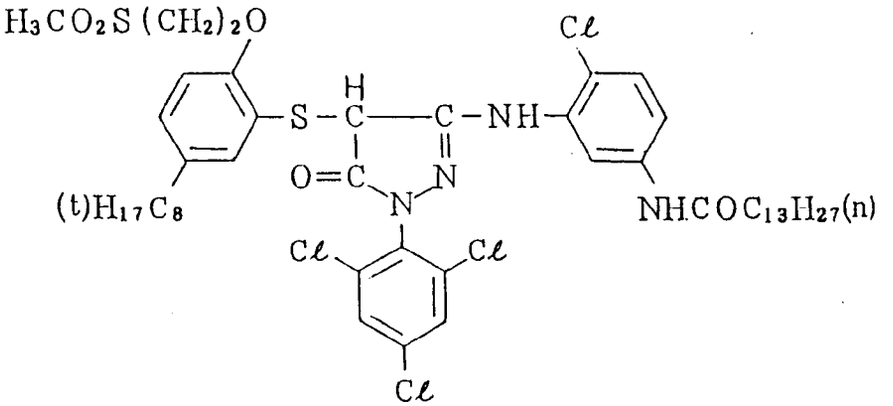
m – 4



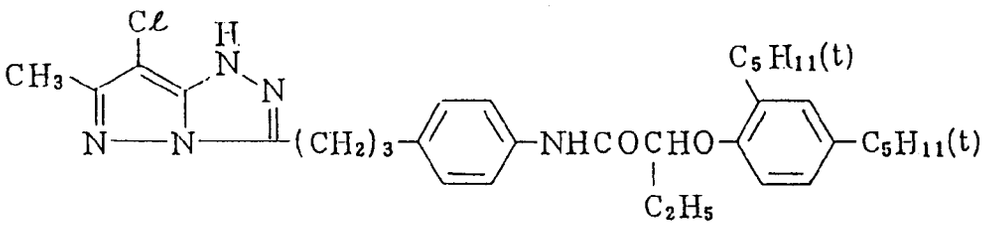
m – 5



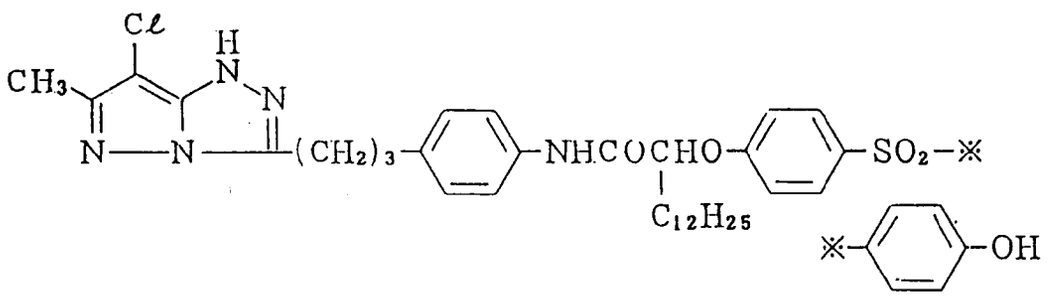
m -- 6



m -- 7



m -- 8



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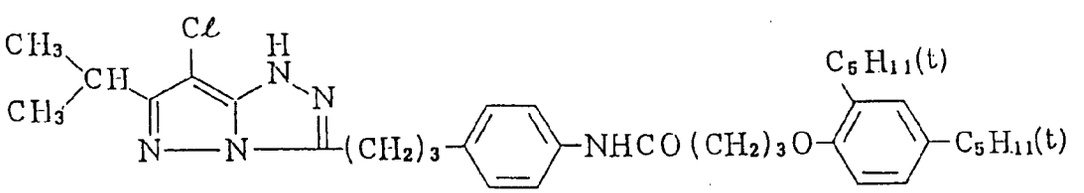

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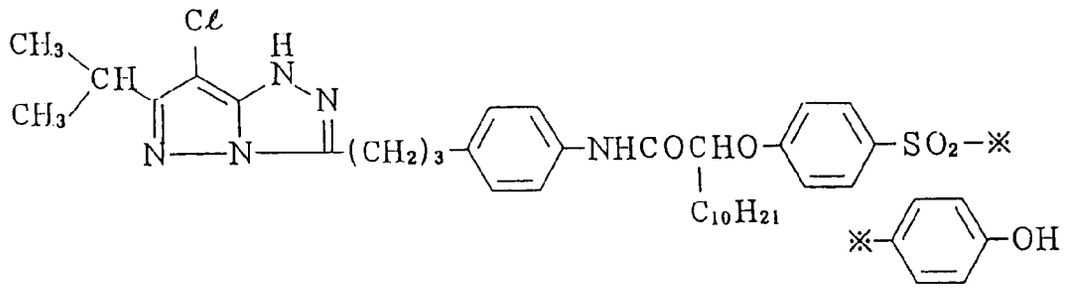

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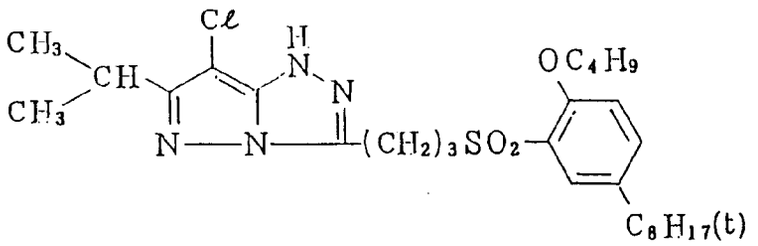
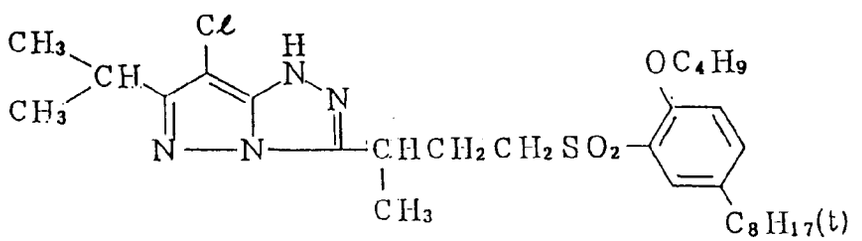
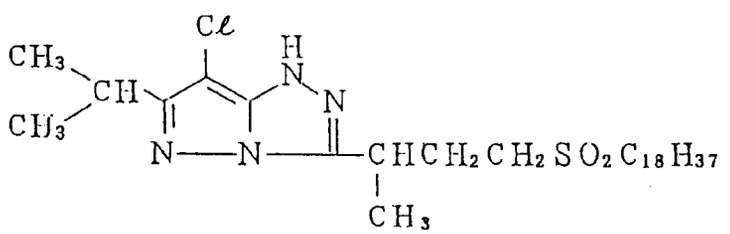


m - 12



m - 13



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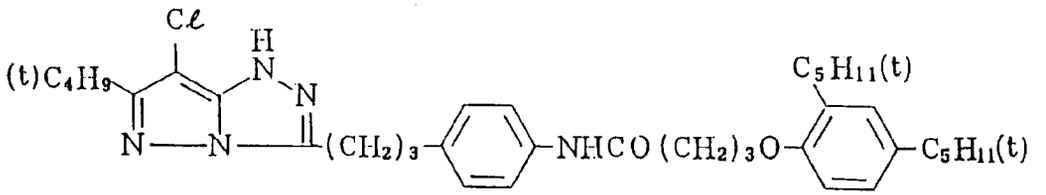
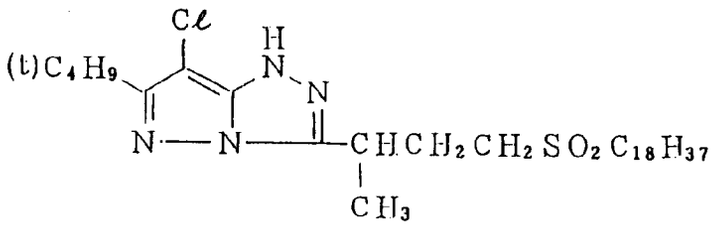
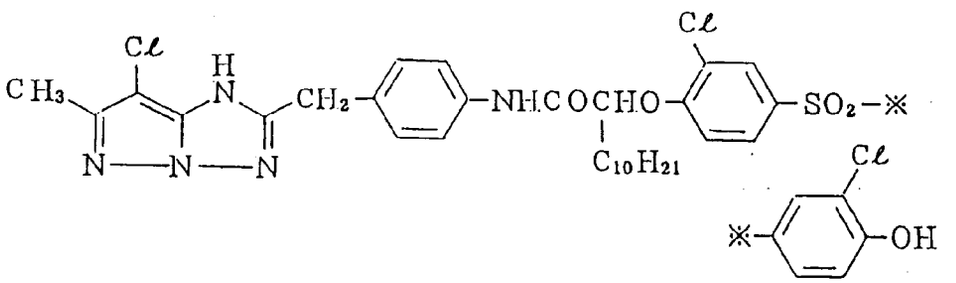


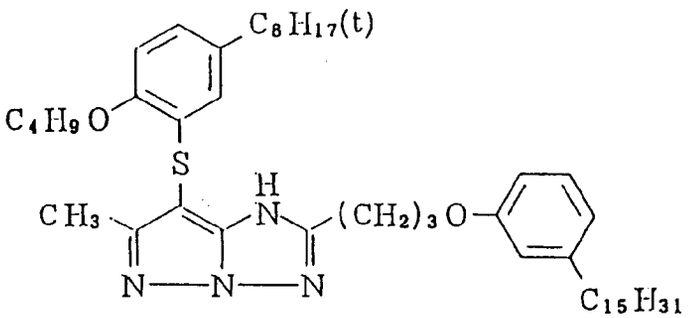
m – 15



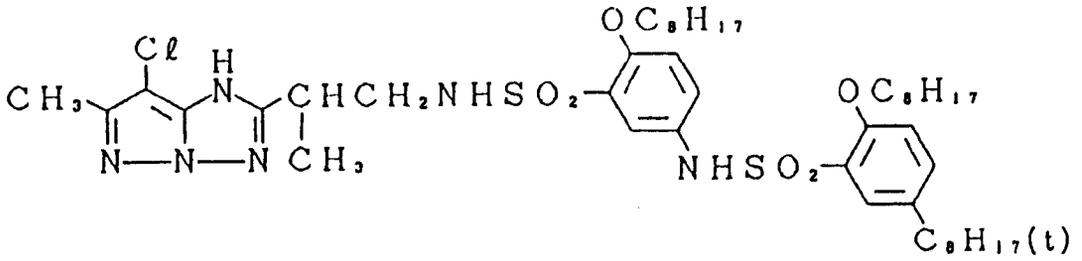
m – 16



m – 17

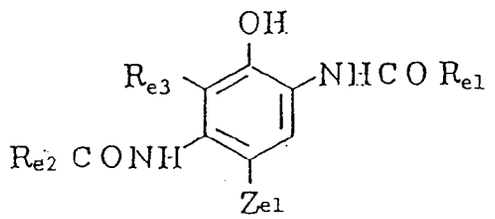


m－18



The cyan dye-forming couplers preferably used are phenol and naphthol cyan dye forming couplers. Among these couplers, the particularly preferred couplers are those represented by the following formula [E] or [F].

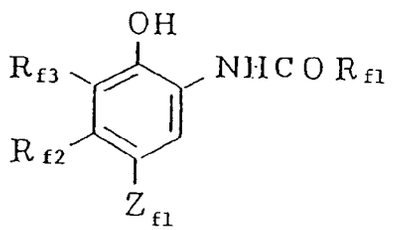
Formula [E]



In this formula, R_{e1} represents an alkyl group, cycloalkyl group or heterocyclic group. R_{e2} represents an alkyl group or phenyl group. R_{e3} represents a hydrogen atom, halogen atom, alkyl group or alkoxy group. Z_{e1} represents a hydrogen atom, or a group being capable of split off by the reaction with an oxidation product of the color developing agent.

R_{e1} through R_{e3} are optionally substituted.

Formula [F]



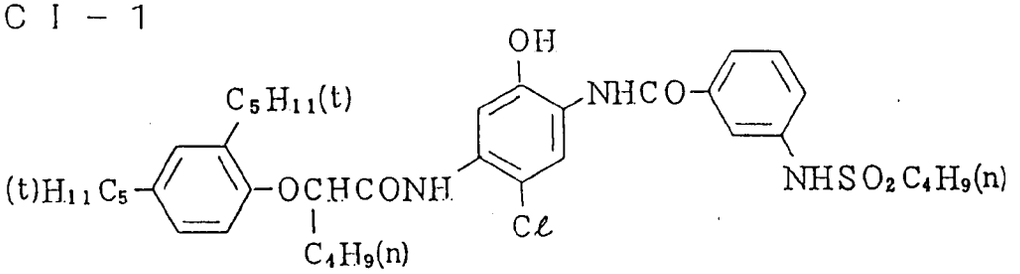
In this formula, R_{f1} represents an alkyl group such as a methyl group, ethyl group, propyl group, butyl group, and nonyl group. R_{f2} represents an alkyl group such as a methyl group and ethyl group. R_{f3} represents a hydrogen atom, halogen atom such as fluorine, chlorine and bromide, or alkyl group. Z_{f1} represents a hydrogen atom, or a group capable of being split off by the reaction with an oxidation product of the color developing agent.

R_{f1} through R_{f3} may have a substituent group.

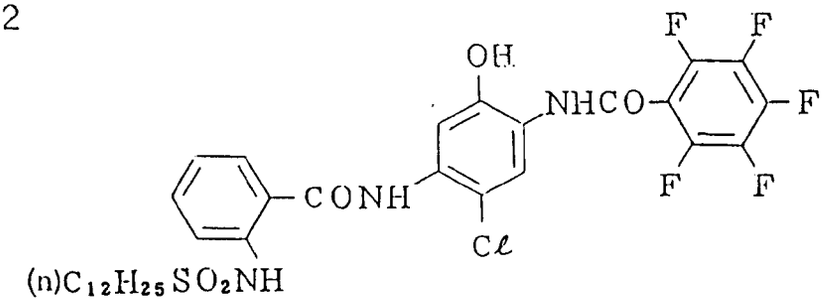
The examples of such a cyan dye-forming coupler are described, for example, in U.S. Patent Nos. 2,306,410, 2,362,598, 2,367,531, 2,369,929, 2,423,730, 2,474,293, 2,476,008, 2,498,466, 2,545,687, 2,728,660, 2,772,162, 2,895,826, 2,976,146, 3,002,836, 3,419,390, 3,446,622, 3,476,563, 3,737,316, 3,758,308, and 3,839,044, British Patent Nos. 478,991, 945,452, 1,084,480, 1,377,233, 1,388,024, and 1,543,040, Japanese Patent O.P.I. Publication Nos. 37425/1972, 10135/1975, 25228/1975, 112038/1975, 117422/1975, 130441/1975, 6551/1976, 37647/1976, 52828/1986, 108841/1976, 109630/1978, 48237/1979, 66129/1979, 131931/1979, 32071/1980, 146050/1984, 31953/1984, and 117249/1985.

The typical examples are listed below.

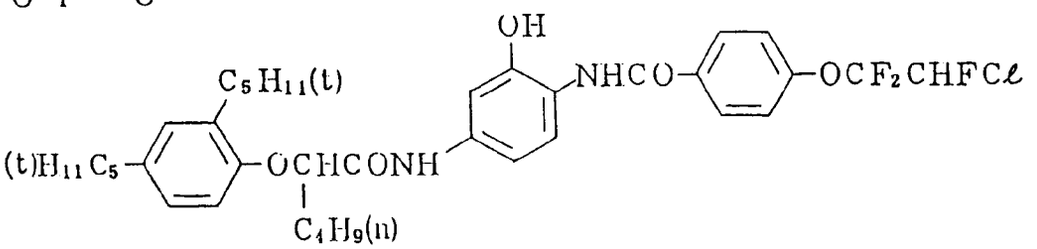
C I - 1



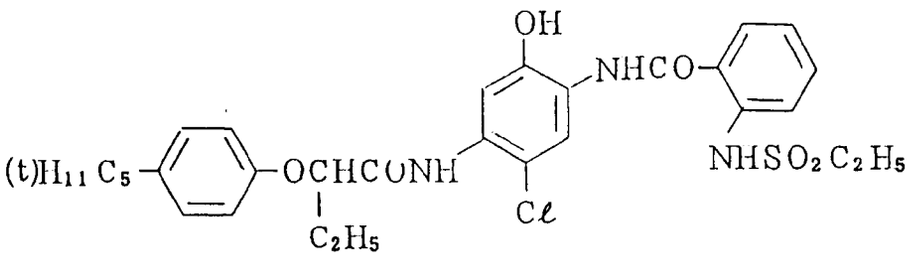
C I - 2



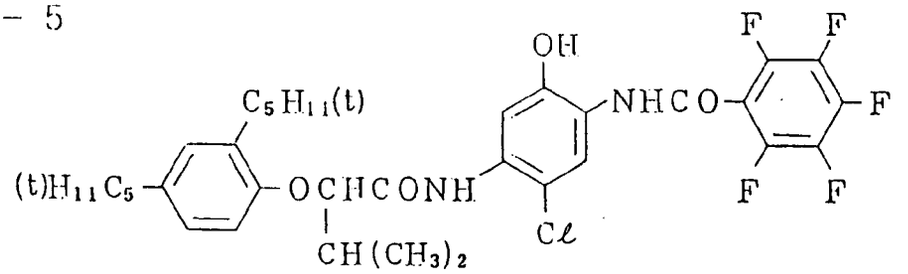
C I - 3



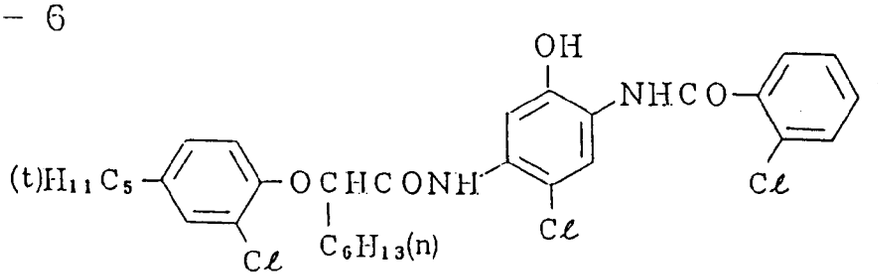
C I - 4



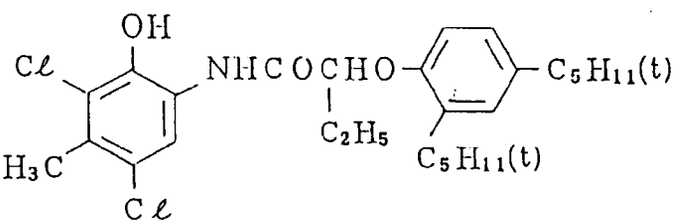
C I - 5



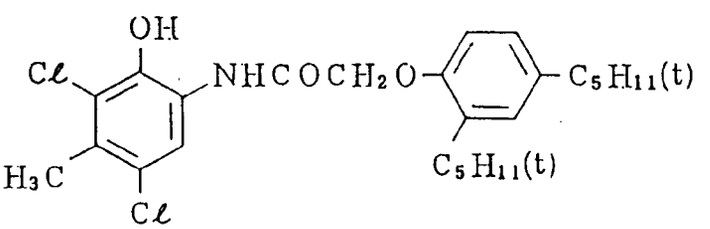
C I - 6



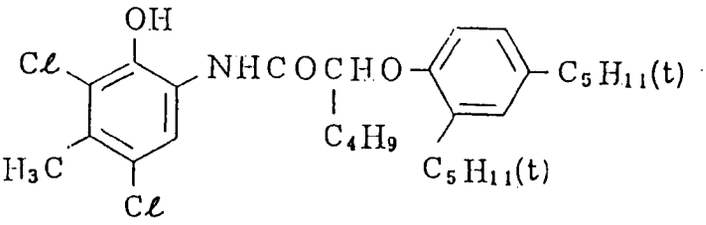
C I - 7



C I - 8



C I -- 9



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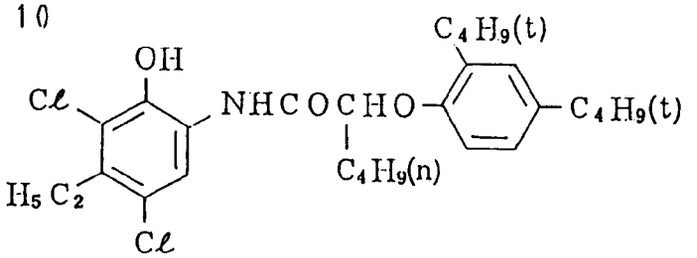
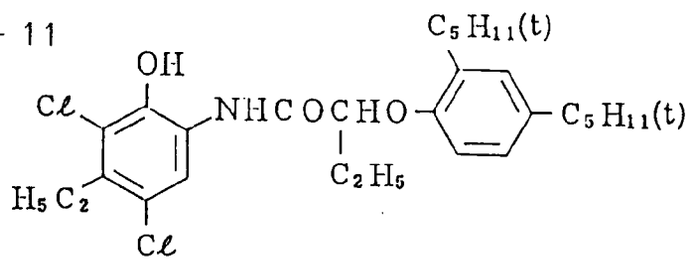
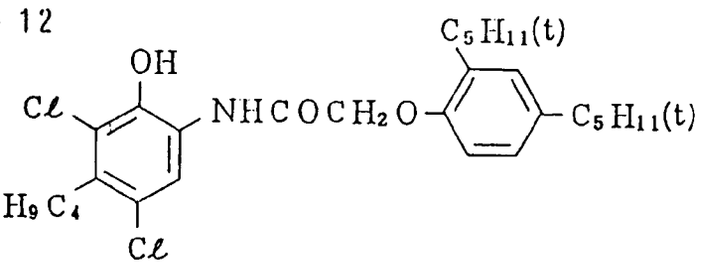


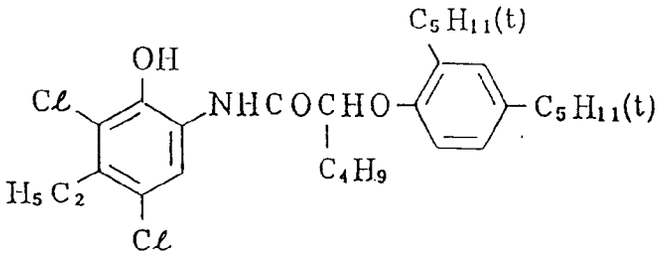
C I -- 11



C I -- 12



C I – 13



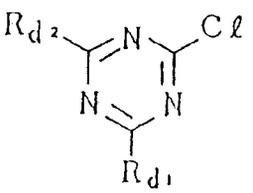
The dye forming coupler preferably used in the invention is incorporated into each silver halide emulsion layer, preferably, at a rate of 1×10^{-3} to 1 mol, or, more preferably, 1×10^{-2} to 8×10^{-1} mol per mol silver halide.

The preferable binder, or protective colloid, incorporated into the silver halide photographic light-sensitive element according to the invention is gelatin. Other useful binders include a gelatin derivative, graft polymer of gelatin and another high-molecular compound, protein, sugar derivative, cellulose derivative, and hydrophilic colloid of synthesized high-molecular compound such as monomer or polymer.

The photographic emulsion layers and other hydrophilic colloid layers of the silver halide photographic light-sensitive element of the invention are preferably hardened by using hardeners individually or in combination which enhance layer strength by bridging between binder, or protective colloidal, molecules. The hardeners are preferably incorporated at a rate enough to eliminate hardeners added to processing solutions. However, the hardeners may be added to processing solutions.

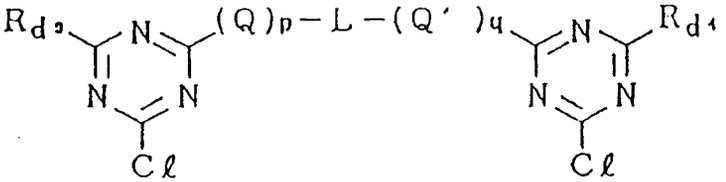
A chlorotriazine hardener, represented by the following formula [HDA] or [HDB], is preferably used to harden the silver halide emulsion layers.

Formula [HDA]



In this formula, R_{d1} represents a chlorine atom, hydroxy group, an optionally substituted alkyl group, alkoxy group, alkylthio group, or an -OM group (M represents a monovalent metal atom), -NR′R″ group (R′ and R″ independently represent a hydrogen atom, alkyl group or aryl group), or -NHCOR‴ group (R‴ represents an alkyl group or aryl group). R_{d2} is the same as R_{d1} above, except that it may not represent a chlorine atom.

Formula [HDB]

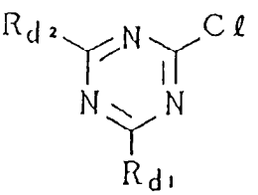


In this formula, R_{d3} and R_{d4} independently represent a chlorine atom, hydroxy group, or an optionally substituted alkyl group, alkoxy group, or an -OM group in which M represents a monovalent metal atom. Q and Q′ independently represent a connecting group such as -O-, -S- or -NH-. L represents an alkylene group or

an arylene group. p and q independently represent 0 or 1.

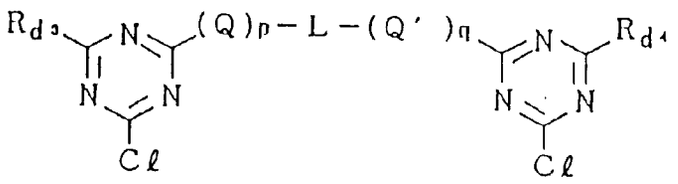
The typical examples of the preferred hardeners represented by formula [HDA] or [HDB] above are hereinunder listed.

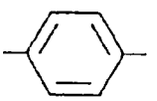
Formula [HDA]



Compound No.	R_{d1}	R_{d2}
HD-1	-OH	-ONa
HD-2	-Cℓ	-ONa
HD-3	-OCH$_3$	-ONa
HD-4	-Cℓ	-OC$_2$H$_5$
HD-5	-Cℓ	-OK
HD-6	-OH	-OK
HD-7	-Cℓ	-NH$_2$
HD-8	-Cℓ	-NHCOCH$_3$
HD-9	-OH	-NHC$_2$H$_5$
HD-10	-CH$_3$	-NHC$_6$H$_5$
HD-11	-NH$_2$	-NHCOC$_6$H$_5$
HD-12	-NHCOCH$_3$	-C$_2$H$_5$

Formula [HDB]



Compound No.	R_{d3}	R_{d4}	Q	p	Q'	q	L
HD-13	$-C\ell$	$-C\ell$	O	1	O	1	
HD-14	$-ONa$	$-ONa$	O	1	O	1	$-CH_2CH_2-$
HD-15	$-ONa$	$-ONa$	—	0	—	0	$-CH_2CH_2-$
HD-16	$-OCH_3$	$-OCH_3$	S	1	S	1	$-CH_2CH_2-$
HD-17	$-ONa$	$-ONa$	$-\overset{H}{\underset{}{N}}-$	1	$-\overset{H}{\underset{}{N}}-$	1	$-CH_2CH_2-$
HD-18	$-ONa$	$-ONa$	$-\overset{H}{\underset{}{N}}-$	1	O	1	$-CH_2CH_2-$
HD-19	$-OH$	$-OH$	O	1	O	1	$-CH_2CH_2-$
HD-20	$-CH_3$	$-CH_3$	O	1	O	1	$-CH_2CH_2-$

The hardener represented by formula either [HDA] or [HDB] is preferably incorporated into silver halide emulsion layers and other structural layers by dissolving the hardener in water, or a solvent compatible with water such as methanol and ethanol, thereby adding the resultant solution to a coating solution for these structural layers. The method of addition can be either a batch process or an in-line process. The timing of addition is not specifically limited. However, the preferred timing of addition is immediately before the application of coating solutions.

These hardeners are added at a rate of 0.5 to 100 mg, or, preferably, at a rate of 2.0 to 50 mg per 1 gram gelatin being applied.

To the silver halide photographic light-sensitive element of the invention various additives such as an anti-stain agent, image-stabilizing agent, ultraviolet absorbent, plasticizer, latex, surface active agent, matting agent, lubricant, and anti-static agent, may optionally be added.

The silver halide photographic light-sensitive element according to the invention may generally form an image by color developing known in the art.

The color developing agents incorporated into the color developers, according to the invention, include aminophenol derivatives and p-phenylenediamine derivatives widely used in various color photographic processes.

To the color developer solution used in processing the silver halide photographic light-sensitive element

of the invention are added, in addition to the primary aromatic amine color developing agent mentioned previously, optionally compounds known as developer components.

The pH value of a color developer solution is normally higher than 7, or, most usually, approx. 10 to 13.

The color developing temperature is usually higher than 15°C, or, generally, within a range of 20 to 50°C. For rapid developing, the preferred temperature is higher than 30°C. A conventional color developing requires 3 to 4 minutes, while the preferred color developing time intended for rapid processing is usually within a range of 20 to 60 seconds, more preferably, 30 to 50 seconds.

Once the color developing is complete, the silver halide photographic light-sensitive element of the invention is subjected to bleaching and fixing. The bleaching and the fixing may be performed simultaneously.

After the fixing, the element is usually subjected to rinsing with water. Stabilizing may substitute the rinsing, or these two steps may be used in combination.

As described above, the silver halide photographic light-sensitive element of the invention excels in rapid processability, as well as in decolorization of the dyes, wherein the resultant photographic image has improved sharpness.

EXAMPLES

Example-1

Using a double jet precipitation process, the following silver chloro-bromide emulsions and silver chloride emulsions were prepared.

Emulsion No.	Grain size (μm)	Silver chloride content (mol%)	Variation coefficient
Em-A (Comparative)	0.5	20	0.12
Em-B (Comparative)	0.5	50	0.13
Em-C (Invention)	0.5	90	0.11
Em-D (Invention)	0.5	95	0.08
Em-E (Invention)	0.5	100	0.08

Em-A through Em-E above were, using a conventional method, subjected to sulfur sensitization by adding sodium thiosulfate, and further subjected to optical sensitization using exemplified sensitizing dye No. C-9. Thus, red-sensitive silver halide emulsions Em-R Nos. A through E were prepared.

On a polyethylene-laminated paper support were simultaneously applied and dried the coating solutions for the first and second layers. Thus, mono-color light-sensitive element sample No. 1 was prepared.

The amounts added for each coating solution are indicated by amounts applied per each independent coat formed.

First layer: red-sensitive silver halide emulsion layer

Contains red-sensitive silver halide emulsion listed in Table-1 in an amount, as converted into metal silver, of 3 mg/dm^2; example cyan coupler CI-5, in an amount of 2 mg/dm^2; example cyan coupler CI-7, in an amount of 2 mg/dm^2; dioctylphthalate as a high boiling organic solvent, in an amount of 3 mg/dm^2; hydroquinone derivative HQ-1 mentioned later, in an amount of 0.15,mg/dm^2; gelatin, in an amount of 14 mg/dm^2; and HD-2 as a hardener in an amount of 0.05 mg/dm^2.

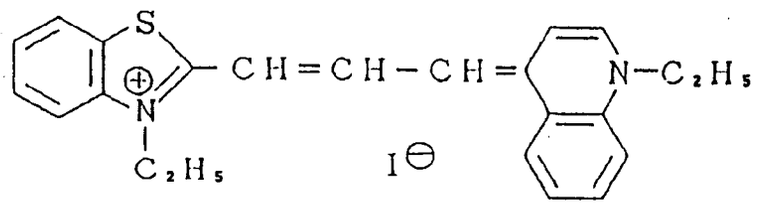
Second layer: protective layer

Contains respective compound listed in Table-1 in an amount of 0.1 mg/dm^2 or Comparative-1 as a comparative compound in an amount of 0.2 mg/dm^2; polyvinyl pyrrolidone weight average molecular weight, 360,000, as a capturing material for fluorescent whitening agent in an amount of 0.55 mg/dm^2; gelatin, in an amount of 20 mg/dm^2; and HD-2 as a hardener, in an amount of 0.05 mg/dm^2.

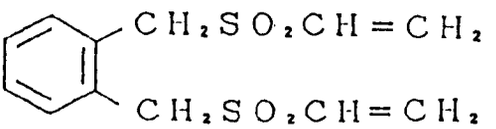
Light-sensitive element sample Nos. 2 through 44 were prepared in manner identical with that of sample No. 1 above, except that the combination of Em, type of compound represented by formula [I], layer containing material for capturing fluorescent whitening agent, and coating solution dissolving them, were modified as listed in Table-1, each substance was used in the same proportion.

Additionally, sample No. 45 was prepared in a manner identical with that of sample No. 10, except that the following sensitizing dye A was used instead of exemplified sensitizing dye No. C-9 in Em-E. Sample Nos. 46 and 47 were prepared in a manner identical with sample No. 10, except that polyvinyl pyrrolidone in the second layer of sample No. 10 was replaced for No. 46 with a like weight of polyvinyl alcohol, with a polymerization degree of approx. 500 and a saponification degree of 88%; and for No. 47 with a copolymer (1 : 1, by molecular ratio) of vinyl pyrrolidone and methacrylic acid. Sample Nos. 48, 49 and 50 were prepared in a manner identical with sample No. 10, except that polyvinyl pyrrolidone added was at a rate of 0.275 mg/dm^2 (No. 48), 0.11 mg/dm^2 (No. 49), or 0.055 mg/dm^2 (No. 50). Sample No. 51 was prepared in a manner identical with that of sample No. 10, except that a hardener, examplified compound No. HD-2, in the first and second layers was replaced with the same weight of the following hardener H-1.

Sensitizing dye A



Hardener H-1



The respective samples prepared above were subjected to the following processes without undergoing exposing, or after undergoing wedge exposing with photographic sensitometer Model KS-7 (Konica Corporation).

[Treatment]

	Temperature	Time
Color developing	34.7 ± 0.3°C	50 sec.
Bleach-fixing	34.7 ± 0.5°C	50 sec.
Stabilizing	30 to 34°C	90 sec.
Drying	60 to 80°C	60 sec.

[Color developer]

Pure water	800 mℓ
Ethylene glycol	10 mℓ
N,N-diethylhydroxylamine	10 g
Potassium chloride	2 g
Potassium sulfite	0.1 g
N-ethyl-N-β-methanesulfonamideethyl-3-methyl-4-aminoaniline sulfite	5 g
Sodium tetrapolyphosphate	2 g
Potassium carbonate	30 g
Fluorescent whitening agent (4,4-diaminostilbenzosulfonate derivative	1 g

Water was added to the components above to prepare a one liter solution, thereby the pH level was adjusted to 10.08.

[Bleach-fixer]

Ferric ammonium ethylenediaminetetraacetate dihydrate	60 g
Ethylenediaminetetraacetic acid	3 g
Ammonium thiosulfate (70% aqueous solution)	100 mℓ
Ammonium sulfite (40% aqueous solution)	27.5 mℓ

The pH level was adjusted to 7.1 using potassium carbonate or glacial acetic acid, thereby water was added to prepare a one liter solution.

[Stabilizer]

5-chloro-2-methyl-4-isothiazoline-3-one	1 g
1-hydroxyethylidene-1,1-diphosphonic acid	2 g

Water was added to the components above to prepare a one liter solution, thereby the pH, level was adjusted to 7.0 using sulfuric acid or potassium hydroxide.

Samples treated with the processes above, and the samples not treated at all, were tested for performance by the following methods. Table-I also lists the test results.

(1) Sensitometry

After the processes above, exposed samples were subjected to sensitometric measurement using PDA-65 (Konica Corporation), whereby the sensitivity and maximum density (Dmax) of each sample was determined. The value of sensitivity is indicated relative to that of light-sensitive element sample No. 1 which has a value of 100.

(2) Sharpness

A resolution test chart was printed on each sample using red exposure light, thereby each sample was treated by the previously specified processing, and then, the resultant cyan dye image was measured for density using a microphotometer, wherein the sharpness value was determined by the following expression.

$$\text{Sharpness (\%)} = \frac{\begin{array}{l}\text{(Maximum density - minimum density)}\\ \text{of printed high-density line image}\\ \text{of 5 lines/mm}\end{array}}{\begin{array}{l}\text{(Maximum density - minimum density)}\\ \text{in larger area}\end{array}} \times 100$$

The larger the value is, the more excellent the sharpness is.

(3) Stain

Each unexposed sample was treated by the previously specified treatment, then using a color analyzer (Model 607, Hitachi, Ltd.), measured for the reflective density at a maximum absorption wavelength described below.

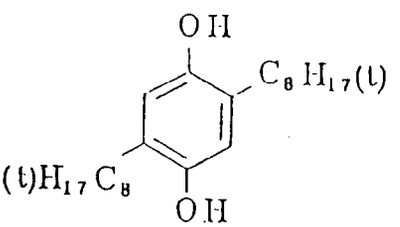
(4) Maximum absorption wavelength

Each non-treated sample was measured for the spectral reflective density using the color analyzer mentioned above, whereby the maximum absorption wavelength was determined.

The structural formulas of hydroquinone derivative HQ-1, and comparative compound, Comparative-1, which employed for comparison with a compound represented by formula [I] are as follows.

Hydroquinone derivative

(HQ-1)



(Comparative-1)

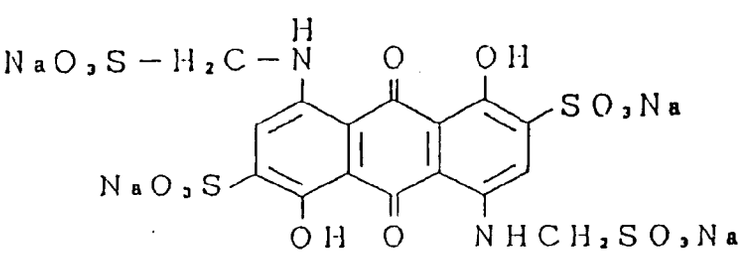


Table 1

Sample No.	Emulsion Em-R No.	Compound of formula [I]		Layer containing capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	Maximum absorption wavelength (nm)	
		Type	Layer for coating solution		Relative sensitivity	Dmax				
1	A	Comparative-1	2nd layer	2nd layer	100	2.12	0.45	0.120	675	Comparative
2	B	Comparative-1	2nd layer	2nd layer	103	2.14	0.44	0.118	675	Comparative
3	C	Comparative-1	2nd layer	2nd layer	110	2.52	0.45	0.118	675	Comparative
4	D	Comparative-1	2nd layer	2nd layer	112	2.56	0.46	0.120	675	Comparative
5	E	Comparative-1	2nd layer	2nd layer	113	2.55	0.45	0.092	666	Comparative
6	E	47	2nd layer	—	104	2.55	0.44	0.092	666	Comparative
7	E	—	—	2nd layer	203	2.56	0.29	0.091	-	Comparative
8	E	47	2nd layer	2nd layer	115	2.55	0.53	0.093	676	Invention
9	E	47	2nd layer	1st layer	116	2.56	0.52	0.092	675	Invention
10	E	47	1st layer	2nd layer	116	2.54	0.53	0.092	676	Invention
11	E	47	1st layer	1st layer	115	2.55	0.52	0.093	675	Invention
12	E	69	2nd layer	—	106	2.55	0.44	0.091	658	Comparative
13	E	69	2nd layer	2nd layer	117	2.55	0.53	0.092	667	Invention

Table 1 (continued 1)

Sample No.	Emulsion Em-R No.	Compound of formula [I]		Layer containing capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	Maximum absorption wavelength (nm)	
		Type	Layer for coating solution		Relative sensitivity	Dmax				
14	E	57	2nd layer	—	105	2.55	0.44	0.092	669	Comparative
15	E	57	2nd layer	2nd layer	116	2.56	0.53	0.093	678	Invention
16	E	60	2nd layer	—	106	2.55	0.43	0.091	650	Comparative
17	E	60	2nd layer	2nd layer	117	2.55	0.52	0.092	659	Invention
18	C	2	2nd layer	—	104	2.53	0.43	0.091	667	Comparative
19	C	2	2nd layer	2nd layer	114	2.54	0.52	0.092	676	Invention
20	D	64	2nd layer	—	105	2.55	0.44	0.091	666	Comparative
21	D	64	2nd layer	2nd layer	116	2.55	0.53	0.092	675	Invention
22	A	64	2nd layer	2nd layer	101	2.12	0.45	0.092	675	Comparative
23	E	48	2nd layer	2nd layer	115	2.55	0.53	0.093	676	Invention
24	E	49	2nd layer	2nd layer	114	2.53	0.52	0.093	676	Invention
25	E	50	2nd layer	2nd layer	115	2.54	0.52	0.093	676	Invention
26	E	52	2nd layer	2nd layer	115	2.54	0.53	0.091	676	Invention

Table 1 (continued 2)

Sample No.	Emulsion Em-R No.	Compound of formula [I]		Layer containing capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	Maximum absorption wavelength (nm)	
		Type	Layer for coating solution		Relative sensitivity	Dmax				
27	E	60	2nd layer	2nd layer	116	2.55	0.53	0.093	677	Invention
28	E	61	2nd layer	2nd layer	116	2.55	0.53	0.093	677	Invention
29	E	62	2nd layer	2nd layer	116	2.54	0.53	0.093	677	Invention
30	E	72	2nd layer	2nd layer	116	2.54	0.52	0.092	677	Invention
31	E	70	2nd layer	2nd layer	117	2.55	0.53	0.092	667	Invention
32	E	73	2nd layer	2nd layer	117	2.56	0.54	0.092	672	Invention
33	E	85	2nd layer	2nd layer	116	2.55	0.53	0.092	672	Invention
34	E	75	2nd layer	2nd layer	117	2.55	0.53	0.092	672	Invention
35	E	81	2nd layer	2nd layer	115	2.54	0.53	0.091	672	Invention
36	E	82	2nd layer	2nd layer	116	2.55	0.53	0.092	672	Invention
37	E	76	2nd layer	2nd layer	116	2.55	0.53	0.092	672	Invention
38	E	77	2nd layer	2nd layer	117	2.55	0.53	0.092	672	Invention
39	E	74	2nd layer	2nd layer	117	2.56	0.54	0.091	672	Invention

Table 1 (continued 3)

Sample No.	Emulsion Em-R No.	Compound of formula [I]		Layer containing capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	Maximum absorption wavelength (nm)	
		Type	Layer for coating solution		Relative sensitivity	Dmax				
40	E	78	2nd layer	2nd layer	116	2.55	0.53	0.090	672	Invention
41	E	79	2nd layer	2nd layer	116	2.56	0.54	0.093	672	Invention
42	E	80	2nd layer	2nd layer	116	2.55	0.53	0.092	670	Invention
43	E	83	2nd layer	2nd layer	115	2.55	0.53	0.093	671	Invention
44	E	84	2nd layer	2nd layer	115	2.55	0.53	0.092	671	Invention
45	E	47	1st layer	2nd layer	110	2.54	0.53	0.092	676	Invention
46	E	47	1st layer	2nd layer	116	2.53	0.52	0.093	672	Invention
47	E	47	1st layer	2nd layer	116	2.54	0.52	0.093	673	Invention
48	E	47	1st layer	2nd layer	116	2.54	0.53	0.092	675	Invention
49	E	47	1st layer	2nd layer	116	2.55	0.52	0.091	674	Invention
50	E	47	1st layer	2nd layer	116	2.55	0.52	0.092	672	Invention
51	E	47	1st layer	2nd layer	116	2.55	0.52	0.092	675	Invention

As is apparent from the results in Table-1, sample Nos. 1 and 2, which used an emulsion, not prescribed

for use in the invention, having a lower silver chloride content and containing comparative dye and a capturing material used in the invention for fluorescent whitening agent, respectively showed insufficient sensitivity and maximum density, and, especially, greater stain, and also failed to attain satisfactory level of sharpness. Sample Nos. 3 through 5, having an emulsion of the invention of a higher silver chloride content unlike sample Nos. 1 and 2, showed still insufficient improvement in stain and sharpness, in spite of improved sensitivity and maximum density. Sample No. 6 and sample Nos. 8 through 51 respectively incorporating a dye represented by formula [I] according to the invention respectively showed improvement to nearly satisfactory level in terms of stain. However, as in the case of sample Nos. 6, 12, 14, 16, 18 and 20, a sample not containing the capturing material as used in the invention did not show significant improvement in sharpness, and, further, incurs greater loss in sensitivity, thus resulting in a disadvantage. Sample No. 7, which did not contain a compound represented by formula [I], though it did contain a compound for capturing fluorescent whitening agent, showed extremely poor sharpness in spite of excellent sensitometric result; this sample is not employable in practical operation. In contrast, samples according to the invention Nos. 8 through 11, 13, 15, 17, 19, 21, and 45 through 51, respectively containing both a dye represented by formula [I] used in the invention and a compound used in the invention for capturing fluorescent whitening agent, showed satisfactorily high sensitivity and high maximum density even after rapid processing, and smaller stains, having the maximum absorption wavelength shifted to the longer wave side when compared to samples not containing a compound for capturing fluorescent whitening agent, and indicated excellent sharpness due to improved spectral absorption property.

As can be understood from the results for sample Nos. 8 through 11, the effects of the invention were attained even by using a variously changed combination of a dye represented by formula [I] and a coating solution where a compound for capturing fluorescent whitening agent was incorporated.

Additionally, with dye Nos. 51, 53, 54, 55, 56, 58, 59, 63, 65, 66, 67, 68 and 71, respectively of the invention, the effects above were achieved.

Also, the use of HD-5, HD-13, or HD-15, instead of HD-2, achieved the same effects above.

The use of an emulsion similar to Em-D, except for the variation coefficient of 0.25, also showed the effects of the invention.

Furthermore, the effects of the invention were achieved by a sample prepared by simultaneously applying and drying not only a coating solution for the first layer, which was unlike the original coating solution, prepared by incorporating the dye used in the invention No. 2, 4, 6 or 7 into the coating solution for the first layer on Example-3, but a coating solution for the second layer, protective layer, containing polyvinyl pyrrolidone, weight average molecular weight, 360,000, in an amount of 0.55 mg/dm^2, gelatin in an amount of 20 mg/dm^2, and a hardener in an amount of 0.05 mg/dm^2.

Example-2

To Em-A through Em-E was added sodium thiosulfate by a conventional method, whereby each emulsion was subjected to sulfur sensitization, and then, to spectral sensitization using sensitizing dye, exemplified compound No. B-11. Thus, green-sensitive silver halide emulsions Em-G Nos. A through E were prepared.

On a polyethylene-laminated paper support were simultaneously applied and dried the coating solutions for the first and second layers. Thus, mono-color light-sensitive element sample No. 2-1 was prepared.

The amounts added for each coating solution are indicated by amounts applied per each independent coat formed.

First layer: green-sensitive silver halide emulsion layer

Contains green-sensitive silver halide emulsion, listed in Table-2, in an amount, as converted into metal silver, of 4 mg/dm^2; example magenta coupler m-3 in an amount of 4 mg/dm^2; dioctylphthalate as a high boiling organic solvent, in an amount of 3 mg/dm^2; hydroquinone derivative HQ-1 in an amount of 0.15 mg/dm^2; gelatin, in an amount of 14 mg/dm^2; and HD-2 as a hardener in an amount of 0.05 mg/dm^2.

Second layer: protective layer

Contains compound represented formula [I] listed in Table-2, in an amount of 0.1 mg/dm^2 or comparative-2 specified below as a comparative compound in an amount of 0.1 mg/dm^2; polyvinyl pyrrolidone as a capturing material for fluorescent whitening agent in an amount of 0.55 mg/dm^2; gelatin, in an amount of 20 mg/dm^2; and HD-2 as a hardener, in an amount of 0.05 mg/dm^2.

Light-sensitive element sample Nos. 2-2 through 2-17 were prepared in a manner identical with that of sample No. 2 above, except that the combination of type of compound represented by formula [I], and coating sol-

ution dissolving it, was modified as listed in Table-2, each substance was used in the same proportion.

Each of the samples prepared above was evaluated for sharpness in a manner identical with example-1 except that a resolution test chart was printed on each sample using green exposure light in order to form a magenta dye image. The results are listed in Table-2.

The structural formula of comparative compound, comparative-2, employed as comparison with a compound represented by formula [I] is as follows.

Comparative-2

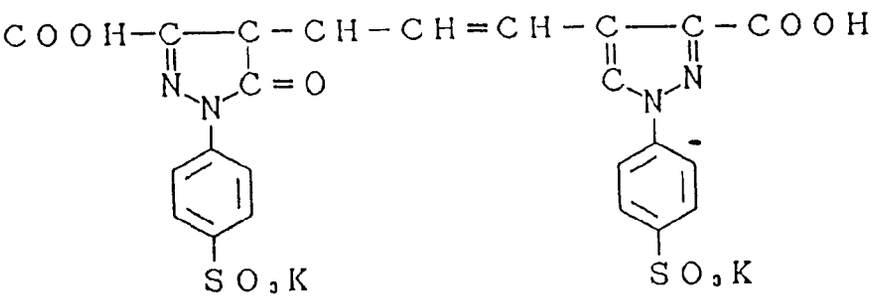


Table 2

Sample No.	Emulsion Em-G No.	Compound of formula [I]		Layer containing capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	
		Type	Layer for coating solution		Relative sensitivity	Dmax			
2-1	A	Comparative-2	1st layer	2nd layer	100	2.26	0.58	0.115	Comparative
2-2	B	Comparative-2	1st layer	2nd layer	102	2.29	0.59	0.115	Comparative
2-3	C	Comparative-2	1st layer	2nd layer	105	2.37	0.58	0.117	Comparative
2-4	D	Compatative-2	1st layer	2nd layer	107	2.39	0.60	0.116	Comparative
2-5	E	Comparative-2	1st layer	2nd layer	108	2.40	0.60	0.118	Comparative
2-6	E	9	1st layer	2nd layer	113	2.43	0.71	0.098	Invention
2-7	E	14	1st layer	2nd layer	113	2.44	0.71	0.097	Invention
2-8	E	10	1st layer	2nd layer	113	2.44	0.72	0.096	Invention
2-9	E	11	1st layer	2nd layer	112	2.44	0.71	0.098	Invention
2-10	E	18	1st layer	2nd layer	114	2.45	0.70	0.098	Invention
2-11	E	19	1st layer	2nd layer	114	2.44	0.70	0.097	Invention
2-12	E	20	1st layer	2nd layer	114	2.45	0.72	0.098	Invention
2-13	E	24	1st layer	2nd layer	113	2.43	0.71	0.098	Invention

Table 2 (continued)

Sample No.	Emulsion Em-G No.	Compound of formula [I]		Layer containing material capturing material for fluorescent whitening agent	Sensitometry		Sharpness	Stain	
		Type	Layer for coating solution		Relative sensitivity	Dmax			
2-14	E	25	1st layer	2nd layer	114	2.44	0.71	0.097	Invention
2-15	E	21	1st layer	2nd layer	114	2.45	0.73	0.096	Invention
2-18	E	28	1st layer	2nd layer	113	2.44	0.70	0.097	Invention
2-19	E	34	1st layer	2nd layer	114	2.45	0.72	0.096	Invention
2-20	E	43	1st layer	2nd layer	114	2.43	0.71	0.097	Invention
2-21	E	45	1st layer	2nd layer	114	2.43	0.71	0.096	Invention
2-22	E	35	1st layer	2nd layer	114	2.44	0.73	0.096	Invention
2-23	E	37	1st layer	2nd layer	112	2.44	0.72	0.096	Invention
2-24	E	46	1st layer	2nd layer	113	2.44	0.72	0.098	Invention
2-16	E	21	1st layer	2nd layer	110	2.42	0.63	0.096	Comparative
2-17	E	21	2nd layer	2nd layer	114	2.44	0.73	0.096	Invention

As is apparent from the results in Table-2, when compared to comparative samples, samples according to the invention, incorporating emulsion used in the invention having a high silver chloride content which contains both a dye represented by formula [I] used in the invention and a capturing material used in the invention

for fluorescent whitening agent, respectively showed the effects of the invention as demonstrated in Example-1.

The use of compound 12, 13, 15, 16, 17, 22, 23, 26, 27, 29, 30, 31, 32, 33, 36, 37, 38, 39, 40, 41, 42, or 44 common showed the effects of the invention.

Example-3

The following silver chloro-bromide emulsion was prepared in a manner identical with that of Example-1.

Emulsion No.	Grain size (μm)	Silver chloride content (mol%)
Em-F	0.8	95

Into each of Em-D, Em-E and Em-F prepared in Example-1 and Example-2 was added chloroauric acid in an amount of 5×10^{-5} mol per mol silver halide, and, further, added sodium thiosulfate in an amount of 2 mg per mol silver halide for chemical sensitization. Next, Em-D sensitized by gold and sulfur as mentioned above was subjected to spectral sensitization using a sensitizing dye, exemplified compound No. D-3, so as to prepare red-sensitive silver halide emulsion Em-R No. D2. Em-E was spectrally sensitized using sensitizing dye, exemplified compound No. B-4, so as to prepare green-sensitive silver halide emulsion Em-G No. E2. Em-F was spectrally sensitized using the following sensitizing dye SD-A, so as to prepare blue-sensitive silver halide emulsion Em-B No. F.

On a polyethylene-laminated paper support were simultaneously applied and dried the coating solutions prepared based on Em-R No. D2, Em-G No. E2 and Em-B No. F above. Thus, the multi-color photographic light-sensitive element was prepared.

The amounts added for each coating solution are indicated by amounts applied per each independent coat formed.

First layer: blue-sensitive silver halide emulsion layer

Contains yellow coupler Y-5 in an amount of 8 mg/dm^2; blue-sensitive silver halide emulsion Em-B No. F in an amount, as converted into metal silver, of 3 mg/dm^2; high boiling organic solvent S-1 in an amount of 3 mg/dm^2; and gelatin in an amount of 16 mg/dm^2.

Second layer: intermediate layer

Contains hydroquinone derivative HQ-1 in an amount of 0.45 mg/dm^2; and gelatin, in an amount of 4 mg/dm^2.

Third layer: green-sensitive silver chloro-bromide emulsion layer

Contains magenta coupler m-3 in an amount of 4 mg/dm^2; a dye listed in Table-3 in an amount of 0.1 mg/dm^2; green-sensitive silver chloro-bromide emulsion Em-G No. E2 in an amount, as converted into metal silver, of 3 mg/dm^2; high boiling organic solvent S-2 in an amount of 4 mg/dm^2; and gelatin in an amount of 16 mg/dm^2.

Fourth layer: intermediate layer

Contains ultraviolet absorbents, UV-1 in an amount of 3 mg/dm^2 and UV-2 in an amount of 3 mg/dm^2; high boiling organic solvent S-1 in an amount of 4 mg/dm^2; hydroquinone derivative HQ-1 in an amount of 0.45 mg/dm^2; and gelatin in an amount of 14 mg/dm^2.

Fifth layer: red-sensitive silver chloride emulsion layer

Contains cyan couplers, CI-7 in an amount of 2 mg/dm^2 and CI-5 in an amount of 2 mg/dm^2; high boiling organic solvent S-2 in an amount of 2 mg/dm^2; red-sensitive silver chloride-bromide emulsion Em-R No. D2 in an amount, as converted into metal silver, of 2 mg/dm^2; a dye listed in Table-3, amount of addition also listed in Table-3, and gelatin in an amount of 14 mg/dm^2.

Sixth layer: intermediate layer

Contains ultraviolet absorbents, UV-1 in an amount of 2 mg/dm^2 and UV-2 in an amount of mg/dm^2; capturing material listed in Table-3 for fluorescent whitening agent, amount of addition also listed in Table-3; high boiling organic solvent S-1 in an amount of 2 mg/dm^2; and gelatin in an amount of 6 mg/dm^2.

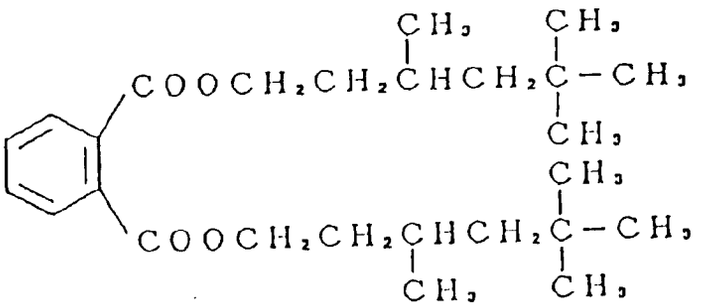
Seventh layer: protective layer

Contains gelatin in an amount of 9 mg/dm^2.

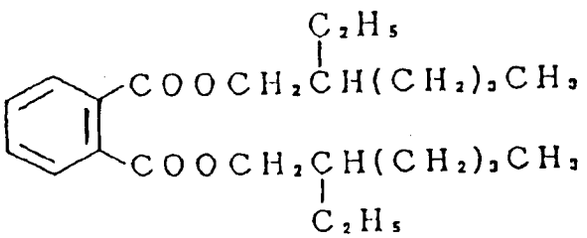
Sample Nos. 3-1 through 3-26 were prepared by variously changing type and amount added of a compound represented by formula [I] into the third and fifth layers, and also by changing type and amount added by a compound as a capturing material used in the invention into the sixth layer. Additionally, sample Nos. 3-27 through 3-32 were prepared by incorporating a dye used in the invention into a coating solution for the second, fourth, sixth or seventh layer.

Those dyes added into the third and fifth layers as listed in Table-3 were as follows: comparative dye No. 1 was the same as that in example-1, comparative dye No. 2 was the same as that in example-2. The structural formulas of high boiling organic solvents S-1 and S-2, ultraviolet absorbents UV-1 and UV-2, and sensitizing dye SD-A are as follows.

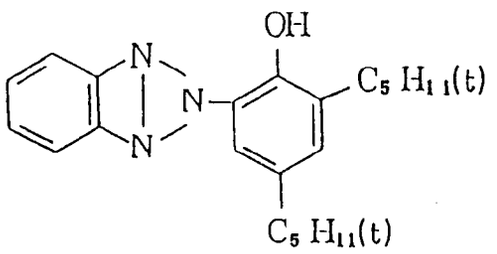
(S - 1)



(S - 2)



(U V - 1)



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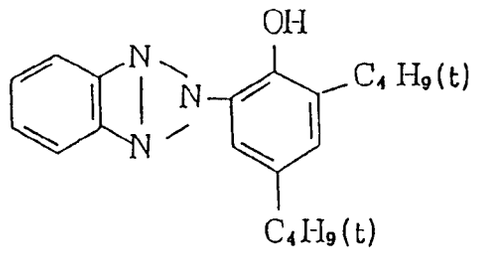
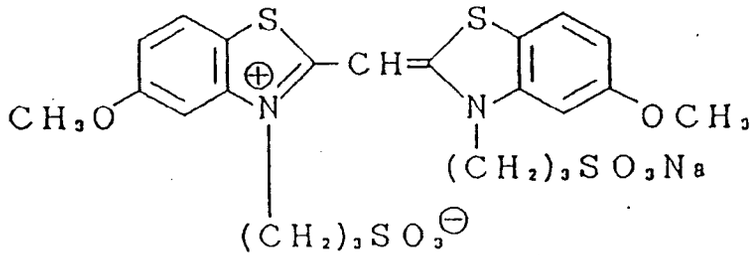


(S D - A)



The respective samples prepared above were subjected to the following processes either without undergoing exposing, or after undergoing exposing through an optical wedge with photographic sensitometer Model KS-7 manufactured by Konica Corporation.

[Treatment]

	Temperature	Time
Color developing	34.7 ± 0.3°C	45 sec.
Bleach-fixing	34.7 ± 0.3°C	45 sec.
Stabilizing	30 to 34°C	2 min.
Drying	60 to 80°C	2 min.

[Color developer]

Pure water	800 mℓ
Diethylene glycol	12 mℓ
N,N-diethylhydroxylamine	12 mℓ
Potassium chloride	2.2 g
Potassium sulfite	0.2 g
N-ethyl-N-β-methanesulfonamideethyl-3-methyl-4-aminaniline sulfate	5.0 g

Diaminostilbene water soluble fluorescent whitening agent	2.0 g

Water was added to the components above to prepare a one liter solution, thereby the pH level was adjusted to 10.1.

[Bleach-fixer]

Pure water	600 mℓ
Ferric ammonium ethylenediaminetetraacetate dihydrate	60 g
Ethylenediaminetetraacetic acid	3 g
Ammonium thiosulfate (70% aqueous solution)	100 mℓ
Ammonium sulfite (40% aqueous solution)	27.5 mℓ

Water was added to the components above to prepare a one liter solution, thereby the pH level was adjusted to 5.5.

Samples treated or not treated were subjected to performance test as specified in (1) through (3) of Example-1.

Table-3 lists the test results.

Table 3

Sample No.	Dye in 3rd layer (mg/dm²)	Dye in 5th layer (mg/dm²)	Dye in 2nd, 4th, 6th, or 7th layer		Capturing material in 6th layer (mg/dm²)	Relative sensitivity			Shaprness	Stain
			Example compound formula [I] (mg/dm²)	Coating solution		B	G	R		
3-1	Comparative-2 (0.1)	Comparative-1 (0.1)	—	—	—	100	100	100	0.37	0.090
3-2	Comparative-2 (0.1)	47 (0.1)	—	—	—	100	100	99	0.39	0.090
3-3	Comparative-2 (0.1)	47 (0.1)	—	—	P-1 (0.2)	100	102	104	0.47	0.091
3-4	Comparative-2 (0.1)	47 (0.1)	—	—	P-1 (0.5)	100	102	104	0.51	0.091
3-5	Comparative-2 (0.1)	47 (0.1)	—	—	P-1 (1.0)	100	100	103	0.52	0.092
3-6	10 (0.1)	47 (0.1)	—	—	P-1 (0.2)	100	100	104	0.50	0.090
3-7	21 (0.1)	47 (0.1)	—	—	P-1 (0.2)	100	101	101	0.53	0.090
3-8	21 (0.1)	47 (0.1) Comparative-1 (0.1)	—	—	P-1 (0.2)	100	100	102	0.52	0.097
3-9	Comparative-2 (0.1)	48 (0.1)	—	—	P-1 (0.2)	101	102	105	0.49	0.090
3-10	10 (0.1)	48 (0.1)	—	—	P-1 (0.2)	101	103	104	0.51	0.090
3-11	18 (0.1)	60 (0.1)	—	—	P-1 (0.2)	101	103	105	0.52	0.090

Table 3 (continued 1)

Sample No.	Dye in 3rd layer (mg/dm²)	Dye in 5th layer (mg/dm²)	Dye in 2nd, 4th, 6th, or 7th layer		Capturing material in 6th layer (mg/dm²)	Relative sensitivity			Shaprness	Stain
			Example compound formula [I] (mg/dm²)	Coating solution		B	G	R		
3-12	20 (0.1)	48 (0.1)	—	—	P-1 (0.2)	101	104	104	0.51	0.090
3-13	20 (0.1)	47 (0.1) Comparative-1 (0.1)	—	—	P-1 (0.2)	100	100	100	0.53	0.096
3-14	21 (0.1)	48 (0.1)	—	—	P-1 (0.2)	101	104	105	0.53	0.090
3-15	21 (0.1)	48 (0.1)	—	—	P-1 (0.2)	95	94	85	0.56	0.090
3-16	34 (0.1)	48 (0.1)	—	—	P-1 (0.2)	102	104	105	0.51	0.090
3-17	39 (0.1)	48 (0.1)	—	—	P-1 (0.2)	102	104	105	0.51	0.090
3-18	33 (0.1)	60 (0.1)	—	—	P-2 (0.5)	101	102	104	0.51	0.091
3-19	33 (0.1)	74 (0.1)	—	—	P-2 (0.5)	101	102	106	0.52	0.091
3-20	Comparative-2 (0.1)	74 (0.1)	—	—	P-1 (0.2)	100	100	105	0.49	0.090
3-21	10 (0.1)	74 (0.1)	—	—	P-1 (0.2)	100	101	105	0.53	0.090
3-22	9 (0.1)	47 (0.1)	—	—	P-1 (0.2)	98	97	88	0.51	0.090

Table 3 (continued 2)

Sample No.	Dye in 3rd layer (mg/dm²)	Dye in 5th layer (mg/dm²)	Dye in 2nd, 4th, 6th, or 7th layer: Example compound formula [I] (mg/dm²)	Dye in 2nd, 4th, 6th, or 7th layer: Coating solution	Capturing material in 6th layer (mg/dm²)	Relative sensitivity B	Relative sensitivity G	Relative sensitivity R	Sharpness	Stain
3-23	34 (0.1)	74 (0.1)	—	—	P-1 (0.2)	100	102	105	0.51	0.090
3-24	21 (0.1)	74 (0.1)	—	—	P-1 (0.2)	101	102	105	0.52	0.090
3-25	21 (0.1)	74 (0.2)	—	—	P-1 (0.2)	96	94	86	0.56	0.091
3-26	21 (0.1)	74 (0.3)	—	—	P-1 (0.2)	93	88	79	0.59	0.092
3-27	—	74 (0.1)	21 (0.1)	2nd layer	P-1 (0.2)	101	104	105	0.52	0.090
3-28	—	74 (0.1)	21 (0.1)	4th layer	P-1 (0.2)	101	103	105	0.52	0.090
3-29	21 (0.1)	—	74 (0.1)	2nd layer	P-1 (0.2)	101	101	105	0.52	0.091
3-30	21 (0.1)	—	74 (0.1)	4th layer	P-1 (0.2)	101	102	105	0.53	0.090
3-31	21 (0.1)	—	74 (0.1)	6th layer	P-1 (0.2)	101	102	105	0.52	0.090
3-32	21 (0.1)	—	74 (0.1)	7th layer	P-1 (0.2)	101	102	105	0.52	0.090

* P-1: Polyvinyl pyrrolidone, weight average molecular weight, 360,000
P-2: Vinylpyrrolidone-vinyl acetate (7 : 3) copolymer

As apparent from the results in Table-3, when compared to comparative sample Nos. 3-1 through 3-32 according to the invention show significantly improved sensitivity-sharpness correlation in the case of the mul-

ti- layered samples. Additionally, it is also apparent that increased addition of capturing material for fluorescent whitening agent in the sixth layer remarkably improved the sharpness.

It is also apparent the effects of the invention are attained regardless of to which coating solution the dye of the invention is added; a coating solution for any of the second, fourth, sixth and seventh layers.

The effects of the invention were attained even by replacing sensitizing dye D-3 in Em-R No. D2 with D-13, or by replacing sensitizing dye B-4 in Em-G No. E2 with B-7.

Example-4

Sample Nos. 4-1 through 4-16 were prepared in a manner identical with sample No. 3-25 in Example-3, except that the combination of a yellow coupler in the first layer, a magenta coupler in the third layer, and a cyan coupler in the fifth layer was changed, while maintaining same mol ratios, as listed in Table-4 below.

Table-4

Sample No.	Yellow coupler in 1st layer	Magenta coupler in 3rd layer	Cyan coupler in 5th layer	Sharpness	Stain
4-1	Y-2	m-1	CI-6/CI-7	0.56	0.091
4-2	Y-2	m-3	CI-6/CI-7	0.56	0.092
4-3	Y-2	m-5	CI-6/CI-7	0.56	0.091
4-4	Y-2	m-12	CI-6/CI-7	0.56	0.091
4-5	Y-2	m-14	CI-6/CI-7	0.56	0.092
4-6	Y-2	m-18	CI-6/CI-7	0.56	0.092
4-7	Y-4	m-1	CI-5/CI-7	0.56	0.092
4-8	Y-4	m-1	CI-5/CI-7	0.56	0.092
4-9	Y-4	m-1	CI-10	0.56	0.092
4-10	Y-4	m-5	CI-10	0.56	0.091
4-11	Y-6	m-3	CI-11	0.56	0.092
4-12	Y-6	m-4	CI-11	0.56	0.091
4-13	Y-6	m-4	CI-11	0.56	0.091
4-14	Y-8	m-3	CI-5/CI-7	0.56	0.092
4-15	Y-8	m-12	CI-5/CI-7	0.56	0.091

* Mixing ratio of CI-5/CI-7 is 1 : 1, in terms of molar ratio.

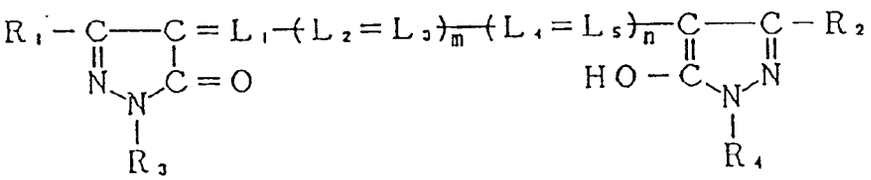
Sample Nos. 4-1 through 4-16 mentioned above were tested in a manner identical with that of Example-

3, whereby it was confirmed that like effects of the invention were achieved even by changing couplers in the respective dyes while the dyes of the invention were maintained.

Claims

1. A silver halide photographic light-sensitive element comprising a support having thereon photographic component layers including at least one silver halide emulsion layer which contains silver halide grains comprising not less than 90 mol% of silver chloride, wherein the proportion of said silver halide grains in said silver halide emulsion layer is not less than 60 wt % of the total silver halide grains contained in said silver halide emulsion layer, and at least one layer among said photographic component layers contains a compound represented by the following formula [I] and a capturing material for fluorescent whitening agent:

Formula [I]



wherein R_1 and R_2 independently represent a -CN group, a $-CFR_5R_6$ group, a $-COR_7$ group, a $-COOR_7$ group, a $-CONHR_5$ group or a $-CF_3$ group, in which R_5 and R_6 independently represent a hydrogen atom, a fluorinated alkyl group having one to four carbon atoms, and R_7 represents an alkyl group or an aryl group which may have a substituent; R_3 and R_4 independently represent a hydrogen atom, or an aliphatic group, an alicyclic group, an aromatic group or a heterocyclic group, each of which is optionally substituted; L_1, L_2, L_3, L_4 and L_5 independently represent an optionally substituted methine group; and m and n independently represent an integer of 0 or 1.

2. The element of claim 1, wherein said capturing material is a homo- or co-polymer of vinyl pyrrolidone.

3. The element of claim 1 or 2, wherein substituents R_3 and R_4 of the compound of formula [I] are each independently 4-sulphophenyl or 2,5-disulphophenyl.

4. The element of claim 1, 2 or 3 wherein the coating weight of said capturing material is within the range of from 0.05 mg/dm^2 to 3.0 mg/dm^2.

5. The element of claim 4, wherein the coating weight of said capturing material is within the range of from 0.1 mg/dm^2 to 2.0 mg/dm^2.

6. The element of any one of the preceding claims, wherein the amount of said capturing material is within the range of from 0.1 % to 50 % by weight to the other binder contained in the photographic component layer in which said capturing material is contained.

7. The element of claim 6, wherein the amount of said capturing material is within the range of form 1 % to 30% by weight to the binder contained in the photographic component layer in which said capturing material is contained.

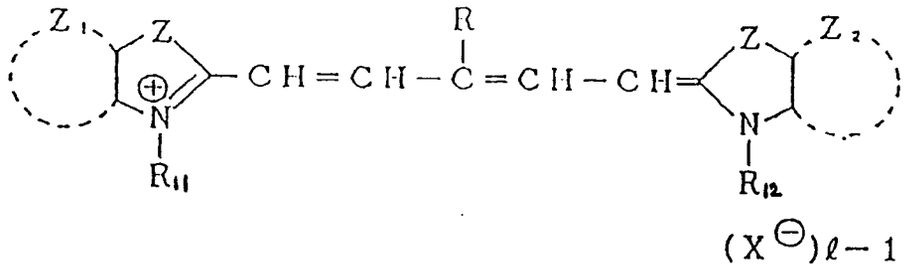
8. The element of any one of the preceding claims, wherein the coating weight of said compound represented by the formula [I] is within the range of from 0.01 mg/dm^2 to 1.0 mg/dm^2.

9. The element of claim 8, wherein the coating weight of said compound represented by the formula [I] is within the range of from 0.03 mg/dm^2 to 0.4 mg/dm^2.

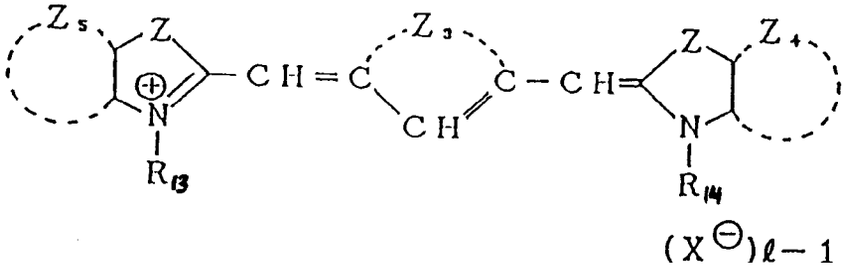
10. The element of any of the preceding claims, wherein at least one said silver halide emulsion layer con-

taining silver halide grains comprising not less than 90 mol% of silver chloride is spectrally sensitized with at least one sensitizing dye selected from the compounds represented by the following formula [C] or [D]:

Formula [C]



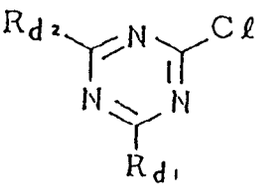
Formula [D]



wherein R represents a hydrogen atom or an optionally substituted alkyl group; R_{11} through R_{14} independently represent an optionally substituted alkyl group or an optionally substituted aryl group; Z_1, Z_2, Z_4 and Z_5 independently represent a group of atoms necessary to complete a benzene ring or a naphthalene ring condensed into a thiazole ring or selenazole ring: Z_3 represents a hydrocarbon group necessary to complete a six-membered ring; ℓ represents an integer of 1 or 2; Z represents a sulfur atom or a selenium atom; and X represents an anion.

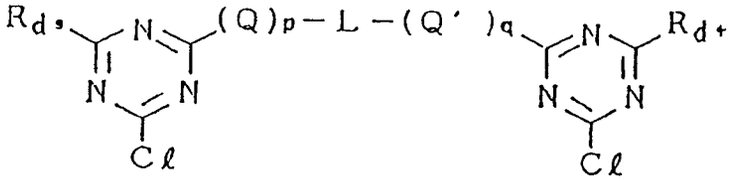
11. The element of any one of the preceding claims, wherein said photographic component layers are hardened with a hardener selected from the compounds represented by the following formula [HDA] or [HDB]:

Formula [HDA]



wherein R_{d1} represents a chlorine atom, a hydroxy group, or an optionally substituted alkyl, alkoxy or alkylthio group, an -OM group, an -NR′R″ group or an -NHCOR group, in which M represents a monovalent metal atom; R′ and R″ independently represent a hydrogen atom, an optionally substituted alkyl or aryl group; and R represents an optionally substituted alkyl or aryl group; and R_{d2} represents a group, apart from chlorine, identical to that defined for R_{d1};

Formula [HDB]

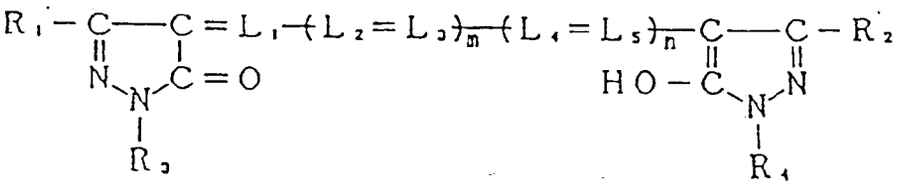


wherein R_{d3} and R_{d4} independently represent a chlorine atom, a hydroxy group, or an optionally substituted alkyl or alkoxy group, or an -OM group, in which M represents a monovalent metal atom; Q and Q' independently represent a binding atom or group of -O-, -S-, or -NH-; L represents an alkylene group or an arylene group; and p and q independently represent an integer of 0 or 1.

Patentansprüche

1. Lichtempfindliches photographisches SilberhalogenidAufzeichnungsmaterial mit einem Schichtträger und darauf aufgetragenen photographischen Schichtkomponenten einschließlich mindestens einer Silberhalogenidkörnchen, umfassend nicht weniger als 90 Mol% Silberchlorid, enthaltenden Silberhalogenid-Emulsionsschicht, wobei der Anteil der betreffenden Silberhalogenidkörnchen in der Silberhalogenid-Emulsionsschicht nicht weniger als 60 Gew.-% der in dieser Silberhalogenid-Emulsionsschicht insgesamt enthaltenen Silberhalogenidkörnchen beträgt und mindestens eine Schicht unter den genannten photographischen Schichtkomponenten eine Verbindung der folgenden Formel [I]

Formel [I]



worin bedeuten:

R_1 und R_2 unabhängig voneinander eine -CN-Gruppe, eine $-CFR_5R_5$-Gruppe, eine $-COR_7$-Gruppe, eine $-COOR_7$-Gruppe, eine $-CONHR_5$-Gruppe oder eine $-CF_3$-Gruppe mit R_5 und R_5 unabhängig voneinander gleich einem Wasserstoffatom oder einer fluorierten Alkylgruppe mit 1 bis 4 Kohlenstoffatom(en) und R_7 gleich einer gegebenenfalls substituierten Alkyl- oder Arylgruppe;

R_3 und R_4 unabhängig voneinander ein Wasserstoffatom oder eine aliphatische Gruppe, eine alicyclische Gruppe, eine aromatische Gruppe oder eine heterocyclische Gruppe, von denen jede gegebenenfalls substituiert ist;

L_1, L_2, L_3, L_4 und L_5 unabhängig voneinander eine gegebenenfalls substituierte Methingruppe und m und n unabhängig voneinander jeweils eine ganze Zahl, nämlich 0 oder 1,

sowie ein Fangmaterial für einen fluoreszierenden Weißmacher enthält.

2. Aufzeichnungsmaterial nach Anspruch 1, wobei das Fangmaterial aus einem Homo- oder Copolymer von Vinylpyrrolidon besteht.

3. Aufzeichnungsmaterial nach Anspruch 1 oder 2, wobei die Substituenten R_3 und R_4 der Verbindung der Formel [I] unabhängig voneinander jeweils für 4-Sulfophenyl oder 2,5-Disulfophenyl stehen.

4. Aufzeichnungsmaterial nach Anspruch 1, 2 oder 3, wobei das Auftraggewicht des Fangmaterials im Bereich von 0,05 mg/dm² bis 3,0 mg/dm² liegt.

5. Aufzeichnungsmaterial nach Anspruch 4, wobei das Auftraggewicht des Fangmaterials im Bereich von 0,1 mg/dm^2 bis 2,0 mg/dm^2 liegt.

6. Aufzeichnungsmaterial nach einem der vorhergehenden Ansprüche, wobei die Menge an dem Fangmaterial im Bereich von 0,1 bis 50 Gew.-% im Bezug auf das in der das Fangmaterial enthaltenden photographischen Schichtkomponente enthaltene sonstige Bindemittel liegt.

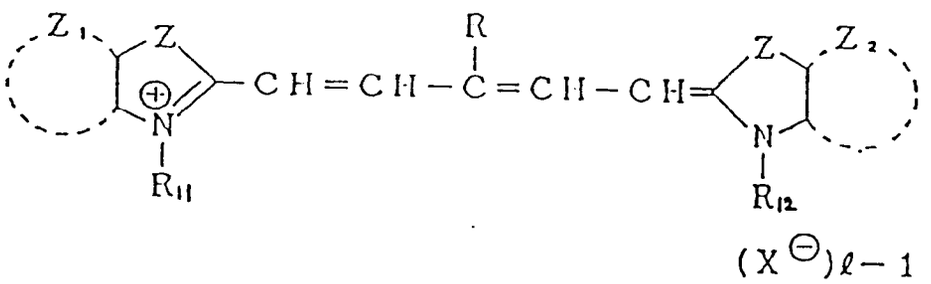
7. Aufzeichnungsmaterial nach Anspruch 6, wobei die Menge an dem Fangmaterial im Bereich von 1 bis 30 Gew.-% in Bezug auf das in der das Fangmaterial enthaltenden photographischen Schichtkomponente enthaltene Bindemittel liegt.

8. Aufzeichnungsmaterial nach einem der vorhergehenden Ansprüche, wobei das Auftraggewicht der Verbindung der Formel [I] im Bereich von 0,01 mg/dm^2 bis 1,0 mg/dm^2 liegt.

9. Aufzeichnungsmaterial nach Anspruch 8, wobei das Auftraggewicht der Verbindung der Formel [I] im Bereich von 0,03 mg/dm^2 bis 0,4 mg/dm^2 liegt.

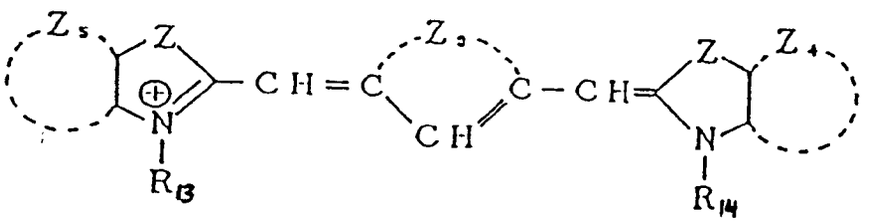
10. Aufzeichnungsmaterial nach einem der vorhergehenden Ansprüche, wobei die mindestens eine Silberhalogenidkörnchen mit mindestens 90 Mol% Silberchlorid enthaltende Silberhalogenid-Emulsionsschicht mit mindestens einem Sensibilisierungsfarbstoff, ausgewählt aus Verbindungen der folgenden Formeln [C] oder [D]:

Formel [C]



$(X^{\ominus})_{l-1}$

Formel [D]



$(X^{\ominus})_{l-1}$

worin bedeuten:

R ein Wasserstoffatom oder eine gegebenenfalls substituierte Alkylgruppe;

R_{11} bis R_{14} unabhängig voneinander eine gegebenenfalls substituierte Alkylgruppe oder eine gegebenenfalls substituierte Arylgruppe;

Z_1, Z_2, Z_4 und Z_5 unabhängig voneinander eine zur Vervollständigung eines an den Thiazol- oder Selenazolring ankondensierten Benzol- oder Naphthalinrings erforderliche Gruppe von Atomen;

Z_3 eine zur Vervollständigung eines sechsgliedrigen Rings erforderliche Kohlenwasserstoffgruppe;

l eine ganze Zahl, nämlich 1 oder 2;

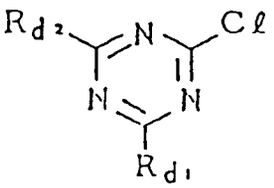
Z ein Schwefel- oder Selenatom und

X^- ein Anion,

spektral sensibilisiert ist.

11. Aufzeichnungsmaterial nach einem der vorhergehenden Ansprüche, wobei die photographischen Schichtkomponenten mit einem Härtungsmittel, ausgewählt aus Verbindungen der folgenden Formel [HDA] oder [HDB]:

Formel [HDA]

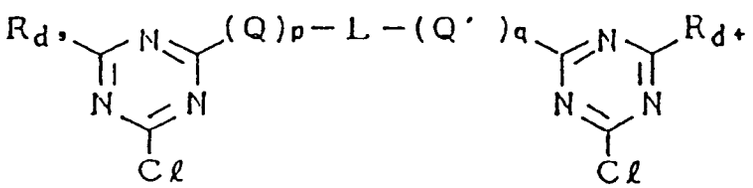


worin bedeuten:

R_{d1} ein Chloratom, eine Hydroxygruppe oder eine gegebenenfalls substituierte Alkyl-, Alkoxy- oder Alkylthiogruppe, eine -OM-Gruppe, eine -NR'R''-Gruppe oder eine -NHCOR-Gruppe mit M gleich einem einwertigen Metallatom, R'und R'' unabhängig voneinander jeweils gleich einem Wasserstoffatom oder einer gegebenenfalls substituierten Alkyl- oder Arylgruppe und R gleich einer gegebenenfalls substituierten Alkyl- oder Arylgruppe und

R_{d2} eine, abgesehen von Chlor, mit R_{d1} identische Gruppe;

Formel [HDB]



worin bedeuten:

R_{d3} und R_{d4} unabhängig voneinander jeweils ein Chloratom, eine Hydroxygruppe oder eine gegebenenfalls substituierte Alkyl- oder Alkoxygruppe oder eine -OM-Gruppe mit M gleich einem einwertigen Metallatom;

Q und Q' unabhängig voneinander jeweils ein bindendes Atom oder eine bindende Gruppe, nämlich -O-, -S- oder -NH-;

L eine Alkylengruppe oder eine Arylengruppe und

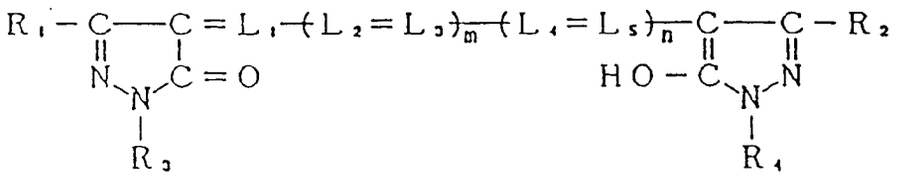
p und q unabhängig voneinander jeweils eine ganze Zahl, nämlich 0 oder 1,

gehärtet sind.

Revendications

1. Elément photographique photosensible à base d'halogénure d'argent, comprenant un support portant des couches de composant photographique, englobant au moins une couche d'émulsion d'halogénure d'argent, qui contient des grains d'halogénure d'argent contenant pas moins de 90 % en moles de chlorure d'argent, dans lequel la proportion desdits grains d'halogénure d'argent dans ladite couche d'émulsion d'halogénure d'argent n'est pas inférieure à 60 % en poids du poids total des grains d'halogénure d'argent contenus dans ladite couche d'émulsion d'halogénure d'argent, et au moins une couche parmi lesdites couches de composant photographique contient un composé représenté par la formule [I] ci-après, et un matériau piège pour un agent de blanchiment fluorescent:

Formule [I]



dans laquelle R_1 et R_2 représentent indépendamment un groupe -CN, un groupe $-CFR_5R_5$, un groupe $-COR_7$, un groupe $-COOR_7$, un groupe $-CONHR_5$ ou un groupe $-CF_3$, dans lesquels R_5 et R_5 représentent indépendamment un atome d'hydrogène, un groupe alkyle fluoré ayant un à quatre atomes de carbone, et R_7 représente un groupe alkyle ou un groupe aryle qui peut porter un susbtituant; R_3 et R_4 représentent indépendamment un atome d'hydrogène ou un groupe aliphatique, un groupe alicyclique, un groupe aromatique ou un groupe hétérocyclique, dont chacun peut être éventuellement susbtitué ; L_1, L_2, L_3, L_4 et L_5 représentent indépendamment un groupe méthine éventuellement substitué ; et m et n représentent indépendamment un nombre entier valant 0 ou 1.

2. Elément selon la revendication 1, dans lequel ledit matériau piège est un homo- ou copolymère de vinylpyrrolidone.

3. Elémént selon la revendication 1 ou 2, dans lequel les substituants R_3 et R_4 du composé de formule [I] représentent chacun indépendamment un groupe 4-sulfophényle ou 2,5-disulfophényle.

4. Elément selon la revendication 1, 2 ou 3, dans lequel le poids de revêtement dudit matériau piège est compris dans la gamme allant de 0,05 mg/dm^2 à 3,0 mg/dm^2.

5. Elément selon la revendication 4, dans lequel le poids de revêtement dudit matériau piège est compris dans la gamme allant de 0,1 mg/dm^2 à 2,0 mg/dm^2.

6. Elément selon l'une quelconque des revendications précédentes, dans lequel la quantité dudit matériau piège est comprise dans la gamme allant de 0,1 % à 50 % en poids par rapport à l'autre liant contenu dans la couche de composant photographique qui contient ledit matériau piège.

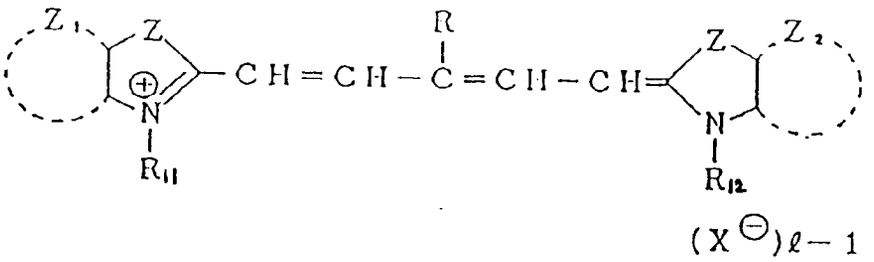
7. Elément selon la revendication 6, dans lequel la quantité dudit matériau piège est comprise dans la gamme allant de 1 % à 30 % en poids par rapport au liant contenu dans la couche de composant photographique qui contient ledit matériau piège.

8. Elément selon l'une quelconque des revendications précédentes, dans lequel le poids de revêtement dudit composé représenté par la formule [I] est compris dans la gamme allant de 0,01 mg/dm^2 à 1,0 mg/dm^2.

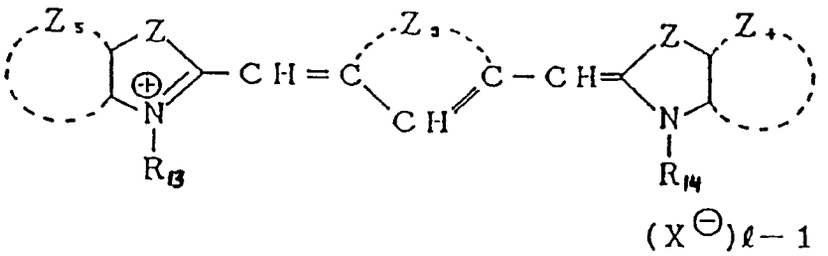
9. Elément selon la revendication 8, dans lequel le poids de revêtement dudit composé représenté par la formule [I] est compris dans la gamme allant de 0,03 mg/dm^2 à 0,4 mg/dm^2.

10. Elément selon l'une quelconque des revendications précédentes, dans lequel au moins une dite couche d'émulsion d'halogénure d'argent contenant des grains d'halogénure d'argent comprenant pas moins de 90 % en moles de chlorure d'argent est soumise à une sensibilisation spectrale avec au moins un colorant sensibilisant choisi parmi les composés représentés par la formule suivante [C] ou [D] :

Formule [C]



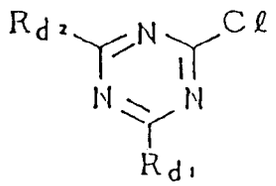
Formule [D]



dans laquelle R représente un atome d'hydrogène ou un groupe alkyle éventuellement substitué ; R_{11} à R_{14} représentent indépendamment un groupe alkyle éventuellement substitué ou un groupe aryle éventuellement substitué ; Z_1, Z_2, Z_4 et Z_5 représentent indépendamment un groupe d'atomes nécessaires pour compléter un noyau benzénique ou un cycle naphtalénique condensé en un cycle thiazole ou sélénazole ; Z_3 représente un groupe hydrocarboné nécessaire pour compléter un cycle à six maillons; l représente un nombre entier qui vaut 1 ou 2; Z représente un atome de soufre ou un atome de sélénium ; et X^- représente un anion.

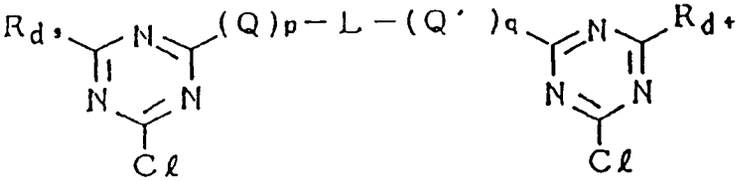
11. Elément selon l'une quelconque des revendications précédentes, dans lequel lesdites couches de composant photographique sont durcies à l'aide d'un durcisseur choisi parmi les composés représentés par la formule suivante [HDA] OU [HDB] :

Formule [HDA]



dans laquelle R_{d1} représente un atome de chlore, un groupe hydroxy ou un groupe alkyle, alcoxy ou alkylthio éventuellement substitué, un groupe -OM, un groupe -NR'R" ou un groupe -NHCOR, dans lequel M représente un atome de métal monovalent; R' et R" représentent indépendamment un atome d'hydrogène, un groupe alkyle ou aryle éventuellement substitué ; et R représente un groupe alkyle ou aryle éventuellement substitué ; et R_{d2} représente un groupe identique à celui défini pour R_{d1}, excepté le chlore ;

Formule [HDB]



dans laquelle R_{d3} et R_{d4} représentent indépendamment un atome de chlore, un groupe hydroxy ou un groupe alkyle ou alcoxy éventuellement substitué, ou un groupe -OM, dans lequel M représente un atome de métal monovalent ;Q et Q′ représentent indépendamment un atome de liaison ou un groupe -O-, -S- ou -NH-; L représente un groupe alkylène ou un groupe arylène ; et p et q représentent indépendamment un nombre entier qui vaut 0 ou 1.