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(54) **Process for producing color filter**

Verfahren zur Herstellung eines Farbfilters

Procédé pour produire un filtre couleur

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(56) References cited:
EP-A- 0 396 824 **EP-A- 0 713 137**
EP-A- 0 740 201

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DescriptionFIELD OF THE INVENTION

[0001] The present invention relates to a process for manufacturing a color filter having red, green and blue colors excellent in the spectral transmission properties and having superior planeness. The present invention further relates to a process for easily mass-producing a color filter.

BACKGROUND OF THE INVENTION

[0002] The microcolor filter (hereinafter referred to as a color filter) is being used in a color face plate for a cathode-ray tube display, a photoelectric transfer element plate for copying, a filter for a single tube-type color television camera, a flat panel display using liquid crystal or a color solid camera element.

[0003] The color filter in common use is constituted by regularly disposing primary colors of red, green and blue, however, the color filter may comprise four or other color hues, if desired. For example, a color filter for camera tube or a color filter for liquid crystal display is required to have a black pattern (black matrix) for various purposes.

[0004] Specific examples of the disposition of red, green and blue colors include mosaic disposition, stripe disposition and delta disposition, and the disposition may be selected according to the requirement.

[0005] Conventionally known methods for producing a color filter include evaporation, dyeing, printing, pigment dispersion, electrodeposition and electrodeposition transfer of a resist. However, the color filter obtained by these methods is deficient in that a complicated production process is required, pinholes or scratches are readily generated, the yield is low, and accuracy is not ensured.

[0006] In order to solve these problems, a process for manufacturing a color filter according to an external development method (for example, JP-A-55-6342, the term "JP-A" as used herein means an "unexamined published Japanese patent application") or an internal development method (for example, JP-A-62-148952 and JP-A-62-71950), using a silver halide color light-sensitive material, has been investigated. The former method requires to perform color development at least three times and the processing procedure is far from simpleness. The latter method is very simple because a color filter can be manufactured by one-shot exposure and one-time development, however, a mask for exposure (master color filter) having a filter of colors in agreement with the spectral sensitivity of the silver halide color light-sensitive material needs be manufactured and this is cumbersome. JP-A-60-133427 describes a process of using two kinds of normal negative silver halide color light-sensitive materials and performing negative/positive reversal of an original color filter pattern to form a color filter.

[0007] However, the color filter obtained by this method is found to be insufficient in the spectral transmission property. Further, the pattern of an original color filter is necessary to form and this remains cumbersome.

[0008] EP-A-713137 discloses a method for producing a color filter having blue, green and red pixel patterns which comprises pattern exposing a silver halide photosensitive material containing photosensitive silver halide on a support, colon developing the material in the presence of a developing agent and a coupler, and desilvering the material, wherein the green pixel pattern comprises a yellow component which has an absorption peak wavelength between 400 nm and 450 nm and satisfies the condition that when the absorbance at the peak wavelength is taken as 1, the absorbance at 500 nm is 0.35 or less, and a cyan component which has an absorption peak wavelength between 630 nm and 700 nm and satisfies the condition that when the absorbance at the peak wavelength is taken as 1, the absorbance at 570 nm is 0.35 or less.

SUMMARY OF THE INVENTION

[0009] A first object of the present invention is to provide a process for manufacturing a color filter, which requires no complicated process, which is suitable for mass production and which is difficult to cause defects in the production process of a panel.

[0010] A second object of the present invention is to provide a process for manufacturing a color filter having red, green and blue areas excellent in the spectral transmission property.

[0011] Other objects and effects of the present invention will be apparent from the following description.

[0012] The above-described objects of the present invention have been achieved by providing a process for producing a color filter having red, green and blue pixel patterns and a black matrix comprising the steps of:

(1) providing a master color filter having pixel patterns colored to red, green and blue, respectively, and having a substantially colorless area corresponding to the black matrix, by a process comprising:

exposing a first silver halide color light-sensitive material comprising a transparent support having thereon at

least three silver halide emulsion layers having different color sensitivity from each other; and color developing and desilvering said exposed light-sensitive material; said first silver halide color light-sensitive material comprises at least a yellow coupler-containing silver halide emulsion Layer, a magenta coupler-containing silver halide emulsion layer and a cyan coupler-containing silver halide emulsion layer;

(2) providing a second silver halide color light-sensitive material comprising a transparent substrate having thereon at least:

a red-sensitive silver halide emulsion Layer containing a coupler which is sensitive to the red color of said master color filter and which forms a red color;
a green-sensitive silver halide emulsion layer containing a coupler which is sensitive to the green color of said master color filter and which forms a green color;
a blue-sensitive silver halide emulsion layer containing a coupler which is sensitive to the blue color of said master color filter and which forms a blue color; and
an infrared-sensitive emulsion;

(3) one-shot exposing said second silver halide color light-sensitive material with white light through the master color filter; and then

(4) color developing and desilvering said one-shot exposed light-sensitive material

characterized in that

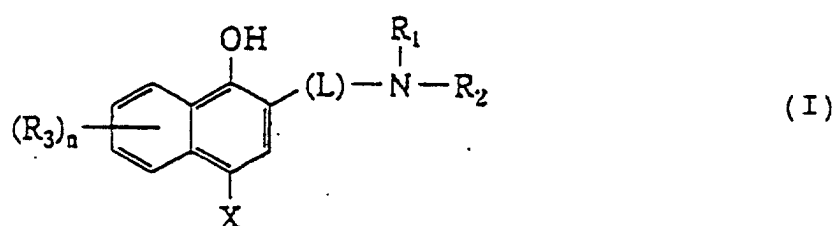
either at least one of said yellow coupler containing silver halide emulsion layer and said magenta coupler-containing silver halide emulsion layer contains an infrared dye-forming coupler, or

said first silver halide color light-sensitive material further comprises a silver halide emulsion layer which contains an infrared dye-forming coupler and which has the same sensitivity as that of either or both of said yellow coupler-containing silver halide emulsion layer and said magenta coupler-containing silver halide emulsion layer.

[0013] In a first preferred embodiment, the pattern exposure of the first silver halide color light-sensitive material is carried out using a laser ray.

[0014] In a second preferred embodiment, the one-shot exposure of the second silver halide color light-sensitive material is carried out in a reduced magnification manner.

[0015] In a third preferred embodiment, the infrared dye-forming coupler is represented by the following formula (I):



wherein L represents -CO- or -SO₂-, R₁ represents an alkyl group, an aryl group or a heterocyclic group, R₂ represents a hydrogen atom, an alkyl group or an aryl group, R₃ represents a substituent, n represents 0, 1, 2, 3 or 4, and X represents a hydrogen atom or a group capable of splitting off upon coupling with an oxidation product of a developing agent.

[0016] Fig. 1 is a view showing one example of the characteristic curve of the silver halide light-sensitive material for the color filter prepared according to the present invention.

[0017] Fig. 2 is a view showing one embodiment of the master color filter used in the present invention.

[0018] Fig. 3 is a view showing one embodiment of the color filter prepared according to the present invention.

[0019] Fig. 4 is a view showing one embodiment of the layer structure of the silver halide light-sensitive material for the color filter prepared according to the present invention.

[0020] The present invention is described in detail below.

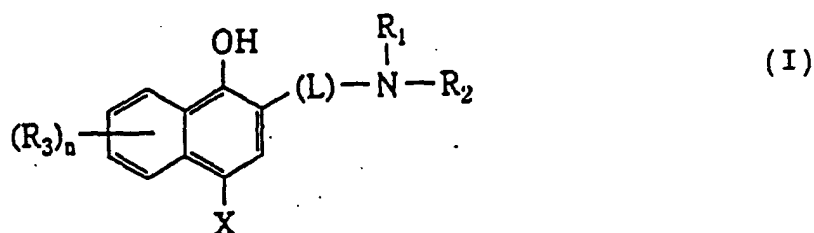
[0021] The master color filter (a) may be manufactured using the above-described evaporation, dyeing, printing,

pigment dispersion, electrodeposition or electrodeposition transfer of a resist, however, in the present invention, from the standpoint of convenience, a silver halide color light-sensitive material (the first silver halide color light-sensitive material) comprising a light-transmittable support having thereon coatings, such as a commercially available color negative film, a color positive film for movies, a color reversal film, a color autpositive (color direct positive) film, a color intermediate film and a light-sensitive material by the silver dye bleaching process, is used. The silver halide light-sensitive material (b) (the second silver halide color light-sensitive material) which will be described below may also be used. The light-sensitive material used for the purpose of manufacturing the master color filter (a) is not limited in the color sensitivity to the combination of blue sensitivity, green sensitivity and red sensitivity, but combination with ultraviolet sensitivity, yellow sensitivity or infrared sensitivity may be used and a plurality of infrared sensitivities different in the sensitive wavelength region may also be used.

[0022] The above-described silver halide color light-sensitive material for master color filter typically comprises a yellow coupler-containing silver halide emulsion layer, a magenta coupler-containing silver halide emulsion layer and a cyan coupler-containing silver halide emulsion layer. For example, the construction may be such that the yellow coupler-containing silver halide emulsion layer has color sensitivity in the blue spectral region, the magenta coupler-containing silver halide emulsion layer has color sensitivity in the green spectral region and the cyan coupler-containing silver halide emulsion layer has color sensitivity in the red spectral region.

[0023] An infrared dye-forming coupler is incorporated into the magenta coupler-containing silver halide emulsion layer, the yellow coupler-containing silver halide emulsion layer or both of these silver halide emulsion layers, or a silver halide emulsion layer having the same color sensitivity as the color sensitivity of either the magenta coupler-containing silver halide emulsion layer or the yellow coupler-containing silver halide emulsion layer or having color sensitivity in both spectral regions of these layers is separately provided and an infrared dye-forming coupler is incorporated into the layer.

[0024] Preferred infrared dye-forming couplers for use in the present invention are those having a peak wavelength at from 700 nm to 1,100 nm in the light absorption spectrum upon color formation by the color development processing. The infrared dye-forming coupler is preferably a compound represented by the following formula (I):



wherein L represents -CO- or -SO₂-, R₁ represents an alkyl group, an aryl group or a heterocyclic group, R₂ represents a hydrogen atom, an alkyl group or an aryl group, R₃ represents a substituent, n represents 0, 1, 2, 3 or 4, and X represents a hydrogen atom or a group capable of splitting off upon coupling with an oxidation product of the developing agent.

[0025] R₁, R₂, R₃, n and X are described in detail below.

[0026] R₁ represents an alkyl group, an aryl group or a heterocyclic group. The alkyl group is a substituted or unsubstituted linear, branched or cyclic alkyl group. The unsubstituted alkyl group is an unsubstituted linear, branched or cyclic alkyl group having from 1 to 36, preferably from 1 to 24, carbon atoms (e.g., methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, decyl, dodecyl, tetradecyl, hexadecyl, octadecyl, isopropyl, t-butyl, 2-ethylhexyl, cyclohexyl, adamantyl).

[0027] Examples of the substituent in the substituted alkyl group include a halogen atom (e.g., fluorine, chlorine, bromine), a hydroxy group, a carboxyl group, a cyano group, a nitro group, an aryl group (having from 6 to 24, preferably from 6 to 14, carbon atoms, e.g., phenyl, naphthyl), an alkoxy group (having from 1 to 36, preferably from 1 to 24, carbon atoms, e.g., methoxy, ethoxy, propoxy, butoxy, hexyloxy, octyloxy, dodecyloxy, tetradecyloxy, hexadecyloxy, octadecyloxy, isopropoxy, 2-ethylhexyloxy, cyclohexyloxy), an aryloxy group (having from 6 to 36, preferably from 6 to 14, carbon atoms, e.g., phenoxy, naphthyloxy), an alkylthio group (having from 1 to 36, preferably from 1 to 24, carbon atoms, e.g., methylthio, ethylthio, butylthio, hexylthio, octylthio, dodecylthio, tetradecylthio, hexadecylthio, octadecylthio, isobutylthio, 2-ethylhexylthio, cyclohexylthio), an arylthio group (having from 6 to 36, preferably from 6 to 14, carbon atoms, e.g., phenylthio, naphthylthio), a carbonyloxy group (having from 2 to 38, preferably from 2 to 24, carbon atoms, e.g., acetoxy, proionyloxy, heptacarbonyloxy, benzoyloxy, 4-t-butylbenzoyloxy, pivaloyloxy), an oxycarbonyl group (having from 2 to 40, preferably from 2 to 26, carbon atoms, e.g., methoxycarbonyl, ethoxycarbonyl, pivaloyloxy, 2-ethylhexyloxycarbonyl, dodecyloxycarbonyl, hexadecyloxycarbonyl, cyclopentyloxycarbonyl, cyclohexyloxycarbonyl, phe-

noxy carbonyl, 2,4-di-*t*-amylphenoxy carbonyl, 4-*t*-octylphenoxy carbonyl, 2,6-di-*t*-butyl-4-methylcyclohexyloxy carbonyl), a carbamoyl group (having from 1 to 48, preferably from 1 to 24, carbon atoms, e.g., carbamoyl, N-methylcarbamoyl, N-ethylcarbamoyl, N-octylcarbamoyl, N-hexadecylcarbamoyl, N-phenylcarbamoyl, N,N-dipropylcarbamoyl, N,N-dibutylcarbamoyl, N,N-diphenylcarbamoyl, N-methyl-N-octadecylcarbamoyl), an acylamino group (having from 1 to 38, preferably from 1 to 24, carbon atoms, e.g., acetyl amino, propionyl amino, octanoyl amino, tetradecanoyl amino, 2-ethylhexanoyl amino, pivaloyl amino, cyclohexanoyl amino, benzoyl amino), an oxycarbonylamino group (having from 2 to 38, preferably 2 to 24, carbon atoms, e.g., methoxycarbonylamino, ethoxycarbonylamino, butoxycarbonylamino, dodecyloxycarbonylamino, hexadecyloxycarbonylamino, phenoxy carbonylamino, 2,6-di-*t*-butyl-4-methylcyclohexyloxy carbonylamino), a carbamoylamino group (having from 2 to 36, preferably from 2 to 24, carbon atoms, e.g., N-methylcarbamoylamino, N-butylcarbamoylamino, N-dodecylcarbamoylamino, N-phenylcarbamoylamino, N,N-dibutylcarbamoylamino, N-octyl-N-phenylcarbamoylamino), an amino group (having from 1 to 36, preferably from 1 to 24, carbon atoms, e.g., ethyl amino, propyl amino, butyl amino, octyl amino, dodecyl amino, hexadecyl amino, diethyl amino, dibutyl amino, cyclohexyl amino, dicyclohexyl amino, anilino, diphenyl amino, 2-ethylhexyl amino), a sulfonamido group (having from 1 to 36, preferably from 1 to 24, carbon atoms, e.g., methanesulfonamido, ethanesulfonamido, butanesulfonamido, octanesulfonamido, hexadecanesulfonamido, benzenesulfonamido, *p*-toluenesulfonamido), a sulfamoyl group (having from 0 to 36, preferably from 0 to 18, carbon atoms, e.g., sulfamoyl, N-ethylsulfamoyl, N-butylsulfamoyl, N-octylsulfamoyl, N-dodecylsulfamoyl, N-phenylsulfamoyl, N,N-diethylsulfamoyl, N,N-dicyclohexylsulfamoyl, N-methyl-N-octadecylsulfamoyl, N-ethyl-N-phenylsulfamoyl), a sulfonyl group (having from 1 to 36, preferably from 1 to 18, carbon atoms, e.g., methylsulfonyl, ethylsulfonyl, butylsulfonyl, octylsulfonyl, hexadecylsulfonyl, phenylsulfonyl, cyclohexylsulfonyl), a sulfamoylamino group (having from 1 to 36, preferably from 1 to 24, carbon atoms, e.g., N-butylsulfamoylamino, N-dodecylsulfamoylamino, N-phenylsulfamoylamino, N,N-diethylsulfamoylamino, N-methyl-N-phenylsulfamoylamino) and an imido group (having from 4 to 24, preferably from 4 to 20, carbon atoms, e.g., succinimido, hexadeceny succinimido, hexadecylsuccinimido, 5,5-dimethylhydantoin-1-yl).

[0028] The substituent in the substituted alkyl group is preferably a halogen atom, a cyano group, a carboxyl group, a hydroxy group, an alkoxy group, an aryloxy group, an alkylthio group, an arylthio group, a carbamoyl group, an amido group, an oxycarbonyl group, a carbonyloxy group, an oxycarbonylamido group, a carbamoylamino group, a sulfonamido group, a sulfamoyl group, a sulfonyl group or an imido group.

[0029] The substituent in the substituted alkyl group is more preferably a halogen atom, a cyano group, an alkoxy group, an aryloxy group, a carbamoyl group, an amido group, an oxycarbonyl group, a carbonyloxy group, an oxycarbonylamido group, a carbamoylamino group, a sulfonamido group, a sulfamoyl group, a sulfonyl group or an imido group.

[0030] These substituents may further have a substituent. The substituted alkyl group may have a plurality of substituents and when two or more substituents are present, they may be the same or different.

[0031] The aryl group is a substituted or unsubstituted aryl group. Examples of the substituent in the substituted aryl group include the substituents described above as the substituent in the substituted alkyl group represented by R₁ and an alkyl group. A substituted aryl group is preferred and the substituent is preferably a halogen atom, a cyano group, an alkyl group, an aryl group, a heterocyclic group, an alkoxy group, an aryloxy group, a heterocyclic oxy group, an alkylthio group, an arylthio group, a carbonyloxy group, a carbamoyloxy group, an oxycarbonyl group, a carbamoyl group, an amino group, an acylamino group, an oxycarbonylamino group, a carbamoylamino group, a sulfonamido group, a sulfamoylamino group, an imido group, a sulfonyl group or a sulfamoyl group, more preferably, a halogen atom, a cyano group, an alkyl group, an aryl group, an alkoxy group, an aryloxy group, a carbonyloxy group, a carbamoyloxy group, an oxycarbonyl group, a carbamoyl group, an acylamino group, an oxycarbonylamino group, a carbamoylamino group, a sulfonamido group, a sulfamoylamino group, an imido group, a sulfonyl group or a sulfamoyl group.

[0032] The heterocyclic group is a 5-, 6- or 7-membered heterocyclic ring containing at least one of a nitrogen atom, an oxygen atom and a sulfur atom (e.g., pyrazolyl, imidazolyl, oxazolyl, thiazolyl, pyridyl, pyrimidyl, triazolyl, tetrazolyl, benzoxazolyl). The heterocyclic group may further be substituted by a substituent described above for the substituted alkyl group represented by R₁ or by an alkyl group.

[0033] R₂ represents a hydrogen atom, an alkyl group or an aryl group, and the alkyl group and the aryl group have the same meanings as the alkyl group and the aryl group described above for R₁, respectively. R₂ is preferably a hydrogen atom.

[0034] R₃ represents a substituent, and n represents 0 or an integer of from 1 to 4. The substituent represented by R₃ includes the substituents described above for the substituted alkyl group represented by R₁ and an alkyl group. The substituent represented by R₃ is preferably a halogen atom, a hydroxy group, a cyano group, an alkyl group, an aryl group, a heterocyclic group, an alkoxy group, an aryloxy group, an alkylthio group, an arylthio group, a carbonyloxy group, an oxycarbonyl group, an acylamino group, an oxycarbonylamino group, a carbamoylamino group, a sulfonamido group, a sulfamoyl group, a sulfonyl group or an imido group, more preferably a halogen atom, an alkoxy group, an oxycarbonyl group, an acylamino group, an oxycarbonylamino group, a carbamoylamino group, a sulfonamido

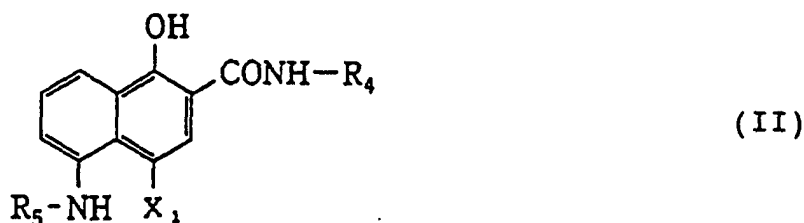
group, a sulfamoyl group or an imido group, and most preferably an acylamino group, an oxycarbonylamino group, a carbamoylamino group or a sulfonamido group. n represents 0 or an integer of from 1 to 4.

[0035] n is preferably 0 or 1.

[0036] X represents a hydrogen atom or a group capable of splitting off upon coupling with an oxidation product of the developing agent. Examples of the group capable of splitting off upon coupling with an oxidation product of the developing agent include a halogen atom (e.g., fluorine, chlorine, bromine, iodine), a heterocyclic group or imido group which splits off by a nitrogen atom (e.g., splitting-off groups described in JP-A-56-38044, JP-B-58-10739 (the term "JP-B" as used herein means an "examined Japanese patent publication"), JP-B-56-54134 and JP-B-56-45135), an alkylthio group (e.g., splitting-off groups described in JP-A-56-126833), an arylthio group (e.g., splitting-off groups described in U.S. Patent 4,351,897, JP-A-2-160233), an alkoxy group (e.g., splitting-off groups described in European Patent 423727), an aryloxy group (e.g., splitting-off groups described in European Patents 428902 and 299726), splitting-off groups described in U.S. Patent 4,072,525, JP-A-5-34878, JP-A-5-313322, European Patent 514896, JP-A-6-34796 and JP-A-7-48376, a carbonyloxy group and a carbamoyloxy group.

[0037] X is preferably a hydrogen atom, a halogen atom, an alkoxy group, an aryloxy group, an alkylthio group, an arylthio group, an imido group, a carbonyloxy group or a carbamoyloxy group, more preferably a hydrogen atom, a halogen atom (e.g., fluorine, chlorine), an alkoxy group, a carbonyloxy group or a carbamoyloxy group, and most preferably a hydrogen atom, a fluorine atom, a chlorine atom, an alkoxy group or a carbamoyloxy group. L represents -CO- or -SO₂-, with -CO- being preferred.

[0038] The coupler represented by formula (I) preferably has a structure represented by the following formula (II):



wherein R₄ has the same meaning as R₁, R₅ represents an acyl group, an oxycarbonyl group, a carbamoyl group or a sulfonyl group, and X₁ has the same meaning as X.

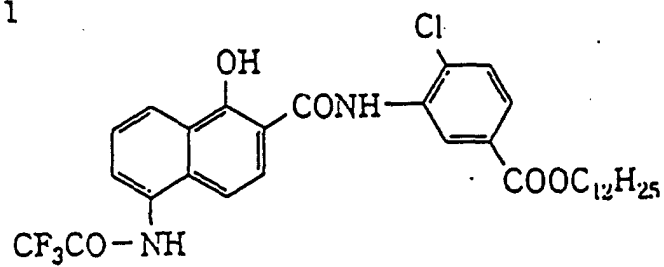
[0039] R₅ is described in detail below.

[0040] R₅ represents an acyl group, an oxycarbonyl group, a carbamoyl group or a sulfonyl group. The acyl group is an acyl group having from 2 to 48, preferably from 2 to 24, carbon atoms (e.g., acetyl, propionyl, 2-ethylhexanoyl, isopropionyl, pivaloyl, octanoyl, decanoyl, tetradecanoyl, hexadecanoyl, cyclohexanoyl, benzoyl, trifluoroacetyl, 4-methylbenzoyl, 2-methoxybenzoyl, 2,5-dichlorobenzoyl, 2-methanesulfonamidobenzoyl, 4-t-butylbenzoyl, 2-(2,4-di-t-amylphenoxy)hexanoyl, 3-tetradecyloxyacetylpropionyl, 2-(4-dodecyloxyphenoxy)butanoyl), the oxycarbonyl group is an oxycarbonyl group having from 2 to 48, preferably from 2 to 24, carbon atoms (e.g., methoxycarbonyl, ethoxycarbonyl, propyloxycarbonyl, butoxycarbonyl, hexyloxycarbonyl, octyloxycarbonyl, dodecyloxycarbonyl, tetradecyloxycarbonyl, hexadecyloxycarbonyl, octadecylcarbonyl, isopropyloxycarbonyl, isobutoxycarbonyl, isoamyloxycarbonyl, cyclohexyloxycarbonyl, 2-ethylhexyloxycarbonyl, 2-methoxyethoxycarbonyl, 2-phenoxyethoxycarbonyl, phenoxycarbonyl), the carbamoyl group is a carbamoyl group having from 2 to 48, preferably from 2 to 24, carbon atoms (e.g., N-methylcarbamoyl, N-ethylcarbamoyl, N-propylcarbamoyl, N-butylcarbamoyl, N-hexylcarbamoyl, N-octylcarbamoyl, N-dodecylcarbamoyl, N-hexadecylcarbamoyl, N,N-diethylcarbamoyl, N,N-dibutylcarbamoyl, N,N-dioctylcarbamoyl, N-methyl-N-octylcarbamoyl, N-phenylcarbamoyl, N,N-diphenylcarbamoyl, N-methyl-N-phenylcarbamoyl, N-cyclohexylcarbamoyl, N-(2-ethylhexyl)carbamoyl), and the sulfonyl group is a sulfonyl group having from 1 to 48, preferably from 1 to 24, carbon atoms (e.g., methylsulfonyl, ethylsulfonyl, butylsulfonyl, dodecylsulfonyl, hexadecylsulfonyl, cyclohexylsulfonyl, phenylsulfonyl, 4-methylphenylsulfonyl, 4-dodecyloxyphenylsulfonyl, 2-octyloxy-5-t-octylphenylsulfonyl).

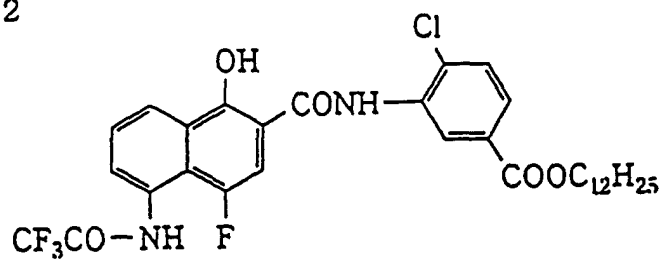
[0041] R₅ is preferably an acyl group, an oxycarbonyl group or a carbamoyl group, more preferably an acyl group or an oxycarbonyl group.

[0042] Specific compound examples of the infrared dye-forming coupler represented by formula (I) are shown below.

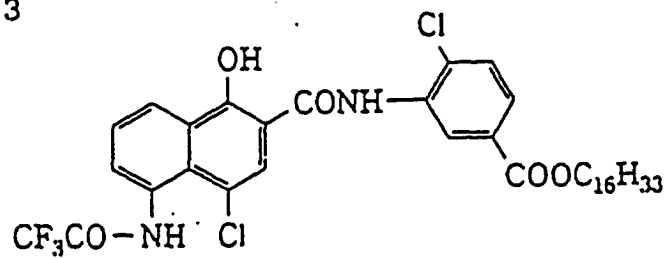
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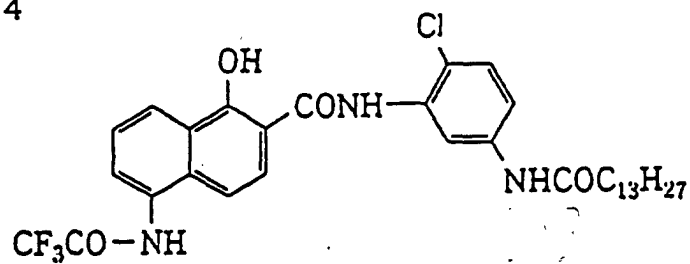
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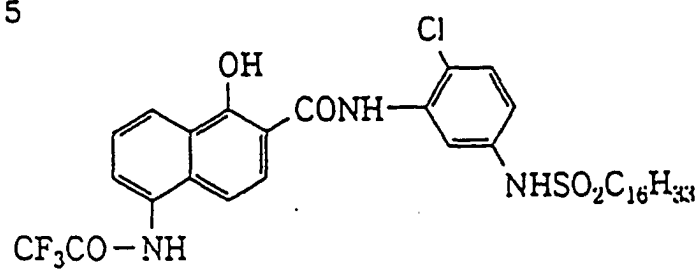
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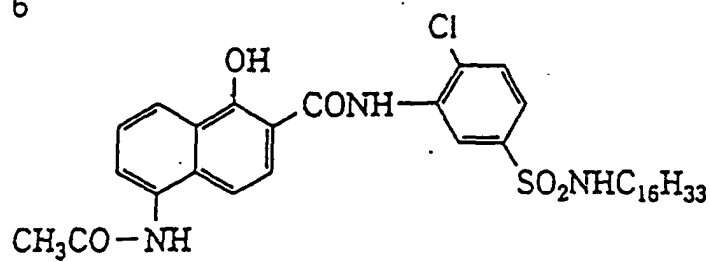
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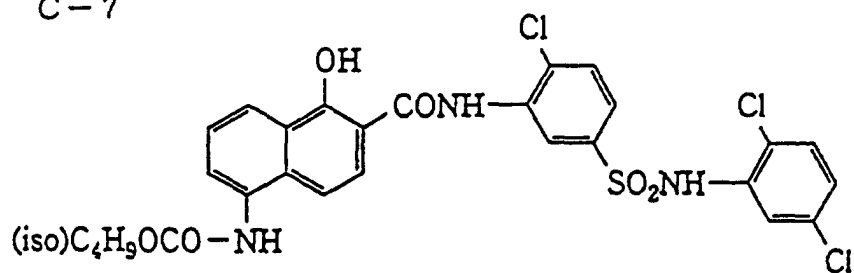
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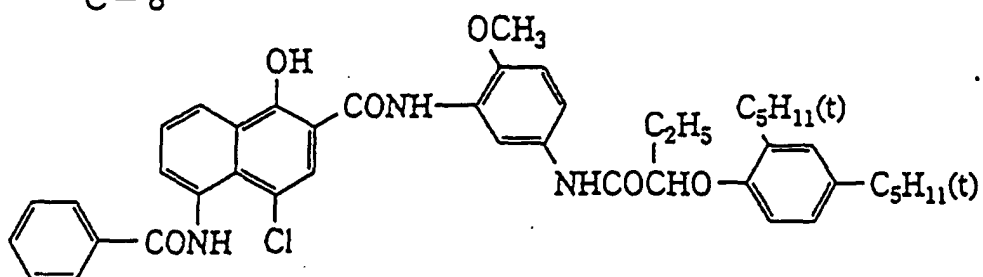
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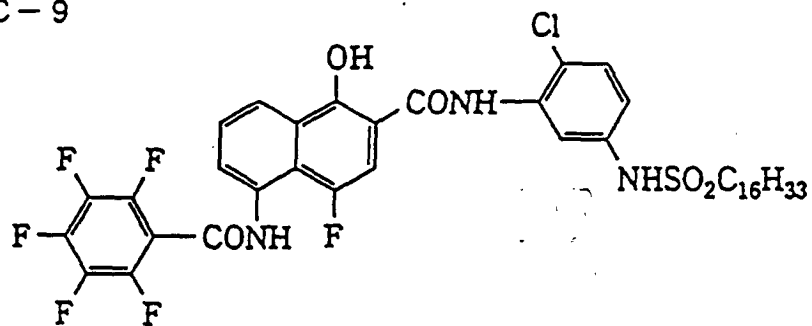
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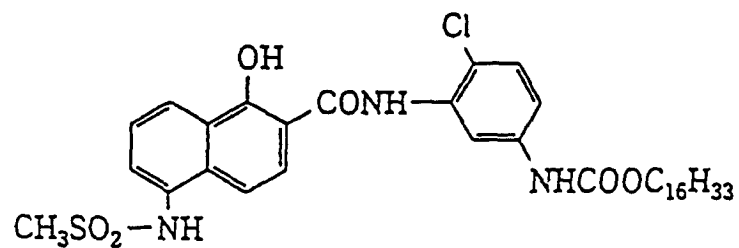
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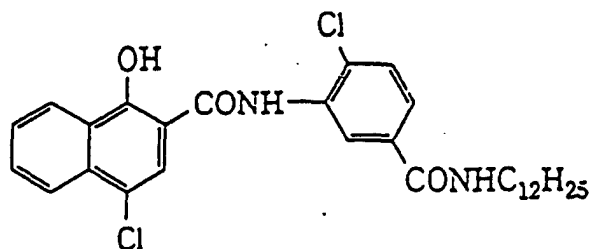
C-9



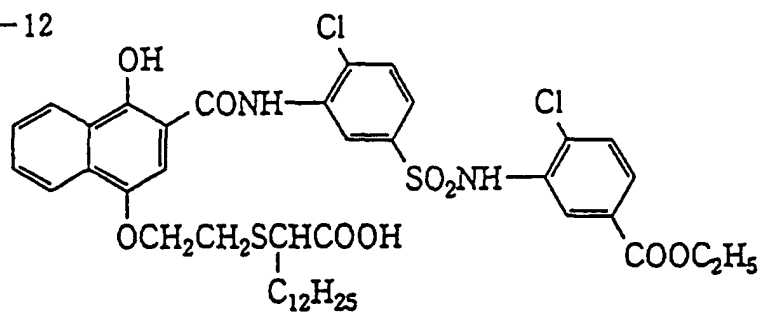
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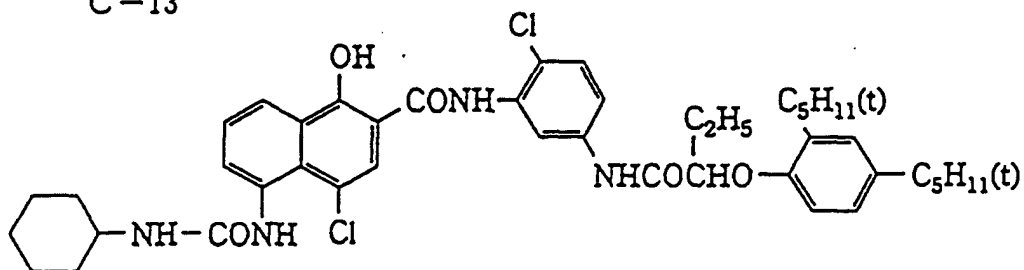
C-11



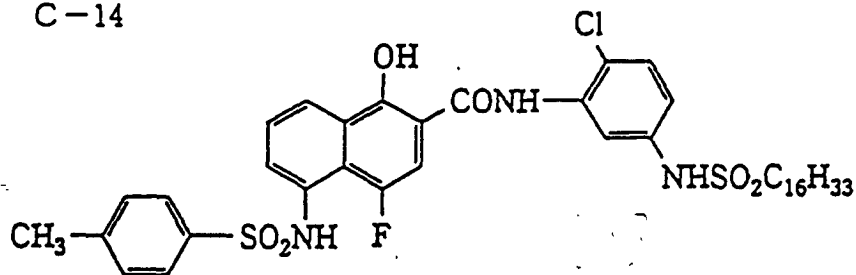
C-12



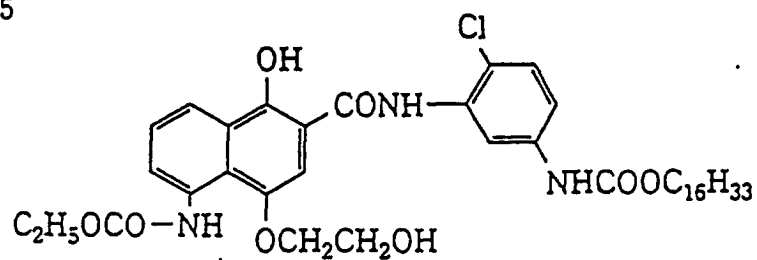
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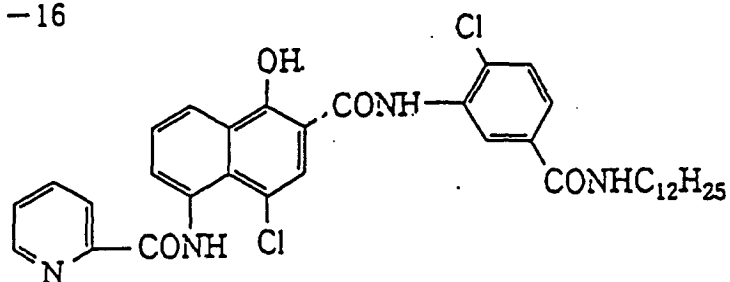
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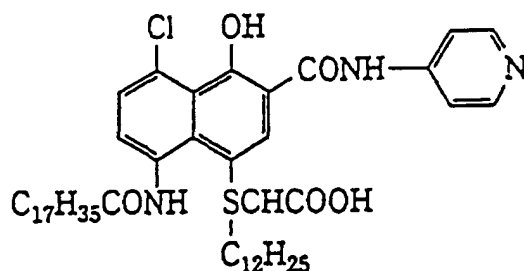
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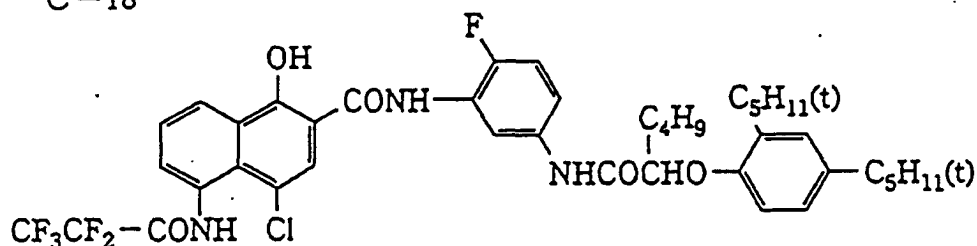
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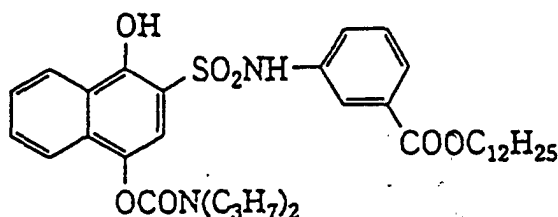
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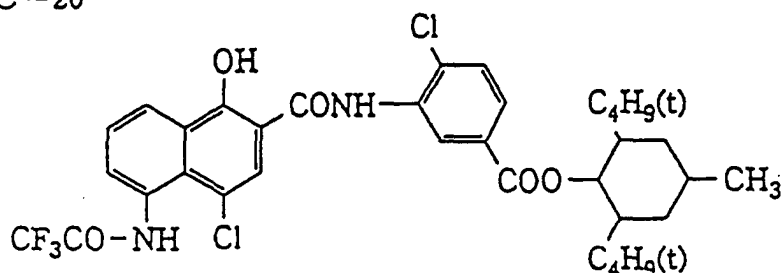
C-18



C-19



C-20



[0043] The amount of the infrared dye-forming coupler for use in the present invention is not particularly limited, however, it is preferably from 0.01 to 1.00 g/m².

[0044] The infrared dye-forming coupler may be added to any layer of the light-sensitive material, however, the color sensitivity of silver halide needs be adjusted so that the infrared dye is contained at least in a red image picture area formed when the light-sensitive material is developed, because out of red, green and blue, red transmits near infrared light most. Therefore, the infrared dye-forming coupler is added to the same layer as the magenta coupler and/or the yellow coupler or to the same layer as the silver halide emulsion layer having the same color sensitivity as these couplers. Alternatively, the infrared dye-forming coupler may be used together with a silver halide emulsion having color sensitivity different from yellow, magenta and cyan respective couplers and subjected to superposition exposure at the time of exposure of the light-sensitive material to thereby form an infrared dye in the red image picture area. The infrared dye may be formed, if desired, in the green, blue, black or other image picture area.

[0045] The above-described silver halide color light-sensitive material (the first silver halide color light-sensitive material) is subjected to pattern exposure by fluorescent tube, CRT, plasma, light emitting diode (LED) or laser as a light source according to digital signals programmed so that red, green and blue colors can be formed, the black matrix area can be substantially colorless and a pixel pattern in the shape required can be obtained. In this case, a laser ray is preferred because the light spot size can be reduced and a high-precision pattern can be written at high speed.

[0046] With respect to the term "the black matrix area is substantially colorless", it is enough if the quantity of light necessary for forming sufficiently black color in the black matrix area can be obtained when the silver halide light-sensitive material (b) for color filter is exposed to white light through the master color filter (a) manufactured, and the area may be colored to gray or other color for controlling the quantity of light (excessive quantity of light causes blur and the pattern obtained becomes poor in the edge sharpness).

[0047] In the present invention, the exposure pattern, namely, the pixel pattern of the master color filter (a) can be easily varied by performing digital exposure using at least three laser light sources. The laser may be selected from various gas lasers, liquid lasers, solid lasers, semiconductor lasers and semiconductor diodes, according to the color sensitivity of the light-sensitive material used. Further, the exposure may also be performed using a wavelength conversion element obtained by combining a nonlinear optical material and a coherent light source such as laser ray. The term "nonlinear optical element" as used herein means a material capable of giving nonlinearity between the polarization and the electric field appeared upon application of a strong photoelectric field such as laser rays. Preferred examples of this material include an inorganic compound such as lithium niobate, potassium dihydrogenphosphate (KDP), lithium iodate and BaB_2O_4 , a urea derivative, a nitroaniline derivative, a nitropyridine-N-oxide derivative such as 3-methyl-4-nitropyridine-N-oxide (POM), and the compounds described in JP-A-61-53462 and JP-A-62-210432. The wavelength conversion element is known to have the monocrystal optical waveguide path form or the fiber form and either is useful.

[0048] The exposure method and exposure apparatus which can be used in the present invention are described in JP-A-2-129625, JP-A-5-176144, JP-A-5-199372, JP-A-6-127021, JP-A-7-15593, JP-A-7-140567, JP-A-7-248549, JP-A-7-248541, JP-A-7-295115, JP-A-7-290760, JP-A-7-301868, JP-A-7-301869, JP-A-7-306481 and JP-A-8-15788. Various commercially available laser exposure apparatuses can of course be used.

[0049] The silver halide color light-sensitive material after the above-described pattern exposure is processed according to the known normal development processing and thereby, a master color filter (a) colored to red, green and blue and having a substantially colorless black matrix area is obtained.

[0050] The silver halide color light-sensitive material (b) for (the second silver halide color light-sensitive material) color filter for use in the present invention is a silver halide color light-sensitive material comprising a transparent substrate having thereon at least a red-sensitive silver halide emulsion layer containing a coupler having sensitivity to the red of the master color filter (a) and forming a red color, a green-sensitive silver halide emulsion layer containing a coupler having sensitivity to the green of the master color filter (a) and forming a green color, a blue-sensitive silver halide emulsion layer containing a coupler having sensitivity to the blue of the master color filter (a) and forming a blue color, and an infrared-sensitive emulsion. The coupler which forms a red color may be a combination of a yellow coupler with a magenta coupler or a red coupler capable of solely forming a red color. The coupler which forms a green color may be a combination of a yellow coupler with a cyan coupler or a green coupler capable of solely forming a green color. The coupler which forms a blue color may be a combination of a cyan coupler with a magenta coupler or a coupler capable of solely forming a blue color.

[0051] According to one embodiment of the silver halide light-sensitive material (b) for color filter used in the present invention, a material having a characteristic curve shown in Fig. 1 is used, the blue-sensitive emulsion layer contains a cyan coupler and a magenta coupler (or contains a blue coupler), the green-sensitive emulsion layer contains a yellow coupler and a cyan coupler (or contains a green coupler), and the red-sensitive emulsion layer contains a yellow coupler and a magenta coupler (or contains a red coupler). In Fig. 1, symbol "a" corresponds to a red-sensitive emulsion, symbol "b" corresponds to a green-sensitive emulsion, symbol "c" corresponds to a blue-sensitive emulsion and symbol "d" corresponds to an infrared-sensitive emulsion. This silver halide light-sensitive material for color filter is exposed to blue, green, red and white lights using a master color filter as shown in Fig. 2 having a pattern in a density capable of giving exposure at the positions of point A and point B in Fig. 1. In Fig. 2, the background area is substantially colorless and transparent, but may be colored to gray or other color for controlling the quantity of light. Thereafter, the light-sensitive material is subjected to color development, desilvering (bleach-fixing) and water washing and then a color filter having formed thereon blue, green and red colors as shown in Fig. 3 is obtained. In Fig. 3, the background area is black.

[0052] Fig. 4 shows another embodiment of the layer structure of the silver halide light-sensitive material (b) for color filter used in the present invention. In Fig. 4, reference numeral 1 represents a protective layer, reference numeral 2 represents an antihalation layer, and reference numeral 3 represents a support. As shown in Fig. 4, a coupler in the same system can be added to a layer adjacent to each silver halide emulsion layer, therefore, color mixing of dyes between respective emulsion layers can be restrained even without the interposition of an interlayer and the color filter can be reduced in the thickness. Of course, an interlayer can be disposed between emulsion layers having different

color sensitivities and in this case, the amount of the color mixing inhibitor added can be reduced. In manufacturing a color filter using this silver halide light-sensitive material, the silver halide light-sensitive material is, in the same manner as above, exposed using a master color filter as shown in Fig. 2 and then subjected to color development, bleach-fixing and water washing. In this silver halide light-sensitive material, the silver halide emulsion layers different in the color sensitivity each is constituted by at least two unit layers. The unit layers having the same color sensitivity may be different or the same in the sensitivity. These two unit layers each contains at least one coupler such that the hues formed are different between layers.

[0053] In the above-described silver halide light-sensitive material, the order of providing three silver halide emulsion layers having color sensitivity to red, green or blue is not limited to the order above but may be freely selected. In addition to the above-described layer structure, a subbing layer, an interlayer, a yellow filter layer capable of bleaching, a protective layer or an ultraviolet absorbing layer may be provided, if desired.

[0054] In the present invention, when one-shot exposure with white light is performed, in the case of equal magnification, the master color filter (a) is placed close to or in contact with the silver halide light-sensitive material (b) for color filter and the binder layers of these two light-sensitive materials face each other. The master color filter (a) may be improved in the adhesion or blur when it is exposed in the state such that the surface on the support side is laminated with a rigid transparent material such as glass or a load such as glass is imposed thereon.

[0055] In the present invention, the pixel pattern of the master color filter (a) may be enlarged or reduced to a similitude by means of a camera for the photomechanical process and exposed on a silver halide light-sensitive material (b) for color filter. In particular, when a pixel pattern of the master color filter (a) is formed larger than the desired size and reduced upon printing, the color filter obtained has a pattern of higher precision and the digital exposure by laser or the like is advantageously facilitated.

[0056] Further, in order to concord the quantity of red, green, blue or white light transmitted through the master color filter (a) with the sensitivity characteristics in the spectrum of the silver halide light-sensitive material (b) for color filter, a color correction filter of various types or an ND (Neutral Density) filter may be interposed between the white light source and the master color filter (a) on exposure.

[0057] The silver halide grain which can be used in the silver halide light-sensitive material (b) for color filter of the present invention includes silver chloride, silver bromide, silver iodochloride, silver chlorobromide and silver iodochlorobromide. The silver chloride content is preferably 50 mol% or more, more preferably 80 mol% or more. The silver iodide content is preferably 2 mol% or less, more preferably 1 mol% or less, still more preferably 0.5 mol% or less.

[0058] The silver halide emulsion for use in the present invention may be a homogeneous crystal structure grain or a multiple structure grain having different halogen compositions between the inside of the grain and the surface of the grain. Further, silver halide having a different composition may be joined to the grain by epitaxial conjunction. Furthermore, a compound other than silver halide, such as silver rhodanate or lead oxide, may be joined thereto.

[0059] In particular, the high silver chloride emulsion for use in the present invention may have a structure such that a stratified or non-stratified silver bromide localized phase is present in the inside and/or surface of silver halide. The halogen composition in the localized phase preferably has a silver bromide content of at least 20 mol%, more preferably in excess of 30 mol%. The silver bromide content in the silver bromide localized phase can be analyzed by the X-ray diffraction method. The application method of the X-ray diffraction method to silver halide grains is described in, for example, C.R. Berry and S.J. Marino, Photographic Science and Technology, Vol. 2, p. 149 (1955), and *ibid.*, Vol. 4, p. 22 (1957). The silver bromide localized phase may be present in the inside of a grain, or at the edge or corner of or on the plane of the grain surface, however, it is preferably joined to the corner part of a grain by epitaxial conjunction.

[0060] In order to achieve a large specific surface area and a high development activity while reducing the silver amount as much as possible, the average grain size of silver halide grains for use in the present invention is preferably from 0.05 to 0.9 μm , more preferably from 0.1 to 0.5 μm . In the case of a tabular grain, the thickness is preferably from 0.05 to 0.9 μm , more preferably from 0.1 to 0.5 μm .

[0061] A monodisperse emulsion having a narrow grain size distribution may also be used. The monodisperse emulsion is a silver halide emulsion, for example, having a grain size distribution such that 80% or more by number or weight of all grains have a size falling within the average grain size $\pm 30\%$. Also, a monodisperse silver halide emulsion having a coefficient of variation of 20% or less, preferably 15% or less, may be used.

[0062] A polydisperse emulsion having a wide grain size distribution may also be used.

[0063] The silver halide emulsion which can be used in the present invention may be prepared by the method described, for example, in Research disclosure (RD) "I. Emulsion Preparation and Types", Vol. 176, No. 17643, pp. 22-23 (December, 1978), *ibid.*, No. 18716, p. 648 (November, 1979), P. Glafkides, Chimie et Physique Photographique, Paul Montel (1967), G.F. Duffin, Photographic Emulsion Chemistry, the Focal Press (1966), and V.L. Zelikman et al, Making and Coating Photographic Emulsion, the Focal Press (1964).

[0064] The monodisperse emulsions described in U.S. Patents 3,574,628 and 3,655,394 and British Patent 1,413,748 are also preferred.

[0065] Furthermore, a tabular grain having an aspect ratio of about 5 or more may also be used in the present

invention. The tabular grain may be easily prepared by the methods described in Gutoff, Photographic Science and Engineering, Vol. 14, pp. 248-257 (1970), U.S. Patents 4,434,226, 4,414,310, 4,433,048 and 4,439,520, and British Patent 2,112,157.

[0066] A mixture of grains having various crystal forms may also be used.

[0067] The light-sensitive silver halide emulsion is usually a silver halide emulsion subjected to chemical sensitization. The chemical sensitization of the light-sensitive silver halide emulsion for use in the present invention may be performed by chalcogen sensitization such as sulfur sensitization, selenium sensitization and tellurium sensitization, noble metal sensitization using gold, platinum or palladium, or reduction sensitization, which are known to the emulsion for normal light-sensitive materials, and these sensitization methods may be used individually or in combination (see, for example, JP-A-3-110555 and Japanese Patent Application No. 4-75794). The chemical sensitization may also be performed in the presence of a nitrogen-containing heterocyclic compound (see, JP-A-62-253159). Further, an antifoggant which will be described later may be added after completion of the chemical sensitization. More specifically, the methods described in JP-A-5-45833 and JP-A-62-40446 may be used.

[0068] At the time of chemical sensitization, the pH is preferably from 5.3 to 10.5, more preferably from 5.5 to 8.5, and the pAg is preferably from 6.0 to 10.5, more preferably from 6.8 to 9.0.

[0069] The coating amount of the light-sensitive silver halide emulsion for use in the present invention is from 1 mg/m² to 10 g/m² as calculated in terms of silver.

[0070] The light-sensitive silver halide emulsion for use in the present invention is subjected to spectral sensitization with a methine dye or the like so that the light-sensitive silver halide can have color sensitivity to green, red or infrared. Further, the blue-sensitive emulsion may be subjected to spectral sensitization in the blue region, if desired.

[0071] The dye which can be used includes cyanine dyes, merocyanine dyes, complex cyanine dyes, complex merocyanine dyes, holopolar cyanine dyes, hemicyanine dyes, styryl dyes and hemioxonol dyes.

[0072] Specific examples thereof include sensitizing dyes described in U.S. Patent 4,617,257, JP-A-59-180550, JP-A-64-13546, JP-A-5-45828 and JP-A-5-45834.

[0073] These sensitizing dyes may be used individually or in combination thereof, and the combination of sensitizing dyes is often used for the purpose of supersensitization or for controlling the wavelength of spectral sensitivity.

[0074] Together with the sensitizing dye, a dye which itself has no spectral sensitization effect, or a compound which absorbs substantially no visible light, but which exhibits supersensitization may be incorporated into the emulsion (for example, those described in U.S. Patent 3,615,641 and JP-A-63-23145).

[0075] The sensitizing dye may be added to the emulsion before, during or after chemical ripening, or may be added before or after nucleation of silver halide grains according to U.S. Patents 4,183,756 and 4,225,666. The sensitizing dye or supersensitizer may be added as a solution of an organic solvent such as methanol, a dispersion of gelatin or a solution of a surface active agent. The amount added is in general on the order of from 10⁻⁸ to 10⁻² mol per mol of silver halide.

[0076] The additives for use in these steps are described in RD, No. 17643, ibid., No. 18716 and ibid., No. 307105, and the pertinent parts thereof are summarized below.

	Kinds of Additives	RD17643	RD18716	RD307105
1.	Chemical sensitizer	p. 23	p. 648, right col.	p. 866
2.	Sensitivity increasing agent		p. 648, right col.	
3.	Spectral sensitizer, supersensitizer	pp. 23-24	p. 648, right col.-p. 649, right col.	pp. 866-868
4.	Brightening agent	p. 24	p. 648, right col.	p. 868
5.	Antifoggant, stabilizer	pp. 24-25	p. 649, right col.	pp. 868-870
6.	Light absorbent, filter dye, UV absorbent	pp. 25-26	p. 649, right col.-p. 650, left col.	p. 873
7.	Dye image stabilizer	p. 25	p. 650, left col.	p. 872
8.	Hardening agent	p. 26	p. 651, left col.	pp. 874-875
9.	Binder	p. 26	p. 651, left col.	p. 873-874
10.	Plasticizer, lubricant	p. 27	p. 650, right col.	p. 876
11.	Coating aid, surface active agent	pp. 26-27	p. 650, right col.	pp. 875-876
12.	Antistatic agent	p. 27	p. 650, right col.	pp. 876-877

[0077] The color developing agent which can be used in the present invention may be sufficient if the oxidation product of the developing agent formed on the development of silver halide makes coupling reaction with a coupler to form a dye and such a color developing agent is known in the photographic field. Specific examples of the color developing agent are described in T.H. James, The Theory of the Photographic Process, 4th ed., pp. 291-334 and pp. 353-361. A particularly preferred color developing agent is a p-phenylenediamine derivative. The color developing

agents described in JP-A-8-254610 and JP-A-7-333107 can also be used.

[0078] In the present invention, various known color couplers may be used, and specific examples thereof are described in patents cited in Research Disclosure (RD), No. 17643, VII-C to G.

[0079] As the coupler for use in the present invention, a two-equivalent coupler substituted by a splitting-off group is preferred more than a four-equivalent color coupler having a hydrogen atom at the active site because the coated silver amount can be reduced.

[0080] A representative example of the yellow coupler which can be used in the present invention is an oil protect-type acylacetamide-base coupler. Specific examples thereof are described in U.S. Patents 2,407,210, 2,875,057 and 3,265,506. In the present invention, a two-equivalent yellow coupler is preferably used and representative examples thereof include oxygen atom-releasing yellow couplers described in U.S. Patents 3,408,194, 3,447,928, 3,935,501 and 4,022,620, and nitrogen atom-releasing yellow couplers described in JP-B-58-10739, U.S. Patents 4,401,752 and 4,326,024, RD, 18053 (April, 1979), British Patent 1,425,020, West German Patent Publication (OLS) Nos. 2,219,917, 2,261,361, 2,329,587 and 2,433,812. The α -pivaloylacetanilide-base coupler is excellent in the fastness, particularly light fastness, of the colored dye, whereas the α -benzoylacetanilide-base coupler can provide a high color density.

[0081] The magenta coupler which can be used in the present invention includes oil protect-type, preferably, 5-pyrazolone-base couplers and pyrazoloazole-base couplers such as pyrazolotriazoles. The 5-pyrazolone-base coupler is preferably substituted by an arylamino group or an acylamino group at the 3-position in view of hue and color density of the colored dye. Representative examples thereof are described in U.S. Patents 2,311,082, 2,343,703, 2,600,788, 2,908,573, 3,062,653, 3,152,896 and 3,936,015. The splitting-off group of the two-equivalent 5-pyrazolone-base coupler is particularly preferably the nitrogen atom splitting-off group described in U.S. Patent 4,310,619 or the arylthio group described in U.S. Patent 4,351,897. The 5-pyrazolone-base coupler having a ballast group described in European Patent 73,636 can provide a high color density.

[0082] The pyrazoloazole-base coupler includes pyrazolobenzimidazoles described in U.S. Patent 3,369,879, preferably pyrazolo[5,1-c][1,2,4]triazoles described in U.S. Patent 3,725,067, pyrazolotetrazoles described in Research Disclosure, No. 24220 (June, 1984), and pyrazolopyrazoles described in Research Disclosure, No. 24230 (June, 1984). In view of small yellow side absorption and light fastness of the colored dye, imidazo[1,2-b]pyrazoles described in European Patent 119,741 are preferred, and pyrazolo[1,5-b][1,2,4]triazole described in European Patent 119,860 is particularly preferred.

[0083] The cyan coupler which can be used in the present invention includes naphthol-base couplers described in U.S. Patents 2,474,293, 4,052,212, 4,146,396, 4,228,233 and 4,296,200, phenolic cyan couplers having an alkyl group of ethyl or greater group at the meta-position of the phenol nucleus described in U.S. Patent 3,772,002, 2,5-diacylamino-substituted phenolic couplers described in U.S. Patents 2,772,162, 3,758,308, 4,126,396, 4,334,011 and 4,327,173, West German Patent Publication (OLS) No. 3,329,729 and JP-B-3-18175, and phenolic couplers having a phenylureido group at the 2-position and an acylamino group at the 5-position described in U.S. Patents 3,446,622, 4,333,999, 4,451,559 and 4,427,767. In particular, carbostyryl-base couplers described in JP-A-7-294714 are preferably used in the present invention because the couplers have excellent heat resistance and light resistance. As the cyan coupler for green color, pyrazolotriazole-base couplers described in JP-A-8-179122 and JP-A-8-136722 are useful.

[0084] Other than the above-described couplers, various couplers described below can be used in the present invention.

[0085] Typical examples of the dye forming polymer coupler are described in U.S. Patents 3,451,820, 4,080,211 and 4,367,282, and British Patent 2,102,173. Examples of the coupler which solely forms a red color includes the red polymer coupler obtained by copolymerizing a yellow coupler component and a magenta coupler component described in JP-A-9-189986. Examples of the coupler which solely forms a green color include the green polymer coupler obtained by copolymerizing a yellow coupler component with a cyan coupler component described in JP-A-9-204026. Examples of the coupler which solely form a blue color include the blue polymer coupler obtained by copolymerizing a cyan coupler component and a magenta coupler component described in JP-A-9-204027.

[0086] A coupler which releases a photographically useful residue upon coupling is also preferably used in the present invention. Preferred examples of the DIR coupler which releases a development inhibitor are described in patents cited in RD, No. 17643, Item VII-F, JP-A-57-151944, JP-A-57-154234, JP-A-60-184248 and U.S. Patent 4,248,962.

[0087] As the coupler which imagewise releases a nucleating agent or development accelerator upon development, those described in British Patents 2,097,140 and 2,131,188, JP-A-59-157638 and JP-A-59-170840 are preferred.

[0088] In addition, couplers which can be used in the light-sensitive material for use in the present invention include competitive couplers described in U.S. Patent 4,130,427, polyequivalent couplers described in U.S. Patents 4,283,472, 4,338,393 and 4,310,618, DIR redox compound-releasing couplers described in JP-A-60-185950, and couplers which release a dye capable of recovering the color after being released described in European Unexamined Patent Publication 173,302A.

[0089] In the present invention, the equivalent ratio of the coupler to silver halide in each silver halide emulsion layer is preferably from 1 to 3. In particular, when a silver halide emulsion used has an average grain size (in the case of a

tabular grain, determined by the thickness) of 0.9 μm or less, particularly 0.5 μm or less, the equivalent ratio is preferably from 1 to 2. The term "equivalent ratio" as used herein has meaning such that assuming that the theoretical amount of silver halide necessary for all couplers to form a color is an equivalent ratio of 1, when silver halide is coated in an amount of, for example, two times the theoretical amount, the equivalent ratio is 2. In other words, when a 2-equivalent coupler is used and the coated silver amount is 2 mols based on 1 mol of the coupler, the equivalent ratio is 1, and when the coated silver amount is 4 mol, the equivalent ratio is 2.

[0090] The coupler for use in the present invention may be incorporated into the light-sensitive material by various known dispersion methods.

[0091] Examples of the high boiling point solvent for use in the oil-in-water dispersion method are described in U.S. Patent 2,322,027. The amount of the high boiling point solvent is 10 g or less, preferably 5 g or less, more preferably from 0.01 to 1 g, per g of the coupler, and 2 g or less, preferably 1 g or less, more preferably 0.5 g or less, per g of the binder. The size of the coupler dispersion (coupler emulsified product) obtained by the oil-in-water dispersion method is from 0.05 to 0.9 μm , preferably from 0.1 to 0.5 μm .

[0092] The process and effect of the latex dispersion method and specific examples of the latex for impregnation are described in U.S. Patent 4,199,363 and West German Patent Publication (OLS) Nos. 2,541,274 and 2,541,230.

[0093] In the light-sensitive material for use in the present invention, the coupler-containing layer preferably uses a dye image preservability improving compound described in European Unexamined Patent Publication EP0,277,589A2. In particular, it is preferably used in combination with a pyrazoloazole-base magenta coupler.

[0094] More specifically, Compound (F) which reacts with the aromatic amine-base developing agent remaining after color development to produce a chemically inactive and substantially colorless compound and/or Compound (G) which reacts with an oxidation product of the aromatic amine-base developing agent remaining after color development to produce a chemically inactive and substantially colorless compound, are preferably used simultaneously or individually, for example, for preventing staining or other side reaction due to a colored dye produced by the reaction of the color developing agent or oxidation product thereof remaining in the layer with a coupler during storage after the processing.

[0095] The silver halide emulsion layer or interlayer of the light-sensitive material for use in the present invention may contain a hydroquinone derivative, an aminophenol derivative, a gallic acid derivative or an ascorbic acid derivative as an antifoggant or a color mixing inhibitor. Among these compounds, preferred are those which hardly generate stains even upon heating at from 160 to 200°C.

[0096] In order to prevent deterioration of the cyan dye image due to heat and, in particular, light, it is more effective to incorporate an ultraviolet absorbent into the cyan color forming layer and both layers adjacent thereto.

[0097] Examples of the ultraviolet absorbent include benzotriazole compounds substituted by an aryl group (for example, those described in U.S. Patent 3,533,794), 4-thiazolidone compounds (for example, those described in U.S. Patents 3,314,794 and 3,352,681), benzophenone compounds (for example, those described in JP-A-46-2784), cinnamic ester compounds (for example, those described in U.S. Patents 3,705,805 and 3,707,395), butadiene compounds (for example, those described in U.S. Patent 4,045,229) and benzoxazole compounds (for example, those described in U.S. Patents 3,406,070 and 4,271,307). An ultraviolet light absorbing coupler (e.g., α -naphthol-base cyan dye forming coupler) or an ultraviolet absorbing polymer may also be used. The ultraviolet absorbent may be mordanted to a specific layer. Among these ultraviolet absorbents, the benzotriazole compound substituted by an aryl group is preferred.

[0098] To the light-sensitive material for use in the present invention, an antifungal or antiseptic as described in JP-A-63-271247 is preferably added so as to prevent various molds and bacteria from proliferation in the hydrophilic colloid layer to deteriorate the image.

[0099] Gelatin is advantageous as the binder or protective colloid which can be used in the silver halide emulsion layer, the interlayer or the protective layer of the light-sensitive material for use in the present invention, however, other hydrophilic polymers may also be used. Examples of the hydrophilic polymer include polyvinyl alcohol, polyvinyl alcohol partial acetal, polyvinyl butyral, poly-N-vinylpyrrolidone, polyacrylic acid, polyacrylamide, polyvinylimidazole, polyvinylpyrazole, carrageenan, gum arabi and a homopolymer or copolymer of cellulose derivatives such as hydroxyalkyl cellulose, carboxymethyl cellulose, cellulose sulfate, cellulose acetate hydrogen phthalate and sodium alginate.

[0100] Also, a graft polymer of gelatin with other polymer may be used and examples of the gelatin graft polymer include those obtained by grafting an acrylic acid, a methacrylic acid, a derivative such as ester or amide of the acrylic acid or methacrylic acid, or a homopolymer or copolymer of vinyl-base monomers such as acrylonitrile or styrene, to gelatin. In particular, graft polymers to a polymer having somewhat compatibility with gelatin, such as a polymer of acrylic acid, methacrylic acid, acrylamide, methacrylamide or hydroxyalkyl methacrylate, are preferred. Examples thereof are described in U.S. Patents 2,763,625, 2,831,767 and 2,956,884, and JP-A-56-65133.

[0101] Representative examples of the synthetic hydrophilic polymer material which can be used are described in West German Patent Publication (OLS) No. 2,312,708, U.S. Patents 3,620,751 and 3,879,205, and JP-B-43-7561.

[0102] The above-described hydrophilic polymers may be used either individually or in combination of two or more thereof.

[0103] The gelatin may be an alkali-processed gelatin, an acid-processed gelatin, an enzyme-processed gelatin or a mixture of these. Further, a gelatin derivative obtained by reacting various compounds such as an acid halide, an acid anhydride, an isocyanate, a bromoacetic acid, an alkanesultone acid, a vinylsulfonamide, a maleinimide compound, a polyalkylene oxide or an epoxy compound, with gelatin may also be used. Specific examples of the gelatin derivative are described in U.S. Patents 2,614,928, 3,132,945, 3,186,846 and 3,312,553, British Patents 861,414, 1,033,189 and 1,005,784, and JP-B-42-26845.

[0104] The total binder amount in the light-sensitive material for use in the present invention is preferably from 3 to 10 g/m², and the amount of binder contained in each silver halide emulsion layer or interlayer is preferably from 0.1 to 1.5 g/m², more preferably from 0.2 to 1.0 g/m².

[0105] The support for use in the present invention is preferably a light-transmitting substrate, however, as described in JP-A-7-244212, silver halide emulsion layers provided on a separate support may be transferred and firmly bonded onto a light-transmitting substrate to prepare a light-sensitive material for color filter. In this case, the support is not necessarily required to be light-transmitting and for example, a support having coated on the back surface thereof carbon black or the like may be used.

[0106] In this case, the binder in the release layer or back layer provided is not counted in the above-described "total binder amount".

[0107] The material constituting the light-transmitting substrate preferably has an optically isotropic property and excellent heat resistance and examples thereof include polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polystyrene, polycarbonate, polyether sulfone, cellulose acetate, polyarylate, soda glass, borosilicate glass and quartz.

[0108] The surface of the substrate constituted by the above-described material may be subjected to undercoating treatment, if desired. Further, the surface may be subjected to glow discharge, corona discharge or ultraviolet (UV) irradiation treatment.

[0109] The light-transmitting substrate may be used in the form of a plate, a sheet or a film. The thickness of the substrate may be appropriately selected depending upon the use and the construction material, however, it is commonly from 0.01 to 10 mm. For example, in the case of a glass substrate, the thickness is from 0.3 to 3 mm.

[0110] The light-sensitive material for use in the present invention is subjected to color development by the usual methods described in RD, No. 17643, pp. 28-29 and *ibid.*, No. 18716, p. 651, left to right columns, to obtain a microcolor filter.

[0111] For example, the light-sensitive material is subjected to color development, desilvering and water washing. In the desilvering process, bleach-fixing processing using a bleach-fixing solution may be performed in place of bleaching using a bleaching solution and fixing using a fixing solution, or bleaching, fixing and bleach-fixing may be combined in any order. Stabilization may be performed in place of water washing, or stabilization may be performed after water washing. Further, mono-bath processing using a mono-bath developing-bleaching-fixing processing solution capable of conducting color development, bleaching and fixing in one bath may also be performed. In combination with these processing steps, pre-hardening processing, neutralization processing therefor, stop-fixing processing, after-hardening processing, regulating or intensification may be performed. In the above-described processing, so-called activator processing may be performed in place of color development processing.

[0112] With respect to the developing apparatus, in the case of a flexible support (substrate), a developing machine used in usual photographic processing may be used. In the case of a hard support such as glass, a developing machine for glass dry plate or a developing apparatus described in JP-A-7-56015 may be used.

[0113] On the color filter produced by the process of the present invention, a heat-resistant and water-proof resin having a high electric resistivity may be provided as an outermost protective layer (overcoat layer). Examples of the resin are described in U.S. Patents 4,171,979, 4,049,861, 4,333,998, 4,698,295 and 4,668,601, European Unexamined Patent Publications 179636A and 556810A, JP-A-3-163416, JP-A-3-188153, JP-A-5-78443, JP-A-1-276101, JP-A-2-179628, JP-A-5-19115, JP-A-5-173012, JP-A-5-264811, JP-A-60-216307, JP-A-63-218771, JP-A-52-22099, JP-A-52-22100, JP-A-53-142447, JP-A-54-137072, JP-A-54-83999, JP-A-55-125104, JP-A-53-57023, JP-A-53-121100, JP-A-56-91233, JP-A-57-90489, JP-A-62-21150, JP-A-62-23042, JP-A-62-23043, JP-A-62-24256, JP-A-62-25758, JP-A-62-229133 and Japanese Patent Application Nos. 8-235621, 8-238154 and 8-276027.

[0114] On the color filter produced by the process of the present invention, a transparent electrode (ITO) may be provided by evaporation coating, for example, vacuum evaporation or sputtering.

[0115] Further thereon, an orientating layer of polyimide resin or the like may be provided.

[0116] Furthermore, a deflecting plate or plate difference film may be provided on the surface opposite to the emulsion surface side of the light-transmitting substrate of the color filter.

[0117] In place of the glass plate, a plastic film substrate having provided thereon a gas barrier layer or hard coat layer may be used as the light-transmitting substrate.

[0118] The color LCD and the production method thereof are described in detail in Shoichi Matsumoto and Ichiryo Tsunoda, Ekisho no Kiso to Oyo (Basic Study and Application of Liquid Crystal), issued by Kogyo Chosa Kai (1991),

Flat Panel Display, 1996, compiled by Nikkei Microdevice, issued by Nikkei BP Sha (1995), Oyo Butsuri (Applied Physics), Vol. 64, No. 10, p. 1042 (1995) and JP-A-1-114820.

[0119] The present invention will be described in greater detail with reference to the following Examples.

[0120] Examples 1 and 2 are not in accordance with the present invention.

EXAMPLE 1

[0121] A color positive film for movies "Fuji Color Positive Film CL" (produced by Fuji Photo Film Co., Ltd.) was subjected to digital exposure as shown in Fig. 2 from the emulsion surface thereof using an He-Cd laser (B light), a green semiconductor excited laser (using SHG) (G light) and an He-Ne laser (R light). Each RGB pixel had a size of $200\text{ }\mu\text{m} \times 300\text{ }\mu\text{m}$, the black matrix (BM) area had a width of $25\text{ }\mu\text{m}$, and the entire picture plane size was $24\text{ cm} \times 16\text{ cm}$.

[0122] The exposed light-sensitive material was developed according to the formulation of ECP-2B processing issued by Eastman Kodak Company to manufacture a master color filter having formed thereon RGB colors.

[0123] A process for manufacturing a color filter using the master color filter prepared is described below.

[0124] On a $100\text{ }\mu\text{m}$ -thick polyethylene terephthalate support having a back layer formed by coating carbon black dispersed in polyvinyl chloride, gelatin subbing was applied and thereon from the first to eighth layers each having the following structure were simultaneously coated one on another to prepare Color Light-Sensitive Material 1A. The components and the coated amounts (unit: g/m^2) are shown below. With respect to the silver halide, the coated amount is calculated in terms of silver.

First Layer (release layer):	
Hydroxyethyl cellulose (HEC-5P500; produced by Daicel Chemical KK)	0.35
Terminal alkyl-modified polyvinyl alcohol (average polymerization degree: 300)	0.08
Antistatic Agent (Cpd-1)	0.03

Second Layer (gelatin adjacent layer):	
Gelatin	0.60

Third Layer (blue-sensitive layer):	
Silver halide emulsion spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and ExS-2) ($\text{AgBr}_{30}\text{Cl}_{70}$; average grain size: $0.35\text{ }\mu\text{m}$)	0.33
Gelatin	1.00
Cyan Coupler (ExC-2)	0.57
Magenta Coupler (ExM-3)	0.05
Ultraviolet Absorbent (Cpd-6)	0.03
Ultraviolet Absorbent (Cpd-7)	0.08
High Boiling Point Solvent (Solv-1)	0.23

Fourth Layer (interlayer):	
Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Yellow Dye (YF-1)	0.17

Fifth Layer (green-sensitive layer):

Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μm)	0.71
Gelatin	1.39
Cyan Coupler (ExC-1)	0.34
Yellow Coupler (ExY-2)	0.47
Discoloration Inhibitor (Cpd-5)	0.01
Stain Inhibitor (Cpd-13)	0.01
High Boiling Point Solvent (Solv-1)	0.27
High Boiling Point Solvent (Solv-2)	0.39
Polymer (Cpd-14)	0.03

Sixth Layer (interlayer):

Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Irradiation Preventive Dye (Dye-1)	0.005
Irradiation Preventive Dye (Dye-2)	0.02

Seventh Layer (red-sensitive layer):

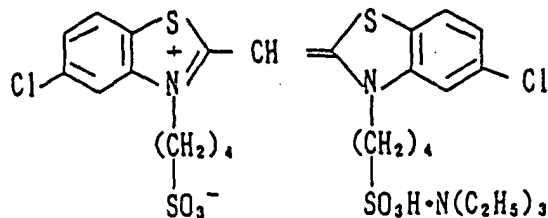
Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl; average grain size: 0.18 μm)	0.36
Gelatin	1.33
Yellow Coupler (EXY-1)	0.61
Magenta Coupler (ExM-2)	0.25
Discoloration Inhibitor (Cpd-3)	0.11
Discoloration Inhibitor (Cpd-4)	0.005
Discoloration Inhibitor (Cpd-5)	0.01
High Boiling Point Solvent (Solv-1)	0.43
High Boiling Point Solvent (Solv-2)	0.11
Polymer (Cpd-14)	0.03

Eighth Layer (protective layer):

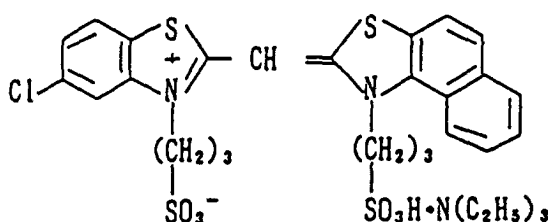
Gelatin	0.70
Antihalation dye (fine particle dispersion)	0.17
Carboxymethyl cellulose	0.05
Polymer (Cpd-15)	0.14
Surface Active Agent (Cpd-16)	0.03
Hardening Agent (H-1)	0.12

[0125] In each layer, sodium dodecylbenzenesulfonate as an emulsification dispersion aid, ethyl acetate as an auxiliary solvent, Surface Active Agent (Cpd-17) as a coating aid and potassium polystyrenesulfonate as a thickening agent were used.

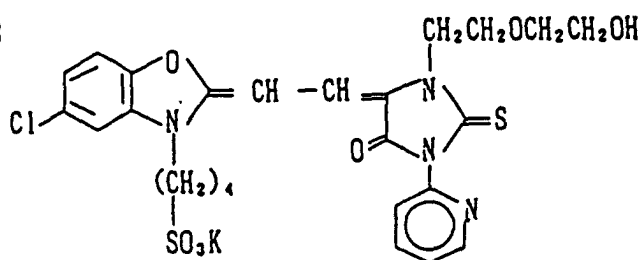
Ex S - 1



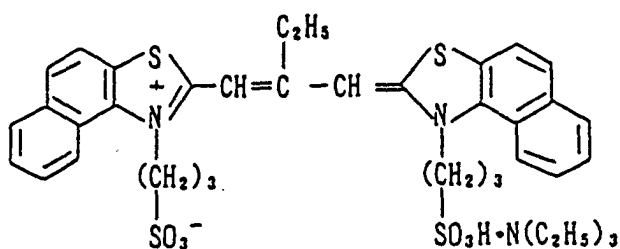
Ex S - 2



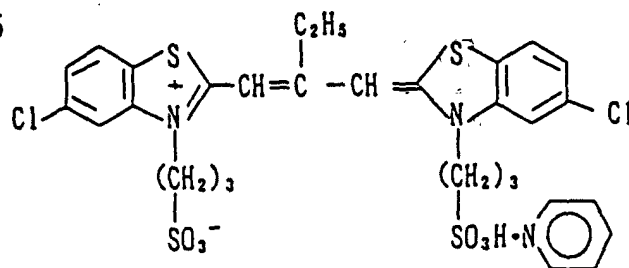
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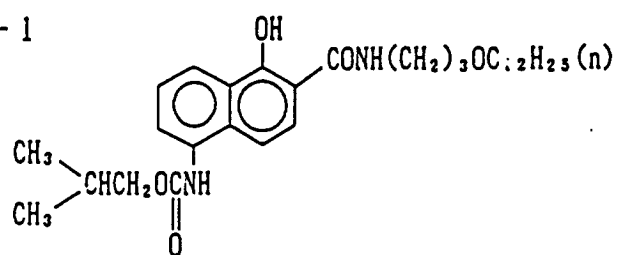
Ex S - 4



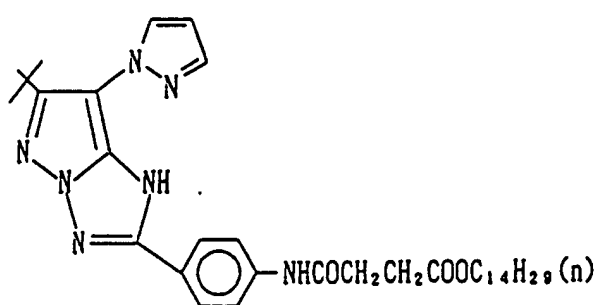
Ex S - 5



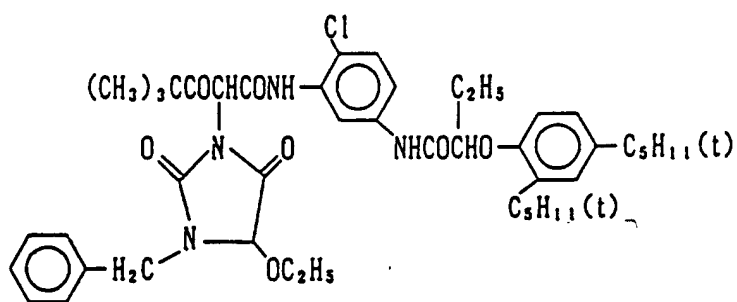
Ex C - 1



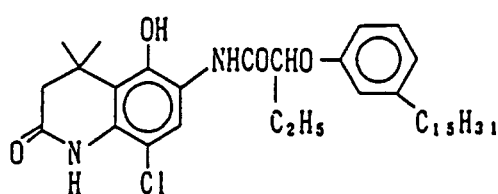
Ex M - 1



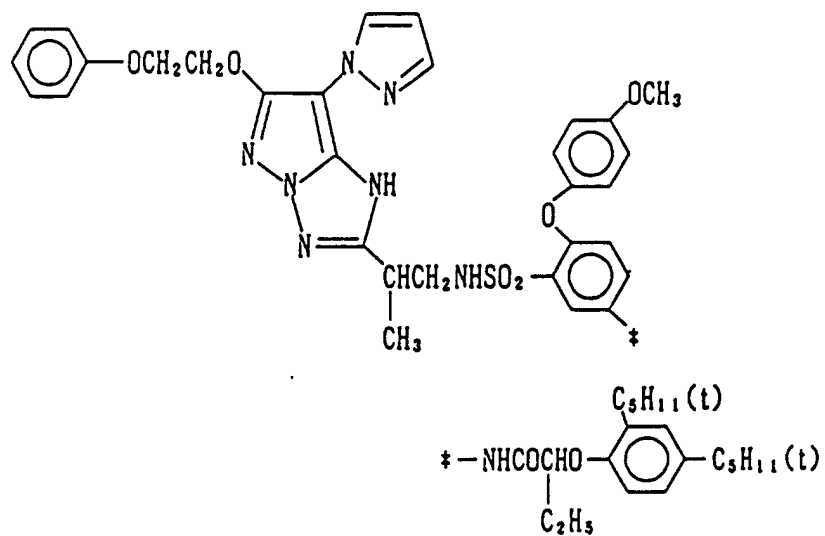
Ex Y - 1



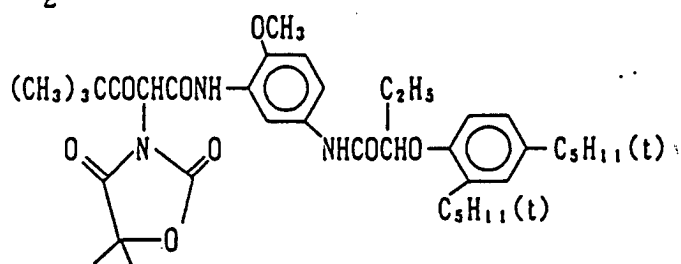
Ex C - 2



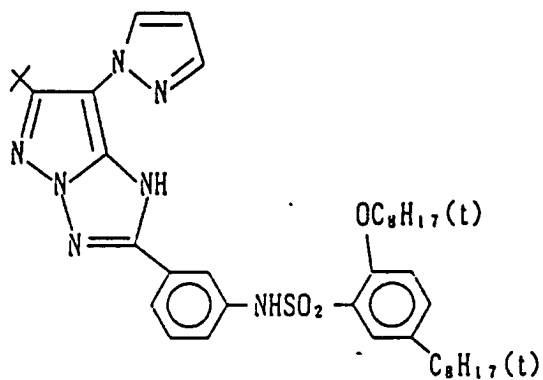
ExM-2



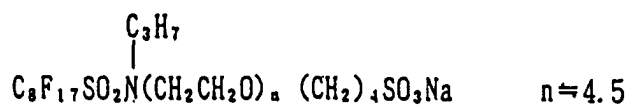
ExY-2



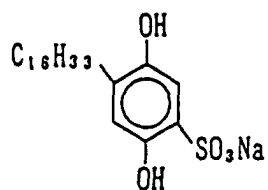
ExM-3



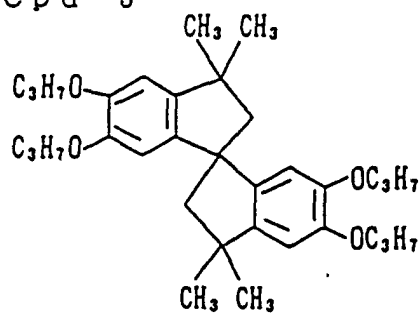
Cpd-1



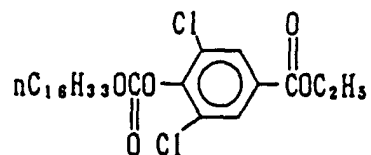
Cp d - 2



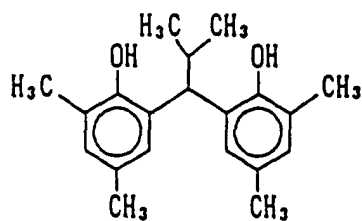
Cp d - 3



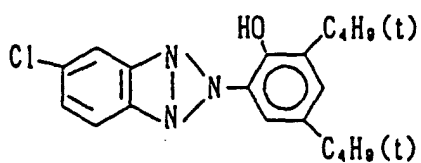
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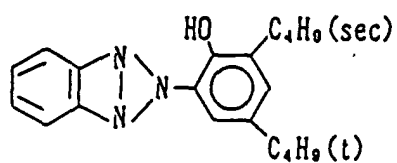
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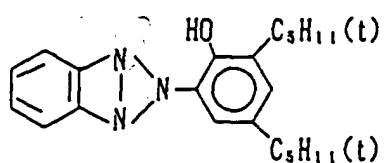
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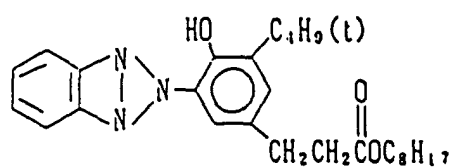
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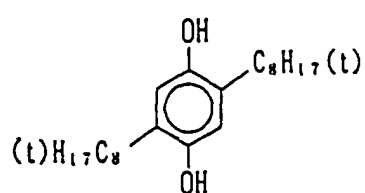
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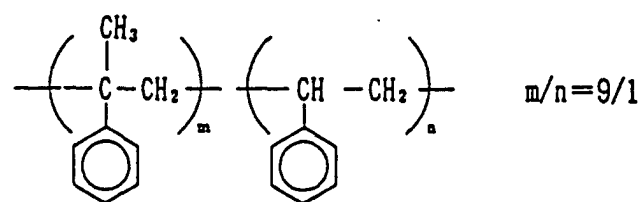
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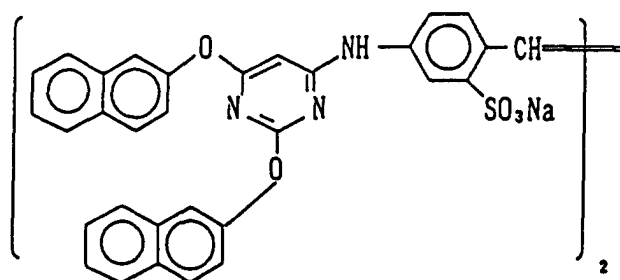
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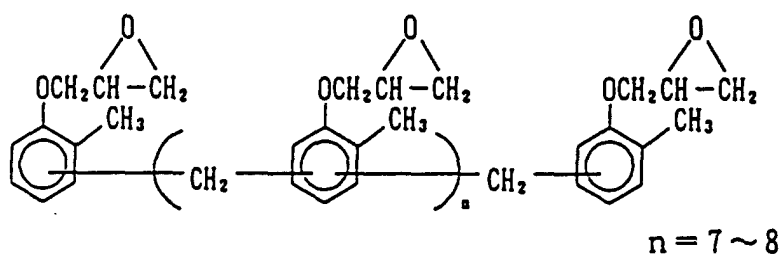
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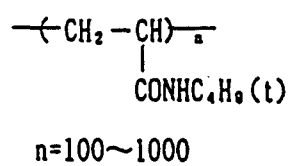
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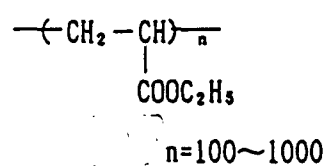
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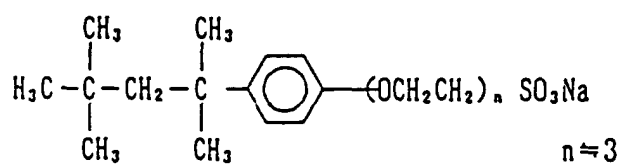
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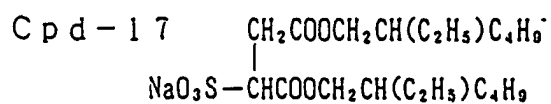


Cp d - 1 5

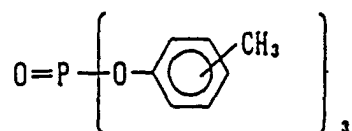


Cp d - 1 6

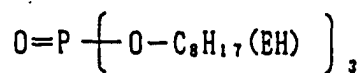




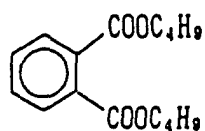
S o l v - 1



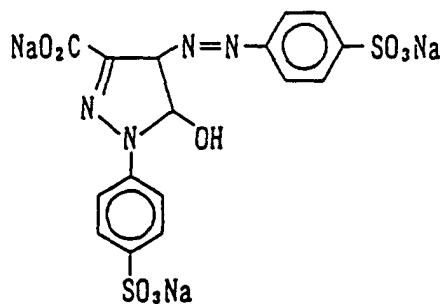
S o l v - 2



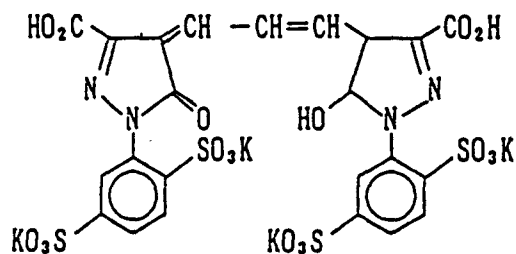
S o l v - 3



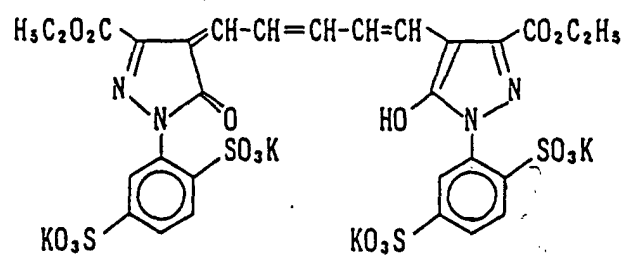
Y F - 1

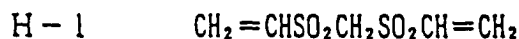


D y e - 1

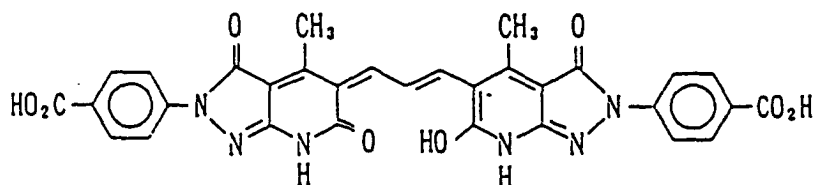


D y e - 2





Antihalation dye



[0126] A 0.7 mm-thick transparent alkali-free glass (20 cm × 30 cm) was used as the light-transmitting substrate. On the surface thereof, a 1:3 (by weight) mixture of gelatin and colloidal silica (average particle size: 7 to 9 mμ) having added thereto saponin as a surface active agent was coated. The dry thickness of the layer formed was 0.2 μm.

[0127] The protective layer of Color Light-Sensitive Material 1A prepared above was adhered onto the coated surface of the light-transmitting substrate. The laminate obtained was traveled at a linear velocity of 0.45 m/min in a laminator where the temperature was set so that the temperature on the contact surface could be about 130°C. After the laminate was cooled almost to room temperature, the support of the light-sensitive material was peeled off together with the release layer from the emulsion surface. Then, second and upper emulsion layers were evenly bonded to the substrate and white spots were not observed.

[0128] The thus-prepared substrate having emulsion layers was subjected to one-shot exposure from the emulsion surface side at an equal magnification or half (1/2) reduction through the master color filter prepared above using a camera for the photomechanical process. The exposed substrate was developed according to the following steps and as a result, a color filter having formed thereon BGR three colors and black color as shown in Fig. 3 in one operation was prepared.

Processing Step	Temperature (°C)	Time
Hardening	38	3 min.
Water washing-1	35	1 min.
Color development	38	80 s
Stopping	38	20 s
Bleach-fixing	38	90 s
Water washing-2	35	40 s
Water washing-3	35	80 s
Drying	60	2 min.

[0129] Each processing solution had the following composition. The stopping solution was an aqueous 2% acetic acid solution.

Hardening Solution:	
Sodium sulfate (anhydrous)	160.0 g
Sodium carbonate (anhydrous)	4.6 g
Glyoxal (40%)	50.0 ml
Water to make	1 ℓ
pH (25°C)	9.5

Color Developer:		
	Water	800 ml
5	D-Sorbitol	0.15 g
	Sodium naphthalenesulfonate-formalin condensate	0.15 g
	Pentasodium nitrilotris (methylenephosphonate)	1.8 g
	Diethylenetriaminepentaacetic acid	0.5 g
10	1-Hydroxyethylidene-1,1-diphosphonic acid	0.15 g
	Diethylene glycol	12.0 ml
	Benzyl alcohol	13.5 ml
	Potassium chloride	6.5 g
	Potassium bromide	0.1 g
15	Potassium carbonate	30.0 g
	Sodium sulfite	2.4 g
	Disodium N,N-bis(sulfonatoethyl)-hydroxylamine	8.0 g
	Triethanolamine	6.0 g
20	Benzotriazole	0.01 g
	N-Ethyl-N-(β -methanesulfonamidoethyl)-3-methyl-4-aminoaniline 3/2 sulfate monohydrate	6.0 g
	Water to make	1 ℓ
	pH (25°C)	10.6

Bleach-Fixing Solution:		
	Water	600 ml
30	Ammonium thiosulfate (750 g/ ℓ)	160 ml
	Ammonium sulfite	40.0 g
	Ammonium ethylenediaminetetraacetate ferrate	55.0 g
	Ethylenediaminetetraacetic acid	5.0 g
	Ammonium nitrate	10.0 g
35	Ammonium bromide	25.0 g
	Water to make	1 ℓ
	pH (25°C)	6.0

Washing Water:

[0130] Deionized water having an electric conductivity of 5 μ S or less

[0131] On the color filter obtained, an overcoat agent "SS5333/SS0333" produced by Nippon Synthetic Rubber KK was coated by means of a spinner to have a dry thickness of 2.5 μ m, pre-heated at 120°C for 30 minutes and then baked at 180°C for 30 minutes to form a protective layer.

EXAMPLE 2

[0132] An optically isotropic 80 μ m-thick polyarylate substrate having laminated on the back surface thereof a polypropylene protective layer (20 μ m) was subjected to glow discharge treatment and thereon two layers of an SBR latex layer and a gelatin layer were coated so as to improve adhesion to the photographic emulsion layer. Further thereon, from the first to ninth layers each having the following structure were simultaneously coated one on another to prepare Color Light-Sensitive Material 2A. The components and the coated amounts (unit: g/m²) are shown below. With respect to the silver halide, the coated amount is calculated in terms of silver.

First Layer (antihalation layer):	
Gelatin	0.70

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(continued)

First Layer (antihalation layer):	
Antihalation dye (fine particle dispersion)	0.17
Carboxymethyl cellulose	0.05
Surface Active Agent (Cpd-16)	0.03
Hardening Agent (H-1)	0.05

Second Layer (first red-sensitive layer):	
Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl; average grain size: 0.18 μ m)	0.11
Gelatin	0.70
Magenta Coupler (ExM-1)	0.15
Discoloration Inhibitor (Cpd-3)	0.08
Discoloration Inhibitor (Cpd-5)	0.01
High Boiling Point Solvent (Solv-4)	0.28
High Boiling Point Solvent (Solv-5)	0.14
Polymer (Cpd-11)	0.08

Third Layer (second red-sensitive layer):	
Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl; average grain size: 0.18 μ m)	0.26
Gelatin	0.64
Yellow Coupler (ExY-1)	0.61
Stain Inhibitor (Cpd-13)	0.08
Discoloration Inhibitor (Cpd-5)	0.04
High Boiling Point Solvent (Solv-6)	0.24
Polymer (Cpd-14)	0.08

Fourth Layer (interlayer):	
Gelatin	0.38
Irradiation Preventive Dye (Dye-1)	0.005
Irradiation Preventive Dye (Dye-2)	0.02

Fifth Layer (first green-sensitive layer):	
Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μ m)	0.23
Gelatin	0.62
Yellow Coupler (ExY-1)	0.54
Discoloration Inhibitor (Cpd-5)	0.03
Stain Inhibitor (Cpd-13)	0.07
High Boiling Point Solvent (Solv-6)	0.22
Polymer (Cpd-14)	0.07

Sixth Layer (second green-sensitive layer):

Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μm)	0.19
Gelatin	0.68
Cyan Coupler (ExC-3)	0.20
Cyan Coupler (ExC-4)	0.03
High Boiling Point Solvent (Solv-7)	0.51
Polymer (Cpd-14)	0.02

Seventh Layer (interlayer):

Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Yellow Dye (YF-1)	0.17

Eighth Layer (blue-sensitive layer):

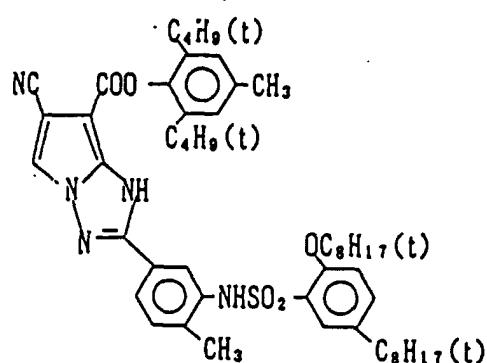
Silver halide emulsion spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and EXS-2) ($\text{AgBr}_{30}\text{Cl}_{70}$; average grain size: 0.35 μm)	0.33
Gelatin	0.98
Cyan Coupler (ExC-2)	0.57
Magenta Coupler (ExM-3)	0.05
Ultraviolet Absorbent (Cpd-6)	0.03
Ultraviolet Absorbent (Cpd-7)	0.08
High Boiling Point Solvent (Solv-1)	0.23
Hardening Agent (H-1)	0.08

Ninth Layer (protective layer):

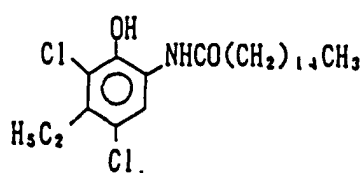
Gelatin (acid-processed)	0.65
Antistatic agent (Cpd-1)	0.01
Snowtex-O (produced by Nissan Kagaku Kogyo KK)	0.19

[0133] In each layer, sodium dodecylbenzenesulfonate as an emulsification dispersion aid, ethyl acetate as an auxiliary solvent, Surface Active Agent (Cpd-17) as a coating aid and potassium polystyrenesulfonate as a thickening agent were used.

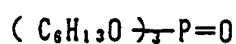
E x C - 3



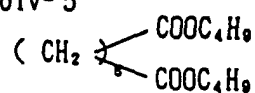
E x C - 4



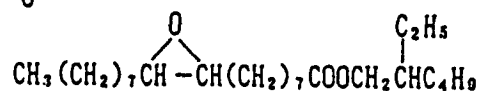
Solv-4



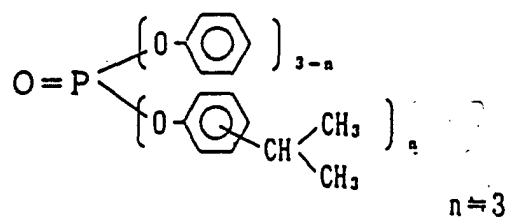
Solv-5



Solv-6



Solv-7



[0134] Color Light-Sensitive Material 2A prepared above was subjected to contact exposure in one shot using the same master color filter as in Example 1 and then developed through the following steps. As a result, a color filter having formed thereon B, G, R three colors and black color in one operation was prepared. The processing solution were the same as those used in Example 1. The after-hardening solution was an aqueous 4% glutaraldehyde solution.

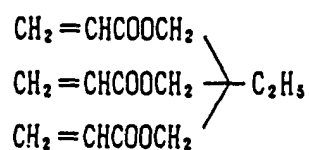
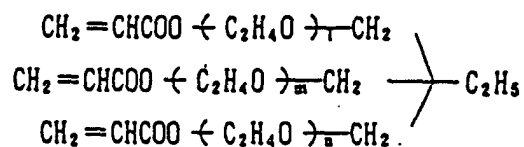
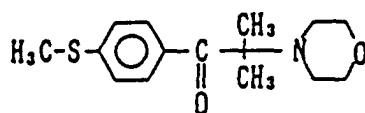
Processing Step	Temperature (°C)	Time
Color development	38	80 s

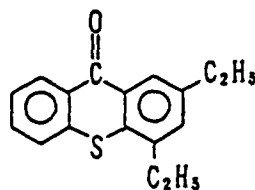
(continued)

Processing Step	Temperature (°C)	Time
Bleach-fixing	38	90 s
Water washing-1	35	40 s
After-hardening	35	3 min.
Water washing-2	35	2 min.
Drying	60	2 min.

[0135] On the color filter layer obtained, the following composition was coated to have a dry thickness of 2.5 μm , then dried and hardened with ultraviolet rays to form a protective layer. The resulting color filter was good in the adhesion between the color filter layer and the protective layer and had good resistance against chemicals. Using the thus-manufactured color filter, a color liquid crystal panel comprising a plastic film substrate was produced.

Formulation of Overcoat Composition:	
Monomer (1)	77.4 wt%
Monomer (2)	7.7
Polymer CAB 531 (produced by Eastman Chemical)	11.7
Photopolymerization initiator	2.4
Sensitizer	0.8
Diluting solvent (MEK) for coating	-

Monomer (1)**Monomer (2)****Photopolymerization initiator**

Sensitizer

[0136] A master color filter having any pixel pattern can be easily manufactured using a commercially available silver halide color light-sensitive material. By subjecting a silver halide color light-sensitive material for color filter to one-shot exposure using this master color filter and then to one-time development processing, a color filter can be easily manufactured within a short time. The color filter obtained has red, green and blue color areas excellent in the spectral characteristics.

EXAMPLE 3

[0137] PEN-1A described in Example 1 of JIII Journal of Technical Disclosure, No. 94-6023 was used and subjected to the surface treatment and then to gelatin subbing in the same manner to prepare color light-sensitive materials (3A, 3B, 4A, 4B) each having the following structure.

[0138] The components and the coating amounts (unit: g/m²) are shown below. With respect to the silver halide and colloidal silver emulsion, the coating amount is calculated in terms of silver. The silver halide emulsion in each layer is a negative silver chlorobromide or silver chloride.

(Color Light-Sensitive Material 3A)

[0139]

First Layer (antihalation layer):	
Gelatin	0.70
Antihalation dye (fine particle dispersion)	0.17
Carboxymethyl cellulose	0.05
Surface Active Agent (Cpd-16)	0.03
Hardening Agent (H-1)	0.05

Second Layer (red-sensitive layer):

Silver chloride spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (average grain size: 0.18 μm)	0.90
Gelatin	2.68
Yellow Coupler (ExY-1)	1.22
Magenta Coupler (ExM-1)	0.30
Discoloration Inhibitor (Cpd-3)	0.16
Discoloration Inhibitor (Cpd-5)	0.02
Polymer (Cpd-11)	0.16
Stain Inhibitor (Cpd-13)	0.16
High Boiling Point Solvent (Solv-4)	0.53
High Boiling Point Solvent (Solv-5)	0.28
High Boiling Point Solvent (Solv-6)	0.48

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Third Layer (interlayer):	
Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.05
Irradiation Preventive Dye (Dye-1)	0.01
Irradiation Preventive Dye (Dye-2)	0.02

Fourth Layer (green-sensitive layer):		
Silver chloride spectrally sensitized by Green Sensitizing Dye (ExS-3) (average grain size: 0.18 μm)		1.37
Gelatin		1.53
Cyan Coupler (ExC-1)		0.66
Yellow Coupler (ExY-2)		0.90
Polymer (Cpd-14)		0.06
High Boiling Point Solvent (Solv-1)		0.52
High Boiling Point Solvent (Solv-2)		0.75

Fifth Layer (interlayer):	
Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.05
Yellow Dye (YF-1)	0.17

Sixth Layer (blue-sensitive layer):		
Silver chlorobromide spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and ExS-2) (Br: 50%, average grain size: 0.35 μm)		0.65
Gelatin		2.42
Cyan Coupler (ExC-2)		0.58
Magenta Coupler (ExM-1)		0.32
Ultraviolet Absorbent (Cpd-6)		0.20
Ultraviolet Absorbent (Cpd-7)		0.40
High Boiling Point Solvent (Solv-1)		1.20
Hardening Agent (H-1)		0.08
High Boiling Point Solvent (Solv-3)		0.25

Seventh Layer (protective layer):	
Gelatin (acid-processed)	0.65
Antistatic agent (Cpd-1)	0.01
Snowtex-O (produced by Nissan Kagaku Kogyo KK)	0.19

[0140] In each layer, sodium dodecylbenzenesulfonate as an emulsification dispersion aid, ethyl acetate as an auxiliary solvent, Surface Active Agent (Cpd-17) as a coating aid and potassium polystyrenesulfonate as a thickening agent were used.

(Color Light-Sensitive Material 3B)

[0141] Color Light-Sensitive Material 3B was prepared by adding 0.30 g/m² of Infrared Dye-Forming Coupler (C-1) to the second layer (red-sensitive layer) of Color Light-Sensitive Material 3A.

(Color Light-Sensitive Material 4A)

[0142]

First Layer (antihalation layer):	
Gelatin	0.70
Colloidal silver emulsion (average grain size: 0.02 μm)	0.20

Second Layer (gelatin layer):	
Gelatin	0.50

Third Layer (red-sensitive layer):	
Silver chloride spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (average grain size: 0.18 μm)	0.70
Gelatin	2.10
Cyan Coupler (ExC-2)	0.93
Ultraviolet Absorbent (Cpd-6)	0.20
Ultraviolet Absorbent (Cpd-7)	0.40
High Boiling Point Solvent (Solv-1)	0.93
Color mixing inhibitor (Cpd-2)	0.02
Compound (Cpd-12)	0.01

Fourth Layer (interlayer):	
Gelatin	0.53
Color Mixing Inhibitor (Cpd-10)	0.18
High Boiling Point Solvent (Solv-1)	0.05
High Boiling Point Solvent (Solv-2)	0.13
Irradiation Preventive Dye (Dye-1)	0.01
Irradiation Preventive Dye (Dye-2)	0.02

Fifth Layer (green-sensitive layer):	
Silver chloride spectrally sensitized by Green Sensitizing Dye (ExS-3) (average grain size: 0.18 μm)	0.60

(continued)

Fifth Layer (green-sensitive layer):

Gelatin	2.21
Magenta Coupler (ExM-1)	0.62
Discoloration Inhibitor (Cpd-3)	0.23
Stain Inhibitor (Cpd-4)	0.01
Polymer (Cpd-15)	0.06
High Boiling Point Solvent (Solv-2)	1.23
High Boiling Point Solvent (Solv-3)	0.33

Sixth Layer (interlayer):

Gelatin	0.63
Color Mixing Inhibitor (Cpd-10)	0.18
High Boiling Point Solvent (Solv-1)	0.05
High Boiling Point Solvent (Solv-2)	0.12
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-8)	0.06
Ultraviolet Absorbent (Cpd-9)	0.04
Polymer (Cpd-11)	0.05
Yellow Dye (YF-1)	0.15

Seventh Layer (blue-sensitive layer):

Silver chlorobromide spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and ExS-2) (Br: 50%, average grain size: 0.35 μ m)	0.90
Gelatin	2.50
Yellow Coupler (ExY-1)	2.12
Stain Inhibitor (Cpd-13)	0.14
Discoloration Inhibitor (Cpd-5)	0.03
Polymer (Cpd-14)	0.06
High Boiling Point Solvent (Solv-6)	0.86
Color Mixing Inhibitor (Cpd-2)	0.01

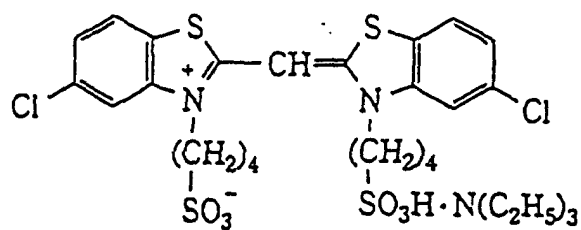
Eighth Layer (ultraviolet absorbing layer):

Gelatin	0.30
High Boiling Point Solvent (Solv-2)	0.12
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-8)	0.06
Ultraviolet Absorbent (Cpd-9)	0.04

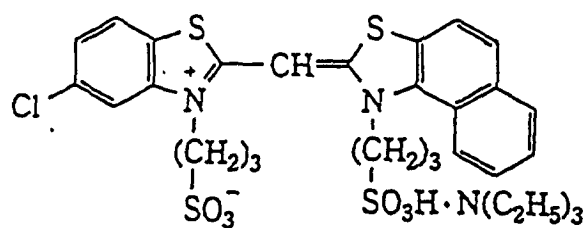
Ninth Layer (protective layer):

Gelatin	0.70
Surface Active Agent (Cpd-16)	0.06
Hardening Agent (H-1)	0.15

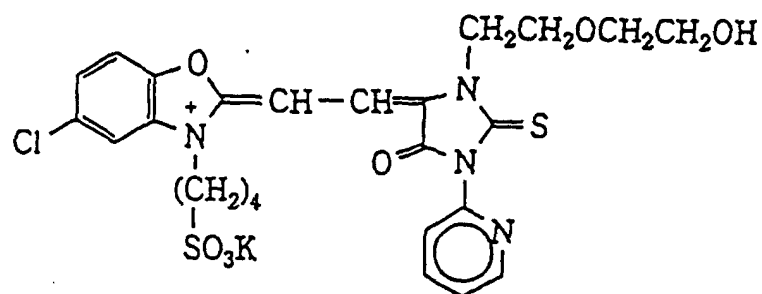
Ex S - 1



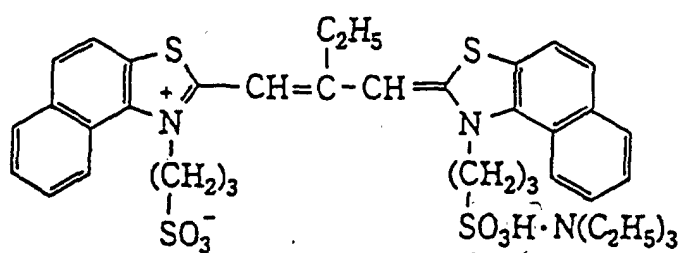
Ex S - 2



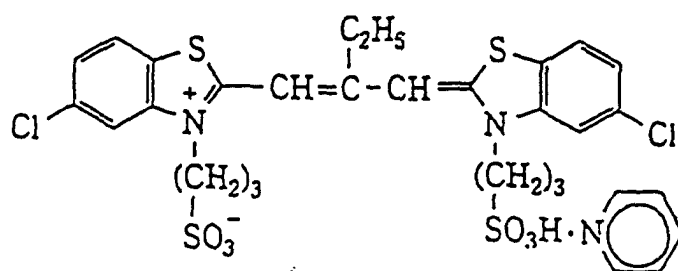
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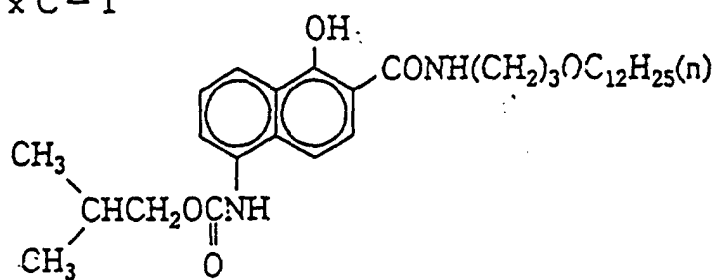
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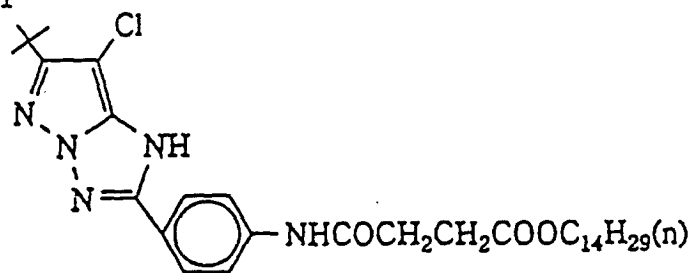
E x S - 5



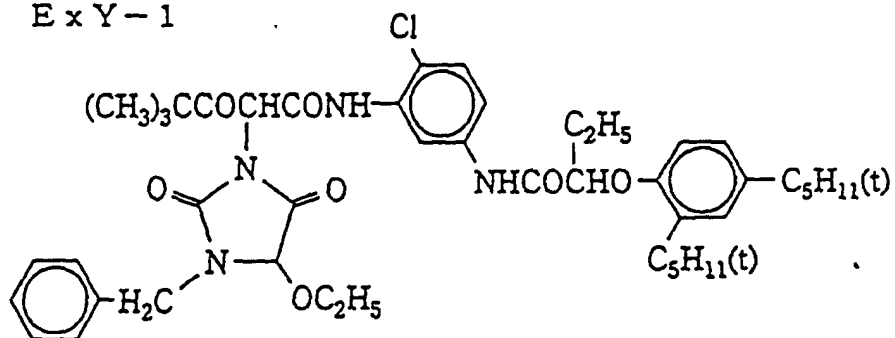
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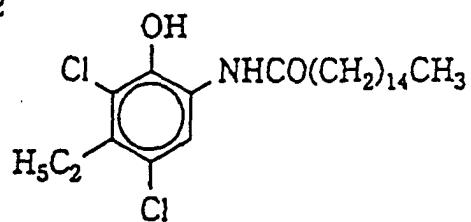
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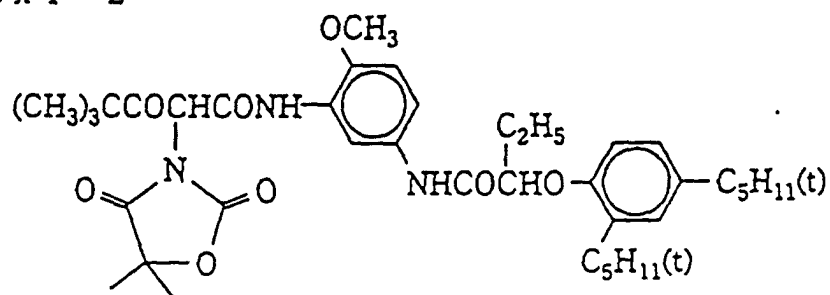
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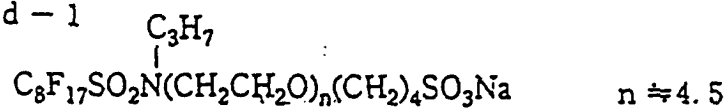
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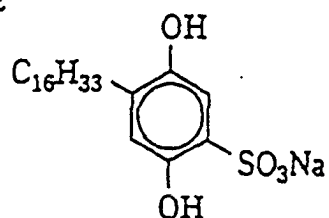
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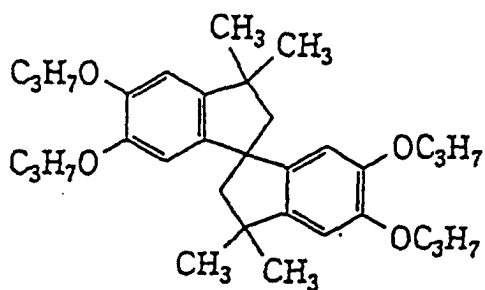
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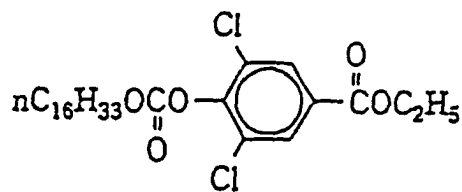
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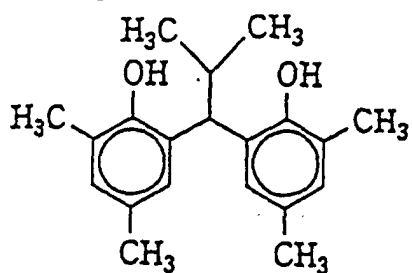
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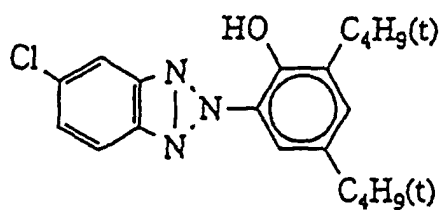
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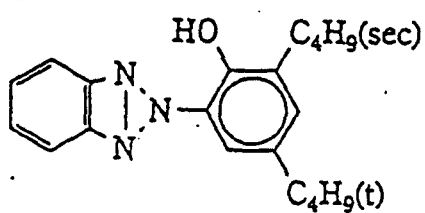
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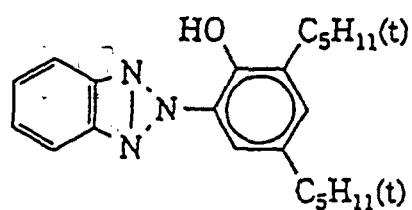
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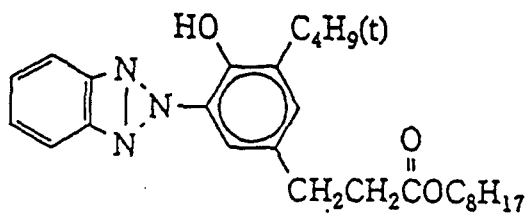
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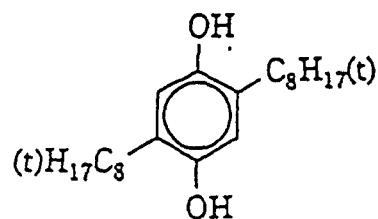
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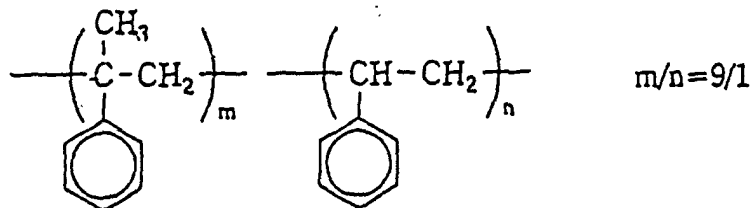
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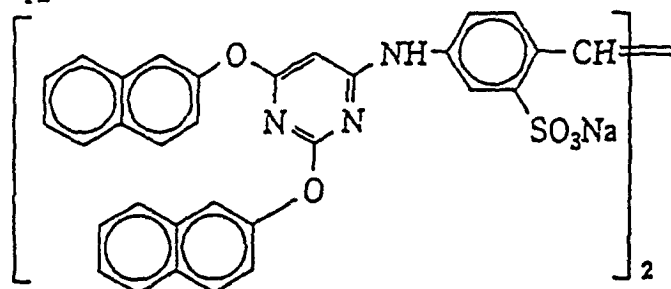
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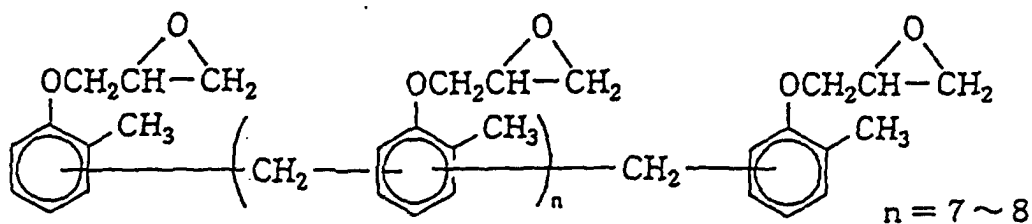
C p d - 11



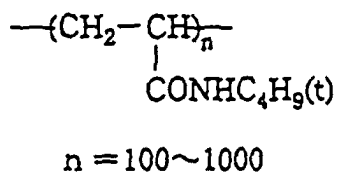
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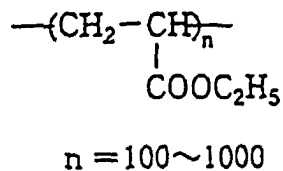
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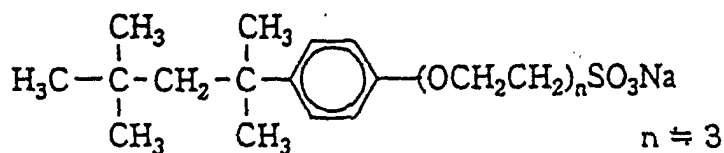
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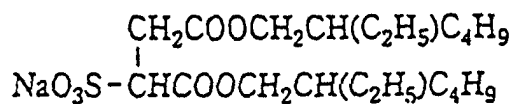
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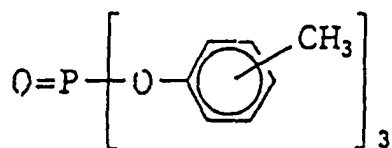
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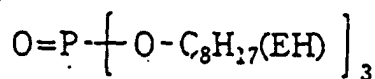
C p d -17



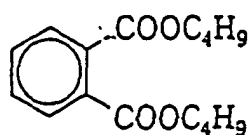
S o l v - 1



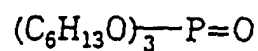
S o l v - 2



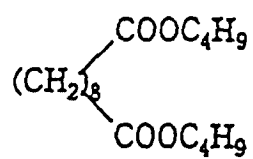
S o l v - 3



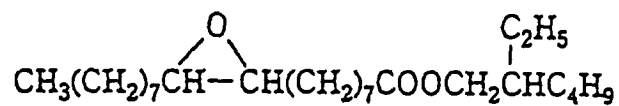
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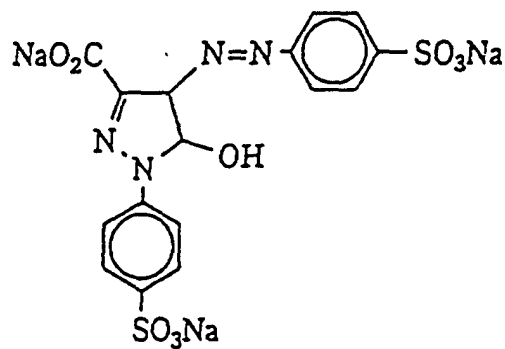
S o l v - 5



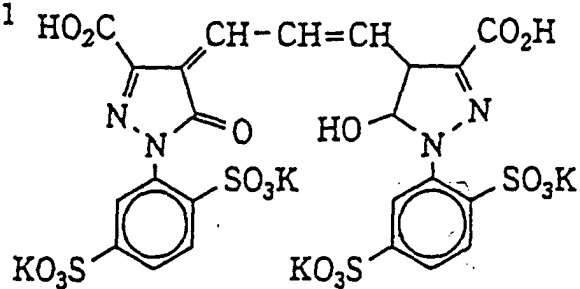
S o l v - 6



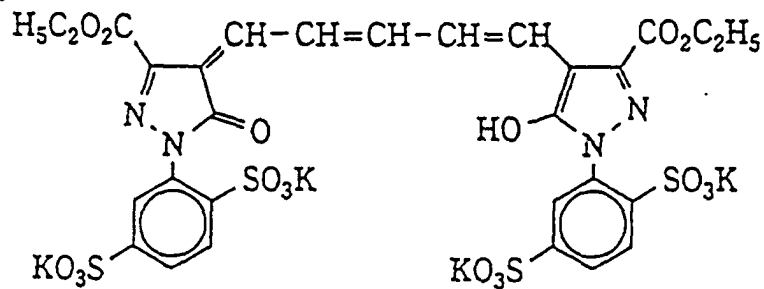
Y F - 1



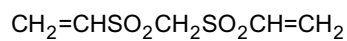
D y e - 1



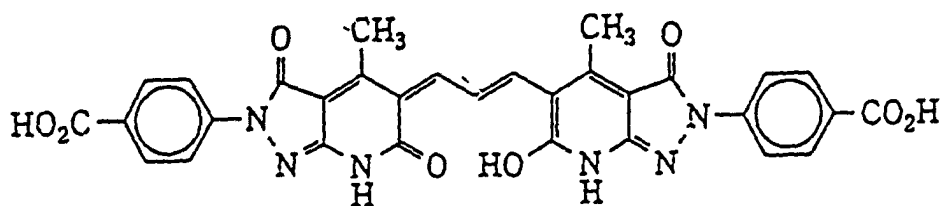
D y e - 2



H-1



Antihalation dye



(Color Light-Sensitive Material 4B)

[0143] Color Light-Sensitive Material 4B was prepared by adding 0.24 g/m² of Infrared Dye-Forming Coupler (C-15) to the fifth layer (green-sensitive layer) and the seventh layer (blue-sensitive layer) of Color Light-Sensitive Material 4A.

[0144] Each of Color Light-Sensitive Materials 3A, 3B, 4A and 4B prepared above was subjected to digital exposure of a pattern as shown in Fig. 2 from the emulsion surface thereof using an He-Cd laser (B light), a green semiconductor excited laser (using SHG) (G light) and an He-Ne laser (R light) while controlling the quantity of light so as to obtain hues in agreement with the color sensitivity of BGR of the silver halide light-sensitive material for color filter which will be described later. Each RGB pixel had a size of 250 μm × 175 μm, the black matrix (BM) area had a width of 25 μm, and the entire picture plane size was 15 cm × 10 cm. The BF area was exposed so as to form gray color having an ND of 0.3 for the purpose of controlling the quantity of light. Further, for the positioning in the after-processing, a dragonfly mark was also printed.

[0145] Each exposed light-sensitive material was developed through the following steps and a master color filter having formed thereon BGR and gray colors in one operation was manufactured.

Processing Step	Temperature (°C)	Time
Color development	38	90 s
Bleach-fixing	38	90 s
Water washing-1	25	30 s
After-hardening	25	3 min.
Water washing-2	25	40 s
Water washing-3	25	90 s
Drying	80	2 min.

Color Developer:

Water	800 ml
D-Sorbitol	0.15 g
Sodium naphthalenesulfonate-formalin condensate	0.15 g
Pentasodium nitrilotris(methylenephosphonate)	1.8 g
Diethylenetriaminepentaacetic acid	0.5 g
1-Hydroxyethylidene-1,1-diphosphonic acid	0.15 g
Diethylene glycol	12.0 ml
Benzyl alcohol	13.5 ml
Potassium chloride	6.5 g
Potassium bromide	0.1 g
Potassium carbonate	30.0 g
Sodium sulfite	2.4 g
Disodium N,N-bis(sulfonatoethyl)-hydroxylamine	8.0 g
Triethanolamine	6.0 g
Benzotriazole	0.01 g
N-Ethyl-N-(β-methanesulfonamidoethyl)-3-methyl-4-aminoaniline 3/2 sulfate monohydrate	6.0 g

(continued)

Color Developer:	
Water to make pH (25°C)	1 ℓ 10.6

Bleach-Fixing Solution:	
Water	600 ml
Ammonium thiosulfate (750 g/ℓ)	160 ml
Ammonium sulfite	40.0 g
Ammonium ethylenediaminetetraacetate ferrate	55.0 g
Ethylenediaminetetraacetic acid	5.0 g
Ammonium nitrate	10.0 g
Ammonium bromide	25.0 g
Water to make	1 ℓ
pH (25°C)	6.0

After-Hardening Solution:
Aqueous 4% glutaraldehyde solution

Washing Water:
Deionized water having an electric conductivity of 5 μS or less

EXAMPLE 4

[0146] A process for manufacturing a color filter using the master color filter prepared in Example 3 is described below.

[0147] On a 100 μm-thick polyethylene terephthalate support having a back layer formed by coating carbon black dispersed in polyvinyl chloride, gelatin subbing was applied and thereon from the first to tenth layers each having the following structure were simultaneously coated one on another to prepare Color Light-Sensitive Material CF-1. The components and the coated amounts (unit: g/m²) are shown below. With respect to the silver halide emulsion, the coated amount is calculated in terms of silver. Unless otherwise indicated, the couplers and other compounds were the same as used in Example 3.

First Layer (release layer):	
Hydroxyethyl cellulose (HEC-SP500; produced by Daicel Chemical KK)	0.35
Terminal alkyl-modified polyvinyl alcohol (average polymerization degree: 300)	0.08
Antistatic Agent (Cpd-1)	0.03

Second Layer (gelatin adjacent layer):	
Gelatin	0.60

Third Layer (blue-sensitive layer):	
Silver halide emulsion spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and ExS-2) (AgBr ₃₀ Cl ₇₀ ; average grain size: 0.35 μm)	0.33
Gelatin	1.00
Cyan Coupler (ExC-4)	0.57
Magenta Coupler (ExM-2)	0.05

(continued)

Third Layer (blue-sensitive layer):

Ultraviolet Absorbent (Cpd-6)	0.03
Ultraviolet Absorbent (Cpd-7)	0.08
High Boiling Point Solvent (Solv-1)	0.23

Fourth Layer (interlayer):

Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Yellow Dye (YF-1)	0.17

Fifth Layer (green-sensitive layer):

Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μm)	0.71
Gelatin	1.39
Cyan Coupler (ExC-1)	0.34
Yellow Coupler (ExY-2)	0.47
Discoloration Inhibitor (Cpd-2)	0.01
Stain Inhibitor (Cpd-13)	0.01
High Boiling Point Solvent (Solv-1)	0.27
High Boiling Point Solvent (Solv-2)	0.39
Polymer (Cpd-14)	0.03

Sixth Layer (interlayer):

Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Irradiation Preventive Dye (Dye-1)	0.005
Irradiation Preventive Dye (Dye-2)	0.02

Seventh Layer (red-sensitive layer):

5	Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl; average grain size: 0.18 μm)	0.36
	Gelatin	1.33
	Yellow Coupler (ExY-1)	0.61
	Magenta Coupler (ExM-1)	0.15
10	Discoloration Inhibitor (Cpd-3)	0.11
	Discoloration Inhibitor (Cpd-4)	0.005
	Discoloration Inhibitor (Cpd-5)	0.01
	High Boiling Point Solvent (Solv-4)	0.26
	High Boiling Point Solvent (Solv-5)	0.14
15	High Boiling Point Solvent (Solv-6)	0.24
	Polymer (Cpd-14)	0.03

Eighth Layer (interlayer):

20	Gelatin	0.38
	Color Mixing Inhibitor (Cpd-2)	0.02
	Color Mixing Inhibitor (Cpd-10)	0.09
	High Boiling Point Solvent (Solv-1)	0.03
25	High Boiling Point Solvent (Solv-3)	0.01
	Ultraviolet Absorbent (Cpd-8)	0.02
	Ultraviolet Absorbent (Cpd-7)	0.02
	Ultraviolet Absorbent (Cpd-6)	0.01
30	Ultraviolet Absorbent (Cpd-9)	0.02
	Polymer (Cpd-11)	0.04

Ninth Layer (infrared-sensitive layer):

35	Silver halide emulsion spectrally sensitized by Infrared Sensitizing Dye (ExS-6) ($\text{AgBr}_{30}\text{Cl}_{70}$; average grain size: 0.2 μm)	0.44
	Stabilizer (Cpd-12)	0.005
	Gelatin	1.42
40	Cyan Coupler (ExC-2)	0.10
	Yellow Coupler (ExY-1)	0.45
	Magenta Coupler (ExM-1)	0.22
	Discoloration Inhibitor (Cpd-3)	0.05
	Discoloration Inhibitor (Cpd-4)	0.005
45	Discoloration Inhibitor (Cpd-5)	0.02
	High Boiling Point Solvent (Solv-1)	0.28
	High Boiling Point Solvent (Solv-2)	0.06
	Stain Inhibitor (Cpd-13)	0.01
50	Polymer (Cpd-14)	0.03

Tenth Layer (protective layer):

55	Gelatin	0.70
	Antihalation dye (fine particle dispersion)	0.17
	Carboxymethyl cellulose	0.05
	Polymer (Cpd-15)	0.14

(continued)

Tenth Layer (protective layer):

Surface Active Agent (Cpd-16)

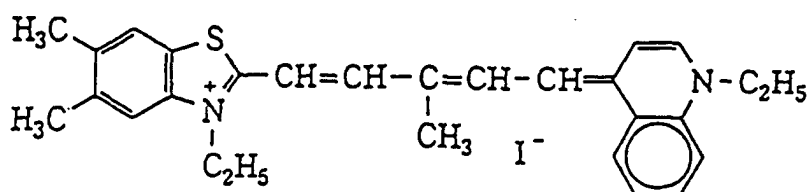
0.03

Hardening Agent (H-1)

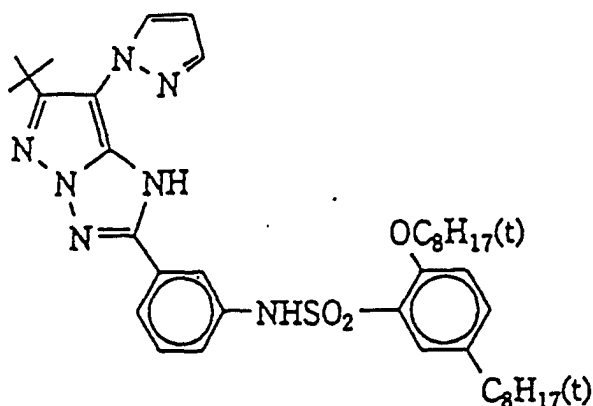
0.12

[0148] In each layer, sodium dodecylbenzenesulfonate as an emulsification dispersion aid, ethyl acetate as an auxiliary solvent, Surface Active Agent (Cpd-17) as a coating aid and potassium polystyrenesulfonate as a thickening agent were used.

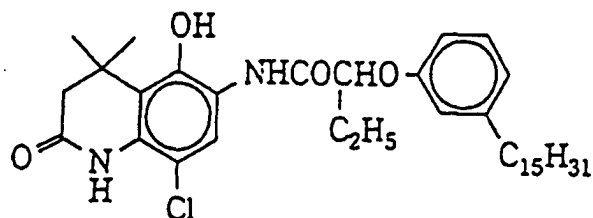
E x S - 6



E x M - 2



E x C - 4



[0149] A 0.7 mm-thick transparent alkali-free glass (24 cm × 32 cm) was used as the light-transmitting substrate. On the surface thereof, a 1:3 (by weight) mixture of gelatin and colloidal silica (average particle size: 7 to 9 mμ) having added thereto saponin as a surface active agent was coated. The dry thickness of the layer formed was 0.2 μm.

[0150] The protective layer of Color Light-Sensitive Material CF-1 prepared above was adhered onto the coated surface of the light-transmitting substrate. The laminate obtained was traveled at a linear velocity of 0.45 m/min in a laminator where the temperature was set so that the temperature on the contact surface could be about 130°C. After

the laminate was cooled almost to room temperature, the support of the light-sensitive material was peeled off together with the release layer from the emulsion surface. Then, second and upper emulsion layers were evenly bonded to the substrate and white spots were not observed.

[0151] The thus-prepared substrate having emulsion layers was subjected to one-shot exposure from the emulsion surface side in a quartered face manner at an equal magnification through each master color filter prepared in Example 3 with its layer surface being put into contact with the substrate. The quartered face manner is as follows. The emulsion layer surface is imaginatively divided into four areas, and each area is exposed (by one-shot exposure) through a master color filter in order while other areas are masked, to prepare four color filters from one light-sensitive material. The exposed substrate was developed according to the following steps and as a result, four sets of a color filter having formed thereon BGR three colors and black color as shown in Fig. 3 in one operation were prepared.

Processing Step	Temperature (°C)	Time
Pre-hardening	25	3 min.
Water washing-1	25	1 min.
Color development	38	80 s
Stopping	25	20 s
Bleach-fixing	38	90 s
Water washing-2	25	40 s
After-hardening	25	3 min.
Water washing-3	25	90 s
Drying	80	2 min.

[0152] The color developer, the bleach-fixing solution and the washing water were the same as used in Example 3 and the stopping solution was an aqueous 2% acetic acid solution.

Sodium sulfate (anhydrous)	160.0 g
Sodium carbonate (anhydrous)	4.6 g
Formalin (37%)	20.0 ml
Water to make	1 ℓ
pH (25°C)	9.5

[0153] The color filters obtained each had a black matrix (BM) having a density of 2.5 or more. In the case where exposure was performed using a master color filter not containing an infrared dye (3A, 4A), the red picture element area was stained, whereas in the case where exposure was performed using a master color filter containing an infrared dye (3B, 4B), the red picture element area formed was free of color staining.

EXAMPLE 5

[0154] An optically isotropic 100 μm -thick polyether sulfone substrate having laminated on the back surface thereof a polypropylene protective layer (thickness: 20 μm) was subjected to glow discharge treatment and thereon two layers of an SBR latex layer and a gelatin layer were coated to have good adhesion to the photographic emulsion layer. Further thereon, from the first to the eleventh layers each having the following structure were simultaneously coated one on another to prepare Color Light-Sensitive Material CF-2 for color filter. The components and the coating amounts (unit: g/m^2) are shown below. With respect to the silver halide emulsion, the coating amount is calculated in terms of silver.

First Layer (antihalation layer):	
Gelatin	0.70
Antihalation dye (fine particle dispersion)	0.17
Carboxymethyl cellulose	0.05
Surface active agent (Cpd-16)	0.03
Hardening Agent (H-1)	0.05

Second Layer (infrared-sensitive layer):

Silver halide emulsion spectrally sensitized by Infrared Sensitizing Dye (ExS-6) ($\text{AgBr}_{30}\text{Cl}_{70}$; average grain size: 0.2 μm)	0.44
Stabilizer (Cpd-12)	0.005
Gelatin	1.42
Cyan Coupler (ExC-4)	0.10
Yellow Coupler (ExY-1)	0.45
Magenta Coupler (ExM-1)	0.22
Discoloration Inhibitor (Cpd-3)	0.05
High Boiling Point Solvent (Solv-1)	0.28
High Boiling Point Solvent (Solv-2)	0.6
Polymer (Cpd-14)	0.03

Third Layer (interlayer):

Gelatin	0.38
Discoloration Inhibitor (Cpd-2)	0.02
Discoloration Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Irradiation Preventive Dye (Dye-3)	0.04

Fourth Layer (first red-sensitive layer):

Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl ; average grain size: 0.18 μm)	0.11
Gelatin	0.70
Magenta Coupler (ExM-1)	0.15
Discoloration Inhibitor (Cpd-3)	0.08
Discoloration Inhibitor (Cpd-5)	0.01
High Boiling Point Solvent (Solv-4)	0.28
High Boiling Point Solvent (Solv-5)	0.14
Polymer (Cpd-11)	0.08

Fifth Layer (second red-sensitive layer):

Silver halide emulsion spectrally sensitized by Red Sensitizing Dyes (ExS-4 and ExS-5) (AgCl ; average grain size: 0.18 μm)	0.26
Gelatin	0.64
Yellow Coupler (ExY-1)	0.61
Stain Inhibitor (Cpd-13)	0.08
Discoloration Inhibitor (Cpd-5)	0.04
High Boiling Point Solvent (Solv-6)	0.24
Polymer (Cpd-14)	0.08

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Sixth Layer (interlayer):	
Gelatin	0.38
Irradiation Preventive Dye (Dye-1)	0.005
Irradiation Preventive Dye (Dye-2)	0.02

Seventh Layer (first green-sensitive layer):	
Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μm)	0.23
Gelatin	0.62
Yellow Coupler (ExY-1)	0.54
Discoloration Inhibitor (Cpd-5)	0.03
Stain Inhibitor (Cpd-13)	0.07
High Boiling Point Solvent (Solv-6)	0.22
Polymer (Cpd-14)	0.07

Eighth Layer (second green-sensitive layer):	
Silver halide emulsion spectrally sensitized by Green Sensitizing Dye (ExS-3) (AgCl; average grain size: 0.18 μm)	0.19
Gelatin	0.68
Cyan Coupler (ExC-3)	0.20
Cyan Coupler (EXC-2)	0.03
High Boiling Point Solvent (Solv-7)	0.51
Polymer (Cpd-14)	0.02

Ninth Layer (interlayer):	
Gelatin	0.38
Color Mixing Inhibitor (Cpd-2)	0.02
Color Mixing Inhibitor (Cpd-10)	0.09
High Boiling Point Solvent (Solv-1)	0.03
High Boiling Point Solvent (Solv-3)	0.01
Ultraviolet Absorbent (Cpd-8)	0.02
Ultraviolet Absorbent (Cpd-7)	0.02
Ultraviolet Absorbent (Cpd-6)	0.01
Ultraviolet Absorbent (Cpd-9)	0.02
Polymer (Cpd-11)	0.04
Yellow Dye (YF-1)	0.17

Tenth Layer (blue-sensitive layer):	
Silver halide emulsion spectrally sensitized by Blue Sensitizing Dyes (ExS-1 and ExS-2) ($\text{AgBr}_{30}\text{Cl}_{70}$; average grain size: 0.35 μm)	0.33
Gelatin	0.98
Cyan Coupler (ExC-4)	0.57
Magenta Coupler (ExM-2)	0.05
Ultraviolet Absorbent (Cpd-6)	0.03
Ultraviolet Absorbent (Cpd-7)	0.08
High Boiling Point Solvent (Solv-1)	0.23

(continued)

Tenth Layer (blue-sensitive layer):

Hardening Agent (H-1)

0.08

Eleventh Layer (protective layer):

Gelatin (acid-processed)

0.65

Antistatic agent (Cpd-1)

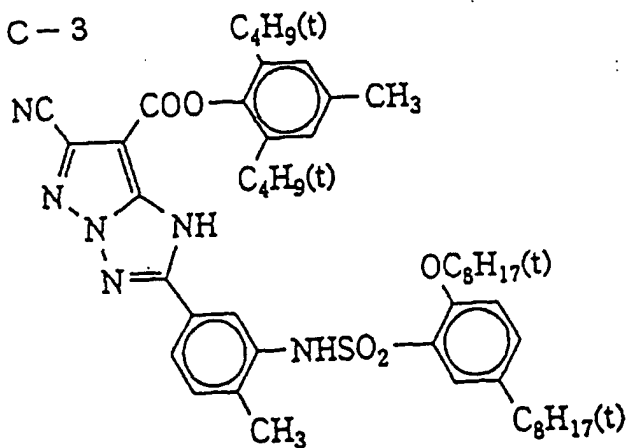
0.01

Snowtex-O (produced by Nissan Kagaku Kogyo KK)

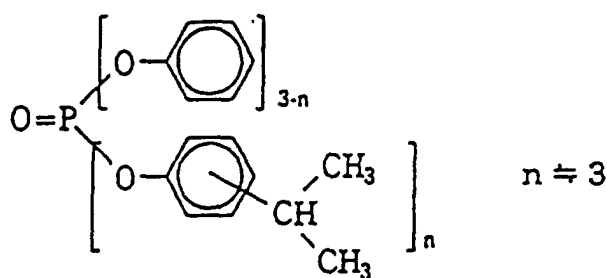
0.19

[0155] In each layer, sodium dodecylbenzenesulfonate as an emulsification dispersion aid, ethyl acetate as an auxiliary solvent, Surface Active Agent (Cpd-17) as a coating aid and potassium polystyrenesulfonate as a thickening agent were used.

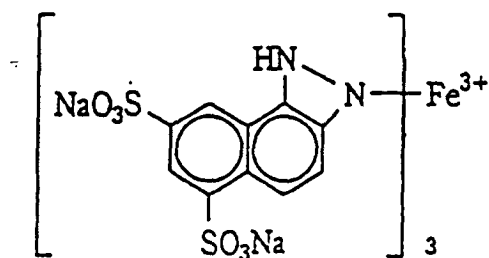
E x C - 3



S o l v - 7



Dye - 3



[0156] Color Light-Sensitive Material CF-2 prepared above was subjected to one-shot exposure at an equal magnification or a half reduction through each of the master color filters prepared in Example 3 using a camera for photo-mechanical process, and then to color development according to the following steps. As a result, color filters each having BGR three colors and black color formed in one operation were prepared. The processing solutions were the same as those used in Example 3.

Processing Step	Temperature (°C)	Time
Color development	38	80 s
Bleach-fixing	38	90 s
Water washing-1	25	1 min.
After-hardening	25	3 min.
Water washing-2	25	2 min.
Drying	80	2 min.

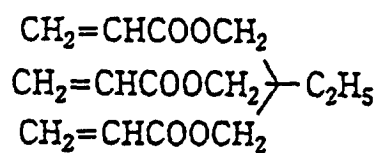
[0157] Similarly to Example 4, in the case where exposure was performed using a master color filter containing an infrared dye (3B, 4B), color staining was not generated and the BM had a high density.

[0158] On the color filter layer obtained, the following composition was coated to have a dry thickness of 2.5 μm , then dried and hardened with ultraviolet rays to form a protective layer. The resulting color filter was good in the adhesion between the color filter layer and the protective layer and had good resistance against chemicals. The picture element by the reduction exposure was small in the roughness as compared with the picture element by the exposure at an equal magnification. Using the thus-manufactured color filter, a color liquid crystal panel comprising a plastic film substrate was produced.

Formulation of Overcoat Composition:	
Monomer (1)	77.4 wt%
Monomer (2)	7.7
Polymer CAB 531 (produced by Eastman Chemical)	11.7
Photopolymerization initiator	2.4
Sensitizer	0.8
Diluting solvent (MEK) for coating	-

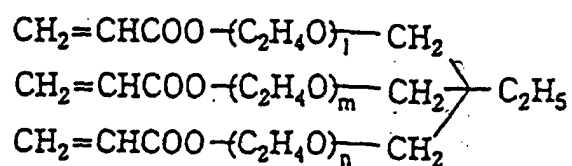
Monomer (1)

[0159]



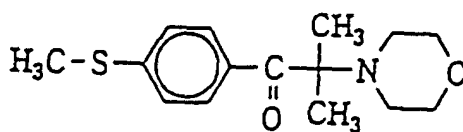
Monomer (2)

[0160]



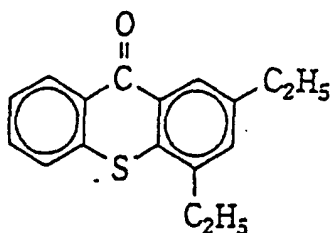
Photopolymerization initiator

[0161]



Sensitizer

[0162]



[0163] A master color filter having any pixel pattern can be easily manufactured using a silver halide color light-sensitive material containing an infrared dye-forming coupler. By subjecting a silver halide color light-sensitive material for color filter to one-shot exposure using this master color filter and then to one-time development processing, a color filter can be easily manufactured within a short time. The color filter obtained has red, green and blue color areas excellent in the spectral characteristics and a black matrix (BM) having a high optical density.

Claims

1. A process for producing a color filter having red, green and blue pixel patterns and a black matrix comprising the steps of:

(1) providing a master color filter having pixel patterns colored to red, green and blue, respectively, and having a substantially colorless area corresponding to the black matrix, by a process comprising:

exposing a first silver halide color light-sensitive material comprising a transparent support having thereon at least three silver halide emulsion layers having different color sensitivity from each other; and color developing and desilvering said exposed light-sensitive material; said first silver halide color light-sensitive material comprises at least a yellow coupler-containing silver halide emulsion layer, a magenta coupler-containing silver halide emulsion layer and a cyan coupler-containing silver halide emulsion layer;

(2) providing a second silver halide color light-sensitive material comprising a transparent substrate having thereon at least:

a red-sensitive silver halide emulsion layer containing a coupler which is sensitive to the red color of said master color filter and which forms a red color;
a green-sensitive silver halide emulsion layer containing a coupler which is sensitive to the green color of said master color filter and which forms a green color;
a blue-sensitive silver halide emulsion layer containing a coupler which is sensitive to the blue color of said master color filter and which forms a blue color; and
an infrared-sensitive emulsion;

(3) one-shot exposing said second silver halide color light-sensitive material with white light through the master color filter; and then

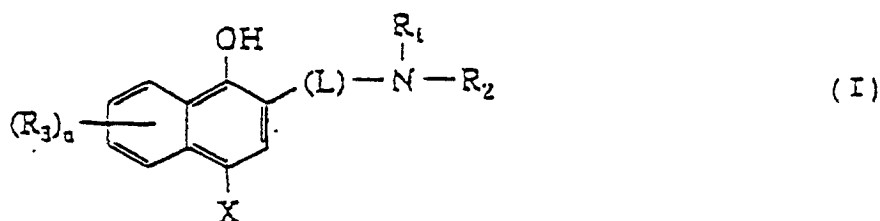
(4) color developing and desilvering said one-shot exposed light-sensitive material

characterized in that

either at least one of said yellow coupler containing silver halide emulsion layer and said magenta coupler-containing silver halide emulsion layer contains an infrared dye-forming coupler, or

said first silver halide color light-sensitive material further comprises a silver halide emulsion layer which contains an infrared dye-forming coupler and which has the same sensitivity as that of either or both of said yellow coupler-containing silver halide emulsion layer and said magenta coupler-containing silver halide emulsion layer.

2. The process as claimed in claim 1, wherein said pattern exposure of said first silver halide color light-sensitive material is carried out using a laser ray.
3. The process as claimed in claim 1 or 2, wherein the one-shot exposure of said second silver halide color light-sensitive material is carried out in a reduced magnification manner.
4. The process as claimed in any of claims 1 to 3 wherein said infrared dye-forming coupler is represented by the following formula (I):



wherein L represents -CO- or -SO₂-, R₁ represents an alkyl group, an aryl group or a heterocyclic group, R₂ represents a hydrogen atom, an alkyl group or an aryl group, R₃ represents a substituent, n represents 0, 1, 2, 3 or 4, and X represents a hydrogen atom or a group capable of splitting off upon coupling with an oxidation product of a developing agent.

Patentansprüche

1. Ein Verfahren zur Herstellung eines Farbfilters mit roten, grünen und blauen Bildelementmustern und einer schwarzen Matrix, umfassend die Stufen:

(1) Das Bereitstellen eines Mutterfarbfilters mit rot, grün bzw. blau gefärbten Bildelementmustern und mit einem im Wesentlichen farblosen Bereich entsprechend der schwarzen Matrix durch ein Verfahren, umfassend:

das Belichten eines ersten lichtempfindlichen Silberhalogenidfarbmaterials, enthaltend einen transparenten Träger mit wenigstens drei darauf befindlichen Silberhalogenidemulsionsschichten mit voneinander jeweils verschiedener Farbempfindlichkeit; und

das Farbentwickeln und das Entsilbern des belichteten, lichtempfindlichen Materials;

wobei das erste lichtempfindliche Silberhalogenidfarbmaterial wenigstens eine einen Gelbkuppler enthaltende Silberhalogenidemulsionsschicht, eine einen Magentakuppler enthaltende Silberhalogenidemulsionsschicht und eine einen Cyankuppler enthaltende Silberhalogenidemulsionsschicht enthält;

(2) Das Bereitstellen eines zweiten lichtempfindlichen Silberhalogenidfarbmaterials, das einen transparenten Träger enthält, auf dem wenigstens angeordnet sind:

eine rottempfindliche Silberhalogenidemulsionsschicht, die einen Kuppler enthält, der auf die rote Farbe des Mutterfarbfilters empfindlich ist, und der eine rote Farbe bildet;

eine grünempfindliche Silberhalogenidemulsionsschicht, die einen Kuppler enthält, der auf die grüne Farbe des Mutterfarbfilters empfindlich ist, und der eine grüne Farbe bildet;

eine blauempfindliche Silberhalogenidemulsionsschicht, die einen Kuppler enthält, der auf die blaue Farbe des Mutterfarbfilters empfindlich ist, und der eine blaue Farbe bildet; und

eine infrarotempfindliche Emulsion;

(3) Das einstufige Belichten des zweiten lichtempfindlichen Silberhalogenidfarbmaterials mit weißem Licht durch das Mutterfarbfilter; und dann

(4) Das Farbentwickeln und das Entsilbern des einstufig belichteten lichtempfindlichen Materials,

dadurch gekennzeichnet, dass

entweder wenigstens eine der den Gelbkuppler enthaltende Silberhalogenidemulsionsschicht und der den Magentakuppler enthaltende Silberhalogenidemulsionsschicht einen Infrarotfarbstoff bildenden Kuppler enthält, oder

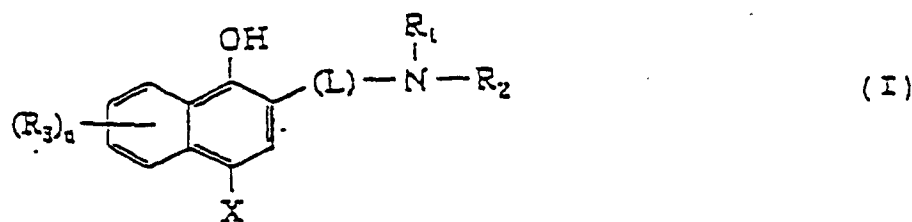
das erste lichtempfindliche Silberhalogenidfarbmaterial weiterhin eine Silberhalogenidemulsionsschicht enthält, welche einen Infrarotfarbstoff bildenden Kuppler enthält, und welche die gleiche Empfindlichkeit hat wie diejenige von entweder einer oder beiden der Gelbkuppler enthaltenden Silberhalogenidemulsionsschicht und der Magentakuppler enthaltenden Silberhalogenidemulsionsschicht.

2. Das Verfahren wie in Anspruch 1 beansprucht, worin die Musterbelichtung des ersten lichtempfindlichen Silberhalogenidfarbmaterials unter Verwendung eines Laserstrahls durchgeführt wird.

3. Das Verfahren wie in Anspruch 1 oder 2 beansprucht, worin die einstufige Belichtung des zweiten lichtempfindli-

chen Silberhalogenidfarbmaterials in verringertem Abbildungsmaßstab durchgeführt wird.

4. Das Verfahren wie in einem der Ansprüche 1 bis 3 beansprucht, worin der Infrarotfarbstoff bildende Kuppler durch die folgende Formel (I) wiedergegeben wird:



worin L -CO- oder -SO₂- bedeutet, R₁ eine Alkylgruppe, eine Arylgruppe oder eine heterocyclische Gruppe bedeutet, R₂ ein Wasserstoffatom, eine Alkylgruppe oder eine Arylgruppe bedeutet, R₃ einen Substituenten bedeutet, n 0, 1, 2, 3 oder 4 bedeutet, und X ein Wasserstoffatom oder eine Gruppe bedeutet, die zur Abspaltung nach dem Kuppeln mit einem Oxidationsprodukt eines Entwicklungsmittels befähigt ist.

Revendications

1. Procédé de préparation d'un filtre couleur ayant des motifs de pixels rouges, verts et bleus et une matrice noire comprenant les étapes consistant à :

(1) fournir un filtre couleur maître ayant des motifs de pixels colorés en rouge, vert et bleu, respectivement, et ayant une zone sensiblement incolore correspondant à la matrice noire, par un procédé comprenant les étapes consistant à:

exposer un premier matériau photosensible couleur à l'halogénure d'argent comprenant un support transparent ayant sur celui-ci au moins trois couches d'émulsion à l'halogénure d'argent ayant une sensibilité de couleur différente l'une de l'autre ; et

développer la couleur et désargenter ledit matériau sensible à la lumière exposé ;

ledit premier matériau photosensible couleur à l'halogénure d'argent comprenant au moins une couche d'émulsion à l'halogénure d'argent contenant un coupleur jaune, une couche d'émulsion à l'halogénure d'argent contenant un coupleur magenta et une couche d'émulsion à l'halogénure d'argent contenant un coupleur cyan ;

(2) fournir un second matériau photosensible couleur à l'halogénure d'argent comprenant un substrat transparent ayant sur celui-ci au moins :

une couche d'émulsion à l'halogénure d'argent sensible au rouge contenant un coupleur qui est sensible à la couleur rouge dudit filtre couleur maître et qui forme une couleur rouge ;

une couche d'émulsion à l'halogénure d'argent sensible au vert contenant un coupleur qui est sensible à la couleur verte dudit filtre couleur maître et qui forme une couleur verte ;

une couche d'émulsion à l'halogénure d'argent sensible au bleu contenant un coupleur qui est sensible à la couleur bleue dudit filtre couleur maître et qui forme une couleur bleue ; et

une émulsion sensible aux infrarouges ;

(3) exposer en un coup ledit second matériau photosensible couleur à l'halogénure d'argent avec une lumière blanche à travers le filtre couleur maître ; et ensuite

(4) développer la couleur et désargenter ledit matériau photosensible exposé en un coup,

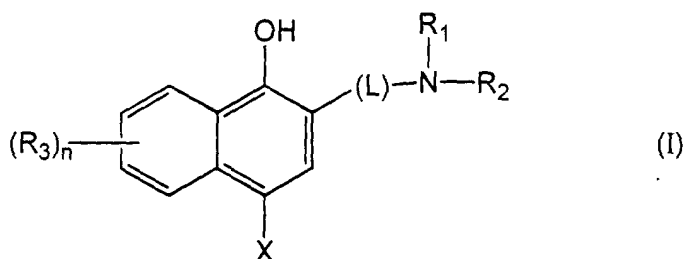
caractérisé en ce que

au moins une de ladite couche d'émulsion à l'halogénure d'argent contenant le coupleur jaune et de ladite couche d'émulsion à l'halogénure d'argent contenant un coupleur magenta contient un coupleur formant un

colorant sensible à l'infrarouge ; ou

ledit premier matériau photosensible couleur à l'halogénure d'argent comprend en outre une couche d'émulsion à l'halogénure d'argent qui contient un coupleur formant un colorant sensible à l'infrarouge et qui a la même sensibilité que l'une ou les deux de ladite couche d'émulsion à l'halogénure d'argent contenant un coupleur jaune et de ladite couche d'émulsion à l'halogénure d'argent contenant un coupleur magenta.

2. Procédé tel que revendiqué dans la revendication 1, **caractérisé en ce que** ladite exposition de motifs dudit premier matériau photosensible couleur à l'halogénure d'argent est effectuée en utilisant un rayon laser.
3. Procédé tel que revendiqué dans la revendication 1 ou 2, **caractérisé en ce que** l'exposition en un coup dudit second matériau photosensible couleur à l'halogénure d'argent est effectuée avec agrandissement réduit.
4. Procédé tel que revendiqué dans l'une quelconque des revendications 1 à 3, **caractérisé en ce que** ledit coupleur formant un colorant sensible à l'infrarouge est représenté par la formule suivante (I):



dans laquelle L représente -CO- ou -SO₂-, R₁ représente un groupe alkyle, un groupe aryle ou un groupe hétérocyclique, R₂ représente un atome d'hydrogène, un groupe alkyle ou un groupe aryle, R₃ représente un substituant, n représente 0, 1, 2, 3 ou 4, et X représente un atome d'hydrogène ou un groupe capable de partir par couplage avec un produit d'oxydation d'un agent développeur.

FIG. 1

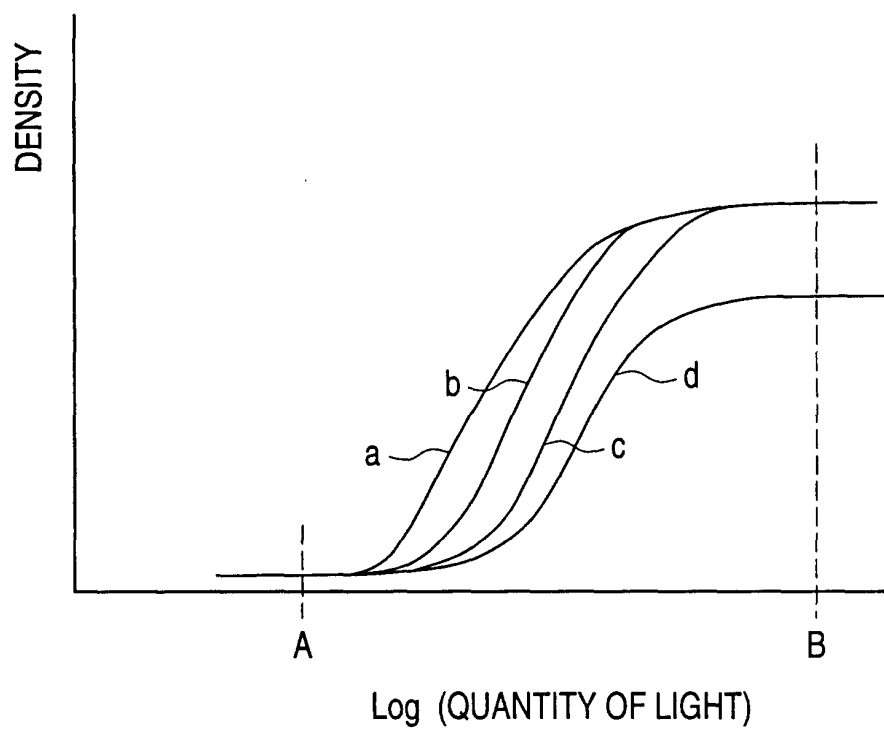


FIG. 2

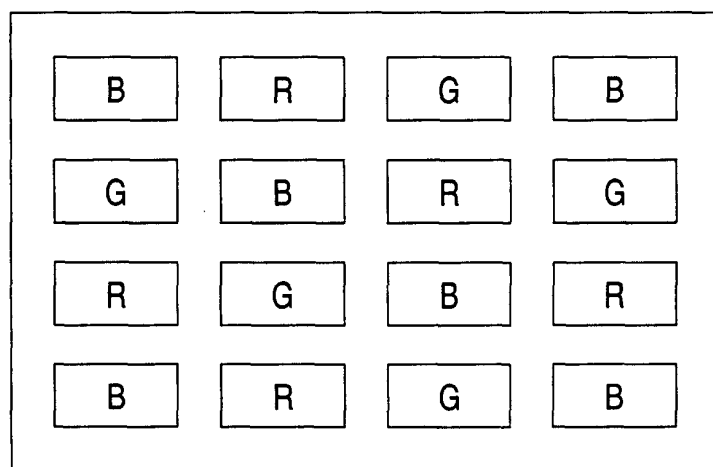


FIG. 3

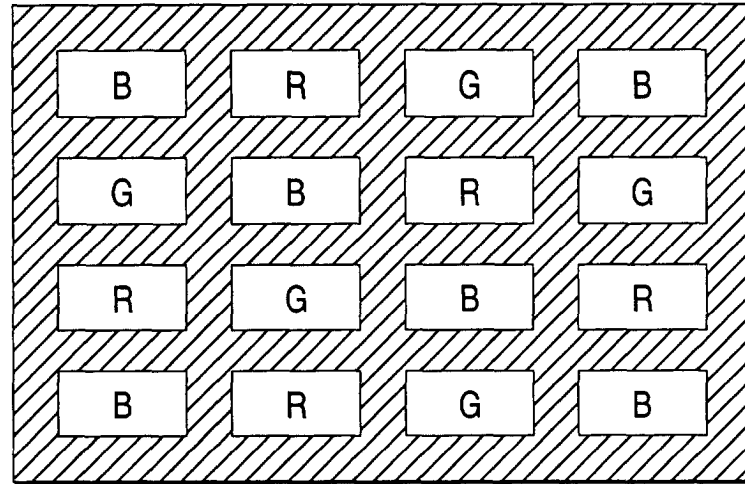


FIG. 4

