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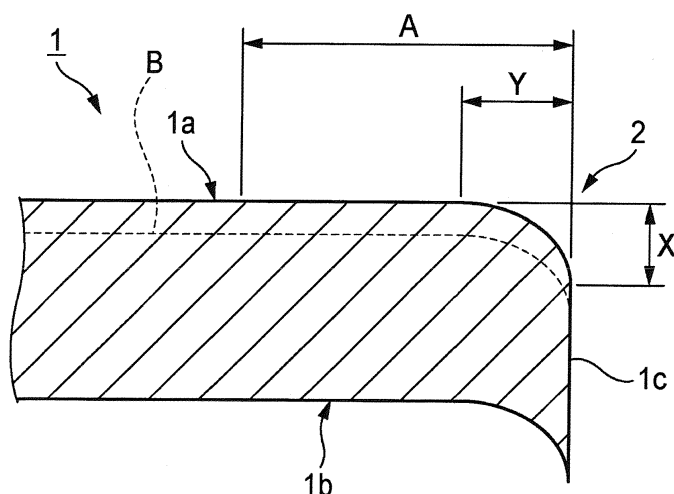
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(54) **Lithographic printing plate precursor for newspaper printing and method for producing the same, and plate making method of lithographic printing plate**

(57) An object of the invention is to provide a lithographic printing plate precursor of on-press development type for newspaper printing which has good on-press development property at the edge portion thereof and is prevented from the occurrence of edge stain even when a large number of printings is performed, a method for producing the same, and a plate making method using the lithographic printing plate precursor and is directed to a lithographic printing plate precursor for newspaper printing including on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in

its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, wherein the lithographic printing plate precursor has a shear droop in which a shear droop amount (X) is from 35 to 150 μm and a shear droop width (Y) is from 50 to 300 μm at an edge of the image-recording layer side, and a region within 1 cm from an edge surface of the lithographic printing plate precursor including the shear droop has been treated with a treating solution containing an anionic or nonionic surfactant, a method for producing the same, and a plate making method using the lithographic printing plate precursor.

FIG. 1



Description**FIELD OF THE INVENTION**

[0001] The present invention relates to a lithographic printing plate precursor for newspaper printing. More particularly, it relates to a lithographic printing plate precursor for newspaper printing capable of undergoing image exposure with laser and on-press development, a method for producing the same, and a plate making method wherein the lithographic printing plate precursor is subjected to on-press development.

BACKGROUND OF THE INVENTION

[0002] In general, a lithographic printing plate is composed of an oleophilic image area accepting ink and a hydrophilic non-image area accepting dampening water (fountain solution) in the process of printing. Lithographic printing is a printing method utilizing the nature of water and oily ink to repel with each other and comprising rendering the oleophilic image area of the lithographic printing plate to an ink-receptive area and the hydrophilic non-image area thereof to a dampening water-receptive area (ink-unreceptive area), thereby making a difference in adherence of the ink on the surface of the lithographic printing plate, depositing the ink only to the image area, and then transferring the ink to a printing material, for example, paper.

[0003] In order to produce the lithographic printing plate, a lithographic printing plate precursor (PS plate) comprising a hydrophilic support having provided thereon an oleophilic photosensitive resin layer (image-recording layer) is used. Specifically, the PS plate is exposed through a mask, for example, a lith film, and then subjected to development processing, for example, with an alkaline developer to remove the unnecessary image-recording layer corresponding to the non-image area by dissolving while leaving the image-recording layer corresponding to the image area, thereby obtaining the lithographic printing plate.

[0004] Due to the recent progress in the technical field, nowadays the lithographic printing plate can be obtained by a CTP (computer-to-plate) technology. Specifically, a lithographic printing plate precursor is directly subjected to scanning exposure using a laser or laser diode without using a lith film and developed to obtain a lithographic printing plate.

[0005] With the progress described above, the issue on the lithographic printing plate precursor has transferred to improvements, for example, in image-forming property corresponding to the CTP technology, printing property or physical property. Also, with the increasing concern about global environment, as another issue on the lithographic printing plate precursor, an environmental problem on waste liquid discharged accompanying the wet treatment, for example, development processing comes to the front.

[0006] In response to the environmental problem, simplification of development or plate making or non-processing has been pursued. As one method of simple plate making, a method referred to as an "on-press development" is practiced. Specifically, according to the method after exposure of a lithographic printing plate precursor, the lithographic printing plate precursor is mounted as it is on a printing machine without conducting conventional development and removal of the unnecessary area of image-recording layer is performed at an early stage of printing step.

[0007] Also, as a method of simple development, a method referred to as a "gum development" is practiced wherein the removal of the unnecessary area of image-recording layer is performed using not a conventional high alkaline developer but a finisher or gum solution of near-neutral pH.

[0008] In the simplification of plate making operation as described above, a system using a lithographic printing plate precursor capable of being handled in a bright room or under a yellow lamp and a light source is preferred from the standpoint of workability. Thus, as the light source, a semiconductor laser emitting an infrared ray having a wavelength of 760 to 1,200 or a solid laser, for example, YAG laser, is used. An UV laser is also used.

[0009] As the lithographic printing plate precursor capable of undergoing on-press development, for instance, a lithographic printing plate precursor having provided on a hydrophilic support, an image-recording layer (heat-sensitive layer) containing microcapsules having a polymerizable compound encapsulated therein is described in JP-A-2001-277740 (the term "JP-A" as used herein means an "unexamined published Japanese patent application") and JP-A-2001-277742. A lithographic printing plate precursor having provided on a support, an image-recording layer (photo-sensitive layer) containing an infrared absorbing agent, a radical polymerization initiator and a polymerizable compound is described in JP-A-2002-287334. A lithographic printing plate precursor capable of undergoing on-press development having provided on a support, an image-forming layer containing a polymerizable compound and a graft polymer having a polyethylene oxide chain in its side chain or a block polymer having a polyethylene oxide block is described in U.S. Patent Publication No. 2003/0064318.

[0010] In the printing using a lithographic printing plate, when the printing is conducted on paper whose size is smaller than that of the printing plate as in a conventional sheet-fed press, the edge of the printing plate does not influence on the printing quality because the edge of the printing plate is positioned out of the paper. However, in the case of continuous printing on rolled paper using a rotary press as in newspaper printing, since the edge of the printing plate is positioned

in the rolled paper, ink adhered to the edge of the printing plate is transferred to the paper to cause a linear stain (edge stain), thereby seriously deteriorating the commercial value of the printed material.

[0011] As the method for preventing the stain due to the edge in the newspaper printing, a method in which an edge surface of an aluminum support are cut at an angle ranging from 10 to 45 degrees relative to the aluminum surface is known (see JP-B-57-46754 (the term "JP-B" as used herein means an "examined Japanese patent publication")). Also, a method in which an edge of lithographic printing plate is bent downward to prevent accumulation of ink on the edge is proposed (see JP-A-10-35130). Any of these methods in which the edge is so processed as to be positioned on the downside than the surface of lithographic printing plate intend to decrease the adhesion of ink on the edge and to decrease contact of the edge with a blanket, thereby preventing transfer of ink adhered to the edge to cause the edge stain.

[0012] Further, it is proposed that in addition to process the edge in the specific shape as described above, the edge is treated with a desensitizing solution containing a hydrophilic organic polymer compound, for example, gum arabic, a soybean polysaccharide or a phosphoric acid compound to make ink hardly cause adhesion (see JP-A-11-52579 and JP-A-2001-75268).

SUMMARY OF THE INVENTION

[0013] The prior arts described above for preventing the edge stain in the newspaper printing have been developed in a system in which a lithographic printing plate precursor is exposed and developed by an automatic developing machine or the like to prepare a lithographic printing plate and the lithographic printing plate is mounted on a printing machine. However, when on-press development is attempted in the newspaper printing, it has been found that a new problem arises. When the edge is so processed as to be positioned on the downside than the surface of lithographic printing plate as in the prior arts in order to prevent the edge stain, the edge is not subjected to on-press development and the edge stain conversely increases. This is because that the edge positioned on the downside than the surface of lithographic printing plate does not sufficiently contact mechanically with rollers or blanket at the on-press development and the image-recording layer cannot be fully removed to cause a remaining layer. Therefore, a new measure is necessary in order to perform on-press development in the newspaper printing and to prevent the edge stain.

[0014] In response thereto, it is proposed that the edge of lithographic printing plate precursor is treated with a solution containing an organic solvent and a hydrophilic organic polymer compound, for example, gum arabic, a cellulose or a phosphoric acid compound and have the specific shape in which the shear droop amount of edge is 25 μm or less to make ink hardly cause adhesion at the on-press development (see JP-A-2011-177983). However, it has been found that the shear droop amount of edge is 25 μm or less is insufficient to prevent the edge stain in case of performing a large amount of printing.

[0015] The present invention has been made in view of the problems described above, and it is an object of the invention to provide a lithographic printing plate precursor of on-press development type for newspaper printing which has good on-press development property at the edge portion thereof and is prevented from the occurrence of edge stain even when a large number of printings is performed, a method for producing the same, and a plate making method using the lithographic printing plate precursor.

[0016] The invention includes the constitutions described below, and the problems described above can be solved therewith.

(1) A lithographic printing plate precursor for newspaper printing comprising on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, wherein the lithographic printing plate precursor has a shear droop in which a shear droop amount (X) is from 35 to 150 μm and a shear droop width (Y) is from 50 to 300 μm at an edge of the image-recording layer side, and a region within 1 cm from an edge surface of the lithographic printing plate precursor including the shear droop has been treated with a treating solution containing an anionic or nonionic surfactant.

(2) The lithographic printing plate precursor for newspaper printing as described in (1) above, wherein the treating solution further contains a water-soluble resin.

(3) The lithographic printing plate precursor for newspaper printing as described in (2) above, wherein the water-soluble resin is a polysaccharide.

(4) The lithographic printing plate precursor for newspaper printing as described in (2) or (3) above, wherein the treating solution further contains an organic solvent.

(5) The lithographic printing plate precursor for newspaper printing as described in any one of (1) to (4) above, wherein the treating solution further contains a phosphoric acid compound.

(6) The lithographic printing plate precursor for newspaper printing as described in any one of (1) to (5) above, wherein the polyoxyalkylene chain in the polymer compound is a polyoxyethylene chain and a repeating unit number

of oxyethylene is from 2 to 50.

(7) The lithographic printing plate precursor for newspaper printing as described in any one of (1) to (6) above, wherein the polymer compound is a polymer compound having a star-like shape.

(8) The lithographic printing plate precursor for newspaper printing as described in any one of (1) to (7) above, wherein the lithographic printing plate precursor for newspaper is a lithographic printing plate precursor having a protective layer on the image-recording layer.

(9) A method for producing a lithographic printing plate precursor for newspaper printing comprising treating a region within 1 cm from an edge surface of a lithographic printing plate precursor for newspaper printing which comprises on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, with a solution containing an anionic or nonionic surfactant.

(10) A plate making method of a lithographic printing plate comprising exposing imagewise a lithographic printing plate precursor for newspaper printing which comprises on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine with infrared laser, treating a region within 1 cm from an edge surface of the lithographic printing plate precursor with a solution containing an anionic or nonionic surfactant, mounting the lithographic printing plate precursor on a cylinder of a printing machine, and developing the lithographic printing plate precursor with at least one of printing ink and dampening water.

(11) The plate making method of a lithographic printing plate as described in (10) above, wherein the dampening water contains a water-soluble resin in an amount from 0.001 to 1% by weight based on a total amount of the dampening water, and at least one of (i) an organic solvent in an amount from 0.01 to 1.0% by weight based on a total amount of the dampening water and (ii) a surfactant in an amount from 0.001 to 0.1% by weight based on a total amount of the dampening water.

[0017] According to the invention, a lithographic printing plate precursor of on-press development type for newspaper printing which has good on-press development property at the edge portion thereof and is prevented from the occurrence of edge stain even when a large number of printings is performed, a method for producing the same, and a plate making method using the lithographic printing plate precursor can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is one example of a cross-sectional shape of an edge of a lithographic printing plate precursor cut by a cutting device.

Fig. 2 is a cross-sectional view showing a cutting portion of a slitter device.

[Description of reference numerals and signs]

[0019]

- 1 Lithographic printing plate precursor
- 1a Image-recording layer surface
- 1b Support surface
- 1c Edge surface
- 2 Shear droop
- 10 Cutting blade
- 10a Upper cutting blade
- 10b Upper cutting blade
- 11 Rotation axis
- 20 Cutting blade
- 20a Lower cutting blade
- 20b Lower cutting blade
- 21 Rotation axis
- 30 Sheet

X Shear droop amount
 Y Shear droop width
 B Boundary between image-recording layer and support

DETAILED DESCRIPTION OF THE INVENTION

[0020] The lithographic printing plate precursor for newspaper printing according to the invention is a lithographic printing plate precursor for newspaper printing comprising on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, wherein the lithographic printing plate precursor has a shear droop in which a shear droop amount (X) is from 35 to 150 μm and a shear droop width (Y) is from 50 to 300 μm at an edge of the image-recording layer side, and a region within 1 cm from an edge surface of the lithographic printing plate precursor including the shear droop has been treated with a treating solution containing an anionic or nonionic surfactant.

[0021] According to the lithographic printing plate precursor for newspaper printing of the invention, the on-press development property at the edge portion is good and the edge stain hardly occurs even when a large number of printings is performed. The reason for this is supposed as described below.

[0022] The enhancement of the on-press development property of the edge portion is possible by decreasing the shear droop amount of the edge to strongly contact the edge portion to a blanket, but in the case where the shear droop amount is small, printing ink tends to accumulate in the edge portion to cause the edge stain, when a large number of printings is performed.

[0023] Due to the increase in the shear droop amount, though the printing ink hardly accumulates in the edge portion so that the edge stain is improved, the on-press development property of the edge portion is deteriorated. According to the treatment of the edge portion of lithographic printing plate precursor of on-press development type with a solution containing an organic solvent and a water-soluble resin, the on-press development property can be improved somewhat but is still insufficient.

[0024] As a result of the detail investigations, the inventors have found that the on-press development property is improved to be compatible with the prevention of edge stain by setting the shear droop amount within a range from 35 to 150 μm , incorporating previously an anionic surfactant or nonionic surfactant into the image-recording layer, and coating a treating solution containing an anionic surfactant or nonionic surfactant on the edge of the lithographic printing plate precursor of on-press development type.

[0025] This is believed to be that the surfactant easily permeates into the image-recording layer to accelerate the on-press development property and simultaneously contributes to hydrophilization of the surface of support to further improve the edge stain.

[0026] Hereinafter, the treating solution and then the lithographic printing plate precursor according to the invention will be described.

[Treating solution]

[0027] The essential component of the treating solution according to the invention is (1) an anionic or nonionic surfactant. A preferred optional component includes, for example, a water-soluble resin, an organic solvent, a plasticizer, an organic solvent for swelling the image-recording layer and a phosphoric acid compound for preventing storage stain. Other optional components include an inorganic salt, a preservative and an antifoamer.

[0028] The treating solution may be an aqueous solution or liquid in which an oil phase component and an aqueous phase component are emulsified.

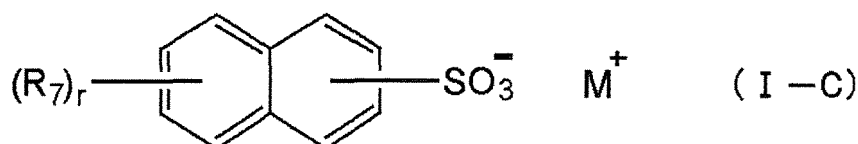
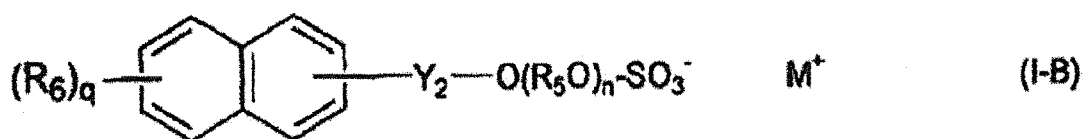
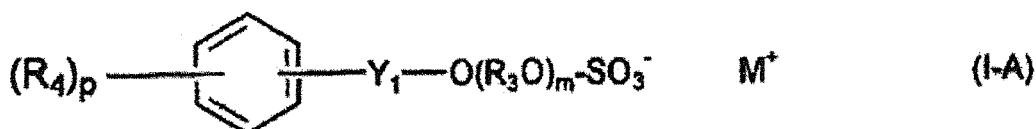
<Surfactant>

[0029] The surfactant which can be used in the invention is an anionic surfactant and/or a nonionic surfactant. An anionic or nonionic surfactant of fluorine-based, silicon-based or the like (typically, a fluorine-based or silicon-based anionic or nonionic surfactant) is not preferred for the anionic or nonionic surfactant according to the invention. The use of such a fluorine-based or silicon-based anionic or nonionic surfactant is not preferred because a coating property of the treating solution becomes poor.

[0030] The anionic surfactant includes, for example, fatty acid salts, abietic acid salts, hydroxyalkanesulfonic acid salts, alkanesulfonic acid salts, dialkylsulfosuccinic acid salts, straight-chain alkylbenzenesulfonic acid salts, branched alkylbenzenesulfonic acid salts, alkyl naphthalenesulfonic acid salts, alkylphenoxy polyoxyethylene propylsulfonic acid salts, polyoxyethylene aryl ether sulfate ester salts, polyoxyethylene alkylsulfophenyl ether salts, N-methyl-N-oleytaurine

sodium salt, N-alkylsulfosuccinic acid monoamide disodium salts, petroleum sulfonic acid salts, sulfated castor oil, sulfated beef tallow oil, sulfate ester salts of fatty acid alkyl ester, alkyl sulfate ester salts, polyoxyethylene alkyl ether sulfate ester salts, fatty acid monoglyceride sulfate ester salts, polyoxyethylene alkyl phenyl ether sulfate ester salts, polyoxyethylene styryl phenyl ether sulfate ester salts, alkyl phosphate ester salts, polyoxyethylene alkyl ether phosphate ester salts, polyoxyethylene alkyl phenyl ether phosphate ester salts, partially saponified products of styrene-maleic anhydride copolymer, partially saponified products of olefin-maleic anhydride copolymer and naphthalene sulfonate formalin condensates. Of the compounds, dialkylsulfosuccinic acid salts, alkyl sulfate ester salts, polyoxyethylene aryl ether sulfate ester salts and alkylnaphthalenesulfonic acid salts are particularly preferably used.

[0031] Specifically, at least one anionic surfactant selected from the group consisting of anionic surfactants represented by formula (I-A), formula (I-B) and formula (I-C) is exemplified.



[0032] In formula (I-A), R_3 represents a straight-chain or branched alkylene group having from 1 to 5 carbon atoms, R_4 represents a straight-chain or branched alkyl group having from 1 to 20 carbon atoms, p represents 0, 1 or 2, Y_1 represents a single bond or an alkylene group having from 1 to 10 carbon atoms, m represents an integer from 1 to 100, when m is 2 or more, plural R_3 may be the same or different from each other, and M^+ represents Na^+ , K^+ , Li^+ or NH_4^+ .

[0033] In formula (I-B), R_5 represents a straight-chain or branched alkylene group having from 1 to 5 carbon atoms, R_6 represents a straight-chain or branched alkyl group having from 1 to 20 carbon atoms, q represents 0, 1 or 2, Y_2 represents a single bond or an alkylene group having from 1 to 10 carbon atoms, n represents an integer from 1 to 100, when n is 2 or more, plural R_5 may be the same or different from each other, and M^+ represents Na^+ , K^+ , Li^+ or NH_4^+ .

[0034] In formula (I-C), R_7 represents a straight-chain or branched alkyl group having from 1 to 20 carbon atoms, r represents 0, 1 or 2, when r is 2, plural R_7 may be the same or different from each other, and M^+ represents Na^+ , K^+ , Li^+ or NH_4^+ .

[0035] According to a preferred embodiment of the invention, in formula (I-A) and formula (I-B), as a preferred example of any of R_3 and R_5 , $-CH_2-$, $-CH_2CH_2-$ or $-CH_2CH_2CH_2-$ is exemplified, and as a more preferred example of any of R_3 and R_5 , $-CH_2CH_2-$ is exemplified. As a preferred example of any one of R_4 and R_6 , CH_3 , C_2H_5 , C_3H_7 or C_4H_9 is exemplified. Any of p and q is preferably 0 or 1. Any of Y_1 and Y_2 is preferably a single bond. Any of n and m is preferably an integer from 1 to 20.

[0036] As specific examples of the compound represented by formula (I-A) or formula (I-B), compounds set forth below are exemplified.

(1)



(2)



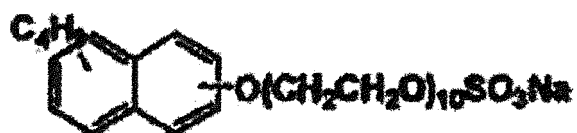
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(4)



(5)



(6)



(7)



(8)



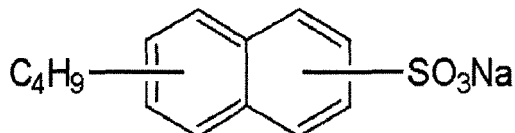
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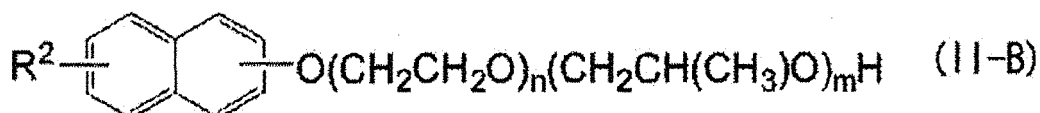
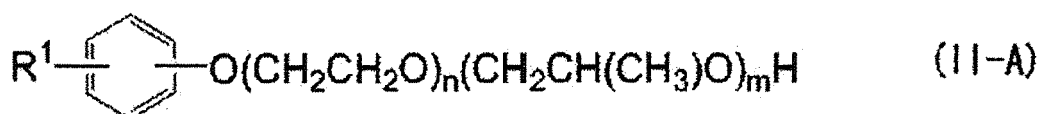
[0037] As specific examples of the compound represented by formula (I-C), compounds set forth below are exemplified.



[0038] As the nonionic surfactant, for example, polyoxyethylene alkyl ethers, polyoxyethylene aryl ethers, glycerin fatty acid partial esters, sorbitan fatty acid partial esters, pentaerythritol fatty acid partial esters, propylene glycol monofatty acid esters, sucrose fatty acid partial esters, polyoxyethylene sorbitan fatty acid partial esters, polyoxyethylene sorbitol fatty acid partial esters, polyethylene glycol fatty acid esters, polyglycerol fatty acid partial esters, polyoxyethylene glycerol fatty acid partial esters, fatty acid diethanolamides, N,N-bis-2-hydroxyalkylamines, polyoxyethylene alkylamines, triethanolamine fatty acid esters and trialkylamine oxides are exemplified. Of the compounds, polyoxyethylene aryl ethers and polyoxyethylene-polyoxypropylene block copolymers are preferably used.

[0039] As other surfactants which can be used in the treating solution according to the invention, nonionic surfactants, for example, polyoxyethylene naphthyl ether, polyoxyethylene alkylphenyl ether, polyoxyethylene alkyl ethers, for example, polyoxyethylene lauryl ether, polyoxyethylene cetyl ether or polyoxyethylene stearyl ether, polyoxyethylene alkyl esters, for example, polyoxyethylene stearate, sorbitan alkyl esters, for example, sorbitan monolaurate, sorbitan monostearate, sorbitan distearate, sorbitan monooleate, sorbitan sesquioleate or sorbitan trioleate, and monoglyceride alkyl esters, for example, glycerol monostearate or glycerol monooleate are preferably exemplified.

[0040] Of the nonionic surfactants, surfactants represented by formula (II-A) shown below and surfactants represented by formula (II-B) shown below are preferably exemplified.



[0041] In formula (II-A), R^1 represents a hydrogen atom or an alkyl group having from 1 to 100 carbon atoms, n and m each represents an integer from 0 to 100, provided that n and m are not 0 at the same time.

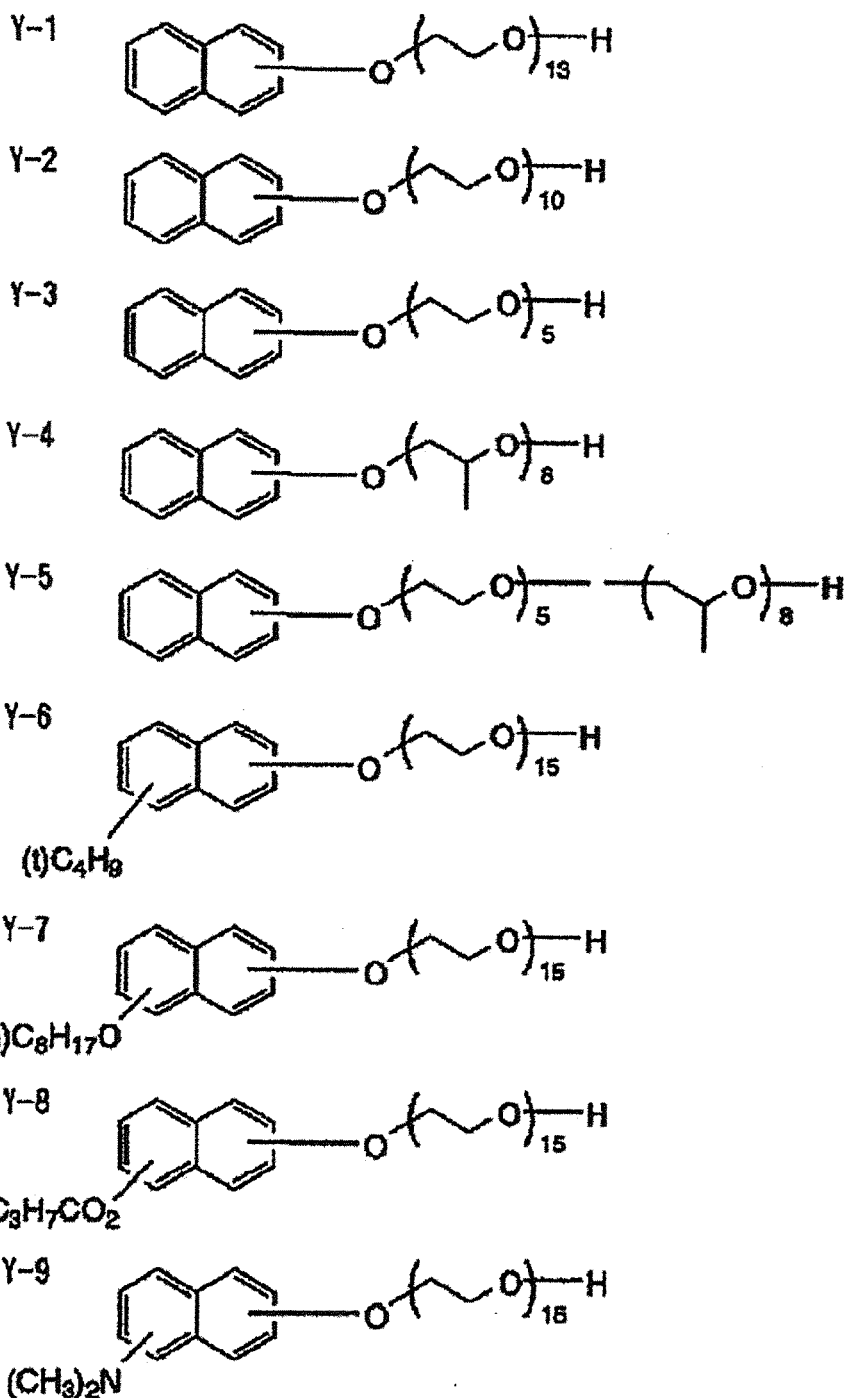
[0042] In formula (II-B), R^2 represents a hydrogen atom or an alkyl group having from 1 to 100 carbon atoms, n and m each represents an integer from 0 to 100, provided that n and m are not 0 at the same time.

[0043] Examples of the compound represented by formula (II-A) include polyoxyethylene phenyl ether, polyoxyethylene methylphenyl ether, polyoxyethylene octylphenyl ether and polyoxyethylene nonylphenyl ether. Examples of the compound represented by formula (II-B) include polyoxyethylene naphthyl ether, polyoxyethylene methylnaphthyl ether, polyoxyethylene octylnaphthyl ether and polyoxyethylene nonylnaphthyl ether.

[0044] In the compounds represented by formula (II-A) and formula (II-B), the repeating unit number (n) of polyoxyethylene chains is preferably from 3 to 50, and more preferably from 5 to 30, and the repeating unit number (m) of polyoxypropylene chains is preferably from 0 to 10, and more preferably from 0 to 5. The polyoxyethylene moiety and polyoxypropylene moiety may form a random or block copolymer.

[0045] The nonionic aromatic ether surfactants represented by formula (II-A) and formula (II-B) may be used individually or in combination of two or more thereof.

[0046] Specific examples of the compound represented by formula (II-A) or formula (II-B) are set forth below. In specific compound Y-5 shown below, the oxyethylene repeating units and oxypropylene repeating units may form any embodiment of a random bond or a block bond.



[0047] Of the surfactants described above, the anionic surfactants which have a high acceleration effect on the on-press development are particularly preferably used. Two or more kinds of the surfactants may be used in combination. For example, a combination use of two or more anionic surfactants different from each other or a combination use of anionic surfactant and a nonionic surfactant is preferred.

[0048] The amount of the surfactant used is not particularly restricted and is preferably from 0.01 to 20% by weight based on the total weight of the treating solution. In the rage described above, the on-press development property is accelerated.

[0049] In addition, heretofore known cationic surfactants or amphoteric surfactants may be used together. The cationic surfactant includes, for example, alkylamine salts, quaternary ammonium salts, polyoxyalkyl amine salts and polyethylene polyamine derivatives. The amphoteric surfactant for use in the invention includes, for example, carboxybetaines, aminocarboxylic acids, sulfobetaines, amino sulfuric esters and imidazolines.

<Water-soluble resin>

[0050] The treating solution according to the invention preferably further contains a water-soluble resin. Examples of the water-soluble resin include a water-soluble resin classified as a polysaccharide, polyvinyl alcohol, polyvinyl pyrrolidone, polyacrylamide and a copolymer of acrylamide, a vinyl methyl ether/maleic anhydride copolymer, a vinyl acetate/maleic anhydride copolymer and a styrene/maleic anhydride copolymer.

[0051] The polysaccharide includes for example, a starch derivative (for example, dextrin, enzyme-decomposed dextrin, hydroxypropylated starch, carboxymethylated starch, phosphorylated starch, polyoxyalkylene-grafted starch or cyclodextrin), a cellulose (for example, carboxymethyl cellulose, carboxyethyl cellulose, methyl cellulose, hydroxypropyl cellulose or methyl propyl cellulose), carrageenan, alginic acid, guar gum, locust bean gum, xanthine gum, gum arabic and a soybean polysaccharide.

[0052] Of the compounds, a starch derivative, for example, dextrin or polyoxyalkylene-grafted starch, gum arabic, carboxymethyl cellulose or a soybean polysaccharide is preferably used.

[0053] The water-soluble resins may be used in combination of two or more thereof. The water-soluble resin may be incorporated preferably in a range from 5 to 40% by weight, more preferably in a range from 10 to 30% by weight, based on the total weight of the treating solution. In the range described above, the treating solution is prevented from difficulty in coating due to its high viscosity to provide good hydrophilizing protective film.

<Organic solvent>

[0054] The treating solution according to the invention also preferably further contains an organic solvent.

[0055] The organic solvent for use in the invention includes, for example, an alcohol solvent, a ketone solvent, an ester solvent, an amide solvent and a hydrocarbon solvent. Of the solvents, the alcohol solvent and hydrocarbon solvent are preferred.

[0056] The alcohol solvent may be a monohydric alcohol or a polyhydric alcohol. Examples of the monohydric alcohol include methyl alcohol, n-propyl alcohol, isopropyl alcohol, n-butyl alcohol, tert-butyl alcohol, n-amyl alcohol, diacetone alcohol, 1-methoxy-2-propanol, aryl alcohol, 2-octanol, 2-ethylhexanol, nonanol, n-decanol, undecanol, n-dodecanol, trimethylnonyl alcohol, benzyl alcohol, phenethyl alcohol, ethylene glycol monoisoamyl ether, ethylene glycol monophenyl ether, ethylene glycol monobenzyl ether and ethylene glycol monohexyl ether.

[0057] Examples of the polyhydric alcohol include ethylene glycol, propylene glycol, triethylene glycol, butylene glycol, hexylene glycol, diethylene glycol, dipropylene glycol and glycerol.

[0058] Of the compounds, benzyl alcohol, phenethyl alcohol, furfuryl alcohol and glycerol are particularly preferred.

[0059] The hydrocarbon solvent includes, for example, an aromatic or aliphatic compound of petroleum fraction (mineral spirit) and squalane.

[0060] The organic solvents may be used individually or in combination of two or more thereof. The amount of the organic solvent used is preferably from 0.5 to 10% by weight, more preferably from 1 to 5% by weight, based on the total weight of the treating solution. In the range described above, tackiness in the area where the treating solution is coated is prevented and permeability of the treating solution into the image-recording layer is excellent.

<Plasticizer>

[0061] The treating solution according to the invention may contain a plasticizer. The plasticizer includes plasticizers having a solidification point of 15°C or less, for instance, a phthalic acid diester, for example, dibutyl phthalate, diheptyl phthalate, di-n-octyl phthalate, di(2-ethylhexyl)phthalate, dinonyl phthalate, didecyl phthalate, dilauryl phthalate or butyl benzyl phthalate, an aliphatic dibasic acid ester, for example, dioctyl adipate, butyl glycol adipate, dioctyl azelate, dibutyl sebacate, di(2-ethylhexyl)sebacate or dioctyl sebacate, an epoxidized triglyceride, for example, epoxidized soybean oil, a phosphate, for example, tricresyl phosphate, trioctyl phosphate or trischloroethyl phosphate, and a benzoate, for example, benzyl benzoate.

[0062] The plasticizers may be used individually or in combination of two or more thereof. The amount of the plasticizer used is preferably from 0.5 to 10% by weight, more preferably from 1 to 5% by weight, based on the total weight of the treating solution.

<Phosphoric acid compound>

[0063] The treating solution according to the invention may contain a phosphoric acid compound. The phosphoric acid compound includes, for example, phosphoric acid, metaphosphoric acid, primary ammonium phosphate, secondary ammonium phosphate, primary sodium phosphate, secondary sodium phosphate, primary potassium phosphate, secondary potassium phosphate, sodium tripolyphosphate, potassium pyrophosphate and sodium hexametaphosphate. Of the compounds, a combination of an acid and a salt, for example, phosphoric acid/ammonium phosphate or metaphosphoric acid/ammonium phosphate is preferably used.

[0064] The content of the phosphoric acid compound in the treating solution for use in the invention is preferably from 0.5 to 3.0% by weight, more preferably from 0.5 to 2.5% by weight, based on the total weight of the treating solution. In the range described above, the storage stain and prevention of crystal deposition after coating are more excellent.

<Other optional components>

[0065] In addition to the components described above, the treating solution for treating the edge of the lithographic printing plate precursor for use in the invention may contain, for example, an inorganic salt, for example, a nitrate or a sulfate, a preservative and an antifoamer. The inorganic salt includes, for example, magnesium nitrate, sodium nitrate, potassium nitrate, ammonium nitrate, sodium sulfate, potassium sulfate, ammonium sulfate, sodium hydrogen sulfate and nickel sulfate.

[0066] The preservative includes, for example, phenol and a derivative thereof, formalin, an imidazole derivative, sodium dehydroacetate, a 4-isothiazolin-3-one derivative, benzisothiazolin-3-one, a benzotriazole derivative, an amidine guanidine derivative, a quaternary ammonium salt, a derivative of pyridine, quinoline or guanidine, diazine, a triazole derivative, oxazole, an oxazine derivative, a nitrobroalcohol, for example, 2-bromo-2-nitropropane-1,3-diol, 1,1-dibromo-1-nitro-2-ethanol or 1,1-dibromo-1-nitro-2-propanol.

[0067] As the antifoamer, for example, a compound of ordinal silicon-based self-emulsified type or emulsified type or a nonionic surfactant having HLB value of 5 or less may be used.

<Method for production of emulsion type>

[0068] In the case where the treating solution is prepared as an emulsion type, it can be prepared according to a conventional method. For instance, as to emulsion dispersion at the production of the treating solution for use in the invention, an aqueous phase is prepared at temperature of $40 \pm 5^\circ\text{C}$, stirred at high speed, gradually adding dropwise an oil phase prepared to the aqueous phase, and after thoroughly stirring, passing through a pressurized homogenizer to prepare an emulsion. In some cases, the treating solution has been prepared as a concentrated form and is appropriately diluted at the time of use.

[Lithographic printing plate precursor of on-press development type]

[0069] The lithographic printing plate precursor for use in the invention comprises a support and an image-recording layer, and if desired, an undercoat layer provided between the support and the image-recording layer and a protective layer provided on the image-recording layer.

(Image-recording layer)

[0070] The image-recording layer according to the invention is an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in its side chain and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine.

[0071] Hereinafter, the constituting components of the image-recording layer are described.

<Polymer compound having polyoxyalkylene chain in its side chain>

[0072] By incorporating the polymer compound having a polyoxyalkylene chain in its side chain (hereinafter, also referred to as a specific polymer compound) into the image-recording layer, permeability of the treating solution is accelerated to improve the on-press development property.

[0073] The specific polymer compound includes an acrylic resin, a polyvinyl acetal resin, a polyurethane resin, a polyurea resin, a polyimide resin, a polyamide resin, an epoxy resin, a methacrylic resin, a polystyrene resin, a novolac type phenolic resin, a polyester resin, a synthesis rubber and a natural rubber, and is particularly preferably an acrylic resin.

[0074] The specific polymer compound does not substantially contain a perfluoroalkyl group. The terminology "does not substantially contain a perfluoroalkyl group" as used herein means that a weight ratio of fluorine atoms present as the perfluoroalkyl group in the specific polymer compound is less than 0.5% by weight, and it is preferred not to contain the perfluoroalkyl group. The weight ratio of fluorine atom is determined by an elemental analysis method.

[0075] Also, the term "perfluoroalkyl group" means the all hydrogen atoms of an alkyl group are substituted with fluorine atoms.

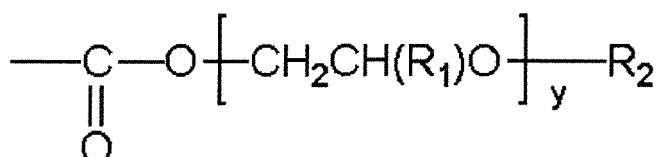
[0076] The alkylene oxide (oxyalkylene) in the polyoxyalkylene chain is preferably an alkylene oxide having from 2 to 6 carbon atoms, more preferably ethylene oxide (oxyethylene) or propylene oxide (oxypropylene), and still more preferably an ethylene oxide.

[0077] A repeating number of alkylene oxide in the polyoxyalkylene chain, that is, poly(alkylene oxide) moiety is preferably from 2 to 50, and more preferably from 4 to 25.

[0078] The repeating number of alkylene oxide of 2 or more is preferred because the permeability of the treating solution is sufficiently improved, and whereas the repeating number of alkylene oxide of 50 or less is preferred because degradation of printing durability due to abrasion is prevented.

[0079] The poly(alkylene oxide) moiety is preferably contained as a side chain of the specific polymer compound, in a structure represented by formula (1) shown below. More preferably, it is contained as a side chain of an acrylic resin in a structure represented by formula (1) shown below.

Formula (1):



[0080] In formula (1), y represents from 2 to 50, and preferably from 4 to 25. R₁ represents a hydrogen atom or an alkyl group. R₂ represents a hydrogen atom or an organic group. The organic group is preferably an alkyl group having from 1 to 6 carbon atoms and includes a methyl group, an ethyl group, an n-propyl group, an isopropyl group, an n-butyl group, a sec-butyl group, an isobutyl group, a tert-butyl group, an n-pentyl group, an isopentyl group, a neopentyl group, an n-hexyl group, an isohexyl group, a 1,1-dimethylbutyl group, a 2,2-dimethylbutyl group, a cyclopentyl group and a cyclohexyl group.

[0081] Above all, R₁ is preferably a hydrogen atom or a methyl group and most preferably a hydrogen atom. R₂ is most preferably a hydrogen atom or a methyl group.

[0082] The specific polymer compound may have a crosslinking property in order to improve the film strength of the image area. In order to impart the crosslinking property to the specific polymer compound, a crosslinkable functional group, for example, an ethylenically unsaturated bond is introduced into a main chain or side chain of the polymer compound. The crosslinkable functional group may be introduced by copolymerization.

[0083] Examples of the polymer compound having an ethylenically unsaturated bond in the main chain thereof include poly-1,4-butadiene and poly-1,4-isoprene.

[0084] Examples of the polymer compound having an ethylenically unsaturated bond in the side chain thereof include a polymer compound of an ester or amide of acrylic acid or methacrylic acid, which is a polymer compound wherein the ester or amide residue (R in -COOR or -CONHR) has an ethylenically unsaturated bond.

[0085] Examples of the residue (R described above) having an ethylenically unsaturated bond include -(CH₂)_nCR¹=CR²R³, -(CH₂O)_nCH₂CR¹=CR²R³, -(CH₂CH₂O)_nCH₂CR¹=CR²R³, -(CH₂)_nNH-CO-O-CH₂CR¹=CR²R³, -(CH₂)_n-O-CO-CR¹=CR²R³ and -(CH₂CH₂O)₂-X (wherein R¹ to R³ each represents a hydrogen atom, a halogen atom or an alkyl group having from 1 to 20 carbon atoms, an aryl group, alkoxy group or aryloxy group, or R¹ and R² or R¹ and R³ may be combined with each other to form a ring. n represents an integer from 1 to 10. X represents a dicyclopentadienyl residue).

[0086] Specific examples of the ester residue include -CH₂CH=CH₂ (described in JP-B-7-21633), -CH₂CH₂O-CH₂CH=CH₂, -CH₂C(CH₃)=CH₂, -CH₂CH=CH-C₆H₅, -CH₂CH₂OCOCH=CH-C₆H₅, -CH₂CH₂-NHCOO-CH₂CH=CH₂ and -CH₂CH₂O-X (wherein X represents a dicyclopentadienyl residue).

[0087] Specific examples of the amide residue include -CH₂CH=CH₂, -CH₂CH₂-Y (wherein Y represents a cyclohexene residue) and -CH₂CH₂-OCO-CH=CH₂.

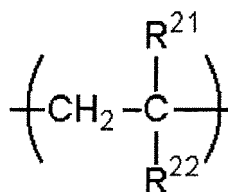
[0088] The specific polymer compound having crosslinkable property is cured, for example, by addition of a free radical (a polymerization initiating radical or a growing radical of a polymerizable compound in the process of polymerization) to the crosslinkable functional group of the polymer compound and undergoing addition polymerization between the

polymer compounds directly or through a polymerization chain of the polymerizable compound to form crosslinkage between the polymer compound molecules. Alternately, it is cured by generation of a polymer compound radical upon extraction of an atom (for example, a hydrogen atom on a carbon atom adjacent to the functional crosslinkable group) in the polymer compound by a free radical and connecting the polymer compound radicals with each other to form crosslinkage between the polymer compound molecules.

[0089] The content of the crosslinkable group (content of the radical polymerizable unsaturated double bond determined by iodine titration) in the specific polymer compound is preferably from 0.1 to 10.0 mmol, more preferably from 1.0 to 7.0 mmol, most preferably from 2.0 to 5.5 mmol, based on 1 g of the polymer compound. In the range described above, good sensitivity and good preservation stability can be obtained.

[0090] The specific polymer compound according to the invention may further contain a copolymerization component as long as the effects of the invention are not impaired, for the purpose of improving various performances, for example, image strength. As the structure of preferred copolymerization component, a structure represented by formula (2) shown below is exemplified.

Formula (2):



[0091] In formula (2), R^{21} represents a hydrogen atom or a methyl group, and R^{22} represents a substituent.

[0092] Preferred examples for R^{22} include an ester group, an amido group, a cyano group, a hydroxy group and an aryl group. Among them, an ester group, an amido group or a phenyl group which may have a substituent is preferred. Examples of the substituent for the phenyl group include an alkyl group, an aralkyl group, an alkoxy group and an acetoxymethyl group.

[0093] The copolymerization component represented by formula (2) includes, for example, an acrylate, a methacrylate, an acrylamide, a methacrylamide, an N-substituted acrylamide, an N-substituted methacrylamide, an N,N-disubstituted acrylamide, an N,N-disubstituted methacrylamide, a styrene, an acrylonitrile and a methacrylonitrile. Preferably, an acrylate, a methacrylate, an acrylamide, a methacrylamide, an N-substituted acrylamide, an N-substituted methacrylamide, an N,N-disubstituted acrylamide, an N,N-disubstituted methacrylamide and a styrene are exemplified.

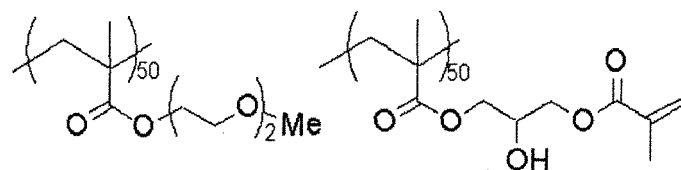
[0094] Specifically, an acrylate, for example, an alkyl acrylate (in which the alkyl group preferably has from 1 to 20 carbon atoms) (for example, methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, amyl acrylate, ethylhexyl acrylate, octyl acrylate, 2,2-dimethylhydroxypropyl acrylate, 5-hydroxypentyl acrylate, trimethylolpropane monoacrylate, pentaerythritol monoacrylate, glycidyl acrylate or benzyl acrylate) or an aryl acrylate (for example, phenyl acrylate), a methacrylate, for example, an alkyl methacrylate (in which the alkyl group preferably has from 1 to 20 carbon atoms) (for example, methyl methacrylate, ethyl methacrylate, propyl methacrylate, isopropyl methacrylate, amyl methacrylate, hexyl methacrylate, cyclohexyl methacrylate, benzyl methacrylate, octyl methacrylate, 4-hydroxybutyl methacrylate, 5-hydroxypentyl methacrylate, 2,2-dimethyl-3-hydroxypropyl methacrylate, trimethylolpropane monomethacrylate, pentaerythritol monomethacrylate or glycidyl methacrylate), a styrene, for example, styrene or an alkylstyrene (for example, methylstyrene, dimethylstyrene, trimethylstyrene, ethylstyrene, diethylstyrene, isopropylstyrene, butylstyrene, hexylstyrene, chloromethylstyrene, ethoxymethylstyrene or acetoxymethylstyrene), acrylonitrile, methacrylonitrile, and a radical polymerizable compound having a carboxylic acid (for example, acrylic acid, methacrylic acid or a salt of these acid groups) are exemplified. Acrylonitrile is more preferred from the standpoint of printing durability.

[0095] A ratio of the repeating unit containing a poly(alkylene oxide) moiety to the total repeating units constituting the specific polymer compound is not particularly restricted and is preferably from 0.5 to 80% by mole, and more preferably from 0.5 to 50% by mole.

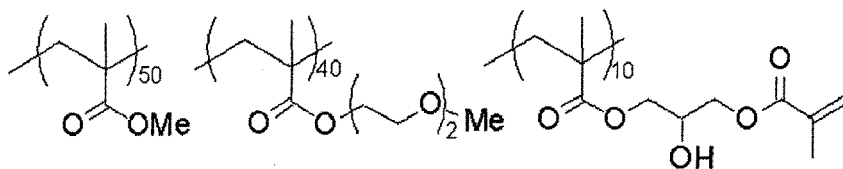
[0096] Specific examples A-1 to A-19 of the specific polymer compound for use in the invention are set forth below, but the invention should not be construed as being limited thereto. A ratio of the repeating units is indicated as a molar ratio. The weight average molecular weight (M_w) of the specific polymer compounds A-1 to A-19 is as follows:

M_w of A-1: 6.0×10^4 ,
 M_w of A-2: 6.0×10^4 ,
 M_w of A-3: 6.0×10^4 ,
 M_w of A-4: 6.0×10^4 ,
 M_w of A-5: 5.5×10^4 ,

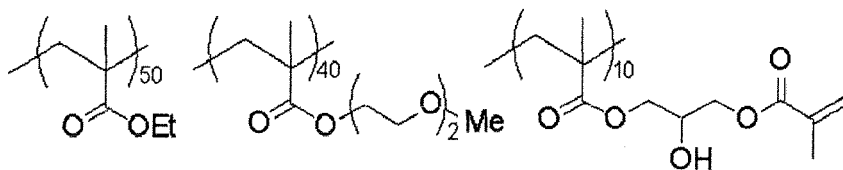
Mw of A-6: 5.5×10^4 ,
 Mw of A-7: 6.5×10^4 ,
 Mw of A-8: 6.0×10^4 ,
 Mw of A-9: 6.0×10^4 ,
 Mw of A-10: 5.0×10^4 ,
 Mw of A-11: 5.0×10^4 ,
 Mw of A-12: 5.0×10^4 ,
 Mw of A-13: 5.0×10^4 ,
 Mw of A-14: 5.0×10^4 ,
 Mw of A-15: 5.5×10^4 ,
 Mw of A-16: 6.0×10^4 ,
 Mw of A-17: 5.0×10^4 ,
 Mw of A-18: 5.0×10^4 ,
 Mw of A-19: 5.0×10^4 ,



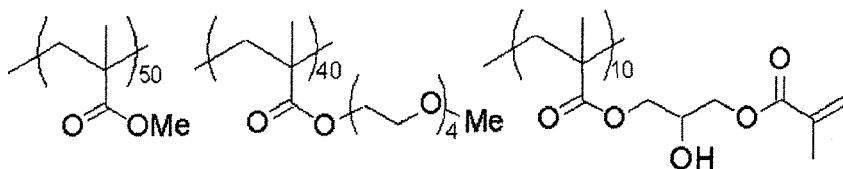
A-1



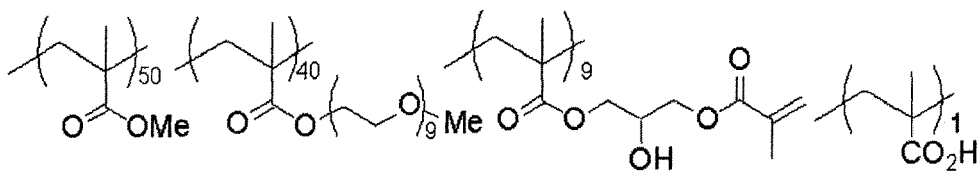
A-2



A-3

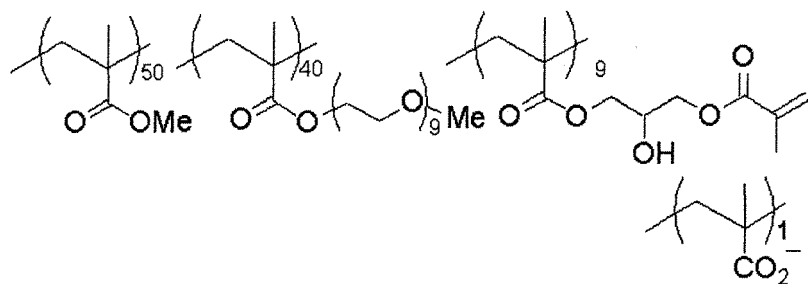


A-4



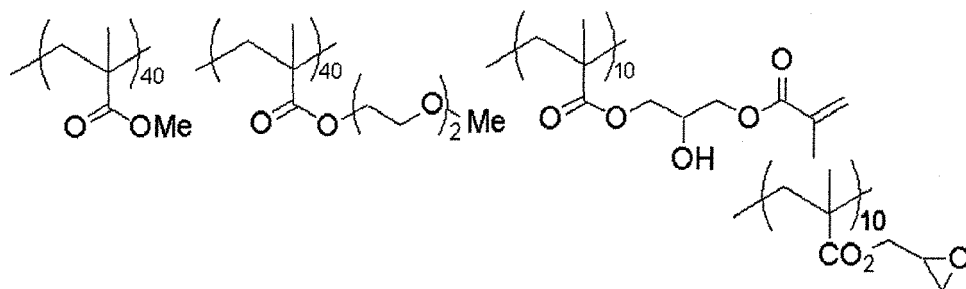
A-5

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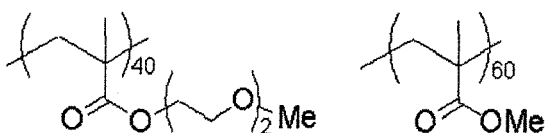
A-6

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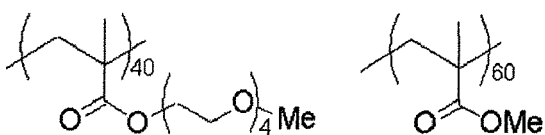
A-7

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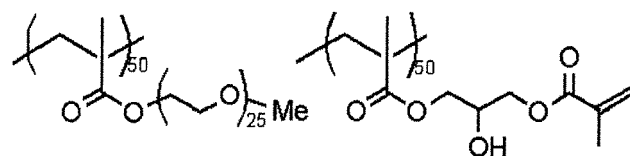
A-8

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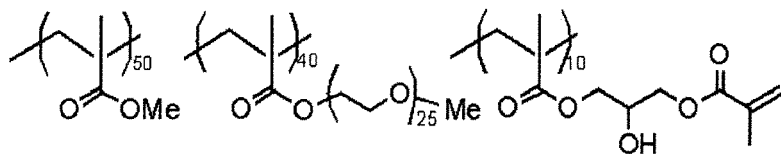
A-9

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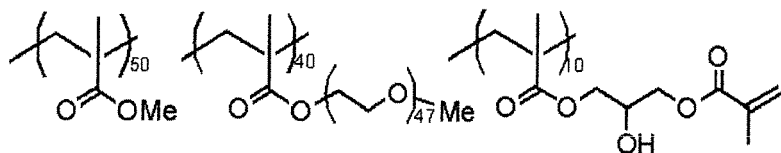
A-10

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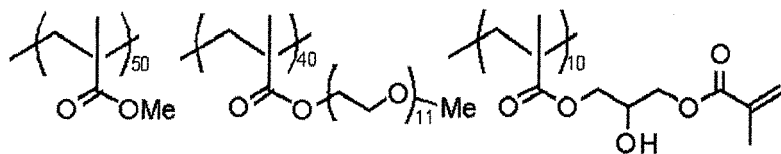
A-11

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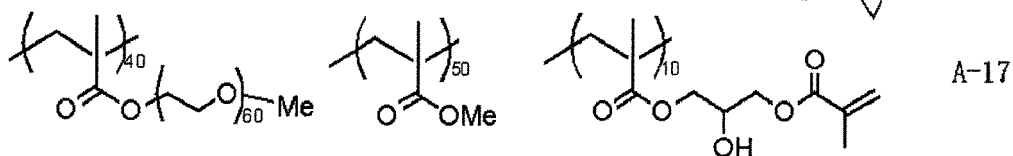
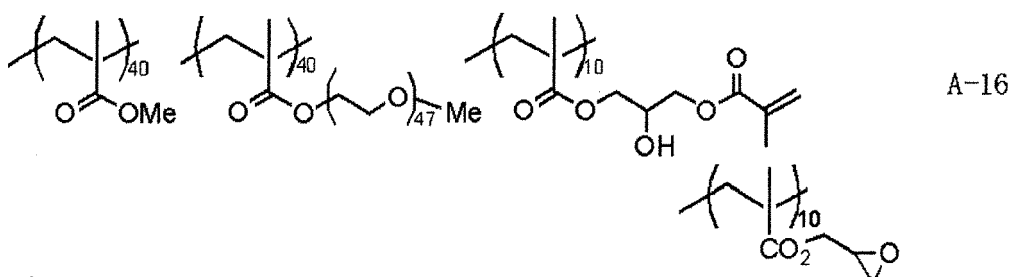
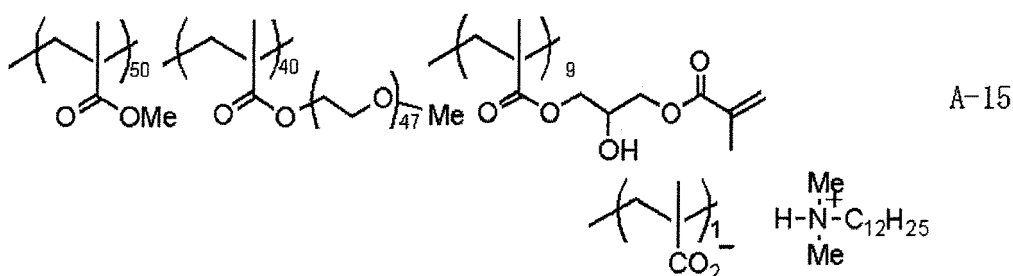
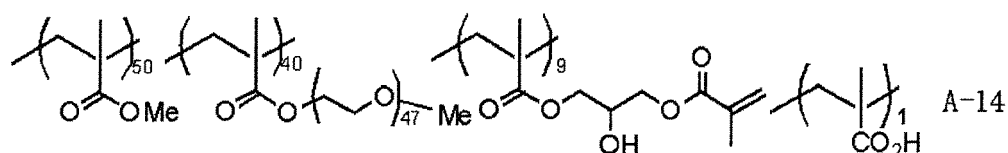
A-12

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A-13

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[0097] The weight average molecular weight (Mw) of the specific polymer compound according to the invention is preferably 2,000 or more, more preferably 5,000 or more, and still more preferably from 10,000 to 300,000.

[0098] According to the invention, a hydrophilic polymer compound, for example, polyacrylic acid or polyvinyl alcohol described in JP-A-2008-195018 may be used together, if desired. Further, an oleophilic polymer compound and a hydrophilic polymer compound may be used in combination.

[0099] As for the configuration of the specific polymer compound according to the invention, it may be present as a binder acting as a bond of each ingredient or in the form of fine particle in the image-recording layer. In the case of existing in the form of fine particle, the average particle size thereof is in a range from 10 to 1,000 nm, preferably in a range from 20 to 300 nm, and particularly preferably in a range from 30 to 120 nm.

[0100] The content of the specific polymer compound according to the invention is preferably from 10 to 80% by weight, more preferably from 15 to 70% by weight, based on the total solid content of the image-recording layer. The range from 10 to 80% by weight is preferred because both the permeability of the treating solution and image-forming property can be surely achieved.

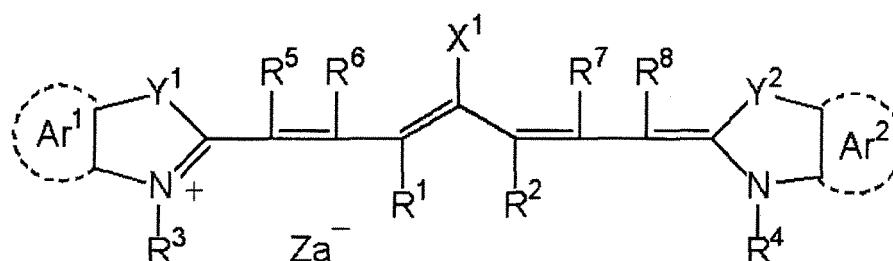
<Infrared absorbing dye>

[0101] The infrared absorbing dye has a function of converting the infrared ray absorbed to heat and a function of being excited by the infrared ray to perform electron transfer and/or energy transfer to the radical polymerization initiator described hereinafter. The infrared absorbing dye for use in the invention includes a dye having an absorption maximum in a wavelength range from 760 to 1,200 nm.

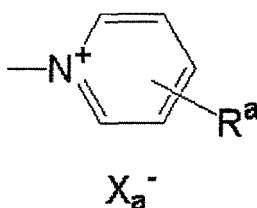
[0102] As the dye, commercially available dyes and known dyes described in literatures, for example, Senryo Binran (Dye Handbook), compiled by The Society of Synthetic Organic Chemistry, Japan (1970) can be used. Specifically, the dye includes an azo dye, a metal complex azo dye, a pyrazolone azo dye, a naphthoquinone dye, an anthraquinone dye, a phthalocyanine dye, a carbonium dye, a quinoneimine dye, a methine dye, a cyanine dye, a squarylium dye, a pyrylium salt and a metal thiolate complex.

[0103] Of the dyes, a cyanine dye, a squarylium dye, a pyrylium salt, a nickel thiolate complex or an indolenine cyanine dye is particularly preferred. A cyanine dye or an indolenine cyanine dye is more preferred. As a particularly preferred example of the dye, a cyanine dye represented by formula (a) shown below is exemplified.

Formula (a)



[0104] In formula (a), X^1 represents a hydrogen atom, a halogen atom, $-N(R^9)(R^{10})$, $-X^2-L^1$ or a group shown below. R^9 and R^{10} , which may be the same or different, each represents an aryl group having from 6 to 10 carbon atoms which may have a substituent, an alkyl group having from 1 to 8 carbon atoms which may have a substituent or a hydrogen atom, or R^9 and R^{10} may be combined with each other to form a ring. R^9 and R^{10} each preferably represents a phenyl group ($-NPh_2$). X^2 represents an oxygen atom or a sulfur atom. L^1 represents a hydrocarbon group having from 1 to 12 carbon atoms, a heteroaryl group or a hydrocarbon group having from 1 to 12 carbon atoms and containing a hetero atom. The hetero atom used herein indicates a nitrogen atom, a sulfur atom, an oxygen atom, a halogen atom or a selenium atom. In the group shown below, Xa^- has the same meaning as Za^- defined hereinafter. R^a represents a hydrogen atom or a substituent selected from an alkyl group, an aryl group, a substituted or unsubstituted amino group and a halogen atom.



[0105] R^1 and R^2 each independently represents a hydrocarbon group having from 1 to 12 carbon atoms. In view of the preservation stability of a coating solution for image-recording layer, it is preferred that R^1 and R^2 each represents a hydrocarbon group having two or more carbon atoms. Alternatively, R^1 and R^2 may be combined with each other to form a ring and in the case of forming a ring, it is particularly preferred that R^1 and R^2 are combined with each other to form a 5-membered or 6-membered ring.

[0106] Ar^1 and Ar^2 , which may be the same or different, each represents an aryl group which may have a substituent. Preferred examples of the aryl group include a benzene ring group and a naphthalene ring group. Preferred examples of the substituent include a hydrocarbon group having 12 or less carbon atoms, a halogen atom and an alkoxy group having 12 or less carbon atoms. Y^1 and Y^2 , which may be the same or different, each represents a sulfur atom or a dialkylmethylene group having 12 or less carbon atoms. R^3 and R^4 , which may be the same or different, each represents a hydrocarbon group having 20 or less carbon atoms which may have a substituent. Preferred examples of the substituent include an alkoxy group having 12 or less carbon atoms, a carboxyl group and a sulfo group. R^5 , R^6 , R^7 and R^8 , which may be the same or different, each represents a hydrogen atom or a hydrocarbon group having 12 or less carbon atoms.

In view of the availability of raw materials, a hydrogen atom is preferred. Za^- represents a counter anion. However, Za^- is not necessary when the cyanine dye represented by formula (a) has an anionic substituent in the structure thereof and neutralization of charge is not needed. Preferred examples of the counter ion for Za^- include a halide ion, a perchlorate ion, a tetrafluoroborate ion, a hexafluorophosphate ion and a sulfonate ion, and particularly preferred examples thereof include a perchlorate ion, a hexafluorophosphate ion and an arylsulfonate ion in view of the preservation stability of a coating solution for image-recording layer.

[0107] Specific examples of the cyanine dye represented by formula (a) which can be preferably used include compounds described in Paragraph Nos. [0017] to [0019] of JP-A-2001-133969, compounds described in Paragraph Nos. [0016] to [0021] of JP-A-2002-23360 and Paragraph Nos. [0012] to [0037] of JP-A-2002-40638, preferably compounds described in Paragraph Nos. [0034] to [0041] of JP-A-2002-278057 and Paragraph Nos. [0080] to [0086] of JP-A-2008-195018, and most preferably compounds described in Paragraph Nos. [0035] to [0043] of JP-A-2007-90850.

[0108] Also, compounds described in Paragraph Nos. [0008] to [0009] of JP-A-5-5005 and Paragraph Nos. [0022] to [0025] of JP-A-2001-222101 are preferably used.

[0109] The infrared absorbing dyes may be used only one kind or in combination of two or more kinds thereof, and it may also be used together with an infrared absorbing pigment other than the infrared absorbing dye. As the pigment, compounds described in Paragraph Nos. [0072] to [0076] of JP-A-2008-195018 are preferred.

[0110] The content of the infrared absorbing dye in the image-recording layer according to the invention is preferably from 0.1 to 10.0% by weight, more preferably from 0.5 to 5.0% by weight, based on the total solid content of the image-recording layer.

<Radical polymerization initiator>

[0111] The radical polymerization initiator which can be used in the invention indicates a compound which initiates or accelerates polymerization of a radical polymerizable compound. The radical polymerization initiator usable in the invention includes, for example, known thermal polymerization initiators, compounds containing a bond having small bond dissociation energy and photopolymerization initiators.

[0112] The radical polymerization initiator according to the invention include, for example, (a) an organic halide, (b) a carbonyl compound, (c) an azo compound, (d) an organic peroxide, (e) a metallocene compound, (f) an azide compound, (g) a hexaarylbiimidazole compound, (h) an organic borate compound, (i) a disulfone compound, (j) an oxime ester compound and (k) an onium salt compound.

[0113] As the organic halide (a), compounds described in Paragraph Nos. [0022] to [0023] of JP-A-2008-195018 are preferred.

[0114] As the carbonyl compound (b), compounds described in Paragraph No. [0024] of JP-A-2008-195018 are preferred.

[0115] As the azo compound (c), for example, azo compounds described in JP-A-8-108621 can be used.

[0116] As the organic peroxide (d), for example, compounds described in Paragraph No. [0025] of JP-A-2008-195018 are preferred.

[0117] As the metallocene compound (e), for example, compounds described in Paragraph No. [0026] of JP-A-2008-195018 are preferred.

[0118] As the azide compound (f), a compound, for example, 2,6-bis(4-azidobenzylidene)-4-methylcyclohexanone is exemplified.

[0119] As the hexaarylbiimidazole compound (g), for example, compounds described in Paragraph No. [0027] of JP-A-2008-195018 are preferred.

[0120] As the organic borate compound (h), for example, compounds described in Paragraph No. [0028] of JP-A-2008-195018 are preferred.

[0121] As the disulfone compound (i), for example, compounds described in JP-A-61-166544 are exemplified.

[0122] As the oxime ester compound (j), for example, compounds described in Paragraph Nos. [0028] to [0030] of JP-A-2008-195018 are preferred.

[0123] As the onium salt compound (k), onium salts, for example, diazonium salts described in S. I. Schlesinger, Photogr. Sci. Eng., 18, 387 (1974), T. S. Bal et al., Polymer, 21, 423 (1980) and JP-A-5-158230, ammonium salts described in U.S. Patent 4,069,055 and JP-A-4-365049, phosphonium salts described in U.S. Patents 4,069,055 and 4,069,056, iodonium salts described in European Patent 104,143, U.S. Patent Publication No. 2008/0311520, JP-A-2-150848, JP-A-2008-195018 and J. V. Crivello et al., Macromolecules, 10 (6), 1307 (1977), sulfonium salts described in European Patents 370,693, 233,567, 297,443 and 297,442, U.S. Patents 4,933,377, 4,760,013, 4,734,444 and 2,833,827 and German Patents 2,904,626, 3,604,580 and 3,604,581, selenonium salts described in J. V. Crivello et al., J. Polymer Sci., Polymer Chem. Ed., 17,1047 (1979), arsonium salts described in C. S. Wen et al., Teh, Proc. Conf. kad. Curing ASIA, p. 478, Tokyo, Oct. (1988), and azinium salts described in JP-A-2008-195018 are exemplified.

[0124] Of the radical polymerization initiators described above, the onium salt, in particular, the iodonium salt, the

sulfonium salt or the azinium salt is more preferred. Specific examples of these compounds are set forth below, but the invention should not be construed as being limited thereto.

[0125] Of the iodonium salts, a diphenyliodonium salt is preferred. In particular, a diphenyliodonium salt substituted with an electron donating group, for example, an alkyl group or an alkoxy group is preferred, and an asymmetric diphenyliodonium salt is more preferred. Specific examples of the iodonium salt include diphenyliodonium hexafluorophosphate, 4-methoxyphenyl-4-(2-methylpropyl)phenyliodonium hexafluorophosphate, 4-(2-methylpropyl)phenyl-p-tolyl-
 5 iodonium hexafluorophosphate, 4-hexyloxyphenyl-2,4,6-trimethoxyphenyliodonium hexafluorophosphate, 4-hexyloxyphenyl-2,4-diethoxyphenyliodonium tetrafluoroborate, 4-octyloxyphenyl-2,4,6-trimethoxyphenyliodonium 1-perfluorobutanesulfonate, 4-octyloxyphenyl-2,4,6-trimethoxyphenyliodonium hexafluorophosphate and bis(4-tert-butylphenyl)io-
 10 dorium tetraphenylborate.

[0126] Examples of the sulfonium salt include triphenylsulfonium hexafluorophosphate, triphenylsulfonium benzoylformate, bis(4-chlorophenyl)phenylsulfonium benzoylformate, bis(4-chlorophenyl)-4-methylphenylsulfonium tetrafluoroborate, tris(4-chlorophenyl)sulfonium 3,5-bis(methoxycarbonyl)benzenesulfonate and iris(4-chlorophenyl)sulfonium hexafluorophosphate.

[0127] Examples of the azinium salt include 1-cyclohexylmethyloxypyridinium hexafluorophosphate, 1-cyclohexyloxy-4-phenylpyridinium hexafluorophosphate, 1-ethoxy-4-phenylpyridinium hexafluorophosphate, 1-(2-ethylhexyloxy)-4-phenylpyridinium hexafluorophosphate, 4-chloro-1-cyclohexylmethyloxypyridinium hexafluorophosphate, 1-ethoxy-4-cyanopyridinium hexafluorophosphate, 3,4-dichloro-1-(2-ethylhexyloxy)pyridinium hexafluorophosphate, 1-benzyloxy-4-phenylpyridinium hexafluorophosphate, 1-phenethyloxy-4-phenylpyridinium hexafluorophosphate, 1-(2-ethylhexyloxy)-4-phenylpyridinium p-toluenesulfonate, 1-(2-ethylhexyloxy)-4-phenylpyridinium perfluorobutanesulfonate, 1-(2-ethylhexyloxy)-4-phenylpyridinium bromide and 1-(2-ethylhexyloxy)-4-phenylpyridinium tetrafluoroborate.

[0128] The radical polymerization initiator can be added preferably in an amount from 0.1 to 50% by weight, more preferably from 0.5 to 30% by weight, particularly preferably from 0.8 to 20% by weight, based on the total solid content of the image-recording layer. In the range described above, good sensitivity and good stain resistance in the non-image
 25 area at the time of printing are obtained.

<Radical polymerizable compound>

[0129] The radical polymerizable compound which can be used in the invention is an addition-polymerizable compound having at least one ethylenically unsaturated double bond and it is selected from compounds having at least one, preferably two or more, terminal ethylenically unsaturated double bonds. The radical polymerizable compound has a chemical form, for example, a monomer, a prepolymer, specifically, a dimer, a trimer or an oligomer, or a mixture thereof

[0130] Examples of the monomer include an unsaturated carboxylic acid (for example, acrylic acid, methacrylic acid, itaconic acid, crotonic acid, isocrotonic acid or maleic acid) and an ester or amide thereof. Preferably, an ester of an unsaturated carboxylic acid with a polyhydric alcohol compound and an amide of an unsaturated carboxylic acid with a polyvalent amine compound are used. An addition reaction product of an unsaturated carboxylic acid ester or amide having a nucleophilic substituent, for example, a hydroxy group, an amino group or a mercapto group, with a monofunctional or polyfunctional isocyanate or epoxy compound, or a dehydration condensation reaction product of an unsaturated carboxylic acid ester or amide with a monofunctional or polyfunctional carboxylic acid is also preferably used. Moreover,
 40 an addition reaction product of an unsaturated carboxylic acid ester or amide having an electrophilic substituent, for example, an isocyanate group or an epoxy group with a monofunctional or polyfunctional alcohol, amine or thiol, or a substitution reaction product of an unsaturated carboxylic acid ester or amide having a releasable substituent, for example, a halogen group or a tosyloxy group with a monofunctional or polyfunctional alcohol, amine or thiol is also preferably used.

[0131] In addition, compounds in which the unsaturated carboxylic acid described above is replaced by an unsaturated phosphonic acid, styrene, vinyl ether or the like can also be used. These compounds are described in references including JP-T-2006-508380 (the term "JP-T" as used herein means a published Japanese translation of a PCT patent application), JP-A-2002-287344, JP-A-2008-256850, JP-A-2001-342222, JP-A-9-179296, JP-A-9-179297, JP-A-9-179298, JP-A-2004-294935, JP-A-2006-243493, JP-A-2002-275129, JP-A-2003-64130, JP-A-2003-280187 and JP-A-10-333321.

[0132] Specific examples of the monomer, which is an ester of a polyhydric alcohol compound with an unsaturated carboxylic acid, include, as an acrylic acid ester, for example, ethylene glycol diacrylate, 1,3-butanediol diacrylate, tetramethylene glycol diacrylate, propylene glycol diacrylate, trimethylolpropane triacrylate, hexanediol diacrylate, tetra-
 50 ethylene glycol diacrylate, pentaerythritol tetraacrylate, sorbitol triacrylate, isocyanuric acid ethylene oxide (EO) modified triacrylate and polyester acrylate oligomer. As a methacrylic acid ester, for example, tetramethylene glycol dimethacrylate, neopentyl glycol dimethacrylate, trimethylolpropane trimethacrylate, ethylene glycol dimethacrylate, pentaerythritol trimethacrylate, bis[p-(3-methacryloxy-2-hydroxypropoxy)phenyl]dimethylmethane and bis[p-(methacryloxyethoxy)phenyl]dimethylmethane are exemplified. Specific examples of the monomer, which is an amide of a polyvalent amine compound with an unsaturated carboxylic acid, include methylene bisacrylamide, methylene bismethacrylamide, 1,6-hexamethylene bisacrylamide, 1,6-hexamethylene bismethacrylamide, diethylenetriamine trisacrylamide, xylylene

bisacrylamide and xylene bismethacrylamide.

[0133] Urethane type addition-polymerizable compounds produced using an addition reaction between an isocyanate and a hydroxy group are also preferably used and specific examples thereof include vinylurethane compounds having two or more polymerizable vinyl groups per molecule obtained by adding a vinyl monomer containing a hydroxy group represented by formula (b) shown below to a polyisocyanate compound having two or more isocyanate groups per molecule, described in JP-B-48-41708.



wherein R^4 and R^5 each independently represents H or CH_3 .

[0134] Also, urethane acrylates as described in JP-A-51-37193, JP-B-2-32293, JP-B-2-16765, JP-A-2003-344997 and JP-A-2006-65210, urethane compounds having an ethylene oxide skeleton described in JP-B-58-49860, JP-B-56-17654, JP-B-62-39417, JP-B-62-39418, JP-A-2000-250211 and JP-A-2007-94138, and urethane compounds having a hydrophilic group described in U.S. Patent 7,153,632, JP-T-8-505958, JP-A-2007-293221 and JP-A-2007-293223 are preferably used.

[0135] Of the compounds described above, an isocyanuric acid ethyleneoxide-modified acrylate, for example, tris(acryloyloxyethyl) isocyanurate or bis(acryloyloxyethyl) hydroxyethyl isocyanurate is particularly preferred from the standpoint of excellent balance between hydrophilicity relating to the on-press development property and polymerization ability relating to the printing durability.

[0136] Details of the method of using the radical polymerizable compound, for example, selection of the structure, individual or combination use or an amount added, can be appropriately determined in accordance with the characteristic design of the final lithographic printing plate precursor. The radical polymerizable compound is used preferably in a range from 5 to 75% by weight, more preferably in a range from 10 to 70% by weight, particularly preferably in a range from 15 to 60% by weight, based on the total solid content of the image-recording layer.

<Anionic or nonionic surfactant>

[0137] The surfactant which can be incorporated into the image-recording layer according to the invention is at least one of an anionic surfactant and a nonionic surfactant.

[0138] The anionic surfactant and nonionic surfactant are same as those described for the treating solution above.

[0139] Of the surfactants, it is preferred to use the same kind of surfactant as that contained in the treating solution, and it is more preferred to use the surfactant having the same structure as that contained in the treating solution. Specifically, in case of using an anionic surfactant in the treating solution, it is preferred to incorporate an anionic surfactant into the image-recording layer, and in case of using a nonionic surfactant in the treating solution, it is preferred to incorporate a nonionic surfactant into the image-recording layer.

[0140] The anionic surfactant is particularly preferably used because of high acceleration effect on on-press development. The surfactants may be used in combination of two or more. For instance, it is preferred to use in combination two or more anionic surfactants different from each other or to use in combination of an anionic surfactant and a nonionic surfactant.

<Polymer compound having star-like shape (star-like polymer compound)>

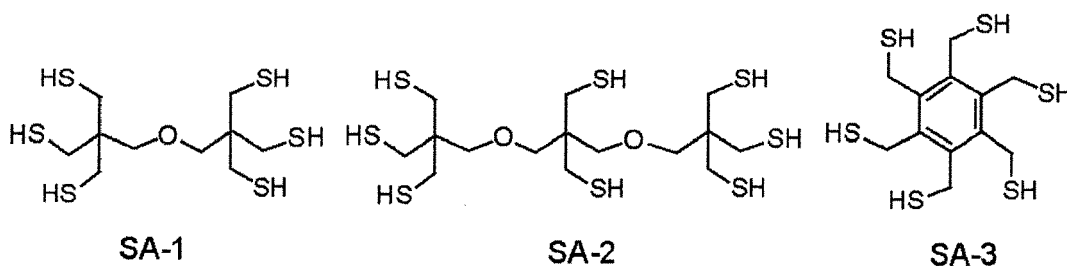
[0141] The image-recording layer may also contain a polymer compound which has a polyfunctional thiol having from 6 to 10 functional groups, as a nucleus and polymer chains connected to the nucleus through a sulfide bond, and in which the polymer chains have a polymerizable group (hereinafter, also referred to as a polymer compound having a star-like shape or a star-like polymer compound).

[0142] As the polyfunctional thiol having from 6 to 10 functional groups which is use as the nucleus in the star-like polymer compound, any compound having from 6 to 10 thiol groups in its molecule is suitably used. The polyfunctional thiol compound includes the compounds described below.

(Compound A)

[0143] Compound obtained by a method of reacting a sulfuration agent, for example, thiourea, potassium thiocyanate or thioacetic acid with an electrophilic agent, for example, a halide or a sulfonic acid ester of an alcohol, followed by various treatments.

[0144] Specific examples of Compound A include compounds set forth below, but the invention should not be construed as being limited thereto.



(Compound B)

[0145] Compound obtained by a dehydration condensation reaction between a polyfunctional alcohol and a carboxylic acid having a thiol group.

[0146] Of the compounds, a compound obtained by a dehydration condensation reaction between a polyfunctional alcohol having from 3 to 10 functional groups and a carboxylic acid having one thiol group is preferred. A method wherein a polyfunctional alcohol and a carboxylic acid having a protected thiol group are subjected to a dehydration condensation reaction, followed by a deprotection reaction may also be used.

[0147] Specific examples of the polyfunctional alcohol include pentaerythritol, dipentaerythritol, tripentaerythritol, sorbitol, mannitol, iditol, dulcitol and inositol. Dipentaerythritol, tripentaerythritol and sorbitol are preferred, and dipentaerythritol and tripentaerythritol are particularly preferred.

[0148] Specific examples of the carboxylic acid having a thiol group include Mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine, N-(2-mercaptopropionyl)glycine and thiosalicylic acid. Mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are preferred, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are more preferred, and 3-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are particularly preferred.

[0149] Specific examples of Compound B include compounds shown in Table 1 below, but the invention should not be construed as being limited thereto.

TABLE 1: Specific Examples of Compound B

Polyfunctional Alcohol	Carboxylic Acid Having Thiol Group				
	Mercaptoacetic Acid	3-Mercaptopropionic Acid	2-Mercaptopropionic Acid	N-Acetylcysteine	N-(2-Mercaptopropionyl)glycine
Dipentaerythritol	SB-1	SB-2	SB-3	SB-4	SB-5
Tripentaerythritol	SB-7	SB-8	SB-9	SB-10	SB-11
Sorbitol	SB-13	SB-14	SB-15	SB-16	SB-17
Mannitol	SB-19	SB-20	SB-21	SB-22	SB-23
Iditol	SB-25	SB-26	SB-27	SB-28	SB-29
Dulcitol	SB-31	SB-32	SB-33	SB-34	SB-35
Inositol	SB-37	SB-38	SB-39	SB-40	SB-41
					SB-42
					SB-36
					SB-30
					SB-24
					SB-18
					SB-12
					SB-6
					Thiosalicylic Acid

[0150] Of the specific examples shown above, SB-1 to SB-23, SB-25 to SB-29, SB-31 to SB-35 and SB-37 to SB-41 are preferred, SB-2 to SB-5, SB-8 to SB-11 and SB-14 to SB-17 are more preferred, and SB-2, SB-4, SB-5, SB-8, SB-10 and SB-11 are particularly preferred. Since the polyfunctional thiols synthesized from these compounds have a long distance between the thiol groups and a small steric hindrance, the desired star structure can be formed.

(Compound C)

[0151] Compound obtained by a dehydration condensation reaction between a polyfunctional amine and a carboxylic acid having a thiol group.

[0152] Of the compounds, a compound obtained by a dehydration condensation reaction between a polyfunctional amine having from 6 to 10 functional groups and a carboxylic acid having one thiol group is preferred. A method wherein a polyfunctional amine and a carboxylic acid having a protected thiol group are subjected to a dehydration condensation reaction, followed by a deprotection reaction may also be used.

[0153] Specific examples of the polyfunctional amine include pentaethylenhexamine. Specific examples of the carboxylic acid having a thiol group include mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine, N-(2-mercaptopropionyl)glycine and thiosalicylic acid. Mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are preferred, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are more preferred, and 3-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are particularly preferred.

[0154] Specific examples of Compound C include compounds shown in Table 2 below, but the invention should not be construed as being limited thereto.

TABLE 2: Specific Examples of Compound C

Polyfunctional Amine	Carboxylic Acid Having Thiol Group					
	Mercaptoacetic Acid	3-Mercaptopropionic Acid	2-Mercaptopropionic Acid	N-Acetylcysteine	N-(2-Mercaptopropionyl)glycine	Thiosalicylic Acid
Pentaethylenhexamine	SC-1	SC-2	SC-3	SC-4	SC-5	SC-6

[0155] Of the specific examples shown above, SC-1 to SC-5 are preferred, SC-2 to SC-5 are more preferred, and SC-2, SC-4 and SC-5 are particularly preferred. Since the polyfunctional thiols synthesized from these compounds have a long distance between the thiol groups and a small steric hindrance, the desired star structure can be formed.

(Compound D)

[0156] Compound obtained by a dehydration condensation reaction between a compound having a hydroxy group and an amino group and a carboxylic acid having a thiol group.

[0157] Of the compounds, a compound obtained by a dehydration condensation reaction between a polyfunctional alcoholamine having from 6 to 10 functional groups and a carboxylic acid having one thiol group is preferred. A method wherein a polyfunctional alcoholamine and a carboxylic acid having a protected thiol group are subjected to a dehydration condensation reaction, followed by a deprotection reaction may also be used.

[0158] Specific examples of the polyfunctional alcoholamine include 1,3-bis[tris(hydroxymethyl)methylamino]propane, 1-amino-1-deoxy-D-sorbitol and N-methyl-D-glucamine. 1,3-Bis[tris(hydroxymethyl)methylamino]propane and 1-amino-1-deoxy-D-sorbitol are preferred, and 1,3-Bis[tris(hydroxymethyl)methylamino]propane is particularly preferred. Specific examples of the carboxylic acid having a thiol group include mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine, N-(2-mercaptopropionyl)glycine and thiosalicylic acid. Mercaptoacetic acid, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are preferred, 3-mercaptopropionic acid, 2-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are more preferred, and 3-mercaptopropionic acid, N-acetylcysteine and N-(2-mercaptopropionyl)glycine are particularly preferred.

[0159] Specific examples of Compound D include compounds shown in Table 3 below, but the invention should not be construed as being limited thereto.

TABLE 3: Specific Examples of Compound D

Polyfunctional Alcoholamine	Carboxylic Acid Having Thiol Group				
	Mercaptoacetic Acid	3-Mercaptopropionic Acid	2-Mercaptopropionic Acid	N-Acetylcysteine	N-(2-Mercaptopropionyl)glycine
1,3-Bis[tris(hydroxymethyl)methylamino]propane	SD-1	SD-2	SD-3	SD-4	SD-5
1-Amino-1-deoxy-D-sorbitol	SD-7	SD-8	SD-9	SD-10	SD-11
N-Methyl-D-glucamine	SD-13	SD-14	SD-15	SD-16	SD-17
					SD-18
					SD-6
					SD-12
					SD-18

[0160] Of the specific examples shown above, SD-1 to SD-17 are preferred, SD-2 to SD-5 and SD-8 to SD-11 are more preferred, and SD-2, SD-4 and SD-5 are particularly preferred. Since the polyfunctional thiols synthesized from these compounds have a long distance between the thiol groups and a small steric hindrance, the desired star structure can be formed.

(Compound E)

[0161] Compound obtained by a dehydration condensation reaction between a polyfunctional carboxylic acid and an alcohol having a thiol group.

[0162] Of the compounds, a compound obtained by a dehydration condensation reaction between a polyfunctional carboxylic acid having from 3 to 10 functional groups and an alcohol having one or more thiol groups is preferred. A method wherein a polyfunctional carboxylic acid and an alcohol having a protected thiol group are subjected to a dehydration condensation reaction, followed by a deprotection reaction may also be used.

[0163] Specific examples of the polyfunctional carboxylic acid include aconitic acid, citric acid, tetrahydrofuran-2,3,4,5-tetracarboxylic acid, 2,2',2'',2'''-[1,2-ethanediylidene]tetrakis(thio)tetraakisacetic acid, 1,3,5-cyclohexanetricarboxylic acid, 1,2,3,4-cyclobutanetetracarboxylic acid and 1,2,3,4,5,6-cyclohexanehexacarboxylic acid. Citric acid, tetrahydrofuran-2,3,4,5-tetracarboxylic acid, 1,3,5-cyclohexanetricarboxylic acid, 1,2,3,4-cyclobutanetetracarboxylic acid and 1,2,3,4,5,6-cyclohexanehexacarboxylic acid are preferred, and citric acid, 1,3,5-cyclohexanetricarboxylic acid, 1,2,3,4-cyclobutanetetracarboxylic acid and 1,2,3,4,5,6-cyclohexanehexacarboxylic acid are particularly preferred. Specific examples of the alcohol having a thiol group include 2-mercaptoethanol, 1-mercapto-2-propanol, 3-mercapto-1-propanol, 3-mercapto-2-butanol and 2,3-dimercapto-1-propanol. 2-Mercaptoethanol, 3-mercapto-1-propanol and 2,3-dimercapto-1-propanol are preferred, 2-mercaptoethanol and 3-mercapto-1-propanol are more preferred, and 3-mercapto-1-propanol is particularly preferred.

[0164] Specific examples of Compound E include compounds shown in Table 4 below, but the invention should not be construed as being limited thereto.

TABLE 4: Specific Examples of Compound E

Polyfunctional Carboxylic Acid	Alcohol Having Thiol Group				
	2-Mercaptaethanol	1-Mercapto-2-propanol	3-Mercapto-1-propanol	3-Mercapto-2-butanol	2,3-Dimercapto-1-propanol
Aconitic acid	--	--	--	--	SE-1
Citric acid	--	--	--	--	SE-2
Tetrahydrofuran-2,3,4,5-tetracarboxylic acid	--	--	--	--	SE-3
2,2',2'',2'''-[1,2-Ethanedithiylidenetetraakis(thio)]tetraacetic acid	--	--	--	--	SE-4
1,3,5-Cyclohexanetricarboxylic acid	--	--	--	--	SE-5
1,2,3,4-Cyclobutanetetracarboxylic acid	--	--	--	--	SE-6
1,2,3,4,5,6-Cyclohexanexacarboxylic acid	SE-7	SE-8	SE-9	SE-10	--

[0165] Of the specific examples shown above, SE-2, SE-3, SE-5 and SE-6 to SE-10 are preferred, SE-7 and SE-9 are more preferred, and SE-9 is particularly preferred. Since the polyfunctional thiols synthesized from these compounds have a long distance between the thiol groups and a small steric hindrance, the desired star structure can be formed.

5 (Compound F)

[0166] Compound obtained by a dehydration condensation reaction between a multifunctional carboxylic acid and an amine having a thiol group.

10 [0167] Of the compounds, a compound obtained by a dehydration condensation reaction between a polyfunctional carboxylic acid having from 3 to 10 functional groups and an amine having one or more thiol groups is preferred. A method wherein a polyfunctional carboxylic acid and an amine having a protected thiol group are subjected to a dehydration condensation reaction, followed by a deprotection reaction may also be used.

[0168] Specific examples of Compound F include condensation reaction product (SF-1) between 1,2,3,4,5,6-cyclohexanehexacarboxylic acid and 2-aminoethanethiol.

15 [0169] For instance, in order to obtain Compounds B to F each having the same number of thiol groups as that of the functional groups in the polyfunctional alcohol, polyfunctional amine, polyfunctional alcoholamine or polyfunctional carboxylic acid from which Compounds B to F are prepared respectively, it is preferred that the starting materials are so prepared to react that equivalent number β of a carboxyl group, hydroxy group or an amino group which is involved in the reaction in a carboxylic acid having one thiol group and one carboxyl group, an alcohol having one thiol group and one hydroxy group or an amine having one thiol group and one amino group is same as or more than equivalent number α of a hydroxy group, an amino group or a carboxyl group which is involved in the reaction in the polyfunctional alcohol, polyfunctional amine, polyfunctional alcoholamine or polyfunctional carboxylic acid.

20 [0170] For example, Compound SB-1 can be obtained by preparing to react 6 moles or more, preferably 7 moles or more, of mercaptoacetic acid (6 equivalent or more, preferably 7 equivalent or more, in terms of equivalent number of the carboxyl group) relative to one mole of dipentaerythritol (6 equivalent in terms of equivalent number of the hydroxy group).

[0171] Of the polyfunctional thiols, from the standpoint of printing durability and development property, Compound A to Compound E are preferred, Compound A, Compound B, Compound D and Compound E are more preferred, and Compound A, Compound B and Compound D are particularly preferred.

30 [0172] The star-like polymer compound for use in the invention is a polymer compound which has a polyfunctional thiol as described above, as a nucleus and polymer chains connected to the nucleus through a sulfide bond, and in which the polymer chains have a polymerizable group. The polymer chain in the star-like polymer compound according to the invention includes a polymer chain of a known vinyl polymer, (meth)acrylic acid polymer or styrene polymer, which can be produced by radical polymerization from a vinyl monomer, a (meth)acrylic monomer and a styrene monomer respectively, and a polymer chain of (meth)acrylic acid polymer is particularly preferred.

35 [0173] The star-like polymer compound for use in the invention includes that having a polymerizable group, for example, an ethylenically unsaturated bond for increasing film strength of the image area as described in JP-A-2008-195018 in its main chain or side chain, preferably in its side chain. By the polymerizable groups, crosslinkage is formed between the polymer molecules to accelerate curing.

40 [0174] As the polymerizable group, an ethylenically unsaturated group, for example, a (meth)acryl group, a vinyl group, an allyl group or a styryl group or an epoxy group is preferred, a (meth)acryl group, a vinyl group or a styryl group is more preferred in view of polymerization reactivity, and a (meth)acryl group is particularly preferred. The polymerizable group can be introduced into the polymer by a polymer reaction or copolymerization. For example, a reaction between a polymer having a carboxyl group in its side chain and glycidyl methacrylate or a reaction between a polymer having an epoxy group and a carboxylic acid containing an ethylenically unsaturated group, for example, methacrylic acid may be utilized. The polymerizable groups may be used in combination.

[0175] The content of the polymerizable group in the star-like polymer compound is preferably from 0.1 to 10.0 mmol, more preferably from 0.25 to 7.0 mmol, most preferably from 0.5 to 5.5 mmol, per g of the star-like polymer compound.

50 [0176] Also, the star-like polymer compound according to the invention preferably further has a hydrophilic group. The hydrophilic group contributes to impart on-press development property to the image-recording layer. In particular, by coexisting of the polymerizable group and hydrophilic group, it is possible to achieve a good balance between the printing durability and the development property.

[0177] Examples of the hydrophilic group include $-\text{SO}_3\text{M}^1$, $-\text{OH}$, $-\text{CONR}^1\text{R}^2$ (M^1 represents a hydrogen atom, a metal ion, an ammonium ion or a phosphonium ion, and R^1 and R^2 each independently represents a hydrogen atom, an alkyl group, an alkenyl group or an aryl group, or R^1 and R^2 may be combined with each other to form a ring), $-\text{N}^+\text{R}^3\text{R}^4\text{R}^5\text{X}^-$ (R^3 to R^5 each independently represents an alkyl group having from 1 to 8 carbon atoms, and X^- represent a counter anion), a group represented by formula (1) shown below and a group represented by formula (2) shown below.

Formula (1): $-(\text{CH}_2\text{CH}_2\text{O})_n\text{R}$

Formula (2): $-(C_3H_6O)_mR$

[0178] In the formulae above, n and m each independently represents an integer from 1 to 100, R each independently represents a hydrogen atom or an alkyl group having from 1 to 18 carbon atoms.

[0179] When the star-like polymer compound is a star-like polymer compound having a polyoxyalkylene chain (for example, the group represented by formula (1) or (2)) in its side chain, such a star-like polymer compound is also the specific polymer compound according to the invention.

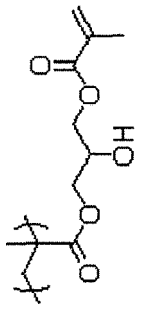
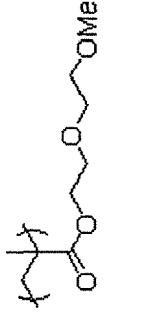
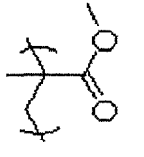
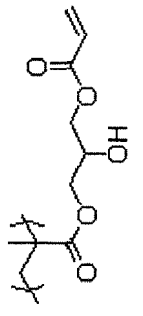
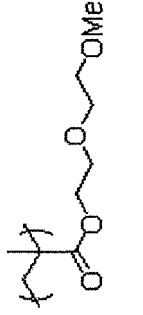
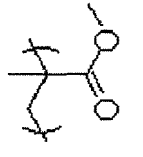
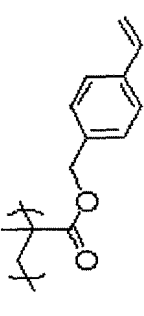
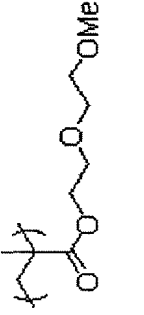
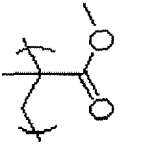
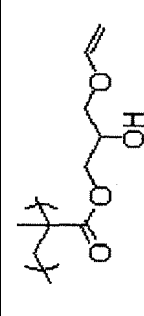
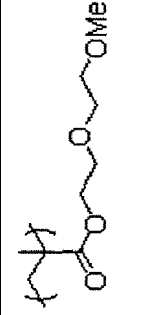
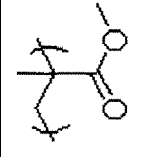
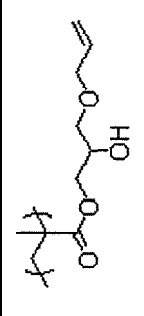
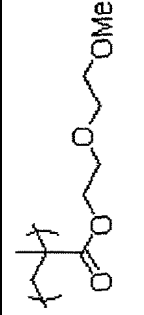
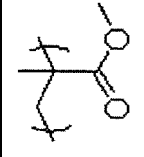
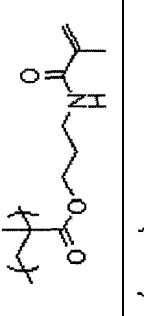
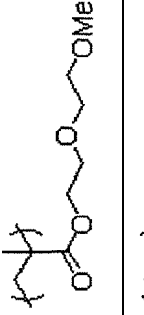
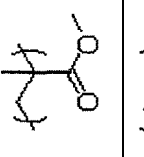
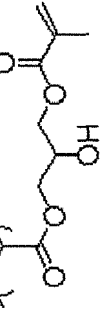
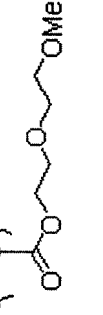
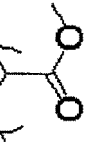
[0180] Of the hydrophilic groups, $-\text{CONR}^1\text{R}^2$, the group represented by formula (1) and the group represented by formula (2) are preferred, $-\text{CONR}^1\text{R}^2$ and the group represented by formula (1) are more preferred, and the group represented by formula (1) is particularly preferred. Further, of the groups represented by formula (1), n is preferably from 1 to 10, and particularly preferably from 1 to 4. R is preferably a hydrogen atom or an alkyl group having from 1 to 4 carbon atoms, and particularly preferably a hydrogen atom or a methyl group. The hydrophilic groups may be used in combination of two or more thereof.

[0181] The star-like polymer compound according to the invention preferably does not substantially have a carboxylic acid group, a phosphoric acid group and a phosphonic acid group. More specifically, the content of the acid group is preferably less than 0.1 mmol/g, more preferably less than 0.05 mmol/g, and particularly preferably less than 0.03 mmol/g. When the content of the acid group is less than 0.1 mmol/g, the development property is more improved.

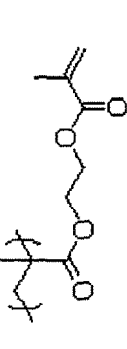
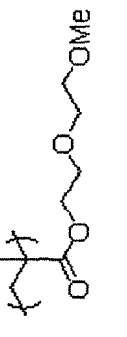
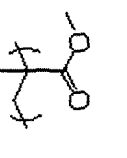
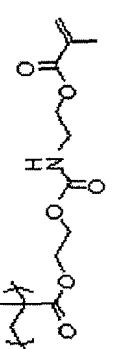
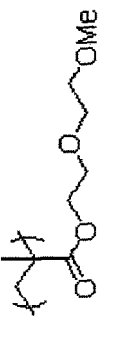
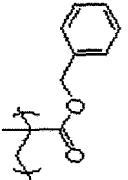
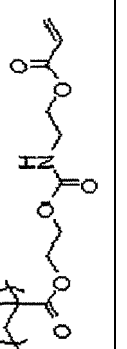
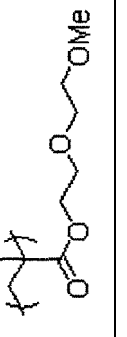
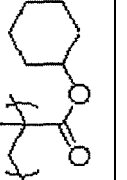
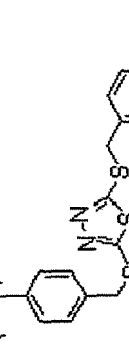
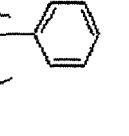
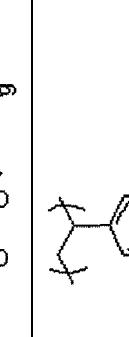
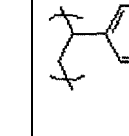
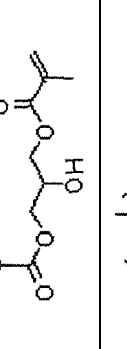
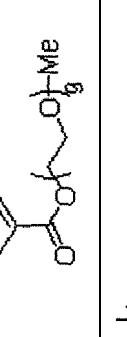
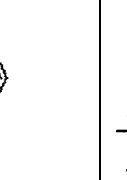
[0182] Further, an oleophilic group, for example, an alkyl group, an aryl group, an aralkyl group or an alkenyl group may be introduced into the star-like polymer compound according to the invention in order to regulate ink receptivity. Specifically, an oleophilic group-containing monomer, for example, an alkyl methacrylate may be copolymerized.

[0183] Specific examples of the star-like polymer compound according to the invention are set forth below, but the invention should not be construed as being limited thereto.

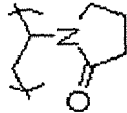
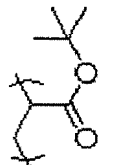
TABLE 5

Polymer No.	Central Nucleus		Polymer Chain						Mw (× 10 ⁴)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	%by Mole	Other Repeating Unit	% by Mole	
P-1	SB-2	1		10		40		50	6.5
P-2	SB-2	1		10		40		50	6.4
P-3	SB-2	1		10		40		50	6.2
P-4	SB-2	1		10		40		50	6.6
P-5	SB-2	1		10		40		50	6.7
P-6	SB-2	1		10		40		50	6.9
P-7	SB-2	1		10		40		50	6.1

(continued)

Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-8	SB-2	1		10		40		50	7.1
P-9	SB-2	1		10		50		40	6.6
P-10	SB-2	1		10		50		40	6.2
P-11	SB-2	1		10		60		30	5.8
P-12	SB-2	1		10		60		30	5.7
P-13	SB-2	1		10		50		40	7.8

(continued)

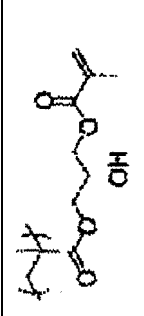
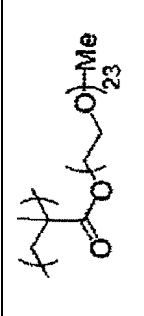
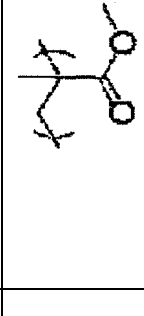
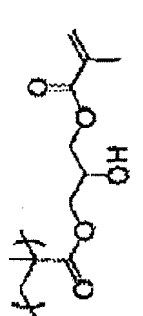
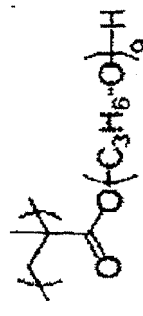
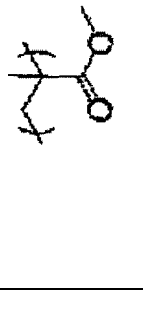
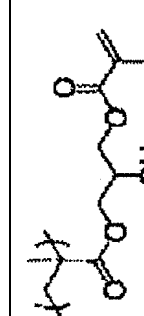
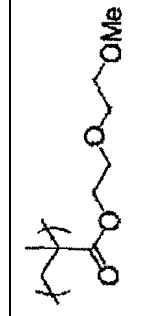
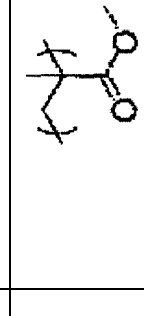
Polymer No.	Central Nucleus		Polymer Chain					Mw (× 10 ⁴)	
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	%by Mole	Other Repeating Unit		% by Mole
P-14	SB-2	1		10		40		50	7.0

*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.

TABLE 6

Polymer No.	Central Nucleus		Polymer Chain						Mw (x 10 ⁴)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	%by Mole	
P-15	SB-2	1		5		8		87	6.3
P-16	SB-2	1		5		6		89	6.4
P-17	SB-2	1		5		10		85	6.1
P-18	SB-2	1		5		5		90	5.9
P-19	SB-2	1		5		26		69	7.2
P-20	SB-2	1		5		12		83	7.1

(continued)

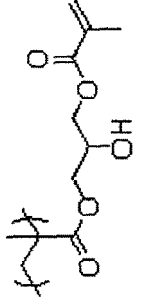
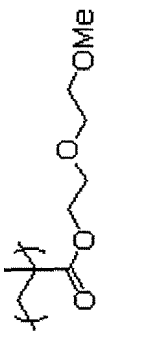
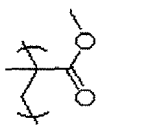
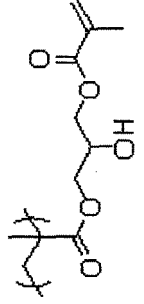
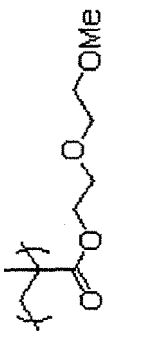
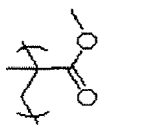
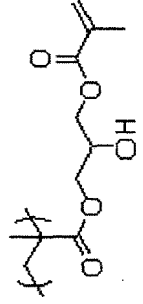
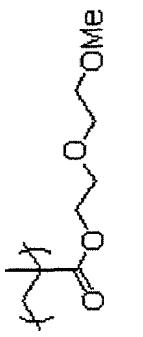
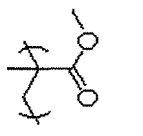
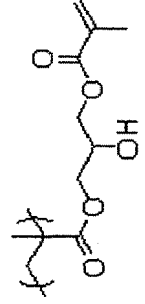
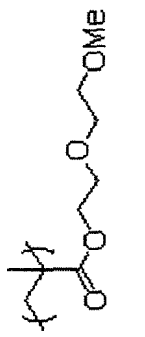
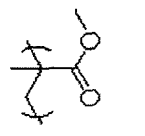
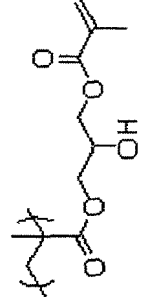
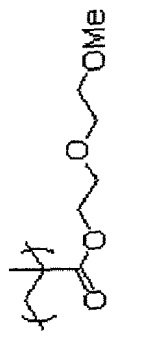
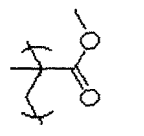
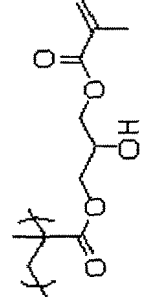
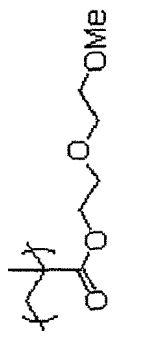
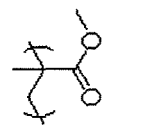
Polymer No.	Central Nucleus		Polymer Chain						Mw (x 10 ⁴)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	%by Mole	
P-21	SB-2	1		5		8		87	6.9
P-22	SB-2	1		5		15		80	6.7
P-23	SB-2	1		5		52		43	7.3

*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.
*2: The number shown in parentheses denotes a molar ratio of the respective units.

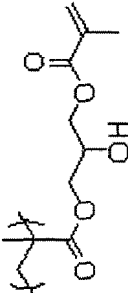
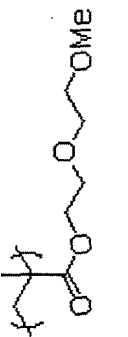
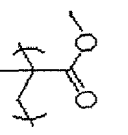
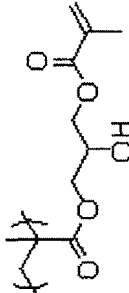
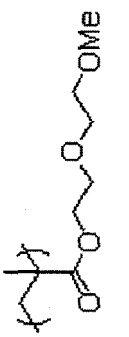
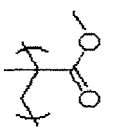
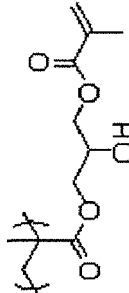
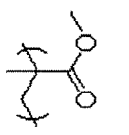
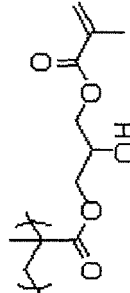
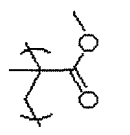
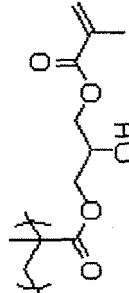
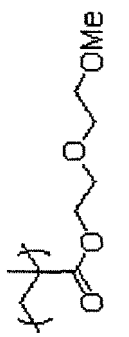
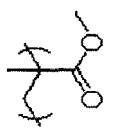
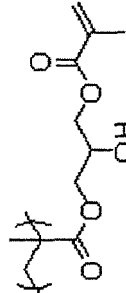
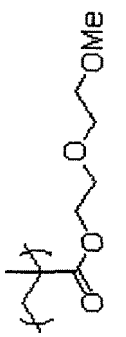
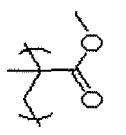
*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.

*2: The number shown in parentheses denotes a molar ratio of the respective units.

TABLE 7

Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-24	SB-1	1		5		52		43	6.7
P-25	SB-3	1		5		52		43	6.2
P-26	SB-4	1		5		52		43	6.6
P-27	SB-5	1		5		52		43	6.6
P-28	SB-6	1		5		52		43	6.5
P-29	SB-7	0.6		5		52		43	7.1

(continued)

Polymer No.	Central Nucleus		Polymer Chain					Mw ($\times 10^4$)	
	No.	% by Mole ⁻¹	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit		%by Mole
P-30	SB-8	0.6		5		52		43	7.1
P-31	SB-9	0.6		5		52		43	6.9
P-32	SB-10	0.6		5		52		43	6.3
P-33	SB-11	0.6		5		52		43	6.5
P-34	SB-12	0.6		5		52		43	6.6
P-35	SB-14	1		5		52		43	6.2

(continued)

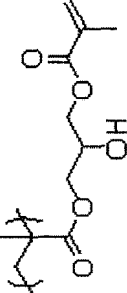
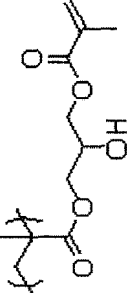
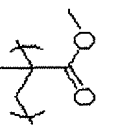
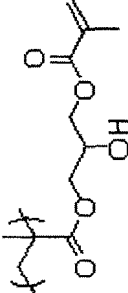
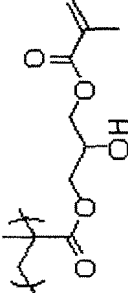
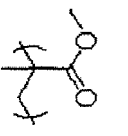
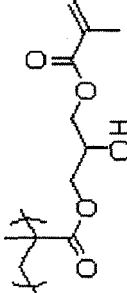
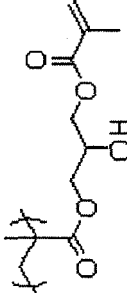
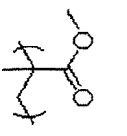
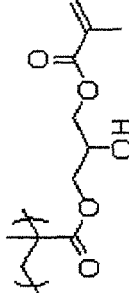
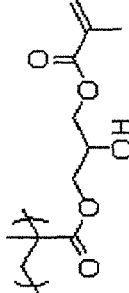
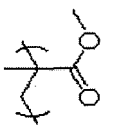
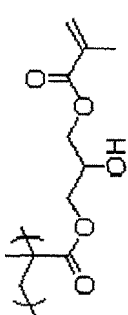
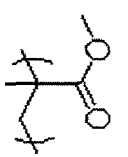
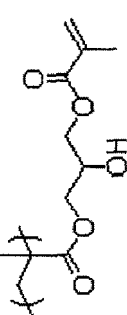
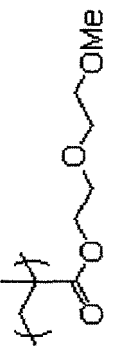
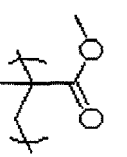
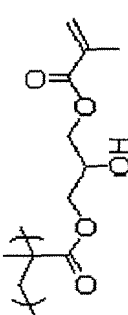
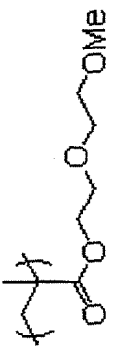
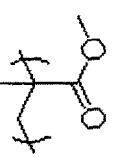
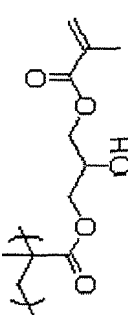
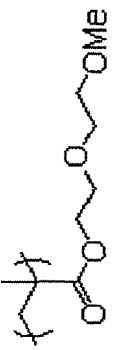
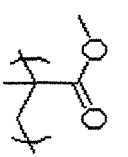
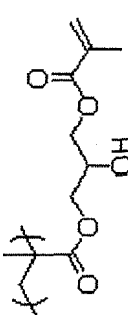
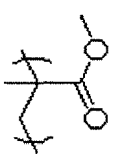
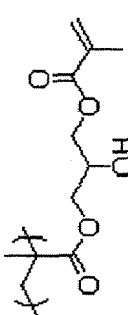
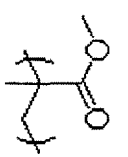
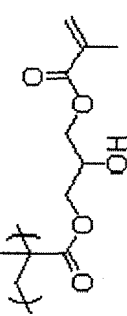
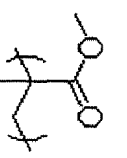
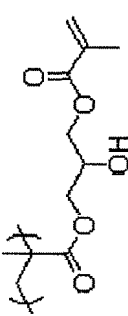
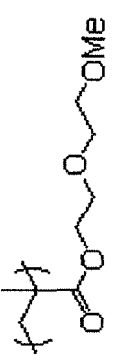
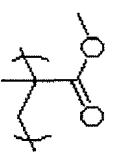
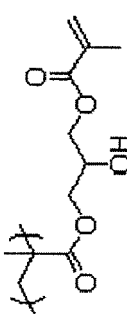
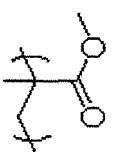
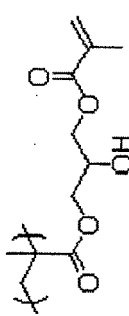
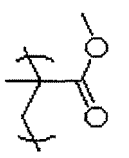
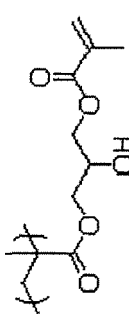
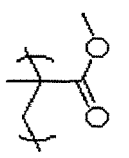
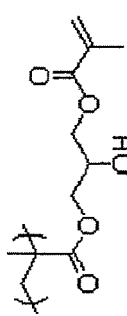
Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-36	SB-15	1		5		52		43	6.1
P-37	SB-16	1		5		52		43	6.3
P-38	SB-17	1		5		52		43	6.4
P-39	SB-20	1		5		52		43	6.3
*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.									

TABLE 8

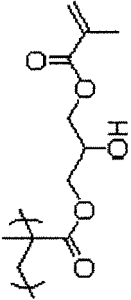
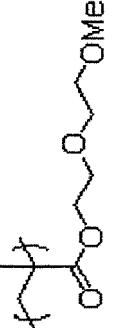
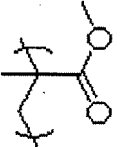
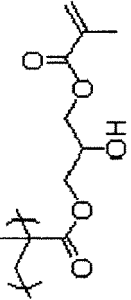
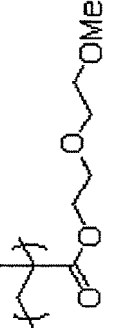
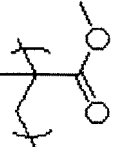
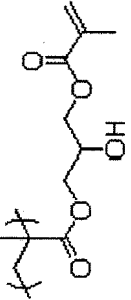
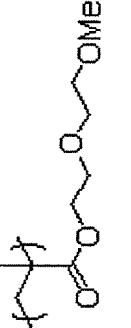
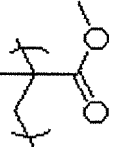
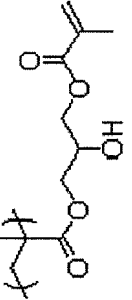
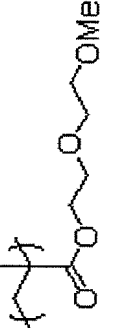
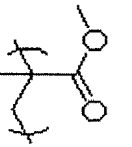
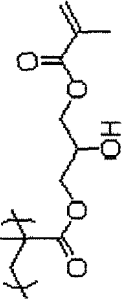
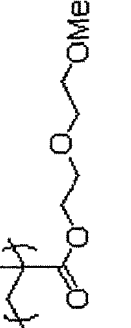
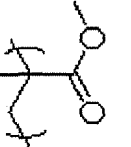
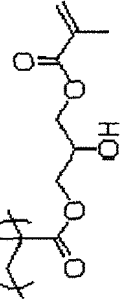
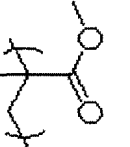
Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	%by Mole	Other Repeating Unit	% by Mole	
P-40	SB-26	1		5		52		43	6.3
P-41	SB-32	1		5		52		43	6.2
P-42	SB-38	1		5		52		43	6.3
P-43	SB-37	1		5		52		43	6.3
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P-45	SC-2	1		5		52		43	6.4

(continued)

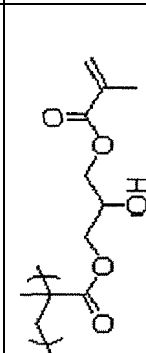
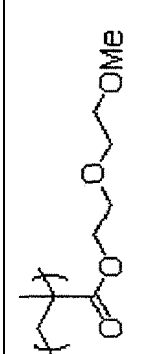
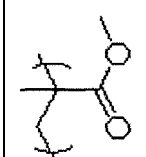
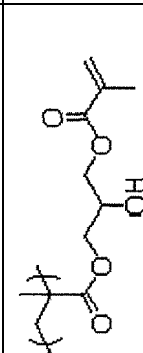
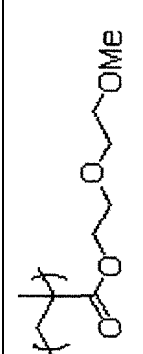
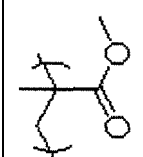
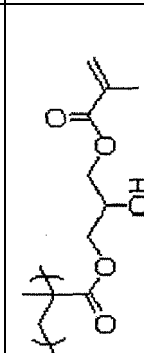
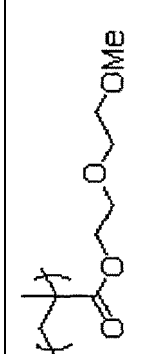
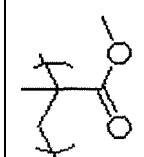
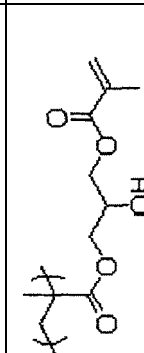
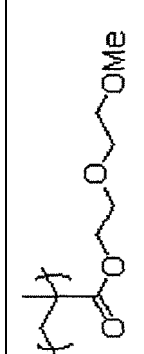
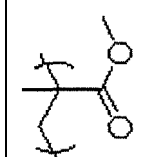
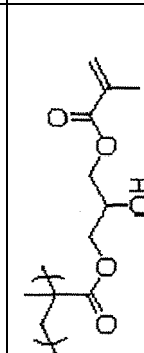
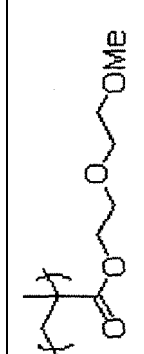
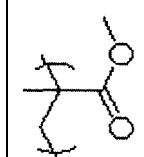
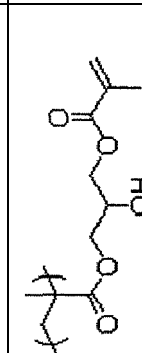
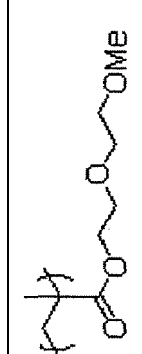
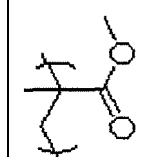
Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-46	SC-4	1		5		52		43	6.4
P-47	SC-5	1		5		52		43	6.3
P-48	SD-2	0.8		5		52		43	6.1
P-49	SD-3	0.8		5		52		43	6.1
P-50	SD-4	0.8		5		52		43	6.1
P-51	SD-5	0.8		5		52		43	6.2

*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.

TABLE 9

Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-52	SD-8	1		5		52		43	6.3
P-53	SD-14	1		5		52		43	6.3
P-54	SA-1	1		5		52		43	6.0
P-55	SA-2	0.6		5		52		43	6.1
P-56	SA-3	1		5		52		43	5.8
P-57	SE-2	1		5		52		43	6.1

(continued)

Polymer No.	Central Nucleus		Polymer Chain						Mw ($\times 10^4$)
	No.	% by Mole ^{*1}	Repeating unit Having Polymerizable Group	% by Mole	Repeating unit Having Hydrophilic Group	% by Mole	Other Repeating Unit	% by Mole	
P-58	SE-3	1		5		52		43	6.0
P-59	SE-5	1		5		52		43	6.0
P-60	SE-6	1		5		52		43	6.1
P-61	SE-7	1		5		52		43	6.2
P-62	SE-9	1		5		52		43	6.2
P-63	SF-1	1		5		52		43	6.1
*1: A ratio (%) of mole number of SH group relative to the total mole number of the monomers.									

[0184] The star-like polymer compound according to the invention can be synthesized according to a known method, for example, radical polymerization of the monomers constituting the polymer chain described above in the presence of the polyfunctional thiol compound described above.

[0185] The weight average molecular weight (Mw) of the star-like polymer compound according to the invention is preferably from 5,000 to 500,000, more preferably from 10,000 to 250,000, and particularly preferably from 20,000 to 150,000. In the range described above, the development property and printing durability are more improved.

[0186] The star-like polymer compounds according to the invention may be used only one kind or two or more kinds in combination. Also, it can be used together with a conventional straight-chain type binder.

[0187] The content of the star-like polymer compound according to the invention in the image-recording layer is preferably from 5 to 95% by weight, more preferably from 10 to 90% by weight, particularly preferably from 15 to 85% by weight, based on the total solid content of the image-recording layer.

[0188] In particular, the star-like polymer compound described in JP-A-2012-148555 is preferred because the permeability of treating solution is accelerated and the on-press development property is improved.

<Hydrophilic low molecular weight compound>

[0189] The image-recording layer according to the invention may contain a hydrophilic low molecular weight compound in order to improve the on-press development property without accompanying decrease in the printing durability.

[0190] Examples of the hydrophilic low molecular weight compound includes a polyol, for example, glycerol, pentaerythritol or tris(2-hydroxyethyl) isocyanurate, an organic amine, for example, triethanol amine, diethanol amine or monoethanol amine, or a salt thereof, an organic phosphonic acid, for example, phenyl phosphonic acid, or a salt thereof, an organic carboxylic acid, for example, tartaric acid, oxalic acid, citric acid, malic acid, lactic acid, gluconic acid or an amino acid, or a salt thereof, and a betaine.

[0191] Of the hydrophilic low molecular weight compounds, it is preferred in the invention to incorporate at least one compound selected from the betaine.

[0192] As the betaine, a compound wherein a number of carbon atoms included in a hydrocarbon substituent on the nitrogen atom is from 1 to 5 is preferred. Specific examples thereof include trimethylammonium acetate, dimethylpropylammonium acetate, 3-hydroxy-4-trimethylammoniobutyrate, 4-(1-pyridinio)butyrate, 1-hydroxyethyl-1-imidazolioacetate, trimethylammonium methanesulfonate, dimethylpropylammonium methanesulfonate, 3-trimethylammonio-1-porpanesulfonate and 3-(1-pyridinio)-1-porpanesulfonate.

[0193] Since the hydrophilic low molecular weight compound has a small structure of hydrophobic portion and almost no surface active function, degradations of the hydrophobicity and film strength in the image area due to penetration of dampening water into the exposed area (image area) of the image-recording layer are prevented and thus, the ink receptivity and printing durability of the image-recording layer can be preferably maintained.

[0194] The amount of the hydrophilic low molecular weight compound added to the image-recording layer is preferably from 0.5 to 20% by weight, more preferably from 1 to 15% by weight, still more preferably from 2 to 10% by weight, based on the total solid content of the image-recording layer. In the range described above, good on-press development property and good printing durability are achieved.

[0195] The hydrophilic low molecular weight compounds may be used individually or as a mixture of two or more thereof.

<Organic fine particle>

[0196] In the invention, an organic fine particle can be incorporated into the image-recording layer in order to improve the on-press development property. The organic fine particle according to the invention is preferably at least one fine particle selected from hydrophobic thermoplastic polymer fine particle, thermo-reactive polymer fine particle, polymer fine particle having a polymerizable group, microcapsule having a hydrophobic compound encapsulated and microgel (crosslinked polymer fine particle). Among them, polymer fine particle having a polymerizable group and microgel are preferred. The organic fine particle according to the invention may be discrete particle of the polymer compound according to the invention described above. According to a particularly preferred embodiment, the organic fine particle contains at least one ethylenically unsaturated polymerizable group. By the presence of the organic fine particle, the effects of enhancing printing durability in the exposed area and on-press development property in the non-image area are obtained.

[0197] As the hydrophobic thermoplastic polymer fine particle, hydrophobic thermoplastic polymer fine particles described, for example, in Research Disclosure, No. 333003, January (1992), JP-A-9-123387, JP-A-9-131850, JP-A-9-171249, JP-A-9-171250 and European Patent 931,647 are preferably exemplified.

[0198] Specific examples of the polymer constituting the polymer fine particle include a homopolymer or copolymer of a monomer, for example, ethylene, styrene, vinyl chloride, methyl acrylate, ethyl acrylate, methyl methacrylate, ethyl methacrylate, vinylidene chloride, acrylonitrile, vinyl carbazole or an acrylate or methacrylate having a polyalkylene structure and a mixture thereof. Among them, polystyrene, a copolymer containing styrene and acrylonitrile and polymethyl

methacrylate are more preferred.

[0199] The average particle size of the hydrophobic thermoplastic polymer fine particle for use in the invention is preferably from 0.01 to 3.0 μm .

[0200] The thermo-reactive polymer fine particle for use in the invention includes polymer fine particle having a thermo-reactive group and forms a hydrophobized region by crosslinkage due to thermal reaction and change in the functional group involved therein.

[0201] As the thermo-reactive group of the polymer fine particle having a thermo-reactive group for use in the invention, although a functional group performing any reaction can be used as long as a chemical bond is formed, a polymerizable group is preferred. For instance, an ethylenically unsaturated group (for example, an acryloyl group, a methacryloyl group, a vinyl group or an allyl group) performing a radical polymerization reaction, a cationic polymerizable group (for example, a vinyl group, a vinyloxy group, an epoxy group or an oxetanyl group), an isocyanate group performing an addition reaction or a blocked form thereof, an epoxy group, a vinyloxy group and a functional group having an active hydrogen atom (for example, an amino group, a hydroxy group or a carboxyl group) as the reaction partner thereof, a carboxyl group performing a condensation reaction and a hydroxyl group or an amino group as the reaction partner thereof, and an acid anhydride performing a ring opening addition reaction and an amino group or a hydroxyl group as the reaction partner thereof are preferably exemplified.

[0202] As the microcapsule for use in the invention, microcapsule having all or part of the constituting components of the image-recording layer encapsulated as described, for example, in JP-A-2001-277740 and JP-A-2001-277742 is exemplified. The constituting components of the image-recording layer may be present outside the microcapsules. It is a more preferred embodiment of the image-recording layer containing microcapsules that the hydrophobic constituting components are encapsulated in microcapsules and the hydrophilic components are present outside the microcapsules.

[0203] According to the invention, an embodiment containing a crosslinked resin particle, that is, a microgel may be used. The microgel can contain a part of the constituting components of the image-recording layer at least one of in the inside and on the surface thereof. In particular, an embodiment of a reactive microgel containing a radical polymerizable group on the surface thereof is preferred in view of the image-forming sensitivity and printing durability.

[0204] In order to conduct microencapsulation or microgelation of the constituting component of the image-recording layer, known methods can be used.

[0205] The average particle size of the microcapsule or microgel is preferably from 0.01 to 3.0 μm , more preferably from 0.05 to 2.0 μm , particularly preferably from 0.10 to 1.0 μm . In the range described above, good resolution and good time lapse stability can be achieved.

[0206] The content of the organic fine particle is preferably in a range from 5 to 90% by weight based on the total solid content of the image-recording layer.

<Other components>

[0207] The image-recording layer according to the invention may further contain other components, if desired. (1) Hydrophilic low molecular weight compound

[0208] The image-recording layer according to the invention may contain a hydrophilic low molecular weight compound in order to improve the on-press development property without accompanying decrease in the printing durability.

[0209] The hydrophilic low molecular weight compound includes, for onstance, a water-soluble organic compound, for example, a glycol, e.g., ethylene glycol, diethylene glycol, triethylene glycol, propylene glycol, dipropylene glycol or tripropylene glycol, or an ether or ester derivative thereof, a polyol, e.g., glycerol, pentaerythritol or tris(2-hydroxyethyl) isocyanurate, an organic amine, e.g., triethanol amine, diethanol amine or monoethanol amine, or a salt thereof, an organic sulfonic acid, e.g., an alkyl sulfonic acid, toluene sulfonic acid or benzene sulfonic acid, or a salt thereof, an organic sulfamic acid, e.g., an alkyl sulfamic acid, or a salt thereof, an organic sulfuric acid, e.g., an alkyl sulfuric acid or an alkyl ether sulfuric acid, or a salt thereof, an organic phosphonic acid, e.g., phenyl phosphonic acid, or a salt thereof, an organic carboxylic acid, e.g., tartaric acid, oxalic acid, citric acid, malic acid, lactic acid, gluconic acid or an amino acid, or a salt thereof and a betaine.

[0210] According to the invention, it is preferred that at least one compound selected from a polyol, an organic sulfate, an organic sulfonate and a betaine is incorporated.

[0211] Specific examples of the organic sulfonate include an alkylsulfonate, for example, sodium n-butylsulfonate, sodium n-hexylsulfonate, sodium 2-ethylhexylsulfonate, sodium cyclohexylsulfonate or sodium n-octylsulfonate; an alkylsulfonate containing an ethylene oxide chain, for example, sodium 5,8,11-trioxapentadecane-1-sulfonate, sodium 5,8,11-trioxaheptadecane-1-sulfonate, sodium 13-methyl-5,8,11-trioxaheptadecane-1-sulfonate or sodium 5,8,11,14-tetraoxatetracosane-1-sulfonate; an arylsulfonate, for example, sodium benzenesulfonate, sodium p-toluenesulfonate, sodium p-hydroxybenzenesulfonate, sodium p-styrenesulfonate, sodium isophthalic acid dimethyl-5-sulfonate, sodium 1-naphthylsulfonate, sodium 4-hydroxynaphthylsulfonate, disodium 1,5-naphthalendisulfonate or trisodium 1,3,6-naphthalenetrisulfonate; and compounds described in Paragraph Nos. [0026] to [0031] of JP-A-2007-276454 and Paragraph Nos.

[0020] to [0047] of JP-A-2009-154525. The salt may also be a potassium salt or a lithium salt.

[0212] The organic sulfate includes a sulfate of alkyl, alkenyl, alkynyl, aryl or heterocyclic monoether of polyethylene oxide. The number of ethylene oxide unit is preferably from 1 to 4. The salt is preferably a sodium salt, a potassium salt or a lithium salt. Specific examples thereof include compounds described in Paragraph Nos. [0034] to [0038] of JP-A-2007-276454.

[0213] As the betaine, a compound wherein a number of carbon atoms included in a hydrocarbon substituent on the nitrogen atom is from 1 to 5 is preferred. Specific examples thereof include trimethylammonium acetate, dimethylpropylammonium acetate, 3-hydroxy-4-trimethylammoniobutyrate, 4-(1-pyridinio)butyrate, 1-hydroxyethyl-1-imidazolioacetate, trimethylammonium methanesulfonate, dimethylpropylammonium methanesulfonate, 3-trimethylammonio-1-porpanesulfonate and 3-(1-pyridinio)-1-porpanesulfonate.

[0214] Since the hydrophilic low molecular weight compound has a small structure of hydrophobic portion and almost no surface active function, degradations of the hydrophobicity and film strength in the image area due to penetration of dampening water into the exposed area (image area) of the image-recording layer are prevented and thus, the ink receptivity and printing durability of the image-recording layer can be preferably maintained.

[0215] The amount of the hydrophilic low molecular weight compound added to the image-recording layer is preferably from 0.5 to 20% by weight, more preferably from 1 to 15% by weight, still more preferably from 2 to 10% by weight, based on the total solid content of the image-recording layer. In the range described above, good on-press development property and good printing durability are achieved.

[0216] The hydrophilic low molecular weight compounds may be used individually or as a mixture of two or more thereof.

(2) Oil-sensitizing agent

[0217] In order to improve the ink receptivity, an oil-sensitizing agent, for example, a phosphonium compound, a nitrogen-containing low molecular weight compound or an ammonium group-containing polymer can be used in the image-recording layer according to the invention. In particular, in the case where an inorganic stratiform compound is incorporated into a protective layer, the oil-sensitizing agent functions as a surface covering agent of the inorganic stratiform compound and prevents deterioration of the ink receptivity due to the inorganic stratiform compound during printing.

[0218] As preferred examples of the phosphonium compound, phosphonium compounds described in JP-A-2006-297907 and JP-A-2007-50660 are exemplified. Specific examples of the phosphonium compound include tetrabutylphosphonium iodide, butyltriphenylphosphonium bromide, tetraphenylphosphonium bromide, 1,4-bis(triphenylphosphonio)butane di(hexafluorophosphate), 1,7-bis(triphenylphosphonio)heptane sulfate and 1,9-bis(triphenylphosphonio)nonane naphthalene-2,7-disulfonate.

[0219] As the nitrogen-containing low molecular weight compound, an amine salt and a quaternary ammonium salt are exemplified. Also, an imidazolinium salt, a benzimidazolinium salt, a pyridinium salt and a quinolinium salt are exemplified. Of the nitrogen-containing low molecular weight compounds, the quaternary ammonium salt and pyridinium salt are preferably used. Specific examples the nitrogen-containing low molecular weight compound include tetramethylammonium hexafluorophosphate, tetrabutylammonium hexafluorophosphate, dodecyltrimethylammonium p-toluenesulfonate, benzyltriethylammonium hexafluorophosphate, benzyltrimethyloctylammonium hexafluorophosphate, benzyltrimethyldodecylammonium hexafluorophosphate and compounds described in Paragraph Nos. [0021] to [0037] of JP-A-2008-284858 and Paragraph Nos. [0030] to [0057] of JP-A-2009-90645.

[0220] The ammonium group-containing polymer may be any polymer containing an ammonium group in its structure and is preferably a polymer containing from 5 to 80% by mole of (meth)acrylate having an ammonium group in its side chain as a copolymerization component. Specific examples thereof include compounds described in Paragraph Nos. [0089] to [0105] of JP-A-2009-208458.

[0221] As to the ammonium group-containing polymer, its reduced specific viscosity value (unit: ml/g) determined according to the measuring method described below is preferably from 5 to 120, more preferably from 10 to 110, and particularly preferably from 15 to 100. When the reduced specific viscosity value described above is calculated in terms of weight average molecular weight (Mw), from 10,000 to 150,000 is preferred, from 17,000 to 140,000 is more preferred, and 20,000 to 130,000 is particularly preferred.

<Measuring method of reduced specific viscosity>

[0222] In a 20 ml measuring flask is weighed 3.33 g (1 g as a solid content) of 30% by weight of polymer solution and the measuring flask is filled up to the gauge line with N-methyl pyrrolidone. The resulting solution is allowed to stand in a thermostatic bath of 30°C for 30 minutes and put into an Ubbelohde viscometer (viscometer constant: 0.010 cSt/s) and a period for running down of the solution at 30°C is measured. The measurement is conducted twice for the same sample and an average value of the measurement is determined. The measurement is also conducted for a blank (only

N-methyl pyrrolidone) in the same manner. The reduced specific viscosity (ml/g) is calculated according to the formula shown below.

$$\text{Reduced specific viscosity (ml/g)} = \frac{\text{Period for running down of sample solution (sec)} - \text{Period for running down of blank (sec)}}{\text{Period for running down of blank (sec)}} \times \frac{30}{100} \times \frac{3.33 \text{ (g)}}{20 \text{ (ml)}}$$

[0223] Specific examples of the ammonium group-containing polymer are set forth below.

- (1) 2-(Trimethylammonio)ethyl methacrylate p-toluenesulfonate/3,6-dioxaheptyl methacrylate copolymer (molar ratio: 10/90, Mw: 45,000)
- (2) 2-(Trimethylammonio)ethyl methacrylate hexafluorophosphate /3,6-dioxaheptyl methacrylate copolymer (molar ratio: 20/80, Mw: 60,000)
- (3) 2-(Ethylidimethylammonio)ethyl methacrylate p-toluenesulfonate/hexyl methacrylate copolymer (molar ratio: 30/70, Mw: 45,000)
- (4) 2-(Trimethylammonio)ethyl methacrylate hexafluorophosphate /2-ethylhexyl methacrylate copolymer (molar ratio: 20/80, Mw: 60,000)
- (5) 2-(Trimethylammonio)ethyl methacrylate methylsulfate/hexyl methacrylate copolymer (molar ratio: 40/60, Mw: 70,000)
- (6) 2-(Butyldimethylammonio)ethyl methacrylate hexafluorophosphate/3,6-dioxaheptyl methacrylate copolymer (molar ratio: 25/75, Mw: 65,000)
- (7) 2-(Butyldimethylammonio)ethyl acrylate hexafluorophosphate/3,6-dioxaheptyl methacrylate copolymer (molar ratio: 20/80, Mw: 65,000)
- (8) 2-(Butyldimethylammonio)ethyl methacrylate 13-ethyl-5,8,11-trioxa-1-heptadecanesulfonate/3,6-dioxaheptyl methacrylate copolymer (molar ratio: 20/80, Mw: 75,000)
- (9) 2-(Butyldimethylammonio)ethyl methacrylate hexafluorophosphate/3,6-dioxaheptyl methacrylate/2-hydroxy-3-methacryloyloxypropyl methacrylate copolymer (molar ratio: 15/80/5, Mw: 65,000)

[0224] The content of the oil-sensitizing agent is preferably from 0.01 to 30.0% by weight, more preferably from 0.1 to 15.0% by weight, still more preferably from 1 to 10% by weight, based on the total solid content of the image-recording layer.

(3) Other components

[0225] Other components, for example, a surfactant, a coloring agent, a print-out agent, a polymerization inhibitor, a higher fatty acid derivative, a plasticizer, a fine inorganic particle, an inorganic stratiform compound, a co-sensitizer or a chain transfer agent may further be added to the image-recording layer. Specifically, compounds and amounts added thereof described, for example, in Paragraph Nos. [0114] to [0159] of JP-A-2008-284817, Paragraph Nos. [0023] to [0027] of JP-A-2006-91479 and Paragraph No. [0060] of U.S. Patent Publication No. 2008/0311520 are preferably used.

[Formation of image-recording layer]

[0226] The image-recording layer according to the invention is formed by dispersing or dissolving each of the necessary components described above in a known solvent to prepare a coating solution and coating the solution on a support by a known method, for example, bar coater coating and drying as described, for example, in Paragraph Nos. [0142] to [0143] of JP-A-2008-195018. The coating amount (solid content) of the image-recording layer formed on the support after coating and drying may be varied according to the intended purpose but is in general preferably from 0.3 to 3.0 g/m². In the range described above, good sensitivity and good film property of the image-recording layer can be achieved.

(Undercoat layer)

[0227] In the lithographic printing plate precursor according to the invention, it is preferred to provide an undercoat layer (also referred to as an intermediate layer) between the image-recording layer and the support. The undercoat layer strengthens adhesion between the support and the image-recording layer in the exposed area and makes removal of the image-recording layer from the support in the unexposed area easy, thereby contributing improvement in the development property without accompanying degradation of the printing durability. Further, in the case of infrared laser exposure, since the undercoat layer acts as a heat insulating layer, decrease in sensitivity due to diffusion of heat generated upon the exposure into the support is prevented.

[0228] As a compound for use in the undercoat layer, specifically, a silane coupling agent having an addition-polymerizable ethylenic double bond reactive group described in JP-A-10-282679 and a phosphorus compound having an ethylenic double bond reactive group described in JP-A-2-304441 are exemplified. More preferably, a polymer resin having an adsorbing group capable of adsorbing to a surface of support, a hydrophilic group and a crosslinkable group as described in JP-A-2005-125749 and JP-A-2006-188038 is exemplified. The polymer resin is preferably a copolymer of a monomer having an adsorbing group, a monomer having a hydrophilic group and a monomer having a crosslinkable group is preferred. More specifically, a polymer resin of copolymer of a monomer having an adsorbing group, for example, a phenolic hydroxy group, a carboxyl group, $-\text{PO}_3\text{H}_2$, $-\text{OPO}_3\text{H}_2$, $-\text{CONHSO}_2-$, $-\text{SO}_2\text{NHSO}_2-$ or $-\text{COCH}_2\text{COCH}_3$, a monomer having a hydrophilic sulfo group and a monomer having a polymerizable crosslinkable group, for example, a methacryl group or an allyl group is exemplified. The polymer resin may contain a crosslinkable group introduced by a salt formation between a polar substituent of the polymer resin and a compound containing a substituent having a counter charge to the polar substituent of the polymer resin and an ethylenically unsaturated bond and may also be further copolymerized with a monomer other than those described above, preferably a hydrophilic monomer.

[0229] The content of the unsaturated double bond in the polymer resin for undercoat layer is preferably from 0.1 to 10.0 mmol, most preferably from 2.0 to 5.5 mmol, per g of the polymer resin.

[0230] The weight average molecular weight of the polymer resin for undercoat layer is preferably 5,000 or more, and more preferably from 10,000 to 300,000.

[0231] The undercoat layer according to the invention may contain a chelating agent, a secondary or tertiary amine, a polymerization inhibitor or a compound containing an amino group or a functional group having polymerization inhibition ability and a group capable of interacting with a surface of aluminum support (for example, 1,4-diazabicyclo[2,2,2]octane (DABCO), 2,3,5,6-tetrahydroxy-p-quinone, chloranil, sulfophthalic acid, hydroxyethylethylenediaminetriacetic acid, dihydroxyethylethylenediaminediacetic acid or hydroxyethyliminodiacetic acid) in addition to the compound for the undercoat layer described above in order to prevent the occurrence of stain due to the lapse of time.

[0232] The undercoat layer is coated according to a known method. The coating amount (solid content) of the undercoat layer is preferably from 0.1 to 100 mg/m², and more preferably from 1 to 30 mg/m².

(Support)

[0233] As the support for use in the lithographic printing plate precursor according to the invention, a known support is employed. Particularly, an aluminum plate subjected to roughening treatment and anodizing treatment according to a known method is preferred.

[0234] Also, an enlarging treatment or a sealing treatment of micropores of the anodized film described in JP-A-2001-253181 and JP-A-2001-322365 or a surface hydrophilizing treatment, for example, with an alkali metal silicate as described in U.S. Patents 2,714,066, 3,181,461, 3,280,734 and 3,902,734 or polyvinyl phosphonic acid as described in U.S. Patents 3,276,868, 4,153,461 and 4,689,272 may be appropriately selected and applied to the aluminum plate, if desired.

[0235] The support preferably has a center line average roughness of 0.10 to 1.2 μm.

[0236] The support may have a backcoat layer containing an organic polymer compound described in JP-A-5-45885 or an alkoxy compound of silicon described in JP-A-6-35174, provided on the back surface thereof, if desired.

(Protective layer)

[0237] In the lithographic printing plate precursor according to the invention, it is preferred to be provided with a protective layer (overcoat layer) on the image-recording layer. The protective layer has a function for preventing, for example, occurrence of scratch in the image-recording layer or ablation caused by exposure with a high illuminance laser beam, in addition to the function for restraining an inhibition reaction against the image formation by means of oxygen blocking.

[0238] With respect to the protective layer having such properties, there are described, for example, in U.S. Patent 3,458,311 and JP-B-55-49729. As a polymer having low oxygen permeability for use in the protective layer, any water-

soluble polymer and water-insoluble polymer can be appropriately selected to use. The polymers may be used in mixture of two or more thereof, if desired. Specifically, for example, polyvinyl alcohol, a modified polyvinyl alcohol, polyvinyl pyrrolidone, a water-soluble cellulose derivative and poly(meth)acrylonitrile are exemplified.

[0239] As the modified polyvinyl alcohol, an acid-modified polyvinyl alcohol having a carboxyl group or a sulfo group is preferably used. Specifically, modified polyvinyl alcohols described in JP-A-2005-250216 and JP-A-2006-259137 are preferably exemplified.

[0240] It is also preferred for the protective layer to contain an inorganic stratiform compound, for example, natural mica or synthetic mica as described in JP-A-2005-119273 in order to increase the oxygen blocking property.

[0241] It is also preferred for the protective layer to contain a polysaccharide. The polysaccharide includes, for example, a starch derivative (for example, dextrin, enzyme-decomposed dextrin, hydroxypropylated starch, carboxymethylated starch, phosphorylated starch, polyoxyalkylene-grafted starch or cyclodextrin), a cellulose (for example, carboxymethyl cellulose, carboxyethyl cellulose, methyl cellulose, hydroxypropyl cellulose or methyl propyl cellulose), carrageenan, alginic acid, guar gum, locust bean gum, xanthine gum, gum arabic and a soybean polysaccharide.

[0242] Of the compounds, a starch derivative, for example, dextrin or polyoxyalkylene-grafted starch, gum arabic, carboxymethyl cellulose or a soybean polysaccharide is preferably used.

[0243] The polysaccharide is preferably added to the protective layer in a range from 1 to 20% by weight, based on the solid content of the protective layer.

[0244] Further, the protective layer may contain a known additive, for example, a plasticizer for imparting flexibility, a surfactant for improving a coating property or a fine inorganic particle for controlling a surface slipping property. The oil-sensitizing agent described with respect to the image-recording layer may also be incorporated into the protective layer.

[0245] The protective layer is coated according to a known method. The coating amount of the protective layer is preferably in a range from 0.01 to 10 g/m², more preferably in a range from 0.02 to 3 g/m², most preferably in a range from 0.02 to 1 g/m², in terms of the coating amount after drying.

[0246] The thickness of the protective layer is preferably in a range from 0.01 to 10 μm, more preferably in a range from 0.02 to 3 μm, and most preferably in a range from 0.05 to 1.0 μm.

[0247] In the case where the lithographic printing plate precursor does not have a further layer (for example, a protective layer) on the image-recording layer, the shear droop is ordinarily formed by the support and image-recording layer.

[0248] In the case where the lithographic printing plate precursor has a protective layer on the image-recording layer, the shear droop is ordinarily formed by the support, image-recording layer and protective layer.

[0249] The shear droop can be formed by cutting the lithographic printing plate precursor.

[Cutting condition and shape of edge of lithographic printing plate precursor]

[0250] The cutting condition of the lithographic printing plate precursor according to the invention is not particularly restricted as long as the shear droop having a shear droop amount (X) from 35 to 150 μm and a shear droop width (Y) from 50 to 300 μm is formed, and methods described in JP-A-8-58257, JP-A-9-211843, JP-A-10-100556 and JP-A-11-52579 can be used.

[0251] Fig. 1 is an example of a cross-sectional shape of a lithographic printing plate precursor having a shear droop at its edge cut by a cutting device. More specifically, the lithographic printing plate precursor 1 has an oblong shape in a top view, and Fig. 1 is a cross-sectional view along one side of the oblong shape.

[0252] In the cross-sectional view, a distance X from the upper end of an edge surface 1c (boundary point between a shear droop 2 and the edge surface 1c) of the lithographic printing plate precursor 1 to an extended line of a top surface of the lithographic printing plate precursor 1 (an image-recording layer surface (a protective layer surface in case of being provided with the protective layer) 1a) is referred to as a "shear droop amount", and a distance Y from a point where the top surface of the lithographic printing plate precursor 1 (an image-recording layer surface (a protective layer surface in case of being provided with the protective layer) 1a) begins to droop to an extended line of the edge surface 1c is referred to as a "shear droop width". Since the edge stain of the lithographic printing plate precursor occurs by transfer of a printing ink component driven from the non-image area to the edge to a blanket, it is necessary to increase the shear droop amount of the edge in order to avoid the contact of the edge to the blanket. The shear droop amount in which the transfer of ink component hardly occur is 35 μm or more. When the shear droop amount exceeds 150 μm, the surface state of edge substrate is severely degraded to cause deterioration of the on-press development property. Further, when the shear droop width is less than 50 μm in the case where the shear droop amount is set in a range from 35 to 150 μm, cracks occur in the edge and printing ink accumulates in the cracks, whereby the stain is apt to occur. In order to reduce the occurrence of crack, the shear droop width is in a range from 50 to 300 μm, and preferably in a range from 70 to 250 μm. The preferred ranges of the shear droop amount and shear droop width are irrelevant to the edge shape of support surface 1b of the lithographic printing plate precursor 1.

[0253] Ordinarily, similar to the image-recording layer surface 1a, the shear droop occurs at a boundary B between the image-recording layer and the support and the support surface 1b in the edge of the lithographic printing plate

precursor 1.

(Means for forming shape shown in Fig. 1)

[0254] The shape described above can be formed by regulating a clearance between an upper cutting blade and a lower cutting blade, an engagement amount and an angle of blade edge.

[0255] For instance, a detailed method for forming the shape shown in Fig. 1 is described below. Fig. 2 is a cross-sectional view showing a cutting portion of a slitter device. In the slitter device, upper and lower paired cutting blades 10, 20 are arranged on right and left sides thereof. These cutting blades 10, 20 are composed of disk-like round blades, and the upper cutting blades 10a and 10b are co-axially supported by a rotation axis 11, while the lower cutting blades 20a and 20b are co-axially supported by a rotation axis 21. The upper cutting blades 10a and 10b are rotated in a direction opposite to the rotational direction of the lower cutting blades 20a and 20b. An aluminum sheet 30 is passed through the clearance between the upper cutting blades 10a and 10b and the lower cutting blades 20a and 20b to cut into pieces having a desired width. More specifically, the intended shape of the edge as shown in Fig. 1 can be formed by adjusting the clearance between the upper cutting blade 10a and the lower cutting blade 20a and the clearance between the upper cutting blade 10b and the lower cutting blade 20b in the cutting portion of slitter device of Fig. 2.

[Treating method]

[0256] The present invention also relates to a method for producing a lithographic printing plate precursor for newspaper printing comprising treating a region within 1 cm from an edge surface of the lithographic printing plate precursor for newspaper printing described above with a solution containing an anionic or nonionic surfactant.

[0257] As to the embodiment of applying the treating solution to the lithographic printing plate precursor according to the invention, the edge of the sheet-form lithographic printing plate precursor may be coated sheet by sheet with the treating solution or the edge of the coil-form lithographic printing plate precursor may be continuously coated with the treating solution. Also, a large number (for example, 1,000 sheets) of the lithographic printing plate precursors were piled to form a stack and the side surface of the stack may be coated with the treating solution. In the latter case, it is of course also possible to coat the treating solution to the stack which has interleaves as described, for example, in JP-B-57-23259 and JP-A-57-99647 between the lithographic printing plate precursors. Further, a method is also preferred wherein after cutting the lithographic printing plate precursor continuously by a slitter or a bundle cutting machine, the edge of the lithographic printing plate precursor was immediately coated by a molten roll or the like impregnated with the treating solution according to the invention. After the coating, the lithographic printing plate precursors were piled in the form of bundle in a stocker of setter and then exposed.

[0258] Alternatively, after imagewise exposure with infrared laser in a setter, the lithographic printing plate precursor may be coated sheet by sheet with the treating solution. The coating after imagewise exposure does not need to pile the lithographic printing plate precursors after coating to prevent the lithographic printing plate precursors from sticking each other due to tackiness. The coating of the treating solution is performed in a region (region A shown in Fig. 1) within 1 cm from the edge surface of the lithographic printing plate precursor, preferably in a region within 0.5 cm from the edge surface, and most preferably in a region within 0.2 cm from the edge surface. It is ordinary that there is no image in the region within 1 cm from the edge surface of the lithographic printing plate precursor.

[0259] The term "region within 1 cm from the edge surface of the lithographic printing plate precursor" indicates an optional region positioned within 1 cm from the edge surface of the lithographic printing plate precursor and may denote "only the edge surface of the lithographic printing plate precursor", a "region within 1 cm from the edge surface of the lithographic printing plate precursor including the edge surface" or a "region within 1 cm from the edge surface of the lithographic printing plate precursor excluding the edge surface".

[0260] The thickness of a layer with the treating solution coated in the region described above is preferably from 0.1 to 50 μm , more preferably from 1 to 25 μm , after drying of the treating solution. In the range described above, good on-press development property is obtained without tackiness between the lithographic printing plate precursor and the coated area.

[0261] In the case of treating by using an anionic surfactant or nonionic surfactant and a water-soluble resin, a method of coating at a time a solution containing both the anionic surfactant or nonionic surfactant and the water-soluble resin is preferred, but a solution containing the anionic surfactant or nonionic surfactant and a solution containing the water-soluble resin may be coated successively. It is preferred to use a successive coating wherein a solution containing the anionic surfactant or nonionic surfactant is coated and then a solution containing the water-soluble resin is coated. The respective solutions are able to be repeatedly coated in many times. Further, after each of the coating steps, a drying step may be performed. Also, after removing the image-recording layer of the edge portion with a high-energy carbon dioxide laser or the like or removing the image-recording layer by cutting, the treating solution may be coated.

[Plate making]

[0262] The plate making of the lithographic printing plate precursor according to the invention is performed by an on-press development method. The on-press development method includes a step in which the lithographic printing plate precursor is imagewise exposed and a printing step in which oily ink and an aqueous component are supplied to the exposed lithographic printing plate precursor without undergoing any development processing to perform printing, and it is characterized in that the unexposed area of the lithographic printing plate precursor is removed in the course of the printing step. The imagewise exposure may be performed on a printing machine after the lithographic printing plate precursor is mounted on the printing machine or may be separately performed using a platesetter or the like. In the latter case, the exposed lithographic printing plate precursor is mounted as it is on a printing machine without undergoing a development processing step. Then, the printing operation is initiated using the printing machine with supplying oily ink and an aqueous component and at an early stage of the printing the on-press development is carried out. Specifically, the image-recording layer in the unexposed area is removed and the hydrophilic surface of support is revealed therewith to form the non-image area. As the oily ink and aqueous component, printing ink and dampening water for lithographic printing of newspaper can be employed, respectively.

[0263] A plate making method of lithographic printing plate according to one preferred embodiment of the invention is a plate making method comprising exposing imagewise the lithographic printing plate precursor for newspaper printing described above with infrared laser, treating a region within 1 cm from an edge surface of the lithographic printing plate precursor with a solution containing an anionic or nonionic surfactant, mounting the lithographic printing plate precursor on a cylinder of a printing machine, and developing the lithographic printing plate precursor with at least one of printing ink and dampening water.

[0264] As the light source used for the image exposure in the invention, a laser is preferred. The laser for use in the invention is not particularly restricted and, for example, a solid laser or semiconductor laser emitting an infrared ray having a wavelength from 760 to 1,200 nm is preferably exemplified.

[0265] With respect to the infrared ray laser, the output is preferably 100 mW or more, the exposure time per pixel is preferably within 20 microseconds, and the irradiation energy is preferably from 10 to 300 mJ/cm². With respect to the laser exposure, in order to reduce the exposure time, it is preferred to use a multibeam laser device.

[0266] The exposed lithographic printing plate precursor is mounted on a plate cylinder of a printing machine. In case of using a printing machine equipped with a laser exposure apparatus, the lithographic printing plate precursor is mounted on a plate cylinder of the printing machine and then subjected to the imagewise exposure.

[0267] When dampening water and printing ink are supplied to the imagewise exposed lithographic printing plate precursor to perform printing, in the exposed area of the image-recording layer, the image-recording layer cured by the exposure forms the printing ink receptive area having the oleophilic surface. On the other hand, in the unexposed area, the uncured image-recording layer is removed by dissolution or dispersion with at least any of the dampening water and printing ink supplied to reveal the hydrophilic surface in the area. As a result, the dampening water adheres onto the revealed hydrophilic surface and the printing ink adheres onto the exposed area of the image-recording layer, whereby printing is initiated.

[0268] While either the dampening water or printing ink may be supplied at first on the surface of lithographic printing plate precursor, it is preferred to supply the dampening water at first in order for the dampening water to permeate, thereby promoting the on-press development.

[Dampening water]

[0269] The dampening water for use in the invention is preferably dampening water having the composition described below.

- (1) Water-soluble resin
- (2) Auxiliary agent for improving wetting property ((2-1) Surfactant and/or (2-2) Solvent)
- (3) pH Adjusting agent
- (4) Others ((i) Preservative, (ii) Chelating agent, (iii) Coloring agent, (iv) Rust inhibitor, (v) Antifoamer, (vi) Masking agent or the like).

[0270] The dampening water for use in the invention preferably contains the water-soluble resin (1) having a content from 0.001 to 1% by weight based on the total amount of the dampening water, and at least one of (i) the organic solvent (2-1) having a content from 0.01 to 1.0% by weight based on the total amount of the dampening water and (ii) the surfactant (2-2) having a content from 0.001 to 0.1 % by weight based on the total amount of the dampening water.

[0271] The dampening water preferably has pH from 7 to 11.

(1) Water-soluble resin

[0272] The water-soluble resin used in the dampening water for use in the invention includes, for instance, a natural product or a modified product thereof, for example, gum arabic, a starch derivative (for example, dextrin, enzyme-decomposed dextrin, hydroxypropylated enzyme-decomposed dextrin, carboxymethylated starch, starch phosphate or octenyl succinated starch), an alginate and a cellulose derivative (for example, carboxymethyl cellulose, carboxyethyl cellulose, methyl cellulose or hydroxyethyl cellulose), a synthetic product, for example, polyethylene glycol and a copolymer thereof, polyvinyl alcohol and a derivative thereof, a polyacrylamide and a copolymer thereof, polyacrylic acid and a copolymer thereof, a vinyl methyl ether/maleic anhydride copolymer, a vinyl acetate/maleic anhydride copolymer, polystyrenesulfonic acid or a copolymer thereof, and polyvinylpyrrolidone. Of the compounds, carboxymethyl cellulose or hydroxyethyl cellulose is particularly preferred. The content of the water-soluble resin is preferably from 0.001 to 1% by weight, more preferably from 0.005 to 0.2% by weight, in the dampening water.

(2-1) Organic solvent

[0273] The organic solvent includes, for example, ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, triethylene glycol monomethyl ether, tetraethylene glycol monomethyl ether, ethylene glycol monoethyl ether, diethylene glycol monoethyl ether, triethylene glycol monoethyl ether, tetraethylene glycol monoethyl ether, ethylene glycol monopropyl ether, diethylene glycol monopropyl ether, triethylene glycol monopropyl ether, tetraethylene glycol monopropyl ether, ethylene glycol monoisopropyl ether, diethylene glycol monoisopropyl ether, triethylene glycol monoisopropyl ether, tetraethylene glycol monoisopropyl ether, ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, triethylene glycol monobutyl ether, tetraethylene glycol monobutyl ether, ethylene glycol monoisobutyl ether, diethylene glycol monoisobutyl ether, triethylene glycol monoisobutyl ether, tetraethylene glycol monoisobutyl ether, ethylene glycol monotertiarybutyl ether, diethylene glycol monotertiarybutyl ether, triethylene glycol monotertiarybutyl ether, tetraethylene glycol monotertiarybutyl ether, propylene glycol monomethyl ether, dipropylene glycol monomethyl ether, tripropylene glycol monomethyl ether, propylene glycol monoethyl ether, dipropylene glycol monoethyl ether, tripropylene glycol monoethyl ether, tetrapropylene glycol monoethyl ether, propylene glycol monopropyl ether, dipropylene glycol monopropyl ether, tripropylene glycol monopropyl ether, propylene glycol monoisopropyl ether, dipropylene glycol monoisopropyl ether, tripropylene glycol monoisopropyl ether, dipropylene glycol monobutyl ether, tripropylene glycol monobutyl ether, propylene glycol monoisobutyl ether, dipropylene glycol monoisobutyl ether, tripropylene glycol monoisobutyl ether, propylene glycol monotertiarybutyl ether, dipropylene glycol monotertiarybutyl ether, tripropylene glycol monotertiarybutyl ether, polypropylene glycol having a molecular weight from 200 to 1,000 and monomethyl, monoethyl, monopropyl, monoisopropyl or monobutyl ether thereof, propylene glycol, dipropylene glycol, tripropylene glycol, tetrapropylene glycol, pentapropylene glycol, ethylene glycol, diethylene glycol, triethylene glycol, butylene glycol, hexylene glycol, 2-ethyl-1,3-hexanediol, 3-methoxy-3-methyl-1-butanol, 1-butoxy-2-propanol, glycerol, diglycerol, polyglycerol, trimethylolpropane, and a 2-pyrrolidone derivative substituted at the 1-position with an alkyl group having from 1 to 8 carbon atoms. Of the compounds, ethylene glycol monotertiarybutyl ether, 3-methoxy-3-methyl-1-butanol or 1-butoxy-2-propanol is particularly preferred. The solvents may be used individually or in combination of two or more thereof. In general, the solvent is suitably used in a range from 0.01 to 1% by weight based on the total weight of the dampening water.

(2-2) Surfactant

[0274] Of the surfactants, for instance, a nonionic surfactant includes, for example, fatty acid salts, abietic acid salts, hydroxyalkanesulfonic acid salts, alkanesulfonic acid salts, dialkylsulfosuccinic acid salts, straight-chain alkylbenzenesulfonic acid salts, branched alkylbenzenesulfonic acid salts, alkylphenoxypolyoxyethylene propylsulfonic acid salts, polyoxyethylene alkylsulfophenyl ether salts, N-methyl-N-oleyltaurine sodium salt, N-alkylsulfosuccinic acid monoamide disodium salts, petroleum sulfonic acid salts, sulfated castor oil, sulfated beef tallow oil, sulfate ester salts of fatty acid alkyl ester, alkyl sulfate ester salts, polyoxyethylene alkyl ether sulfate ester salts, fatty acid monoglyceride sulfate ester salts, polyoxyethylene alkyl phenyl ether sulfate ester salts, polyoxyethylene styryl phenyl ether sulfate ester salts, alkyl phosphate ester salts, polyoxyethylene alkyl ether phosphate ester salts, polyoxyethylene alkyl phenyl ether phosphate ester salts, partially saponified products of styrene-maleic anhydride copolymer, partially saponified products of olefin-maleic anhydride copolymer and naphthalene sulfonate formalin condensates. Of the compounds, dialkylsulfosuccinic acid salts, alkyl sulfate ester salts or alkylphenoxypolyoxyethylene sulfonic acid salts are particularly preferably used.

[0275] A nonionic surfactant includes, for example, polyoxyethylene alkyl ethers, polyoxyethylene alkylphenyl ethers, polyoxyethylene polystyrylphenyl ethers, polyoxyethylene polyoxypropylene alkyl ethers, partial esters of glycerol fatty acid, partial esters of sorbitan fatty acid, partial esters of pentaerythritol fatty acid, esters of propylene glycol monofatty

acid, partial esters of sucrose fatty acid, partial esters of polyoxyethylene sorbitan fatty acid, partial esters of polyoxyethylene sorbitol fatty acid, partial esters of polyglycerol fatty acid, castor oil modified with polyoxyethylene, partial esters of polyoxyethylene glycerol fatty acid, fatty acid diethanolamides, N,N-bis-2-hydroxyalkylamines, polyoxyethylene alkylamines, triethanolamine fatty acid esters, polyoxyethylene-polyoxypropylene block polymers and trialkylamine oxides. In addition, fluorine-based surfactants and silicon-based surfactant may also be used. In the case of using the surfactant, the content thereof is preferably from 0.001 to 0.1% by weight, more preferably from 0.002 to 0.05% by weight, in view of foam formation. The surfactants may be used in combination of two or more thereof

[0276] The dampening water for use in the invention may also be used in an alkaline region of pH from 7 to 10 by incorporating an alkali metal hydroxide, phosphoric acid, an alkali metal salt, an alkali metal carbonate, a silicate or the like as the pH adjusting agent (3).

(3) pH Adjusting agent

[0277] Also, at least one kind of compounds selected from a water-soluble organic acid, inorganic acid and salts thereof may be used. Such a compound is effective for adjusting pH or pH buffering of the dampening water, and for an appropriate degree of etching or corrosion prevention of the support of lithographic printing plate precursor. Examples of the preferred organic acid include citric acid, ascorbic acid, malic acid, tartaric acid, lactic acid, acetic acid, gluconic acid, hydroxyacetic acid, oxalic acid, malonic acid, levulinic acid, sulfanilic acid, p-toluenesulfonic acid, phytic acid and an organic phosphonic acid. Examples of the inorganic acid include phosphoric acid, nitric acid, sulfuric acid and polyphosphoric acid. Further, an alkali metal salt, alkaline-earth metal salt, ammonium salt and organic amine salt of the organic acid and/or inorganic acid may also be used. The organic acids, inorganic acids and salts thereof may be used individually or as a mixture of two or more thereof

EXAMPLES

[0278] The present invention will be described in more detail with reference to the following examples, but the invention should not be construed as being limited thereto. In the examples, a molecular weight of polymer compound is expressed as a weight average molecular weight and a ratio of repeating unit of polymer compound is expressed as a molar ratio.

Examples 1 to 27 and Comparative Examples 1 to 8

[Preparation of Lithographic Printing Plate Precursors (1) to (14)]

(1) Preparation of Support

[0279] An aluminum plate (material: JIS A 1050) having a thickness of 0.3 mm was subjected to a degreasing treatment at 50°C for 30 seconds using a 10% by weight aqueous sodium aluminate solution in order to remove rolling oil on the surface thereof and then grained the surface thereof using three nylon brushes embedded with bundles of nylon bristle having a diameter of 0.3 mm and an aqueous suspension (specific gravity: 1.1 g/cm³) of pumice having a median size of 25 μm, followed by thorough washing with water. The plate was subjected to etching by immersing in a 25% by weight aqueous sodium hydroxide solution of 45°C for 9 seconds, washed with water, then immersed in a 20% by weight aqueous nitric acid solution at 60°C for 20 seconds, and washed with water. The etching amount of the grained surface was about 3 g/m².

[0280] Then, using an alternating current of 60 Hz, an electrochemical roughening treatment was continuously carried out on the plate. The electrolytic solution used was a 1% by weight aqueous nitric acid solution (containing 0.5% by weight of aluminum ion) and the temperature of electrolytic solution was 50°C. The electrochemical roughening treatment was conducted using an alternating current source, which provides a rectangular alternating current having a trapezoidal waveform such that the time TP necessary for the current value to reach the peak from zero was 0.8 msec and the duty ratio was 1:1, and using a carbon electrode as a counter electrode. A ferrite was used as an auxiliary anode. The current density was 30 A/dm² in terms of the peak value of the electric current and 5% of the electric current flowing from the electric source was divided to the auxiliary anode. The quantity of electricity in the nitric acid electrolysis was 175 C/dm² in terms of the quantity of electricity when the aluminum plate functioned as an anode. The plate was then washed with water by spraying.

[0281] The plate was then subjected to an electrochemical roughening treatment in the same manner as in the nitric acid electrolysis above using as an electrolytic solution, a 0.5% by weight aqueous hydrochloric acid solution (containing 0.5% by weight of aluminum ion) having temperature of 50°C and under the condition that the quantity of electricity was 50 C/dm² in terms of the quantity of electricity when the aluminum plate functioned as an anode. The plate was then washed with water by spraying.

[0282] The plate was then subjected to an anodizing treatment using as an electrolytic solution, a 15% by weight aqueous sulfuric acid solution (containing 0.5% by weight of aluminum ion) at a current density of 15 A/dm² to form a direct current anodized film of 2.5 g/m², washed with water and dried to prepare Support (1).

[0283] Thereafter, in order to ensure the hydrophilicity of the non-image area, Support (1) was subjected to silicate treatment using a 2.5% by weight aqueous sodium silicate No. 3 solution at 60°C for 10 seconds and subsequently washed with water to obtain Support (2). The adhesion amount of Si was 10 mg/m². The center line average roughness (Ra) of Support (2) was measured using a stylus having a diameter of 2 μm and found to be 0.51 μm.

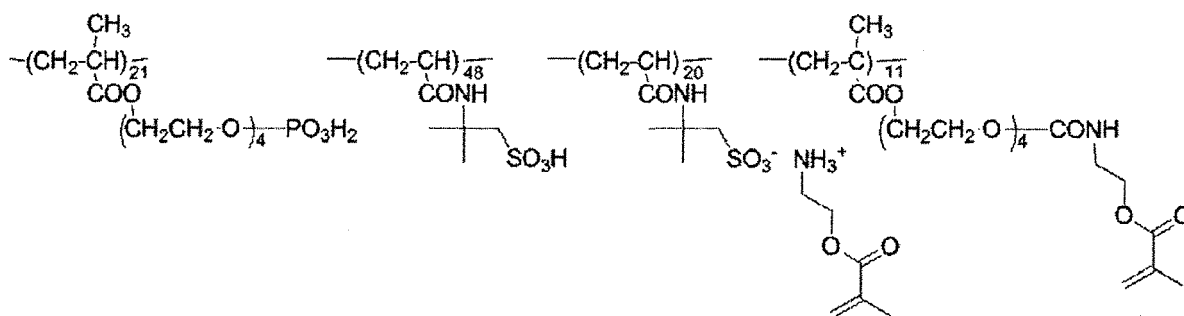
(2) Formation of Undercoat layer

[0284] Coating solution (1) for undercoat layer having the composition shown below was coated on Support (2) described above so as to have a dry coating amount of 20 mg/m² to prepare a support having an undercoat layer.

<Coating solution (1) for undercoat layer>

Compound (1) for undercoat layer having structure shown below	0.18 g
Hydroxyethyliminodiacetic acid	0.10 g
Methanol	55.24 g
Water	6.15 g

[0285] Compound (1) for undercoat layer



(Mw: 100,000)

(3) Formation of Image-recording layer

[0286] Coating solution (1) for image-recording layer having the composition shown below was coated on the undercoat layer formed as described above by a bar and dried in an oven at 100°C for 60 seconds to form an image-recording layer having a dry coating amount of 1.0 g/m².

[0287] Coating solution (1) for image-recording layer was prepared by mixing Photosensitive solution (1) shown below with Microgel solution (1) shown below just before the coating, followed by stirring.

<Photosensitive solution (1)>

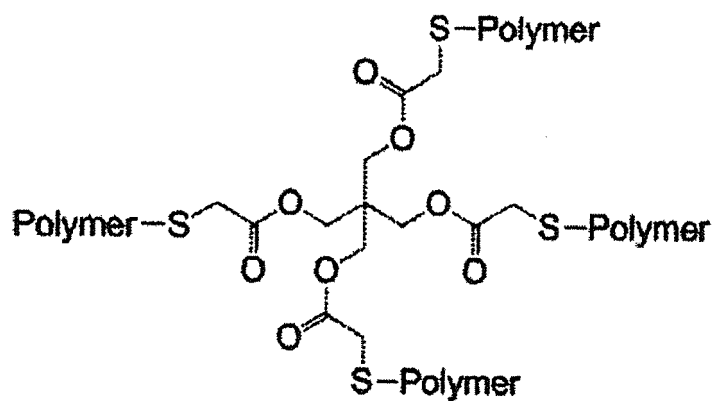
Specific polymer compound (Binder polymer (1) having structure shown below [Mw: 50,000, n: EO unit number as shown in Table 10])	0.240 g
Infrared absorbing dye (1) having structure shown below	0.030 g
Radical polymerization initiator (1) having structure shown below	0.162 g
Radical polymerizable compound (Tris(acryloyloxyethyl) isocyanurate (NK ESTER A-9300, produced by Shin-Nakamura Chemical Co., Ltd.))	0.192 g
Anionic/nonionic surfactant having structure shown below as shown in Table 10	0.050 g
Oil-sensitizing agent (Phosphonium compound (1) having structure shown below)	0.055 g
Fluorine-based surfactant (1) having structure shown below	0.008 g
2-Butanone	1.091 g
1-Methoxy-2-propanol	8.609 g
Ammonium group-containing polymer having structure shown below	0.040 g

<Microgel solution (1)>

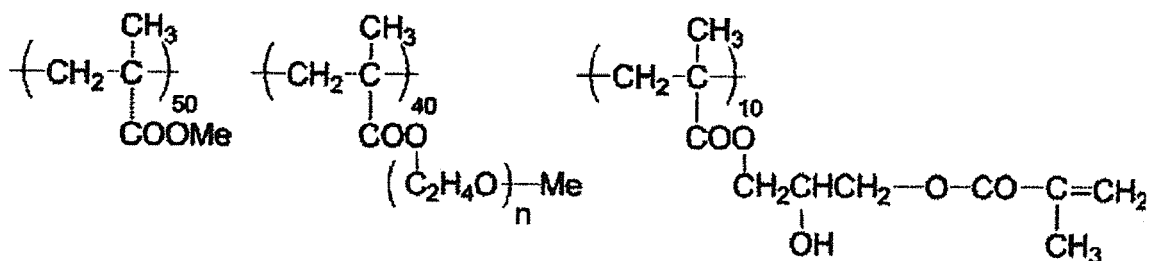
Microgel (1)	2.640 g
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Distilled water	2.425 g
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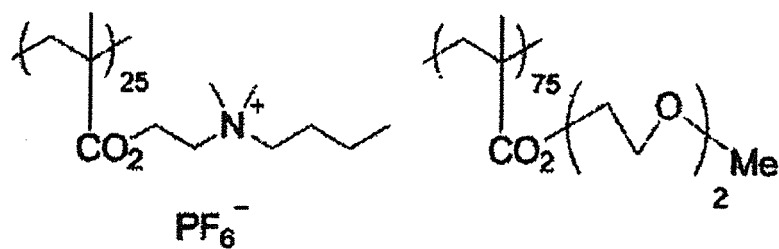
[0288] Polymer moiety described above:



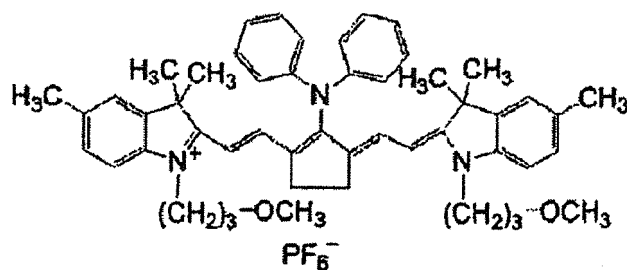
Binder polymer (1):



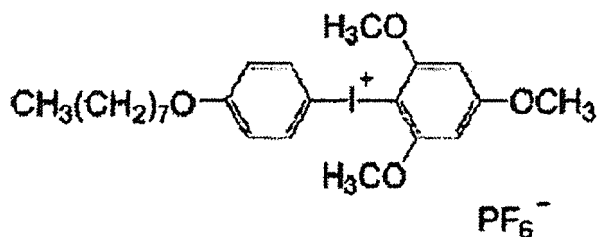
Ammonium group-containing polymer:



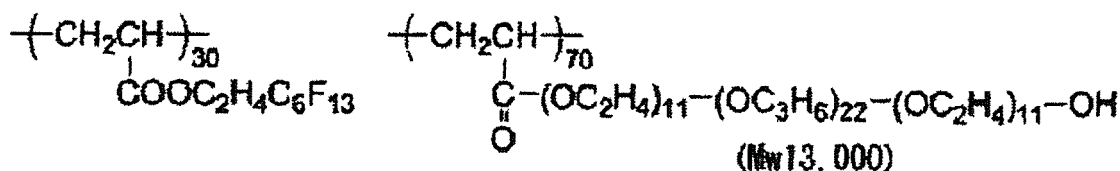
Infrared absorbing agent (1):



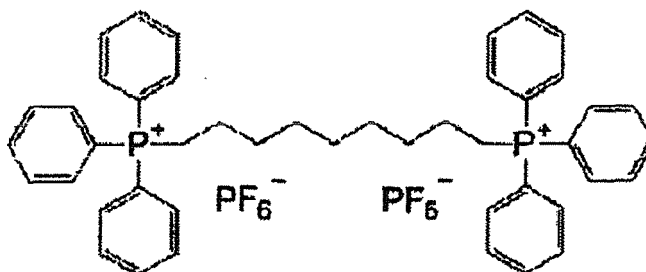
Radical polymerization initiator (1)



Fluorine-based surfactant (1):



Phosphonium compound (1):



[0289] Preparation method of Microgel (1) is shown below.

<Preparation of Microgel (1)>

[0290] An oil phase component was prepared by dissolving 10 g of adduct of trimethylol propane and xylene diisocyanate (TAKENATE D-110N, produced by Mitsui Chemicals Polyurethanes, Inc.), 3.15 g of pentaerythritol triacrylate (SR444, produced by Nippon Kayaku Co., Ltd.) and 0.1 g of PIONIN A-41C (produced by Takemoto Oil & Fat Co., Ltd.) in 17 g of ethyl acetate. As an aqueous phase component, 40 g of an aqueous 4% by weight solution of PVA-205 was prepared. The oil phase component and the aqueous phase component were mixed and the mixture was emulsified using a homogenizer at 12,000 rpm for 10 minutes. The resulting emulsion was added to 25 g of distilled water and stirred at room temperature for 30 minutes and then at 50°C for 3 hours. The microgel liquid thus-obtained was diluted using distilled water so as to have the solid content concentration of 15% by weight to prepare Microgel (1). The average particle size of the microgel was measured by a light scattering method and found to be 0.2 μm.

(4) Formation of Protective layer

[0291] Coating solution (1) for protective layer having the composition shown below was coated on the image-recording layer described above by a bar and dried in an oven at 120°C for 60 seconds to form a protective layer having a dry coating amount of 0.15 g/m², thereby preparing Lithographic printing plate precursors (1) to (14), respectively.

<Coating solution (1) for protective layer>

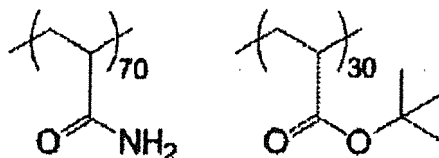
Dispersion of inorganic stratiform compound (1) shown below	1.5 g
Hydrophilic polymer (1) having structure shown below [Mw: 30,000] (solid content)	0.55 g
Aqueous 6% by weight solution of polyvinyl alcohol (CKS 50, sulfonic acid-modified, saponification degree: 99% by mole or more, polymerization degree: 300, produced by Nippon Synthetic Chemical Industry Co., Ltd.)	0.10 g

(continued)

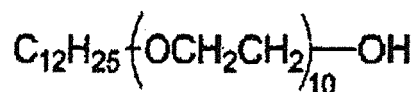
Aqueous 6% by weight solution of polyvinyl alcohol (PVA-405, saponification degree: 81.5 % by mole, polymerization degree: 500, produced by Kuraray Co., Ltd.) 0.03 g

Aqueous 1% by weight solution of surfactant (EMALEX 710, produced by Nihon Emulsion Co., Ltd.) 0.86 g
 Ion-exchanged water 6.0 g

[0292] Hydrophilic polymer (1):



[0293] EMALEX 710:



<Preparation of Dispersion of inorganic stratiform compound (1)>

[0294] To 193.6 g of ion-exchanged water was added 6.4 g of synthetic mica (SOMASIF ME-100, produced by CO-OP Chemical Co., Ltd.) and the mixture was dispersed using a homogenizer until an average particle size (according to a laser scattering method) became 3 μm to prepare Dispersion of inorganic stratiform compound (1). The aspect ratio of the inorganic particle thus-dispersed was 100 or more.

TABLE 10: Lithographic Printing Plate Precursors (1) to (14)

No. of Lithographic Printing Plate Precursor	EO Unit Number of Binder Polymer (1)	Surfactant
1	4	Anionic Surfactant 1
2	2	Anionic Surfactant 1
3	25	Anionic Surfactant 1
4	47	Anionic Surfactant 1
5	4	Anionic Surfactant 2
6	4	Nonionic Surfactant 1
7	2	Nonionic Surfactant 1
8	25	Nonionic Surfactant 1
9	47	Nonionic Surfactant 1
10	60	Anionic Surfactant 1
11	60	Nonionic Surfactant 1
12 (for Comparative Example)	1	Anionic Surfactant 1
13 (for Comparative Example)	1	Nonionic Surfactant 1
14 (for Comparative Example)	4	None
* In Table 10, the EO unit number denotes a repeating unit number of ethylene oxide.		

Anionic Surfactant 1:



15



25



35

40

45

50

55

(continued)

(The content shown below is based on the total amount of the treating solution, and the component other than the components shown below is water)				
No. of Treating Solution	Surfactant (% by weight in terms of solid state content)	Water-soluble Resin (% by weight)	Organic Solvent (% by weight)	Phosphoric Acid Compound (% by weight)
5	NEWCOL B4-SN (*1) (5% by weight)	Etherified starch (*4) (10% by weight)	Benzyl alcohol (2% by weight)	Sodium hexametaphosphate (1% by weight)
6	NEWCOL B4-SN (*1) (5% by weight)	Soybean polysaccharide (*5) (10% by weight)	Benzyl alcohol (2% by weight)	Primary ammonium phosphate (1% by weight)
7	PELEX NBL (*2) (5% by weight)	Etherified starch (*4) (10% by weight)	Benzyl alcohol (2% by weight)	Sodium hexametaphosphate (1% by weight)
8	PELEX NBL (*2) (5% by weight)	Gum arabic (10% by weight)	Benzyl alcohol (2% by weight)	Sodium hexametaphosphate (1% by weight)
9	NEWCOL B13 (*3) (5% by weight)	Gum arabic (10% by weight)	Benzyl alcohol (2% by weight)	Sodium hexametaphosphate (1% by weight)
10	-	Soybean polysaccharide (*5) (10% by weight)	-	Primary ammonium phosphate (1% by weight)
(*1): Anionic surfactant, produced by Nippon Nyukazai Co., Ltd. (60% aqueous solution) (*2): Anionic surfactant, produced by Kao Corp. (35% aqueous solution) (*3): Nonionic surfactant, produced by Nippon Nyukazai Co., Ltd. (100%) (*4): Etherified starch, PENON JE-66, produced by Nippon Starch Chemical Co., Ltd. (100%) (*5): Soybean polysaccharide, SOYA GUM K-31, produced by Fuji Oil Co., Ltd. (100%)				

[0298] <Treating method>

[0299] As to the sample cut, the treating solution was coated in a region within 1 cm from the edge surface of the lithographic printing plate precursor (region including the shear droop) before or after exposure by a cloth impregnated with the treating solution. In Table 13, the No. of Treating Solution (first time) denotes a number of the treating solution coated the first time. The No. of Treating Solution (second time) denotes a number of the treating solution coated the second time after coating the treating solution (first time) and then drying at room temperature for one hour.

[0300] The thickness of the layer formed by the treating solution after coating was 30 μm . The thickness of the layer formed by the treating solution was determined by measuring the thickness of the sample provided with the layer formed by the treating solution and the thickness of the sample before coating the treating solution based on the shape measurement of sample described above and calculating a difference between the thicknesses measured.

<Preparation of Dampening Water>

[0301] Dampening waters A to D were prepared according to the formulation shown below.

TABLE 12: Preparation of Dampening Water

(The component other than the components shown below is pure water) (Unit: % by weight)				
Formulation of Dampening Water	A	B	C	D
Carboxymethyl cellulose (water-soluble resin)	0.05	0.05	None	None
Ethylene glycol mono-tert-butyl ether (organic solvent)	0.6	None	0.6	None

(continued)

(The component other than the components shown below is pure water) (Unit: % by weight)				
Formulation of Dampening Water	A	B	C	D
Propylene glycol 700 (nonionic surfactant)	0.005	0.005	0.005	0.005
Citric acid	0.03	0.03	0.03	0.03
Ammonium nitrate	0.03	0.03	0.03	0.03
2,2-Dibromo-2-nitroethanol	0.01	0.01	0.01	0.01
2-Methyl-5-chloro-4-isothiazoline-3-one	0.01	0.01	0.01	0.01

[Evaluation of Lithographic Printing Plate Precursor]

(1) On-press development property (observation of remaining layer in the edge)

[0302] The lithographic printing plate precursor obtained was exposed by LUXEL PLATESETTER T-6000III equipped with an infrared semiconductor laser (produced by FUJIFILM Corp.) under the conditions of a rotational number of an external drum of 1,000 rpm, laser output of 70% and resolution of 2,400 dpi.

[0303] After the exposure, 20,000 sheets of printing was performed by a web offset press using SOYBI KKST-S (scarlet) produced by InkTec Co., Ltd. as ink for newspaper and dampening water shown in Table 12 at a printing speed of 100,000 sheets per hour. After the printing, the ink on the printing plate was removed with CLEANSER, the edge portion of the printing plate was observed by SEM and the presence or absence of the remaining layer was determined to evaluate according to the criteria shown below.

- A: No remaining layer at all
- B: Intermediate level between A and C
- C: Slight remaining layer but at an acceptable level
- D: Intermediate level between C and E
- E: Definite remaining layer and at an unacceptable level

(2) Edge stain

[0304] The 1,000th printing material in the printing described above was sampled and the degree of line-like stain at the edge portion was evaluated according to the criteria shown below.

- A: No stain at all
- B: Intermediate level between A and C
- C: Slight stain but at an acceptable level
- D: Intermediate level between C and E
- E: Definite stain and at an unacceptable level

(3) Edge stain at printing of 30,000 sheets

[0305] The 30,000th printing material in the printing described above was sampled and the degree of line-like stain at the edge portion was evaluated according to the criteria shown below.

- A: No stain at all
- B: Intermediate level between A and C
- C: Slight stain but at an acceptable level
- D: Intermediate level between C and E
- E: Definite stain and at an unacceptable level

(4) Printing durability due to abrasion of image

[0306] After performing the evaluation for the on-press development property described above, the printing was continued. As the increase in a number of printed materials, the image-recording layer was gradually abraded to cause decrease in the ink density on the printed material. A number of printed materials wherein a value obtained by measuring a halftone dot area rate of the 50% halftone dot of FM screen on the printed material using a Gretag densitometer

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decreased by 5% from the value measured on the 100th printed material was determined to evaluate the printing durability. The printing durability is at an acceptable level when 30,000 or more sheets were printed.

[0307] The results obtained are shown in Table 13 and Table 15.

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TABLE 13: Examples 1 to 27 and Comparative Examples 1 to 8

(Coating solution (1) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	Printing Durability ($\times 10^4$ sheets)
Example 1	1	A	35	100	1		Before Exposure	A	C	C	5.0
Example 2	1	A	50	100	1		Before Exposure	A	C	C	5.0
Example 3	1	A	60	100	1		Before Exposure	A	C	C	5.0
Example 4	1	A	150	200	1		Before Exposure	B	B	C	5.0
Example 5	1	A	150	200	3		Before Exposure	A	B	C	5.0
Example 6	1	A	40	50	1		Before Exposure	A	C	C	4.5
Example 7	1	A	60	100	2		Before Exposure	A	A	A	5.0
Example 8	1	A	40	50	4		Before Exposure	A	A	C	5.0
Example 9	1	A	40	50	8		Before Exposure	A	A	A	5.0
Example 10	2	A	60	100	8		Before Exposure	A	A	A	4.5
Example 11	3	A	60	100	8		Before Exposure	A	A	A	4.5
Example 12	4	A	60	100	8		Before Exposure	A	A	A	4.5

(continued)

(Coating solution (1) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			Printing Durability ($\times 10^4$ sheets)
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	
Example 13	5	A	60	100	8		Before Exposure	A	A	A	5.0
Example 14	6	A	60	100	9		Before Exposure	A	A	A	5.0
Example 15	7	A	60	100	9		Before Exposure	A	A	A	5.0
Example 16	8	A	60	100	9		Before Exposure	A	A	A	5.0
Example 17	9	A	60	100	9		Before Exposure	A	A	A	5.0
Example 18	1	A	60	100	3	10	Before exposure	A	A	A	5.0
Example 19	1	A	60	100	6		After Exposure	A	A	A	5.0
Example 20	1	A	150	200	1		Before Exposure	A	A	A	5.0
Example 21	1	A	60	100	1		Before Exposure	A	B	B	5.0
Example 22	1	B	60	100	1		Before Exposure	A	C	C	5.0
Example 23	1	C	60	100	1		Before Exposure	A	C	C	5.0
Example 24	1	D	60	100	1		Before Exposure	A	C	C	5.0

(continued)

(Coating solution (1) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	Printing Durability (× 10 ⁴ sheets)
Example 25	10	A	60	100	8		Before Exposure	A	B	B	5.0
Example 26	11	A	60	100	9		Before Exposure	A	B	B	5.0
Example 27	1	A	150	100	9		Before Exposure	B	B	B	5.0
Comparative Example 1	1	A	60	100			No Treatment	E	E	E	5.0
Comparative Example 2	1	A	20	100	5		Before Exposure	A	D	D	4.0
Comparative Example 3	1	A	170	300	5		Before Exposure	E	E	E	5.0
Comparative Example 4	1	A	100	500	5		Before Exposure	D	E	E	5.0
Comparative Example 5	1	A	35	45	5		Before Exposure	A	E	E	5.0
Comparative Example 6	12	A	60	100	5		Before Exposure	D	D	D	5.0
Comparative Example 7	13	A	60	100	9		Before Exposure	D	D	D	5.0
Comparative Example 8	14	A	60	100	5		Before Exposure	E	E	E	5.0

[0308] According to the lithographic printing plate precursors of on-press development type of the examples, the effects of achieving good on-press development property at the edge portion and of preventing the edge stain after printing a large number of printing materials are obtained in comparison with the lithographic printing plate precursors of on-press development type of the comparative examples.

Examples 28 to 51 and Comparative Examples 9 to 16

[Preparation of Lithographic Printing Plate Precursors (15) to (26)]

(1) Formation of Image-recording layer

[0309] Coating solution (2) for image-recording layer having the composition shown below was coated on the support having the undercoat layer described above by a bar and dried in an oven at 70°C for 60 seconds to form an image-recording layer having a dry coating amount of 0.6 g/m².

<Coating solution (2) for image-recording layer>

Specific polymer compound (fine particle shape) (Aqueous dispersion of polymer fine particle as shown in Table 14)	Amount added*)
Infrared absorbing dye (2) having structure shown below	0.2 g
Radical polymerization initiator (IRGACURE 250, produced by Ciba Specialty Chemicals, Inc.)	0.5 g
Radical polymerizable compound (SR-399, produced by Sartomer Co.)	1.50 g
Mercapto-3-triazole	0.2 g
BYK 336 (produced by BYK-Chemie GmbH)	0.4 g
KLUCEL M (produced by Hercules Chemical Co., Inc.)	4.8 g
ELVACITE 4026 (produced by Ineos Acrylics Inc.)	2.5 g
n-Propanol	55.0 g
2-Butanone	17.0 g

[0310] Amount added*): The amount of the specific polymer compound added was an amount corresponding to 40% by weight based on the total solid content of the image-recording layer.

[0311] The compounds indicated using their trade names in the composition described above are shown below.

IRGACURE 250: (4-Methoxyphenyl)[4-(2-methylpropyl)phenyl]iodonium hexafluorophosphate (75% by weight propylene carbonate solution)

SR-399: Dipentaerythritol pentaacrylate

BYK 336: Modified dimethylpolysiloxane copolymer (25% by weight xylene/methoxypropyl acetate solution)

KLUCEL M: Hydroxypropyl cellulose (2% by weight aqueous solution)

ELVACITE 4026: Highly branched polymethyl methacrylate (10% by weight 2-butanone solution)

Infrared absorbing dye (2):

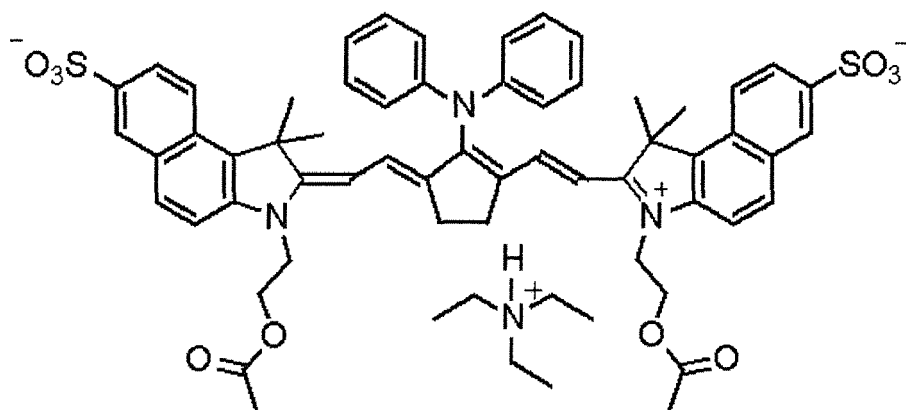


TABLE 14: Lithographic Printing Plate Precursors (15) to (27)

No. of Lithographic Printing Plate Precursor	Specific Polymer Compound	Surfactant
	Kind (EO Repeating Unit Number)	
15	Polymer Compound Fine Particle (1) (20)	Anionic Surfactant 1
16	Polymer Compound Fine Particle (2) (40)	Anionic Surfactant 1
17	Polymer Compound Fine Particle (3) (4)	Anionic Surfactant 1
18	Polymer Compound Fine Particle (4) (2)	Anionic Surfactant 1
19	Polymer Compound Fine Particle (1) (20)	Nonionic Surfactant 1
20	Polymer Compound Fine Particle (2) (40)	Nonionic Surfactant 1
21	Polymer Compound Fine Particle (3) (4)	Nonionic Surfactant 1
22	Polymer Compound Fine Particle (4) (2)	Nonionic Surfactant 1
23	Polymer Compound Fine Particle (5) (90)	Anionic Surfactant 1
24	Polymer Compound Fine Particle (5) (90)	Nonionic Surfactant 1
25 (for Comparative Example)	Polymer Compound Fine Particle (6) (1)	Anionic Surfactant 1
26 (for Comparative Example)	Polymer Compound Fine Particle (6) (1)	Nonionic Surfactant 1
27 (for Comparative Example)	Polymer Compound Fine Particle (7) (None)	Anionic Surfactant 1

(Preparation of Aqueous dispersion of polymer compound fine particle (1))

[0312] A stirrer, a thermometer, a dropping funnel, a nitrogen inlet tube and a reflux condenser were attached to a 1,000 ml four-neck flask and while carrying out deoxygenation by introduction of nitrogen gas, 10 g of polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20), 200 g of distilled water and 200 g of n-propanol were charged therein and heated until the internal temperature reached 70°C. Then, a mixture of 10 g of styrene (St), 80 g of acrylonitrile (AN) and 0.8 g of 2,2'-azobisisobutyronitrile previously prepared was dropwise added to the flask over a period of one hour. After the completion of the dropwise addition, the mixture was continued to react as it was for 5 hours. Then, 0.4 g of 2,2'-azobisisobutyronitrile was added and the internal temperature was raised to 80°C. Thereafter, 0.5 g of 2,2'-azobisisobutyronitrile was added over a period of 6 hours. At the stage after reacting for 20 hours in total, the polymerization proceeded 98% or more to obtain Aqueous dispersion of polymer compound fine particle (1) of PEGMA/St/AN (10/10/80 in a weight ratio). The particle size distribution of the polymer compound fine particle had the maximum value at the particle size of 150 nm.

[0313] The particle size distribution was determined by taking an electron microphotograph of the polymer compound fine particle, measuring particle sizes of 5,000 fine particles in total on the photograph, and dividing a range from the largest value of the particle size measured to 0 on a logarithmic scale into 50 parts to obtain occurrence frequency of each particle size by plotting. With respect to the aspherical particle, a particle size of a spherical particle having a particle area equivalent to the particle area of the aspherical particle on the photograph was defined as the particle size.

(Preparation of Aqueous dispersion of polymer compound fine particle (2))

[0314] Aqueous dispersion of polymer compound fine particle (2) was prepared in the same manner as in the preparation of Aqueous dispersion of polymer compound fine particle (1) except for changing the polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20) to polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 40).

(Preparation of Aqueous dispersion of polymer compound fine particle (3))

[0315] Aqueous dispersion of polymer compound fine particle (3) was prepared in the same manner as in the preparation of Aqueous dispersion of polymer compound fine particle (1) except for changing the polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20) to polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 4).

(Preparation of Aqueous dispersion of polymer compound fine particle (4))

[0316] Aqueous dispersion of polymer compound fine particle (4) was prepared in the same manner as in the preparation of Aqueous dispersion of polymer compound fine particle (1) except for changing the polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20) to polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 2).

(Preparation of Aqueous dispersion of polymer compound fine particle (5))

[0317] Aqueous dispersion of polymer compound fine particle (5) was prepared in the same manner as in the preparation of Aqueous dispersion of polymer compound fine particle (1) except for changing the polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20) to polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 90).

(Preparation of Aqueous dispersion of polymer compound fine particle (6))

[0318] Aqueous dispersion of polymer compound fine particle (6) was prepared in the same manner as in the preparation of Aqueous dispersion of polymer compound fine particle (1) except for changing the polyethylene glycol methyl ether methacrylate (PEGMA, average repeating unit number of ethylene glycol: 20) to ethylene glycol methyl ether methacrylate (EGMA).

(Preparation of Aqueous dispersion of polymer compound fine particle (7))

[0319] A stirrer, a thermometer, a dropping funnel, a nitrogen inlet tube and a reflux condenser were attached to a 1,000 ml four-neck flask and while carrying out deoxygenation by introduction of nitrogen gas, 350 ml of distilled water was charged therein and heated until the internal temperature reached 80°C. As a dispersing agent, 1.5 g of sodium dodecylsulfate was added, then as an initiator, 0.45 g of ammonium persulfide was added, and thereafter 5.0 g of styrene and 40.0 g of acrylonitrile were dropwise added from the dropping funnel over a period of about one hour. After the completion of the dropwise addition, the mixture was continued to react as it was for 5 hours. Then, the unreacted monomers were removed by steam distillation. Subsequently, the mixture was cooled and adjusted to pH 6 with aqueous ammonia. Finally, pore water was added so as to have a nonvolatile component of 15% by weight to obtain Aqueous dispersion of polymer compound fine particle (7). The particle size distribution of the polymer compound fine particle measured in the same manner as in Aqueous dispersion of polymer compound fine particle (1) had the maximum value at the particle size of 60 nm.

[Cutting, Treatment and Evaluation of Lithographic Printing Plate Precursor]

[0320] The cutting, treatment and evaluation of lithographic printing plate precursor were performed in the same manner as in Lithographic printing plate precursors (1) to (14). The evaluation results obtained are shown in Table 15 below.

TABLE 15: Examples 28 to 51 and Comparative Examples 9 to 16

(Coating solution (2) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	Printing Durability ($\times 10^4$ sheets)
Example 28	15	A	35	100	1		Before Exposure	A	C	C	4.0
Example 29	15	A	50	100	1		Before Exposure	A	C	C	4.0
Example 30	15	A	60	100	1		Before Exposure	A	C	C	4.0
Example 31	15	A	150	200	1		Before Exposure	B	B	C	4.0
Example 32	15	A	150	200	3		Before Exposure	A	B	C	4.0
Example 33	15	A	40	50	1		Before Exposure	A	C	C	3.5
Example 34	15	A	60	100	2		Before Exposure	A	A	A	3.5
Example 35	15	A	40	50	4		Before Exposure	A	A	C	3.0
Example 36	15	A	40	50	8		Before Exposure	A	A	A	3.5
Example 37	16	A	60	100	8		Before Exposure	A	A	A	4.0
Example 38	17	A	60	100	8		Before Exposure	A	A	A	4.0
Example 39	18	A	60	100	8		Before Exposure	A	A	A	4.0

(continued)

(Coating solution (2) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	Printing Durability ($\times 10^4$ sheets)
Example 40	19	A	60	100	9		Before Exposure	A	A	A	3.0
Example 41	20	A	60	100	9		Before Exposure	A	A	A	4.0
Example 42	21	A	60	100	9		Before Exposure	A	A	A	4.0
Example 43	22	A	60	100	9		Before Exposure	A	A	A	4.0
Example 44	15	A	60	100	3		Before Exposure	A	A	A	4.0
Example 45	15	A	60	100	6	10	Before exposure	A	A	A	4.0
Example 46	15	A	150	200	1		After Exposure	A	A	A	4.0
Example 47	15	B	60	100	1		Before Exposure	A	A	A	4.0
Example 48	15	C	60	100	1		Before Exposure	A	B	B	4.0
Example 49	15	D	60	100	1		Before Exposure	A	C	C	4.0
Example 50	23	A	60	100	8		Before Exposure	A	C	C	4.0
Example 51	24	A	60	100	9		Before Exposure	A	C	C	4.0

(continued)

(Coating solution (2) for Image-recording layer)											
	No. of Lithographic Printing Plate Precursor	Dampening Water	Shear Droop Amount (μm)	Shear Droop Width (μm)	No. of Treating Solution (first time)	No. of Treating Solution (second time)	Treating Method	Evaluation Result			
								Remaining Layer	Line-like Stain (1,000 sheets)	Line-like Stain (30,000 sheets)	Printing Durability ($\times 10^4$ sheets)
Comparative Examples 9	15	A	60	100			No Treatment	E	E	E	4.0
Comparative Example 10	15	A	20	100	5		Before Exposure	A	D	D	4.0
Comparative Example 11	15	A	170	300	5		Before Exposure	E	E	E	4.0
Comparative Example 12	15	A	100	500	5		Before Exposure	D	E	E	4.0
Comparative Example 13	15	A	35	45	5		Before Exposure	A	E	E	4.0
Comparative Example 14	25	A	60	100	5		Before Exposure	E	E	E	5.0
Comparative Example 15	26	A	60	100	5		Before Exposure	E	E	E	5.0
Comparative Example 16	27	A	60	100	8		Before Exposure	E	E	E	5.0

[0321] According to the lithographic printing plate precursor of on-press development type of the examples, the effects of achieving good on-press development property at the edge portion and of preventing the edge stain after printing a large number of printing materials are obtained in comparison with the lithographic printing plate precursors of on-press development type of the comparative examples.

Claims

1. A lithographic printing plate precursor for newspaper printing comprising on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in a side chain of the polymer compound and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, wherein the lithographic printing plate precursor has a shear droop in which a shear droop amount (X) is from 35 to 150 μm and a shear droop width (Y) is from 50 to 300 μm at an edge of the image-recording layer side, and a region within 1 cm from an edge surface (1c) of the lithographic printing plate precursor including the shear droop has been treated with a treating solution containing an anionic or nonionic surfactant, in which the shear droop amount (X) is a distance from an upper end of the edge surface (1c) of the lithographic printing plate precursor to an extended line of a top surface of the lithographic printing plate precursor, and the shear droop width (Y) is a distance from a point where the top surface of the lithographic printing plate precursor begins to droop to an extended line of the edge surface (1c).
2. The lithographic printing plate precursor for newspaper printing as claimed in Claim 1, wherein the treating solution further contains a water-soluble resin.
3. The lithographic printing plate precursor for newspaper printing as claimed in Claim 2, wherein the water-soluble resin is a polysaccharide.
4. The lithographic printing plate precursor for newspaper printing as claimed in Claim 2 or 3, wherein the treating solution further contains an organic solvent.
5. The lithographic printing plate precursor for newspaper printing as claimed in any one of Claims 1 to 4, wherein the treating solution further contains a phosphoric acid compound.
6. The lithographic printing plate precursor for newspaper printing as claimed in any one of Claims 1 to 5, wherein the polyoxyalkylene chain in the polymer compound is a polyoxyethylene chain in which a repeating unit number of oxyethylene is from 2 to 50.
7. The lithographic printing plate precursor for newspaper printing as claimed in any one of Claims 1 to 6, wherein the polymer compound is a polymer compound having a star-like shape.
8. The lithographic printing plate precursor for newspaper printing as claimed in any one of Claims 1 to 7, wherein the lithographic printing plate precursor further comprises a protective layer on the image-recording layer.
9. A method for producing a lithographic printing plate precursor for newspaper printing, comprising treating a region within 1 cm from an edge surface of a lithographic printing plate precursor for newspaper printing which comprises on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in a side chain of the polymer compound and an anionic or nonionic surfactant and is capable of being developed with at least one of printing ink and dampening water on a cylinder of a printing machine, with a solution containing an anionic or nonionic surfactant.
10. A plate making method of a lithographic printing plate comprising:
 - exposing imagewise a lithographic printing plate precursor for newspaper printing which comprises on a support, an image-recording layer which contains an infrared absorbing dye, a radical polymerization initiator, a radical polymerizable compound, a polymer compound having a polyoxyalkylene chain in a side chain of the polymer compound and an anionic or nonionic surfactant and is capable of being developed with at least one of printing

ink and dampening water on a cylinder of a printing machine with infrared laser;
treating a region within 1 cm from an edge surface of the lithographic printing plate precursor with a solution
containing an anionic or nonionic surfactant;
mounting the treated lithographic printing plate precursor on a cylinder of a printing machine; and
5 developing the mounted lithographic printing plate precursor with at least one of printing ink and dampening water.

11. The plate making method of a lithographic printing plate as claimed in Claim 10, wherein the dampening water
contains a water-soluble resin in an amount from 0.001 to 1% by weight based on a total amount of the dampening
water, and at least one of (i) an organic solvent in an amount from 0.01 to 1.0% by weight based on a total amount
10 of the dampening water and (ii) a surfactant in an amount from 0.001 to 0.1% by weight based on a total amount of
the dampening water.

FIG. 1

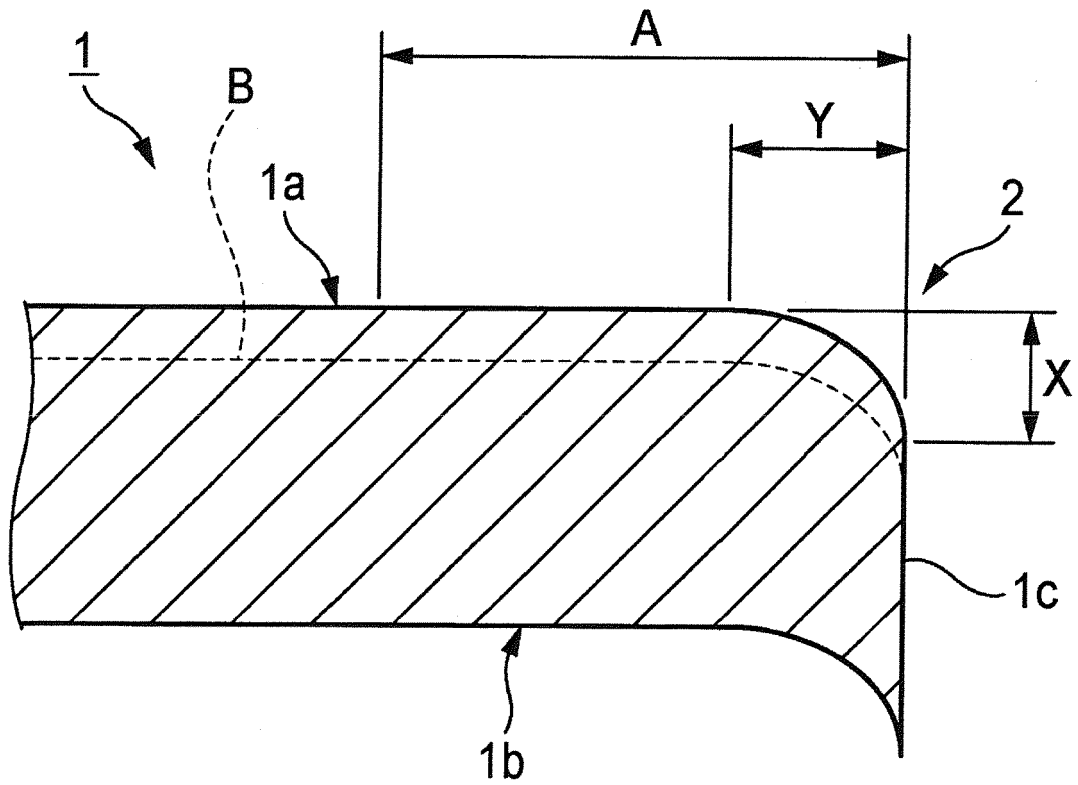
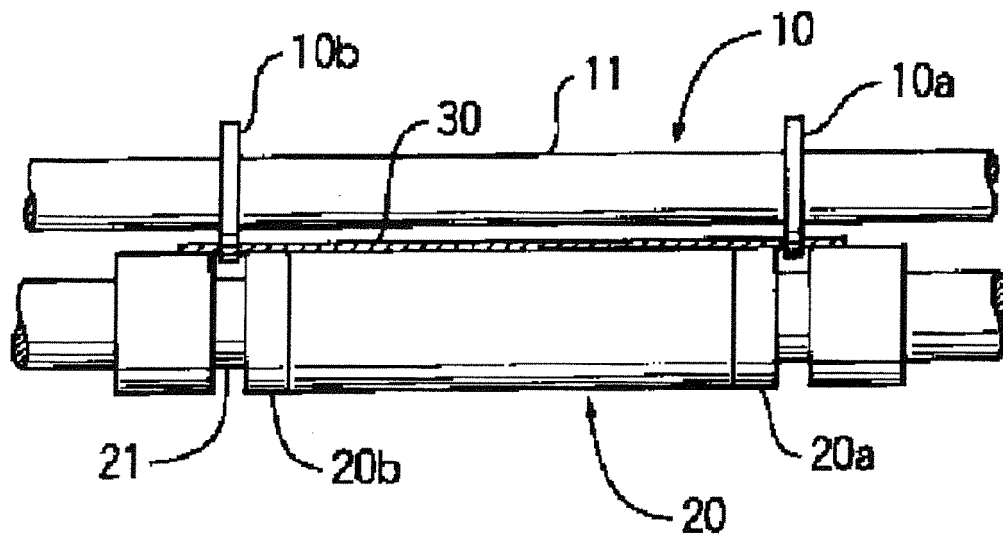


FIG. 2



REFERENCES CITED IN THE DESCRIPTION

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